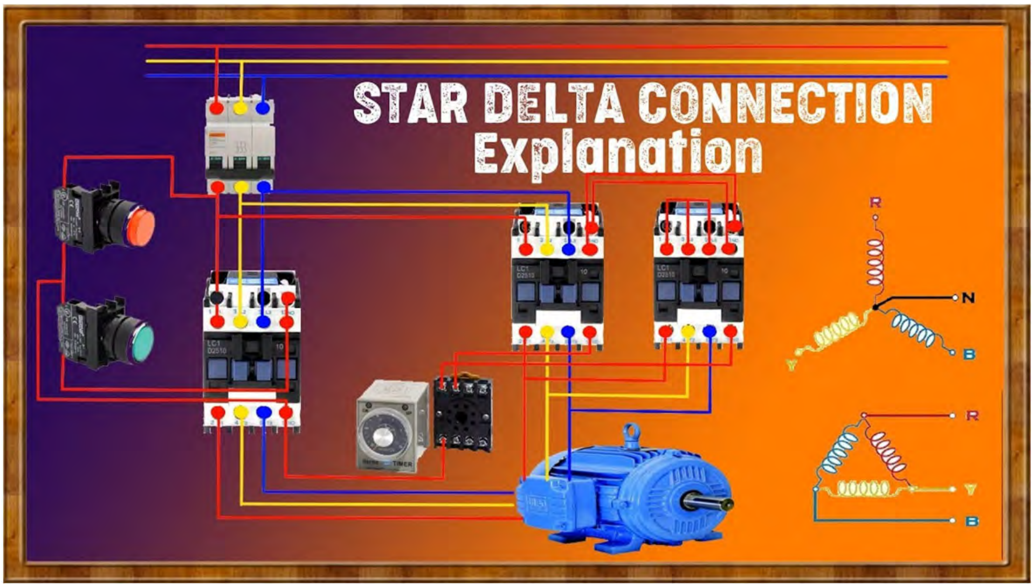
Annex 5.2.6 Training Material for "Designing of Star-Delta Control Panel" at WASA Lahore

DESIGNING
OF
STAR DELTA
ELECTRICAL MOTOR
CONTROL PANEL

1

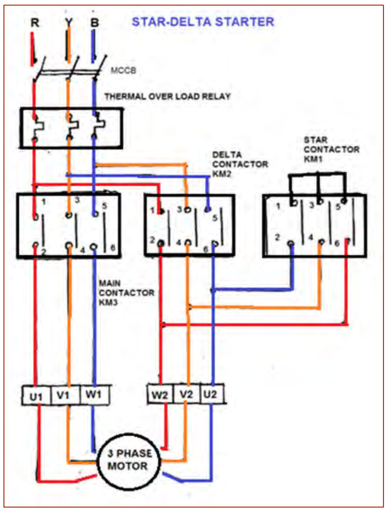
PARTS OF MCU



2

STAR DELTA PANEL IN A NUT SHELL

- The motor's wiring terminal is initially connected in a star configuration.
- ON push-button switch actuates the main magnetic contactor, the star contactor, and the timer, while leaving only the delta contactor open or deactivated until the timer reaches a preset time.
- Star Connection voltage is effectively reduced to 58% or 230v & current is 33% FLC
- After reaching the specified preset time period(75% or %80 of full load speed), the timer causes the circuit to switch from star contactor to the delta contactor.
- This change provides full voltage by increasing star voltage to 173% to the motor to achieve the required full power for the load(The phase currents increase by the same ratio.)



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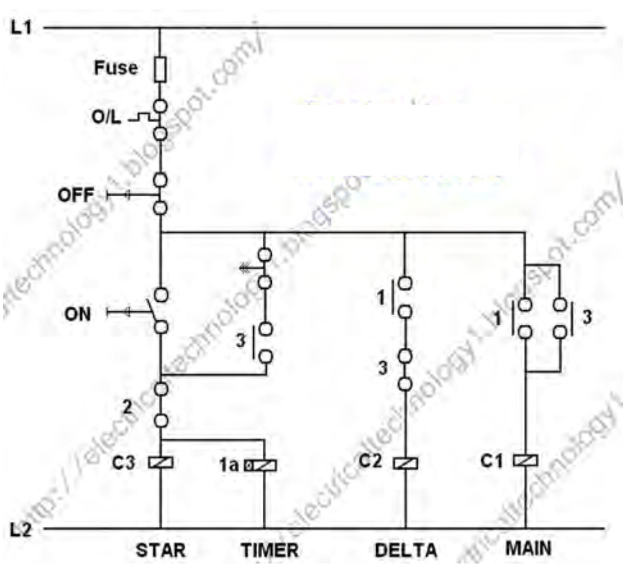
CONTROL CIRRCUIT DIAGRAM OF STAR DELTA STARTER



Operation & Working of Automatic Star Delta Starter

From L1 The phase current flows to thermal overload contact through fuse, then OFF push button, On push button interlocking contact 2, and then C3. This way, the circuit is completed, as a result;

1. Contactor coil C3 and timer coil (I1) is energized at once and the motor winding then connected in Star. When C3 is energized, its auxiliary open links will be closed and vice versa (i.e. close links would be open). Thus C1 Contactor is also energized and Three Phase Supply will reach to the motor. Since winding is connected in Star, hence each phase will get √3 times less than the line voltage i.e. 230V. Hence Motor starts safely.
2. The close contact of C3 in the Delta line opens because of which there would be no chance of activation of contactor 2 (C2) .
3. After leaving the push button, Timer coil and coil 3 will receive a supply through Timer contact (Ia) , Holding contact 3 and the close contact 2 of C2.
4. When Contactor 1 (C1) is energized, then the two open contact in the line of C1 and C2 will be closed.

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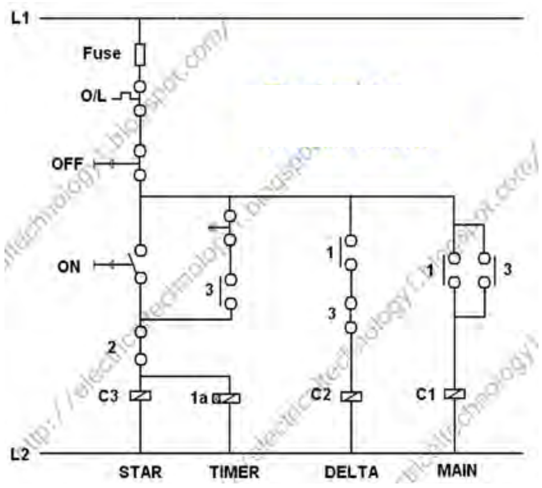
CONTROL CIRRCUIT DIAGRAM--------2



- For the specific time (generally 5-10 seconds) in which the motor will be connected in star, after that the Timer contact (Ia) will be open (We may change by rotating the timer knob to adjust the time again) and as a result;
- Contactor 3 (C3) will be off, because of which the open link of C3 will be close (which is in the line of C2) thus C2 will also energize. Similarly, When C3 off, then star connection of winding will also open. And C2 will be closed. Therefore, the motor winding will be connected in Delta. In addition, Contact 2 (which is in the line C3) will open, by which, there would not be any chance of activation of coil 3 (C3)
- Since the motor is connected in Delta now, therefore, each phase of the motor will receive full line voltage (400V) and the motor will start to run in full motion.

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Designing a star Delta panel

- Suppose our motor is 110KW
- Our voltage is 400 V
- Suppose Motor Power Factor is 0.8
- Motor Efficiency is 0.94

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Calculating Motor full load Line-current

- Motor full load Line-current = (Motor power in watts) / (1.732 × Voltage × efficiency × pf)
- FLC = (110 X 1000)/(400*1.732*0.94*0.80)=211.14A
- Our motor's full load current is **211.14** amperes

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Main & Star-delta contactor calculation

- A star-delta starter consists of three contactors –
  The main contactor, the Delta contactor, and the star contactor.
- **Main contactor rating** = **58%X Full Load Line Current** =0.58 **X** 211.14= 122.46A
- **Delta contactor rating** = **58%X Full Load Line Current** = 122.46A
- **Star contactor rating** = **33%X Full Load Line Current** = 69.7 A
- Making/breaking capacity of contactor = 10 x $\mathbf{I}_{FLC}$= 2111.4A
- The contactor must be selected such that its rating is higher than the calculated values.

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Over Load Relay design

- ❖ Relay setting Min (70% of FLC Phase)
- ❖ Relay setting Max (120% of FLC Phase) or
- ❖ As our FLC is 211.14 A, 70% will be 148A and 120% will be 253.36 A. The Overload Relay will be 148A to 254A range.

- **Fuse rating calculation**
- Time delay fuses are more preferred and the rating should not exceed 175% of the full load line current.
- **Time delay fuse rating for star-delta starter** = 1.75 * $\mathbf{I}_{FLC}$ = 369.49 A (max)

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Circuit Breaker design

- Inverse current circuit breakers are used to protect motors from short circuits. The circuit breaker rating should not exceed 250% of the full load line current.
- The National Electrical Code (NEC 430.52) requires inverse time circuit breakers to be sized to a maximum of 250% of the motor full-load amperes (FLA).
- Circuit breaker, MCB or MCCB is selected 2.5 times in order to avoid nuisance trips.
- **Circuit breaker rating for star-delta starter** = 2.5 * **211.14** = 527.85 A. say 528A
- As standard rating of 528A is not available therefore next rating 600A or 630A will be used

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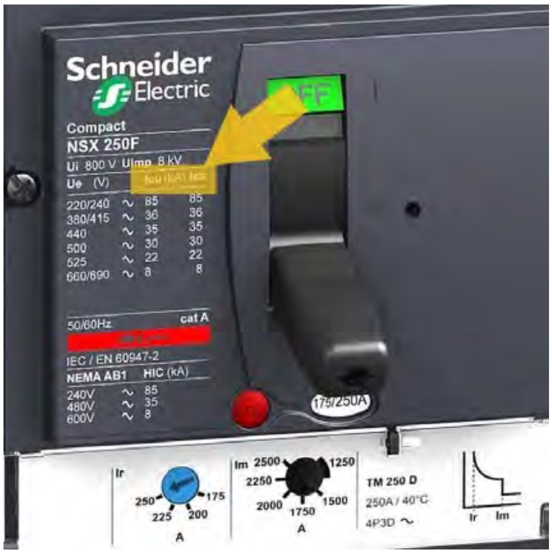
Type name				NF630-CW		NF630-SW		
Rated current In (Amp.)				500 600 630				
Number of poles				2	3	2	3	4
Reted insulation voltage Ui (V)				690		690		
Rated short-circuit breaking capacity (kA)	IEC 60947-2 (Icu/Ics)	AC	690V	–		10/10		
			500V	18/9		30/30		
			440V	36/18		42/42		
			400V	36/18		50/50		
			230V	50/25		85/85		
		DC (*1)	250V	20/10		40/40		
Standard Attached Parts (4-pole models are provided with auxiliary handle.)	Front connection			Mounting screw: M6×72 (4pcs) Insulating barrier: (2P: 2pcs, 3P: 4pcs, 4P: 6pcs)				
	Rear connection			Mounting screw: M6×85 (4pcs)				

Type NF630-SW

Molded case Circuit Breaker



MCCB

The term Ultimate breaking capacity (I_{cu}) define the maximum short circuit current that a circuit breaker can interrupt without damaging itself. It can be considered as the upper limit for the short circuit current that it can safely handle. It is denoted as I_{cu} and rated in kilo-Amperes.

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UNDER VOLTAGE/OVER VOLTAGE RELAYS

- **Protective relays detect electrical faults , isolate the faults from the system and activate alarms in a faulty condition**

- The over- and under voltage relay is a secondary relay which is connected to the voltage transformers of the object to be protected.
- The unit continuously measure the fundamental wave of the phase-to-phase voltages of the object. On detection of fault, the relay will activate and trip the circuit breaker, provide alarms, record fault data, etc., in accordance with the application and the configured relay functions.

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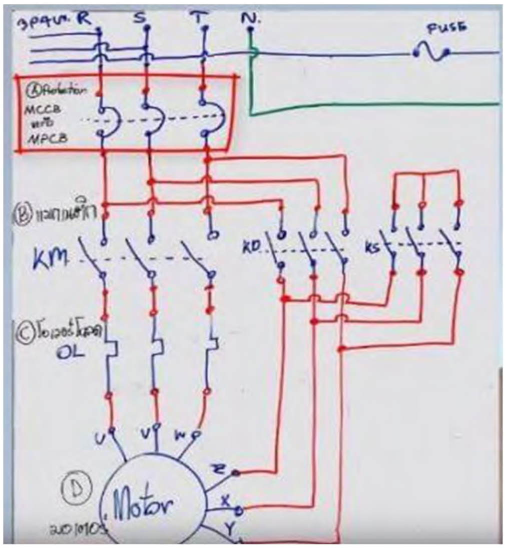
Protection; General circuit diagram



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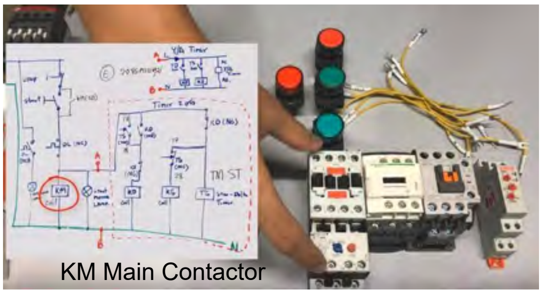
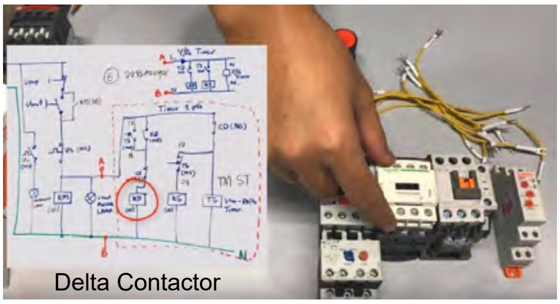
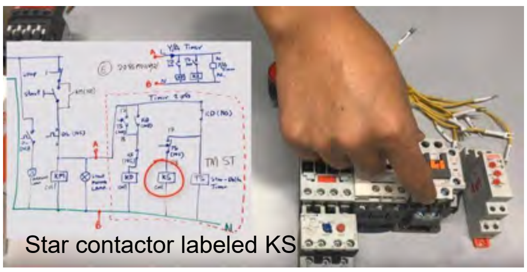
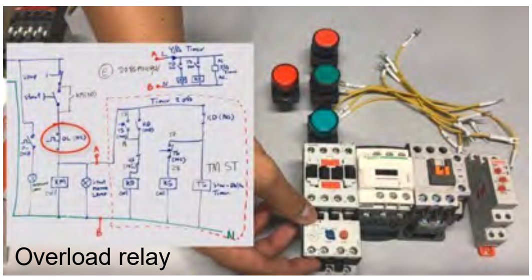
The control circuits


KM Main Contactor


Delta Contactor


Star contactor labeled KS


Overload relay

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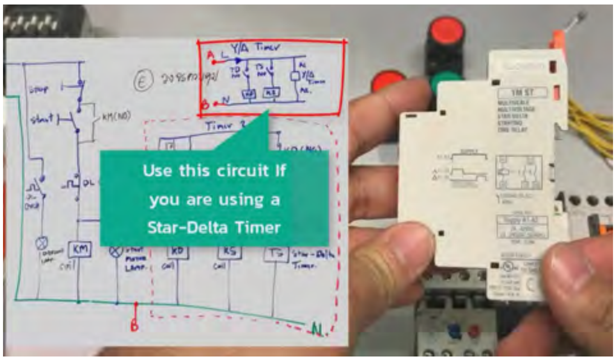
Star-Delta timer

Since it is better to have a delay function. Let's take a look at the specific function of a Timer that is designed for the Star-Delta application.



- You can see more information from the diagram on the side of the timer. As you supply the current from A1 to A2 the Star Contactor will start, then there will be a transition delay, we can set the value of this. Then the Delta contactor will start. The transition function prevents both the star and delta contractor from working at the same time. Now, if you were to use a normal timer there will be no transition delay the timer will immediately switch the contactor from Star to Delta. This will work but there is a chance that both star and delta contactors will be working at the same time and may cause some problems.

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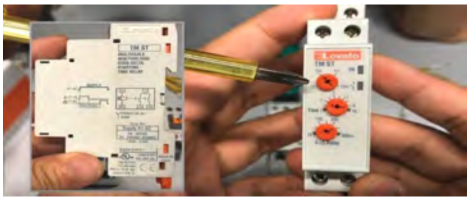

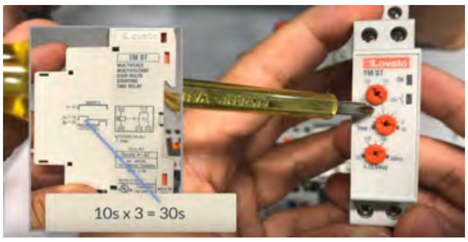

Setting up the timer.

- The top dial is the range and is like a multiplier.
- The second dial is the time period that the star contactor will be ON. For example, if we set this to 30 seconds, this will means that the Star contactor will be on for 30 seconds.
- The last setting is the period to delay between Star and Delta. The delay here has a minimum of 20 milliseconds. The maximum transition time you can set for this timer is 300 milliseconds.

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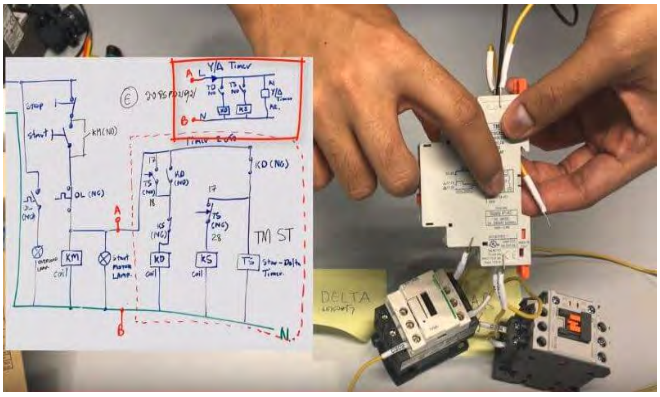
Setting up the timer



- The other contact 28 is connected to Delta A1 and the A2 also goes to the neutral.
- There are 3 connections to the neutral, these three here.
- From the Line there should only be 1 connection; this one.
- Now, the circuit is complete and we can start the motor using this Star-Delta configuration!

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DESIGNING POWER CABLES

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Types of power wires/cables

General classification

1. Copper cables: have less voltage drop and more current carrying capacity.
2. Aluminum cables: Low current carrying capacity and more voltage drop. These are mostly used on HT side of Transformer

Other classifications

- **PVC insulated PVC sheathed:**
- **XLPE cross linked polyethylene insulated PVC sheathed has** more tensile strength and impact resistance. It has higher overloading capacity under emergency conditions.
- PVC insulated Cable is 70 Centigrade while XLPE is 90 Centigrade
- **Armored cable is used for HT applications**

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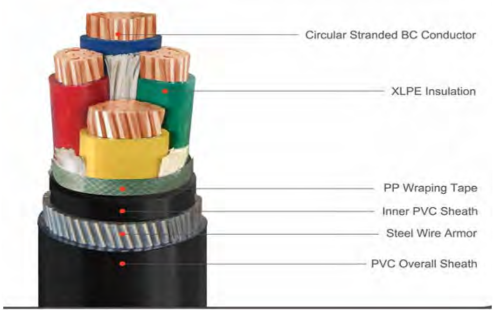
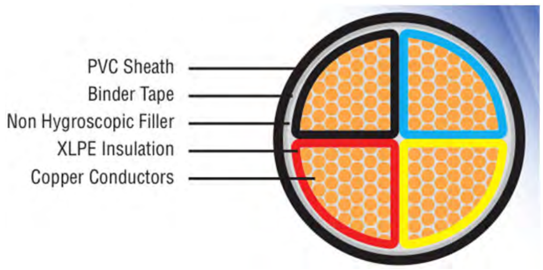


CU/XLPE/PVC



The no hygroscopic material fills the spaces between the interior parts of the cable, preventing moisture from entering minor leaks in the sheath and migrating inside the cable.

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LOW VOLTAGE, XLPE & PVC CABLES

- **Low voltage cables are from 0.6 to 1KV.**
- **XLPE** stands for cross-linked polyethylene. **XLPE cable** has a high chemical resistance and moisture resistance. **XLPE Cable** can be used at high temperatures and high voltage applications.
- Due to greater capacity to withstand heat, the permissible maximum continuous conductor operating temperature is 90℃ and for momentary short circuits the permissible temperature is 250℃. **Maximum working temperature of conductor:** PVC insulated Cable is 70 Centigrade, XLPE insulated Cable is 90 Centigrade.
- XLPE insulation dissipates heat from conductors much faster
- XLPE cable can carry 15% to 30% higher current than a PVC cable with the same conductor size.

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(UNARMOURED COPPER CONDUCTOR). CU/XLPE/PVC
Standard: IEC 60502-1, 60228
0.6/1 KV : 90^{O} C XLPE with outer sheath PVC
Ambient Temperature: 30^{O} C ,Conductor Operating Temperature: 90^{O} C

Laying technique varies the Current carrying capacity

Cross Sectional Area of Conductor	**Enclosed in Conduit**		**Air or in perforated cable tray**	
	2 core	3 core	2 core	3 core
mm^2	A	A	A	A
70	221	194	289	246
120	305	268	410	346
150	334	300	473	399
240	459	398	641	538

Current carrying capacity varies somewhat from manufacturer to manufacture

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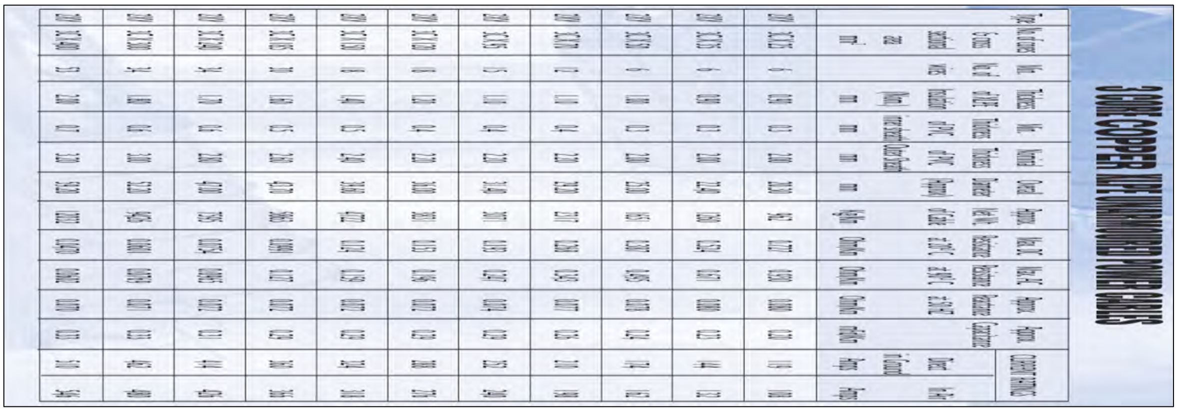
Current carrying capacity of cables--1



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Simple formula for sizing cable

Suppose a 3 phase motor of 110 KW capacity having 0.8 power factor and 94% efficiency.

Current for sizing cable will be calculated as below;

- **kW = I x V x √3 x pf x efficiency**
- **Full load Current = kWx1000 / (V x 1.732 x pf x efficiency)**
- **110x1000/(400x 1.732 x 0.8 x 0.94)= 211.12 A**
- As per NEC code the size of Cable for Branch circuit is **125% of Motor Full Load Current. However keeping the safety factor normally 150% is taken.**
- **Cable size from Lesco panel to main panel** = 1.5 x Full Load Current =211.12*1.5=316.7A
- Consult table—1,slide-26 the current carrying capacity of 120mm² cable in air is 276 amperes and capacity of next size 150mm² is 318 amps. So the suitable cable size is 150mm2. But In Pakistan cables are not of exact quality therefore better to choose one size bigger cable.
- We will choose 185mm² size

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Cable size from star delta starter to motor

- Cable size for motor starter to motor
- Simple way
- Total 6 cables if single core used, 3 for star and 3 for Delta
- Delta Connection (58% of FLC Line)=0.58*211.12*1.5= 183.7 A (50mm2 has less capacity than required therefore, use next higher rating cable that is **70mm2 with capacity of 198amp.**) but due to safety factor take next bigger size that is 95mm2.
- Star connection (33% of FLC Line)=0.33*211.12*1.5= 104.5 A **(Exact size is 25mm2 however better to choose 35mm2)**

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Detailed designing
Why 150% is multiplied

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De-Rating factors related to variation in ambient air temperature because cables are designed for 30° ambient air temperature internationally

Air Temperature in Deg.		20°	25°	30°	35°	40°	45°	50°	55°
	Normal PVC	1.32	1.25	1.16	1.09	1	0.9	0.8	0.8
De-Rating factors	HR PVC	1.22	1.17	1.12	1.06	1	0.94	0.87	0.8
	XLPE	1.2	1.16	1.11	1.06	1	0.95	0.88	0.8

Temperature Correction Factor, K1 when cable is in the Air = 0.88 (for 50° Ambient temperature & XLPE cable)

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Rating factor: Cable laid direct in open in racks

If many cables are grouped together, they will all heat up. The heat won't be able to dissipate properly hence it will warm up the cable itself and those in its contact. This will raise the temperature further. **Hence we have to derate the current carrying capacity of the cable according to the grouping factor.**
Let's suppose1 tray having 6 cables each touching to each other.

No. of Racks	No. of Cables per Rack(Apart)					No. of Cables per Rack(Touching)				
	1	2	3	6	9	1	2	3	6	9
1	1	0.98	0.96	0.93	0.92	1	0.84	0.8	**0.75**	0.73
2	1	0.95	0.93	0.9	0.89	1	0.8	0.76	0.71	0.69
3	1	0.94	0.92	0.89	0.88	1	0.78	0.74	0.7	0.68
6	1	0.93	0.9	0.87	0.86	1	0.76	0.72	0.65	0.66

Cable Grouping Factor (No of Tray Factor), K2 = 0.75 (for 1 tray having 6 cable)
Total derating factor = K1 x K2

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The ultimate current carrying capacity and cable size

- Total de-rating factor = **K1 x K2=0.88*0.75=0.66**
- Delta Connection current = 211.12*0.58=122.5 A
- Star connection cable =211.12*0.33=69.67 A
- With de-rating factor 0.66 the current will become as:
- Delta Connection cable = 122.5/0.66=**185.6 A**
- Star connection cable =104.5/0.66 =**105.56 A**
- From the table current capacity of 70 mm² ,XLPE unarmored copper cable in Air is 198 Amp
- Next size may be **95mm2** for 240 A. Similarly star connection current **25mm2** has capacity of 108 Amp.You can take next size 35mm2

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Voltage drop

Nominal Area of Conductor (Sq. mm)	P.V.C. Cable Single Phase	P.V.C. Cable Three Phase	XLPE Cable Single Phase	XLPE Cable Three System
1.5	43.44	37.62	46.34	40.13
2.5	29.04	25.15	30.98	26.83
4	17.78	15.4	18.98	16.44
6	11.06	9.58	11.8	10.22
10	7.4	6.41	7.88	6.82
16	4.58	3.97	4.9	4.24
25	2.89	2.5	3.08	2.67
35	2.1	1.8	2.23	1.94
50	1.55	1.3	1.65	1.44
70	1.1	0.94	1.15	1
95	0.79	0.68	0.83	0.7
120	0.63	0.55	0.66	0.56
150	0.52	0.46	0.55	0.48
185	0.42	0.37	0.44	0.4
240	0.34	0.3	0.35	0.3
300	0.28	0.26	0.3	0.26
400	0.24	0.22	0.24	0.22
500	0.23	0.2	0.23	0.2
630	0.2	0.18	0.21	0.18
800	0.19	—#	0.2	—#
1000	0.18	—#	0.18	—#

- Voltage drop, V = 0.55 Volts/Km/Amp (as per Havell's brochure)
- =0.55*317/1000=0.174 volts per meter in our case .It will be 8.7 volts if cable length is 50 meters.

- **Terminal voltage at motor 400-8.7=391.3 volts, It is** 2% voltage drop .
- It is satisfactory as voltage drop for a motor is allowed up to 5% .
- It means that this cable should not be long than 115 meters in any case at any site.

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Thanks

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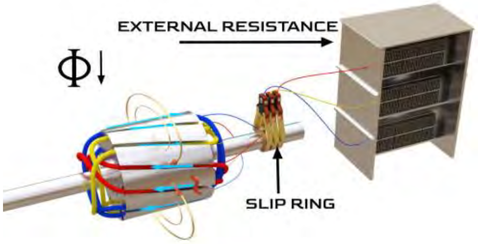
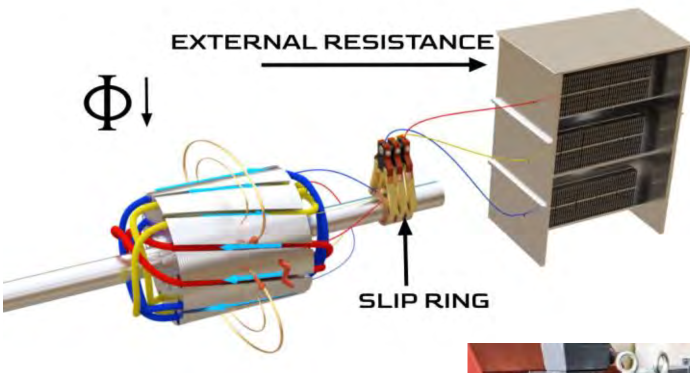
Annex 5.2.7 Training Material for "Slip Ring Motors and starters" at WASA Lahore

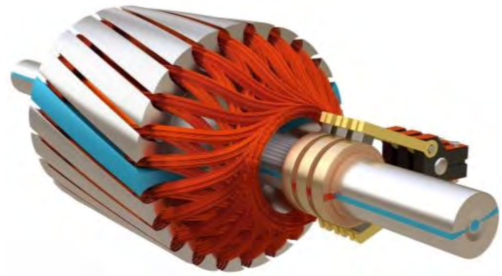
SLIP RING MOTORS AND STARTERS

What is a Slip Ring Motor?

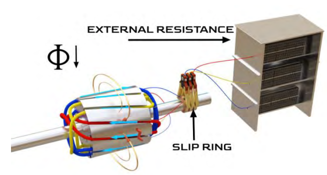


- A slip ring motor, also known as a wound rotor motor, is a type of three-phase induction motor with a unique rotor design.
- Unlike the standard squirrel-cage rotor, a slip ring motor has two windings, stator and rotor where the rotor windings connected to external slip rings, which are in turn linked to resistors.
- By adjusting the resistance in the rotor circuit, slip ring motors can provide:
- smoother starting,
- higher torque at low speeds, and
- improved control over the motor's performance,
- The slip ring induction motor has a high starting torque because the resistance of the motor winding increases with the addition of external resistance. The starting torque is enhanced as the power factor of the rotor circuit improves during the start up process.





Slip Ring motor working



- The key elements in the principle of operation of slip ring motors include:
- **1. Stator:** The stator forms the stationary part of the motor and consists of a laminated iron core wound with multiple coils of insulated copper wire. These coils, known as stator windings, are evenly distributed around the core and are connected to an external power supply. When an electrical current flows through the stator windings, a magnetic field is created.
- **2. Rotor:** The rotor is the rotating part of the motor and is connected to the load. In slip ring motors, the rotor comprises a cylindrical core with conductive bars or coils embedded in it. These conductive elements are interconnected by the slip rings, which are mounted on the rotor shaft. Carbon brushes, in contact with the slip rings, allow electrical power to be transferred to the rotor.
- **3. Slip Rings and Carbon Brushes:** The slip rings are metallic rings that are insulated from the rotor shaft and rotate along with it. The carbon brushes, mounted on stationary holders, make direct contact with the slip rings. As the rotor rotates, the carbon brushes maintain constant electrical contact with the slip rings, enabling the transfer of electrical current from the power supply to the rotor.

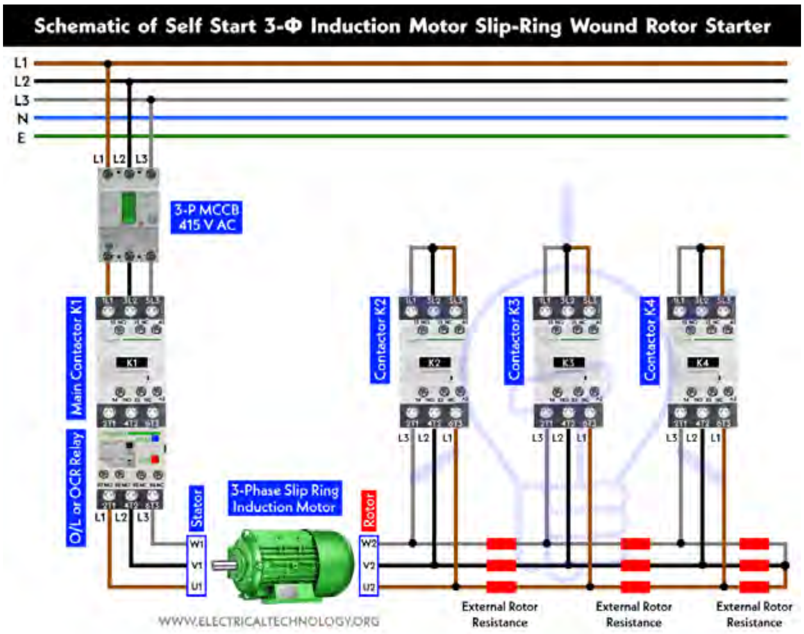
Slip Ring motor working---cont.

- **Induction and Magnetic Field Interaction:** The principle of operation of slip ring motors relies on the interaction between the magnetic fields generated by the stator and the rotor. When electrical power is supplied to the stator windings, a rotating magnetic field is produced. This rotating magnetic field induces an electromotive force in the rotor conductive elements, creating a secondary magnetic field in the rotor.
- **5. Rotor Resistance Control:** Slip ring motors offer the advantage of adjustable speed control by varying the resistance in the rotor circuit. This is achieved by introducing external resistance through the slip ring connections. By adjusting the resistance, the torque-speed characteristic of the motor can be altered, allowing precise control over the motor's rotational speed and torque output.
- The principle of operation of slip ring motors enables them to excel in various industrial applications that demand high starting torque, adjustable speed control, and robust performance. These motors find extensive use in industries such as mining, cement, metal processing, and more, powering a wide range of equipment including crushers, mills, hoists, and conveyors.

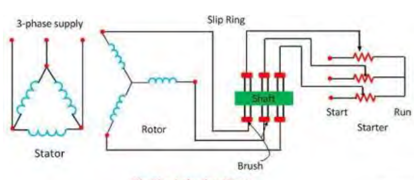
SLIP RING MOTOR STARTER

1. In a slip ring induction motor with a high rating, a rotor resistance starter is used.
2. It employs an external resistance/phase in the rotor circuit in order for the rotor to generate a high torque value.
3. When the external resistance is at its highest, high torque is produced at low speeds.
4. Initially, supply power is linked to the stator via a three-pole contactor, and an external rotor resistance is applied at the same time.
5. The high resistance limits the starting current, allowing the motor to start safely even while under a heavy load.
6. When resistance is added to the rotor circuit of a slip ring induction motor, the starting current is reduced but the beginning torque is increased when compared to straight-line starting.

•Hence, a rotor resistance starter is used for slip ring induction motor of high ratings.

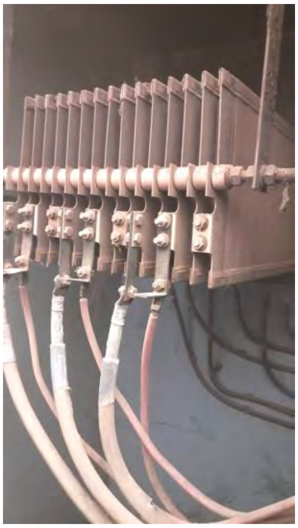


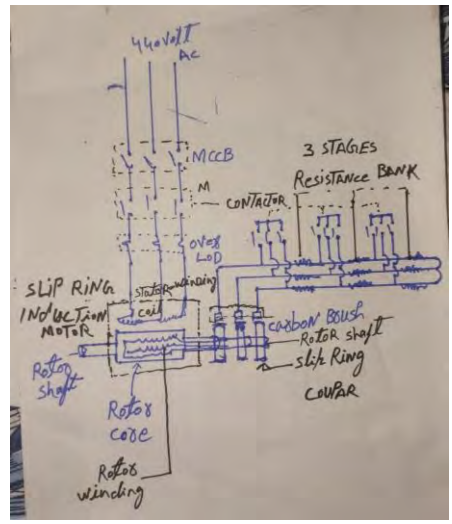
- 4 Nos. of Contactors
- Thermal overload Relay
- 3 Phase-MCCB
- ON-OFF Pushbuttons

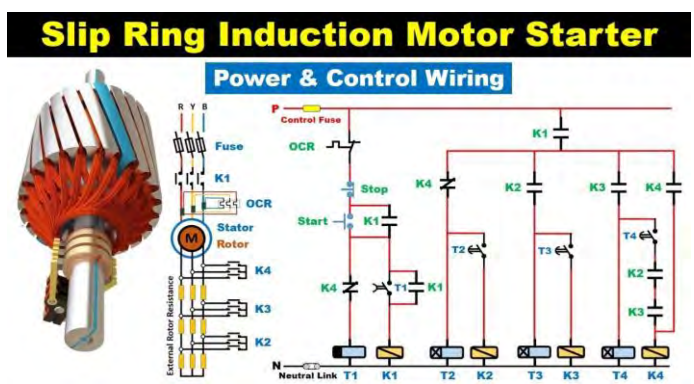


2.6 Ohm resistance bank

Electric panel







• How Does a Slip Ring Rotor Starter Work?

- The operation of a slip ring rotor starter can be broken down into several steps:

1. **Starting:** When the motor is initially started, the slip rings are short-circuited. This means that the rotor windings are connected directly to the stator windings, creating a high resistance to the rotor current. As a result, the rotor experiences a reduced inrush current during start up, preventing excessive heating and mechanical stress.

2 **Speed Control:** As the motor accelerates, the resistance in the rotor circuit is gradually decreased. This is typically done by adjusting the position of the brushes or using a rheostat. Reducing the resistance in the rotor circuit allows the rotor to approach synchronous speed more quickly.

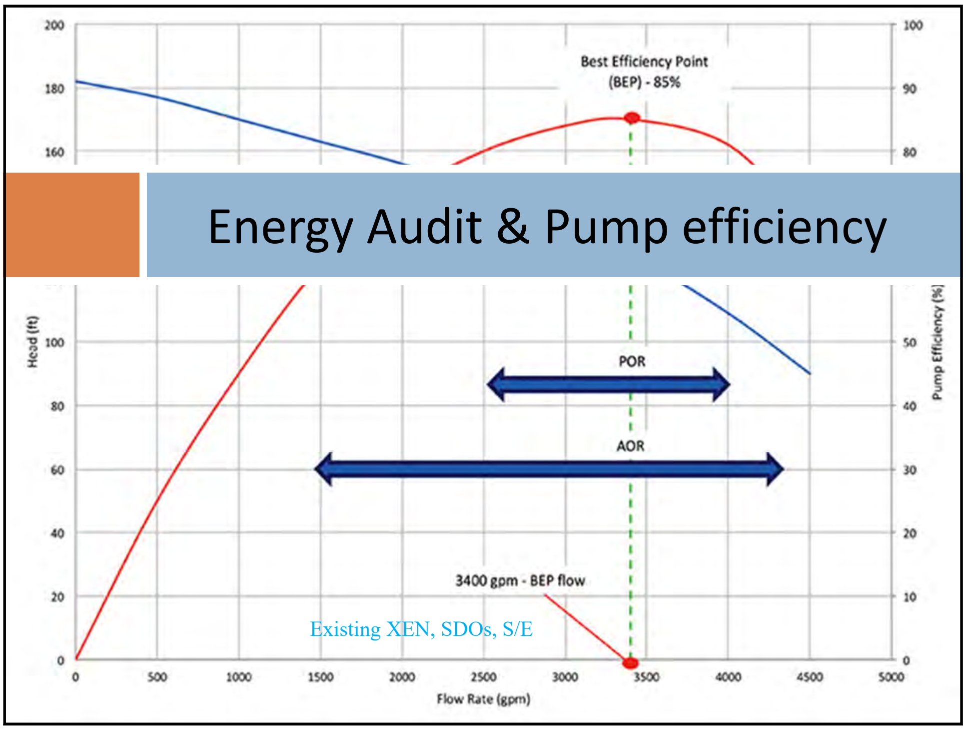
3 **Running:** Once the motor reaches near synchronous speed, the slip rings are completely disconnected from the rotor circuit. At this point, the motor operates like a standard squirrel-cage induction motor, running efficiently at its rated speed.

Slip-Ring Motors Versus Squirrel Cage Motors

- The slip-ring induction motors have the following advantages over the squirrel cage motors:
- High starting torque with low starting current.
- Smooth acceleration under heavy loads.
- a slip-ring motor can be switched ON and OFF more frequently, compared to a squirrel cage motor. It can also withstand a prolonged starting time, while accelerating heavy loads. Now the external resistance will have to be suitable for such duty/load requirements.
- Restriction in starting current and a requirement for high starting torque to accelerate heavy rotating masses sometimes limit the use of a squirrel cage motor. For such applications a slip-ring motor provides a better alternative.
- Adjustable speed.
- **The disadvantages of slip-ring motors are:**
  (i) The initial and maintenance costs are greater than those of squirrel cage motors.
- (ii) The speed regulation is poor when run with resistance in the rotor circuit

Annex 5.2.8 Training Material for "Practical Training on Energy Audit and Pump Efficiency" at WASA Lahore

Energy Audit & Pump efficiency



1

PUMP EFFICIENCY MEASUREMENT

Simple formula for Pump efficiency(η_p)

$=\rho \times g \times Q \times H /(60{,}000\times Kw)$

Assume flow rate(Q): 42.5 m^3/min

Head (H): 14 m

Pump power required=115KW

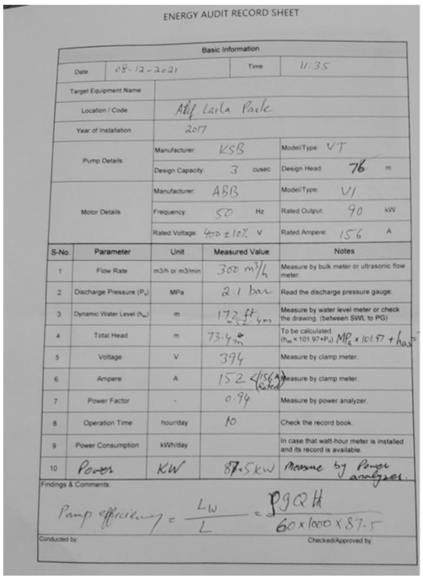
Efficiency would be=1000×9.81×42.5×14/(60,000*115)=.84 or 84%

2

Main activities of Energy Audit

- For comparing current efficiency with designed efficiency we carryout energy audit:
- Check pressure gauge at discharge pipe
- Check flow with flow meter and,
- power consumption with energy analyzer
- Check static water level with level meter and dynamic water level
- Compare the BEP with existing head, flow rate, efficiency and pump input KW with designed values
- You would note that the flow or pressure requirements have changed.
- The pump is loosing efficiency with the passage of time.

3


ENERGY AUDIT RECORD SHEET

Basic Information			
Date	08-12-2021	Time	11:35
Target Equipment Name			
Location / Code	Atif Laila Park		
Year of Installation	2017		
Pump Details	Manufacturer: KSB	Model/Type: VT	
	Design Capacity: 3 cusec	Design Head: 76 m	
Motor Details	Manufacturer: ABB	Model/Type: V/	
	Frequency: 50 Hz	Rated Output: 90 kW	
	Rated Voltage: 400 ± 10% V	Rated Ampere: 156 A	

S-No.	Parameter	Unit	Measured Value	Notes
1	Flow Rate	m3/h or m3/min	300 m3/h	Measure by bulk meter or ultrasonic flow meter.
2	Discharge Pressure (P_d)	MPa	2.1 bar	Read the discharge pressure gauge.
3	Dynamic Water Level (h_{wl})	m	172 ft = 52.4m	Measure by water level meter or check the drawing. (between SWL to PG)
4	Total Head	m	73.4m	To be calculated. (h_{wl} × 101.97+P_d) $MP_d \times 101.97 + h_{wl}$
5	Voltage	V	394	Measure by clamp meter.
6	Ampere	A	152 < (156 A Rated)	Measure by clamp meter.
7	Power Factor	-	0.94	Measure by power analyzer.
8	Operation Time	hour/day	10	Check the record book.
9	Power Consumption	kWh/day		In case that watt-hour meter is installed and its record is available.
10	Power	KW	87.5kw	Measure by Power analyzer.

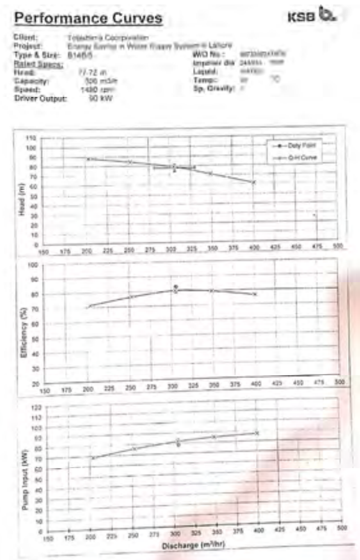
Findings & Comments:

Pump efficiency $= \frac{L_W}{L} = \frac{\rho g Q H}{60 \times 1000 \times 87.5}$

Conducted by: Checked/Approved by:

Energy Audit Calculations
Pressure measured=2.1 bar
Delivery head=mpa*101.97
=0.21*101.97=21.4m
Dynamic head measured
=52.4m
Total head of pump=52.4+21.4
=73.8m
Power consumed=87.5*0.936
=81.9KW
Present flow =300m3/h
=5m3/min

4



Parameters	Original parameters	Current parameters
Pump head	79.47 m	73.8m
Pump power	82.37 KW	81.9 KW
Flow	306m3/h	300m3/h
Efficiency	80%	73.66%

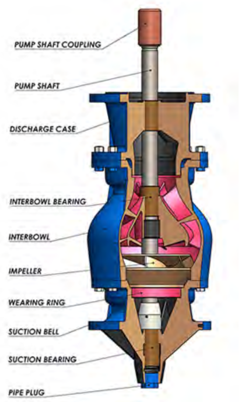
Energy audit shows that flow rate, pump head and power consumed has changed and pump is loosing efficiency.

5

How Energy Audit of tubewells can help in improving of efficiency

After comparing with original values if we found that Pump flow rate & pressure is reduced:

- Wearing out of impellers
- Impeller loose.
- Wear rings worn.
- It may be the indication of lowering of water table and strainer partially clogged.
- You can take remedial measures accordingly



6

Ways to improve the energy efficiency

7

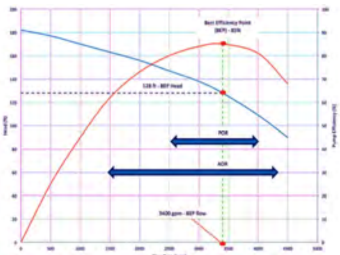
Energy saving with power factor improvement

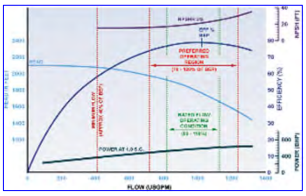
- A power factor of 0.7 for example, indicates that only 70% of power supplied to your motor is being used effectively and 30% is being wasted.
- So you are using 70% of power but power company is supplying you100 %(70+30%) of power that's why they charge penalty for the power wasted by your system but not reflected in your consumed KWH units.
- For example if a motor of 100 KW has 0.7 power factor, it will draw current as I=100x1000/1.732 x400 x0.7=206 A
- But if power factor is 0.9 the motor will draw current as 160 A(above formula).
- So 46 A current is reduced by improving PF from 0.7 to 0.9
- Formula for PF=KW/KVA, you can calculate the KVA by formula; KVA=√3x V x I
- Suppose a 100 KW motor is drawing 180A, KVA =1.73 x400 x180/1000=124.5 KVA & PF=100/124.5=0.8

8

Avoid operating pump far away to the right or left from its Best Efficiency point.

- A pump operating off the right of the curve(more than 120%) is cavitating.
- The shaft rattles; packing is worn; bearings are destroyed by hammering and shafts are bent. Pumps will get hot and cavitation will erode the impeller metal.
- **This may be the case if you install high head pump on a very low head out of BEP**
- When you operate pump more than 30% out of the BEP on left side meaning that now head is too much and flow is less. Consequently efficiency is less and pump is cavitating.
- **WASA,s many lift stations are classical example of this situation due to excessive suction head.**





9

Variable frequency drives

- Variable frequency drives vary the rotational speed of the motor to achieve the actual head and flow demand of the application, rather than what the pump can produce.

With impeller diameter (D) held constant

$$\frac{Q_1}{Q_2} = \left(\frac{N_1}{N_2}\right)$$

Law 1b. Pressure or Head is proportional to the square of shaft speed:

$$\frac{H_1}{H_2} = \left(\frac{N_1}{N_2}\right)^2$$

Law 1c. Power is proportional to the cube of shaft speed:

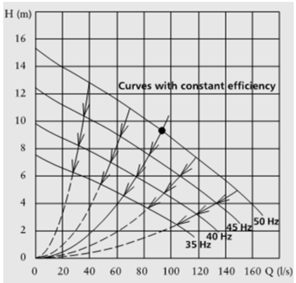
$$\frac{P_1}{P_2} = \left(\frac{N_1}{N_2}\right)^3$$

- VFDs are typically used to limit unnecessary energy consumption in two scenarios;
  - ✓ the first being to slow the motor down on a pump that has been oversized at specification stage.
  - ✓ The second use of a VFD is where there are differing duty demands on the pump at different times. When this is the case, the pump needs to be able to run at maximum capacity when required but may operate at less than this for long periods of time.

10

How Variable Frequency Drive work

- ***Energy Saving:*** The affinity laws state that the flow is proportional to impeller speed at a specific point on the pump curve.
- The hydraulic (pump) efficiency remains constant when the speed is reduced.
- Assume a centrifugal pump with VFD is operating at **600 rpm**(**10 pole** motor) normal frequency 50 Hz with BEP power **50KW**.
- VFD reduces its frequency to 40 Hz.
- RPM will be reduced to120*40/10=**480rpm**
- Power drops to**=P2=50/** (600/480)^3
- **=25.6 KW**



With impeller diameter (D) held constant

$$\frac{Q_1}{Q_2} = \left(\frac{N_1}{N_2}\right)$$

Law 1b. Pressure or Head is proportional to the square of shaft speed:

$$\frac{H_1}{H_2} = \left(\frac{N_1}{N_2}\right)^2$$

Law 1c. Power is proportional to the cube of shaft speed:

$$\frac{P_1}{P_2} = \left(\frac{N_1}{N_2}\right)^3$$

11

Use multiple pumping systems

- The use of multiple pumps is an alternative energy efficient solution to VFDs for a system with different duty requirements.
- When the requirements of the “worst-case” conditions are significantly higher than normal operating conditions, a single pump could spend most of its working life operating far away from its Best Efficiency Point.
- The installation of a second, smaller pump that is specified to meet the average system demand would relieve the larger pump from the burden of operating far below its optimum capacity.

12

Improvements in the electrical motor working

- **Over-Heating**

Around 55% of insulating failures in motors occur due to overheating caused by poor power quality (low voltage), or a high temperature operating environment.

- **Contamination**

Contamination **from dust, dirt and chemicals** is one of the leading causes of motor failure. Foreign bodies can dent bearing raceways and balls

- **Vibration**

The motor positioned on an uneven or unstable surface often causes vibration. Vibration can also be a result of loose bearings, misalignment, or corrosion.

13

LOW VOLTAGE CAUSES HIGH CURRENT & OVERHEATING OF MOTOR

- For a motor having 90% power factor and rotating a pump consuming 100 KW power. When voltage is 400 V the current will be 160 A.

Current=100/1.732×400×0.9/1000=160A

And if voltage becomes 320V the current will be 200 A thus

25 % more current will be flowing causing overheating of motor.

14

Carry out maintenance

- Undertaking routine maintenance can also reduce energy consumption.
- The replacement of eroded wear rings is vital, as increased wear ring clearance increases leakage and therefore the pump efficiency decreases.
- A pump's energy efficiency can degrade as much as 10-25% before it's replaced. When it gets to this stage, the best way to reduce your pump's long-term energy costs is to upgrade it!

Air in pipelines can reduce the efficiency

Reduced Pumping Efficiency:

- Air in pipelines can reduce the efficiency of the pumping system.
- The air trapped at the high points of the system blocks flow, increasing the pressure head and thus the energy required for flow to occur.

15

Possible improvements in mechanical working for efficiency improvement

- Partially closed valve or some other obstruction in the discharge line may be cleared
- Clogged suction may be cleared
- Ruptured suction line may be repaired
- Clogged impeller may be cleared
- Excessive suction lift may be reduced
- Only installation of manual bar screens(rough screens) is inadequate to remove complete debris and floating material from wastewater.
- **A standard needs to be set for bar spacing, bar thickness, angle of inclination and total height.**

16

Avoid oversizing the pump set

◆ It's common for engineers to be conservative when specifying a pump, with them often including a margin of safety in terms of the supplied pump's duty compared to what the application requires.

◆ Pumps, are typically oversized by **20-30%**. As a higher performance in terms of flow and pressure requires more power from the motor, an oversized pump can result in unnecessary energy consumption.

◆ A pump is generally considered to be oversized when it is not operated **within 20 per cent of its Best Efficiency Point (BEP).**

◆ Oversized motors can also contribute to reduce the energy efficiency of the system

An oversized pump can be identified in a number of ways, including:

- The pump has a flow rate that varies more than 10 to 20 per cent from the pump's BEP flow rate
- If there is excessive flow noise
- If bearings and seals need frequent replacement
- It has intermittent operation, such as pump cycling
- **Controlling flow of an oversized pump with throttle valve is not recommendedThrottle Valves:**
- **Throttle valves** provide flow control in two ways: by increasing the upstream backpressure, which reduces pump flow, and by directly dissipating fluid energy. By increasing the backpressure on a pump, throttle valves make a **pumping system less efficient.**

17

Impeller trimming is cost effective solution to control oversizing keeping the parameters near BEP

- If a pump is oversized, trimming the impeller is a relatively cost-effective way of reducing the pressure and flow that is produced.
- Whilst trimming the impeller is much more energy efficient than using a throttling valve to achieve the required duty, as an impeller is shaved, the clearances between it and the casing get larger, making it less efficient than a full-sized impeller. For that reason, variable speed drives are often the preferred choice when it comes to energy efficiency.
- it should be limited to about 75 per cent of the pump's maximum impeller diameter, and as the impeller is shaved, the clearances between it and the casing become larger, resulting in greater flow recirculation and reduced pumping efficiency if it is shaved excessively.

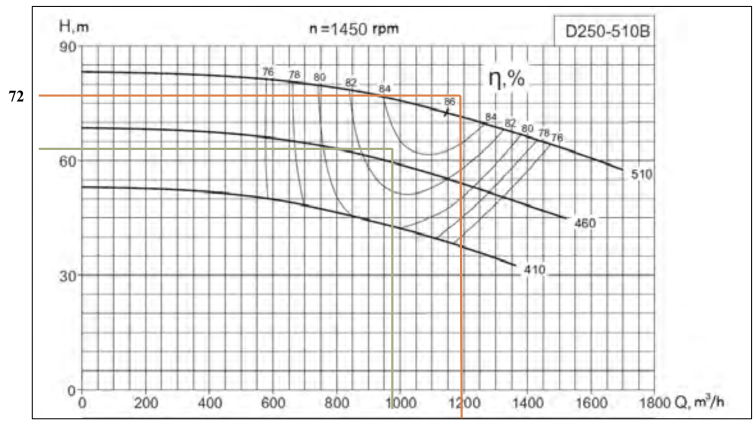
18

How Impeller trimming works

- **Flow capacity: Q1/Q2 = D1/D2**
- **Head: H1/H2 = (D1/D2)^2**
- **Motor power: BHP1/BHP2 = (D1/D2)^3**
- Suppose a tubewell pump is discharging 306m3/h but required flow is 250m3/h and existing impeller dia is 254mm with motor HP=120.
- 306/288=254/D2 so D2 will be=254/1.0625=239 mm. So you can trim impeller by 15mm
- **Head: H1/H2 = (D1/D2)^2**
- 70/H2=(254/239)^2= H2=61.97m
- In that case new BHP will be 100 instead of 120

19

Impeller Trimming means like choosing small dia impeller



20

Proper sizing of suction and delivery pipe

- Discharge diameter can be calculated by the following formula.
- D =146 ×√Q/V
- Q: Discharge Quantity (m3/sec)
- V: Flow Velocity (m/s), V is generally kept from 1.5 to 3m/s
- So if flow is 42.5m3/min (25 cusec) and velocity is 2.5m/s the discharge pipe will be 600 mm diameter
- Delivery pipe size is often given by the manufacturer in the pump performance curves also
- **Keep suction size one stage bigger and even two stage bigger than suction size of the pump**

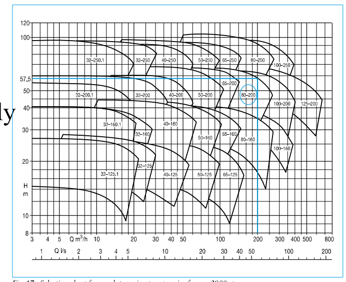


Fig. 17: Selection chart for a volute casing pump series for n = 2900 rpm
(First number = nominal diameter of the discharge nozzle, second number = nominal impeller diameter)

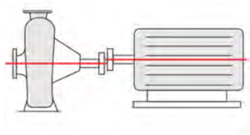
Free fall vertical drop in wet well is not recommended by Hydraulic Institute Specs ANSI/HI 9.8-2012

- A free fall into open sumps from the inlet conduit into the pool below with the consequent entrainment of air in the liquid and the release of odors.
- The air bubbles, easily captured by currents carried into the pumps, cause loss of capacity and damage to the pump.
- **One % of air can reduce efficiency as much as 15%**

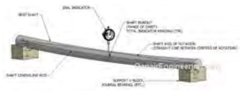
Damaged impeller from air entrainment

Causes of pump drawing too much power

- Misalignment

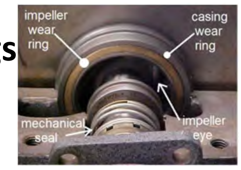


- Bent shaft



- Excessively tight stuffing box packi

- Worn wearing rings



23

Annex 5.2.9 Training Material for "Energy Audit" at WASA Lahore

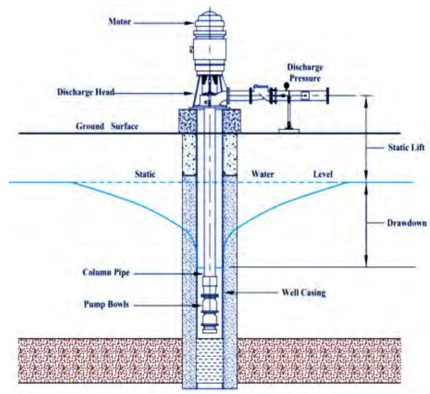
ENERGY AUDIT AT PAK BLOCK TUBEWELL

Energy Audit on8/3/23

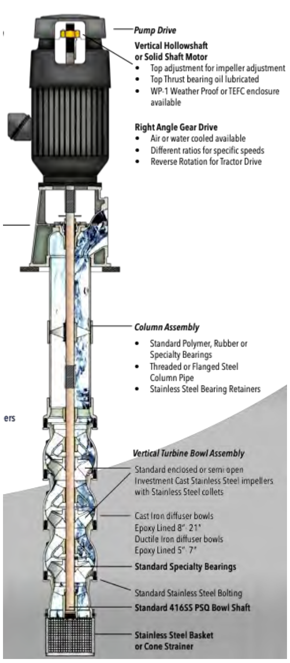
Energy Audit Record sheet				
Location of pump---PAK Block AIT				
Date	**8/03/2023**	**Time**	11 am	
Year of installation				
Pump details		Manufacturer **KSB**		Model/Type
		Design capacity		Design head
				Actual head at commissioning
Motor details		Manufacturer		Rated output 90KW
		Rated voltage 400		**Actual power consumed at commissioning**
		PF=.89		Rated current 156A
S-No	**Parameter**	**unit**	**Measured value**	**Remarks**
1	Flow rate	m3/h	382	Bulk flow meter or Utrasonic meter
	Duty hours	hrs	8	Log book
2	Total flow in a month	m3	240*382=**91,680**	Flow rate*hrs
3	**Motor input power**	KW	85.2	From energy bill
	Total units consumed as per working hrs		85.2*240=20448	
	From bill Units charged Regular units plus peak		24,424	From energy bill
4	Total bill charged (RS)		**635,941**	From energy bill
5	Average Power consumed	KWh/m3	**0.22**	
6	Average Power cost	PKR/m3	**6.93**	
Observations:				

Annex 5.2.10 Training Material for "Tube wells performance monitoring and rehabilitation" at WASA Lahore

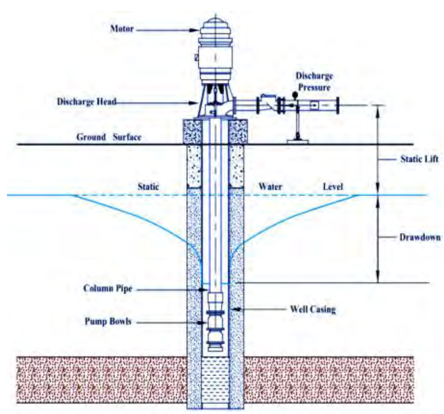
Tube Wells Performance Monitoring & Rehabilitation

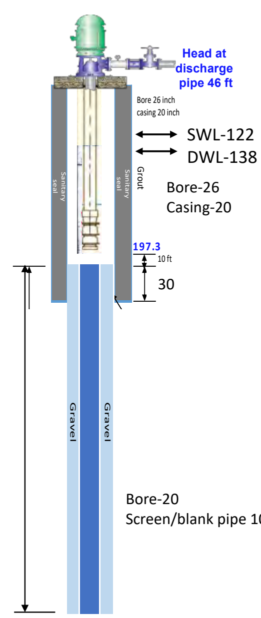


GENERAL LAY OUT



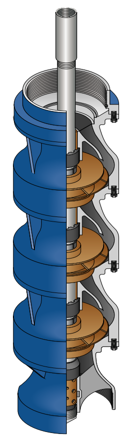
Cone of deperession due to draw down

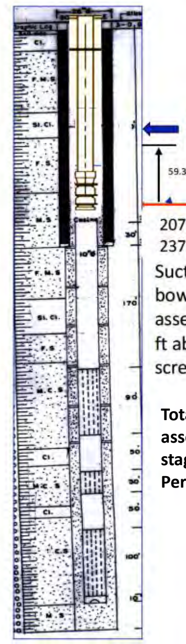




Lets take example of a 4 cusec Tube Well

- Bore size for Pump housing-26 inch
- Housing pipe size-20 inch
- Bore size for casing and filter-20 inch
- Casing blank pipe 10 inch dia-F/Glass
- **Screen-F/Glass, 10 inch size -220 ft long**
- Overlap of Housing and column pipe-30ft
- Pump setting is 10 ft above lower casing
- **Assume 5 stage pump**
- **Total head of pump 250ft**
- **Each stage creates 50 feet head**



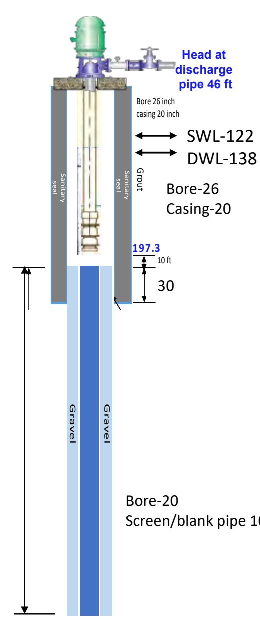


Suction of the bowl assembly is 10 ft above the screen casing

Total height of bowl assembly of 5 stages 4.3ft
Per stage-9.25 inch

Pump setting depth & Head calculation

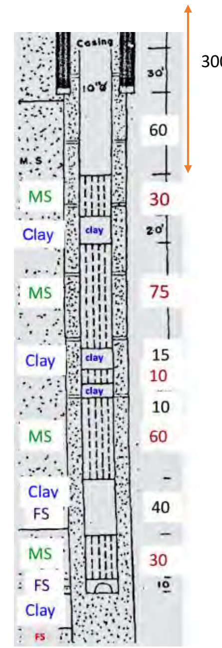
- Static water level, Plus draw down, Plus anticipated draw down at the end of design life, Plus Safety margin (safety factor), Plus Pump submergence to the impeller inlet;
- Static Water Level-122 ft
- Draw Down-16 ft
- Draw down in 15 years-45 ft (assume 3ft/year)
- Safety factor=10ft
- Pump setting: Top at 122 +16+ 45+10=193ft
- Pump height=4.3ft
- **Bottom at 197.3 ft**
- **Head of the Tube well**
- **Pump setting 197.3 Plus frictional losses 7 ft**
- **Plus head required at discharge of the tube well=46 ft**
- **197.3+46+7ft safety=250 ft**



Well screen length,entrance velocity & placement

- Optimum length based on
  - thickness of the aquifer
  - available drawdown and
  - nature of the stratification of the aquifer

MIT Classification	
Silt/Clay	< 0.06 mm
Fine Sand	0.06 – 0.20 mm
Medium Sand	0.20 – 0.60 mm
Course Sand	0.60 – 2.00 mm
Fine Gravel	> 2.00 mm



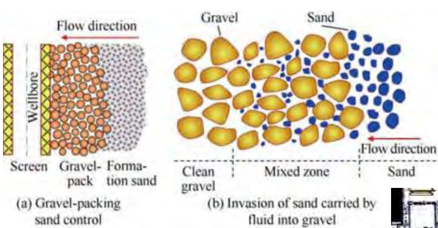
$$\text{Length of screen} = \frac{Q}{[p \times D * Sop \times (1 - Clogr) \times V]}$$

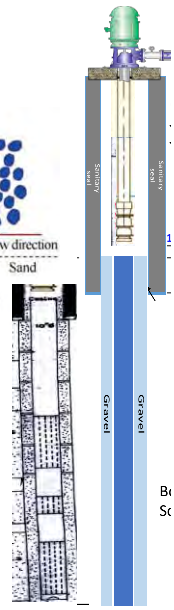
- Q =Discharge, D= Dia of screen, SOP=Screen opening ratio(10%), Clogr=Cloging ratio of screen(30%)
- For 4 cusec T/W the screen length is about 220 feet in sections as per availability of water bearing aquifer
- **Entrance Velocity:** Enough open area must be provide so that the entrance velocity of water generally does not exceed the design standard of 0.1 ft/s
- The normal slot size shall be i.0, 1.6, and 3.2mm. For fibre reinforced plastic (FRP) pipes, the slot width shall not be less than 1.6mm.
- The size of the screen openings is decided based on the size of the gravel.

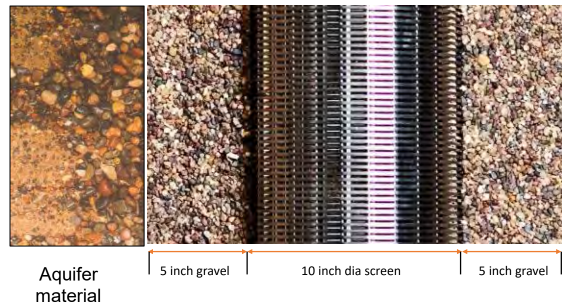
Diameter of the screen and vertical velocity

- Screen diameter depends upon vertical velocity taken for design: Q=A*V, A=Q/V
- **WASA Criteria:** V=7ft/s
- **JICA :** Adopted the same criteria as of WASA Lahore
- **AWWA standard**: The diameter of the selected well screen shall not be less than the minimum size needed to maintain a vertical velocity within the screen barrel of not greater than 4 ft/sec
- **Many Universities and other designers take 5ft/s**
- **For a 4 cusec Tube well the dia of the screen will be:**
- 10 inch as per JICA and WASA criteria;
- 13.5 inch as per AWWA criteria
- 12 inch as per other designers/Universities
- So, diameter is changeable within certain limits.
- Present depths of bore in Lahore invites thinking over changing the diameter of screen to 12 inch to reduce depth and length of the screen.
- For example the length of 10 inch screen is about 220 ft by WASA standard
- It will be 182 ft if dia is considered as 12 inch and it will fit into same borehole with 4 inch gravel around it.

Screen, Gravel and natural strata



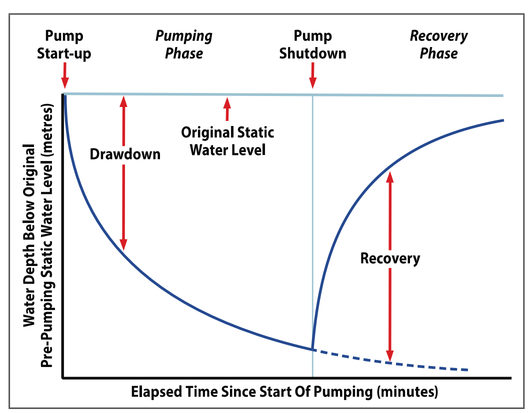


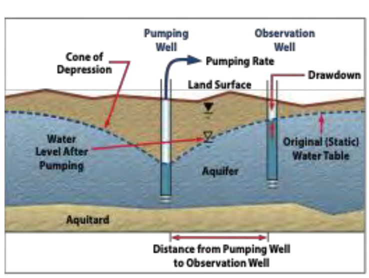


Bore size for screen and blind pipe -20 inch

Well Yield

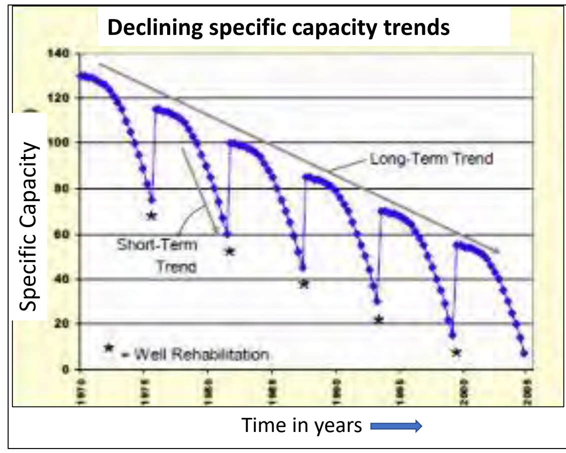
- Minimum durations of typical pumping tests are 24 to 72 hours unless stabilization of the pumping water level occurs.
- i.e.Constant rate pumping for 24 hours.
- Monitoring of draw down continuously.
- 90 per cent recovery should be within 2-3hours after the pump stops.





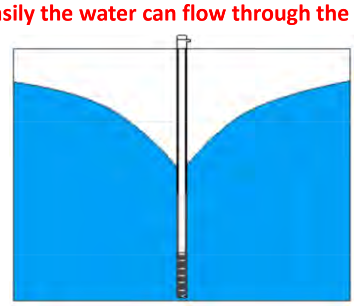
Specific capacity of a Tube well

- Yield of a well per unit draw down is called the specific yield of the well.
- For a 2 cusec capacity Tube well, if its draw down is 15 ft, the SC will be 2/15=0.133 cusec/ft of DD
- Over time, almost all wells experience some loss in specific capacity.

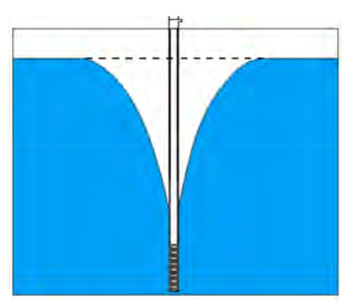


The principles of efficient well operation

The shape of the cone of depression is dependent on the permeability (hydraulic conductivity) of the formation, how easily the water can flow through the formation.



Water moves easily through highly permeable formations(Coarse grained) resulting in a flat cone of depression extending relatively far from the well. The head required to move water through this type of formation is small, causing little drawdown.



Wells in low permeability formations(fine containing much silt or clay) have greater drawdown and the cone of depression does not extend as far from the well. This requires more head to move the water and causes greater drawdown in the well. In this case, the cone of depression does not extend as far from the well

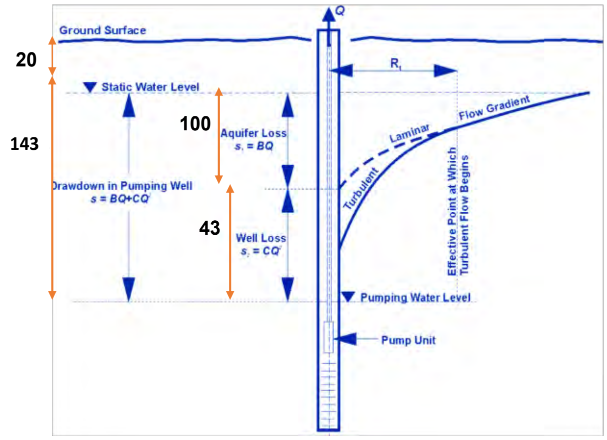
Well Efficiency

- The efficiency of a pumping well expresses the ratio of aquifer loss (theoretical drawdown) to total (measured) drawdown in the well. (Kruseman and de Ridder, 1990).
- A well efficiency of 70% or more is usually considered acceptable, with 65% being accepted as the minimum efficiency (Kresic, 1997).
- The well efficiency is defined by:

$$\eta = \frac{s_1}{s} = \frac{s_1}{s_1 + s_2}$$

- where:
- S1= aquifer loss or theoretical draw down
- S= Well Loss or actual pumping water level
- The well efficiency=100/143=70%

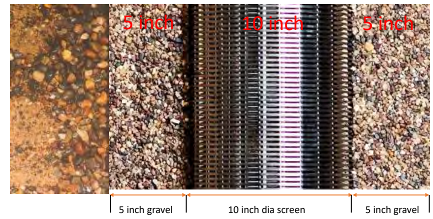
In an actual field situation, the pumping water level inside the well casing (actual) **is rarely equal** to that just outside the casing (theoretical) due to head losses through screens, gravel packs, etc.



Screen blockage increases draw down and loss of efficiency

- Well screen problems generally fall into three categories:
- physical blockage,
- biological blockage and
- chemical blockage.
- No matter how screen blockage happens, it increases the drawdown and pumping energy requirements.

Physical plugging of the screen



Over time, almost all wells experience some loss in specific capacity.
Slow movement of fine particles into the near well area where they hinder water flow into the well.

- **As the pathways for normal water flow into the suction area decrease because of the accumulation of fines, the velocity of the water flow increases, creating turbulence in the near well area.**
- This greater turbulence increases the movement of fines into the well suction area, **increasing sand pumping, often to unacceptable levels.**
- **As the sand, silt and other materials accumulate in the bottom of the screen, the inlet area is reduced.**
- The most common reasons of sand pumping are **holes in the casing from corrosion, migration of fines from over pumping, poor placement or sizing of the gravel pack, screen openings that are too wide and poor well development following construction.**

BIOLOGICAL BLOCKAGE

- **Iron related bacteria:** Generally, if the iron amount in the water is greater than 0.3 parts per million (ppm), iron bacteria problems will arise. Even small quantities of iron provide a source of energy for the growth and development of iron bacteria. These bacteria form a slimy organic substance on the well screen, **pump intake and pump column**, **and in the water-bearing aquifer materials surrounding the screen**
- A hard scale is noticed when pulling the pump or check the ID in a piping system. The color associated with each type of scale is as follows:

red/ brown = iron **black** = manganese

green/ blue = sulfates **white/ light brown** = calcium

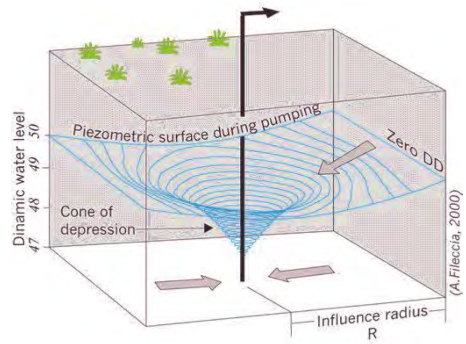
If you have information on water quality, look for any one or combination of the following:

pH > (greater) 7 **iron** > 1.0 ppm **hardness** > 200ppm

sulfates > 20 ppm **manganese** > .02 ppm

Aerobic Slime forming Bacteria

- Most slime problems are caused by naturally occurring, common soil bacteria found in every aquifer. Most are not a health issue.
- **The slime can plug screen openings, the gravel pack and sometimes the aquifer materials outside the screen.**
- **Aquifers have a natural direction of flow called a gradient. When a well is installed and pumped, the direction of flow and velocity change drastically toward the bore hole. This flow has a tendency to continuously bring more of these naturally occurring bacteria to the well.**

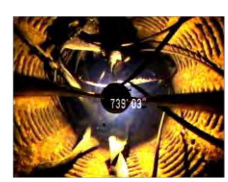


- Poor development techniques in new wells, which results in low well efficiency, **increases the tendency for both precipitation of minerals and the production of slime.**
- Actual plugging in wells and piping really only appear in approximately 3-4% of all well **and most often occur in the first 4 years of operation.**

Mineral Incrustation

- **Most mineral deposits on well screens are calcium and magnesium carbonates or calcium and magnesium sulfates.**
- **They precipitate out of the water where the water velocity is highest and the pressure is lowest: at or near the entrance to the well screen.**
- **Water entering the well screen at a rate greater than 0.1 foot per second can contribute to more rapid mineral deposition.**
- **Over pumping a well or cascading water will increase precipitation**.
- **The principal indicators of incrusting groundwater are: total hardness > 330 ppm, total alkalinity > 300 ppm, iron content > 2 ppm, and pH > 8.**
- **Acids are commonly used to dissolve these deposits and return a well yield. Calcium is the easiest scale to dissolve.**
- Mineral scale is generally a problem only in the screen area

Incrustation cements parts of the gravel pack and aquifer materials on the outside of the screen



What are Well performance loss Mechanism

a) WELL DESIGN

I. Screen intake velocity

II. Screen placement/Filter pack

III. Lack of development

Aquifer type	Well problems	Major maintenance frequency requirement
Alluvial	Silt, clay, sand intrusion.Incrustation of screens,Biologic fouling	2-5 years

b) GROUND WATER CHEMISTRY

I. High iron, manganese or nutrients

I. Highly oxidizing conditions –due to pump operation

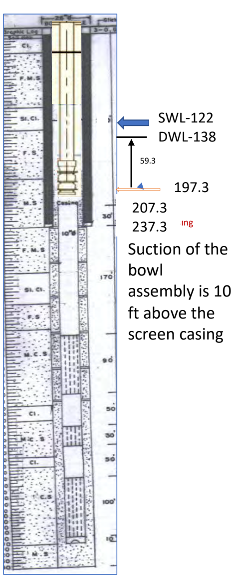
II. Positive Saturation Index, Hardness, Alkalinity, pH – Precipitation of $CaCO_3$ or $CaSO_4$

LETS TAKE EXAMPLES OF WELL PERFORMANCE LOSS MECHANISM

SCREEN ENTRANCE VELOCITY

- **Maximum velocity is recommended as 0.1ft/s**
- At high entrance velocity rates, there is high friction loss and turbulent flow develops at the well screen which causes an increased potential for mineral incrustations and corrosion.
- Turbulent flow also reduces pump efficiency and results in lower overall well efficiency due to head losses at the screen.
- In reality, entrance velocity is a balancing act between screen length, well diameter, screen open area and aquifer thicknesses
- **Public Health Engineering Department recommends 0.05ft/s velocity.** In my view due to the reason that their Tube wells are mostly of 0.5 to 1 cusec and in the cities where good aquifer is limited and there is always a threat of brackish layer to mix with sweet layer.
- **JICA took Inflow velocity into screens as per USA standard = 0.03 m/sec or 0.1ft/s**
- **Indian standard is also the same (0.03 m/sec or 0.1ft/s**

Scenerio-1: Ignoring screen cloging ratio during design



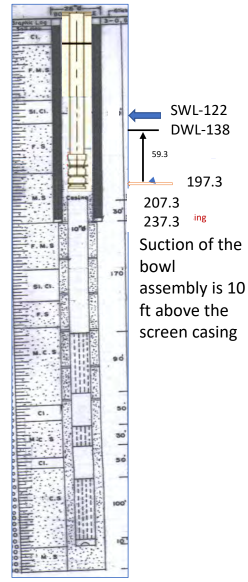
For a 4 cusec Tube well, Length of screen = 4/2.6*0.1***0.7***0.1) = **220ft**

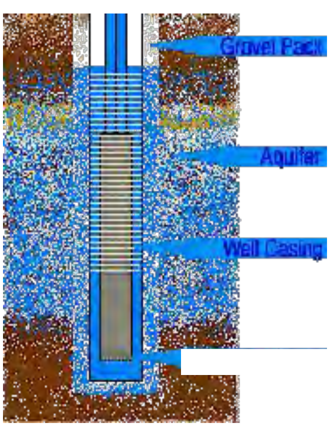
- **Available water at he pump suction when T/W is new= about 5 cfs but pump will lift 4 cusec. Sufficient water will be available throughout its design life till clogging is more than 30%**
- Suppose at design stage phase no provision is considered for screen clogging ratio.
- In that case the Length of screen will be=**4/(2.6*0.1*0.1)=154ft** and with safety factor it may be **180** ft
- **In this case when T/W is new it gives 4 cusec but gradually it will reduce the flow as screen is clogging day by day thus not providing sufficient water for 4 cusec pump.**
- **When screen is 30% clogged, available water for pump in the suction of pump=2.8cusec**
- Actually the screen starts getting clogged very soon especially when water has CaCO3 or CaSO4 .

Scenerio-II:Sand Pumping

The sand, silt and other materials accumulated in the bottom of the screen, the inlet area has reduced due to migration of fines from:

- over pumping,
- poor placement or sizing of the gravel pack, screen openings are too wide.
- Poor well development following construction.
- Hole in the screen or blank pipe.
- Now rehabilitation/redevelopment may work and flow may be cleared from sand





Well Development

Purpose: To mitigate mud cake, fines from gravel pack, & protect pump from sand.

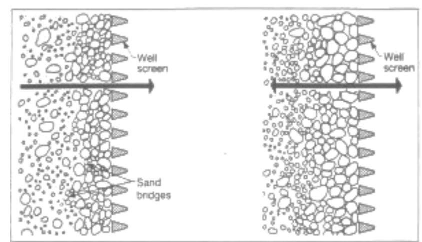
Select Gravel Pack based on formation and screen slot size

Size Screen to Retain 90% of Gravel Pack

The width of screen slots ranges from 1.5 to 4 mm and the length ranges from 5 to 12.5 cm.
Gravel size ranges from 2mm to 12.5mm(IS)
Fiberglass screen slot size-1.6mm or more
Public Health criteria:
Screen slot size1*1/30 inch(25*0.8mm)
Gravel 3mm to 9.5mm

Proper well development prevents fast degrading

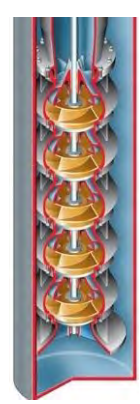
- Proper well development, at the time on initial construction, can largely **prevent or significantly delay any degrading of well capacity caused by the movement of fines.**
- Proper well development at the time of construction **will stabilize the near well area** so that subsequent pumping cycles will not result in sediment movement.
- **Sand pumping in screen wells can erode the screen to the point where replacement or other action needs to be taken.**
- If development is not perfect. It will result accumulation of fine sand in the lower part of the screen plugging the water flow.

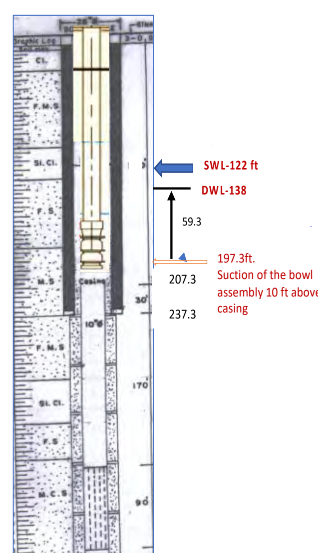


Effective development requires movement of fluid in **both directions** through screen openings. Movement in only one direction does not produce the proper development effect (Sterrett 2007).

Scenerio-III: Draw Down depletion rate is not estimated correctly

- The draw down decline rate was estimated as 3ft/Anum.
- Actual decline at 4 ft/anum.
- So, draw down in 13 years=**138+52=190**
- And after 14 years the dynamic level will be=**194** thus 1st bowl/stage will be out of water(Dynamic water level will be below this stage).
- At this point the pump will be discharging air in the water and condition of suction break may prevail.
- within 15th year there will be no flow as the dynamic level will be(198) below complete bowl assembly.





Head will be increased 50 ft by each bowl/stage.

JICA RECOMMENDATIONS(2014 Study)

- It is recommended that WASA address the life-span extension of a tube well pumping station; and the system can be changed from the **present full replacement of the entire Tube well to the replacement of a pump only.**
- To support this, it is necessary to establish the **tube well cleaning method suitable to the tube wells in Lahore and to establish a regular tube well cleaning program from the the time it is commissioned.**
- In addition, the actual **measurement of water production should be done at least once a year for all the WASA tube wells**
- **and operation control should be established through the regular energy audit**.
- WASA should **install Tube wells according to ground water table instead of applying uniform formula regarding capacity and head of pumps**. It has resulted in relatively inefficient operation of tube wells thus wasting energy

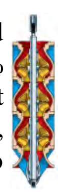
Benefits of not applying uniform formula regarding capacity and head of pump

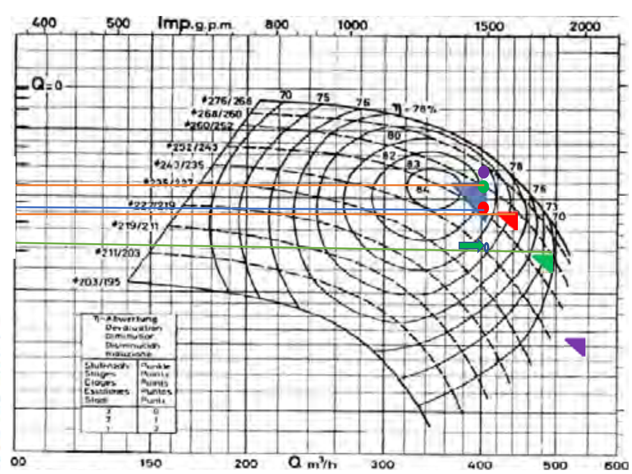
Example-I

Standard pump is 64 m head and 82.5% efficiency. When installed on a 57m site it gave 77% efficiency but when selected pump impeller was trimmed it improved pump efficiency from 77% to 82 %, reducing required power from 90 kW to 68 kW.

Example-II

This is a 4 stage pump and when installed on a 48m site it reduced efficiency to 70% but when one stage was reduced it improved efficiency from 70% to 83 %, reducing required power from 88 kW to 49.5 kW.





Standard pump is suitable for 64 m(210ft) head and 82.5% efficiency.4 stages with 16m head by each stage

Regular monitoring matters

- **Proactive Approach**

 Evaluate well on a periodic basis
 Evaluate pump on a periodic basis

 Water chemistry monitoring
 Bacterial assessments
 Perform systematic maintenance

- **Reactive Approach**

 Respond only when well approaching failure
 Lack of identification of a problem
 Cost benefit or budgetary to delaying response

Identify a problem

A. Visually

- Surface clues – deposit/slimes • Downhole Camera

B. Mechanically:

- Evaluate pump performance through Energy Audit
- Evaluate Changes in Flow or Pressure

C. Hydraulically

- Well Performance: Specific capacity

D. Chemically

- Water quality testing–iron, manganese, biological

ENERGY AUDIT

Measured at site

S-No	Parameter	Measured Value	Remarks
1	Flow rate in m3/h		Bulk Flow meter or Portable ultrasonic flow meter
2	Discharge pressure in psi or bar		Pressure gauge at delivery
3	Static suction head(plus draw down of tube well)		By water level meter
4	Voltage in volts(v)		By clamp meter
5	Current in amperes(A)		By clamp meter
6	Power factor		By power analyzer
7	Power consumed by motor/pump		By power analyzer

You must have record of Pump Performance curves and Tube well log & pump name plate

Unit	Parameter	Value/detail
Pump	Design Flow in m3/h	
	Design head and actual head in m at commissioning	
	Design power in KW	
	Original Efficiency	
Electric motor	Rated output of motor KW	
	Rated Current	
	Rated voltage	
	Motor efficiency	

ENERGY AUDIT---2.

After comparing with original values if we found that Pump flow rate reduced and head is increased by 15 meters, pressure and efficiency is reduced from 76% to 50%.

- It is also observed that :
- As Pump is running out of minimum recommended range of 70% of BEP therefore, we understand that more likely reasons may be:
- **Excessive Lowering of water table over the last-15 years.**
- **clogging of strainer**
- **Pump repair required**

Parameters	Original parameters	Current parameters
Pump head	**64 m**	**79 m**
Pump power	**23 KW**	**15 KW**
Flow	**100 m3/h**	**50m3/h,**
Efficiency	**76%**	**50%**

Energy audit shows that:

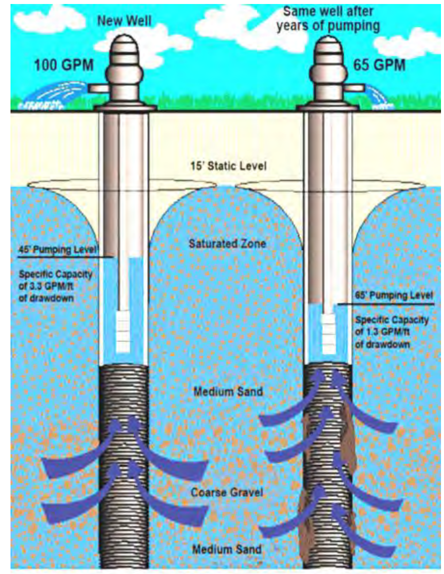
flow rate has reduced,

pump head increased and

pump is loosing efficiency.

Monitoring of Specific capacity

- **If critical losses fall to greater than -15 and down to -40% then generally regular maintenance will not bring the well back to original.**
- **Wells that have lost more than 60% of the original capacity** may not respond so well to radical rehabilitation and only a fraction.
- **Another rule of thumb is that if the wells performance has declined by 25%, it is time to begin rehabilitation efforts.**
- **In well maintenance and in well rehabilitation, as in many areas of life, “the earlier the intervention the simpler and cheaper the fix.”**



Typical flow conditions in a new well.

Flow conditions altered due to a build up of mineral scale and or biological debris.

Monitoring of Specific capacity--Cont.

- **Scenerio-1: Draw down is exessive.**
- Suppose the T/W is of 4 cusec, the original specific capacity is 4/16=0.25 cusec/ft of DD
- **The flow has reduced to 3.0 cusec and draw down is 20.Now the capacity will be 3/20=0.15cusec/ft dd. It has reduced 40% SC. Suitable for rehabilitation.**
- **Scenerio-2 Draw down is as expected and flow is not reduced so much**
- The flow has reduced to 3.5cfs and draw down is 18. The specific capacity will be=3.5/18=0.194cusec/ft dd. Capacity has reduced about 22%.Rehabilitation may give good results and may save from fast deterioration.

SC reduced considerably mainly due to excessive draw down due to less recharging of aquifer and less due to screen blockage

- The flow has reduced to 3cfs in 10 years and draw down is 43.5. The specific capacity will be=3/43.5=0.07cusec/ft dd. Specific Capacity has reduced about 72%.
- Rehabilitation will not enhance specific capacity up to a certain limit because decrease is due to decline of draw down due to less recharging of aquifer than the capacity of the T/W.
- Rehabilitation including pump repair will enhance the discharge of the tube well.May be.0. 75 cusec
- SC will become 3.75/43.5=0.086. So, enhancement of SC about 23%

Rehabilitation Methods

Rehabilitation is performed to remove these blockages and restore the well's Specific Capacity and improve the well's efficiency. There are both short-term and long-term declines in Specific Capacity over the normal life span of a well. Short-term declines are caused by the plugging as a result of one or more physical, chemical or biological processes and may be partially reversed with well rehabilitation efforts. However, the causes of the plugging can generally not be removed completely resulting in a chronic, long-term decline in Specific Capacity over the life of the well until Specific Capacity reaches the point where a replacement well is needed

Rules of thumb

- Well production decline of 25% indicates need for rehabilitation
- Rehabilitation Costs:
  – Well operator's preventative maintenance costs
- 10-20% of cost of hiring well rehab specialist
- – Well rehabilitation costs 10-20% of installing new well

Chemical Treatment

1. **Acids – Inorganic and Organic**
2. **Anti-Bacterial**
   - **Chlorine**
   - **Ozone**
   - **Hydrogen Peroxide**

Acidizing:

Water quality deterioration is an early indication of the need for some type of intervention.

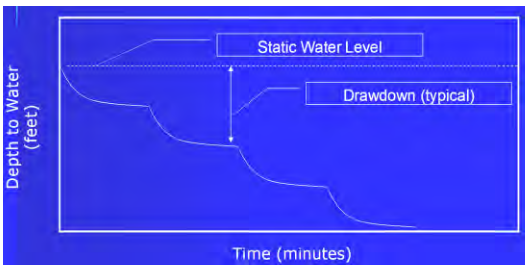
- **HCL also called Muriatic acid is the most common acid used for rehabilitation of incrustation ($CaCO_3$ and $CASO_4$)**
- Muriatic acid, a common product used for acidizing a well, is an industrial name for a hydrochloric acid solution with about **30 percent concentration**, a very strong acid. It provides a fast chemical reaction to dissolve carbonate scales and incrustation. **It is particularly effective against iron and manganese oxides but doesn't remove biological buildup very effectively.**

ACIDIZING----Cont.

- It is usually introduced into the well **through a tremie.**
- **The contact time may vary from a few hours to 15 hours after the acid solution has been introduced and agitated.**
- **The well water PH is measured** as an indication that the acid has reacted with the encrustation to the degree that the acidity of the solution had been lost and all possible reaction has been completed for this session. **When the well PH has reached 6.5-7, the well is agitated again.**
- Sulfamic acid is not as aggressive as HCL, but is available as a powder so it is easier to transport and handle. Also it gives off less concentrated toxic fumes than does HCL.
- Hydrochloric (HCl) acid is a fast-reacting mineral acid commonly used in a **liquid form of 31% strength at a rate of 3% to 12% of the targeted treatment volume.**
- **Sulfamic acid is available in a 99% active form typically used at a rate of 2% to 5% of the targeted treatment volume.**

Redevelopment: Over Pumping

- Over pumping is **the simplest method of removing fine particles from formations**. The theory is that if a sand free yield can be achieved by over pumping then a sand free flow will be the result when pumping at the normally expected lower rate.
- However, over pumping by itself is not considered the best well development approach. Over pumping is considered a limited approach to well development **because water flows in a single direction only.**
- Backwashing reverses water flow and helps in the dilution, agitation and removal of sediment, fine particles and drilling fluids. Backwashing requires the introduction of water back into the well.

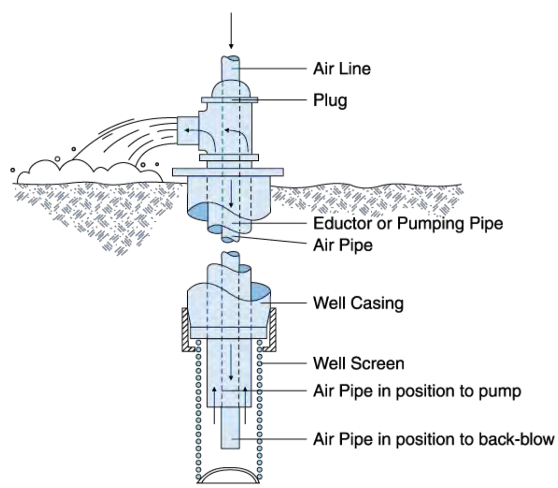


Step draw down test (2-8 hrs) Typical water level response

Quite often, the redevelopment process is combined with chemical treatment to dislodge, dissolve and remove minerals and iron deposits in the well.
Introducing chemicals (acids) about 24 hours prior to starting the redevelopment operation is common.

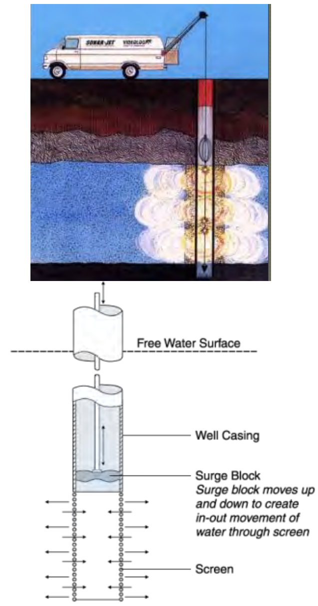
REDEVELOPMENT: AIR LIFTING

- Airlift pumping forces compressed air through an air line to the bottom of the well. As air bubbles rise, they create a surging effect that carries water and dislodged materials out of the well.
- Airlift pumping is alternated with short periods of no pumping, which forces water and chemicals out into the formation to help break up minerals and bacteria lodged in the aquifer formation surrounding the screen.
- This method of well development is effective only if the water is deep enough in the well to get the surging action. **Airlifting does not work if the lift to the surface is too great.**



Redevelopment: Mechanical Surging

- Surging alternately forces water into and out of the formation through the well screen openings.
- **A pistonlike tool moves up and down in the well to create the surging action. The water surging through the well screen loosens the minerals and fines in the borehole and draws them into the well to be removed by pumping or bailing.**
- While common for bridge or louvered well screens, **surging is not very effective with very deep wells (more than 200 feet) or those with multiple screens.**
- The results of mechanical surging should be measured by checking the well yield periodically, every hour after the process begins. **Surge plunger should be a good fit in the casing.** The plunger may be attached directly to the drill stem or operated by hand depending on well depth.



REDEVELOPMENT: JETTING WITH WATER

- **The process of jetting with water consists of operating a horizontal jet inside the well screen so that jetting energy is directed out through the screen openings.**
- The equipment required includes a jetting tool with two or more equally spaced nozzles; a high-pressure pump or compressor; hoses and connections; pipe; and a clean, potable water supply for jetting.
- **The jets force water through the screen openings, agitating and rearranging the particles of the aquifer surrounding the screen.**
- **The lowest nozzle velocity for effective jetting is considered to be approximately 100 feet/second.**
- **Jetting pressures in screens constructed of PVC or other less abrasion-resistant materials (e.g., fiberglass) should typically not exceed 100 psi, although with some, low-flow, high-pressure jetting tools with higher pressures can be used.**

High-velocity jetting tool with centralizers hanging on high pressure hose

The 8-inch jetting tool (made for 10-inch wells) has four jets that are diametrically opposed and one bottom jet (Sterrett 2007).

Disinfection

- The last step in rehabilitating a well is to chlorinate using liquid or solid forms of chlorine. Chlorination will help kill the remaining iron bacteria and other bacteria introduced during the rehabilitation process. **Do not combine acid treatment with chlorination because that can produce dangerous gases(When Sodium hypochlorite is mixed with an acid, chlorine gas is given off.)**
- **Chlorination**

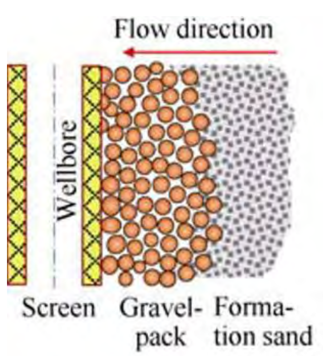
  AWWA suggests a 100 ppm chlorination solution for routine disinfection
- **Shock or Super Chlorination**
- Now the rule of thumb is 200 to 300 ppm (maximum)

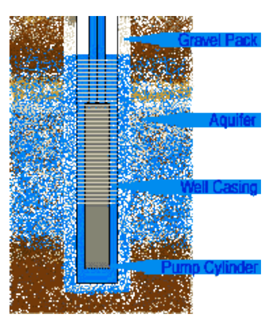
Use of Chlorine in Arsenic environment

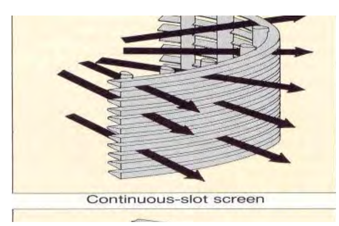
- If the well is located in an area of high, naturally occurring, arsenic, **high concentrations of free chlorine could increase the release of arsenic into the well water after the treatment process.**
- In this type of environment, a well should **not to exceed a dose of 100 mg/L free chlorine** and the **well should be pumped 30 minutes after the initial dose** has been placed in the well.
- **Arsenic trichloride is an inorganic compound with the formula $AsCl_3$, also known as arsenous chloride or butter of arsenic. This poisonous oil is colourless, although impure samples may appear yellow.**
- **Arsenic is released into the groundwater due to increased water demands that have lowered the water table allowing oxygen to get into arsenic-rich zones of the aquifer. This exposure to oxygen causes chemical reactions that release arsenic into the groundwater.**

THANKS

Entrance velocity depends upon slot opening type and size 0.1ft/s is recommended

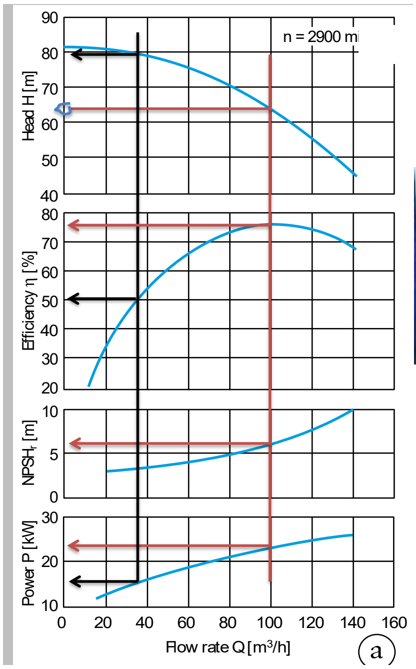


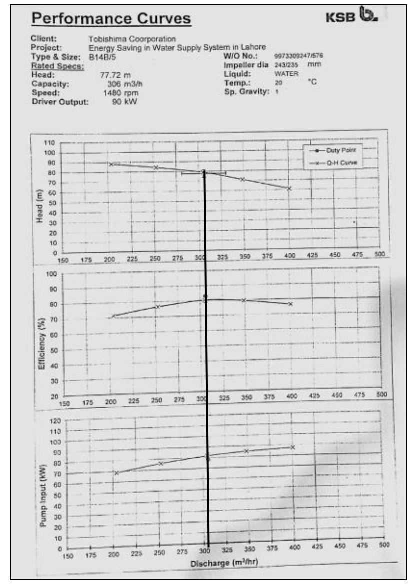




As the pathways for normal water flow into the suction area decrease because of the accumulation of fines, the velocity of the water flow increases, creating turbulence in the near well area. This greater turbulence increases the movement of fines into the well suction area, increasing sand pumping, often to unacceptable levels.

Performance curves





Annex 5.2.11 Training Material for "Relationship of Head, Motor capacity, and Delivery size with Pump flow" at WASA Lahore

Relationship of Head, Motor capacity, and Delivery size with Pump flow

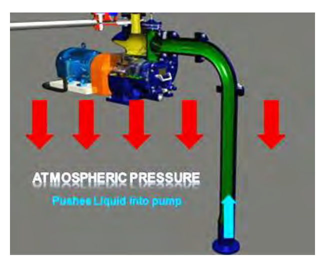
Centrifugal Pump Basics

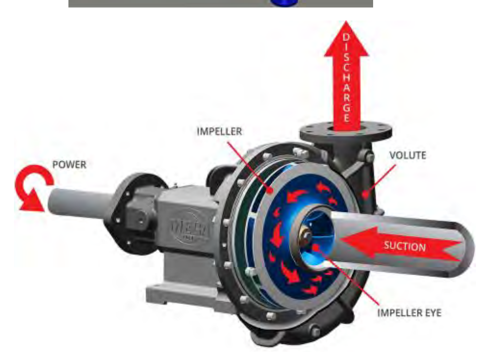
- Centrifugal pumps require that the fluid be available to the pump's suction nozzle with sufficient energy.
- As such impeller of the pump should be submerged in to suction water.
- Pumps do not suck liquid into the pump.

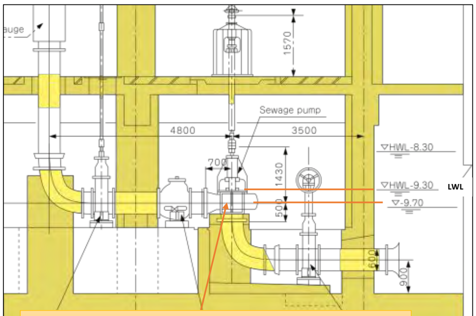
❖ Rather, Centrifugal **pump creates a partial vacuum and atmospheric pressure forces water into the suction of the pump**

❖ Atmospheric pressure is 14.7 psi=33.9 feet

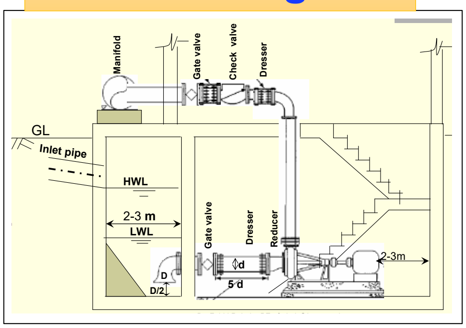
❖ **So this is the atmospheric pressure minus pressure losses that reaches at suction port of a pump**



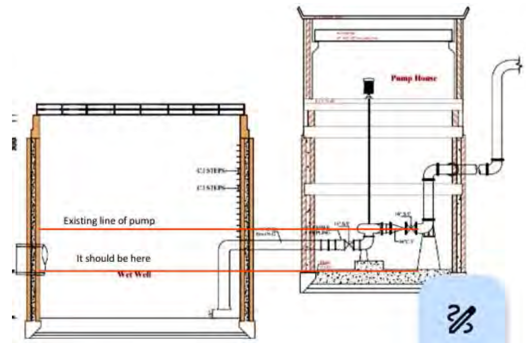




Correct design

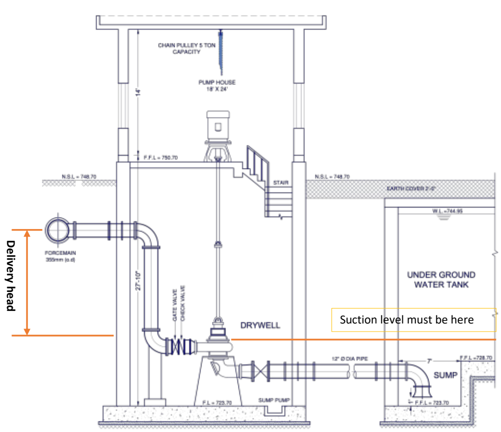


Wrong design

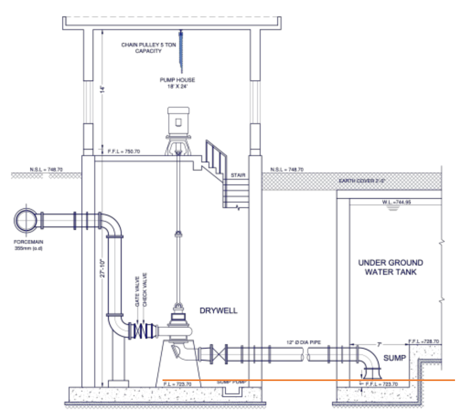


The impeller should always be submerged in water, otherwise it will not be able to draw sufficient flow and operate correctly.
Insufficient flow can cause cavitation, where the water inside actually starts to boil due to the low pressure, this can cause severe damage to the pumps impellers.

Calculation of head of a pump



Force main of HDPE pipe of 350mm dia is 1800 RFT long



Wrong calculation

Head of a pump

- **Delivery head**= Final delivery point elevation- pump center line=**38 feet**
- **Head loss in Force main** of HDPE pipe of 355mm(internal dia-334mm) dia is 1800 RFT long

V	**=**	**1.318 C $R^{0.63}$ $S^{0.54}$**
For HDPE Pipe, C = 130		
5.31	=	1.318 x 130 x $(1.09/4)^{0.63}$ $S^{0.54}$
$S^{0.54}$	=	5.31/1.318 x 130 x $(1.09/4)^{0.63}$
$S^{0.54}$	=	5.31/1.318 x 130 x .0.44
$S^{0.54}$	=	$(0.071)^{1/0.54}$
S	=	0.0073
Head losses in 1800 ft. length	=	1800 x 0.0073 = 15.00ft.

- **Minor head loss**=Losses in pump fittings=**2.2ft**
- **Total head required**= Delivery head+ Pipe head loss+ Minor head loss(bends,valves bellmouth etc)+Force mainhead loss=38+15+2.2=55.2Ft. Add 5 feet more=**60 feet**

Pump house head loss or minor losses

$$\boxed{h_m = k\frac{V^2}{2g}}$$

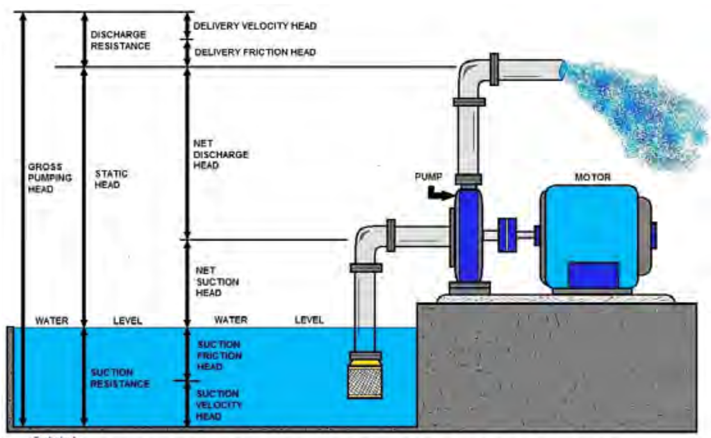
- Gate valves=2No, Check valve=1 No 90^0 Bends=4 Nos
- K values for 12 inch gate valve=0.1
- Loss=**0.08*2=0.16**
- 90 long radius bend=**0.21**
- Loss=0.081*4= **0.324**
- Check valve=1.3
- Loss= **0.5**
- Total=0.16+0.21+0.324+0.5=1.194ft. Head loss for 25 feet pipe inside pump house=1 ft, So, total head loss inside is 2.194 ft **say 2.2 ft**

Friction Losses in Pipe Fittings
Resistance Coefficient K (use in formula hf = Kv²/2g)

Fitting		LD	Nominal Pipe Size											
			½	¾	1	1¼	1½	2	2½-3	4	6	8-10	12-16	18-24
			K Value											
Angle Valve		55	1.48	1.38	1.27	1.21	1.16	1.05	0.99	0.94	0.83	0.77	0.72	0.66
Angle Valve		150	4.05	3.75	3.45	3.30	3.15	2.85	2.70	2.55	2.25	2.10	1.95	1.80
Ball Valve		3	0.08	0.08	0.07	0.07	0.06	0.06	0.05	0.05	0.05	0.04	0.04	0.04
Butterfly Valve								0.86	0.81	0.77	0.68	0.63	0.35	0.30
Gate Valve		8	0.22	0.20	0.18	0.18	0.15	0.15	0.14	0.14	0.12	0.11	0.10	0.10
Globe Valve		340	9.2	8.5	7.8	7.5	7.1	6.5	6.1	5.8	5.1	4.8	4.4	4.1
Plug Valve Branch Flow		90	2.43	2.25	2.07	1.98	1.89	1.71	1.62	1.53	1.35	1.26	1.17	1.08
Plug Valve Straightaway		18	0.48	0.45	0.41	0.40	0.38	0.34	0.32	0.31	0.27	0.25	0.23	0.22
Plug Valve 3-Way Thru-Flow		30	0.81	0.75	0.69	0.66	0.63	0.57	0.54	0.51	0.45	0.42	0.39	0.36
Standard Elbow	90°	30	0.81	0.75	0.69	0.66	0.63	0.57	0.54	0.51	0.45	0.42	0.39	0.36
	45°	16	0.43	0.40	0.37	0.35	0.34	0.30	0.29	0.27	0.24	0.22	0.21	0.19
	long radius 90°	16	0.43	0.40	0.37	0.35	0.34	0.30	0.29	0.27	0.24	0.22	0.21	0.19
Close Return Bend		50	1.35	1.25	1.15	1.10	1.05	0.95	0.90	0.85	0.75	0.70	0.65	0.60
Standard Tee	Thru-Flow	20	0.54	0.50	0.46	0.44	0.42	0.38	0.36	0.34	0.30	0.28	0.26	0.24
	Thru-	60	1.62	1.50	1.38	1.32	1.26	1.14	1.08	1.02	0.90	0.84	0.78	0.72
90 Bends, Pipe Bends, Flanged Elbows, Butt-Welded Elbows	r/d=1	20	0.54	0.50	0.46	0.44	0.42	0.38	0.36	0.34	0.30	0.28	0.26	0.24
	r/d=2	12	0.32	0.30	0.28	0.26	0.25	0.23	0.22	0.20	0.18	0.17	0.16	0.14
	r/d=3	12	0.32	0.30	0.28	0.26	0.25	0.23	0.22	0.20	0.18	0.17	0.16	0.14
	r/d=4	14	0.38	0.35	0.32	0.31	0.29	0.27	0.25	0.24	0.21	0.20	0.18	0.17
	r/d=6	17	0.46	0.43	0.39	0.37	0.36	0.32	0.31	0.29	0.26	0.24	0.22	0.20
	r/d=8	24	0.65	0.60	0.55	0.53	0.50	0.46	0.43	0.41	0.36	0.34	0.31	0.29
	r/d=10	30	0.81	0.75	0.69	0.66	0.63	0.57	0.54	0.51	0.45	0.42	0.39	0.36
	r/d=12	34	0.92	0.85	0.78	0.75	0.71	0.65	0.61	0.58	0.51	0.48	0.44	0.41
	r/d=14	38	1.03	0.95	0.87	0.84	0.80	0.72	0.68	0.65	0.57	0.53	0.49	0.46
	r/d=16	42	1.13	1.05	0.97	0.92	0.88	0.80	0.76	0.71	0.63	0.59	0.55	0.50
	r/d=18	45	1.24	1.15	1.06	1.01	0.97	0.87	0.83	0.78	0.69	0.64	0.60	0.55

In case of a lift station

Suction head will also be added while calculating total head



FACTORS IN DETERMINING A TYPICAL PUMP INSTALLATION

Sizing force main/delivery pipe

The velocity is kept in the range of 6-10ft/s in the design criteria of WASA Lahore prepared under the JICA guidance.
5ft/s is fixed by the design criteria of this project (mainly adopted on the design criteria of Public Health Engineering Department).

Book of Larry W Mays "Hydraulic Design" page 10.34 says as follows:

10.7.2.1 *Pump suction and discharge piping installation guidelines.* Section 1.4 in the Hydraulic Institute (HI) publication ANSI/HI 1.1–1.5 (1994) and Chap. 6 in API Recommended Practice 686 (1996) provide considerable discussion and many recommendations on the layout of piping for centrifugal pumps to help avoid the hydraulic problems discussed above.

10.7.2.2 *Fluid velocity.* The allowable velocities of the fluid in the pump suction and discharge piping are usually in the following ranges:

Suction:	3–9 ft/s (4–6 ft/s most common)
	1.0–2.7 m/s (1.2–1.8 m/s most common)
Discharge:	5–15 ft/s (7–10 ft/s most common)
	1.5–4.5 m/s (2–3 m/s most common)

- Diameter may be calculated with a simple formula

$$D = 1.128\sqrt{\frac{Q}{V}}$$

where:
D = pipe diameter, m (ft)
Q = discharge in pipe, m^3/s (cfs)
V = maximum velocity, m/s (fps)

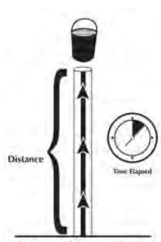
Motor efficiencies IEC standards

- Efficiency varies with speed,capacity and efficiency class. Better to mention efficiency.
- More speed(less poles) more efficiency.
- Bigger motors have more efficiency.

KW	Pole	IE 1	IE 2	IE 3	IE 4
75	4	92.7	94	95	96
45	4	91.7	93.1	94.6	95.7
30	4	90.7	92.3	93.6	94.9

Minimum 50 Hz Efficiency [according to IEC/EN 60034-30-1:2014, IEC 60034-2-1:2014]

Power kW	IE1 (Standard Efficiency)				IE2 (High Efficiency)				IE3 (Premium Efficiency)				IE4 (Super Premium Efficiency)			
	2 poles	4 poles	6 poles	8 poles	2 poles	4 poles	6 poles	8 poles	2 poles	4 poles	6 poles	8 poles	2 poles	4 poles	6 poles	8 poles
0,12	45	50	38,3	31	53,6	591	50,6	39,8	60,8	64,8	57,7	50,7	66,5	69,8	64,9	62,3
0,18	52,8	57	45,5	38	60,4	647	56,6	45,9	65,9	69,9	63,9	58,7	70,8	74,7	70,1	67,2
0,2	54,6	58,5	47,6	39,7	61,9	659	58,2	47,4	67,2	71,1	65,4	60,6	71,9	75,8	71,4	68,4
0,25	58,2	61,5	52,1	43,4	64,8	685	61,6	50,6	69,7	73,5	68,6	64,1	74,3	77,9	74,1	70,8
0,37	63,9	66	59,7	49,7	69,5	727	67,6	56,1	73,8	77,3	73,5	69,3	78,1	81,1	78	74,3
0,4	64,9	66,8	61,1	50,9	70,4	735	68,8	57,2	74,6	78	74,4	70,1	78,9	81,7	78,7	74,9
0,55	69	70	65,8	56,1	74,1	771	73,1	61,7	77,8	80,8	77,2	73	81,5	83,9	80,9	77
0,75	72,1	72,1	70	61,2	77,4	796	75,9	66,2	80,7	82,5	78,9	75	83,5	85,7	82,7	78,4
1,1	75	75	72,9	66,5	79,6	814	78,1	70,8	82,7	84,1	81	77,7	85,2	87,2	84,5	80,8
1,5	77,2	77,2	75,2	70,2	81,3	828	79,8	74,1	84,2	85,3	82,5	79,7	86,5	88,2	85,9	82,6
2,2	79,7	79,7	77,7	74,2	83,2	843	81,8	77,6	85,9	86,7	84,3	81,9	88	89,5	87,4	84,5
3	81,5	81,5	79,7	77	84,6	855	83,3	80	87,1	87,7	85,6	83,5	89,1	90,4	88,6	85,9
4	83,1	83,1	81,4	79,2	85,8	866	84,6	81,9	88,1	88,6	86,8	84,8	90	91,1	89,5	87,1
5,5	84,7	84,7	93,1	81,4	87	877	86	83,8	89,2	89,6	88	86,2	90,9	91,9	90,5	88,3
7,5	86	86	84,7	83,1	88,1	887	87,2	85,3	90,1	90,4	89,1	87,3	91,7	92,6	91,3	89,3
11	87,6	87,6	86,4	85	89,4	898	88,7	86,9	91,2	91,4	90,3	88,6	92,6	93,3	92,3	90,4
15	88,7	88,7	87,7	86,2	90,3	906	89,7	88	91,9	92,1	91,2	89,6	93,3	93,9	92,9	91,2
18,5	89,3	89,3	88,6	86,9	90,9	912	90,4	88,6	82,4	92,6	91,7	90,1	93,7	94,2	93,4	91,7
22	89,9	89,9	89,2	87,4	91,3	916	90,9	89,1	92,7	93	92,2	90,6	94	94,5	93,7	92,1
30	90,7	90,7	90,2	88,3	92	923	91,7	89,8	93,3	93,6	92,9	91,3	94,5	94,9	94,2	92,7
37	91,2	91,2	90,8	88,8	92,5	927	92,2	90,3	93,7	93,9	93,3	91,8	94,8	95,2	94,5	93,1
45	91,7	91,7	91,4	89,2	92,9	931	92,7	90,7	94	94,2	93,7	92,2	95	95,4	94,8	93,4
55	92,1	92,1	91,9	89,7	93,2	935	93,1	91	94,3	94,6	94,1	92,5	95,3	95,7	95,1	93,7
75	92,7	92,7	92,6	90,3	93,8	940	93,7	91,6	94,7	95	94,6	93,1	95,6	96	95,4	94,2
90	93	93	92,9	90,7	94,1	942	94	91,9	95	95,2	94,9	93,4	95,8	96,1	95,6	94,4
110	93,3	93,3	93,3	91,1	94,3	945	94,3	92,3	95,2	95,4	95,1	93,7	96	96,3	95,8	94,7
132	93,5	93,5	93,5	91,5	94,6	947	94,6	92,6	95,4	95,6	95,4	94	96,2	96,4	96	94,9
160	93,8	93,8	93,8	91,9	94,8	949	94,8	93	95,6	95,8	95,6	94,3	96,3	96,6	96,2	95,1
200	94	94	94	92,5	95	95,1	95	93,5	95,8	96	95,8	94,6	96,5	96,7	96,3	95,4
250	94	94	94	92,5	95	95,1	95	93,5	95,8	96	95,8	94,6	96,5	96,7	96,5	95,4
315	94	94	94	92,5	95	95,1	95	93,5	95,8	96	95,8	94,6	96,5	96,7	96,6	95,4
355	94	94	94	92,5	95	95,1	95	93,5	95,8	96	95,8	94,6	96,5	96,7	96,6	95,4
400	94	94	94	92,5	95	95,1	95	93,5	95,8	96	95,8	94,6	96,5	96,7	96,6	95,4
450	94	94	94	92,5	95	95,1	95	93,5	95,8	96	95,8	94,6	96,5	96,7	96,6	95,4
500-1000	94	94	94	92,5	95	95,1	95	93,5	95,8	96	95,8	94,6	96,5	96,7	96,6	95,4



Wrong calculation of Motor capacity:

Static Head = = 764.31 – 726.95, 37.36 ft. *Say 38ft.*
Losses within pump house = 10 ft.
Head losses in 1800 ft. length =15ft
Total pumping head =38=10=15=63 ft

- This calculation is just pumping HP required to operate pump.
- On this basis Motor capacity will be calculated by dividing motor efficiency.

Water horsepower is the minimum power that is required to move the water. In other words, it is the power that the pump would require to lift water.
In other words this is the power which shall be consumed by pump from the motor's total power.

Design of Pump Motor

$$\textbf{\textit{HP Formula}} = \left(\frac{\tau\, Q\, H}{550\, e}\right)$$

HP for efficiency of 70%:

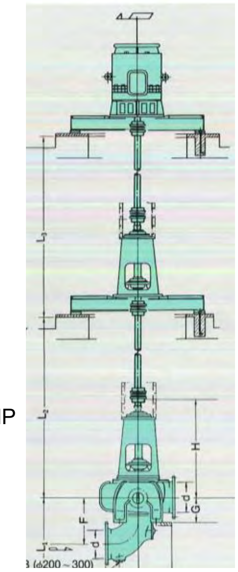
= (62.4 x 5 x 65 / 550 x 0.70)

= 52.67, *Say 55*

HP of motor to be installed, by increasing 15%:

= 55 x 1.15 = 63.25, *Say 65*

Correct way to calculate Motor HP

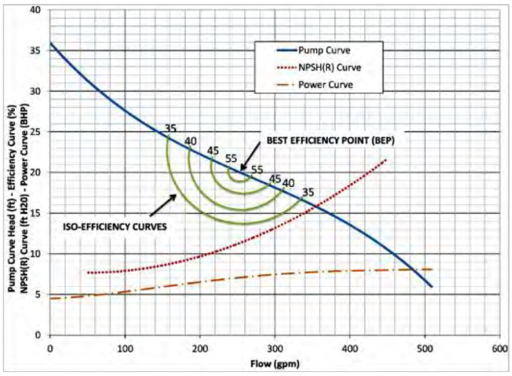


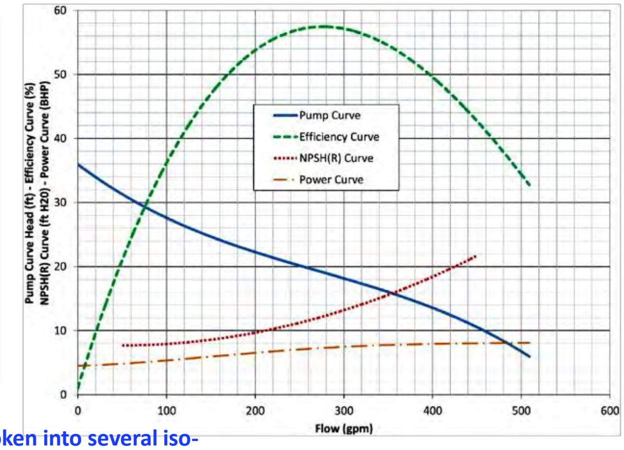
- You have to decide flow, head and efficiency for the pump according to site requirement.
- P_{whp} = water horsepower (HP) = $\dfrac{(SG*h*Q)}{(550*e)}$
- SG(Specific Gravity) = **62.43** pounds- per cubic foot for water
- Q (Flow) =in cusec
- h (Head)= in feet
- e = pump efficiency (decimal value)
- Pump efficiency=80% in general or any efficiency as per actual pump
- Pumping water horse power**=(62.43*60*5)/(550*0.8)=42.56 HP**
- If motor efficiency is IE-2 class 93.1%' the motor power required= **42.56 /0.931=45.71HP**
- General practice is some safety factor is taken(up to 15%). In this case may be 15% 6.857HP
- Total capacity may be **45.27 + 6.867=52.56 HP**
- but standard motor is either of **50HP or 60 HP**
- So take 60 HP motor

Reasons to Determine Motor Loading

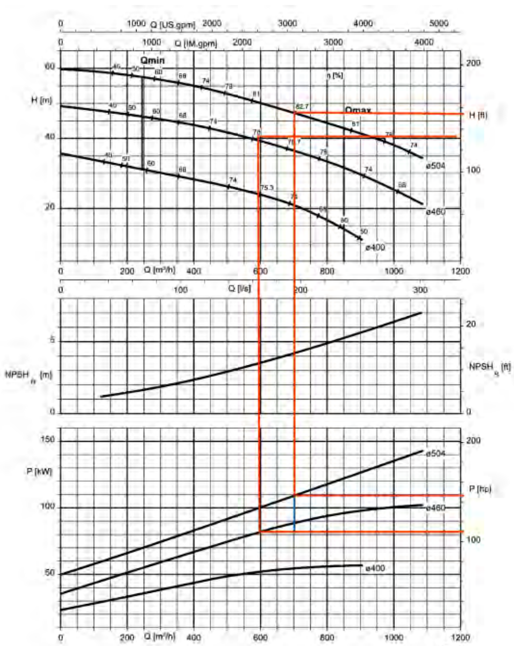
- Most electric motors are designed to run at 50% to 100% of rated load. Maximum efficiency is usually near 75% of rated load. Thus, a 10-horsepower (hp) motor has an acceptable load range of 5 to 10 hp; **peak efficiency is at 7.5 hp. A motor's efficiency tends to decrease dramatically below about 50% load.**
- A motor is considered underloaded when it is in the range where efficiency drops significantly with decreasing load.
- Overloaded motors can overheat and lose efficiency.
- Many motors are designed with a service factor that allows occasional overloading. Service factor is a multiplier that indicates how much a motor can be overloaded under ideal ambient conditions. **For example, a 10-hp motor with a 1.15 service factor can handle an 11.5-hp load for short periods of time without incurring significant damage.**

Pump Performance curves





- Instead of an efficiency curve, **the efficiency is broken into several iso-efficiency lines with each line representing a constant efficiency.**
- It is read much like a topographic map, with the iso-efficiency lines corresponding to elevation lines on the map.



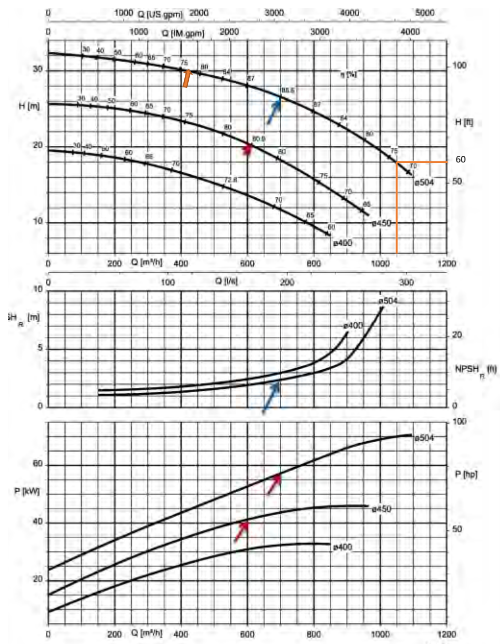
Pump Performance curves

Another common curve variation is to show **multiple impeller diameters** on the same curve. As the impeller diameter decreases in size, the performance is reduced. **This allows the pump performance to be modified to meet specific application requirements.**

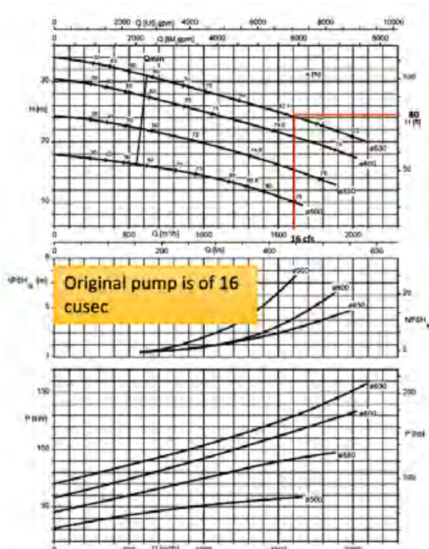
Additionally, a reduction in diameter reduces the pump power requirement. A reduction of only 8.7% in the impeller diameter can result in a 31% reduction in power requirements.

What happens when pump is installed without considerin its duty point

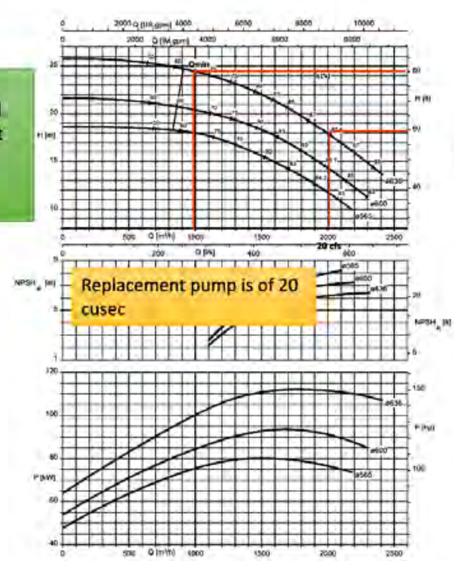
- This pump's duty point is at **7** cusec flow at **85 ft head** and 88.6% efficiency and power consumption 77HP.
- If same pump is operated at 100 ft head, its efficiency will drop to 77% and flow will reduce to 4.16 cusec, 60 HP.
- and if operated at lower head 60 ft its efficiency will drop to 72% and **flow will increase to 10.3 cusec with 95 HP consumption**(This may be the designed capacity of motor).It will be cavitating and breakdown very soon.Its motor may burn fist.



Replacement of a pump with a big pump but flow is even reduced from original one



Replacement pump although of 20 cusec will produce 10 cusec flow at just 65% efficiency if replaced in place of original pump



What happens if a motor is replaced with higher rpm motor

Suppose pump of 8 cusec capacity is operated at 750 rpm with 80 HP motor & 80 feet head.

Parameters	Original values	Changed values	Effect		
			Q (cfs)	H(feet)	P(HP)
RPM	750	1000	8 to 10.67	80-142	80-190

Law 2. With shaft speed (N) held constant:

Law 2a. Flow is proportional to the impeller diameter:

$$\frac{Q_1}{Q_2} = \left(\frac{D_1}{D_2}\right)$$

Law 2b. Pressure or Head is proportional to square of impeller diameter:

$$\frac{H_1}{H_2} = \left(\frac{D_1}{D_2}\right)^2$$

Law 2c. Power is proportional to the cube of impeller diameter:

$$\frac{P_1}{P_2} = \left(\frac{D_1}{D_2}\right)^3$$

With impeller diameter (D) held constant

$$\frac{Q_1}{Q_2} = \left(\frac{N_1}{N_2}\right)$$

Law 1b. Pressure or Head is proportional to the square of shaft speed:

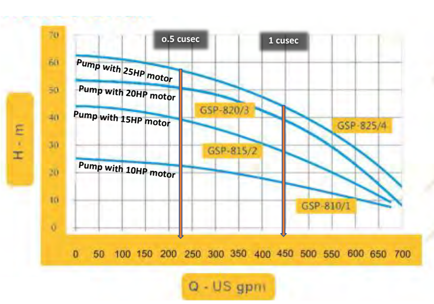
$$\frac{H_1}{H_2} = \left(\frac{N_1}{N_2}\right)^2$$

Law 1c. Power is proportional to the cube of shaft speed:

$$\frac{P_1}{P_2} = \left(\frac{N_1}{N_2}\right)^3$$

- New motor will increase the flow up to 10.7 cusec
- Higher RPM may damage the bearings of the pump
- This motor, if 80HP, will be overloaded and may damage very quickly after heating up because 80HP power is required for just 8 cusec at 80 feet head and when flow will be increased the power requirement will also increase to 190HP

Local pumps: Same flow at different head with different capacity motors



Performance Chart

Model	Outer Dia	Discharge size ⌀	HP	Q - Capacity (US-gpm / LPM)													
				0	200	250	300	350	400	450	500	550	600	625	650	675	700
				0	757	946	1136	1325	1514	1703	1893	2082	2271	2366	2461	2555	2650
				H - Total Head (m) @ 2900 rpm													
GSP-810/1	8"	5"/6"	10	24.8	20.7	19.6	18.5	17.5	16.6	15.7	14.8	13.5	12	11.2	10.2	9.2	8.2
GSP-815/2			15	44.2	37	35.3	33.2	31	29.5	27.7	25.7	22.6	18.5	16.7	14.5	12	9
GSP-820/3			20		52	50	48	44.8	40.7	37.2	33.6	29.3	24	21	17.5	14	10
GSP-825/4			25			61	56	51.5	47.5	43	37.3	32	26.3	22	18	14.5	10.5

Motor capacity does not tell the flow. It is designed according to flow of pump at certain head.
You can see that same pumps with same motors produce 0.5 cusec at higher heads.

- at 58m by 25 HP motor pump,
- at 50m by 20HP, motor pump
- at 36.5 by 15HP motor pump
- at 22m by 10HP motor pump

- There are 4 pumps in the graph with different motor capacities which can produce same range of flow at different head
- Pump with 25 Hp motor produces 1 cusec flow at 43 m head
- Pump with 20 Hp motor produces 1 cusec flow at 37.2m head
- Pump with 15 Hp motor produces 1 cusec flow at 27.7m head
- Pump with 10 Hp motor produces 1 cusec flow at 15.7m head

Size of delivery pipe depends upon velocity

- **Size of delivery pipe is fixed based upon velocity of fluid required in it.**
- General range of velocity is 4 -10 ft/s.
- d=(Q/V*0.785)^0.5
- =1.128√(Q/V)
- **Suppose a 1 cusec pump:**
- Delivery will be **5** inch if velocity is taken 7 ft/s
- Delivery will be 6 inch if velocity is taken 5 ft/s
- Delivery will be 7 inch if velocity is taken 4 ft/s
- **Suppose a 0.5 cusec pump:**
- Delivery will be 3.5 inch if velocity is taken 7-8 ft/s
- Delivery will be 4 inch if velocity is taken 5 ft/s
- Delivery will be **5** inch if velocity is taken 4 ft/s

- **Suppose a 0.25 cusec pump:**
- Delivery will be 2 inch if velocity is taken 10 ft/s
- Delivery will be 2.5 inch if velocity is taken 7-8 ft/s
- Delivery will be 3 inch if velocity is taken 5 ft/s
- Delivery will be 3.5 inch if velocity is taken 4 ft/s

Deep well ejector pumps

Jet pumps

Standard size of Local Low head pumps.

Motor size increases with decrease of flow

MODEL	MOTOR (HP)	V	A	rpm	MAX. SUCTION (m)	MAX. HEAD (m)	DISCHARGE (l/min)
G - I	0.5	200 ~ 230	3	2900	15	15	30
G - II	1	200 ~ 230	6.5		21	21	22
		380 ~ 440	1.5				
G - III	2	200 ~ 230	12		27	35	22
		380 ~ 440	3				
G - IV	2.5	200 ~ 230	14		38	38	17
		380 ~ 440	3.8				

Performance Chart

Model	Size	Motor			Depth of Water (ft)	Q - Capacity (lpm / US-gpm)							
		HP	kW	A		10	15	20	25	30	35	40	45
						4.3	6.5	8.7	10.8	13.0	15.2	17.3	19.5
						H - Total Head (ft)							
GJP-C-0.5	1 1/4" x 3/4"	0.5	0.33	3	10		87.6	82	75.5	70.5	65.5	60	44.5
					15		85.5	80.5	74	69	63.5		
					20	92	84	79	72	62			
					25	90	82	74					

Annex 5.2.12 Training Material for "Plumbing (Distribution Pipe), Jointing / Welding and Pressure Test" at WASA Lahore

Plumbing(Distribution pipe)
PART-1 PIPES (HDPE)
PART-2 JOINTS
PART-3 PRESSURE TEST

DIFFERENT PIPE MATERIALS USED BY WASA

Experience of target trainees

Objective of this training:

To enable the participants for:

- Selection of appropriate specification of materials (pipe, joint, valves).
- Selection of specifications of the material used for leakage repair
- To enable the participants to understand the use of HDPE pipe and its fittings and welding

Pipe material now being used in WASA Lahore

Pipe material	Standard for Pipe	Standard for fittings	Manufacturer name and address
HDPE	ISO-4427	ISO-4427	1. M/s Dadex Eternit Limited Address: 34-A/1, Block 6, PECHS, Shahrah-e-Faisal, Karachi, Pakistan. http://www.dadex,com
			2. M/s BBJ Pipe Industries (PVT) LTD Address: BBJ House, 40 Abbot Road, Lahore, Pakistan. https://www.bbj.com.pk
			3. M/s Jamal PVC (PVT) LTD Address: 88 Raiwind Road, Lahore, Pakistan. https://jamalpipe.com.pk/
			4. M/s Alpha Pipe Industries LTD Address: Office 206-07, 2nd Floor, Amin Manison, GT Road, Peshawar.

History of HDPE Pipe

- Polyethylene (PE) pipe was first used as pressure pipe in the US in the 1950s. These first materials were high density polyethylenes (HDPEs), which were prone to stress cracking and had poor resistance to rapid crack propagation (RCP).
- It was improved with the passage of time.
- **PE100 is the third generation of pipe grade PE**.
  It has an optimum balance of three key properties:

✓ **Minimum Required Strength (MRS)** – this provides long-term strength and creep resistance.

✓ **Stress crack resistance** (sometimes referred to as slow crack growth resistance).

✓ **Rapid crack** propagation resistance.

- HDPE PE100 pipe is easy to install, light, flexible, corrosion-free and has a service life of up to 100 years. It can be jointed using butt fusion or electrofusion to create a leak-free pressure network for gas or water.
- For the trenchless applications butt fusion is most widely used because this results in a smooth exterior profile with no protrusions that might cause difficulties in pulling the pipe into the ground or host pipe.

HDPE PE100 Pipe Types

- **PE100 RC:** RC indicates resistance to cracking.
- **PE100 RT:** RT indicates resistance to temperature.
- **Barrier PE Pipe:** Certain gases and liquids can permeate through PE.

Major specifications of PE-100 covered in ISO-4427

S.NO	Characteristics	Requirement
1	Minimum Required Strength (MRS)	10 mpa
2	Hydrostatic Design Basis (HDB) Pressure	1600 psi (11 MPa)
3	Allowable Compressive Strength	7.93 MPa
4	Tensile Strength at Yield	23mpa
5	Density (Compound)	959 kg/m3
6	Modulus of Elasticity (50 years):	200mpa
7	Elongation at break	> 600%
8	Flexural Modulus	1000 Mpa
9	Poisson’s Ratio	0.45
10	Thermal Expansion Co-efficient	1.3 x 10-4 ° C-1

ISO grades of HDPE pipe

- Polyethylene is available in various classes and is frequently specified with a number indicating the minimum tensile strength of the material in N/mm^2(MPA) at 20° C over 50 years:
- PE40 means 4 MPA strength
- PE63 means 6.3 MPA strength
- PE80 means 8 MPA strength
- PE100 means 10MPA strength

EQUIVALANT GRADES OF ASTM

ISO Grade	ASTM Grade	Designation	Density gm/cm^3
PE 80	PE 3608	HDPE	0.940---0.947
PE 100	PE 4710	HDPE	0.947---0.955

Countries which use the metric system and follow ISO as standards designate HDPE pipe as *Polyethylene Pipe (PE)* and ASTM Standards nomenclature refers to it as *High Density Polyethylene Pipe (HDPE)*.

PE-100 PIPE DIMENSIONS WITH DIFFERENT SDRs

PE-100 PIPE DIMENSIONS CONFIRMING TO ISO 4427 & DIN 8074				
Outer Diameter	**SDR-21**	**SDR-17**	**SDR-11**	**SDR-9**
	PN-8	PN-10	PN-16	PN-20
	WALL THICKNESS			
mm	mm	mm	mm	mm
110	5.3	6.6	10	12.3
125	6	7.4	11.4	14

JOINTS & FITTINGS

- Any part used to join two sections of pipes. Joints and Fittings are available in the same materials as those of water supply pipes.
- Detachable piece of pipe or tubing that connects to another piece of pipe or connects two such pieces.
- Types of Fittings:
  - Elbow: Used to change the direction of flow between two pipes. Generally available with an angle of 22.5°, 45° and 90°. Reducer elbows are used if pipe sizes are different.
  - Reducer Elbow: A pipe fitting used to reduce the flow size from larger to smaller by reducing size of pipe.

JOINTS & FITTINGS

- Concentric Reducer: A cone shaped with gradual decreasing around the pipe but air may accumulate resulting in cavitation.
- Eccentric Reducer: One edge is parallel to the connecting pipe due to which air accumulation is not possible.
- Tee : This is T shaped fitting with one inlet and two outlets. Outlets are arranged at 90 degrees to the inlet. It can combine flow from two inlets to one outlet. If 3 sides are same in size, called at equal tee, otherwise its called as unequal tee.

JOINTS & FITTINGS

- Cross: Contains four openings, generally used for fire sprinkler systems.
- Coupling: Used to connect pipes of same diameter. It is also helpful if the pipe is broken or leakage occurs.
- Compression Coupling: Regular coupling which is provided between pipes and prevents the leakage through gaskets or rubber seals.

Cross

Compression Coupling

JOINTS & FITTINGS

- Union: Functions similar to coupling but coupling can not be removed after fixing. Union consists of male nut and female ended threads so it can be removed easily.

- Adapter: Used to connect pipes that do not have special ends. The adapters make them threaded either male or female. They are generally used for copper and PVC pipes. One end of adapter is plain which is welded or glued to plain end of pipe.

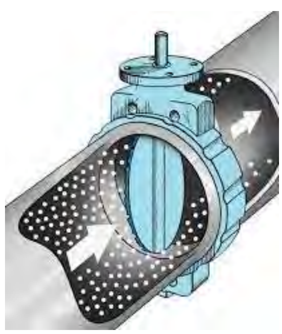
- Cap: It has the same function as the Plug but the difference is, plug contains male threads and cap contains female threads. Available in rubber, copper, steel, plastic.

Union

Adapter

Cap

Common Valves Used In WASA Lahore



Butterfly Valves

Gate Valves

Valves Standards

Type of valves	Standard for valves used in WASA	Remarks
Gate valves	**BS EN-1171**	Used for isolation only.
Check Valves	**BSEN 1563**	Used to prevent reverse flow (non-return).
Butterfly valves	**ISO 10631, BS 5155, EN-593,**	Used for isolation as well as throttling.
Air valves	**ISO 4126-1, EN-1074**	Used to release the air entrapped in the pipelines.

FLANGE STANDARDS TO CONNECT VALVES AND FITTINGS

Flanges may be of:
1 ASME-ANSI B16.5
2 OR EN 1092
3 OR BS standard BS-10

EN Flanges

❖**Flat facing (FF)** Mainly used at connection to cast iron equipment, valves and specialties.

❖**Raised facing (RF)** These pipe flanges are the most commonly used flanges.

❖**Ring type joint (RTJ)** These are most reliable type of flanges but are costlier than the other Types. Used in high pressure (Class 600 and higher rating) and/or high temperature services

Procedure for welding of HDPE pipe

ISO 21307:2017

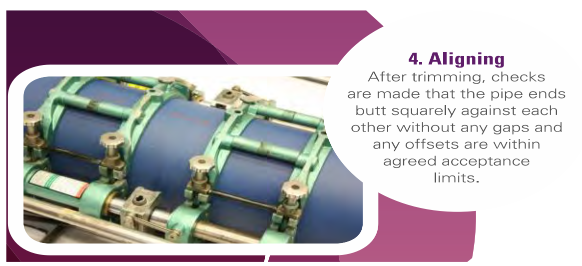
What is fusion welding

- Butt fusion welding technique and Electric fusion (EF) are used to join HDPE pipes.
- Butt fusion is a combination of temperature and force resulting in two mating surfaces flowing together to produce a joint.
- Fusion bonding occurs when the joint cools below the melt temperature of the material.

STEPS OF FUSION

- Peering
- Checking alignment
- Facing
- Heating
- Fusion
- Cooling of Joint

WELDING PROCEDURE



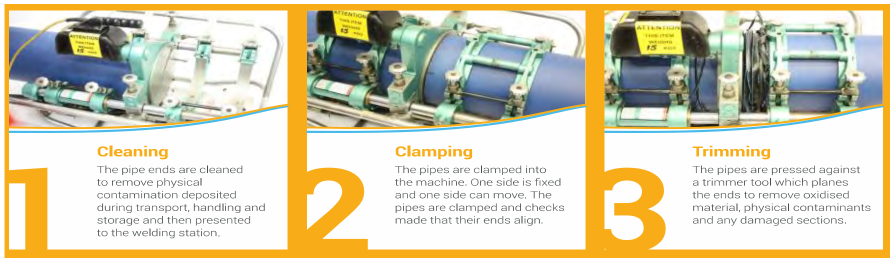
Welding Preparation:

– The welding zone must be protected from unsuitable weather conditions (e.g. humidity effects, wind and temperatures below 0° C).

Alignment of pipes:

– The pipes must be aligned when they are clamped into the mirror welder in such a way that the surfaces are in the same plane (parallel) to each other. Position the pipe in a way that approx. 40mm is protruding behind the last clamp. By doing this, you will have approx. 10 to 15mm to shave from, and the remaining 25 to 30 mm should be sufficient for welding.

WELDING PROCEDURE--CONT

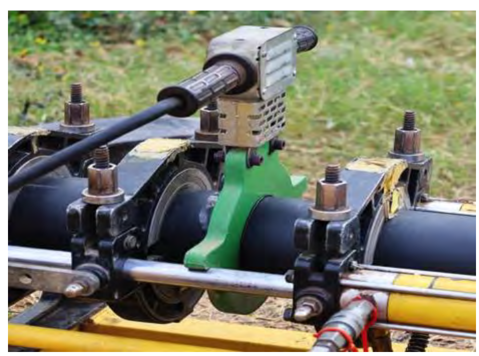


- **Shaving of surfaces:**
  - After the dry matching is completed, open up the pipes and introduce the shaver. Turn the shaver on and adjust to suitable speed.
  - Press the two pipes together, and shave until a continuous strip of HDPE is peeling off on both sides of the shaver. Once constant peeling off is observed, release the pressure on the pipes and separate the pipes. Do not turn off the shaver until the pipes are apart. If the shaver is stopped during shaving, the shaver will create an end cut-mark and the shaving operation will have to be repeated.
  - Once the pipes are correctly aligned, separate the pipes again for cleaning. Remove chips inside the pipes on both sides, all chips scattered under the pipes, and also inside the machine. Remove the chips by using a brush or a small hook made out of a thin steel wire. Do not touch the shaved pipe ends, always clean the surface with a clean rag and mineral spirits/alcohol before you introduce the mirror plate.

Procedure for welding of HDPE pipe

Heating of Surface:

- Push the pipes together against the mirror and raise the pressure to the Bead-up pressure. This pressure needs to be maintained until the Bead-up height has been reached. The bead up height is the height of the bead, which is pressing up against the mirror.
- As soon as the Bead up height has been reached, release the pressure down to the Heat Soak pressure. Heat soak pressure is the pressure maintained during the Heat Soak time.
- As soon as the heat soak time has elapsed, separate the pipes, remove the mirror, and then press together.

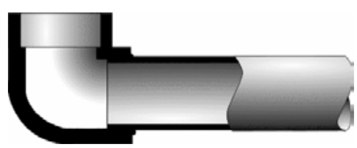


- **Fusion of Surfaces:**
  - This operation has to be done quite fast, since there is actually a time limit "Transfer time" from the removal of the mirror until the two pipes are pressed together and reached the Fusion pressure. Fusion pressure is the pressure that shall reach during the Transfer time and maintained during the Cooling time.
- **Cooling of Joint:**
  - Cooling time is the time in which the pipe has to be left undisturbed. Under no circumstances shall the clamps be opened or the pressure released until the cooling time has elapsed.
- **Checks of Weld Seam:**
  - The mirror-welding machine, if coupled to a data log, will give a print out confirming the parameters used during welding of a specific seam and approval/rejection of the welded seam.

Jointing of HDPE Pipe with Fittings & Pipe

- **Joining HDPE with Fittings**
  - All the joints and fittings of HDPE are joined to the pipe by using heat fusion joining technique as per ASTM F 2620/ISO21307. The internal surface of the joint/ fitting and external surface of the pipe are heated simultaneously to their fusion temperature using heating machine. The parts are joined and then allowed to cool.

Pipe Fusion Joint



Standard Socket Fusion Joint

ISO 21307:2017(E)
jointing procedures

- The following three butt fusion jointing procedures are described in detail in 5.2 to 5.4:
- **— single low-pressure fusion jointing procedure;**
  — dual low-pressure fusion jointing procedure;
  — single high-pressure fusion jointing procedure.
- **ISO 21307:2017(E)**
- The dual low-pressure fusion jointing procedure is only applicable for pipes and spigot end fittings with a wall thickness greater than 22 mm.
- NOTE For the purpose of this document the minimum cooling time under pressure, for all three butt fusion jointing procedures, is based on cooling to a mid-wall temperature of 80 ° C (at an ambient temperature of (23 ± 2) ° C).

jointing procedures

5.2 Dual low-pressure fusion jointing procedure

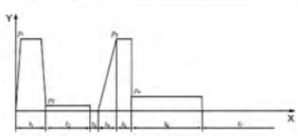
Butt fusion jointing conforming to the dual low-pressure jointing pressure procedure shall be performed as specified in Table 2.

Figure 2 illustrates the dual low-pressure jointing pressure cycle, with an explanation of the individual elements of the fusion jointing cycle.

Table 2 — Parameters and values for dual low-pressure fusion jointing procedure

Parameter	Unit	Value
Heater plate temperature	°C	230 (+10; −5)
Initial bead-up pressure	MPa	0,15 ± 0,02
Minimum initial bead-up size	mm	0,5 + 0,1 e_n [a]
Minimum heat soak time	s	10 e_n + 60
Heat soak pressure	MPa	0 to drag pressure
Maximum heater plate removal time	s	≤10
Fusion jointing pressure	MPa	0,15 ± 0,02
Fusion jointing time	s	10 ± 1
Cooling-cycle reduced pressure	MPa	(0,025 ± 0,002) [b]
Minimum cooling time in the machine under reduced pressure	min	See Table A.2
Minimum cooling time out of the machine	min	See Table A.2

[a] Not exceeding 6 mm.
[b] If the wall thickness is above 20 mm.



Key
X time
Y pressure
t_1 initial bead-up time
t_2 heat soak time
t_3 heater plate removal time
t_4 time to achieve fusion jointing pressure
t_5 fusion jointing time (bead roll-over time)
t_6 cooling time in the machine under reduced pressure
t_7 cooling time in machine without pressure or out of machine
p_1 initial bead-up pressure
p_2 heat soak pressure
p_3 fusion jointing pressure
p_4 cooling-cycle reduced pressure

Figure 2 — Dual low-pressure fusion jointing cycle

5.3 Single high-pressure fusion jointing procedure

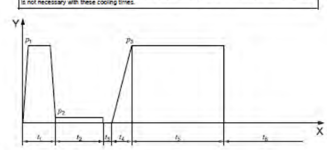
Butt fusion jointing confoming to the single high-pressure procedure shall be perfomed as specified in Table 3. This procedure is standardized for pipes or fittings with a wall thickness of minimum 5 mm up to and including 70 mm.

Figure 3 illustrates the single high-pressure fusion jointing cycle, with an explanation of the individual elements of the fusion jointing cycle.

Table 3 — Parameters and values for single high-pressure fusion jointing procedure

Parameter	Unit	Value
Heater plate temperature	°C	200 to 230
Initial bead-up fusion jointing pressure	MPa	0,52 ± 0,1
Minimum heat soak time	s	(11 ± 1) × e_n
Minimum bead size after heating	mm	0,15 e_n + 1
Heat soak pressure	MPa	0 to drag pressure
Maximum heater plate removal time	s	0,1 e_n + 8
Fusion jointing pressure	MPa	0,52 ± 0,1
Minimum cooling time in the machine under pressure	min	0,43 e_n
Minimum cooling time out of the machine	min	[a]

[a] A cooling time out of the machine and before rough handling may be recommended, but in most cases is not necessary with these cooling times.



Key
X time
Y pressure
t_1 initial bead-up time
t_2 heat soak time
t_3 heater plate removal time
t_4 time to achieve fusion jointing pressure
t_5 cooling time in the machine under pressure
t_6 cooling time out of the machine
p_1 initial bead-up pressure
p_2 heat soak pressure
p_3 fusion jointing pressure

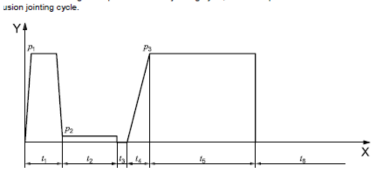
Figure 3 — Single high-pressure fusion jointing cycle

Table 1 — Parameters and values for single low-pressure fusion jointing procedure

Parameter	Unit	Value
Heater plate temperature	°C	200 to 245
Initial bead-up pressure	MPa	0,17 ± 0,02
Minimum initial bead-up size	mm	0,5 + 0,1 e_n [a]
Minimum heat soak time	s	(11 ± 1) e_n
Heat soak pressure	MPa	0 to drag pressure
Maximum heater plate removal time	s	0,1 e_n + 4
Fusion jointing pressure	MPa	0,17 ± 0,02
Maximum time to achieve interfacial pressure	s	0,4 e_n + 2
Minimum cooling time in the machine under pressure	min	e_n + 3
Minimum cooling time out of the machine	min	e_n + 3

[a] Maximum 6 mm.

1 illustrates the single low-pressure fusion jointing cycle, with an explanation of the individual elements usion jointing cycle.



e
ssure
al bead-up time
t soak time
t_3 heater plate removal time
t_4 time to achieve fusion jointing pressure
t_5 cooling time in the machine under pressure
t_6 cooling time out of the machine
p_1 initial bead-up pressure
p_2 heat soak pressure
p_3 fusion jointing pressure

Figure 1 — Single low-pressure fusion jointing cycle

Quality control

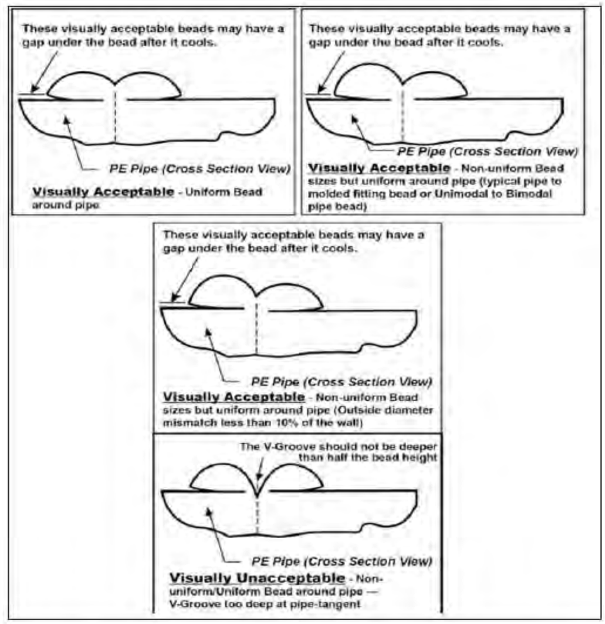
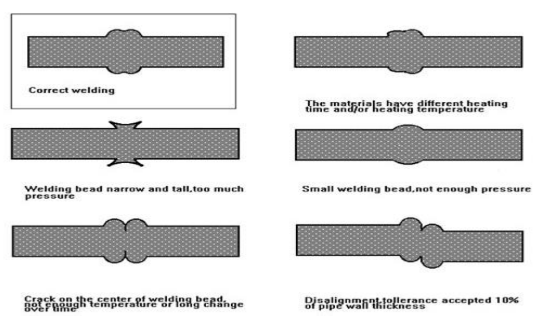


Figure 3 – Outside Diameter Butt Fusion Bead Guideline as per ASTM F2620

Observed Condition	Possible Cause
Excessive double bead width	Overheating; Excessive joining force
Double bead v-groove too deep	Excessive joining force Insufficient heating; Pressure during heating
Flat top on bead	Excessive joining force; overheting
Non uniform bead size around pipe	Misalignment; worn equipment; Incomplete facing
One bead larger than the other	Misalignment Component slipped in clamp; worn equipment Defective heating tool; Incomplete facing dissimilar material – see note above.



Observed Condition	Possible Cause
Beads not rolled over to surface	Shallow v-groove – Insufficient heating & insufficient joining force Deep v-groove – Insufficient heating & excessive joining force
Beads too small	Insufficient heating; Insufficient joining force
Beads too large	Excessive heating time
Squareish outer bead edge	Pressure during heating
Rough, sandpaper-like, bubbly, or pockmarked melt bead surface	Hydrocarbon contamination

Testing on joints

6.2 Destructive joint integrity testing

•— hydrostatic pressure testing at 80 ° C for 1 000 h in accordance with ISO 1167-1, ISO 1167-3 and ISO 1167-4 (or another test in accordance with national or local standards);

•— high-speed tensile testing in accordance with ASTM F2634 (or another test in accordance with national or local standards).

6.3 Non destructive joint integrity testing

•The fusion joint shall be examined visually and it shall have:

•— proper alignment with no part of the mating pipe having mismatch in excess of 10 % of the pipe wall thickness;

•— a uniform double roll back bead that is consistent with the fusion procedure being used.

PART-3 PRESSURE TEST

Hydraulic pressure testing of laid water supply lines as per AWWA –C605-94

HYDRAULIC TEST OF LAID WATER SUPPLY & SEWER LINES

- Sewer Lines: A standard Exfiltration Test is performed to test the leakage of laid sewer line of precast concrete pipes. the sewer line is filled with water to the specified test head and the rate of water loss is determined. If the rate is less than or equal to the allowable limit, the section of sewer tested is acceptable.
- Standards values of allowable and actual leakage are determined as per ASTM C969 "Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines".
- Water supply lines: Leakage test of laid water supply lines is performed as per AWWA standards. Average test pressure is usually 1.5 times the working pressure of pipe. For example, a pipe which has a working pressure of 200 ft, the test pressure will be 300 ft. Testing is usually carried out upon lengths of pipe not exceeding 1000 ft (300m).
- Leakage is defined as the volume of water that is pumped into the pipeline to maintain pressure within ± 5 psi of the test pressure after it is filled and purged of air, for a duration of 2 hours.

PROCEDURE FOR HYDRAULIC TEST OF WATER SUPPLY LINES

- It is an important test to check the leakage of laid pipes, joints and fittings under a specified pressure. It is performed before backfilling of trenches.
- The water supply line to be tested should be isolated from the distribution system by using valves.
- The pipe line should be properly filled, flushed, and purged of all air before filling it with water.
- The specified test pressure shall be applied by means of an approved pumping assembly connected to the pipe.
- The test pressure shall not exceed pipe or thrust-restraint design pressures.
- The test pressure shall be maintained for the specified time during which the system and all exposed pipe, fittings, valves, and hydrants shall be carefully examined for leakage.

PROCEDURE FOR HYDRAULIC TEST OF WATER SUPPLY LINES

- Test pressure: 150% of working pressure at point of test, but not less than 125% of normal working pressure at highest elevation. Time duration of the test shall be 2 hours.
- No installation will be accepted if the leakage is greater than that determined by the formula:

$$L = \frac{ND\sqrt{P}}{7,400}$$

Where:

L = allowable leakage, in gallons per hour
N = number of joints in the length of pipeline tested
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in pounds per square inch (gauge)

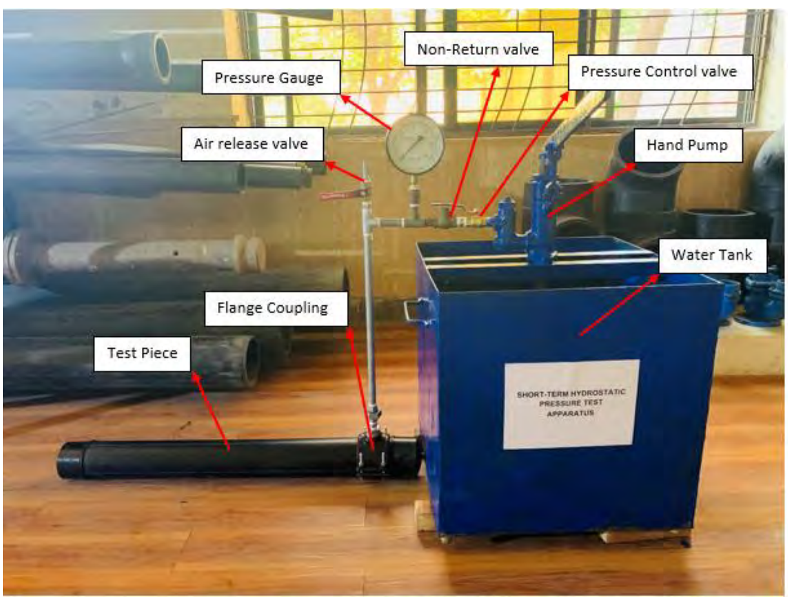
- So, allowable leakage mainly depends upon the diameter of pipe.

PROCEDURE FOR HYDRAULIC TEST OF WATER SUPPLY LINES IN THE DISTRIBUTION SYSTEM

Practical training

- Hydrostatic pressure testing of HDPE pipe at training center WASA
- Differentiating various types of valves available at training center. Checking standards of flanges of valves available at training center.
- Field tour of trainees to see butt fusion welding if a HDPE pipe is being laid.

Arrangement of hydrostatic pressure testing of HDPE pipe in Training center



TEST PROCEDURE FOR HYDRAULIC TEST AT TRAINING CENTER

Test procedure:

1. Fill the water tank with a specific volume of clean water at ambient temperature.
2. Before fixation/ installation of the test piece, hand-pump the water to check if the pumping arrangement is working properly.
3. Check all the valves and fittings for any leakage before starting the test.
4. Take a test piece of HDPE pipe. The length of test piece should be equal to or more than 5 times the nominal diameter of the pipe in case of pipes less than 6 inches diameter, and equal to or more than 3 times the nominal diameter in case of pipes larger than 6 inches diameter. ?? I would like to know this reason
5. Check the test piece to be empty of any foreign/ unwanted materials. End caps are butt/ fusion welded at the ends of test piece by a heating machine.

HYDRAULIC TEST OF LAID WATER SUPPLY & SEWER LINES

Test procedure (continued):

6. Make a small hole in the test piece through which test liquid (water) will go into the test piece. Attach/ fix the flange coupling at the test piece by means of nuts & bolts.
7. Make sure that needle of pressure gauge is at zero. Start the hand pump slowly and continuously increase the pressure. Open the air release valve to allow the entrapped air to escape.
8. Keep the test piece at test pressure for 4 hours and allow the pipe to expand, pump the small amount of water if the pressure drops upto 5% of the test pressure.
9. Again, keep the test piece under pressure for 4 hours to determine if there is any leakage, crack, yielding or breakage.
10. Release the water pressure after 8 hours and remove the test piece.

TEST REPORT OF HDPE

GOVERNMENT OF PAKISTAN
MINISTRY OF SCIENCE AND TECHNOLOGY
PAKISTAN STANDARDS & QUALITY CONTROL AUTHORITY

QUALITY CONTROL CENTRE

234-Pitac Compound, Ferozepur Road, Lahore. 042-99230617-18

TEST REPORT

Your Ref. No. QCD/1160-61
Dated:- 06-07-2020

Our Ref. No. QCC/4(362)/20-21 (1571)
Dated:- 7-9-7-20

Sample Received from: The Dy. Director (Q.C.D)
Report issue to Training Centre, WASA
Block-A,Gulshan-e-Ravi,
LAHORE

No. of Samples: One (01)
Specification against which tested
PS:3580-14/ ISO-4427

SUBJECT: - TESTING OF SAMPLES STATED TO BE "HDPE PRESSURE PIPE" 32" PN-8 (800MM) DIA JAMAL BRAND" AGAINST TENDER NO. P&S/25.01/6193 LAYING OF FORCEMENT OF ICHA MORR DISPOSAL LAYING FORCEMENT AND REPLACEMENT OF SEWERAGE SYSTEM AT SULTAN AHMAN ROAD.
(M/S: AL-AWAN CONSTRUCTION COMPANY)

The above sample as received has been tested with the following test results:-

S. No	Description of Tests.	Results Corresponding to Labs. Registration Nos.
		PE/36
1.	Density (g/cm^3)	0.958
2.	Mean Outside Dia (mm)	805.0
3.	Wall Thickness (mm) Min. Max.	 38.8 41.5
4.	Longitudinal Reversion Test at 110°C (%)	NA
5.	Tensile Strength (N/mm^2)	24.8
6.	Elongation at Break (%)	405
7.	Marking	Present

End of Test Report

Assistant Director (Physical)

(MASOOD AHMED KHAN)
Director QCC (North)
Lahore (0129)

Annex 5.2.13 Training Material for "Proper Handling of Leakages from Valves & Connections" at WASA Lahore

PROPER HANDLING OF LEAKAGE FROM VALVES & SERVICE CONNECTIONS

WASA LAHORE

Existing XEN, SDOs, S/E

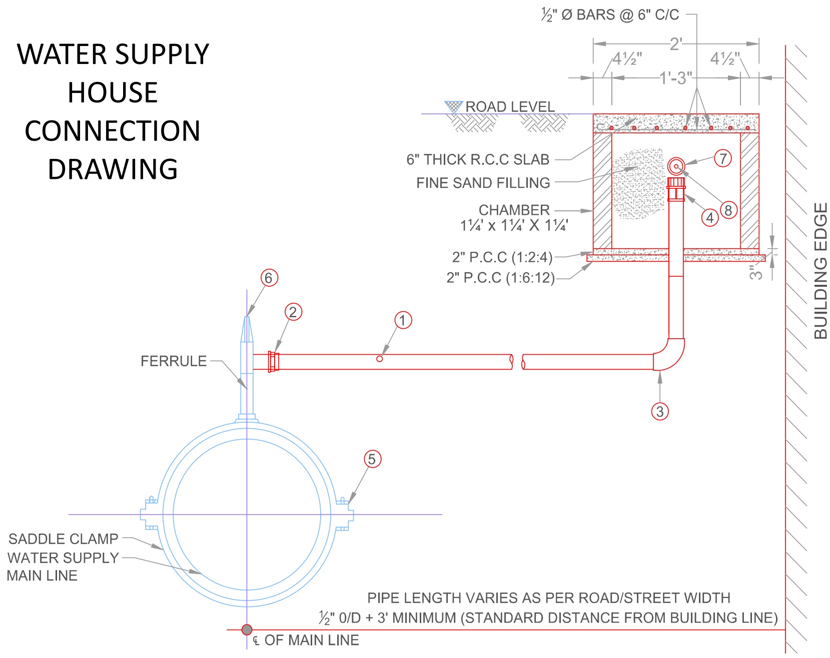
1

Service Connections in WASA Lahore

- Previously mostly GI pipes were used for house connections.
- Now the HDPE or PPRC pipe is used
- Service connection is made according to standard WASA Drawing
- WASA approved plumbers/plumbing contractors carryout the job under WASA supervision.
- Service connection from main line to consumer's premises is the responsibility of consumer
- Every WASA Operation Subdivision(under SDO) has its own plumbing contractors.

2

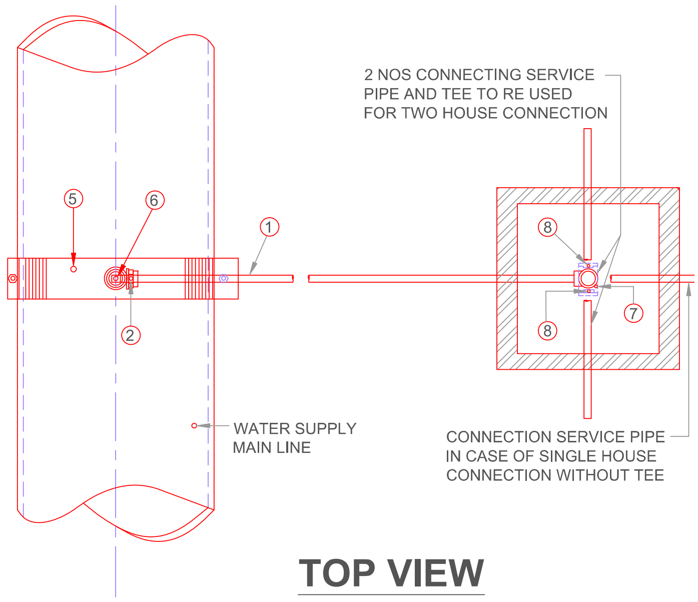
WATER SUPPLY
HOUSE
CONNECTION
DRAWING



3

SECTIONAL VIEW

SCALE **N.T.S**



TOP VIEW

SCALE **N.T.S**

4

COMPONENTS FOR FORMATION OF W/SUPPLY CONNECTION (FOR 3/4" DIA SERVICE PIPE)

CONNECTION FROM 6" DIA LINE

S.NO	DESCRIPTION	QUANTITY
1	P.E.PIPE 25mm	1
2	PP FEMALE ADAPTER 25mm x 3/4"	1
3	PP EQUAL BEND 25mm	1
4	PP MALE ADAPTER 25mm x 3/4"	1
5	PP SADDLE CLAMP 90mm x 3/4"	1
6	BRASS FERRULE 3/4"	1
7	G.I BEND 3/4"	1
8	G.I.END CAP 3/4"	2

CONNECTION FROM 8" DIA LINE

S.NO	DESCRIPTION	QUANTITY
1	P.E.PIPE 25mm	1
2	PP FEMALE ADAPTER 25mm x 3/4"	1
3	PP EQUAL BEND 25mm	1
4	PP MALE ADAPTER 25mm x 3/4"	1
5	PP SADDLE CLAMP 90mm x 3/4"	1
6	BRASS FERRULE 3/4"	1
7	G.I BEND 3/4"	1
8	G.I.END CAP 3/4"	2

CONNECTION FROM 3" DIA LINE

S.NO	DESCRIPTION	QUANTITY
1	P.E.PIPE 25mm	1
2	PP FEMALE ADAPTER 25mm x 3/4"	1
3	PP EQUAL BEND 25mm	1
4	PP MALE ADAPTER 25mm x 3/4"	1
5	PP SADDLE CLAMP 90mm x 3/4"	1
6	BRASS FERRULE 3/4"	1
7	G.I BEND 3/4"	1
8	G.I.END CAP 3/4"	2

CONNECTION FROM 4" DIA LINE

S.NO	DESCRIPTION	QUANTITY
1	P.E.PIPE 25mm	1
2	PP FEMALE ADAPTER 25mm x 3/4"	1
3	PP EQUAL BEND 25mm	1
4	PP MALE ADAPTER 25mm x 3/4"	1
5	PP SADDLE CLAMP 90mm x 3/4"	1
6	BRASS FERRULE 3/4"	1
7	G.I BEND 3/4"	1
8	G.I.END CAP 3/4"	2

NOTE:-

FOR SINGLE HOUSE CONNECTION USE EQUAL BEND AND 1 No END CAP

5

COMPONENTS FOR FORMATION OF W/SUPPLY CONNECTION (FOR 1" DIA SERVICE PIPE)

CONNECTION FROM 6" DIA LINE

S.NO	DESCRIPTION	QUANTITY
1	P.E.PIPE 32mm	1
2	PP FEMALE ADAPTER 32mm x 1"	1
3	PP EQUAL BEND 32mm	1
4	PP MALE ADAPTER 32mm x1"	1
5	PP SADDLE CLAMP 90mm x 1"	1
6	BRASS FERRULE 1"	1
7	G.I BEND 1"	1
8	G.I.END CAP 1"	2

CONNECTION FROM 8" DIA LINE

S.NO	DESCRIPTION	QUANTITY
1	P.E.PIPE 32mm	1
2	PP FEMALE ADAPTER 32mm x1"	1
3	PP EQUAL BEND 32mm	1
4	PP MALE ADAPTER 32mm x 1"	1
5	PP SADDLE CLAMP 90mm x 1"	1
6	BRASS FERRULE 1"	1
7	G.I BEND 1"	1
8	G.I.END CAP 1"	2

CONNECTION FROM 3" DIA LINE

S.NO	DESCRIPTION	QUANTITY
1	P.E.PIPE 32mm	1
2	PP FEMALE ADAPTER 32mm x 1"	1
3	PP EQUAL BEND 32mm	1
4	PP MALE ADAPTER 32mm x 1"	1
5	PP SADDLE CLAMP 90mm x 1"	1
6	BRASS FERRULE 1"	1
7	G.I BEND 1"	1
8	G.I.END CAP 1"	2

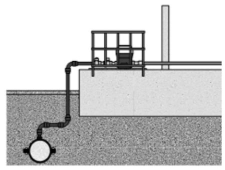
CONNECTION FROM 4" DIA LINE

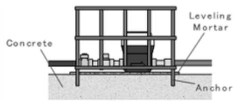
S.NO	DESCRIPTION	QUANTITY
1	P.E.PIPE 32mm	1
2	PP FEMALE ADAPTER 32mm x 1"	1
3	PP EQUAL BEND 32mm	1
4	PP MALE ADAPTER 32mm x 1"	1
5	PP SADDLE CLAMP 90mm x1"	1
6	BRASS FERRULE 1"	1
7	G.I BEND 1"	1
8	G.I.END CAP 1"	2

6

PROPOSED SOP FOR INSTALLATION OF CONSUMER WATER METER

- Turn water supply line off
- Before installing the new meter, always run the water to flush the service line at a slow rate to ensure the line is free of any rust or sediment.
- Service connection should be branched directly from water distribution pipe by ¾ or 1” and 90° of bend pipe UPVC/HDPE or non-corrosive pipe & fittings shall be used.
- The cut of the polyethylene pipe must be straight.
- In principle, MS cage should be selected with concrete base and meter should be installed on the ground. MS cage should be installed on meter

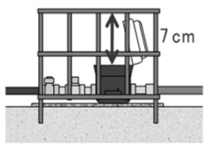


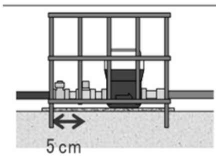


7

SOP---CONT.

- For opening the meter cover, 70mm or more of space is required at the top.
- For opening/closing the magnetic valve, 50mm or more space is required around shutoff valve. At the site, valve operation should be carried out and confirmed.
- Meter should be installed horizontally.
- confirm that there is no water supply branch upstream of the meter.
- **Storage Tank** If customer has storage tank, it should be confirmed that the float valve is installed.





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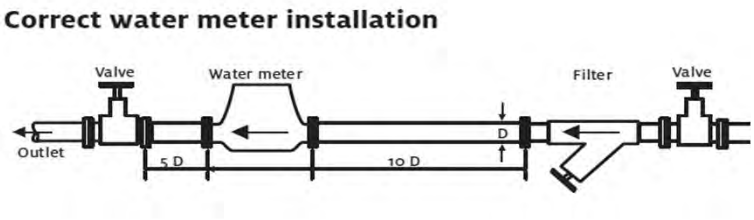
SOP---CONT.



Fittings and valves required

- As Non-return valve is demanded in built in water meter therefore only a shutoff valve is required before meter.
- A strainer before meter may be beneficial due to particles in our water supply system.
- A shutoff valve on downstream of meter is also demanded in certain Utilities to isolate house from water meter for maintenance.

9

Water Meter Installation Check Sheet

No.	Check items	Check
1	Meter is connected to WASA pipeline.	
2	There is no branch upstream the meter.	
3	Meter is installed in the correct flow direction.	
4	Meter is installed horizontally.	
5	Shutoff valve is installed upstream & downstream of the meter.	
6	Non-return valve is inbuilt in the meter,.	
7	Meter is easy to remove for maintenance works.	
8	Meter is easy to read by meter readers.	
9	Meter is not an obstacle to traffic.	
10	Theft prevention of meter is given.	
11	Illegal suckion pump is not installed.	
12	It is not connected to groundwater piping outside the premises	
13	If customer has storage tank, float valve is installed.	
16	Proper water pressure is secured at customer’s tap	

10

Leakage from service connections

Water leaks from pipes, joints, valves and fittings of the service connection either due to bad quality of materials used, poor workmanship, corrosion, age of the installations or through vandalism:

- **Unauthorized connections**: Illegal connections are not installed as per standard practice therefore start leaking.
- **Age of the system:** With age particularly CI, MS and GI pipes get corroded and leaks occur resulting in loss of water and reduced pressure and pollution of supplies.
- **High Water Pressure:**
- **Corroded Pipes if metal pipes are used**
- **Damaged Pipe Joints**

  One of the most vulnerable areas of a pipe is its joints.

11

Leakage --------cont.

- **Service line passes through septic tank**: The service lines of consumers are old and sometimes pass through house sewage pits and start leaking.
- **Underground Movements:** The growth of tree roots, flooding and even small earthquakes can shift the placement of your pipes. As the ground moves, your pipes can twist, bend, crack or separate altogether- causing underground leaks.
- **Loose fittings**

12

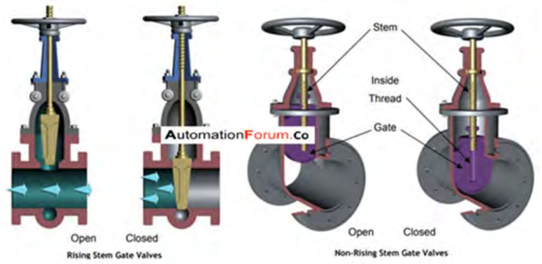
Typical places of service connection to look for leakages

- Check ferrule
- Check bends
- Check valves
- Check couplings
- Check if line is passing through septic tank

13

Leakage from valves

- Valves are **prone to leaking, corrosion and damage**.
- Generally Valves discs stick into body when not turned for a long time.
- Gate valves stick when packing is not replaced and not lubricated for a long time
- Corrosion is built up if ignored for a long time.
- Debris in the water cause the sticking of disc.



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Leakage from gate valves

- **Gate valve** mostly leak from the gland. This is due to a build up of deposits against the seal and the seal getting a bit displacement. The water valve stem passes through a “packing” nut and washer, which provide a watertight seal.
- Over time, though, this packing material can harden or disintegrate. And when this happens, it won't form a solid seal and will cause leaking.

15

Wear of the seat seals of Gate Valves

- The **seat of a metal seated gate valve has a pocket that can entrap solids** and prevent the valve from closing fully.
- The **resilient seat type greatly reduces this problem** because it has no pocket in the body in which the gate seats.
- The disc is encapsulated with a resilient material (usually vulcanized rubber) that presses against the smooth, body of the valve.

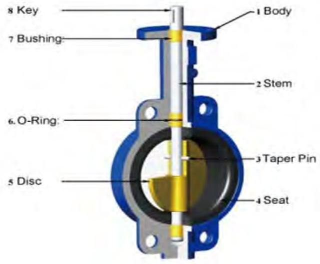
NO Pocket in resilient Seated gate valve

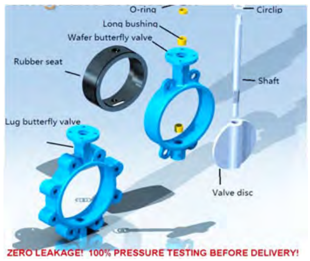
Pocket in metal seated gate valve

16

Leakage from Butterfly valves

- Some installed **butterfly valves** are **oversized or undersized** and that may be the cause of leakage.
- Any misalignment during installation can change its pressure rating capability which can lead to valve leakage.
- Valve seat are covered in dirt or the valve stem and disk is rusted.





17

Leakage from Butterfly valves---Cont.

- Seat is scored.
- Seal is damaged.
- Insufficient actuator movement.
- Worn stem packing.
- Gasket between valve body and bonnet is damaged

18

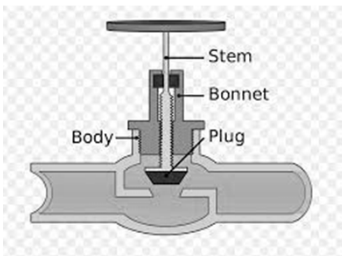
Leakage from Ball valves

- Most leaking ball valves are caused by differences in pipeline pressure levels. If the pipeline pressure exceeds the pressure range of the ball valve, resulting in leakage of the valve stem.
- Here are some other factors that may cause ball valve stem leakage:
- Packing gland deflection or compression failure
- Insufficient or invalid packing

19

Leakage from Globe valve

- **Globe valve:** If the globe valve allows water to pass through it when it is fully closed, the problem is in the seating.
- If water leaks from the point where the stem (handle) enters the bonnet, the problem is the packing. If the leak is at the joint where the body and bonnet connect, the problem is the **gasket**.



20

Leakage from Swing Check Valve

- **Incorrect installation and assembly**
  Our tip? Remember to take note of flow capacity and the positioning and orientation of the valve during installation.
- **Insufficient maintenance**
  Regular maintenance is a sure-fire way to safeguard against failing valves. Look out for any signs of wear and check the pipeline for debris, which can get stuck in the valve and cause damage to the internal mechanisms.
- **Reverse flow**
  This can be extremely costly and dangerous when it occurs at the pump discharge, causing the pump to spin backwards, which damages the pump and valve over time.

21

Necessity of valves turning

To avoid valves problems;

❖ It is desirable to turn each valve in the system at least once in a year.

❖ Many utilities have a regular valve-turning program in which a percentage of the valves are opened and closed on a regular basis.

❖ Valve turning and maintenance record is maintained and kept up to date.

22

Lack of record

- System maps, designs of the site connections and historic records of the equipment installed in the distribution system are often not available in WASA, whereas some minimum information is required to operate and maintain the system efficiently.
- As most of the leaks take place from valves and service connections therefore, record of leakage required to be saved for analyzing the areas with more leakages.

23

Proposed leakages record data sheet

SR. No	Date	Location/address	Detail of pipe line, size & its material	Valve type & size (if leakage from valve)	Reason of leakage	Detail of repair And fittings used	Remarks

Sub Engineer

SDO/Assistant Director

24

Annex 5.2.14 Training Material for "Water meters selection and installation" at WASA Lahore

WATER METERS SELECTION AND INSTALLATION




REFERENCE DOCUMENTS

- ***E VAN ZYL:*** *INTRODUCTION TO INTEGRATED WATER METER MANAGEMENT*
- *DIRECTIVE 2014/32/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014*
- ***BS EN ISO 4064-1:2014. Water meters for cold potable water and hot water.*** *Part 1: Metrological and technical requirements.* *https://www.iso.org*
- *OIML R-49-1 2013:Water meters for cold potable water and hot water. Part 1: Metrological and technical requirements.* https://www.oiml.org

Main Categories of Consumer Water Meters

Mechanical Meters

Static or Electronic Meters

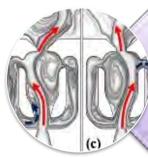
Types of Mechanical Meters

- Velocity Meters
  - Single Jet
  - Multi Jet
- VOLUMETRIC METERS
  - Piston Meters
  - Nutating Disc Meters

Types of Static or Electronic Meters

Electromagnetic meters

Ultrasonic meters



Fluidic Oscillator

Mechanical water meters Rotary Piston

Piston glides in a circulation motion

A known volume of water passes through the meter at each stroke or oscillation of a piston. PD meters calculate the volume of water consumed by counting the number of reciprocations or revolutions of the piston.

Characteristics of Rotary piston Meters

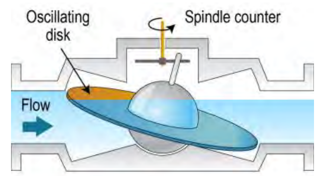
- The meter housing is typically made out **of brass or plastic,** and the internal components from **plastic**.
- **These can be installed in virtually any position without significant loss in accuracy. They can also be placed close to bends or pumps**
- These are sensitive to **sand or other suspended solids in the water** that can get stuck between the piston and chamber wall, jamming the meter.
- **Thus it is important that these meters should only be installed in systems with very good water quality, and they should always be provided with built-in strainers.**
- These meters are very sensitive to low flows and are especially suitable for applications where low flow rates or on-site leakage frequently occur, such as domestic consumers.

Characteristics of Rotary piston Meters

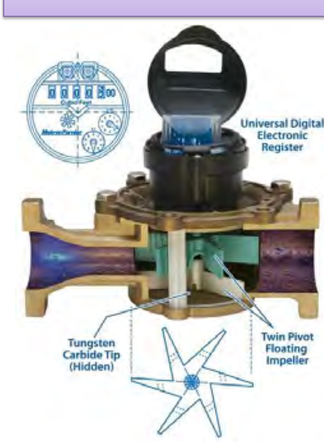
- As rotating piston meters age and wear through use, water is able to leak past the piston more easily, and thus the meters tend to under- register with age.
- If air is forced through the meter, the metering error can be quite severe and the wear on the moving parts of the meter is increased substantially.
- **It is recommended that an air valve is installed at an elevated point upstream of the meter to remove air from the system.**
- Not affected by the velocity profile

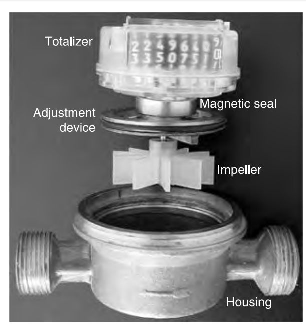
Nutating Disc Meters

- ❖ The moving element is a disc that oscillates around the symmetry axis of the chamber, dividing it in separate compartments.
- ❖ These are common in many countries, especially in North America.
- ❖ The consumption is determined by counting the number of cycles in which a chamber of known volume is filled and emptied.



VELOCITY WATER METERS SINGLE JET





- The water is channeled through a *single* jet over a radial-vane impeller placed inside the body of the meter.
- Impeller rate of rotation is proportional to the flow velocity of the water, or in other words, to the circulating flowrate.

SINGLE JET METERS

- **Resistant to suspended solids.**
- **Small and can be installed in tight spaces.**
- **They are generally affected by the installation orientation.** Most single jet meters have to be installed perfectly horizontally and upright to ensure accurate measurements (especially at low flows.)
- **Affected by disturbances in the velocity profile.**

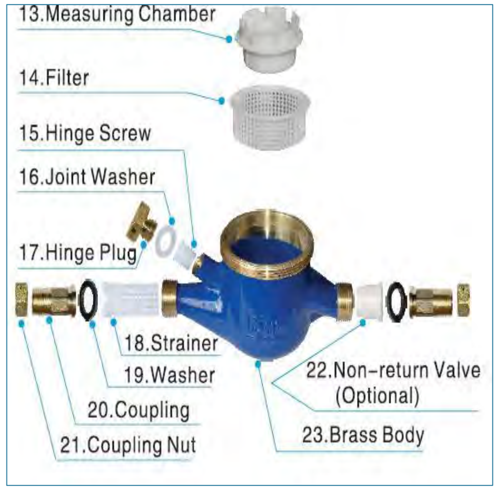
MULTIJET METERS

- Similar to single jet meters, except that they use a number of jets to drive the impeller at multiple points. This means that the forces on the impeller are better balanced than in single jet meters
- Water Uniformly Spread Across Multiple Inlet Ports
- Impeller velocity determines flow rate
- Register determines volume
- Horizontal Multijet Meters are not suitable for vertical installation.
- Multijet meters use an internal bypass with a regulating screw to adjust the flow passing through the impeller

Parts of Multijet meters

NON RETURN VALVE

- Strainers on the inlet side of the meter, which can be removed for cleaning.
- A second internal strainer often covers the openings of the meter chamber.

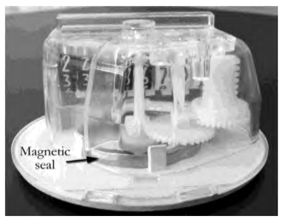


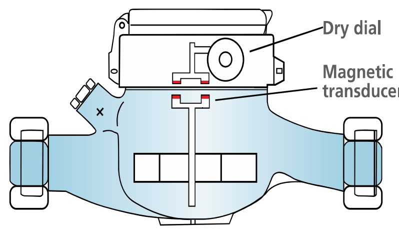
Benefits of Multi jet Meters

- High Accuracy
- Low head loss,
- Passes particles
- Low wear over long term
- Quiet operation
- Can be recalibrated for accuracy.

Dry type totalizers

- **The reading mechanism hermetically separated from the water flow chamber.**
- **The counter and indicator are placed in a sealed chamber.**
- **Dry dial meters often use magnetic transducers, and thus require special protection against magnetic fields that may interfere with the meter reading.**





The picture also shows an anti-fraud metallic ring that prevents the manipulation by means of an external magnetic field.

Advantages & Disadvantages of Dry type totalizers

Their counters and indicators do not come into direct contact with the water,

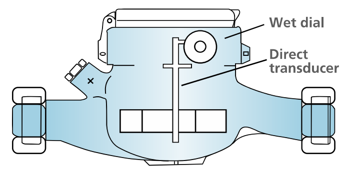
and are thus protected from suspended particles that may create problems due to settling or obstruction of the counter gears.

The transparent window covering the dial doesn't have to be strong enough to sustain the water pressure in the network, which reduces the cost of the meter.

On the negative side, if any damp gets past the seal, condensation can form on the inside of the meter window, making the meter impossible to read.

Wet dial water meters

- The counter and indicator is either filled with water from the network or housed in a sealed chamber that is filled with a mixture of water and glycerine (to stop algae from growing).
- A benefit of wet dial meters is that damp is not a problem.
- Not suitable for dirty water, or water with high iron content.
- Transparent window housing has to be strong enough to withstand the full pressure in the distribution network, adding to the cost of these meters.
- Better quality meters use 14 mm armour plate glass lenses.



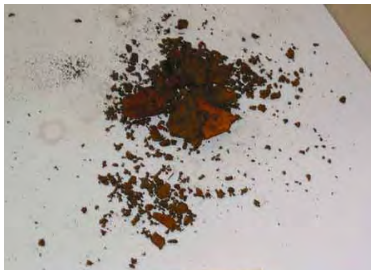
PROBLEMS OF MECHANICAL WATER METERS

Overall, mechanical meters are very dependable at a variety of flow levels. They are relatively low in cost. However, these meters are prone to the **following issues:**

- **Mechanical parts are susceptible to effects of sediments and debris, corrosion, scale formation and water chemistry.** Deposition of the turbine may cause over registration at medium and high flows, but under registration at low flows.
- **Moving parts in the meters wear out over time. This result in under- registration and loss of revenue with age, particularly at lower flow rates.** As a result, **all mechanical meters should be replaced after a specified period, unless meter testing shows they are still operating to specification**
- **To maintain performance, mechanical meters require periodically sampled inspection processes,** commonly known as **meter testing programs.**

PROBLEMS OF MECHANICAL WATER METERS

Steel pipe corrosion



PARTIAL CLOGGING CAUSED BY SUSPENDED PARTICLES

Foreign objects and quality of water
The error curve of most meters, regardless of their technology, may be seriously affected by the quality of the water.

Sand particles damage to piston meter

lime scale build-up

lime scale in a PD meter

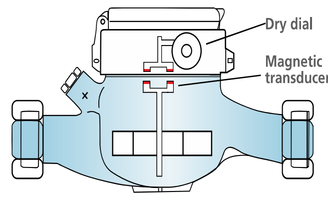
Limescale built-up in the inside of a single jet water meter housing

lime scale build-up
Excessive build-up of lime scale will influence the rotation of the impeller, even stopping it, leading to a significant under-registration

Multi-jet dry type meter not suitable for vertical installation

For Multi-jet dry type meter: The measuring impeller and register are magnetically coupled not directly connected.

If the meter is installed vertically the distance between the two magnets will change therefore the connecting force of the two magnets will change and can possibly even intermittently lose total connection at higher velocities therefore causing a decrease in accuracy.

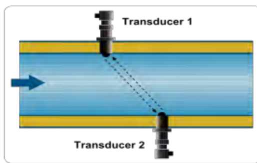


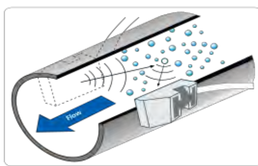
METER FOR
VERTICAL INSTALLATION

ELECTRONIC METERS

- No moving parts
- No maintenance
- Better low flow accuracy
- Better high flow accuracy

ULTRASONIC FLOWMETERS

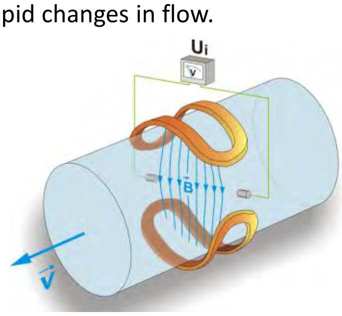




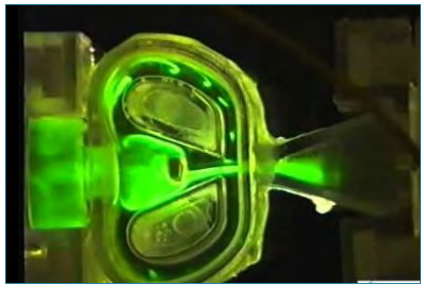
- **Ultrasonic meters simply measure water by sending an ultrasonic signal in the upstream direction and another in the downstream direction.**
- **The time for the signal to go upstream is slower than downstream.. The time difference is then used to calculate the flow rate and total amount of water flowing.**
- Ultrasonic technology is very effective for measurement of larger pipe diameters, problems exist with small diameter pipes. suspended particles or air bubbles in the water.
- The suspended particles or air bubbles and sediments can disturb the ultrasound signal, and reduce the pipe diameter.

Electromagnetic meters

- Uses Faraday's Law of Electromagnetic Induction
- A magnetic field is created across the pipe.
- When water, which is an electrical conductor, moves through the magnetic field, a voltage is induced that is detected by electrodes in the body of the meter.
- The voltage is directly proportional to the flow velocity, which allows the flow rate to be calculated.
- ***Magmeter*** performance is not affected by **temperature, pressure, or viscosity.** These meters can handle rapid changes in flow.
-



Fluidic Oscillator Meters



Based on Bernoulli's Theory - A slow moving high pressure gas becomes fast moving low pressure gas at the nozzle exit forming a jet of gas.

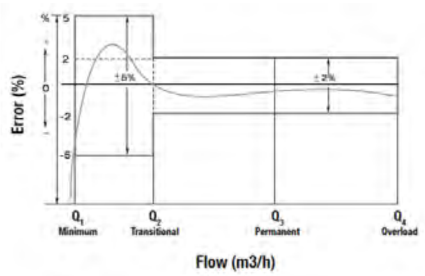
In short:-

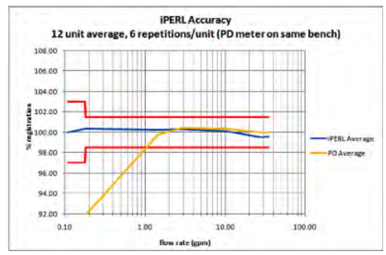
- **Meter Design Generates Oscillations**
- **Electrodes Count Oscillations**
- **Higher Flow Rate = More Oscillations per Time Period**

COMPARISON OF MECHANICAL AND STATIC METERS

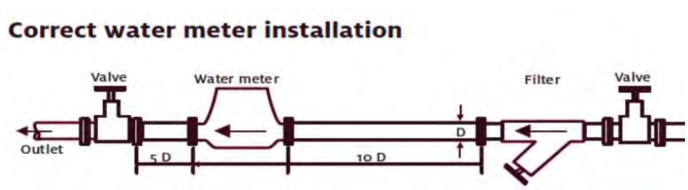
SR. NO	MECHANICAL METERS	STATIC METERS
1	Mechanical meters use either positive displacement or velocity to measure usage.	Electric signals are used for flow measurement
2	Regular maintenance is required	The only maintenance most need is a replacement for battery in case of Ultrasonic meters every 15-20 years
3	They are relatively low in cost.	High cost
4	Moving parts in the meters wear out over time.	No moving parts
5	Low flow accuracy is relatively less as compared to high flow.	Static meters can maintain the same level of accuracy long-term, especially at very low flows.
6	Effected by grit , particulate and scale formation	Not effected by grit etc
7	Make noise	Quite operation
8	Improper installation can result in inaccuracy or premature wear.	Static meter can be installed non-level, horizontal, vertical, or inclined, and with the register facing up, down, or sideways.

Comparison of accuracy curves Class 2 water meters





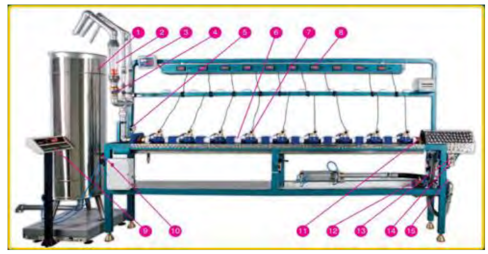
GENERAL RECOMMENDATIONS FOR INSTALLATION OF METERS



- **In utilities where interruptions of the supply are common, or in elevated positions, where trapped air may be found, it is convenient to install air valves upstream from the meter**
- **As Non-return valve is demanded in built** in water meter therefore only a shutoff valve is required before meter.
- **A strainer** before meter may be beneficial due to particles in our water supply system.
- A **shutoff valve** on downstream of meter is also demanded in certain Utilities to isolate house from water meter for maintenance.

6.Water Meters Calibration Methods

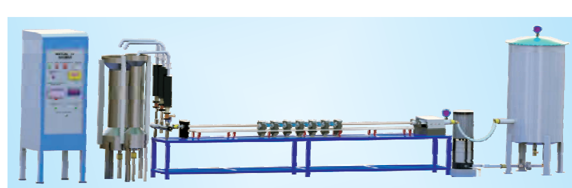
TEST METHODS:
Calibrated Tanks
(Volumetric Method),
Reference Flow meter
(Comparative Method)
Weighing Scales
(Gravimetric Method).



- **Gravimetric system.**
- In the gravimetric system, the water passed through the water meter is collected in the water tank and its weight is measured by the weighing scale placed under the tank.
- The measurement error percentage is calculated by comparing the value of volume taken from the water meter display and his value taken from the weighing scale.

6.1 Volumetric & Comparative Method

- **Volumetric Method:**
- The calibration method is to drive a known volume of fluid through the flow meter at a given rate.
- That volume of water collected in a tank is compared with water meter reading
- **Comparative Method**
- **Calibrated master meter** is installed in line with the meter being tested. The meter can be left in place for some time before comparing the volumes through the two meters. This is an accurate method



Major International Water Metering Standards

(1) International Organization of Legal Metrology (OIML)

OIML R49-1 (Metrological and technical requirements)

- OIML R49-2 (Test methods)
- OIML R49-3 (Test Report Format)

(2) International Standards Organization (ISO)

- ISO 4064 Part 1 (Specifications)
- ISO 4064 Part 2 (Installation Requirements)
- ISO 4064 Part 3 (Test Methods and equipment)

(3) Measuring Instruments Directive (MID) 2004/22/EC **of European Parliament and of Council.**

- Annex MI-001

(4) American Water Works Association (AWWA)

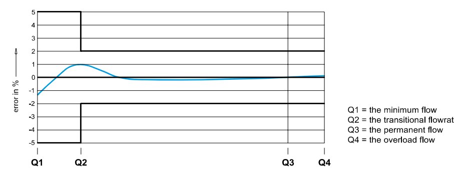
- AWWA C 700 (PD Meters)
- AWWA C 708 (Multi-Jet Meters)
- AWWA C 712 (Fluidic Oscillator Meters)
- AWWA C 713 (Single-Jet Meters)
- AWWA M6 (Meters- Selection, Installation, Testing and Maintenance)

ISO & OIML ARE NOW IDENTICAL

- The combined standard is now referred as,
- ISO 4064:2014|OIML R 49:2013
- European Standard is now: BS EN ISO 4064-1:2017
- Measuring Instruments Directive (MID) 2004/22/EC of European Parliament and of Council is another standard

METROLOGICAL REQUIREMENTS OF OIML,ISO & MID ARE SAME

- OIML R 49-1: 2013 (E) /ISO4064-2014& BS EN ISO 4064-1:2017
- Flow rate characteristics are defined by ;
- Q1 Minimum flow
- Q2 Transitional flow
- Q3 permanent flow
- Q4 Overload flow
- Q2/Q1 shall be 1.6
- Q4/Q3 shall be 1.25



Typical accuracy curve

- A water meter shall be designated by the numerical value of *Q*3 in m3/hr..
- MID
- The values for the flow rate range shall fulfil the following conditions:
- Q3/Q1 ≥ 10
  Q2/Q1 = 1.6
  Q4/Q3 = 1.25

METROLOGICAL REQUIREMENTS
OIML R 49-1: 2013 (E) /ISO4064-2014 &
BS EN ISO 4064-1:2017

4.1.3 The value of Q_3 , expressed in m^3/h, shall be chosen from the following list:

1	1.6	2.5	4	6.3
10	16	25	40	63
100	160	250	400	630
1 000	1 600	2 500	4 000	6 300

The list may be extended to higher or lower values in the series.

4.1.4 The value of the ratio Q_3/Q_1 shall be chosen from the following list:

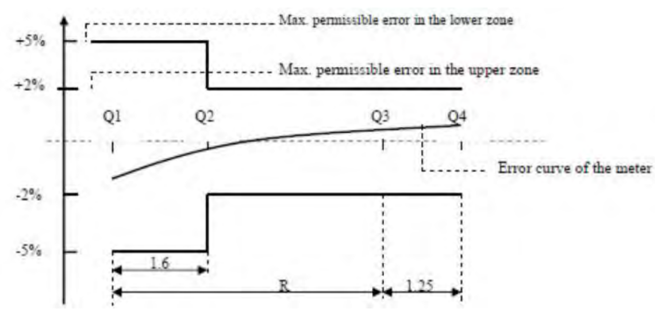
40	50	63	80	100
125	160	200	250	315
400	500	630	800	1 000

The list may be extended to higher values in the series.

This Q3/Q1 is expressed as R

METROLOGICAL REQUIREMENTS---Cont.
OIML R 49-1: 2013 (E) /ISO4064-2014

- If Q3 is fixed, the greater the ratio of Q3/Q1 the lesser the Q1 & lesser the ratio the greater the minimum flow.
- Normally manufacturers make(OIML/ISO & MID) meters with Ratio of Q3/Q1 as160, 200 & 250 for 15mm class and,100, 80 and 40 for other sizes.



Selecting Metrological characteristics for water meters

- Normally error is observed in water meters at minimum flow rates therefore a meter should be capable to measure small flow rate (Q1) within accuracy limits.
- For mechanical meters of half inch size minimum flow(Q1) is around 15-16 l/hr or even less and permanent flow(Q3) around 2.5 M3/hr.
- The manufacturers have meters with minimum flow rate range higher than this.
- If you choose Q3 as 2.5 and Q3/Q1 as R160 the minimum flow(Q1) will be 15.6 liters/hr.
- NMI Australia demands that For 15 mm and 20 mm meters the minimum value of *Q3/Q1 shall be R 200*

COMPARISON OF VARIOUS STANDARDS

15mm cold water meters Multijet type

Standard	Minimum Flow l/h Q1	Permanent Flow Q3	Overload Flow /h Q4	Pressure range bar	Temperature range °C	Accuracy requirement	Remarks
AWWA C708	60	2.3	4.5	10	27	lower flow rate zone±3 % upper flow rate zone±1.5%	Q3/Q1=38 Q4/Q3=1.95
OIML/ISO & European Standard	15.6	2.5	3.125	0.3-10	0.1-30 0.1-50	lower flow rate zone ±5 % upper flow rate zone ±2 % for meters up to 30 °C±3 % for greater than 30 C	Q3/Q1=160 Q4/Q3=1.25
MID	15.6	2.5	3.125	0.3-10	0.1-30	lower flow rate zone ±3 % upper flow rate zone ±2 % for meters up to 30 C ±3 % for greater than 30C	Q3/Q1=160 Q4/Q3=1.25

Water temperature range up to 50C is only available in OIML/ISO.

Minimum flow of AWWA is 60 l/h which may not be suitable for our conditions where flow is normally less & suitable meter will be capable of recording low flow accurately within MPE limit.

Accuracy requirement of AWWA is more strict than OIML/ISO and MID.

METERS CERTIFICATION

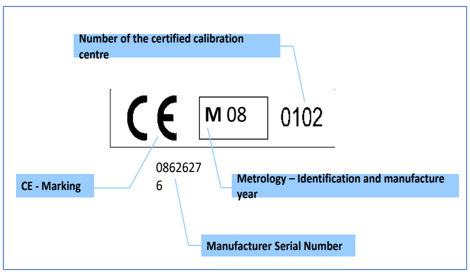
- OIML is the only organization which issues test certificates through notified bodies approved centrally by OIML.
- MID: Type examination certificates are issued by the authorities nominated by the member states.
- ISO does not issue any test certificate. Compliance certification is performed by external certification bodies, which are largely private and are not nominated by ISO, therefore no control over them.

Practical Training

- Trainees will visit WASA Meter Repair Workshop and learn:
- Various types of water meters in dismantled position and compare these in construction and performance.
- Know and identify the nomenclature of each part
- Know about the frequent complaints and defects in water meters.
- Practically carryout the calibration of a water meter at test bench and find the error % and compare it with OIML and ISO accuracy limit.

THANKS

Marking of Water Meters according to MID



OIML CERTIFICATE

ANNEXE CERTIFICAT OIML R49/2013-FR2-15.01 rev3

ANNEX OIML CERTIFICATE

Identification of the certified pattern : water meter ITRON type Woltex. The conformity was established by the results of tests and examinations provided in the associated Test Report n° D7015324-AA, and the associated evaluation reports P17119-2 (18 pages)

Characteristics

Type	WE50/ MWE50	WE65/ MWE65	WE80/MWE80	WE100-WE125/ MWE100-MWE125		WE150/ MWE150	
Nominal Diameter DN (mm)	50	65	80	100/125		150	
Length (mm)	200/210/ 300/312	200/220/ 225/300	200/220/ 225/350	250/290		300/340	
Connections	Flanges DN 50	Flanges DN 65	Flanges DN80	Flanges DN 100 & DN125		Flanges DN 150	
Register	TVM / Glass Metal						
Indicating range (m^3)	999 999 or 9 999 999					9 999 999*	
Verification scale (dm^3)	0.2 or 2					2*	
Cyclic volume (dm^3)	19					200	
Q_3 (m^3/h)	40	63	100	100	160	250	400
Q_4 (m^3/h)	50	78.7	125	125	200	312.5	500
Q_3/Q_1	100	100	100	100	160	100	160
Q_2/Q_1	1.6						

TOTAL 04 PAGES


LNE

Etat Membre de l'OIML
Member State of OIML
FRANCE

CERTIFICAT OIML DE CONFORMITE
OIML CERTIFICATE OF CONFORMITY
N° R 49/2013-FR2-15.01 rev3

Autorité de délivrance : Laboratoire National de Métrologie et d'Essais
Personne responsable (Person responsible) : Thomas LOMMATZSCH

Demandeur : ITRON FRANCE - 11 boulevard Pasteur FRANCE 67500 HAGUENAU

Fabricant : ITRON FRANCE 11 boulevard Pasteur FRA 67500 HAGUENAU

Identification du type certifié : compteur d'eau ITRON type WOLTEX (WE)

Caractéristiques : voir annexe

Ce certificat atteste la conformité du modèle mentionné ci-dessus (représenté par les échantillons identifiés dans les rapports d'essais associés) aux exigences de la Recommandation suivante de l'Organisation Internationale de Métrologie Légale – OIML) :

OIML R49/2013

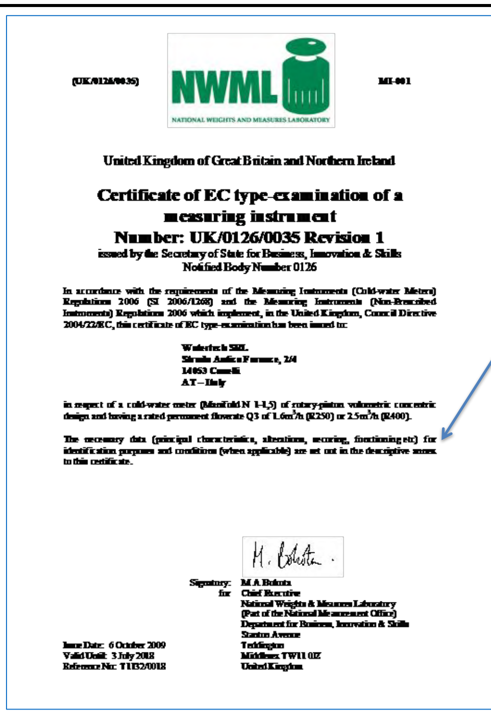
Ce certificat s'applique uniquement aux caractéristiques métrologiques et techniques du modèle d'instrument concerné, telles que couvertes par la Recommandation Internationale applicable. Ce certificat ne constitue en rien une approbation internationale à caractère légal. Note importante : à part la mention du numéro de référence du certificat avec le nom de l'Etat Membre de l'OIML dans lequel le certificat a été délivré, une reproduction partielle du certificat ou des rapports d'essais associés n'est pas autorisée, mais ils peuvent être reproduits dans leur totalité.

OIML

Laboratoire national de métrologie et d'essais

OIML Certificates Issuing Authorities for R-49

1. **CZ1:** Czech Metrology Institute (CMI)
2. **DE1:** Physikalisch-Technische Bundesanstalt (PTB). **(Germany)**
3. **DK2:** FORCE Certification A/S.**(Denmark)**
4. **FR2:** Laboratoire National de Métrologie et d'Essais (LNE).**(France)**
5. **GB1:** NMO. **(Great Britian)**
6. **NL1:** NMi Certin B.V. **(Netherlands)**
7. **SK1:** Slovak Legal Metrology (SLM).**(Slovak)**



(UK/0126/0035) NWML NATIONAL WEIGHTS AND MEASURES LABORATORY MI-001

United Kingdom of Great Britain and Northern Ireland

Certificate of EC type-examination of a measuring instrument
Number: UK/0126/0035 Revision 1
issued by the Secretary of State for Business, Innovation & Skills
Notified Body Number 0126

In accordance with the requirements of the Measuring Instruments (Cold-water Meters) Regulations 2006 (SI 2006/1268) and the Measuring Instruments (Non-Prescribed Instruments) Regulations 2006 which implement, in the United Kingdom, Council Directive 2004/22/EC, this certificate of EC type-examination has been issued to:

Watertech SRL
Strada Antica Fornace, 2/4
14053 Canelli
AT – Italy

in respect of a cold-water meter (Manifold N 1-1,5) of rotary-piston volumetric concentric design and having a rated permanent flowrate Q3 of 1.6m³/h (R250) or 2.5m³/h (R400).

The necessary data (principal characteristics, alterations, securing, functioning etc) for identification purposes and conditions (when applicable) are set out in the descriptive annex to this certificate.

Signatory: M A Bolonta
for Chief Executive
National Weights & Measures Laboratory
(Part of the National Measurement Office)
Department for Business, Innovation & Skills
Stanton Avenue
Teddington
Middlesex TW11 0JZ
United Kingdom

Issue Date: 6 October 2009
Valid Until: 3 July 2018
Reference No: T1132/0018

EC Type examination certificate

The necessary data (principal characteristics, alterations, securing, functioning etc) for identification purposes and conditions (when applicable) are set out in the descriptive annex to this certificate.

The certificate contains 8 pages

Annex 5.2.15 Training Material for "Pressure Testing of Water Distribution Model" at WASA Lahore

Project for Improving the Capacity of WASAs in Punjab Province Phase 2

PROPER HANDLING OF LEAKAGE FROM SERVICE CONNECTIONS

PRESSURE TESTING OF CONNECTIONS MODEL

WASA LAHORE

1

OVERVIEW OF NRW- Water Balance

<table>
<tr><td rowspan="7">System Input Volume:
837,182,250m3/yr
Error Margin[+/-]:5%</td><td rowspan="4">Authorized Consumption:
689.719,428 m3/yr
Error Margin [+/-]: 0.0%
82.3%</td><td rowspan="2">Billed Authorized Consumption:
661.477,333m3/yr
79%</td><td>Billed Metered Consumption:
48,070,335 m3/yr
5.7%</td><td rowspan="2">Revenue Water:
661,477,333 m3/yr
79%</td></tr>
<tr><td>Billed Unmetered Consumption:
613,406,998m3/yr
73.3%</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption:
28,242,094m3/yr
Error Margin [+/-]: 4.1%
3.3%</td><td>Unbilled Metered Consumption:
5,212,200m3/yr
0.6%</td><td rowspan="5">Non-Revenue Water:
175,704,917m3/yr
Error Margin [+/-]: 23.8%
21%</td></tr>
<tr><td>Unbilled Unmetered Consumption:
23,029,894m3/yr
Error Margin [+/-]: 5%
2.75%</td></tr>
<tr><td rowspan="3">Water Losses:
147,462,822m3/yr
Error Margin:28.4%
17.6%</td><td rowspan="2">Apparent Losses:
56,682,822 m3/yr
Error Margin [+/-]: 1.9%
6.7%</td><td>Unauthorized Consumption:
50001335m3/yr
Error Margin [+/-]: 4.9%
5.9%</td></tr>
<tr><td>Customer Meter Inaccuracies and Data Handling Errors: 6,681,589m3/yr
Error Margin [+/-]: 2%
0.8%</td></tr>
<tr><td colspan="2">Real Losses: 90,779,898m3/yr
Error Margin [+/-]: 39.7%
10.8%</td></tr>
</table>

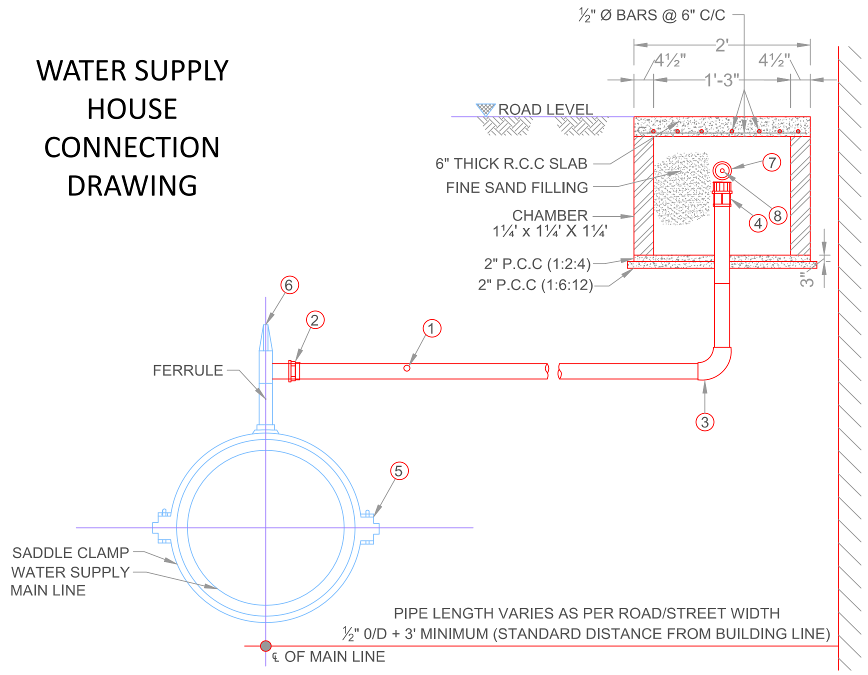
2

Service Connections in WASA Lahore

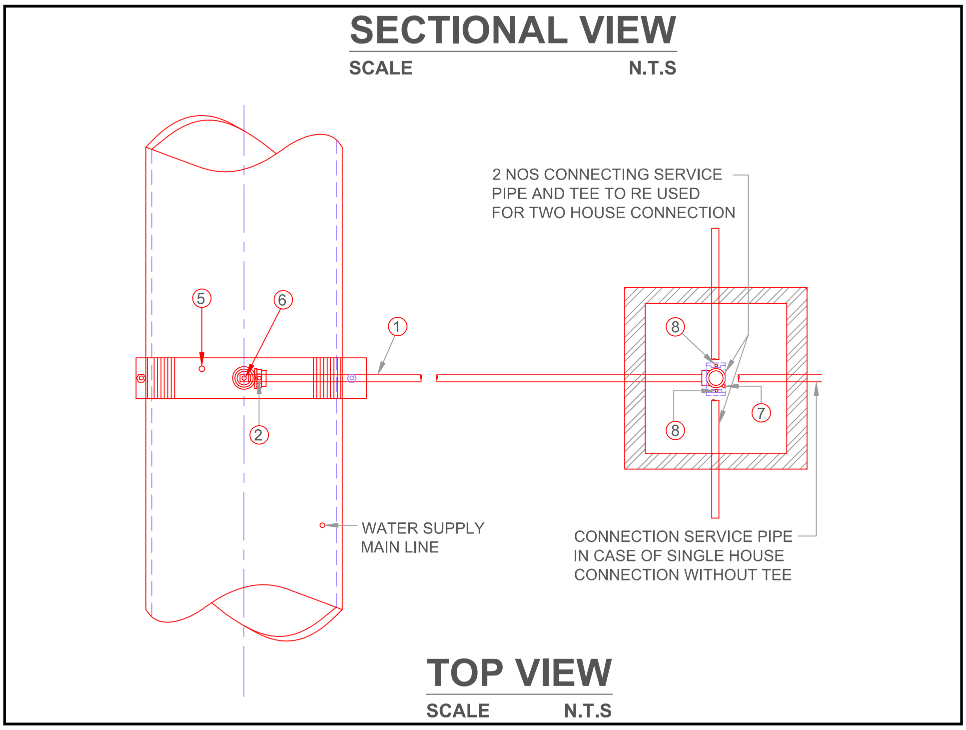
- Previously mostly GI pipes were used for house connections.
- Now PPRC pipe is used.
- Service connection may be made according to standard WASA Drawing
- WASA approved plumbers/plumbing contractors carryout the job under WASA supervision.
- Service connection from main line to consumer's premises is the responsibility of consumer

3

WATER SUPPLY
HOUSE
CONNECTION
DRAWING



4



5

COMPONENTS FOR FORMATION OF W/SUPPLY CONNECTION (FOR 3/4" DIA SERVICE PIPE)

CONNECTION FROM 6" DIA LINE

S.NO	DESCRIPTION	QUANTITY
1	P.E.PIPE 25mm	1
2	PP FEMALE ADAPTER 25mm x 3/4"	1
3	PP EQUAL BEND 25mm	1
4	PP MALE ADAPTER 25mm x 3/4"	1
5	PP SADDLE CLAMP 90mm x 3/4"	1
6	BRASS FERRULE 3/4"	1
7	G.I BEND 3/4"	1
8	G.I.END CAP 3/4"	2

CONNECTION FROM 8" DIA LINE

S.NO	DESCRIPTION	QUANTITY
1	P.E.PIPE 25mm	1
2	PP FEMALE ADAPTER 25mm x 3/4"	1
3	PP EQUAL BEND 25mm	1
4	PP MALE ADAPTER 25mm x 3/4"	1
5	PP SADDLE CLAMP 90mm x 3/4"	1
6	BRASS FERRULE 3/4"	1
7	G.I BEND 3/4"	1
8	G.I.END CAP 3/4"	2

CONNECTION FROM 3" DIA LINE

S.NO	DESCRIPTION	QUANTITY
1	P.E.PIPE 25mm	1
2	PP FEMALE ADAPTER 25mm x 3/4"	1
3	PP EQUAL BEND 25mm	1
4	PP MALE ADAPTER 25mm x 3/4"	1
5	PP SADDLE CLAMP 90mm x 3/4"	1
6	BRASS FERRULE 3/4"	1
7	G.I BEND 3/4"	1
8	G.I.END CAP 3/4"	2

CONNECTION FROM 4" DIA LINE

S.NO	DESCRIPTION	QUANTITY
1	P.E.PIPE 25mm	1
2	PP FEMALE ADAPTER 25mm x 3/4"	1
3	PP EQUAL BEND 25mm	1
4	PP MALE ADAPTER 25mm x 3/4"	1
5	PP SADDLE CLAMP 90mm x 3/4"	1
6	BRASS FERRULE 3/4"	1
7	G.I BEND 3/4"	1
8	G.I.END CAP 3/4"	2

NOTE:-

FOR SINGLE HOUSE CONNECTION USE EQUAL BEND AND 1 No END CAP

6

COMPONENTS FOR FORMATION OF W/SUPPLY CONNECTION (FOR 1" DIA SERVICE PIPE)

CONNECTION FROM 6" DIA LINE

S.NO	DESCRIPTION	QUANTITY
1	P.E.PIPE 32mm	1
2	PP FEMALE ADAPTER 32mm x 1"	1
3	PP EQUAL BEND 32mm	1
4	PP MALE ADAPTER 32mm x1"	1
5	PP SADDLE CLAMP 90mm x 1"	1
6	BRASS FERRULE 1"	1
7	G.I BEND 1"	1
8	G.I.END CAP 1"	2

CONNECTION FROM 8" DIA LINE

S.NO	DESCRIPTION	QUANTITY
1	P.E.PIPE 32mm	1
2	PP FEMALE ADAPTER 32mm x1"	1
3	PP EQUAL BEND 32mm	1
4	PP MALE ADAPTER 32mm x 1"	1
5	PP SADDLE CLAMP 90mm x 1"	1
6	BRASS FERRULE 1"	1
7	G.I BEND 1"	1
8	G.I.END CAP 1"	2

CONNECTION FROM 3" DIA LINE

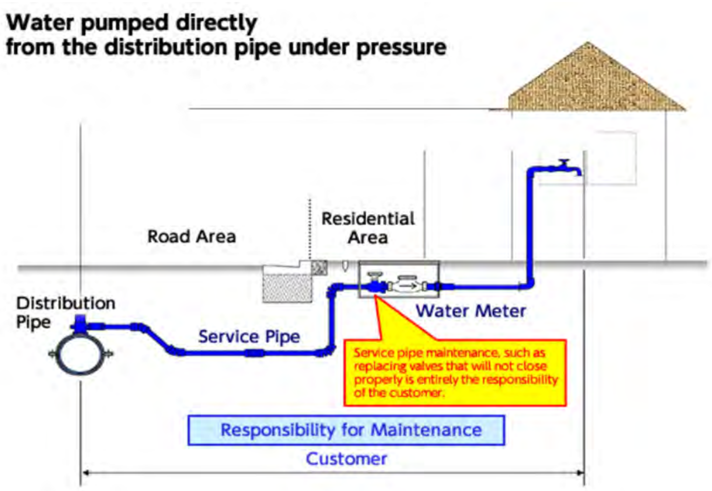
S.NO	DESCRIPTION	QUANTITY
1	P.E.PIPE 32mm	1
2	PP FEMALE ADAPTER 32mm x 1"	1
3	PP EQUAL BEND 32mm	1
4	PP MALE ADAPTER 32mm x 1"	1
5	PP SADDLE CLAMP 90mm x 1"	1
6	BRASS FERRULE 1"	1
7	G.I BEND 1"	1
8	G.I.END CAP 1"	2

CONNECTION FROM 4" DIA LINE

S.NO	DESCRIPTION	QUANTITY
1	P.E.PIPE 32mm	1
2	PP FEMALE ADAPTER 32mm x 1"	1
3	PP EQUAL BEND 32mm	1
4	PP MALE ADAPTER 32mm x 1"	1
5	PP SADDLE CLAMP 90mm x1"	1
6	BRASS FERRULE 1"	1
7	G.I BEND 1"	1
8	G.I.END CAP 1"	2

7

Layout of service house connection



8

Leakage from service connections--1

Water leaks from pipes, joints, valves and fittings of the service connection either due to bad quality of materials used, poor workmanship, corrosion, age of the installations or through vandalism:

i. **Unauthorized connections**: Illegal connections are not installed as per standard practice therefore start leaking.

ii. **Age of the system**: With age particularly CI, MS and GI pipes get corroded and leaks occur resulting in loss of water and reduced pressure and pollution of supplies.

iii. **High Water Pressure:**

iv. **Corroded Pipes if metal pipes are used**

v. **Damaged Pipe Joints**
One of the most vulnerable areas of a pipe is its joints.

9

Leakage from service connections--2

Vi **Service line passes through septic tank**: The service lines of consumers are old and sometimes pass through house sewage pits and start leaking.

vii. **Underground Movements:** The growth of tree roots, flooding and even small earthquakes can shift the placement of your pipes. As the ground moves, your pipes can twist, bend, crack or separate altogether- causing underground leaks.

viii. **Loose fittings**

10

Typical places of service connection to look for leakages

- Check ferrule
- Check bends
- Check valves
- Check couplings
- Check if line is passing through septic tank

11

Plumbing and leakage control in water supply

	PPRC	GI
Life	50 years	20 years
Operating Temp	-20 C to 55 C	-10 C to 70 C
Diameter range	1 to 4 inch (20 to 110 mm)	½ to 24 inch (12 to 600 mm)
Joints	Heat fusion	Socket joints
Pressure rating (PN)	PN 16 to 20 (PN can vary depending on wall thickness of pipe)	PN 30 to 90
Disadvantages/ Health Hazards	These pipes are made up of plastic so they are not suitable to be exposed directly to sunlight as the plastic content is not resistant to ultra violet rays.	Corrosion can make pipe unsafe as lead like heavy metals can exist in zinc because of galvanizing process and lead consumption can cause severe health problem.
Cost	Rs. 150 per Rm for 20mm pipe	Rs. 318 per Rm for 20mm pipe
Common use	Household plumbing system for hot and cold pipes	Distribution system, rising mains (can be laid in open)

12

Pressure testing of model connections

13

Thanks

14

Pipe Sizes & Lengths of Water Supply Network

Sr. No.	Diameter (Ø)	Length (km)
1	2"	2.14
2	2.5"	5.51
3	3"	355.45
4	4"	2572.46
5	6"	617.84
6	8"	258.41
7	9"	11.41
8	10"	270.72

Sr. No.	Diameter (Ø)	Length (km)
9	12"	150.52
10	16"	7.01
11	18"	18.68
12	20"	10.82
13	24"	13.53
14	30"	0.93
15	32"	3.30
16	2.5mm	0.38

Sr. No.	Diameter (Ø)	Length (km)
17	80mm	0.46
18	110mm	104.30
19	160mm	35.85
20	200mm	8.36
21	250mm	7.84
22	315mm	6.33
23	500mm	0.01
24	630mm	0.24

15

Material	Length
AC	3201
CI	460
DI	19
GI	3
MS	251
PVC	17.5
HDPE	510

16

Pumping Stations/Tubewells

- Total No of TWs = 594
- Total Design Capacity = 1730 cfs
- Current Pumping Capacity = 1500 cfs
    - (TWs running for almost 10hrs/day in winters, on yearly average 15hr/day)

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Annex 5.2.16 Training Material for "Working of a water supply network (water Supply Model)" at WASA Lahore

Working of water supply network
(Water supply model)

October 2023

WATER SUPPLY MINIATURE MODEL

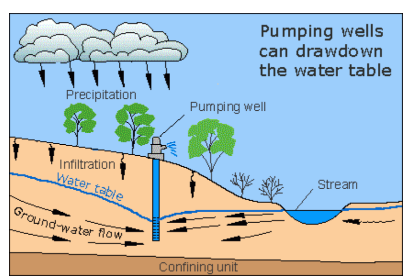
WATER SUPPLY MINIATURE MODEL

The parts of miniature model

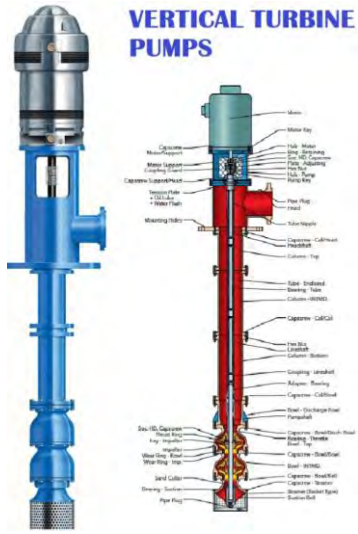
1. Water Tank representing ground water
2. Pumps with suction pipes representing Tube wells
3. Pressure Gauges
4. Valves(Sluice valve, Buterfly valve and check valves) to control the flow in the water supply pipes.
5. Chlorinator for liquid chlorination(Disinfection of water supply)
6. Water meter at the main line for flow measurement
7. Consumer water meters at the final delivery branches representing consumer flow metering
8. Return line reresenting used water and need for wastewater handling

Ground Water: AQUIFER

- Aquifers are layers of rock and soil with water flowing through their small pores.
- For the most part, there are not giant caves under earth's surface containing violent rivers of water flowing quickly through them.
- Instead, groundwater drips slowly and gently through the small spaces within rocks, between rocks, and between loose materials such as sand and gravel.
- A good aquifer for the installation of a well-screen is a permeable layer below the groundwater table.
- During drilling you may come across different aquifers at different depths, separated by impermeable layers.
- When water is pumped from a well, the water table is generally lowered into a cone of depression at the well. Groundwater normally flows down the slope of the water table towards the well.



Turbine pump, motor and discharge pipe



PRESSURE RECORDING

- What is meant by the accuracy class of a pressure gauge?
- On the dial of a pressure gauge we always find an indication of the accuracy class.
- The accuracy class of a pressure gauge defines the permissible deviation of the display in percent of the full scale value.
- For plastic cases, this is 4 % or 2.5 %, whereas for chrome steel or stainless steel instruments it is 1.6 % or 1.0 %.
- For test gauges, the accuracy class is 0.6 %, 0.25 % or even 0.1 %, depending on the display range used. What does this mean in practice? With a measuring range of 0 to 100 bar and an accuracy class of 1.0 %, the permissible deviation is 1 bar over the entire measuring range.

Sluice and check valves

- **Gate valves** control water flow by sliding the metal gate up or down.

i. **These are on off valves.**

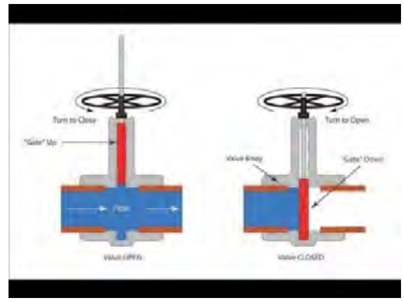
ii. Gate valves **should never be used to reduce the flow of water;** Using them to adjust water flow can wear them out.

iii. **Has allowable leakage rate**

iv. **Pressure loss is minimum**

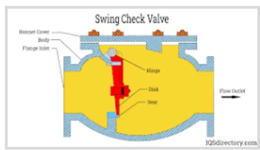
v. Metal seated gate **valves have a pocket** between the seats to enable the wear travel

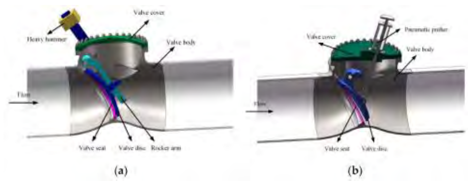
vi. **Erosion& chattering**



- **Check valves:**

i. **To ensure the unidirectional flow. It prevents backward flow. The swing check valve has a disc in it which opens on forward water thrust and closes during backward flow**





Butterfly

- Butterfly valve is a shut-off valve. It is also used for regulating flow.
- Quarter turn valve: Basically, the disk is operable up to 90 degrees and that's why it is called a quarter-turn valve.
- The disc can interrupt flow even when it is open
- Not recommended for high differential pressures
- Pressure drop is an important parameter when sizing the valve.
- Low maintenance
- Simple, rapid operation

DIFFERENT PIPE MATERIALS USED BY WASA

Pipe material already used in WASA Lahore

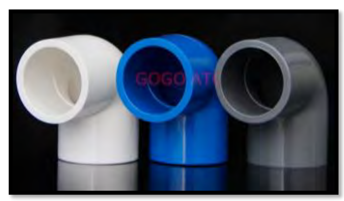
Pipe material	Approximate % of total length of existing water supply Pipe	Standard for Pipe	Standard for fittings
AC **Field pressure testing**	71	ISO 160:1980 ISO 4483	ISO 160:1980
DI	1.0	ISO-2531	ISO-2531
CI	10	ASTM A74-21	ASTM A74-21
MS	6.0	BS EN 10255:2004	BS EN 10255:2004
PVC	1.0	BS 3505,ISO 1452	BS 3505,ISO 1452
HDPE	12	ISO-4427	ISO-4427

Pipe material now being used in WASA Lahore

Pipe material	Standard for Pipe	Standard for fittings
HDPE	**ISO-4427**	**ISO-4427**

PE-100 PIPE DIMENSIONS CONFIRMING TO ISO 4427 & DIN 8074				
Outer Diameter	**SDR-21**	**SDR-17**	**SDR-11**	**SDR-9**
	PN-8	PN-10	PN-16	PN-20
	WALL THICKNESS			
mm	mm	mm	mm	mm
110	5.3	6.6	10	12.3
125	6	7.4	11.4	14

JOINTS & FITTINGS



Compression Coupling

Compression Coupling: Regular coupling which is provided between pipes and prevents the leakage through gaskets or rubber seals.

JOINTS & FITTINGS

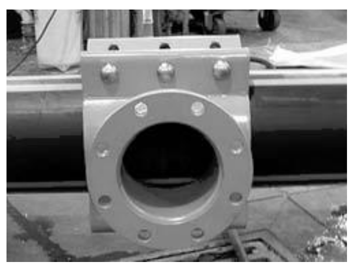
- Concentric Reducer: A cone shaped with gradual decreasing around the pipe but air may accumulate resulting in cavitation.
- Eccentric Reducer: One edge is parallel to the connecting pipe due to which air accumulation is not possible.
- Tee : This is T shaped fitting with one inlet and two outlets. Outlets are arranged at 90 degrees to the inlet. It can combine flow from two inlets to one outlet. If 3 sides are same in size, called at equal tee, otherwise its called as unequal tee.
- Union: Functions similar to coupling but coupling can not be removed after fixing. Union consists of male nut and female ended threads so it can be removed easily.
- Adapter: Used to connect pipes that do not have special ends. The adapters make them threaded either male or female. They are generally used for copper and PVC pipes. One end of adapter is plain which is welded or glued to plain end of pipe.
- Cap: It has the same function as the Plug but the difference is, plug contains male threads and cap contains female threads. Available in rubber, copper, steel, plastic.






Mechanical saddles

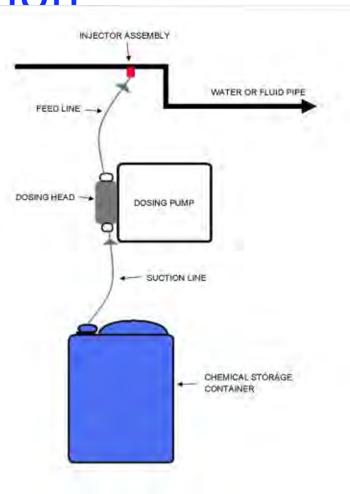
- Back-up ring materials are steel, primer coated steel, epoxy coated steel, or stainless steel. Ductile iron and fiberglass back-up ring materials are also available.
- Without a back-up ring, a PE flange will leak between the bolts.
- A flange gasket may not be required between PE flanges. Gaskets may be needed for higher pressures and for connections between PE and non-PE flanges.
- If used, gasket materials should be chemically and thermally compatible with the internal fluid and the external environment, and should be of appropriate hardness, thickness and style.



Mechanical Flange Adapter

Chlorination/Disinfection

- Disinfection is used in water treatment to reduce pathogens to an acceptable level.
- Disinfection must be capable of destroying all pathogens (Bacteria, Viruses, Protozoa).
- *WHO recommends that a minimum residual chlorine concentration of 0.2 mg/L is maintained to the point of delivery to the consumer.*
- *For effective disinfection, the WHO recommends at least 30 minutes contact time, where the residual chlorine concentration is ≥0.5 mg/L and the pH of the water is <pH 8.*
- Hypo chlorinator doses liquid chlorine. WASA uses hypochlorite solution having about 18% chlorine concentration.
- Chlorinator dose(mg/l) is set according to flow of the tube well. Lesser capacity Tube well flow needs lesser dose and more capacity more dose.



MAIN CATEGORIES OF BULK FLOW METERS

Mechanical flow meters;

- **Woltmann,**
- **Paddle wheel & Propeller.**

Electronic flow meters;

- **Electromagnetic**
- **Ultrasonic**

❖ Static or Electronic flow meters

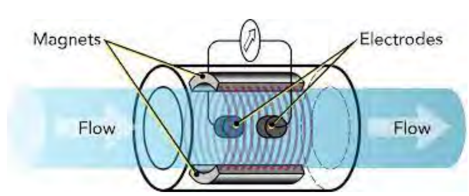
- ❖ No moving parts
- ❖ more accuracy than mechanical meters if used in favorable conditions
- TYPES
- ❖ Ultrasonic
- ❖ Electromagnetic

❖ Mechanical flow meters

- Performance is significantly affected with the velocity profile therefore, use of tranquilizing lengths of pipe upstream of the meter is often necessary.
- Low sensitivity for low flow rates.

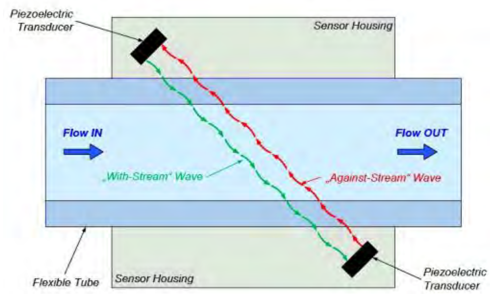
Electromagnetic Flow Meters

- The operation of electromagnetic meters is based in Faraday's induction law.
- This law states that a voltage (*E*) appears between the ends of any conductor passing through a magnetic field.
- The flow of the fluid creates an induced voltage which is proportional to the flow velocity
- **Air and sand with almost no conductivity will not present a problem,** and the velocity of water will be used to calculate the flowrate.
- if the concentration of the ions is high(brackish), the meter will be inferring that everything flowing through the meter is water, and consequently the error will be considerable.
- The diameter of the electromagnetic meter must allow a velocity ranging from 1 to 5 m/s in normal operating conditions.



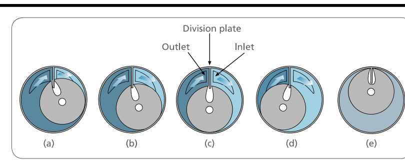
ULTRASONIC FLOW METERS

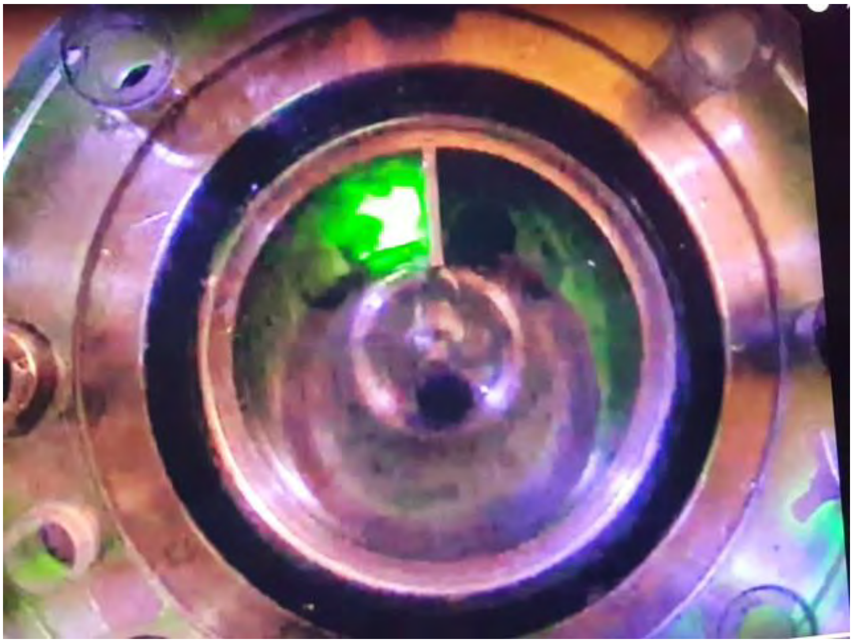
- Two types based on sound waves (1)Transit time (2)Doppler.
- Flow meter uses two ceramic piezoelectric transducers that can work both as emitters and receivers of sound waves.
- Ultrasonic signals (sound waves) moving in the direction of flow require less time to travel between the two transducers as compared to signals moving against the flow.
- The velocity of the fluid will be obtainable simply from the difference in transit times.
- Ultrasonic flow meters are designed to measure flow rate in pipes completely full of water.
- Air at the top of the pipe or sediments resting at the bottom can cause deviations in the assumed cross sectional area.
- Additionally, air in the water can disrupt the transducer signal and give inaccurate readings.



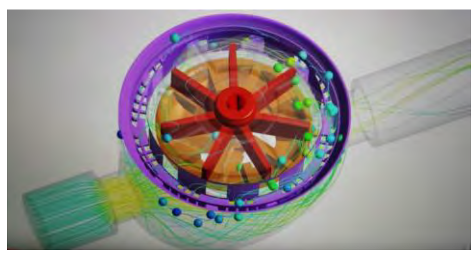
Rotary Piston consumer water meter

- **Piston glides in a circulation motion**
- **A known volume of water passes through the meter at each stroke or oscillation of a piston.** PD meters calculate the volume of water consumed by counting the number of reciprocations or revolutions of the piston.
- These are sensitive to **sand or other suspended solids in the water** that can get stuck between the piston and chamber wall, jamming the meter.
- **Thus it is important that these meters should only be installed in systems with very good water quality, and they should always be provided with built-in strainers.**
- These meters are very sensitive to low flows and are especially suitable for applications where low flow rates or on-site leakage frequently occur, such as domestic consumers.





MULTIJET CONSUMER WATER METERS



- The water is channeled through *multiple* jets over a radial-vane impeller placed inside the body of the meter.
- Impeller rate of rotation is proportional to the flow velocity of the water, or in other words, to the circulating flowrate.

mWater Application

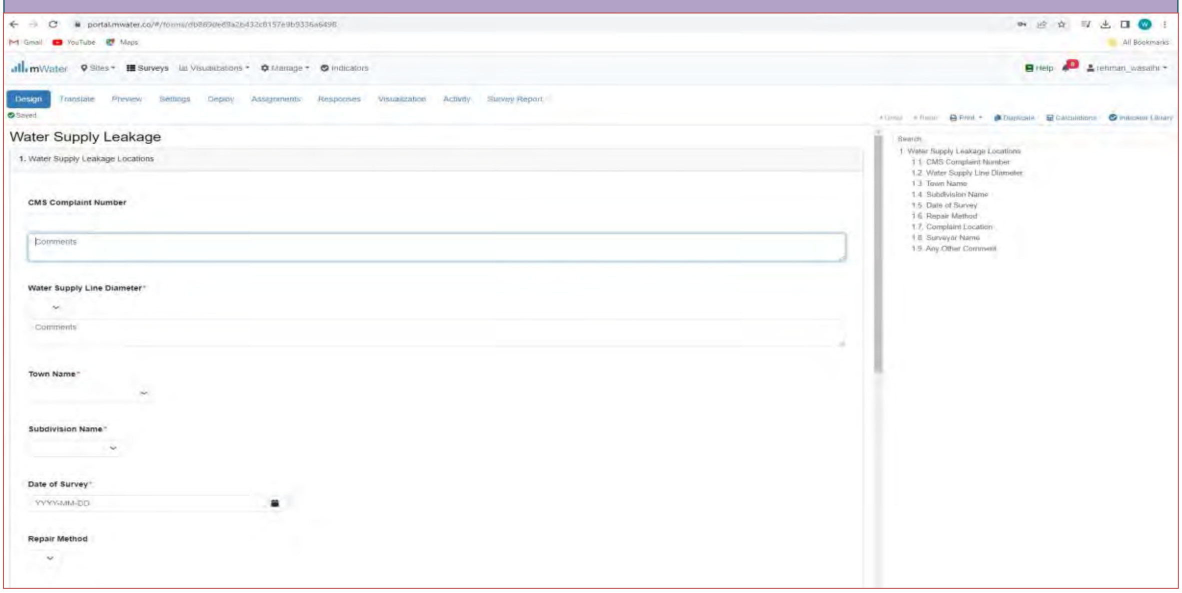
mWater application is used to collect field data regarding water and Sanitation worldwide. It is an open source tool. There are two parts of this application:

i. Web Portal (for form generation, deployment and data visualization)

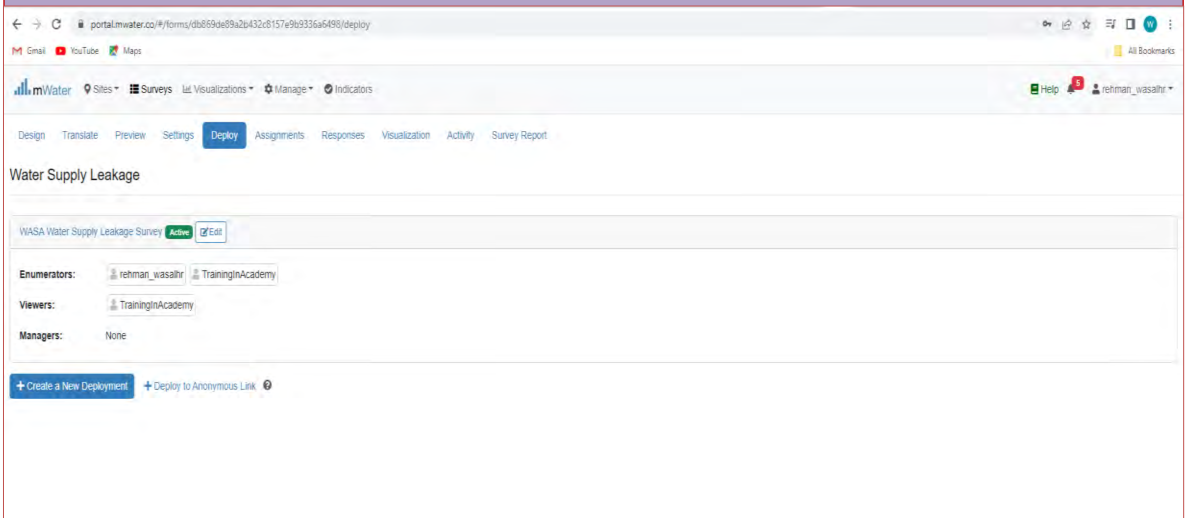
ii. Mobile Application for Field survey by using the given forms

https://portal.mwater.co/#/resource_center/about_mwater

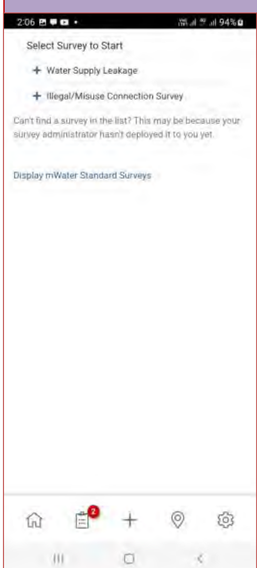
WATER SUPPLY LEAKAGE SURVEY THROUGH mWATER APPLICATION

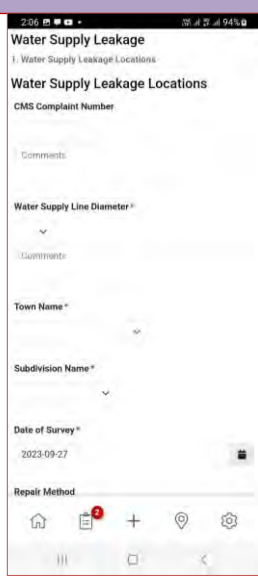


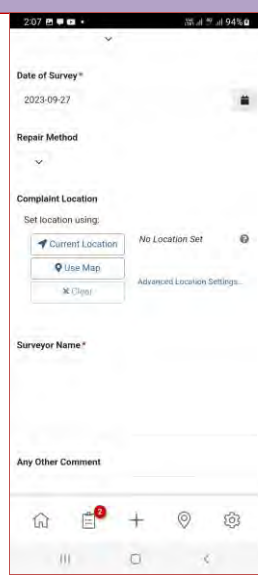
SURVEY DEPLOYMENT

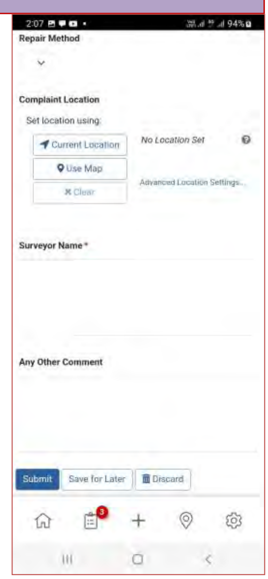


SURVEY APPLICATION ON MOBILE









HYDRAULIC PRESSURE TESTING OF LAID WATER SUPPLY LINES AS PER AWWA – C605-94

HYDRAULIC TEST OF LAID WATER SUPPLY LINES

- Leakage test of laid water supply lines is performed as per AWWA standards. Average test pressure is usually 1.5 times the working pressure of pipe. For example, a pipe which has a working pressure of 25 psi, the test pressure will be approx. 40 psi. Testing is usually carried out upon lengths of pipe not exceeding 1000 ft (300m).
- Leakage is defined as the volume of water that is pumped into the pipeline to maintain pressure within ± 5 psi of the test pressure after it is filled and purged of air, for a duration of 2 hours.
- It is an important test to check the leakage of laid pipes, joints and fittings under a specified pressure. It is performed before backfilling of trenches.

HYDRAULIC TEST OF LAID WATER SUPPLY & SEWER LINES

- The water supply line to be tested should be isolated from the distribution system by using valves.
- The pipe line should be properly filled, flushed, and purged of all air before filling it with water.
- The specified test pressure shall be applied by means of an approved pumping assembly connected to the pipe.
- The test pressure shall not exceed pipe or thrust-restraint design pressures.
- The test pressure shall be maintained for the specified time during which the system and all exposed pipe, fittings, valves, and hydrants shall be carefully examined for leakage.

HYDRAULIC TEST OF LAID WATER SUPPLY & SEWER LINES

- Test pressure: 150% of working pressure at point of test, but not less than 125% of normal working pressure at highest elevation. Time duration of the test shall be 2 hours.
- No installation will be accepted if the leakage is greater than that determined by the formula:

$$L = \frac{ND\sqrt{P}}{7{,}400}$$

Where:

L	=	allowable leakage, in gallons per hour
N	=	number of joints in the length of pipeline tested
D	=	nominal diameter of the pipe, in inches
P	=	average test pressure during the leakage test, in pounds per square inch (gauge)

- So, allowable leakage mainly depends upon the diameter of pipe.

HYDRAULIC TEST OF SEWER LINES

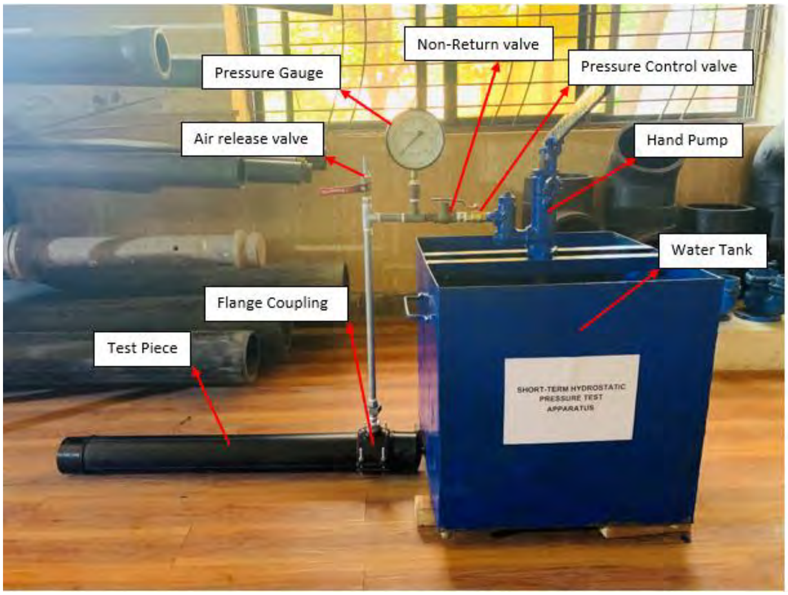



FIELD LEAKAGE OF WATER SUPPLY LINES IN THE DISTRIBUTION SYSTEM






ARRANGEMENT OF HYDROSTATIC PRESSURE TESTING OF HDPE PIPE IN TRAINING CENTER



TEST PROCEDURE FOR HYDRAULIC TEST AT TRAINING CENTER

Test procedure:

1. Fill the water tank with a specific volume of clean water at ambient temperature.
2. Before fixation/ installation of the test piece, hand-pump the water to check if the pumping arrangement is working properly.
3. Check all the valves and fittings for any leakage before starting the test.
4. Take a test piece of HDPE pipe.
5. Check the test piece to be empty of any foreign/ unwanted materials. End caps are butt/ fusion welded at the ends of test piece by butt fusion machine.
6. Make a small hole in the test piece through which test liquid (water) will go into the test piece. Attach/ fix the flange coupling at the test piece by means of nuts & bolts.

HYDRAULIC TEST OF LAID WATER SUPPLY & SEWER LINES

Test procedure (continued):

7. Make sure that needle of pressure gauge is at zero. Start the hand pump slowly and continuously increase the pressure. Open the air release valve to allow the entrapped air to escape.
8. Keep the test piece at test pressure for 4 hours and allow the pipe to expand, pump the small amount of water if the pressure drops upto 5% of the test pressure.
9. Again, keep the test piece under pressure for 4 hours to determine if there is any leakage, crack, yielding or breakage.
10. Release the water pressure after 8 hours and remove the test piece.

Annex 5.2.17 Training Material for "Leakage Control, Plumbing and Pipe Replacement Plan" at WASA Lahore

Plumbing(Distribution pipe), JOINTS AND PRESSURE TEST

Existing XEN, SDOs, S/E

1

DIFFERENT PIPE MATERIALS USED BY WASA

2

Pipe material already used in WASA Lahore

Pipe material	Approximate % of total length of existing water supply Pipe	Standard for Pipe	Standard for fittings
AC **Field pressure testing**	71	ISO 160:1980 ISO 4483	ISO 160:1980
DI	1.0	ISO-2531	ISO-2531
CI	10	ASTM A74-21	ASTM A74-21
MS	6.0	BS EN 10255:2004	BS EN 10255:2004
PVC	1.0	BS 3505,ISO 1452	BS 3505,ISO 1452
HDPE	12	ISO-4427	ISO-4427

3

Pipe material now being used in WASA Lahore

Pipe material	Standard for Pipe	Standard for fittings	Manufacturer name and address
HDPE	**ISO-4427**	**ISO-4427**	**1. M/s Dadex Eternit Limited** **Address: 34-A/1, Block 6, PECHS, Shahrah-e-Faisal, Karachi, Pakistan.** **http://www.dadex,com**
			2. M/s BBJ Pipe Industries (PVT) LTD **Address: BBJ House, 40 Abbot Road, Lahore, Pakistan. https://www.bbj.com.pk**
			3. M/s Jamal PVC (PVT) LTD **Address: 88 Raiwind Road, Lahore, Pakistan. https://jamalpipe.com.pk/**
			4. M/s Alpha Pipe Industries LTD **Address: Office 206-07, 2nd Floor, Amin Manison, GT Road, Peshawar.**

4

History of HDPE Pipe

- Polyethylene (PE) pipe was first used as pressure pipe in the US in the 1950s. These first materials were high density polyethylenes (HDPEs), which were prone to stress cracking and had poor resistance to rapid crack propagation (RCP).
- It was improved with the passage of time.
- **PE100 is the third generation of pipe grade PE**.
  It has an optimum balance of three key properties:
- ✓ **Minimum Required Strength (MRS)** – this provides long-term strength and creep resistance.
- ✓ **Stress crack resistance** (sometimes referred to as slow crack growth resistance).
- ✓ **Rapid crack** propagation resistance.
- HDPE PE100 pipe is easy to install, light, flexible, corrosion-free and has a service life of up to 100 years. It can be jointed using butt fusion or electrofusion to create a leak-free pressure network for gas or water.
- For the trenchless applications butt fusion is most widely used because this results in a smooth exterior profile with no protrusions that might cause difficulties in pulling the pipe into the ground or host pipe.

HDPE PE100 Pipe Types

- **PE100 RC:** RC indicates resistance to cracking.
- **PE100 RT:** RT indicates resistance to temperature.
- **Barrier PE Pipe:** Certain gases and liquids can permeate through PE.

5

Major specifications of PE-100 covered in ISO-4427

S.NO	Characteristics	Requirement
1	Minimum Required Strength (MRS)	10 mpa
2	Hydrostatic Design Basis (HDB) Pressure	1600 psi (11 MPa)
3	Allowable Compressive Strength	7.93 MPa
4	Tensile Strength at Yield	23mpa
5	Density (Compound)	959 kg/m3
6	Modulus of Elasticity (50 years):	200mpa
7	Elongation at break	> 600%
8	Flexural Modulus	1000 Mpa
9	Poisson’s Ratio	0.45
10	Thermal Expansion Co-efficient	1.3 x 10-4 ° C-1

6

ISO grades of HDPE pipe

- Polyethylene is available in various classes and is frequently specified with a number indicating the minimum tensile strength of the material in N/mm^2(MPA) at 20° C over 50 years:
- PE40 means 4 MPA strength
- PE63 means 6.3 MPA strength
- PE80 means 8 MPA strength
- PE100 means 10MPA strength(It is 3rd generation pipe)

7

SDR and MOP calculation

- **SDR pipe : "Standard Dimensional Ratio"**
- The **SDR pipe** is the "**Standard Dimensional Ratio**" and refers to the geometry of the pipe. **SDR** is defined as the **ratio of the nominal outside diameter to the nominal wall thickness**.
- **SDR = dn/en**
- Where **dn** is the nominal outside diameter of the pipe and **en** is the nominal (minimum) wall thickness of the pipe. Therefore a higher SDR indicates a thinner-walled pipe at any given diameter.
- **MOP = 20 MRS / C (SDR - 1)**
- **Example : What is the MOP or pressure rating of an SDR 17 PE100 water pipe?**
- For PE100 the MRS = 10 MPa. For water applications the minimum recommended service design coefficient 'C' is 1.25.
- **Maximum operating pressure (MOP) = 20 * 10 / 1.25 (17 - 1)**
- MOP = 10 bar
- Similarly if SDR is 21 its Maximum operating pressure will be=20*10/1.25(21-1)=**8 bar**

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PE-100 PIPE DIMENSIONS WITH DIFFERENT SDRs

PE-100 PIPE DIMENSIONS CONFIRMING TO ISO 4427 & DIN 8074				
Outer Diameter	**SDR-21**	**SDR-17**	**SDR-11**	**SDR-9**
	PN-8	PN-10	PN-16	PN-20
	WALL THICKNESS			
mm	mm	mm	mm	mm
110	5.3	6.6	10	12.3
125	6	7.4	11.4	14

Less SDR means more wall thickness

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JOINTS & FITTINGS

Compression Coupling

Compression Coupling: Regular coupling which is provided between pipes and prevents the leakage through gaskets or rubber seals.

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JOINTS & FITTINGS

- **Concentric Reducer:** A cone shaped with gradual decreasing around the pipe but air may accumulate resulting in cavitation.
- **Eccentric Reducer:** One edge is parallel to the connecting pipe due to which air accumulation is not possible.
- **Tee** : This is T shaped fitting with one inlet and two outlets. Outlets are arranged at 90 degrees to the inlet. It can combine flow from two inlets to one outlet. If 3 sides are same in size, called at equal tee, otherwise its called as unequal tee.
- **Union**: Functions similar to coupling but coupling can not be removed after fixing. Union consists of male nut and female ended threads so it can be removed easily.
- **Adapter:** Used to connect pipes that do not have special ends. The adapters make them threaded either male or female. They are generally used for copper and PVC pipes. One end of adapter is plain which is welded or glued to plain end of pipe.
- **Cap:** It has the same function as the Plug but the difference is, plug contains male threads and cap contains female threads. Available in rubber, copper, steel, plastic.






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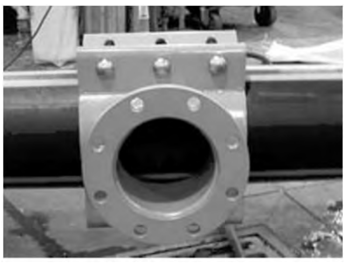
- Back-up ring materials are steel, primer coated steel, epoxy coated steel, or stainless steel. Ductile iron and fiberglass back-up ring materials are also available.
- Without a back-up ring, a PE flange will leak between the bolts.
- A flange gasket may not be required between PE flanges. Gaskets may be needed for higher pressures and for connections between PE and non-PE flanges.
- If used, gasket materials should be chemically and thermally compatible with the internal fluid and the external environment, and should be of appropriate hardness, thickness and style.

Mechanical saddles



Mechanical Flange Adapter

12

Common Valves Used In WASA Lahore

Air and check Valves

Butterfly Valves

Gate Valves

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Valves Standards

Type of valves	Standard for valves used in WASA	Remarks
Gate valves	**BS EN-1074**	Used for isolation only.
Check Valves	**BSEN 1563**	Used to prevent reverse flow (non-return).
Butterfly valves	**ISO 10631, BS 5155, EN-593,**	Used for isolation as well as throttling.
Air valves	**ISO 4126-1, EN-1074**	Used to release the air entrapped in the pipelines.

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COMMON FLANGE STANDARDS APPLIED IN WASA TO CONNECT VALVES AND FITTINGS

Flanges may be of:
1 ASME-ANSI B16.5
2 OR EN 1092
3 OR BS standard BS-10

EN Flanges

❖**Flat facing (FF)** Mainly used at connection to cast iron equipment, valves and specialties.
❖**Raised facing (RF)** These pipe flanges are the most commonly used flanges.
❖**Ring type joint (RTJ)** These are most reliable type of flanges but are costlier than the other Types. Used in high pressure (Class 600 and higher rating) and/or high temperature services

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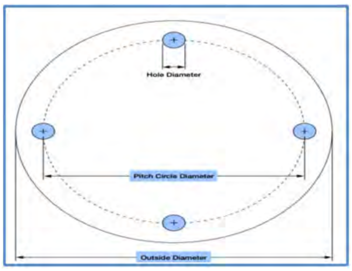
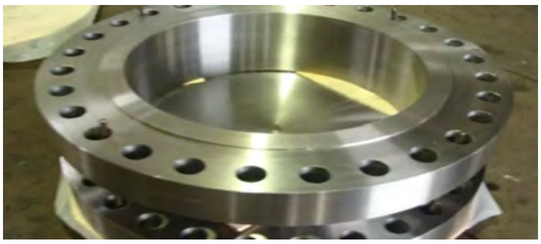
COMPARISON OF 600 mm FLANGE STANDARDS

Standard	Class	Flange Dia	Bolt Hole Dia	Flange Thickness	N0.of Bolts
ASME B16.5	150	813	35	48	20
	300	914	41	70	24
EN 1092 Old BS 4504	10	780		42	20
	16	840	36	54	20
BS 10	E	826	32	38	16
	F	851		41	24





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Annex 5.2.18 Training Material for "Construction management for Pipe installation" at WASA Lahore

CONSTRUCTION MANAGEMENT FOR PIPE INSTALLATION

Construction Management

In order to ensure proper performance of the contract, inspection alone may not be sufficient to ensure quality assurance. The purpose of construction management is to secure high-quality construction objects by having the *supervisor* (& contractor) check the process, materials, and construction status at the place of performance.

contents

Captor-1: Role of supervisor

1-1. Important role of supervisor as well as contractor

How to protect your workers and third party persons?

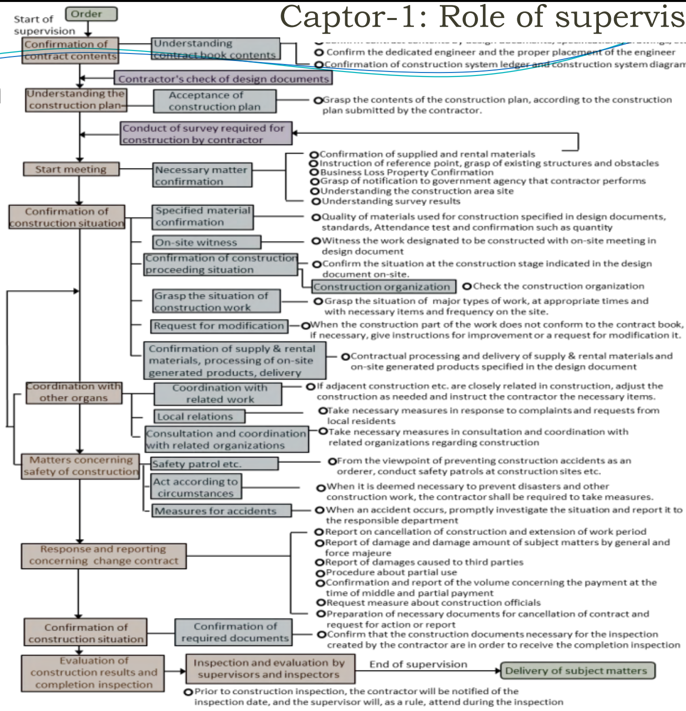
How to prevent leakage?

How to expand life span?

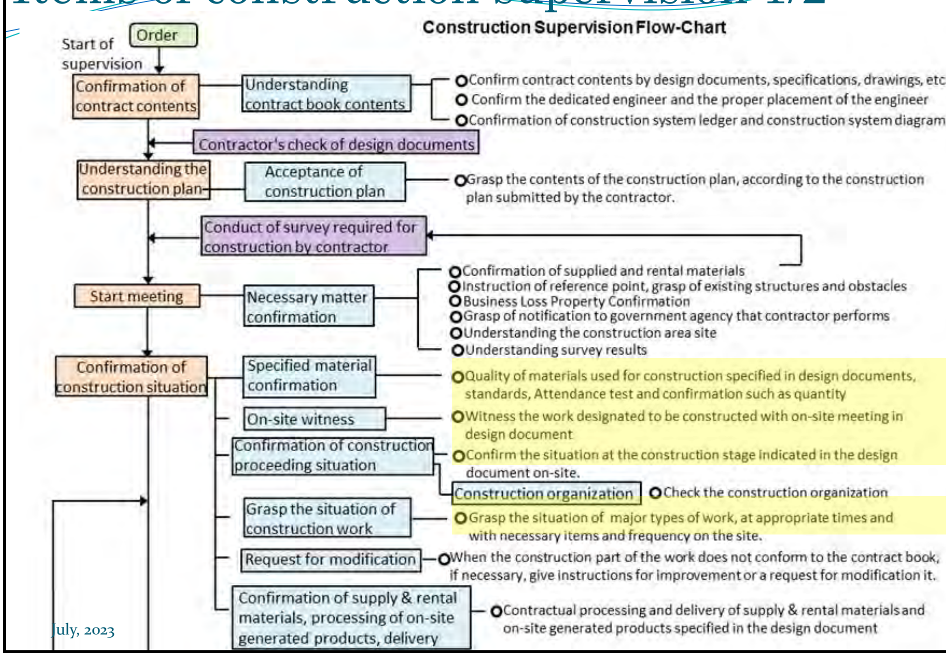
Construction management

- 1. Safety issues
- 2. Quality management

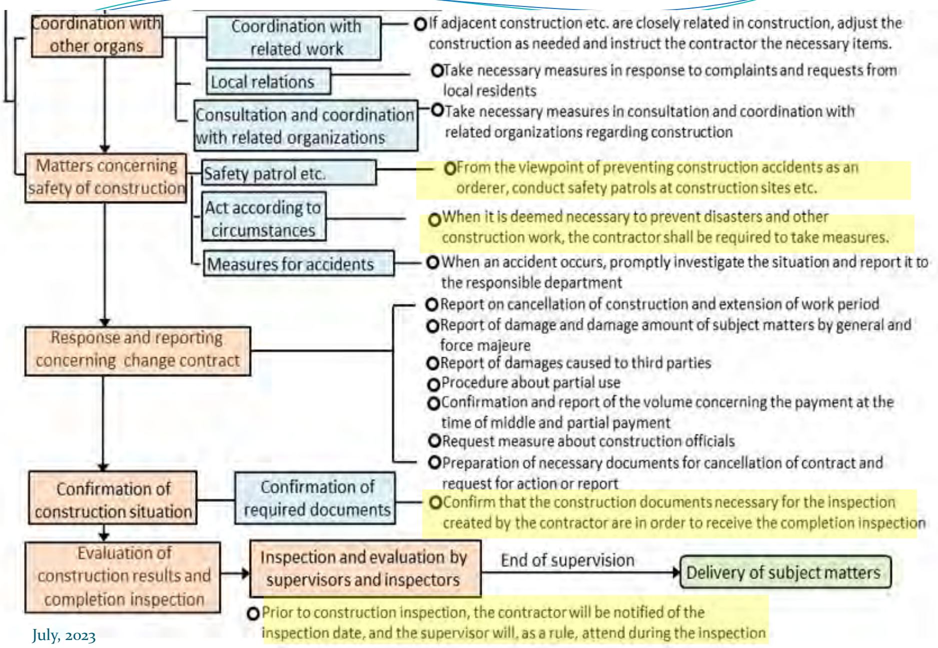
Items of construction supervision



Items of construction supervision 1/2



Items of construction supervision 2/2



Captor-2: Safety management

- 2-1. Improvement of safety awareness
  - Safety education against accidents:
    Safety is No.1 priority
- 2-2 Confirmation of the obstacle matters
- 2-3 Separation of working area (to avoid third party accidents):
- 2-4 Public announcement (Customer satisfaction) :

What are the problems caused by poor construction management?

1. **Personal injury**
   1. Pedestrian
   2. Vehicles
   3. Workers & Operator
2. **Leakage**
   1. Pipes
   2. Fittings : Valve, Fire hydrant, Air valve
   3. Reservoirs, Water tanks
3. **Shorter life span**
   1. Pipelines
   2. Fittings
   3. Concrete facilities, Electric facilities, etc.

Affect to ・・・・

- Accidental injuries and deaths make people unhappy
- lose money
- Lose customer trust
- NRW increases (NRW ratio is going up)
- Income decreases
- Lack of proper maintenance
  - Cause accident
  - Cause inconvenience
- Inability to future plan

Fall into a negative spiral

2-1 Improve safety awareness

Safety Education & Safety Meeting

Contractor, subcontractor workers and third party against accidents

Safety meeting on site

Safety meeting before working, Individual safety equipment inspection

2-1 Improvement safety awareness: 2/2

Self protection

- Helmet

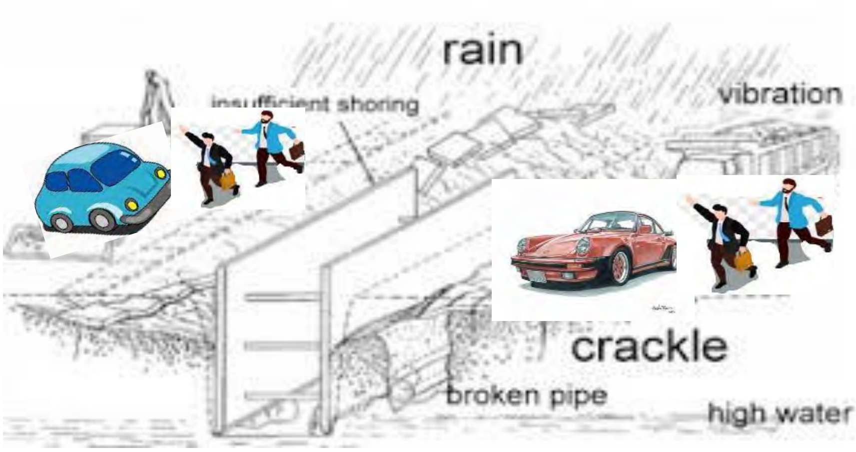

- Long shoes


- Safety shoes


- Safety belt

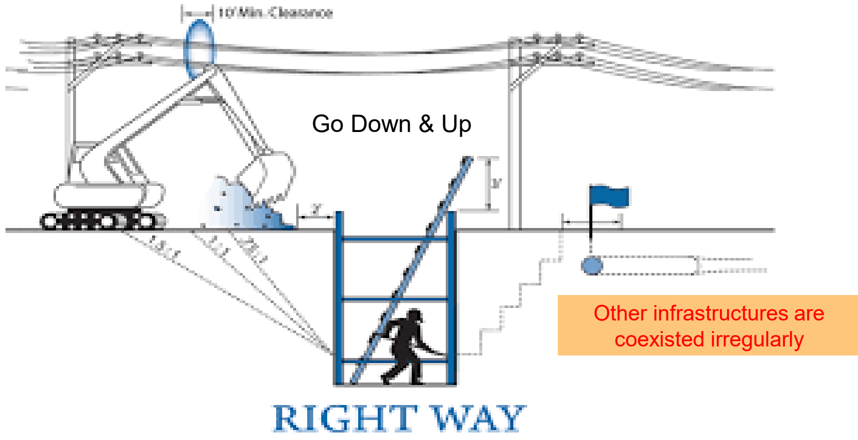

2-2. Confirmation of the obstacle matters: 1/3

Pedestrians, Vehicles, Rain, Vibration, High ground water, Other infrastructure pipe & cable



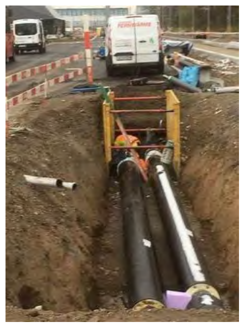
2-2 Confirmation of the obstacle matters :2/3

Cables in the air, Excavated earth wall, Heavy vehicle , Other infrastructure pipes/cables



- 2-3 Separation of construction site

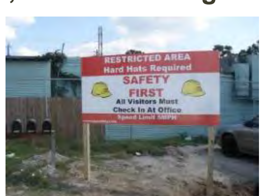
Protect workers and third party against accidents



2-3 Separation of construction site

Protect workers and third party against accidents:

- Caution sign
  - Color corn, Fence net, Barricade, Rope
  - **Construction sign bords, Traffic detour guidance, Traffic controller**



- 2-4 Public announcement (Customer satisfaction & prevention of accidents)

News of the water service

To residents.
Construction No.201

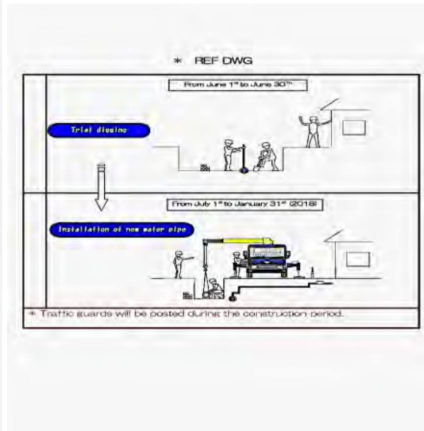
We are installing earthquake-proof water pipes due to the construction of MICE facility

Although some inconveniences may be caused to the residents during the period below, we will make efforts to complete it sooner and safely.

*Please refer to the reverse side

Construction name	MM21Diameter 600mm water pipe replacement
Construction site	1-1 Minatomirai, Nishi-ku
Construction period	April 11, 2017~March 7, 2018
Construction hours	Daytime 9:00AM~5:00PM Night time 9:00PM~6:00AM
contractor	Toshida construction Co., Ltd. TEL 045-981-1138 Person in charge : Takashi Oota TEL090-1434-8744 FAX045-981-0630 ※ Please contact us if you have any questions.
Orderer, client	Sothern Construction Division, Water Distribution Department, Yokohama Waterworks Bureau TEL 045-252-7094 Supervisor Jun Oono FAX 045-241-1070

Location Map



3. Construction Quality management

- 3-1. Material & Tools
- 3-2. Construction Technology, knowledge
- 3-3. Drawings

3-1. Material & Tools

- Confirm by supervisor, site agent

◆Material
- Standards specified in the construction documents
- Standards approved by accreditation bodies
- Quantity
- Judgment based on tests and test results for items that require compounding

◆Tools: Improper use of appropriate equipment may affect quality or cause accidents.
- Specified equipment
- Maintenance status
- Proper usage
- Qualified Operator

MATERIAL INSPECTION & TOOLS

Specification

Butt fusion machine

3-2. Construction Technology/Knowledge

- On-site observation, Picture & Document confirmation by supervisor

- In order to maintain the quality of the deliverables, It needs checking step by step of the construction stages.
- Especially for water supply facilities, it is difficult to confirm at the final inspection because the facility is buried underground, so this kind of confirmation is important.
- Mostly confirmation curried by the picture management.

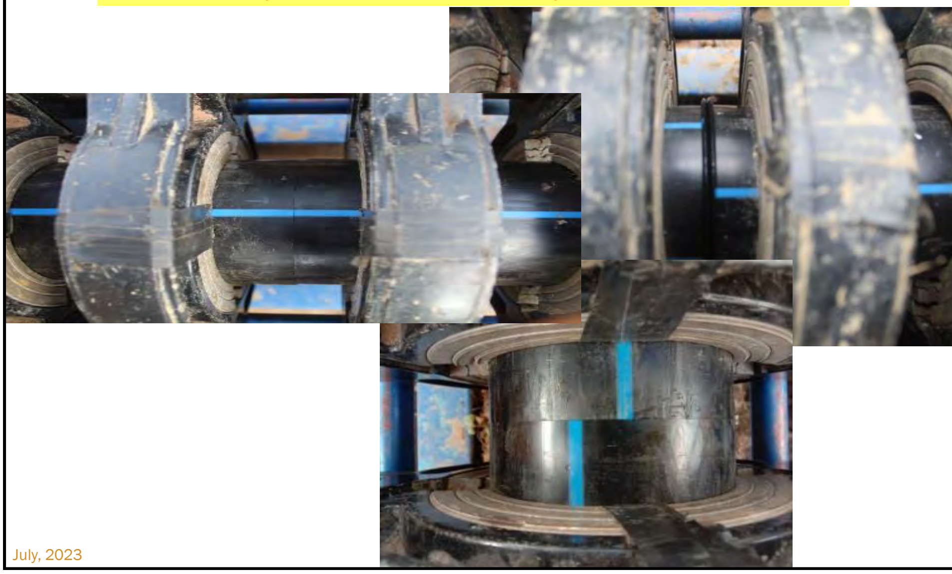
- Sample pictures were taken for “Construction daily report”

EXCAVATION WORK
MEASUREMENT OF DEPS OF TRENCH BED

Check Depth, Width using measure

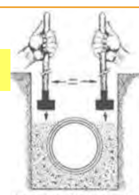
PE PIPE CONNECTION :BUTTE FUSION

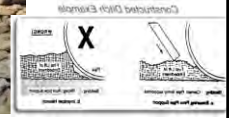
Check Pipe surface flatness, Temperature, Bead size.



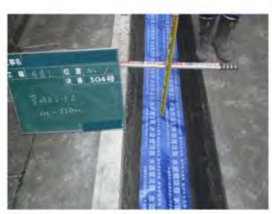
PIPE LYING WORK

Check Pipe depth, Backfill thickness, Back fill material





indication sheet or tape:



BACK FILLING WORK

Compacting with appropriate equipment, Rammer, Engine compactor.

Back filling and compaction should be done by each layers. (t=300mm approx.)

CONSTRUCTION OF VALVE CHAMBER/MANHOLE

Check Material, Measure geometry of chamber etc.

MEASUREMENT OF CONCRETE THRUST BLOCK

Check Material, Measure geometry of chamber etc.

MEASUREMENT OF CONCRETE THRUST BLOCK

- Thrust Block for pipe bend

Dimension of the thrust block should be done strictly by technical specifications

FIRE HYDRANT INSTALLATION

Check Material, Measure geometry of concrete block.

CLEAR AFTER WORKS

Check Road surface compaction, clear dust/stones/extra mud .

PRESSURE TEST

Ensure the specified water pressure

Check water residual chlorine

SAMPLE OF DAILY REPORT

TAKE 2-3 PHOTOS (OVERALL AND DETAIL) FOR EACH CONSTRUCTION ITEM, MEASURE DIMENSIONS AND TAKE WITH WHITEBOARD

Material Inspection
2 pictures

Material Inspection

Date ວັນທີ: 07/06/2021
Construction Site ສະຖານທີ່ກໍ່ສ້າງ: ໂຊນ C, ST 0+000-0+100
Work Type ປະເພດການກໍ່ສ້າງ:
Materials & Dimensions ວັດສະດຸ & ຂະໜາດ: HDPE DN63 x 3.8mm
Standard ມາດຕະຖານ(ຍີ່ຫໍ້): TOYO PN10Bar (PE100), 1ໂຕ້ງ=100m
Photo Description ລາຍລະອຽດຮູບຖ່າຍ:

Leveling management
2 pictures

Leveling measurement

Date ວັນທີ: 07/06/2021
Construction Site ສະຖານທີ່ກໍ່ສ້າງ: ໂຊນ C, ST 0+000-0+100
Work Type ປະເພດການກໍ່ສ້າງ:
Materials & Dimensions ວັດສະດຸ & ຂະໜາດ:
Photo Description ລາຍລະອຽດຮູບຖ່າຍ:

SAMPLE: PIPE LYING WORK CHECK SHEET

3.1. Pipe laying construction confirmation check sheet

[Construction name:]
Working day: / /
Name of person in charge:

Major items	Small item	Point to be checked	Confirmation column	
Preparatory work	Material inspection	Are the materials necessary for construction prepared without excess or deficiency?		
		Are there any scratches or dirt on the piping material?		
		Are there any malfunctions in the equipment used?		
	Morning assembly	Do all workers understand the construction content and construction scope?		
		Today's construction contents:		
Excavation work	Pavement cutting	Are the pavement cutting points marked?		
	Buried object	Have you confirmed whether there are buried objects of other companies at the drilling site?	is there	Absent
		Buried items from other companies	DN: mm	Earth cover: cm
	Excavation work	Did you dig around the buried objects?		
		Did you floor without unevenness?		
		Is the necessary excavation width and depth based on the construction standards secured?	width: cm	depth: cm
	Dewatering	Did dewatering work be carried out when water was collected in the ditch?		
Laying work	Laying	Are two points suspended with a nylon band or the like when the pipe is suspended?		
	Joining	Have you cleaned the joints so that there are no foreign objects?		
		Did you take a picture of each joint?		
		Are joints constructed according to the manual? How much the pipe outside gap?:Must<10% of pipe wall thickness for Butt Fusion Joint.	mm	
	Occupied position	Have you measured the offset and covering of the pipes?	Standard soil covering: cm	
	Soil covering	Has the necessary earth covering been secured based on the construction standards?		

Backfill	General	Did you confirm the composition of paving plate restoration?	paving
	Roadbed	Are the roadbeds free of foreign material and gravel?	
		Has the pipe circumference been compacted evenly to the bottom of the tube?	
		Did the roadbed compact under 20cm/layer without unevenness?	
		Was the pipe circumference sand backfilled based on construction standards?	
	Sub-roadbed	Was the sub-roadbed compacted under 10 cm/layer without unevenness?	
	Paving	Have you confirmed that the pavement material is free of foreign matter?	
Quality control	Water filling	Was the air exhausted sufficiently?	
	Drainage	Was the pipe washed at a sufficient flow rate?	
	Pressure test	Check that the standard is met as a result of the pressure test.	
	Water quality test	Is the water quality test conducted after drainage and does it meet the standards?	
After construction	Clean up	Did you clean the area including the work site?	
	Safety	Are there any injuries to workers?	
	Damage	Is there damage to the surrounding structure during the work?	
	Record	Did you record today's construction details below?	
Check next process	Confirmation	Have you confirmed the next construction schedule?	
	Plans	Scheduled construction:	

SERVICE PIPE CONNECTION

◆ Material

Service pipes & connections are causing a lot of leaks

Appropriate equipment, construction methods, and materials eliminate water leakage.

SERVICE PIPE CONNECTION

◆ Pipe drilling (Tapping)

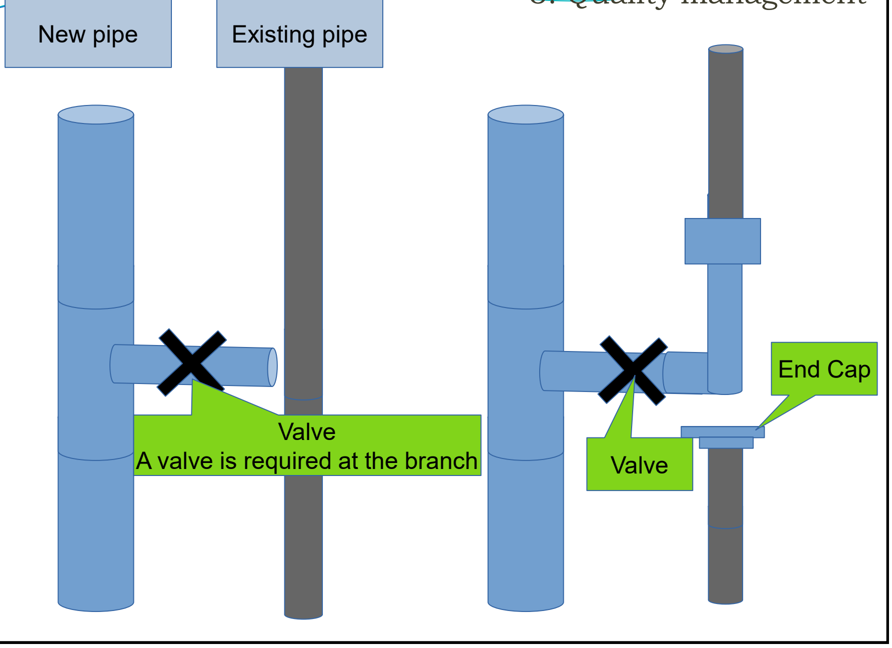
Service pipes & connections are causing a lot of leaks

What is he what is he going to do ?

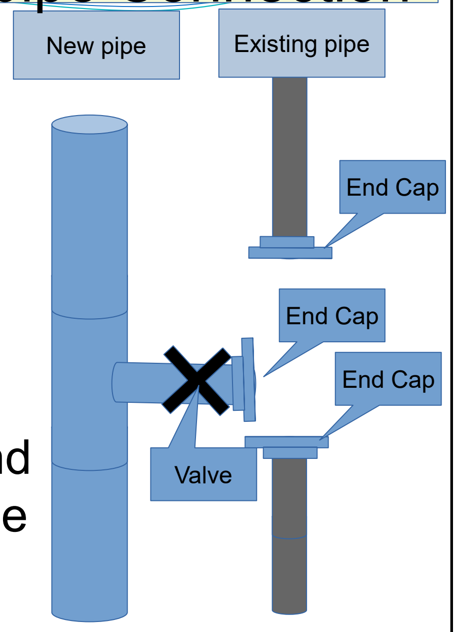
Drilling Tools: Electric & Manual

Appropriate equipment, construction methods, and materials eliminate water leakage.

New and Existing pipe Connection



New and Existing pipe Connection



Old Pipe

1.Remove
2.Concrete
3.Sandbag

If the old pipe is not blocked, earth and sand will enter and cause the road to cave in.

3-3. Drawings

COMPLETION DOCUMENTS: DRAWINGS, INSPECTION RECORD, TEST RESULT REPORT, QUANTITY/CONTENTS DOCUMENTS

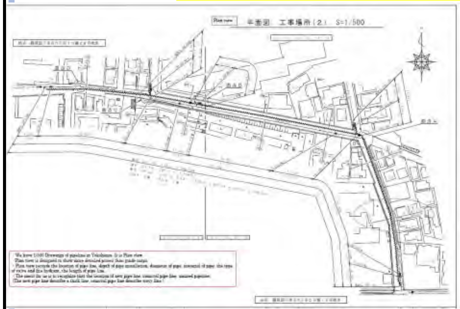
AMONG THE DOCUMENTS ACCOMPANYING THE COMPLETION OF CONSTRUCTION, **DRAWINGS** ARE IMPORTANT FOR MAINTENANCE OF FACILITIES AND CUSTOMER SERVICE.

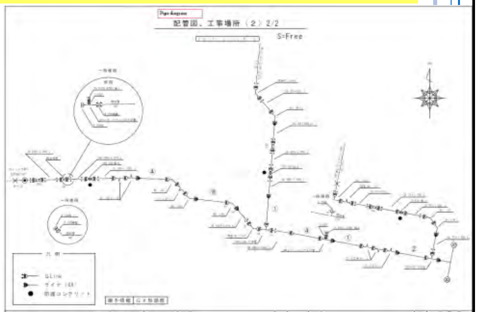
- As built drawings
- Daily reports with check sheet(log book)
- Technical standards & Specifications

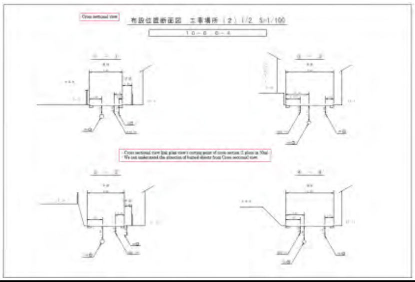
AS BUILT DRAWINGS

3. Quality management

Plain, Cross section, Pipe diagram, Off-set



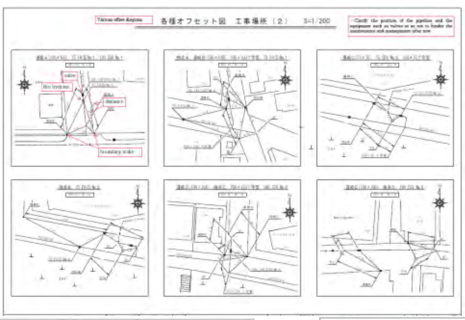


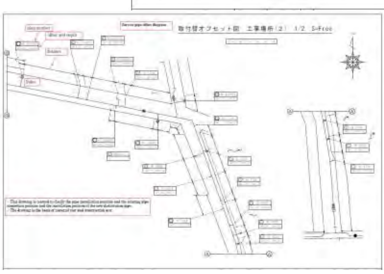


AS BULT DRAWINGS

3. Quality management

Off-set: Pipe & fitting, Design of service pipe, Material list



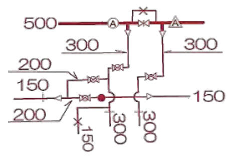


Pipe explanation of the Maps

As build drawings are the basic information necessary for mapping (GIS), pipe network calculation, and maintenance.

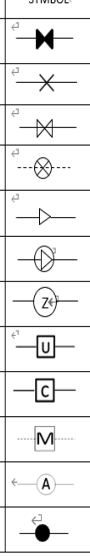
WASA-L

Yokohama



Example of Distribution Pipeline Symbols (Valves, Reducer, Hydrant, etc.)

SAMPLE: LEGEND FOR WATER DISTRIBUTION FACILITIES



S/NO	SYMBOL	DESCRIPTION
1		Permanently closed valve
2		Valve
3		Service Pipe Valve
4		Service Pipe Cock
5		Pipe size reducer
6		Pressure reducing valve
7	Z	Non Return Valve
8	U	Ultrasonic Flow Meter
9	C	Conventional Meter
10	M	Household or Commercial Water Meter
11	A	Air release valve
12		Fire Hydrant
13		Drain or Washout valve
14		Public Tap or Supply standing Tap
15		Transmission Pipe
16		Distribution Pipe
17		Service pipe
18		Branch Pipe
19		Crossing Pipe
20		Pipe end cap
21	D250, VP, Dp1. 8m, 1995	Diameter, Material, Depth, Year of Installation
22		Culvert or Sheath pipe
23		Offset of Valve, Fire hydrant, etc.
24	P	Pump
25		Valve or Meter Chamber

DESIGN CRITERIA

DESIGN CRITERIA
WASA LAHORE

WASA
LAHORE

Water Distribution System

Standards & Technical Specifications of Rwanda (WASA -L)

Thank you for your time and attention.

Let tell the WASA staff what you have learned and teach them how to make good products through safe construction works!

Annex 5.2.19 Training Material for "Utilization of mWater app and Web Portal for field data collection" at WASA Lahore

Utilization of mWater app & GIS for field data collection

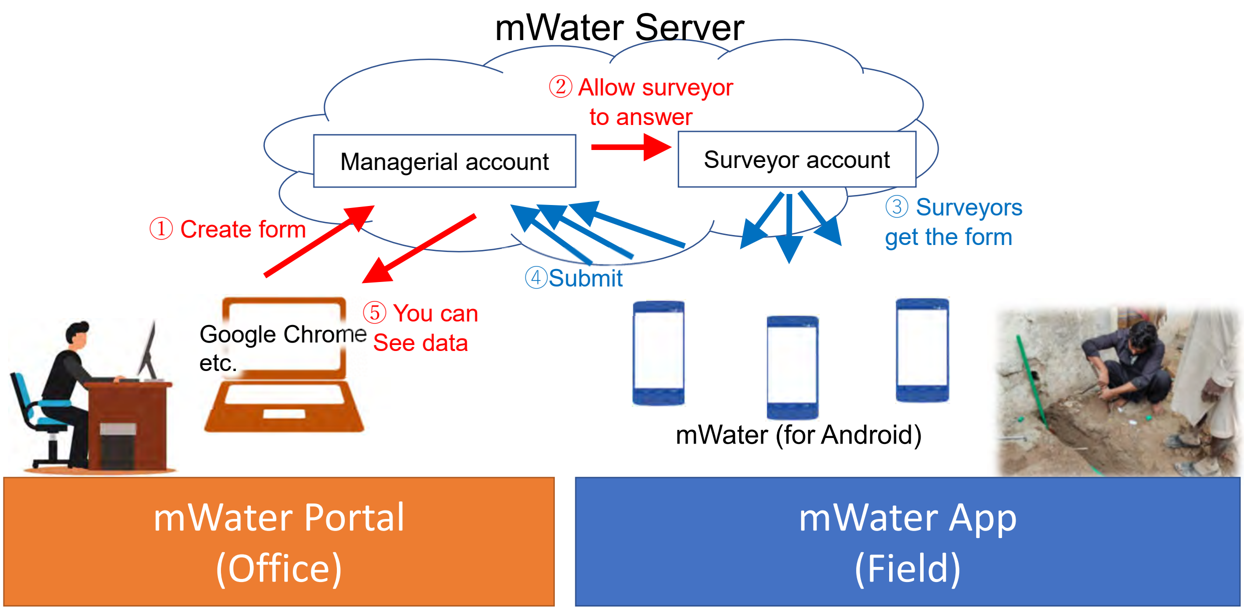
Utilization of mWater app and Web Portal for field data collection

1

What is mWater?

2

Data Collection and transmission from the field to office



3

mWater App

(for Android)

4

mWater App

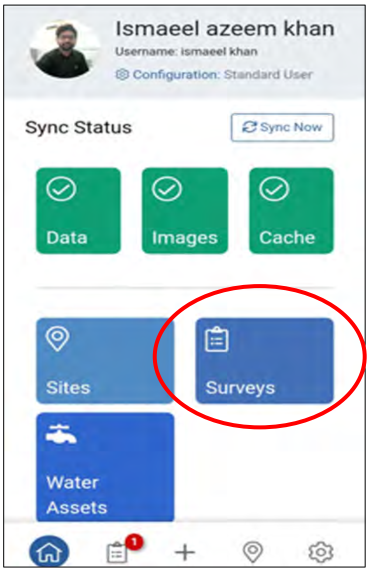
- Download from Play store with the name of **(mWater surveyor)**

- Made Log-In ID on App and use it for Portal on PC.

5

mWater App

- After logging in, Click "Survey" icon

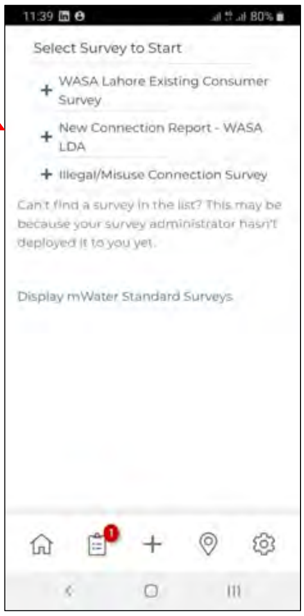


- Click icon "Start Survey"

6

mWater App

- Select Form



7

mWater App

Put the information about the connection, location, town and the problem identified etc.

8

mWater app

- Take photo

  and

- Click "Submit".

- When Internet is not available, Click "Save for Later"

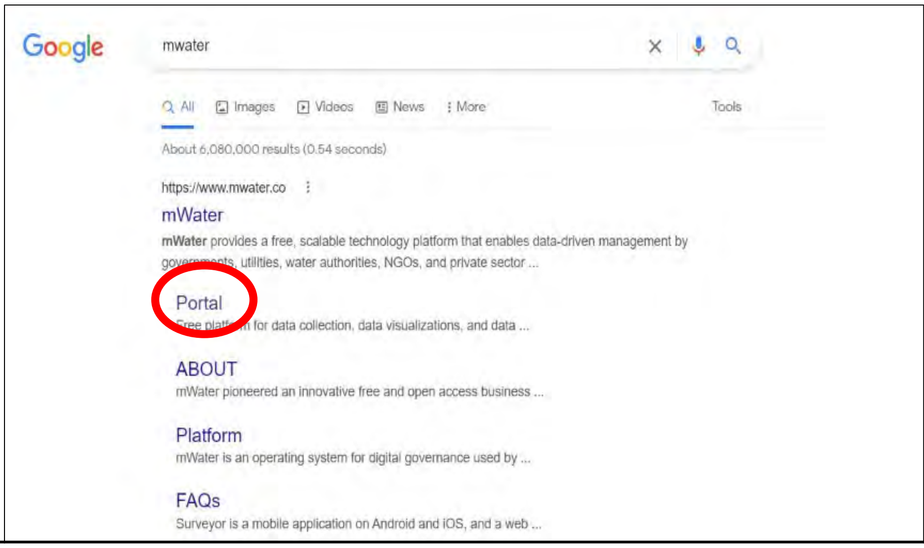
9

mWater Portal

10

mWater Portal

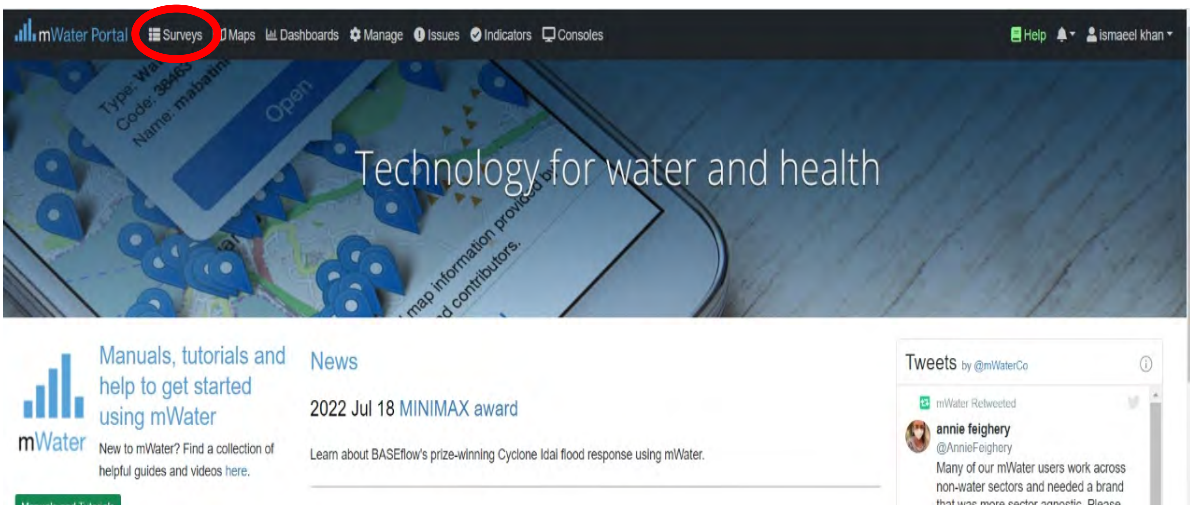
- After the submission from mWater app, we can see the results on our PC or browser on smartphone or tablet, and analyze the results.



11

mWater Portal

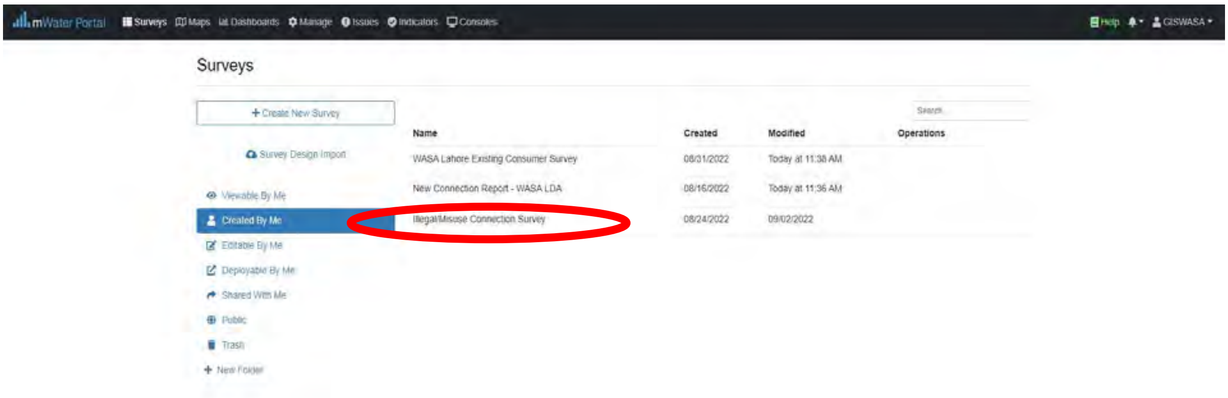
- After Log in, click on “Survey” ICON.



12

mWater Portal

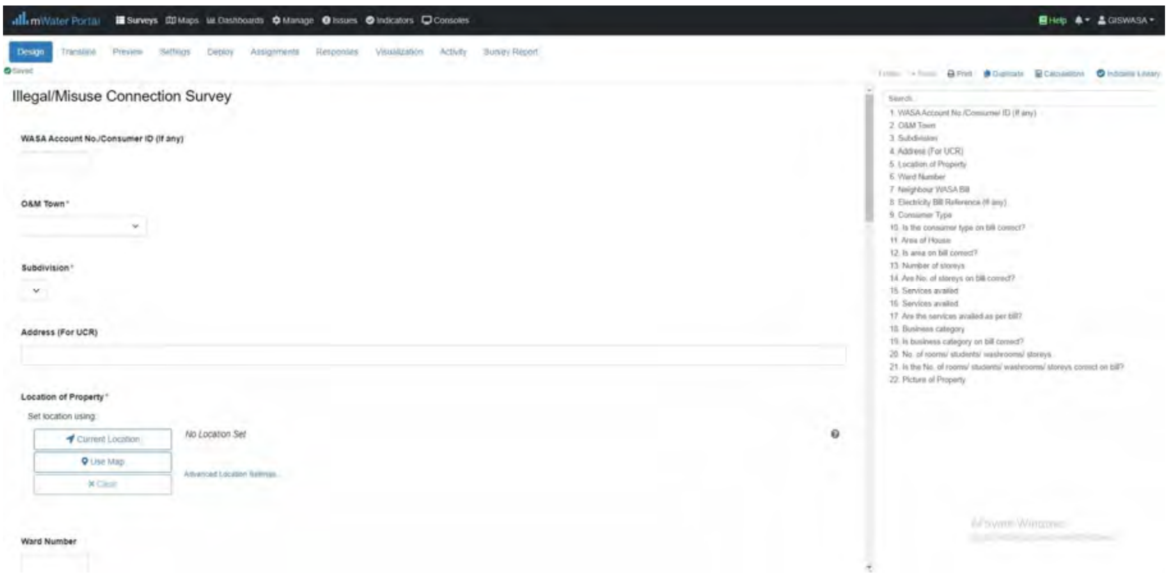
- We can either use prepared form or create new survey



13

mWater Portal

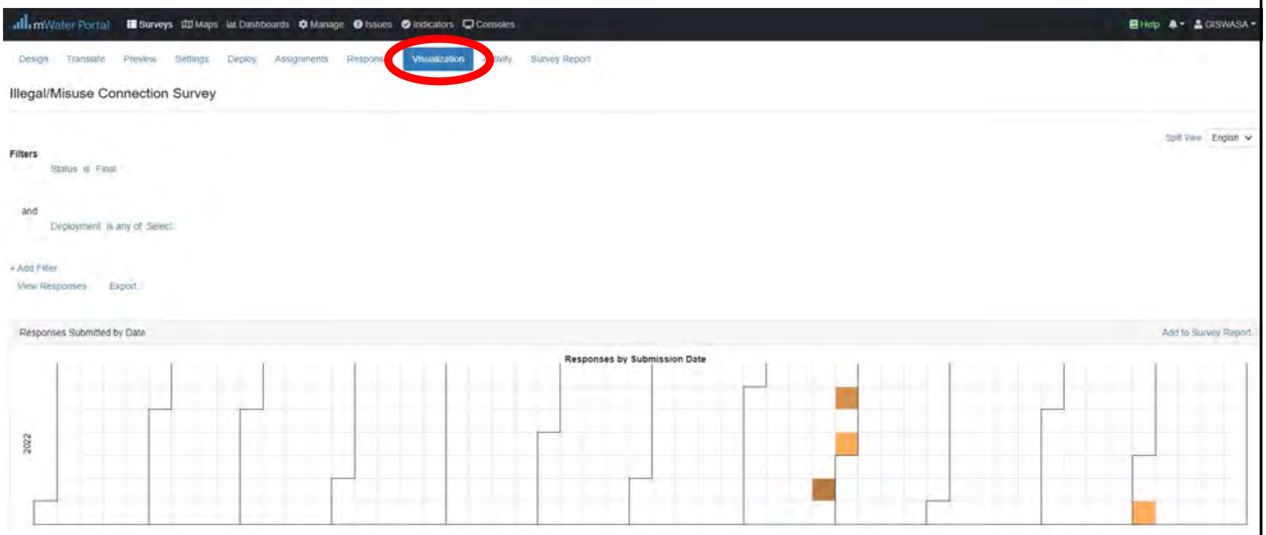
- Click on the Illegal/Misuse Connection Survey form



14

mWater Portal

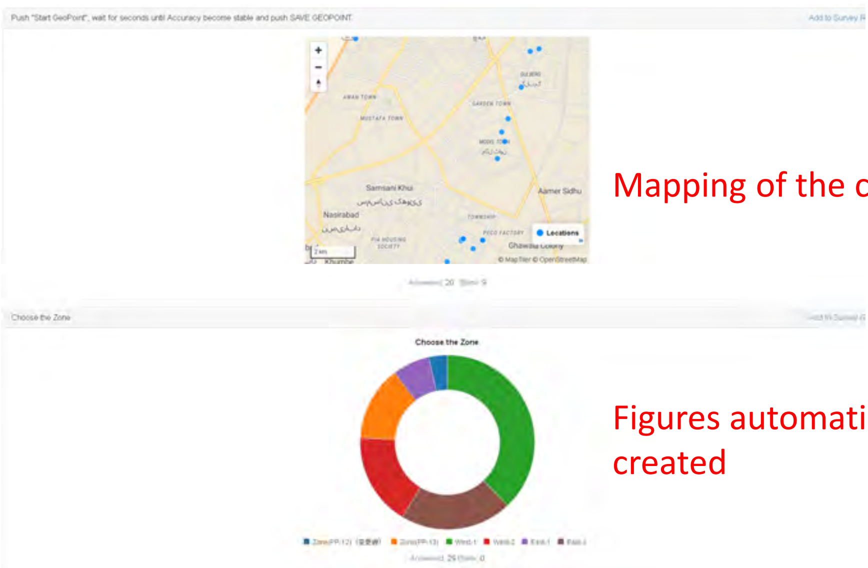
- To see the form click on visualization



15

mWater Portal

- Example of Visualized data



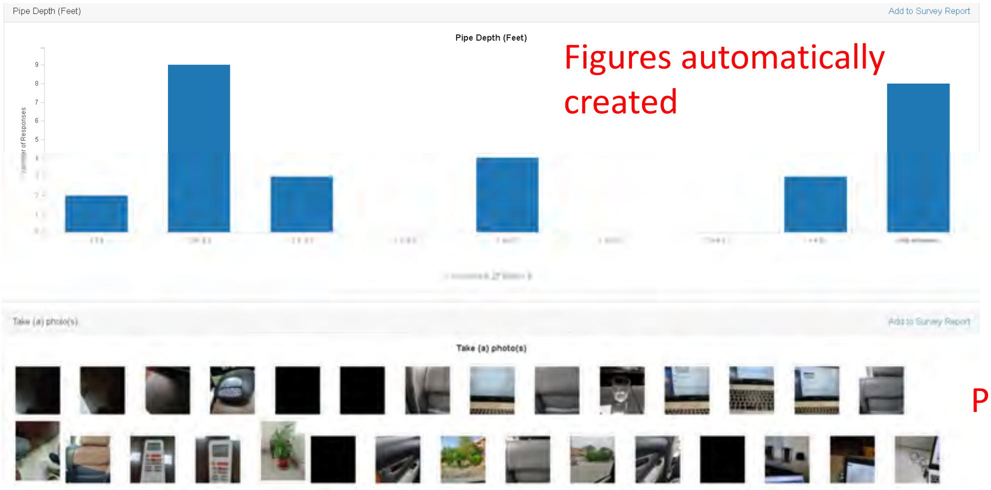
Mapping of the cases

Figures automatically created

16

mWater Portal

- Example of Visualized data



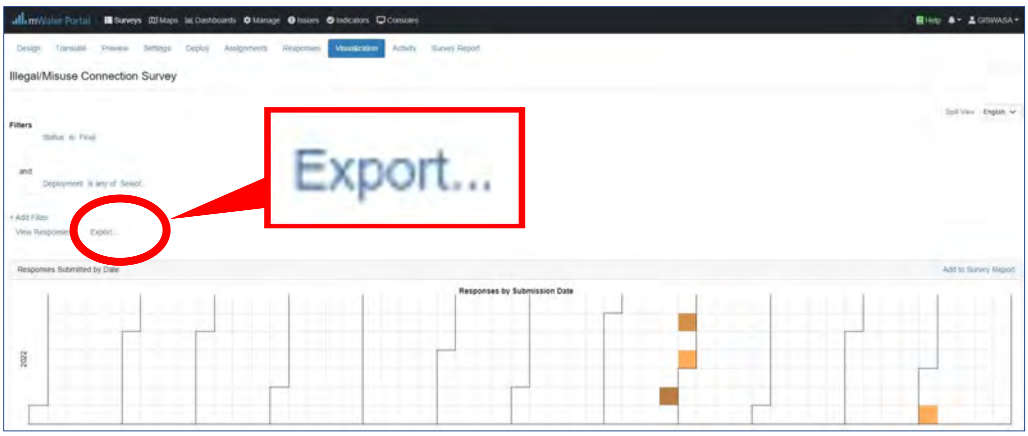
Figures automatically created

Photos

17

mWater Portal

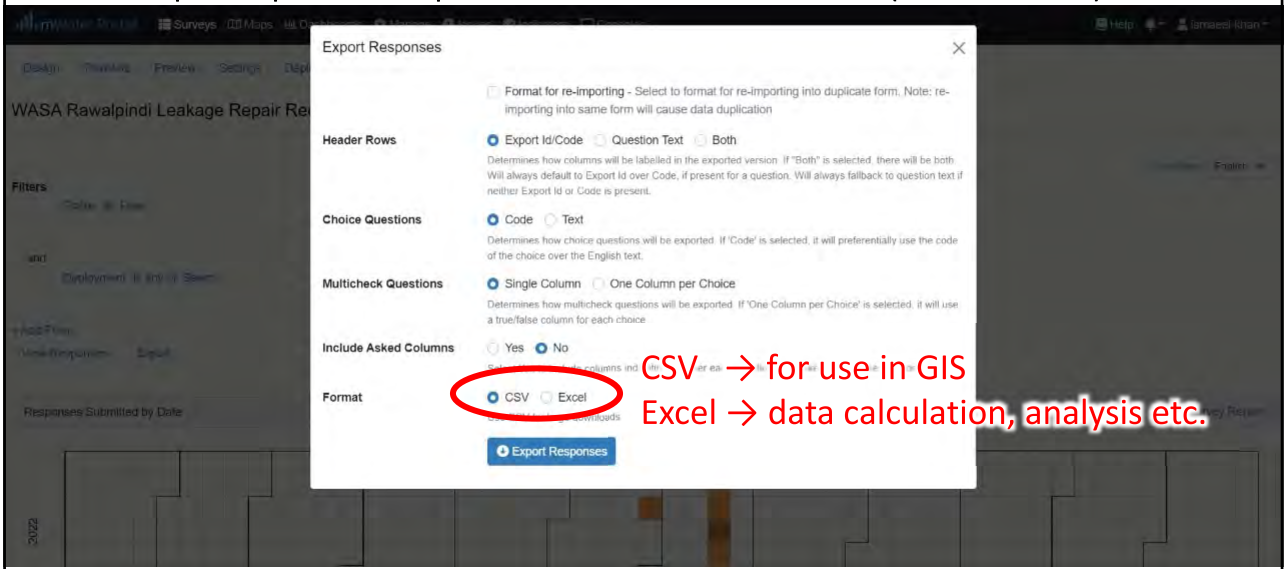
- We can export file by clicking "Export" option.



18

mWater Portal

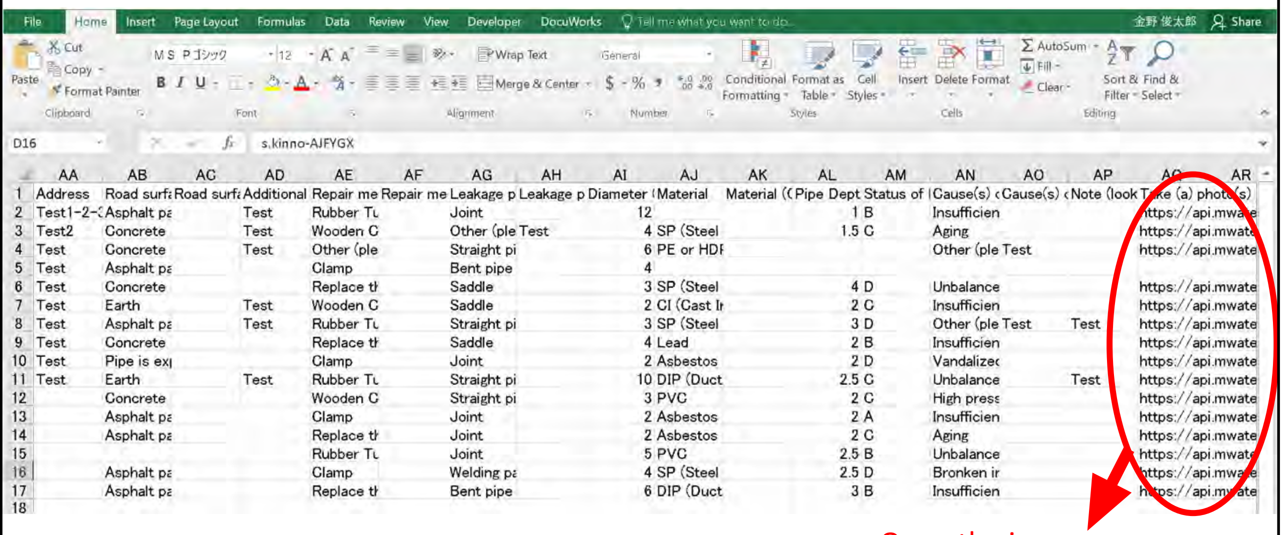
Click on Export Option to export this file into Excel or CSV (used in QGIS)



19

Downloaded Excel sheet

(.xlsx or .csv)



	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ
1	Address	Road surfa	Road surfa	Additional	Repair me	Repair me	Leakage p	Leakage p	Diameter (	Material	Material ((	Pipe Dept	Status of (	Cause(s) c	Cause(s) c	Note (look	Take (a) photo(s)
2	Test1-2-3	Asphalt pa		Test	Rubber Tu		Joint		12			1	B	Insufficien			https://api.mwate
3	Test2	Concrete		Test	Wooden C		Other (ple	Test	4	SP (Steel		1.5	C	Aging			https://api.mwate
4	Test	Concrete		Test	Other (ple		Straight pi		6	PE or HDF				Other (ple	Test		https://api.mwate
5	Test	Asphalt pa			Clamp		Bent pipe		4								
6	Test	Concrete			Replace th		Saddle		3	SP (Steel		4	D	Unbalance			https://api.mwate
7	Test	Earth		Test	Wooden C		Saddle		2	CI (Cast Ir		2	C	Insufficien			https://api.mwate
8	Test	Asphalt pa		Test	Rubber Tu		Straight pi		3	SP (Steel		3	D	Other (ple	Test	Test	https://api.mwate
9	Test	Concrete			Replace th		Saddle		4	Lead		2	B	Insufficien			https://api.mwate
10	Test	Pipe is exp			Clamp		Joint		2	Asbestos		2	D	Vandalized			https://api.mwate
11	Test	Earth		Test	Rubber Tu		Straight pi		10	DIP (Duct		2.5	C	Unbalance		Test	https://api.mwate
12		Concrete			Wooden C		Straight pi		3	PVC		2	C	High press			https://api.mwate
13		Asphalt pa			Clamp		Joint		2	Asbestos		2	A	Insufficien			https://api.mwate
14		Asphalt pa			Replace th		Joint		2	Asbestos		2	C	Aging			https://api.mwate
15					Rubber Tu		Joint		5	PVC		2.5	B	Unbalance			https://api.mwate
16		Asphalt pa			Clamp		Welding pa		4	SP (Steel		2.5	D	Bronken ir			https://api.mwate
17		Asphalt pa			Replace th		Bent pipe		6	DIP (Duct		3	B	Insufficien			https://api.mwate
18																	

All the answers are shown in the table

Open the image on web browser

20

QGIS

(PC Software)

21

QGIS Software

Index

- Use of QGIS software
- How to see mWater data and show them on **QGIS**.
- How to utilize the data

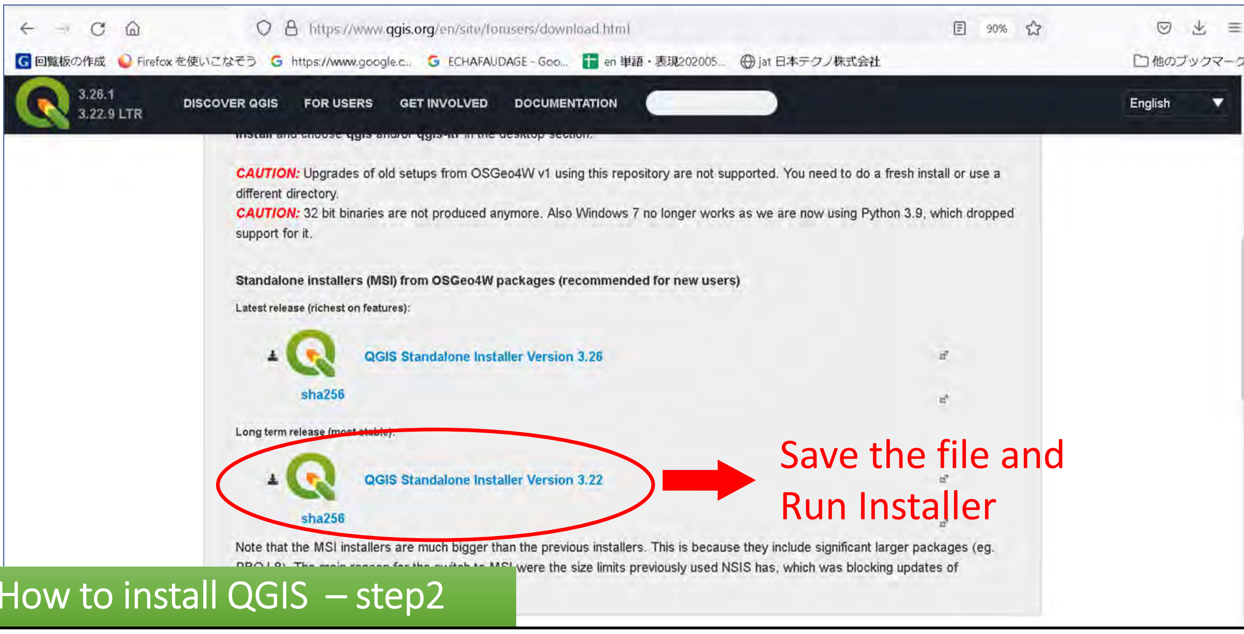
22

QGIS Software

How to install QGIS – step1

23

QGIS Software

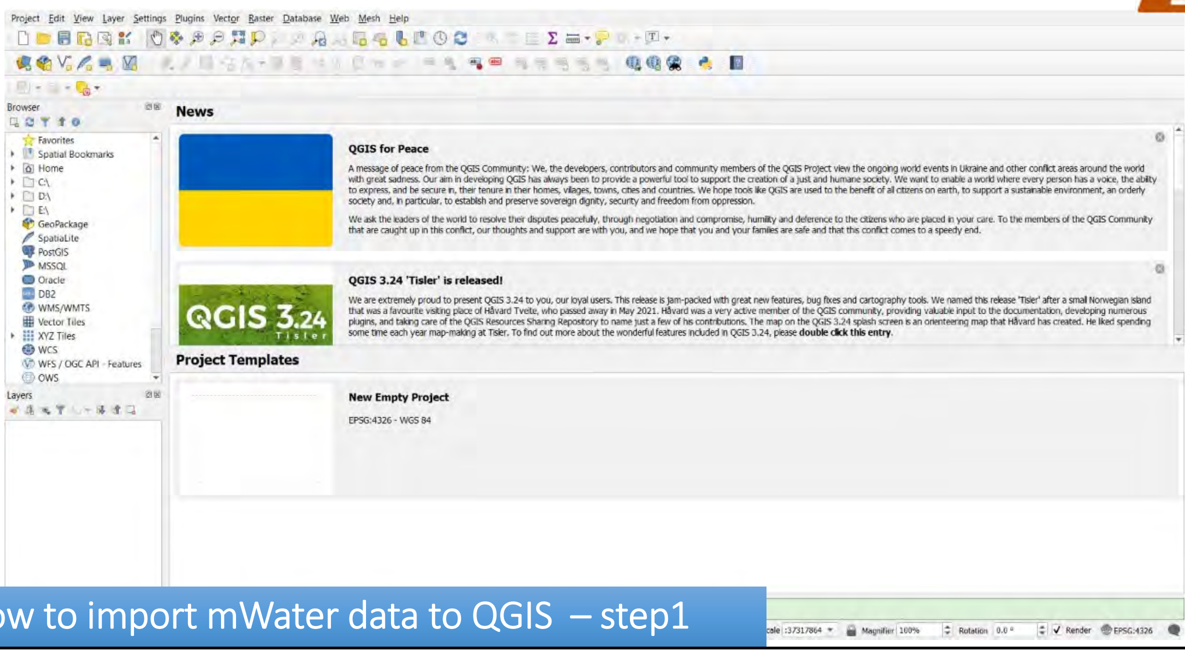


Save the file and
Run Installer

How to install QGIS – step2

24

QGIS Software

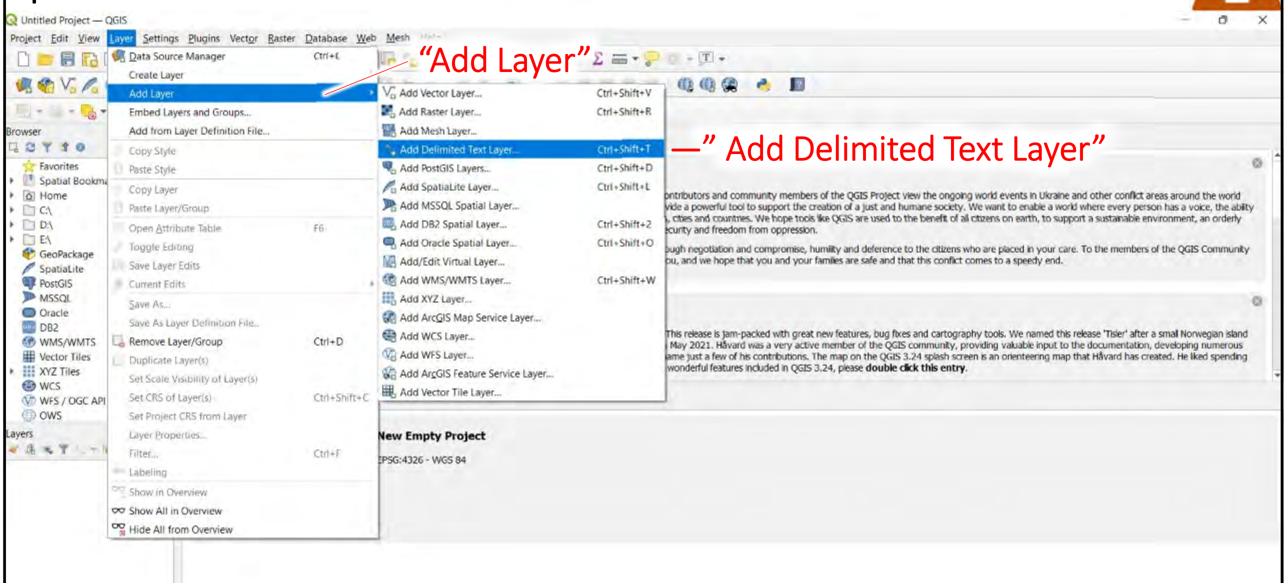


How to import mWater data to QGIS – step1

25

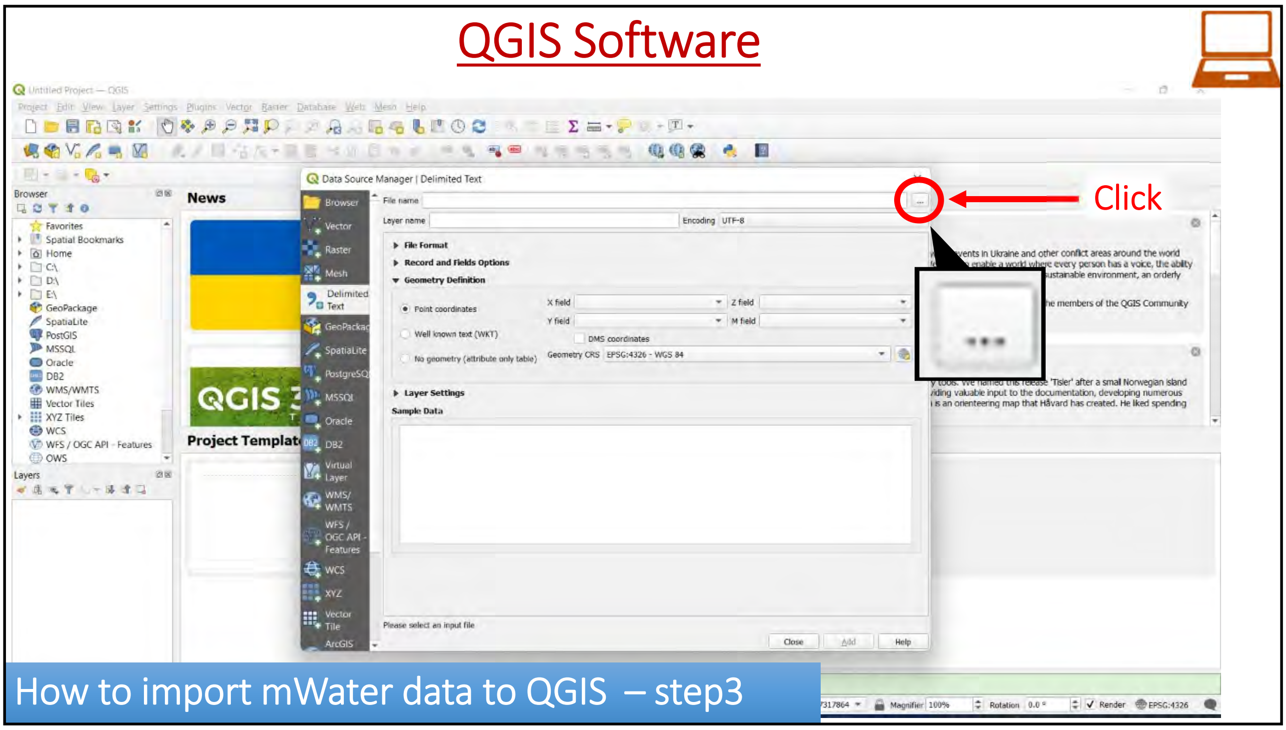
pc

QGIS Software

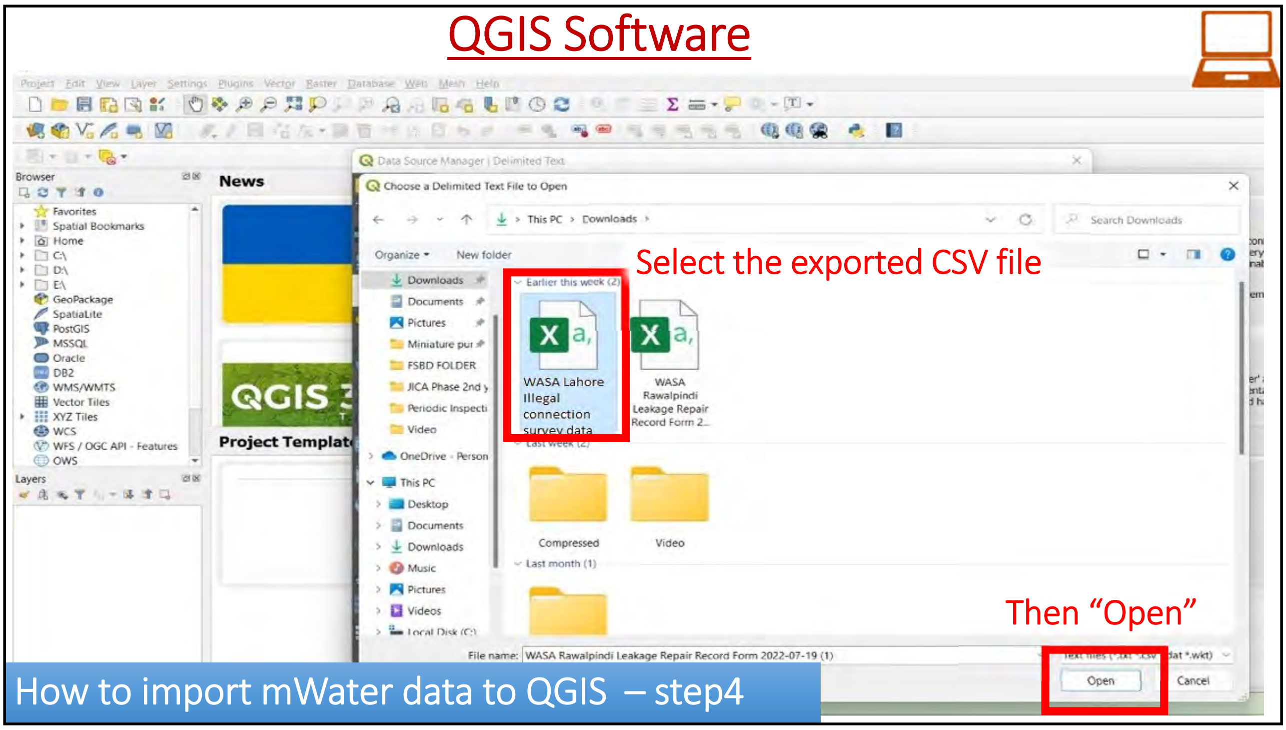


How to import mWater data to QGIS – step2

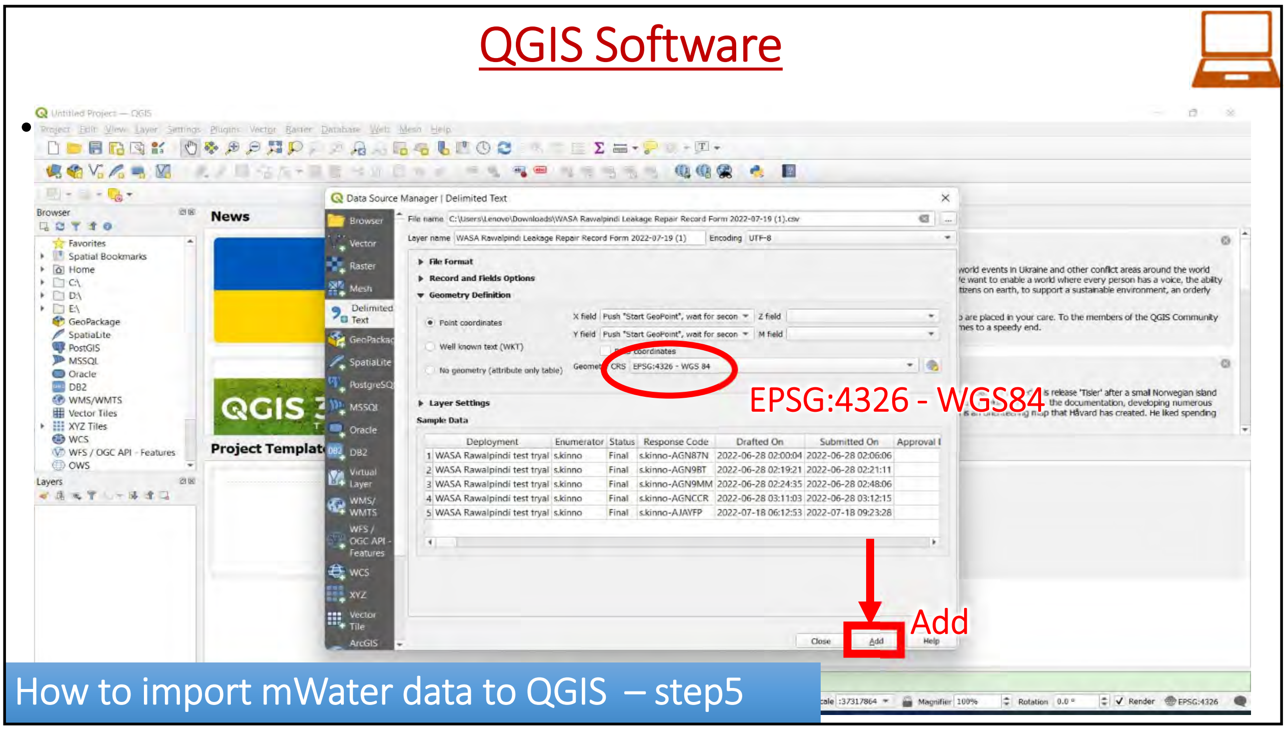
26


QGIS Software
Click
How to import mWater data to QGIS – step3

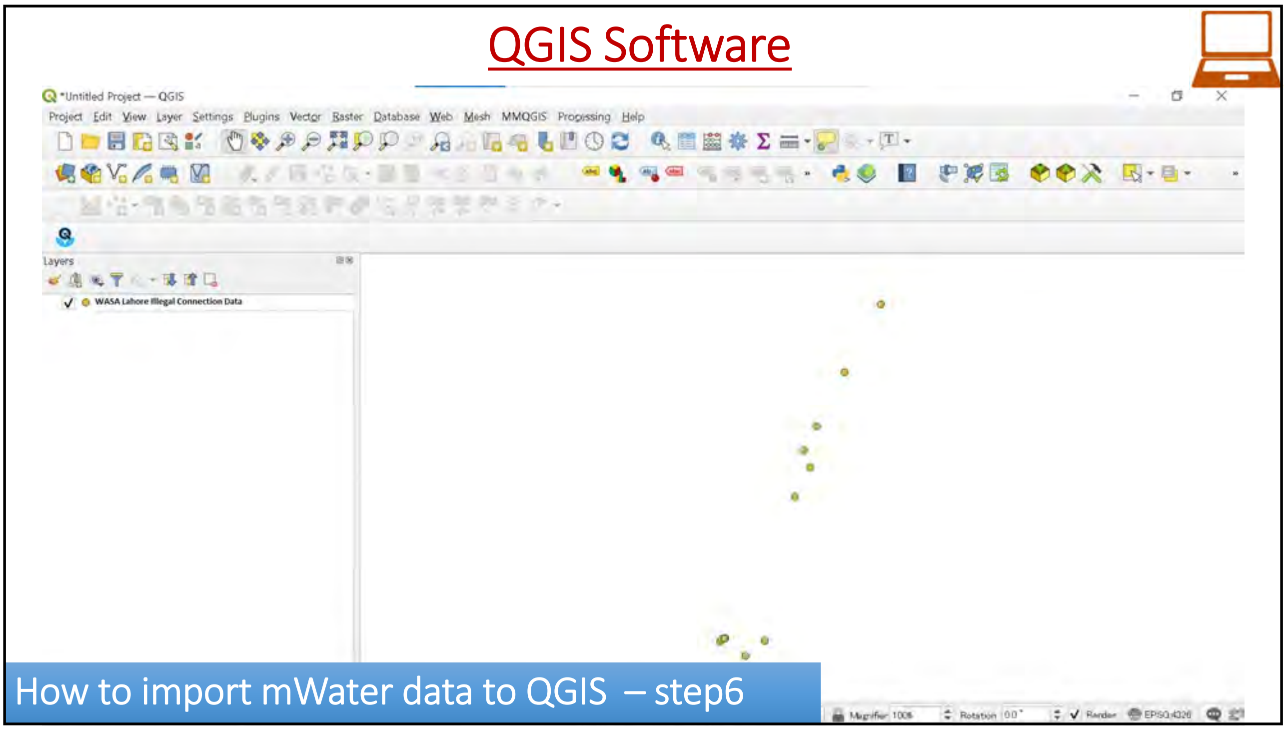
27


QGIS Software
Select the exported CSV file
Then “Open”
How to import mWater data to QGIS – step4

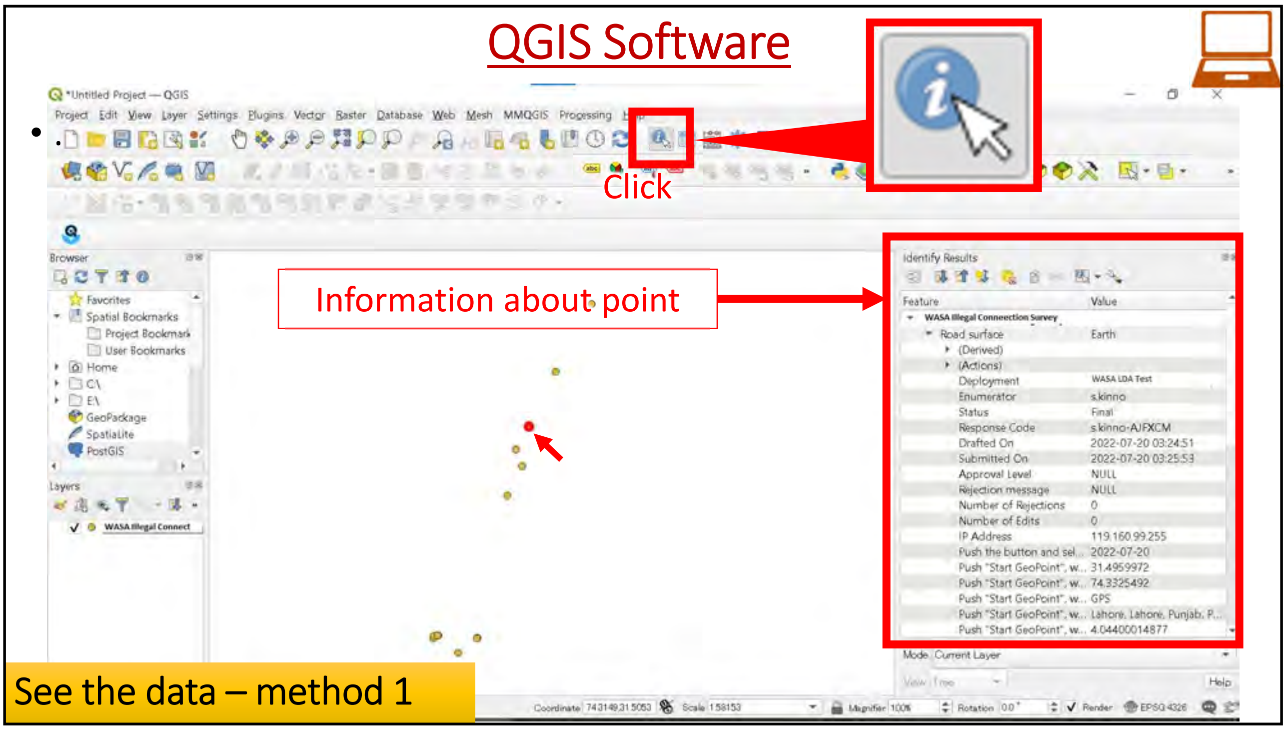
28


QGIS Software
EPSG:4326 - WGS84
Add
How to import mWater data to QGIS – step5

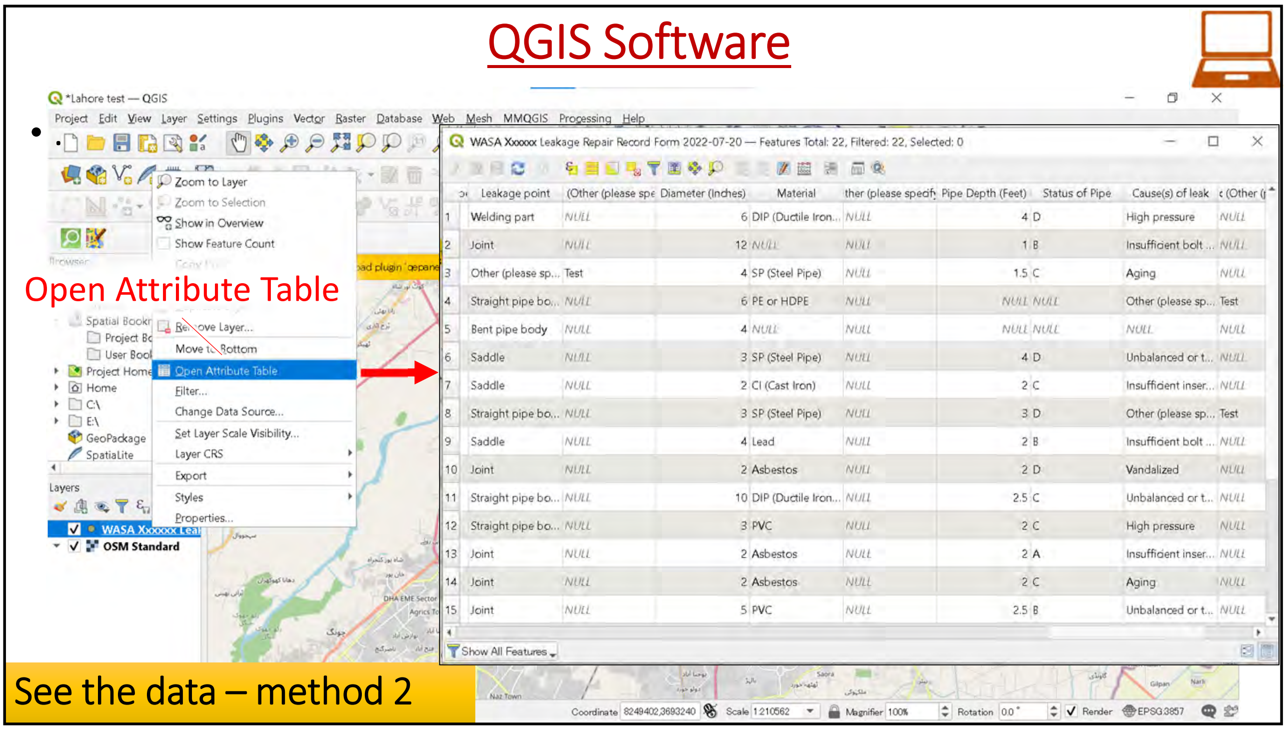
29


QGIS Software
How to import mWater data to QGIS – step6

30

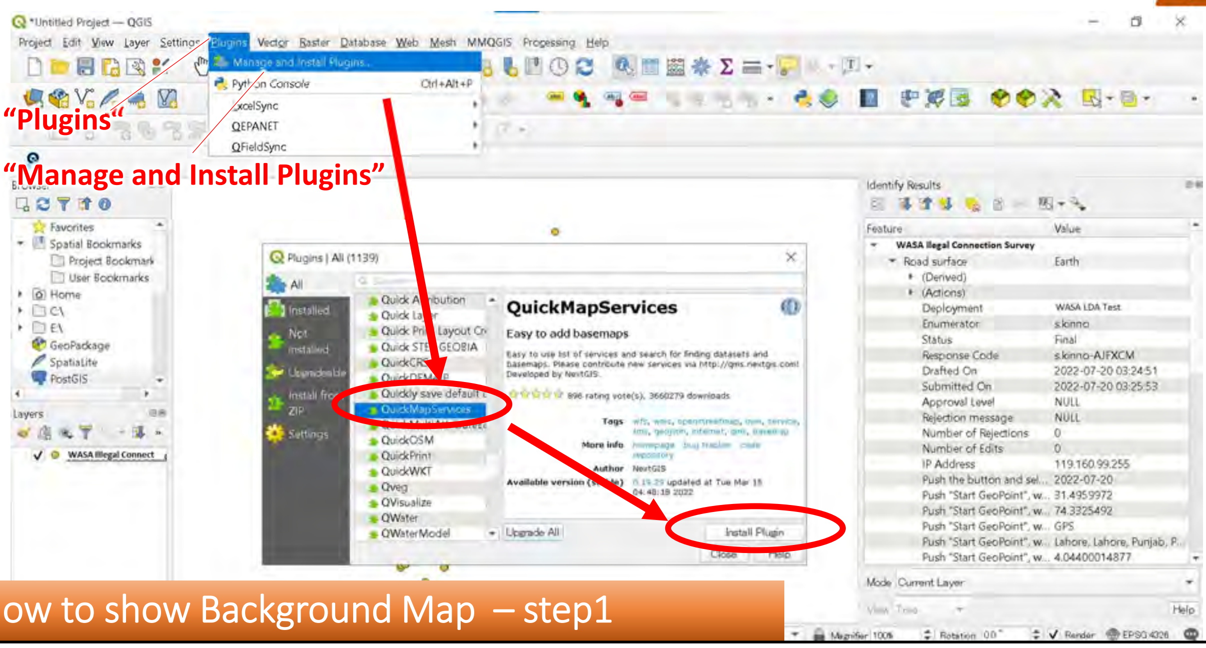

QGIS Software
Click
Information about point
See the data – method 1

31


QGIS Software
Open Attribute Table
See the data – method 2

32

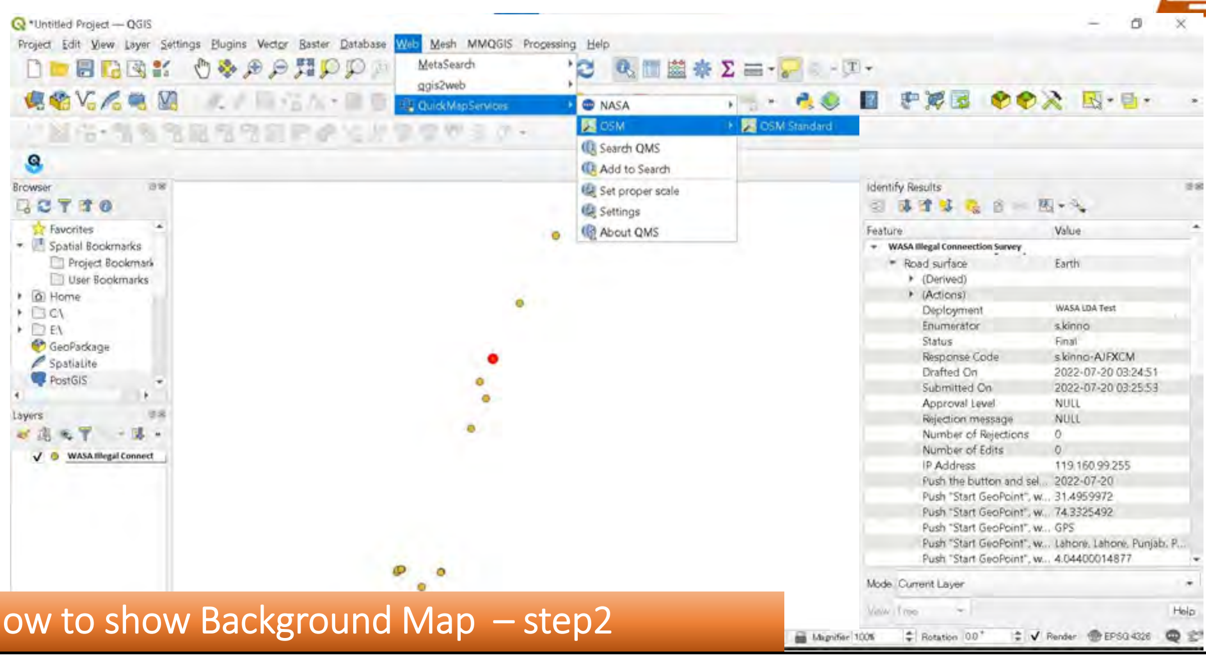
QGIS Software



How to show Background Map – step1

33

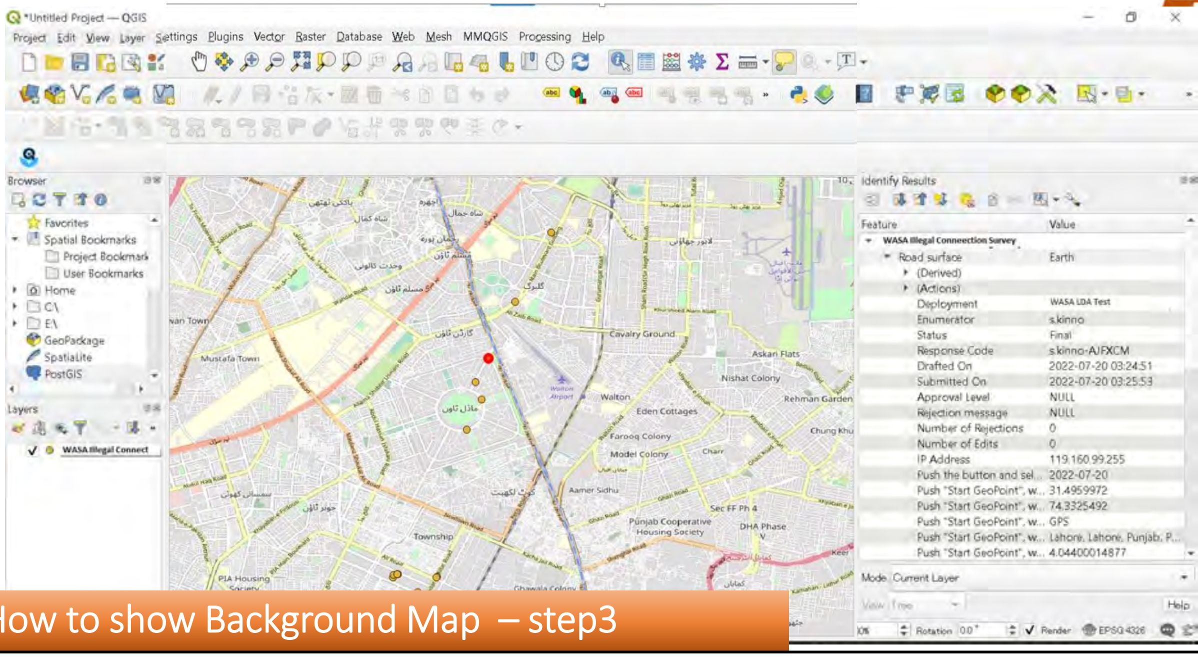
QGIS Software



How to show Background Map – step2

34

QGIS Software



How to show Background Map – step3

35

Take full advantage of the data

Visualization in mWater Portal

- Quick check of the data

Excel

- Integrate and conserve all the data, calculate and analyze etc..

QGIS

- Visualize data on map and express the parameters as you like
- Prioritize the area for recovery
- Locate defaulters and compare with population data for analysis

→ **Exhibit the Revenue and Recovery Efficiency**

- Accurate and reliable reporting
- Smart and informed allocation of resources

36

Annex 5.3.1 In-house Training plan at WASA Faisalabad

In house Training Plan at WASA Faisalabad

Year	Month		O&M on Sewerage and Drainage			O&M on Mechanical and Electrical Equipment			Leakage Control, Plumbing and Pipe	
			Cleaning of sewerage and drainage pipelines	Repair of Crown Failure	Remodeling of drains and channels	Energy Audit (Mech. & Electrical)	Efficient pumping machinery (Mech.)	Reducing energy fluctuation.)	Pipe Replacement/ Repair of leakage	Valves, chambers and pressure
2022	Jun.	Early (1-10)				plan	plan	plan		
		Mid (11-20)	plan	plan	plan	plan				
		End (21-31)								
	Jul.	Monsoon								
	Aug.									
	Sep.									
		End (21-31)				plan				
	Oct.	Early (1-10)					plan			
		Mid (11-20)						plan		
		End (21-31)								
	Nov.	Early (1-10)							plan	
		Mid (11-20)								plan
		End (21-31)								
	Dec.	Early (1-10)	plan							
		Mid (11-20)		plan	plan					
		End (21-31)								
2023	Jan.	Early (1-10)	plan							
		Mid (11-20)								
		End (21-31)		plan						
	Feb.	Early (1-10)			plan					
		Mid (11-20)				plan				
		End (21-31)								
	Mar.	Early (1-10)					plan			
		Mid (11-20)								
		End (21-31)						plan		
	Apr.	Early (1-10)								
		Mid (11-20)								
		End (21-31)								
	May	Early (1-10)								
		Mid (11-20)								
		End (21-31)								
	Jun.	Early (1-10)								
		Mid (11-20)								
		End (21-31)								
	Jul.	Monsoon								
	Aug.									
	Sep.									
		End (21-31)				plan				
	Oct..	Early (1-10)					plan			
		Mid (11-20)			plan					
		End (21-31)								plan
	Nov.	Early (1-10)							plan	
		Mid (11-20)								
		End (21-31)						plan		plan
	Dec.	Early (1-10)	plan	plan						
		Mid (11-20)								
		End (21-31)				plan	plan			

Note: Plan from June to July 2022 was prepared in January 2022.
Plan from August to December 2022 was prepared in August 2022.
Plan from January to April 2023 was prepared in December 2022.
Plan from May to mid-September 2023 was not prepared.
Plan from mid-September to December 2023 was prepared in August 2023.

Annex 5.3.2 In-house Training plan at WASA Multan

In-house Training Plan at WASA Multan

Year	Month		O&M on Sewerage and Drainage			O&M on Mechanical and Electrical Equipment			Leakage Control, Plumbing and Pipe		
			Cleaning of sewerage and drainage pipelines	O&M of waste water treatment plant	Flow measurement of open channels	Energy Audit (Mech. & Electrical)	O&M of Pump (Mech.)	Electrical Panel, MCU and wiring (Elect.)	Replacement planning using GIS	Leakage control and plumbing with Service pipe	Distribution Pipe
2022	Jun.	Early (1-10)				plan	plan				
		Mid (11-20)									
		End (21-31)						plan			
	Jul.	Monsoon									
	Aug.										
	Sep.										
	Oct.	Early (1-10)						plan			
		Mid (11-20)	plan	plan	plan	plan	plan				
		End (21-31)							plan	plan	plan
	Nov.	Early (1-10)						plan			
		Mid (11-20)	plan	plan	plan						
		End (21-31)							plan	plan	plan
	Dec.	Early (1-10)									
		Mid (11-20)	plan	plan	plan			plan			
		End (21-31)				plan	plan		plan	plan	plan
2023	Jan.	Early (1-10)									
		Mid (11-20)									
		End (21-31)									
	Feb.	Early (1-10)				plan	plan	plan			
		Mid (11-20)	plan	plan	plan						
		End (21-31)									
	Mar.	Early (1-10)								plan	plan
		Mid (11-20)							plan		
		End (21-31)									
	Apr.	Early (1-10)									
		Mid (11-20)									
		End (21-31)									
	May	Early (1-10)									
		Mid (11-20)									
		End (21-31)									
	Jun.	Early (1-10)									
		Mid (11-20)									
		End (21-31)									
	Jul.	Monsoon									
	Aug.										
	Sep.										
	Oct..	Early (1-10)						plan			
		Mid (11-20)	plan	plan	plan	plan	plan		plan		
		End (21-31)								plan	plan
	Nov.	Early (1-10)						plan			
		Mid (11-20)	plan	plan	plan				plan		
		End (21-31)				plan	plan			plan	plan
	Dec.	Early (1-10)									
		Mid (11-20)	plan	plan	plan				plan		
		End (21-31)				plan	plan			plan	plan

Note: Plan from June to July 2022 was prepared in January 2022.
Plan from August to December 2022 was prepared in August 2022.
Plan from January to April 2023 was prepared in December 2022.
Plan from May to mid-September 2023 was not prepared.
Plan from mid-September to December 2023 was prepared in August 2023.

Annex 5.3.3 In-house Training plan at WASA Gujranwala

In-house Training Plan at WASA Gujranwala

Year	Month		O&M on Sewerage and Drainage		O&M on Mechanical and Electrical Equipment			Leakage Control, Plumbing and Pipe Replacement Plan		
			Cleaning of sewerage and drainage pipelines	Flow measurement of open channels	Energy Audit (Mech. & Electrical)	O&M of Pump (Mech.)	Electrical Panel, MCU and wiring (Elect.)	Replacement planning using GIS	Leakage control and plumbing with Service pipe	Distribution Pipe
2022	Jun.	Early (1-10)	plan	plan						
		Mid (11-20)			plan	plan				
		End (21-31)					plan			
	Jul.		Monsoon							
	Aug.									
	Sep.									
	Oct.	Early (1-10)						plan		plan
		Mid (11-20)					plan			
		End (21-31)								
	Nov.	Early (1-10)	plan					plan		plan
		Mid (11-20)	plan	plan						
		End (21-31)								
	Dec.	Early (1-10)					plan			
		Mid (11-20)			plan	plan				
		End (21-31)	plan	plan						
2023	Jan.	Early (1-10)						plan		
		Mid (11-20)								
		End (21-31)								plan
	Feb.	Early (1-10)	plan	plan						
		Mid (11-20)			plan		plan			
		End (21-31)								
	Mar.	Early (1-10)								
		Mid (11-20)			plan	plan				
		End (21-31)								
	Apr.	Early (1-10)								
		Mid (11-20)								
		End (21-31)								
	May	Early (1-10)								
		Mid (11-20)								
		End (21-31)								
	Jun.	Early (1-10)								
		Mid (11-20)								
		End (21-31)								
	Jul.	Monsoon								
	Aug.									
	Sep.									
	Oct..	Early (1-10)			plan	plan	plan			
		Mid (11-20)								
		End (21-31)	plan	plan						
	Nov.	Early (1-10)			plan	plan		plan		
		Mid (11-20)					plan		plan	plan
		End (21-31)								
	Dec.	Early (1-10)	plan	plan				plan		
		Mid (11-20)			plan	plan	plan		plan	plan
		End (21-31)								

Note: Plan from June to July 2022 was prepared in January 2022.
Plan from August to December 2022 was prepared in August 2022.
Plan from January to April 2023 was prepared in December 2022.
Plan from May to mid-September 2023 was not prepared.
Plan from mid-September to December 2023 was prepared in August 2023.

Annex 5.3.4 In-house Training plan at WASA Rawalpindi

In-house Training Plan at WASA Rawalpindi

Year	Month		O&M on Sewerage and Drainage		O&M on Mechanical and Electrical Equipment			Leakage Control, Plumbing and Pipe Replacement Plan		
			Cleaning of sewerage and drainage pipelines	Flow measurement of open channel / Sludge volume measurement	Energy Audit (Mech. & Electrical)	O&M of Pump (Mech.)	Electrical Panel, and wiring (Elect.)	Replacement planning using GIS	Leakage control and plumbing with Service Pipe	Distribution Pipe
2022	Jun.	Early (1-10)								
		Mid (11-20)					plan			
		End (21-31)			plan	plan				
	Jul.	Monsoon								
	Aug.									
	Sep.									
	Oct.	Early (1-10)	plan	plan						
		Mid (11-20)						plan	plan	plan
		End (21-31)								
	Nov.	Early (1-10)	plan	plan						
		Mid (11-20)						plan	plan	plan
		End (21-31)			plan		plan			
	Dec.	Early (1-10)	plan	plan	plan	plan				
		Mid (11-20)						plan	plan	plan
		End (21-31)					plan			
2023	Jan.	Early (1-10)								
		Mid (11-20)								
		End (21-31)	plan	plan						
	Feb.	Early (1-10)								
		Mid (11-20)								
		End (21-31)			plan		plan			
	Mar.	Early (1-10)			plan	plan		plan		
		Mid (11-20)							plan	plan
		End (21-31)								
	Apr.	Early (1-10)								
		Mid (11-20)								
		End (21-31)								
	May	Early (1-10)								
		Mid (11-20)								
		End (21-31)								
	Jun.	Early (1-10)								
		Mid (11-20)								
		End (21-31)								
	Jul.	Monsoon								
	Aug.									
	Sep.									
	Oct..	Early (1-10)			plan					
		Mid (11-20)				plan	plan			
		End (21-31)	plan	plan						
	Nov.	Early (1-10)			plan					
		Mid (11-20)				plan		plan		
		End (21-31)	plan	plan			plan		plan	plan
	Dec.	Early (1-10)								
		Mid (11-20)			plan			plan		
		End (21-31)	plan	plan		plan	plan		plan	plan

Note: Plan from June to July 2022 was prepared in January 2022.
Plan from August to December 2022 was prepared in August 2022.
Plan from January to April 2023 was prepared in December 2022.
Plan from May to mid-September 2023 was not prepared.
Plan from mid-September to December 2023 was prepared in August 2023.

Annex 5.4.1 Participant list for In-house Training at 4WASAs

List of participants for in-house training at WASA Faisalabad

Date	Training topic	Batch No.	Name of Trainee	Designation
2022/1/27	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Shahzaib Shamshad	Pump Operator
2022/1/27	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. M. Aftab	Supervisor/ WC
2022/1/27	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Sajjadullah	Deputy Director
2022/1/27	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. M. Farhan Ali	Deputy Director
2022/1/27	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Salman Hashmi	Deputy Director
2022/1/27	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Afzal	Mechanic/ Work Charge
2022/1/27	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Mohsin Latif	Electrician / WC
2022/1/27	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. M. Hussain	Mechanic (In-line)
2022/1/27	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Khalid	Supervisor (In-line)
2022/1/27	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. M. Abdullah	Supervisor / WC
2022/1/27	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Farooq Ahmed	Sub Engineer
2022/6/24	ME1: Energy Audit (Mech. & Electrical)	1	Mr. Asif Hanif	Pump Operator
2022/6/24	ME1: Energy Audit (Mech. & Electrical)	1	Mr. Afzal	Mechanic/ Work Charge
2022/6/24	ME1: Energy Audit (Mech. & Electrical)	1	Mr. M. Sulaiman	Pump Operator
2022/6/24	ME1: Energy Audit (Mech. & Electrical)	1	Mr. M. Hussain	Mechanic (In-line)
2022/6/24	ME1: Energy Audit (Mech. & Electrical)	1	Mr. M. Shakeel	Pump Operator
2022/6/24	ME1: Energy Audit (Mech. & Electrical)	1	Mr. M. Abdullah	Supervisor
2022/6/24	ME1: Energy Audit (Mech. & Electrical)	1	Mr. Tasawwar Hussain	Assistant Director (Revenue)
2022/6/24	ME1: Energy Audit (Mech. & Electrical)	1	Mr. M. Nawaz	Mechanic
2022/11/17	ME1: Energy Audit (Mech. & Electrical)	2	Mr. Khalid Sardar	Sub Engineer
2022/11/17	ME1: Energy Audit (Mech. & Electrical)	2	Mr. M. Asif	Pump Operator
2022/11/17	ME1: Energy Audit (Mech. & Electrical)	2	Mr. Afzal	Mechanic/ Work Charge
2022/11/17	ME1: Energy Audit (Mech. & Electrical)	2	Mr. Mohsin Latif	Electrician / WC
2022/11/17	ME1: Energy Audit (Mech. & Electrical)	2	Mr. Abdullah	Work Charge
2022/11/17	ME1: Energy Audit (Mech. & Electrical)	2	Mr. Aftab	Supervisor/ Work Charge
2022/11/17	ME1: Energy Audit (Mech. & Electrical)	2	Mr. Farooq Ahmed	Sub Engineer
2022/11/17	ME1: Energy Audit (Mech. & Electrical)	2	Mr. Tariq Hafeez	Senior Sub Engineer
2022/11/17	ME1: Energy Audit (Mech. & Electrical)	2	Mr. Zain-ul-abdeen	Electrician/ Work Charge
2022/11/17	ME1: Energy Audit (Mech. & Electrical)	2	Mr. Rana Sultan	Supervisor
2022/11/17	ME1: Energy Audit (Mech. & Electrical)	2	Mr. Muhammad Abrar ul Hassan	Sub Engineer/ WC
2023/2/18	ME1: Energy Audit (Mech. & Electrical)	3	Mr. Shahzaib Shamshad	Pump Operator (TR)
2023/2/18	ME1: Energy Audit (Mech. & Electrical)	3	Mr. Muhammad Sohail	Pump Operator (In-line)
2023/2/18	ME1: Energy Audit (Mech. & Electrical)	3	Mr. Muhammad Aslam	Pump Operator (JBC)
2023/2/18	ME1: Energy Audit (Mech. & Electrical)	3	Mr. Sufian	Pump Operator (W/C)
2023/2/18	ME1: Energy Audit (Mech. & Electrical)	3	Mr. Talha	Pump Operator (W/C)
2023/2/18	ME1: Energy Audit (Mech. & Electrical)	3	Mr. Arslan	Pump Operator (W/C)
2023/2/18	ME1: Energy Audit (Mech. & Electrical)	3	Mr. Muhammad Arshad	Pump Operator (W/C)
2023/2/18	ME1: Energy Audit (Mech. & Electrical)	3	Mr. Tariq Hafeez	Senior Sub Engineer
2023/2/18	ME1: Energy Audit (Mech. & Electrical)	3	Mr. Afzal	Mechanic/ Work Charge
2023/2/18	ME1: Energy Audit (Mech. & Electrical)	3	Mr. Aftab	Supervisor/ Work Charge
2023/2/18	ME1: Energy Audit (Mech. & Electrical)	3	Mr. Mohsin	Electrician/ Work Charge
2023/2/18	ME1: Energy Audit (Mech. & Electrical)	3	Mr. Asif Hanif	Pump Operator
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Mr. M. Talha	Operator/ WC
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Mr. Arsalan	Operator/ WC
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Mr. Ali Raza	Technician/ WC
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Mr. Sufyan	Operator/ WC

Date	Training topic	Batch No.	Name of Trainee	Designation
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Mr. Mudassar Hussain	Operator/ WC
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Mr. Mohsin Latif	Electrician/ WC
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Mr. M. Afzal	Mechanic/ WC
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Mr. Umer Farooq	Electrician Helper/ WC
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Mr. M. Atif Murtaza	Electrical Technician/ WC
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Mr. Ghulam Muhiyuddin	Electrician
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Mr. Irfan Ul Haq	Assistant Director
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Ms. Bareera Zafar	Assistant Director
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Azhar Shabbir	Electrician
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Mr. Abdul Aziz	Deputy Director
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Mr. Wajahat Atta	SCADA Operator/ WC
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Mr. Talha Hafeez	Lab In charge/ WC
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Mr. M. Umer	Supervisor/ R
2023/6/3	ME1: Energy Audit (Mech. & Electrical)	4	Mr. M. Arshad	Operator/ WC
2023/7/4	ME1: Energy Audit (Mech. & Electrical)	5	Mr. Irfan Ul Haq	Assistant Director
2023/7/4	ME1: Energy Audit (Mech. & Electrical)	5	Mr. Talha	Work Charge
2023/7/4	ME1: Energy Audit (Mech. & Electrical)	5	Mr. Ghulam Muhiyuddin	Electrician
2023/7/4	ME1: Energy Audit (Mech. & Electrical)	5	Mr. Arshad	Work Charge
2023/7/4	ME1: Energy Audit (Mech. & Electrical)	5	Mr. Umar Farooq	Work Charge
2023/7/4	ME1: Energy Audit (Mech. & Electrical)	5	Mr. M. Atif Murtaza	Work Charge
2023/7/4	ME1: Energy Audit (Mech. & Electrical)	5	Mr. Azhar Shabbir	Electrician
2023/7/4	ME1: Energy Audit (Mech. & Electrical)	5	Mr. M. Waqas	Sub engineer
2023/7/4	ME1: Energy Audit (Mech. & Electrical)	5	Mr. M. Umer	Supervisor
2023/7/4	ME1: Energy Audit (Mech. & Electrical)	5	Mr. Allah Rakha	Pump Operator
2023/8/24	ME1: Energy Audit (Mech. & Electrical)	6	Mr.Muhammad Umer	Supervisor
2023/8/24	ME1: Energy Audit (Mech. & Electrical)	6	Mr.Arsalan Mustafa	Operator
2023/8/24	ME1: Energy Audit (Mech. & Electrical)	6	Mr.Atif Murtaza	Electrical Technician
2023/8/24	ME1: Energy Audit (Mech. & Electrical)	6	Mr.Ahmed Kabir	Electrical supervisor
2023/8/24	ME1: Energy Audit (Mech. & Electrical)	6	Mr.Ghulam Mohudin	Electrical Supervisor
2023/8/24	ME1: Energy Audit (Mech. & Electrical)	6	Mr.Bilal Hafeez	IT Technician
2023/8/24	ME1: Energy Audit (Mech. & Electrical)	6	Mr.Muhammad Afzal	Mechanic

Date	Training topic	Batch No.	Name of Trainee	Designation
2023/8/24	ME1: Energy Audit (Mech. & Electrical)	6	Mr.Mohsin	Electrician
2023/8/24	ME1: Energy Audit (Mech. & Electrical)	6	Mr.Irfan Ul Haq	Assistant Director
2023/8/24	ME1: Energy Audit (Mech. & Electrical)	6	Mr.Abdul Aziz	Deputy Director
2023/8/24	ME1: Energy Audit (Mech. & Electrical)	6	Miss.Ayeza Saleem	Assistant Director
2023/8/24	ME1: Energy Audit (Mech. & Electrical)	6	Miss.Bareera Zafar	Assistant Director
2023/10/16	ME1: Energy Audit (Mech. & Electrical)	7	Mr.Ghulam Saleem	Fitter Coolie/ Machenic
2023/10/16	ME1: Energy Audit (Mech. & Electrical)	7	Mr.MUhammad Shahid	Water Supply Supervisor
2023/10/16	ME1: Energy Audit (Mech. & Electrical)	7	Mr.Ghulam Mohiudin	Water Supply Supervisor
2023/10/16	ME1: Energy Audit (Mech. & Electrical)	7	Mr.Muhammad Umar	Water Supply Supervisor
2023/10/16	ME1: Energy Audit (Mech. & Electrical)	7	Mr.Ali Husnain	Pump Operator
2023/10/16	ME1: Energy Audit (Mech. & Electrical)	7	Mr.Ahsan	Water Supply Supervisor
2023/10/16	ME1: Energy Audit (Mech. & Electrical)	7	Mr.Muhammad Muneer	Wireless Operator
2023/10/16	ME1: Energy Audit (Mech. & Electrical)	7	Mr.Muhammad Shakeel	Pump Operator
2023/10/16	ME1: Energy Audit (Mech. & Electrical)	7	Mr.Muhammad Shahbaz	Water Supply Supervisor
2022/6/24	ME2: Efficient pumping machinery (Mech.)	pilot	Mr. Tasawwar Hussain	Assistant Director (Revenue)
2022/6/24	ME2: Efficient pumping machinery (Mech.)	pilot	Mr. M. Abdullah	Supervisor
2022/6/24	ME2: Efficient pumping machinery (Mech.)	pilot	Mr. M. Shakeel	Pump Operator
2022/6/24	ME2: Efficient pumping machinery (Mech.)	pilot	Mr. M. Nawaz	Mechanic
2022/6/24	ME2: Efficient pumping machinery (Mech.)	pilot	Mr. Asif Hanif	Pump Operator
2022/6/24	ME2: Efficient pumping machinery (Mech.)	pilot	Mr. Afzal	Mechanic/ Work Charge
2022/6/24	ME2: Efficient pumping machinery (Mech.)	pilot	Mr. M. Sulaiman	Pump Operator
2022/6/24	ME2: Efficient pumping machinery (Mech.)	pilot	Mr. M. Hussain	Mechanic (In-line)
2022/10/20	ME2: Efficient pumping machinery (Mech.)	1	Mr. Muhammad Ramzan	Supervisor
2022/10/20	ME2: Efficient pumping machinery (Mech.)	1	Mr. Sajjad Ullah	Deputy Director
2022/10/20	ME2: Efficient pumping machinery (Mech.)	1	Mr. Farooq Ahmed	Sub Engineer
2022/10/20	ME2: Efficient pumping machinery (Mech.)	1	Mr. Khalid Zawar	Pump Operator
2022/10/20	ME2: Efficient pumping machinery (Mech.)	1	Mr. Pervez Ahmed	Pump Operator
2022/10/20	ME2: Efficient pumping machinery (Mech.)	1	Mr. Sohail Abbas	Pump Operator
2022/10/20	ME2: Efficient pumping machinery (Mech.)	1	Mr. Abdullah	Work Charge
2022/10/20	ME2: Efficient pumping machinery (Mech.)	1	Mr. Shakeel	Work Charge
2022/10/20	ME2: Efficient pumping machinery (Mech.)	1	Mr. Afzal	Work Charge
2022/10/20	ME2: Efficient pumping machinery (Mech.)	1	Mr. Aftab	Work Charge
2022/10/20	ME2: Efficient pumping machinery (Mech.)	1	Mr. Ali Ruman	Work Charge
2022/10/20	ME2: Efficient pumping machinery (Mech.)	1	Mr. Mohsin	Work Charge
2022/11/17	ME2: Efficient pumping machinery (Mech.)	2	Mr. Pervez Ahmed	Pump Operator
2022/11/17	ME2: Efficient pumping machinery (Mech.)	2	Mr. Sohail Abbass	Pump Operator
2022/11/17	ME2: Efficient pumping machinery (Mech.)	2	Mr. Afzal	Mechanic/ Work Charge
2022/11/17	ME2: Efficient pumping machinery (Mech.)	2	Mr. Khalid Zawar	Pump Operator
2022/11/17	ME2: Efficient pumping machinery (Mech.)	2	Mr. Muhammad Ramzan	Supervisor
2022/11/17	ME2: Efficient pumping machinery (Mech.)	2	Mr. Farooq Ahmed	Sub Engineer
2022/11/17	ME2: Efficient pumping machinery (Mech.)	2	Mr. Sajjadullah	Deputy Director
2022/11/17	ME2: Efficient pumping machinery (Mech.)	2	Mr. Mohsin	Electrician/ Work Charge
2022/11/17	ME2: Efficient pumping machinery (Mech.)	2	Mr. Shakeel	Work Charge

Date	Training topic	Batch No.	Name of Trainee	Designation
2022/11/17	ME2: Efficient pumping machinery (Mech.)	2	Mr. Aftab	Supervisor/ Work Charge
2022/11/17	ME2: Efficient pumping machinery (Mech.)	2	Mr. Abdullah	Work Charge
2022/11/17	ME2: Efficient pumping machinery (Mech.)	2	Mr. Ali Ruman	Work Charge
2023/2/18	ME2: Efficient pumping machinery (Mech.)	3	Mr. Muhammad Sohail	Pump Operator (In-line)
2023/2/18	ME2: Efficient pumping machinery (Mech.)	3	Mr. Muhammad Aslam	Pump Operator (JBC)
2023/2/18	ME2: Efficient pumping machinery (Mech.)	3	Mr. Sufian	Pump Operator (W/C)
2023/2/18	ME2: Efficient pumping machinery (Mech.)	3	Mr. Muhammad Arshad	Pump Operator (W/C)
2023/2/18	ME2: Efficient pumping machinery (Mech.)	3	Mr. Arslan	Pump Operator (W/C)
2023/2/18	ME2: Efficient pumping machinery (Mech.)	3	Mr. Talha	Pump Operator (W/C)
2023/2/18	ME2: Efficient pumping machinery (Mech.)	3	Mr. Afzal	Mechanic/ Work Charge
2023/2/18	ME2: Efficient pumping machinery (Mech.)	3	Mr. Aftab	Supervisor/ Work Charge
2023/2/18	ME2: Efficient pumping machinery (Mech.)	3	Mr. Mohsin	Electrician/ Work Charge
2023/2/18	ME2: Efficient pumping machinery (Mech.)	3	Mr. Asif Hanif	Pump Operator
2023/2/18	ME2: Efficient pumping machinery (Mech.)	3	Mr. Shahzaib Shamshad	Pump Operator (TR)
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Mr. Irfan Ul Haq	Assistant Director
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Mr. Roohan Javaid	Director
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Mr. Wajahat Atta	SCADA Operator/ WC
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Mr. Talha Hafeez	Lab In charge/ WC
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Mr. M. Umer	Supervisor/ R
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Mr. M. Arshad	Operator/ WC
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Mr. M. Talha	Operator/ WC
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Mr. Arsalan	Operator/ WC
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Mr. Ali Raza	Technician/ WC
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Mr. Sufyan	Operator/ WC
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Mr. Mudassar Hussain	Operator/ WC
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Mr. Mohsin Latif	Electrician/ WC
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Mr. M. Afzal	Mechanic/ WC
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Mr. Umer Farooq	Electrician Helper/ WC
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Mr. M. Atif Murtaza	Electrical Technician/ WC
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Mr. Ghulam Muhiyuddin	Electrician
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Ms. Bareera Zafar	Assistant Director
2023/6/3	ME2: Efficient pumping machinery (Mech.)	4	Azhar Shabbir	Electrician
2023/8/23	ME2: Efficient pumping machinery (Mech.)	5	Mr.Ghulam Mohudin	Electrical Supervisor
2023/8/23	ME2: Efficient pumping machinery (Mech.)	5	Mr.Atif Murtaza	Electrical Technician
2023/8/23	ME2: Efficient pumping machinery (Mech.)	5	Mr.Arsalan Mustafa	Operator
2023/8/23	ME2: Efficient pumping machinery (Mech.)	5	Mr.Muhammad Umer	Supervisor
2023/8/23	ME2: Efficient pumping machinery (Mech.)	5	Miss.Ayeza Saleem	Assistant Director
2023/8/23	ME2: Efficient pumping machinery (Mech.)	5	Miss.Bareera Zafar	Assistant Director
2023/8/23	ME2: Efficient pumping machinery (Mech.)	5	Mr.Irfan ul Haq	Assistant Director
2023/8/23	ME2: Efficient pumping machinery (Mech.)	5	Mr.Abdul Aziz	Deputy Director
2023/8/23	ME2: Efficient pumping machinery (Mech.)	5	Mr.Mohsin	Electricain
2023/8/23	ME2: Efficient pumping machinery (Mech.)	5	Mr.Muhammad Afzal	Mechanic
2023/8/23	ME2: Efficient pumping machinery (Mech.)	5	Mr.Bilal Hafeez	IT Technician

Date	Training topic	Batch No.	Name of Trainee	Designation
2023/8/23	ME2: Efficient pumping machinery (Mech.)	5	Mr.Ahmed Kabir	Electrical Supervisor
2023/11/18	ME3: Reducing energy fluctuation	pilot	Muhammad Aslam	Electrician
2023/11/18	ME3: Reducing energy fluctuation	pilot	Azhar Shabbir	Electrician
2023/11/18	ME3: Reducing energy fluctuation	pilot	Mohsin Latif	D/W
2023/11/18	ME3: Reducing energy fluctuation	pilot	Muhammad Afzal	D/W
2023/11/18	ME3: Reducing energy fluctuation	pilot	Aftaab	D/W
2023/11/18	ME3: Reducing energy fluctuation	pilot	Adnan Akram	Electrician
2023/11/18	ME3: Reducing energy fluctuation	pilot	Usman	Electrician
2023/11/18	ME3: Reducing energy fluctuation	pilot	ILLyas	Electrician
2023/11/18	ME3: Reducing energy fluctuation	pilot	Sadam Hussin	Electrician
2023/11/18	ME3: Reducing energy fluctuation	pilot	Adnan	Electrician
2023/11/18	ME3: Reducing energy fluctuation	pilot	Abdur Rehman	Electricain
2023/11/18	ME3: Reducing energy fluctuation	pilot	Ghulam Mohi-id-Din	Electrician
2024/1/3	ME3: Reducing energy fluctuation	1	Azhar Shabbir	Electrician
2024/1/3	ME3: Reducing energy fluctuation	1	Adnan Akram	Electrician
2024/1/3	ME3: Reducing energy fluctuation	1	Muhammad Adnan	Electrician
2024/1/3	ME3: Reducing energy fluctuation	1	Muhammad Abdullah	Chlorine Supervisor
2024/1/3	ME3: Reducing energy fluctuation	1	Muhammad Aftab	Generator Operator
2024/1/3	ME3: Reducing energy fluctuation	1	Abdul Rehman	Electrician
2024/1/3	ME3: Reducing energy fluctuation	1	Saeed Ahmed	Electrician
2024/1/3	ME3: Reducing energy fluctuation	1	Usman Rehman	Electrician
2024/1/3	ME3: Reducing energy fluctuation	1	Muhammad Saeed	Electrician
2024/1/3	ME3: Reducing energy fluctuation	1	M. Ilyas	D/W
2024/1/3	ME3: Reducing energy fluctuation	1	Shakeel Ashraf	Electrician
2022/12/8	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	pilot	Mr. Adnan Gul	Director C 1
2022/12/8	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	pilot	Mr. Ghulam Shabbir	D.D – DC 1
2022/12/8	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	pilot	Mr. Muhammad Maqbool	D.D – O&M East
2022/12/8	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	pilot	Mr. Syed Furqan Haider	D.D – O&M (DC 2)
2022/12/8	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	pilot	Mr. Makhdoom Babar	D.D - O&M West
2022/12/8	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	pilot	Mr. Hassan Nasir	D.D – P&D
2022/12/8	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	pilot	Mr. Muhammad Rafi	Director – P&D
2022/12/8	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	pilot	Mr. Roohan Javaid	Director – W. R
2022/12/8	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	pilot	Mr. Adnan Nisar	DMD - East
2022/12/8	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	pilot	Mr. Jabbar Anwar	Managing Director
2023/2/1	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	1	Mr. Qaiser Gill	Supervisor
2023/2/1	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	1	Mr. Naeem Khan	Sub Engineer
2023/2/1	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	1	Mr. Azam Hussain	Sub Engineer
2023/2/1	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	1	Mr. Ahmad Raza	Assistant Director
2023/2/1	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	1	Mr. Tassaduq Rasool	Sub Engineer

Date	Training topic	Batch No.	Name of Trainee	Designation
2023/2/1	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	1	Mr. Arslan Ahmad Khilji	Sub Engineer
2023/3/29	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	2	Mr. Arif Masih	Sewerman
2023/3/29	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	2	Mr. Tahir Shabbir	Senior Sub Engineer
2023/3/29	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	2	Mr. Tasawer Shahzad	Sub Engineer
2023/3/29	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	2	Mr. Zeeshan Bashir	Sub Engineer
2023/3/29	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	2	Mr. Waqas Ahmad	Sub Engineer
2023/3/29	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	2	Mr. David hydaite	Senior Supervisor
2023/3/29	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	2	Mr. Rizwan Ahmad	Pump Operator
2023/3/29	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	2	Mr. Yaqoob	Senior Supervisor
2023/3/29	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	2	Mr. Latif	Sewerman
2023/3/29	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	2	Mr. Ashiq Younis	Sewerman
2023/11/3	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	3	Mr. Usman	Electrition
2023/11/3	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	3	Mr. Haroon	Operator Helper
2023/11/3	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	3	Mr. ilyas	Operator
2023/11/3	SD1: Cleaning of sewerage and drainage pipelines and Repair of Crown Failures	3	Mr. Ishtiaq	Supervisor
2022/12/8	SD2: Remodeling of drains and chennels	pilot	Mr. Makhdoom Babar	D.D - O&M West
2022/12/8	SD2: Remodeling of drains and chennels	pilot	Mr. Syed Furqan Haider	D.D – O&M (DC 2)
2022/12/8	SD2: Remodeling of drains and chennels	pilot	Mr. Hassan Nasir	D.D – P&D
2022/12/8	SD2: Remodeling of drains and chennels	pilot	Mr. Muhammad Rafi	Director – P&D
2022/12/8	SD2: Remodeling of drains and chennels	pilot	Mr. Roohan Javaid	Director – W. R
2022/12/8	SD2: Remodeling of drains and chennels	pilot	Mr. Adnan Nisar	DMD - East
2022/12/8	SD2: Remodeling of drains and chennels	pilot	Mr. Jabbar Anwar	Managing Director
2022/12/8	SD2: Remodeling of drains and chennels	pilot		Sub Engineer
2022/12/8	SD2: Remodeling of drains and chennels	pilot		Sub Engineer
2022/12/8	SD2: Remodeling of drains and chennels	pilot		Sub Engineer
2022/12/8	SD2: Remodeling of drains and chennels	pilot	Mr. Adnan Gul	Director C 1
2022/12/8	SD2: Remodeling of drains and chennels	pilot	Mr. Ghulam Shabbir	D.D – DC 1
2022/12/8	SD2: Remodeling of drains and chennels	pilot	Mr. Muhammad Maqbool	D.D – O&M East
2023/2/2	SD2: Remodeling of drains and chennels	1	Mr. Qaiser Gill	Supervisor
2023/2/2	SD2: Remodeling of drains and chennels	1	Mr. Arslan Ahmad Khilji	Sub Engineer
2023/2/2	SD2: Remodeling of drains and chennels	1	Mr. Tassaduq Rasool	Sub Engineer
2023/2/2	SD2: Remodeling of drains and chennels	1	Mr. Azam Hussain	Sub Engineer
2023/2/2	SD2: Remodeling of drains and chennels	1	Mr. Naeem Khan	Sub Engineer
2023/2/2	SD2: Remodeling of drains and chennels	1	Mr. Ahmad Raza	Assistant Director
2023/3/30	SD2: Remodeling of drains and chennels	2	Mr. Arif Masih	Sewerman

Date	Training topic	Batch No.	Name of Trainee	Designation
2023/3/30	SD2: Remodeling of drains and chennels	2	Mr. Tahir Shabbir	Senior Sub Engineer
2023/3/30	SD2: Remodeling of drains and chennels	2	Mr. Tasawer Shahzad	Sub Engineer
2023/3/30	SD2: Remodeling of drains and chennels	2	Mr. Zeeshan Bashir	Sub Engineer
2023/3/30	SD2: Remodeling of drains and chennels	2	Mr. Waqas Ahmad	Sub Engineer
2023/3/30	SD2: Remodeling of drains and chennels	2	Mr. David hydaite	Senior Supervisor
2023/3/30	SD2: Remodeling of drains and chennels	2	Mr. Umer Rafique	Sub Engineer
2023/3/30	SD2: Remodeling of drains and chennels	2	Mr. Ashiq Younis	Sewerman
2023/3/30	SD2: Remodeling of drains and chennels	2	Mr. Latif	Sewerman
2023/3/30	SD2: Remodeling of drains and chennels	2	Mr. Yaqoob	Senior Supervisor
2023/3/30	SD2: Remodeling of drains and chennels	2	Mr. Rizwan Ahmad	Pump Operator
2022/12/8	SD3: O&M of waste water treatment plant	pilot	Mr. Makhdoom Babar	D.D - O&M West
2022/12/8	SD3: O&M of waste water treatment plant	pilot	Mr. Adnan Gul	Director C 1
2022/12/8	SD3: O&M of waste water treatment plant	pilot	Mr. Ghulam Shabbir	D.D – DC 1
2022/12/8	SD3: O&M of waste water treatment plant	pilot	Mr. Muhammad Maqbool	D.D – O&M East
2022/12/8	SD3: O&M of waste water treatment plant	pilot	Mr. Jabbar Anwar	Managing Director
2022/12/8	SD3: O&M of waste water treatment plant	pilot	Mr. Adnan Nisar	DMD - East
2022/12/8	SD3: O&M of waste water treatment plant	pilot	Mr. Roohan Javaid	Director – W. R
2022/12/8	SD3: O&M of waste water treatment plant	pilot	Mr. Muhammad Rafi	Director – P&D
2022/12/8	SD3: O&M of waste water treatment plant	pilot	Mr. Syed Furqan Haider	D.D – O&M (DC 2)
2022/12/8	SD3: O&M of waste water treatment plant	pilot	Mr. Hassan Nasir	D.D – P&D
2023/2/2	SD3: O&M of waste water treatment plant	1	Mr. Arslan Ahmad Khilji	Sub Engineer
2023/2/2	SD3: O&M of waste water treatment plant	1	Mr. Ahmad Raza	Assistant Director
2023/2/2	SD3: O&M of waste water treatment plant	1	Mr. Azam Hussain	Sub Engineer
2023/2/2	SD3: O&M of waste water treatment plant	1	Mr. Naeem Khan	Sub Engineer
2023/2/2	SD3: O&M of waste water treatment plant	1	Mr. Tassaduq Rasool	Sub Engineer
2023/2/2	SD3: O&M of waste water treatment plant	1	Mr. Qaiser Gill	Supervisor
2022/10/20	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Mohsin	Work Charge
2022/10/20	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Sajjadullah	Deputy Director
2022/10/20	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Noman Noor	Assistant Director
2022/10/20	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Tariq Hafeez	Senior Sub Engineer
2022/10/20	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Farooq Ahmed	Sub Engineer
2022/10/20	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Muhammad Ramzan	Supervisor
2022/10/20	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Khalid Zawar	Pump Operator
2022/10/20	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Pervez Ahmed	Pump Operator

Date	Training topic	Batch No.	Name of Trainee	Designation
2022/10/20	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Sohail Abbass	Pump Operator
2022/10/20	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Afzal	Mechanic/ Work Charge
2022/10/20	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Aftab	Supervisor/ Work Charge
2022/10/20	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Abdullah	Work Charge
2022/10/20	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Ali Ruman	Work Charge
2022/10/20	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Shakeel	Work Charge
2022/11/17	LC1: Replacement planning using mWater and QGIS	1	Mr. Shahbaz Younas	Supervisor
2022/11/17	LC1: Replacement planning using mWater and QGIS	1	Mr. Muhammad Ahsan	Supervisor
2022/11/17	LC1: Replacement planning using mWater and QGIS	1	Mr. Asif Ali	Supervisor
2022/11/17	LC1: Replacement planning using mWater and QGIS	1	Mr. Ramzan	Supervisor
2022/11/17	LC1: Replacement planning using mWater and QGIS	1	Mr. Hassan Mustafa	Assistant Director
2022/11/17	LC1: Replacement planning using mWater and QGIS	1	Mr. Muhammad Umar Farooq	Supervisor
2022/11/17	LC1: Replacement planning using mWater and QGIS	1	Mr. Muhammad Waqas	Sub Engineer
2022/11/17	LC1: Replacement planning using mWater and QGIS	1	Mr. Usman Javed	Supervisor/ WC
2022/11/17	LC1: Replacement planning using mWater and QGIS	1	Mr. Talha	Supervisor
2023/1/4	LC1: Replacement planning using mWater and QGIS	2	M. Asad	
2023/1/4	LC1: Replacement planning using mWater and QGIS	2	Ali Ruman	WC
2023/1/4	LC1: Replacement planning using mWater and QGIS	2	Khalid Yousaf	
2023/1/4	LC1: Replacement planning using mWater and QGIS	2	Mr. Hassan Mustafa	Assistant Director
2023/1/4	LC1: Replacement planning using mWater and QGIS	2	Tauheed Anwar	Sub Engineer
2023/1/4	LC1: Replacement planning using mWater and QGIS	2	M. Shahid	Supervisor
2023/1/4	LC1: Replacement planning using mWater and QGIS	2	Baber Saleem	
2023/1/4	LC1: Replacement planning using mWater and QGIS	2	M. Iqbal	
2023/6/17	LC1: Replacement planning using mWater and QGIS	3	Mr.Usman Javed	Supervisor
2023/6/17	LC1: Replacement planning using mWater and QGIS	3	Mr.Sufyan	Fitter Coolie(Field Person)
2023/6/17	LC1: Replacement planning using mWater and QGIS	3	Mr.Ali Hamza	Fitter Coolie(Field Person)
2023/6/17	LC1: Replacement planning using mWater and QGIS	3	Mr.Zulfiqar Ali	Fitter Coolie (Field Person)
2023/6/17	LC1: Replacement planning using mWater and QGIS	3	Mr.Mudassar Hussain	Fitter Coolie(Field Person)

Date	Training topic	Batch No.	Name of Trainee	Designation
2023/6/17	LC1: Replacement planning using mWater and QGIS	3	Mr.Muhammad Umar	Supervisor
2023/6/17	LC1: Replacement planning using mWater and QGIS	3	Mr.Hasnain Ali	Supervisor
2023/6/17	LC1: Replacement planning using mWater and QGIS	3	Mr.Bahadur Khan	GIS Operator
2023/6/17	LC1: Replacement planning using mWater and QGIS	3	Mr.Talha Tahir	Field Inspector
2023/6/17	LC1: Replacement planning using mWater and QGIS	3	Mr.Nouman Munir	Assistant Field Inspector
2023/6/17	LC1: Replacement planning using mWater and QGIS	3	Mr.Athar Shabbir	Electric Supervisor
2023/6/17	LC1: Replacement planning using mWater and QGIS	3	Mr.Muhammad Atif Murtaza	Electric Technician
2023/9/26	LC1: Replacement planning using mWater and QGIS	4	Mr.Ali Ruman	Sub Engineer
2023/9/26	LC1: Replacement planning using mWater and QGIS	4	Mr.Tassawar	Assistant Director
2023/9/26	LC1: Replacement planning using mWater and QGIS	4	Mr.Farrukh Saghir	Assistant Director
2023/9/26	LC1: Replacement planning using mWater and QGIS	4	Mr.Shahnawaz	Assistant Director
2023/9/26	LC1: Replacement planning using mWater and QGIS	4	Mr.Masab Ali	Assistant Director
2023/9/26	LC1: Replacement planning using mWater and QGIS	4	Mr.Kamran	Assistant Director
2023/9/26	LC1: Replacement planning using mWater and QGIS	4	Mr.Abdullah Awan	Assistant Director
2023/9/26	LC1: Replacement planning using mWater and QGIS	4	Mr.Kashif Ali	Sub Engineer
2023/9/26	LC1: Replacement planning using mWater and QGIS	4	Mr.Nouman Noor	Sub Engineer
2023/9/26	LC1: Replacement planning using mWater and QGIS	4	Mr.Mohammad Umar	Work Charge
2023/9/26	LC1: Replacement planning using mWater and QGIS	4	Mr. Muhammad Shereyar	Work Charge
2023/9/26	LC1: Replacement planning using mWater and QGIS	4	Mr.Waleed Tariq	Supervisor
2023/9/26	LC1: Replacement planning using mWater and QGIS	4	Mr.Shehbaz Younas	Supervisor
2023/9/26	LC1: Replacement planning using mWater and QGIS	4	Mr.Asif Ali	Supervisor
2023/9/26	LC1: Replacement planning using mWater and QGIS	4	Mr.Ramzan	Supervisor
2023/5/19	LC2: Valves, chambers and pressure	pilot	Mr. Shahid hussain	Supervisor
2023/5/19	LC2: Valves, chambers and pressure	pilot	Mr. Muhammad Saleem	mechanic
2023/5/19	LC2: Valves, chambers and pressure	pilot	Mr. Nazir Hussain	Fitter

Date	Training topic	Batch No.	Name of Trainee	Designation
2023/5/19	LC2: Valves, chambers and pressure	pilot	Mr. Ali Hamza	Pump Operator
2023/5/19	LC2: Valves, chambers and pressure	pilot	Mr. Iftekhar	Pump Operator
2023/5/19	LC2: Valves, chambers and pressure	pilot	Mr. Kamran	Fitter Colie
2023/5/19	LC2: Valves, chambers and pressure	pilot	Mr. Fiyaz	Fitter Colie
2023/5/19	LC2: Valves, chambers and pressure	pilot	Mr. Muhammad Yasin	Supervisor
2023/5/19	LC2: Valves, chambers and pressure	pilot	Mr. Aziz Ahmad	Supervisor
2023/5/19	LC2: Valves, chambers and pressure	pilot	Mr. Asif Ali	Supervisor
2023/5/19	LC2: Valves, chambers and pressure	pilot	Mr. Khalid Yousaf	Supervisor
2023/7/11	LC2: Valves, chambers and pressure	1	Mr. Muhammad Asif	Fitter Colie
2023/7/11	LC2: Valves, chambers and pressure	1	Mr. Shahbaz Ahmad	Supervisor
2023/7/11	LC2: Valves, chambers and pressure	1	Mr. Mohsin Azhar	Supervisor
2023/7/11	LC2: Valves, chambers and pressure	1	Mr. Usman Javed	Daily Wages Supervisor
2023/7/11	LC2: Valves, chambers and pressure	1	Mr. Waleed Tariq	Daily Wages Supervisor
2023/7/11	LC2: Valves, chambers and pressure	1	Mr. Hamza Niaz	Assistant Director
2023/7/11	LC2: Valves, chambers and pressure	1	Mr. Ali Ruman	Daily Wages Sub Engineer
2023/7/11	LC2: Valves, chambers and pressure	1	Mr. Asghar Ali	Supervisor
2023/7/11	LC2: Valves, chambers and pressure	1	Mr. Umer Farooq	Junior Clerk
2023/7/11	LC2: Valves, chambers and pressure	1	Mr. Khalid Yousuf	Supervisor
2023/7/11	LC2: Valves, chambers and pressure	1	Mr. Ahsan	Supervisor
2023/7/11	LC2: Valves, chambers and pressure	1	Mr. Atiq	Sub Engineer
2023/8/30	LC2: Valves, chambers and pressure	2	Mr. Masab Ali	Assistant Director
2023/8/30	LC2: Valves, chambers and pressure	2	Mr. Usman Javed	Work Charge (Sub Engineer)
2023/8/30	LC2: Valves, chambers and pressure	2	Mr. Shahbaz Younas	Supervisor
2023/8/30	LC2: Valves, chambers and pressure	2	Mr. Rouf	Sub Engineer
2023/8/30	LC2: Valves, chambers and pressure	2	Mr. Umar	Work Charge (Sub Engineer)
2023/8/30	LC2: Valves, chambers and pressure	2	Mr. Atif Murtaza	Work Charge (Electric technician)
2023/8/30	LC2: Valves, chambers and pressure	2	Mr. Ahmed Shabbir	Supervisor (Electric)
2023/8/30	LC2: Valves, chambers and pressure	2	Mr. Muhammad Umer	Supervisor (
2023/8/30	LC2: Valves, chambers and pressure	2	Mr. Umar Farooq	Work Charge (Electrition helper)

Date	Training topic	Batch No.	Name of Trainee	Designation
2023/8/30	LC2: Valves, chambers and pressure	2	Mr. Arslan Mustafa	Work Charge (Operator)
2023/8/30	LC2: Valves, chambers and pressure	2	Mr. Muhammad Khubaib Rasool	Work Charge (Sub Engineer)
2023/8/30	LC2: Valves, chambers and pressure	2	Mr. Rohan javaid	Deputy Director
2023/8/30	LC2: Valves, chambers and pressure	2	Miss Ayeza Saleem	Assistant Director
2023/8/30	LC2: Valves, chambers and pressure	2	Mr. Asad Munir	Assistant Director
2023/8/30	LC2: Valves, chambers and pressure	2	Mr. Hamza Niaz	Assistant Director
2023/8/30	LC2: Valves, chambers and pressure	2	Mr. Ali Abdullah	Assistant Director
2023/12/6	LC2: Valves, chambers and pressure	3	Mr. Nadeem Sadiq	Senior Supervisor
2023/12/6	LC2: Valves, chambers and pressure	3	Mr. Shahbaz Younas	Supervisor
2023/12/6	LC2: Valves, chambers and pressure	3	Mr. Zulfiqar Ali	Water Supervisor
2023/12/6	LC2: Valves, chambers and pressure	3	Mr. Muhammad Saleem	Fitter Colie
2023/12/6	LC2: Valves, chambers and pressure	3	Mr. Nisar Ahmad	Water Supervisor
2023/12/6	LC2: Valves, chambers and pressure	3	Mr. Asif Ali	Supervisor
2023/12/6	LC2: Valves, chambers and pressure	3	Mr. Muhammad Shahid Hussain	Water Supervisor
2023/12/6	LC2: Valves, chambers and pressure	3	Mr. Ramzan	Supervisor
2023/2/9	LC3: Repair of leakage	pilot	Mr. Farooq Ahmed	Sub Engineer
2023/2/9	LC3: Repair of leakage	pilot	Mr. Asif Hanif	Operator
2023/2/9	LC3: Repair of leakage	pilot	Mr. Muhammad Shakeel	Operator
2023/2/9	LC3: Repair of leakage	pilot	Mr. Jabir Ali	Work Charge
2023/2/9	LC3: Repair of leakage	pilot	Mr. Shahbaz Younis	Supervisor
2023/2/9	LC3: Repair of leakage	pilot	Mr. Muhammad Shahid Hussain	Supervisor
2023/2/9	LC3: Repair of leakage	pilot	Mr. Shafqat Hafeez	Supervisor
2023/2/9	LC3: Repair of leakage	pilot	Mr. Muhammad Aftab	Supervisor/ WC
2023/2/9	LC3: Repair of leakage	pilot	Mr. Ghulam Hussain	Fitter/ WC
2023/2/9	LC3: Repair of leakage	pilot	Mr. Riaz Nasir	Field worker
2023/2/9	LC3: Repair of leakage	pilot	Mr. Tariq Hafeez	Senior Sub Engineer
2023/2/9	LC3: Repair of leakage	pilot	Mr. Muhammad Saad	Sub Engineer/ WC
2023/2/9	LC3: Repair of leakage	pilot	Mr. Usman Javed	Sub Engineer/ WC
2023/7/11	LC3: Repair of leakage	1	Mr. Ali Ruman	Daily Wages Supervisor
2023/7/11	LC3: Repair of leakage	1	Mr. Shahid	Supervisor
2023/7/11	LC3: Repair of leakage	1	Mr. Sajid Ali	Daily Wages Fitter Colie
2023/7/11	LC3: Repair of leakage	1	Mr. zulfiqar Ali	Daily wages fitter
2023/7/11	LC3: Repair of leakage	1	Mr. Hasnain Ali	Daily Wages
2023/7/11	LC3: Repair of leakage	1	Mr. Mohsin Azhar	Supervisor
2023/7/11	LC3: Repair of leakage	1	Mr. Waleed Tariq	Daily Wages Supervisor
2023/7/11	LC3: Repair of leakage	1	Mr. Hamza Niaz	A.D
2023/7/11	LC3: Repair of leakage	1	Mr. Asghar Ali	Supervisor
2023/7/11	LC3: Repair of leakage	1	Mr. Umer Farooq	Junior Clerk

Date	Training topic	Batch No.	Name of Trainee	Designation
2023/7/11	LC3: Repair of leakage	1	Mr. Khalid Yousaf	Supervisor
2023/7/11	LC3: Repair of leakage	1	Mr. Ahsan	Supervisor
2023/8/30	LC3: Repair of leakage	2	Mr. Umar Farooq	Work Charge (Electriction helper)
2023/8/30	LC3: Repair of leakage	2	Mr. Khubaib Rasool	Work Charge (Sub Engineer)
2023/8/30	LC3: Repair of leakage	2	Miss Ayeza Saleem	Assistant Director
2023/8/30	LC3: Repair of leakage	2	Mr. Asad Munir	Assistant Director
2023/8/30	LC3: Repair of leakage	2	Mr. Hamza Niaz	Assistant Director
2023/8/30	LC3: Repair of leakage	2	Mr. Ali Abdullah Awan	Assistant Director
2023/8/30	LC3: Repair of leakage	2	Mr. Masab Ali	Assistant Director
2023/8/30	LC3: Repair of leakage	2	Mr. Usman Javed	Work Charge (Sub Engineer)
2023/8/30	LC3: Repair of leakage	2	Mr. Shahbaz Younas	Supervisor
2023/8/30	LC3: Repair of leakage	2	Mr. Umar	Work Charge (Sub Engineer)
2023/8/30	LC3: Repair of leakage	2	Mr. Atif Murtaza	Work Charge (Electrition Technician)
2023/8/30	LC3: Repair of leakage	2	Mr. Ahmed Shabbir	Supervisor (Electrical)
2023/8/30	LC3: Repair of leakage	2	Mr. Muhammad Umer	Supervisor
2023/8/30	LC3: Repair of leakage	2	Mr. Arslan Mustafa	Work Charge (Operator)
2023/9/27	LC3: Repair of leakage	3	Mr. Shahbaz	Supervisor
2023/9/27	LC3: Repair of leakage	3	Mr. Sabir Ali	Work Charge
2023/9/27	LC3: Repair of leakage	3	Mr. Khalid Masood	Work Charge
2023/9/27	LC3: Repair of leakage	3	Mr. Usman Idrees	Work Charge
2023/9/27	LC3: Repair of leakage	3	Mr. Mubashar Hassan	Helper/field staff
2023/9/27	LC3: Repair of leakage	3	Mr. Jabbar Ali	Work Charge
2023/9/27	LC3: Repair of leakage	3	Mr. Ahmad Gill	Assistant Director
2023/9/27	LC3: Repair of leakage	3	Mr. Ahsan	Work Charge
2023/9/27	LC3: Repair of leakage	3	Mr. Umer javaid	Work Charge
2023/9/27	LC3: Repair of leakage	3	Mr. Shehriyar	Work Charge
2023/9/27	LC3: Repair of leakage	3	Mr. Shahid	Work Charge
2023/12/22	LC3: Repair of leakage	4	Mr. Usman	Work Charge
2023/12/22	LC3: Repair of leakage	4	Mr. Muhammad Rafique	Fitter
2023/12/22	LC3: Repair of leakage	4	Mr. Rizwan	Fitter Colie
2023/12/22	LC3: Repair of leakage	4	Mr. Muhammad Khalid	Supervisor
2023/12/22	LC3: Repair of leakage	4	Mr. Muhammad Ramzan	Supervisor
2023/12/22	LC3: Repair of leakage	4	Mr. Muhammad Shahid	Supervisor
2023/12/22	LC3: Repair of leakage	4	Mr. Muhammad Asif	Supervisor
2023/12/22	LC3: Repair of leakage	4	Mr. Umer Farooq	Fitter
2023/12/22	LC3: Repair of leakage	4	Mr. Khobaib	Work Charge
2023/12/22	LC3: Repair of leakage	4	Mr. Rashid	Fitter

List of participants for in-house training at WASA Multan

Date	Module Name	Batch No.	Name of Trainee	Designation
2022/6/29	ME1: Energy Audit (Mech. & Electrical)	pilot	M. Hassan	Plumber
2022/6/29	ME1: Energy Audit (Mech. & Electrical)	pilot	Qasim	Sr. Sub Engineer
2022/6/29	ME1: Energy Audit (Mech. & Electrical)	pilot	M. Nadeem	DD
2022/6/29	ME1: Energy Audit (Mech. & Electrical)	pilot	Hafeez Laghari	AD
2022/6/29	ME1: Energy Audit (Mech. & Electrical)	pilot	Arif Abbas	DD
2022/6/29	ME1: Energy Audit (Mech. & Electrical)	pilot	Omer Zafar Gurmani	SDO
2023/3/18	ME1: Energy Audit (Mech. & Electrical)	1	M. Fahad	Operator
2023/3/18	ME1: Energy Audit (Mech. & Electrical)	1	Basharat Ali	Sub Engineer
2023/3/18	ME1: Energy Audit (Mech. & Electrical)	1	Yaseen	Helper
2023/3/18	ME1: Energy Audit (Mech. & Electrical)	1	Naeem	Operator
2023/3/18	ME1: Energy Audit (Mech. & Electrical)	1	Khalil Ahmed	Operator
2023/8/3	ME1: Energy Audit (Mech. & Electrical)	2	Mr.Omer Gurmani	Assistant Director
2023/8/3	ME1: Energy Audit (Mech. & Electrical)	2	Mr.Javed	Technician
2023/8/3	ME1: Energy Audit (Mech. & Electrical)	2	Mr.Fakhar Rehman	Fitter
2023/8/3	ME1: Energy Audit (Mech. & Electrical)	2	Mr.Sajad Awan	Electrician
2023/8/3	ME1: Energy Audit (Mech. & Electrical)	2	Mr.Ahmed Akram	Lineman
2023/8/3	ME1: Energy Audit (Mech. & Electrical)	2	Mr.Mushtaq Ahmed	Lineman
2023/8/3	ME1: Energy Audit (Mech. & Electrical)	2	Mr.Irfan Ali	Deputy Pump Operator
2022/6/30	ME2: O&M of Pump (Mech.)	pilot	Shafqat	D/O
2022/6/30	ME2: O&M of Pump (Mech.)	pilot	M. Nadeem	Helper
2022/6/30	ME2: O&M of Pump (Mech.)	pilot	M. Ahmed	Helper
2022/6/30	ME2: O&M of Pump (Mech.)	pilot	M. Khalid	D/O
2022/6/30	ME2: O&M of Pump (Mech.)	pilot	M. Imran	Helper
2022/6/30	ME2: O&M of Pump (Mech.)	pilot	Nazam Abbas	D/O
2022/6/30	ME2: O&M of Pump (Mech.)	pilot	M. Aamin Iqbal	D/O
2022/6/30	ME2: O&M of Pump (Mech.)	pilot	M. Yaseen	Helper
2022/6/30	ME2: O&M of Pump (Mech.)	pilot	Basharat	Sub engineer
2022/6/30	ME2: O&M of Pump (Mech.)	pilot	M. Khalid	D/O
2022/11/2	ME2: O&M of Pump (Mech.)	1	Mr. Muhammad Adeel	AD
2022/11/2	ME2: O&M of Pump (Mech.)	1	Mr. Ahmed Akram	Helper
2022/11/2	ME2: O&M of Pump (Mech.)	1	Mr. Hashim	Pump Operator
2022/11/2	ME2: O&M of Pump (Mech.)	1	Mr. Muhammad Bilal	Pump Operator
2022/11/2	ME2: O&M of Pump (Mech.)	1	Mr. Abdul Qadir	Sub Engineer
2022/11/2	ME2: O&M of Pump (Mech.)	1	Mr. Muhammad Asif	Sub Engineer
2023/8/2	ME2: O&M of Pump (Mech.)	2	Mr.Fakhar Rehman	Fitter
2023/8/2	ME2: O&M of Pump (Mech.)	2	Mr.Omer Gurmani	Assistant Director
2023/8/2	ME2: O&M of Pump (Mech.)	2	Mr.Ahmed Akram	Lineman
2023/8/2	ME2: O&M of Pump (Mech.)	2	Mr.Sajad Awan	Electrician
2023/8/2	ME2: O&M of Pump (Mech.)	2	Mr.Irfan Ali	Deputy Pump operator
2023/8/2	ME2: O&M of Pump (Mech.)	2	Mr.Mushtaq Ahmed	Lineman
2023/8/2	ME2: O&M of Pump (Mech.)	2	Mr.Javed	Technician
2023/3/16	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	Rehan	Operator
2023/3/16	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	Farrukh	Operator
2023/3/16	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	Adil	Operator
2023/3/16	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	Ghulam Jafar	Sr. Sub Engineer
2023/3/16	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	Nadeem	Deputy Director
2023/6/21	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Mr. Khalil Ahmed	Supervisor

Date	Module Name	Batch No.	Name of Trainee	Designation
2023/6/21	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Mr. M. Asif	Supervisor
2023/6/21	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Mr. M. Naveed	Supervisor
2023/6/21	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Mr. Hammad	Supervisor
2022/12/1	SD1: Cleaning of sewerage and drainage pipelines	pilot	Mr. Hafeez Leghari	Assistant Director
2022/12/1	SD1: Cleaning of sewerage and drainage pipelines	pilot	Mr. Abdul Moeed	Assistant Director
2022/12/1	SD1: Cleaning of sewerage and drainage pipelines	pilot	Mr. Ikram	Assistant Director
2022/12/1	SD1: Cleaning of sewerage and drainage pipelines	pilot	Mr. Shakeel Ahmad	Senior Sub Engineer
2022/12/1	SD1: Cleaning of sewerage and drainage pipelines	pilot	Mr. Muhammad Asif	Senior Sub Engineer
2023/5/4	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Muhammad Akbar	Sewerman
2023/5/4	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Sajid Ali	Sewerman
2023/5/4	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Zubair	Sewerman
2023/5/4	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Allah Dita	Sewerman
2023/5/4	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Abdul Moeed	Assistant Director
2023/5/4	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Shafique	Sewerman
2023/5/4	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Muhammad Shakeel Ahmad	Senior Sub Engineer
2023/5/4	SD1: Cleaning of sewerage and drainage pipelines	1	???	
2022/12/3	SD2: Flow measurement	pilot	Mr. Qari Khursheed	Supervisor
2022/12/3	SD2: Flow measurement	pilot	Mr. Kashif	Disposal Operator
2022/12/3	SD2: Flow measurement	pilot	Mr. Ramzan	Senior Sewer man
2022/12/3	SD2: Flow measurement	pilot	Mr. Akbar	Senior Sewer man
2022/12/3	SD2: Flow measurement	pilot	Mr. Shakeel Ahmad	Senior Sub Engineer
2023/6/27	SD2: Flow measurement	1	Mr. Ahmad Raza	Helper
2023/6/27	SD2: Flow measurement	1	Mr. Bisharat	Sub Engineer
2023/6/27	SD2: Flow measurement	1	Mr. Rafiq	Sewerman
2023/6/27	SD2: Flow measurement	1	Mr. Sajid	Assistant Director
2023/6/27	SD2: Flow measurement	1	Mr. Hammad	Daily Wages
2023/6/27	SD2: Flow measurement	1	Mr. Hafeez Ullah	Assistant Director
2023/6/27	SD2: Flow measurement	1	Mr. Allah Wasaya	Sewerman
2023/6/27	SD2: Flow measurement	1	Mr. Mubashir	Helper
2022/12/2	SD3: O&M of waste water treatment plant	pilot	Mr. Shakeel Ahmad	Senior Sub Engineer
2022/12/2	SD3: O&M of waste water treatment plant	pilot	Mr. Muhammad Asif	Senior Sub Engineer
2022/12/2	SD3: O&M of waste water treatment plant	pilot	Mr. Abdul Moeed	Assistant Director
2022/12/2	SD3: O&M of waste water treatment plant	pilot	Mr. Muhammad Fiaz	Sub Engineer
2022/12/2	SD3: O&M of waste water treatment plant	pilot	Mr. Adeel	Sub Engineer
2023/5/6	SD3: O&M of waste water treatment plant	1	Mr. Muhammad Haider	Sewerman
2023/5/6	SD3: O&M of waste water treatment plant	1	Mr. Abdul Moeed	Assistant Director
2023/5/6	SD3: O&M of waste water treatment plant	1	Mr. Qari Khurshid Ahmad	Helper Disposal Station
2023/5/6	SD3: O&M of waste water treatment plant	1	Mr. Sajid Ali	Sewerman

Date	Module Name	Batch No.	Name of Trainee	Designation
2023/5/6	SD3: O&M of waste water treatment plant	1	Mr. Muhammad Akbar	Sewerman
2023/5/6	SD3: O&M of waste water treatment plant	1	Mr. Allah Ditta	Sewerman
2023/5/6	SD3: O&M of waste water treatment plant	1	Mr. Zakir Hussain	Sewerman
2023/5/6	SD3: O&M of waste water treatment plant	1	Mr. Muhammad Riyaz	Sewerman
2022/10/6	LC1: Replacement planning using mWater and QGIS	pilot	Asif Frances	AD
2022/10/6	LC1: Replacement planning using mWater and QGIS	pilot	Amir Hussain Bukhari	Sr. Sub Engineer
2022/10/6	LC1: Replacement planning using mWater and QGIS	pilot	M. Shoaib Sarwar	Sr. Sub Engineer
2022/10/6	LC1: Replacement planning using mWater and QGIS	pilot	M. Shakeel Ahmad	Sr. Sub Engineer
2022/10/6	LC1: Replacement planning using mWater and QGIS	pilot	Abdul Moeed	AD
2022/10/6	LC1: Replacement planning using mWater and QGIS	pilot	Basharat Ali	Sub Engineer
2022/10/6	LC1: Replacement planning using mWater and QGIS	pilot	Hafiz Ullah	AD
2022/10/6	LC1: Replacement planning using mWater and QGIS	pilot	Omer Zafar	AD
2022/11/2	LC1: Replacement planning using mWater and QGIS	1	Mr. Muhammad Bilal	Pump Operator
2022/11/2	LC1: Replacement planning using mWater and QGIS	1	Mr. Muhammad Adeel	AD
2022/11/2	LC1: Replacement planning using mWater and QGIS	1	Mr. Muhammad Asif	Sub Engineer
2022/11/2	LC1: Replacement planning using mWater and QGIS	1	Mr. Abdul Qadir	Sub Engineer
2022/11/2	LC1: Replacement planning using mWater and QGIS	1	Mr. Muhammad Hammad	Supervisor
2022/11/2	LC1: Replacement planning using mWater and QGIS	1	Mr. Hashim	Pump Operator
2022/11/2	LC1: Replacement planning using mWater and QGIS	1	Mr. Ahmed Akram	Helper
2023/6/22	LC1: Replacement planning using mWater and QGIS	2	Mr.Shahid Hameed	Recovery Inspector
2023/6/22	LC1: Replacement planning using mWater and QGIS	2	Mr.Shakeel Ahmed	Sr.Sub Engineer
2023/6/22	LC1: Replacement planning using mWater and QGIS	2	Mr.Amir Hussain Bukhari	Sub Engineer
2023/6/22	LC1: Replacement planning using mWater and QGIS	2	Mr.Mansoor Bashir	Senior Computer Operator
2023/6/22	LC1: Replacement planning using mWater and QGIS	2	Mr.Abdul Majeed	Deputy Director
2023/6/22	LC1: Replacement planning using mWater and QGIS	2	Mr.Rameez Hashmi	Assistant Director
2023/6/22	LC1: Replacement planning using mWater and QGIS	2	Mr.Basharat Ali	Sub Engineer
2023/6/22	LC1: Replacement planning using mWater and QGIS	2	Mr.Mushtaq Ahmed	Work Charge
2023/6/22	LC1: Replacement planning using mWater and QGIS	2	Mr.Zeeshan Ahmed	Work Charge
2023/6/22	LC1: Replacement planning using mWater and QGIS	2	Mr.Younas	Work Charge
2023/6/22	LC1: Replacement planning using mWater and QGIS	2	Mr.Javaid Iqbal	Work Charge

Date	Module Name	Batch No.	Name of Trainee	Designation
2023/9/20	LC1: Replacement planning using mWater and QGIS	3	Mr. Abdul Razzaq	Field Staff/ Helper
2023/9/20	LC1: Replacement planning using mWater and QGIS	3	Mr.Shabir	Field Staff/Plumber
2023/9/20	LC1: Replacement planning using mWater and QGIS	3	Mr.Sadiq	Field Staff
2023/9/20	LC1: Replacement planning using mWater and QGIS	3	Mr.Amir	Field Supervisor/Fitter
2023/9/20	LC1: Replacement planning using mWater and QGIS	3	Mr.Syeda Bukhari	Lab Incharge
2023/9/20	LC1: Replacement planning using mWater and QGIS	3	Mr.Rashid Mehmood	Assistant Director GIS
2023/11/15	LC1: Replacement planning using mWater and QGIS	4	Mr.Taufeeq Ahmed	Recovery Inspector
2023/11/15	LC1: Replacement planning using mWater and QGIS	4	Mr.Faheem Ali	Recovery Assistant
2023/11/15	LC1: Replacement planning using mWater and QGIS	4	Mr.Shehzad Farooq	Recovery Inspector
2023/11/15	LC1: Replacement planning using mWater and QGIS	4	Mr.Imtiaz Ahmed	Recovery Inspector
2023/11/15	LC1: Replacement planning using mWater and QGIS	4	Mr.Muhammad Asif	Recovery Inspector
2023/11/15	LC1: Replacement planning using mWater and QGIS	4	Mr.Malik Sajid Nawaz	Circle Officer
2023/11/15	LC1: Replacement planning using mWater and QGIS	4	Mr.Imran Aslam	Recovery Inspector
2023/11/15	LC1: Replacement planning using mWater and QGIS	4	Mr.Malik Shakeel Ahmed	Circle Incharge
2023/11/15	LC1: Replacement planning using mWater and QGIS	4	Mr.Muhammad Yousaf	Recovery Assistant/ Naib Qasid
2023/11/15	LC1: Replacement planning using mWater and QGIS	4	Mr.Rameez Hashmi	Assistant Director Revenue
2023/11/15	LC1: Replacement planning using mWater and QGIS	4	Mr.Abdul Majeed	Deputy Director Revenue
2023/11/15	LC1: Replacement planning using mWater and QGIS	4	Mr.Shahid Mehmood	Recovery Assistant
2023/3/17	LC2: Distribution Pipe	pilot	Mr. Muhammad Nasir	Fitter
2023/3/17	LC2: Distribution Pipe	pilot	Mr. Abdul Hadi	Lineman
2023/3/17	LC2: Distribution Pipe	pilot	Mr. Shoaib	Lineman
2023/3/17	LC2: Distribution Pipe	pilot	Mr. Muhammad Shafi	Fitter
2023/3/17	LC2: Distribution Pipe	pilot	Mr. Muhammad Ashfaq	Lineman
2023/3/17	LC2: Distribution Pipe	pilot	Mr. Sheraz Hassan	Helper Operator
2023/3/17	LC2: Distribution Pipe	pilot	Mr. Javaid	Supervisor
2023/3/17	LC2: Distribution Pipe	pilot	Mr. Tahir	SDO
2023/5/25	LC2: Distribution Pipe	1	Mr. Basharat Ali	Sub Engineer
2023/5/25	LC2: Distribution Pipe	1	M. Khalil	Operator
2023/5/25	LC2: Distribution Pipe	1	Mr. Muhammad Ashraf	Supervisor
2023/5/25	LC2: Distribution Pipe	1	Mr. Muhammad Javed	Supervisor
2023/5/25	LC2: Distribution Pipe	1	Mr. Tanveer Abbas	Fitter
2023/5/25	LC2: Distribution Pipe	1	Mr. Ilahi Bukhsh	Plumber
2023/5/25	LC2: Distribution Pipe	1	Mr. Abdul Moeed	Assistant Director
2023/5/25	LC2: Distribution Pipe	1	Mr. Haider Ali	Helper
2023/5/25	LC2: Distribution Pipe	1	Mr. Muhammad Asif	Helper

Date	Module Name	Batch No.	Name of Trainee	Designation
2023/5/25	LC2: Distribution Pipe	1	Mr. Falak Shair	Operator
2023/7/19	LC2: Distribution Pipe	2	Mr. Khalil Ahmad	Helper
2023/7/19	LC2: Distribution Pipe	2	Mr. Nadeem	Deputy Director
2023/7/19	LC2: Distribution Pipe	2	Mr. Tanveer	Helper
2023/7/19	LC2: Distribution Pipe	2	Mr. Shoaib Amar	Lineman
2023/7/19	LC2: Distribution Pipe	2	Mr. Jahanzaib Ahmad	Daily Wages
2023/7/19	LC2: Distribution Pipe	2	Mr. Muhammad Raoof	Daily Wages
2023/7/19	LC2: Distribution Pipe	2	Mr. Muhammad Naveed	Operator
2023/7/19	LC2: Distribution Pipe	2	Mr. Muhammad Imran	Helper
2023/7/19	LC2: Distribution Pipe	2	Mr. Muhammad Ahmad	Helper
2023/7/19	LC2: Distribution Pipe	2	Mr. Basharat Ali	Sub Engineer
2023/2/2	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Abdul Moeed	Assistant Director
2023/2/2	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Khawar	Lineman
2023/2/2	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Muhammad Anees Khan	Dewatering Pump Operator
2023/2/2	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Ahmed Akram	Lineman
2023/2/2	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Muhammad Ashraf	Supervisor
2023/2/2	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Muhammad Tahir	Assistant Director
2023/2/2	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Muhammad Javaid	Supervisor
2023/2/2	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Wasim	Lineman
2023/7/20	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Hafeez Leghari	Assistant Director
2023/7/20	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Said Ullah	Sub Engineer
2023/7/20	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Alamgir Syed	Assistant Director
2023/7/20	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Omer Zafar	Assistant Director
2023/7/20	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Asif Francis	Assistant Director
2023/7/20	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Muhammad Ikram	Assistant Director
2023/7/20	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Ghulam Jaffar	Assistant Director
2023/7/20	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Khizar Hayat	Assistant Director
2023/7/20	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Arslan Ali	Sub Engineer
2023/7/20	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Amir Bukhari	Senior Sub Engineer
2023/7/20	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Shoaib Sarwar	Senior Sub Engineer
2023/7/20	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Ishaq Javaid	Senior Sub Engineer
2023/7/20	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Abdul Qadir	Sub Engineer

Date	Module Name	Batch No.	Name of Trainee	Designation
2023/7/20	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Muhammad Arshad	Sub Engineer
2023/7/20	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Shakeel Ahmad	Senior Sub Engineer
2023/8/24	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Muhammad Nadeem	Deputy Director
2023/8/24	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Muhammad Arshad	Sub Engineer
2023/8/24	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Ahmad Akram	Lineman
2023/8/24	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Amir Bukhari	Senior Sub Engineer
2023/8/24	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Muhammad javaid	Supervisor
2023/8/24	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Muhammad jaffar	Helper
2023/8/24	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Ghulam Abbas	Helper

List of participants for in-house training at WASA Gujranwala

Date	Module Name	Batch	Name of Trainee	Designation
2022/2/10	ME1: Energy Audit (Mech. & Electrical)	pilot		
2022/2/10	ME1: Energy Audit (Mech. & Electrical)	pilot		
2022/2/10	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Waqar Serwar	Sub Engineer
2022/2/10	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Amir	Clerk
2022/2/10	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Abdul Majeed	Electrician
2022/2/10	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Nauman Ijaz	Assistant Pump Operator
2022/6/9	ME1: Energy Audit (Mech. & Electrical)	1		
2022/6/9	ME1: Energy Audit (Mech. & Electrical)	1		
2022/6/9	ME1: Energy Audit (Mech. & Electrical)	1	Mr. Hussain	Tube well Operator
2022/6/9	ME1: Energy Audit (Mech. & Electrical)	1	Mr. Waqas	Tube well Operator
2022/6/9	ME1: Energy Audit (Mech. & Electrical)	1	Mr. Sheraz	Electrician
2022/6/9	ME1: Energy Audit (Mech. & Electrical)	1	Mr. Amir	Assistant Electric Block
2023/7/18	ME1: Energy Audit (Mech. & Electrical)	2	Mr. Haseeb	Clerk
2023/7/18	ME1: Energy Audit (Mech. & Electrical)	2	Mr. Talha Noman	Work Charge
2023/7/18	ME1: Energy Audit (Mech. & Electrical)	2	Mr. M. Suleman	Work Charge
2023/7/18	ME1: Energy Audit (Mech. & Electrical)	2	Mr. Qaiser Mehmood	Work Charge
2023/7/18	ME1: Energy Audit (Mech. & Electrical)	2	Mr. Qaiser Salim	Work Charge
2023/7/18	ME1: Energy Audit (Mech. & Electrical)	2	Mr. Aun	Assistant Pump Operator
2023/7/18	ME1: Energy Audit (Mech. & Electrical)	2	Mr. Afaq	Work Charge
2023/10/19	ME1: Energy Audit (Mech. & Electrical)	3	Mr.Haseeb	Junior Clerk
2023/10/19	ME1: Energy Audit (Mech. & Electrical)	3	Mr.Qaiser Salim	Sub Engineer (Work Charge)
2023/10/19	ME1: Energy Audit (Mech. & Electrical)	3	Mr.Qaiser Mehmood	Sub Engineer (Work Charge)
2023/10/19	ME1: Energy Audit (Mech. & Electrical)	3	Mr.Sikandar	Operator
2023/10/19	ME1: Energy Audit (Mech. & Electrical)	3	Mr.Muhammad Tanzil Javaid	Sub Engineer
2023/10/19	ME1: Energy Audit (Mech. & Electrical)	3	Mr.Talha Noman	Work Charge
2023/10/19	ME1: Energy Audit (Mech. & Electrical)	3	Mr.Muhammad Suleman	Electrical Technician (Work Charge)
2023/10/19	ME1: Energy Audit (Mech. & Electrical)	3	Mr.Usama	Junior Clerk
2023/10/19	ME1: Energy Audit (Mech. & Electrical)	3	Mr.Amir Shehzad	
2023/11/16	ME1: Energy Audit (Mech. & Electrical)	4	Mr.Jabbar Aftab	Sub Engineer
2023/11/16	ME1: Energy Audit (Mech. & Electrical)	4	Mr.Alham Rabbani	Sub Engineer
2023/11/16	ME1: Energy Audit (Mech. & Electrical)	4	Mr.Qaiser Salim	Sub Engineer (Workcharge)
2023/11/16	ME1: Energy Audit (Mech. & Electrical)	4	Mr.Qaiser Mehmood	Sub Engineer (Workcharge)
2023/11/16	ME1: Energy Audit (Mech. & Electrical)	4	Mr.Sheraz	Field Electrician
2023/11/16	ME1: Energy Audit (Mech. & Electrical)	4	Mr.Khurram Shehzad	Electrician (Workcharge)
2023/11/16	ME1: Energy Audit (Mech. & Electrical)	4	Mr.Amir Shehzad	
2023/11/16	ME1: Energy Audit (Mech. & Electrical)	4	Mr.Noman Ijaz	Tube well operator
2023/11/16	ME1: Energy Audit (Mech. & Electrical)	4	Mr.Umar Rasheed	Sub Engineer
2023/11/28	ME1: Energy Audit (Mech. & Electrical)	5	Mr.Abbas Masih	Disposal Driver/Operator
2023/11/28	ME1: Energy Audit (Mech. & Electrical)	5	Mr.Muzammal Maqsood	Tube well Operator
2023/11/28	ME1: Energy Audit (Mech. & Electrical)	5	Mr.Sunny Masih	Disposal Operator
2023/11/28	ME1: Energy Audit (Mech. & Electrical)	5	Mr.Khalid Azam	Assistant Pump Operator
2023/11/28	ME1: Energy Audit (Mech. & Electrical)	5	Mr.Yaqoob Masih	Machine driver
2023/11/28	ME1: Energy Audit (Mech. & Electrical)	5	Mr.Mubarik Masih	Supervisor/Mechanical
2023/11/28	ME1: Energy Audit (Mech. & Electrical)	5	Mr. Siddique	Supervisor/Electrician
2023/11/28	ME1: Energy Audit (Mech. & Electrical)	5	Mr.Muhammad Sheraz	Supervisor/Electrician
2023/11/28	ME1: Energy Audit (Mech. & Electrical)	5	Mr.Ilham Rabbani	Sub Engineer
2022/6/21	ME2: O&M of Pump (Mech.)	pilot	Mr. Salman	Disposal Driver
2022/6/21	ME2: O&M of Pump (Mech.)	pilot	Mr. Tariq	Disposal Operator
2022/6/21	ME2: O&M of Pump (Mech.)	pilot	Mr. Taimoor	Work Charge
2022/6/21	ME2: O&M of Pump (Mech.)	pilot	Mr. Siddique	Junior Clerk

Date	Module Name	Batch	Name of Trainee	Designation
2022/6/21	ME2: O&M of Pump (Mech.)	pilot	Mr. Shabbir	
2022/10/20	ME2: O&M of Pump (Mech.)	1		
2022/10/20	ME2: O&M of Pump (Mech.)	1		
2022/10/20	ME2: O&M of Pump (Mech.)	1		
2022/10/20	ME2: O&M of Pump (Mech.)	1		
2022/10/20	ME2: O&M of Pump (Mech.)	1		
2022/10/20	ME2: O&M of Pump (Mech.)	1		
2022/11/24	ME2: O&M of Pump (Mech.)	2	Mr. M. Akmal	Assistant Pump Operator
2022/11/24	ME2: O&M of Pump (Mech.)	2	M. Amir	
2022/11/24	ME2: O&M of Pump (Mech.)	2	Khurram	Electrician
2022/11/24	ME2: O&M of Pump (Mech.)	2		
2022/11/24	ME2: O&M of Pump (Mech.)	2	Mr. Nauman Ijaz	Assistant Pump Operator
2022/11/24	ME2: O&M of Pump (Mech.)	2	Syed Zulfiqar Ali	Electrician
2022/11/24	ME2: O&M of Pump (Mech.)	2	Abdul Majeed	Electrician
2023/7/19	ME2: O&M of Pump (Mech.)	3	Mr. Haseeb	Clerk
2023/7/19	ME2: O&M of Pump (Mech.)	3	Mr. Afaq	Work Charge
2023/7/19	ME2: O&M of Pump (Mech.)	3	Mr. Qaiser Salim	Sub Engineer, Work Charge
2023/7/19	ME2: O&M of Pump (Mech.)	3	Mr. Qaiser Mehmood	Sub Engineer, Work Charge
2023/7/19	ME2: O&M of Pump (Mech.)	3	Mr. Talha Nauman	Assistant Pump Operator
2023/10/18	ME2: O&M of Pump (Mech.)	4	Mr.Amir Shehzad	
2023/10/18	ME2: O&M of Pump (Mech.)	4	Mr.Haseeb	Junior Clerk
2023/10/18	ME2: O&M of Pump (Mech.)	4	Mr.Usama	Junior Clerk
2023/10/18	ME2: O&M of Pump (Mech.)	4	Mr.Muhammad Suleman	Electrical Technician(Work Charge)
2023/10/18	ME2: O&M of Pump (Mech.)	4	Mr.Talha Noman	Work Charge
2023/10/18	ME2: O&M of Pump (Mech.)	4	Mr.Qaiser Mehmood	Sub Engineer (Work Charge)
2023/10/18	ME2: O&M of Pump (Mech.)	4	Mr.Qaiser Salim	Sub Engineer (Work Charge)
2023/10/18	ME2: O&M of Pump (Mech.)	4	Mr.Muhammad Tanzil Javaid	Sub Engineer
2023/11/28	ME2: O&M of Pump (Mech.)	5	Mr.Muhammad Siddque	Supervisor/Electrician
2023/11/28	ME2: O&M of Pump (Mech.)	5	Mr.Mubarik Masih	Supervisor/Mechanical
2023/11/28	ME2: O&M of Pump (Mech.)	5	Mr.Yaqoob Masih	Machine Driver
2023/11/28	ME2: O&M of Pump (Mech.)	5	Mr.Khalid Azam	Assistant Pump Operator
2023/11/28	ME2: O&M of Pump (Mech.)	5	Mr.Sunny Masih	Disposal Station Operator
2023/11/28	ME2: O&M of Pump (Mech.)	5	Mr.Muzammal Maqsood	Tube well operator
2023/11/28	ME2: O&M of Pump (Mech.)	5	Mr.Abbas Masih	Disposal Station Operator
2023/11/28	ME2: O&M of Pump (Mech.)	5	Mr.Ilham Rabbani	Sub Engineer
2023/11/28	ME2: O&M of Pump (Mech.)	5	Mr.Muhammad Sheraz	Supervisor/Electrician
2022/11/25	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	Mr. M. Akmal	Tube well operator
2022/11/25	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	Mr. Amir	
2022/11/25	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	Mr. Khurram	Electrician
2022/11/25	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	Syed Zulfiqar Ali	Electrician
2022/11/25	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	Mr. Abdul Majeed	Electrician
2022/11/25	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	Mr. Nauman Ijaz	Tube well operator
2023/3/2	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Mr. Jabbar Aftab	Sub Engineer
2023/3/2	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Mr. Javed	Plumber

Date	Module Name	Batch	Name of Trainee	Designation
2023/3/2	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Mr. Nauman Iftikhar	Pump Operator
2023/3/2	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Mr. Amir Shahzad	Electrical Clerk
2023/3/2	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Mr. Nauman	Assistant Pump Operator
2023/3/2	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Mr. Tariq	Helper
2023/3/2	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Mr. Haneeq	Helper
2023/3/2	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Mr. Zain-ul-abdeen	Assistant Director
2023/7/12	ME3: Electrical Panel, MCU and wiring (Elect.)	2	Mr. M. Suleman	Assistant Electrical/ Work Charge
2023/7/12	ME3: Electrical Panel, MCU and wiring (Elect.)	2	Mr. Nauman	Pump Operator
2023/7/12	ME3: Electrical Panel, MCU and wiring (Elect.)	2	Mr. Rana Ilham	Sub Engineer
2023/7/12	ME3: Electrical Panel, MCU and wiring (Elect.)	2	Mr. Jabbar Aftab	Sub Engineer
2023/7/12	ME3: Electrical Panel, MCU and wiring (Elect.)	2	Mr. Zain Ul Abideen	Sub Engineer
2023/7/12	ME3: Electrical Panel, MCU and wiring (Elect.)	2	Mr. Amir Shahzad	Assistant Electrical
2023/11/16	ME3: Electrical Panel, MCU and wiring (Elect.)	3	Umar Rasheed	
2023/11/16	ME3: Electrical Panel, MCU and wiring (Elect.)	3	Nauman Ijaz	
2023/11/16	ME3: Electrical Panel, MCU and wiring (Elect.)	3	Ilham Rabbani	
2023/11/16	ME3: Electrical Panel, MCU and wiring (Elect.)	3	Qaiser Salim	
2023/11/16	ME3: Electrical Panel, MCU and wiring (Elect.)	3	Qaiser Mehmood	
2023/11/16	ME3: Electrical Panel, MCU and wiring (Elect.)	3	Sheraz	
2023/11/16	ME3: Electrical Panel, MCU and wiring (Elect.)	3	Khuram Shahzad	
2023/11/16	ME3: Electrical Panel, MCU and wiring (Elect.)	3	Amir Shahzad	
2023/11/16	ME3: Electrical Panel, MCU and wiring (Elect.)	3	Jabbar Afteb	
2022/12/29	SD1: Cleaning of sewerage and drainage pipelines	pilot	Mr. Ghulam Dastagir Butt	Supervisor
2022/12/29	SD1: Cleaning of sewerage and drainage pipelines	pilot	Mr. Zain-ul-abdeen	Sub Engineer
2022/12/29	SD1: Cleaning of sewerage and drainage pipelines	pilot	Mr. Jabbar Aftab	Sub Engineer
2022/12/29	SD1: Cleaning of sewerage and drainage pipelines	pilot	Mr. Khurram Sajjad	Sub Engineer
2022/12/29	SD1: Cleaning of sewerage and drainage pipelines	pilot	Mr. Yaqoob Khushi	Sub Engineer
2023/1/27	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Kashif	Sewerman
2023/1/27	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Hamza	Supervisor/ WC
2023/1/27	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Ghulam Dastagir Butt	Supervisor
2023/1/27	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Qaiser	Supervisor

Date	Module Name	Batch	Name of Trainee	Designation
2023/1/27	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Anthony	Sewerman
2023/1/27	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Haris	Sewerman/ WC
2023/1/27	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Mubasher	Sewerman
2023/1/27	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Rashid	Sewerman
2023/4/3	SD1: Cleaning of sewerage and drainage pipelines	2	Mr. Nauman	Pump Operator
2023/4/3	SD1: Cleaning of sewerage and drainage pipelines	2	Mr. Sarmad Waheed	Assistant Director
2023/4/3	SD1: Cleaning of sewerage and drainage pipelines	2	Mr. Zain-ul-abdeen	Sub Engineer
2023/4/3	SD1: Cleaning of sewerage and drainage pipelines	2	Mr. Haseeb Ul Rehman	Supervisor
2023/4/3	SD1: Cleaning of sewerage and drainage pipelines	2	Mr. Samson	Sewerman
2023/4/3	SD1: Cleaning of sewerage and drainage pipelines	2	Mr. Faryad	Sewerman
2023/4/3	SD1: Cleaning of sewerage and drainage pipelines	2	Mr. Tanveer	Sewerman
2022/12/29	SD2: Flow measurement	pilot	Mr. Ghulam Dastagir But	Sub Engineer
2022/12/29	SD2: Flow measurement	pilot	Mr. Yaqoob Khushi	Sub Engineer
2022/12/29	SD2: Flow measurement	pilot	Mr. Khurram Sajjad	Sub Engineer
2022/12/29	SD2: Flow measurement	pilot	Mr. Jabbar Aftab	Sub Engineer
2022/12/29	SD2: Flow measurement	pilot	Mr. Zain-ul-abdeen	Sub Engineer
2023/1/25	SD2: Flow measurement	1	Mr. Haris	Sewerman/ WC
2023/1/25	SD2: Flow measurement	1	Mr. Qaiser	Supervisor
2023/1/25	SD2: Flow measurement	1	Mr. Ghulam Dastagir Butt	Supervisor
2023/1/25	SD2: Flow measurement	1	Mr. Hamza	Supervisor/ WC
2023/1/25	SD2: Flow measurement	1	Mr. Rashid	Sewerman
2023/1/25	SD2: Flow measurement	1	Mr. Kashif	Sewerman
2023/1/25	SD2: Flow measurement	1	Mr. Mubasher	Sewerman
2023/1/25	SD2: Flow measurement	1	Mr. Anthony	Sewerman
2023/4/4	SD2: Flow measurement	2	Mr. Zain-ul-abdeen	Sub Engineer
2023/4/4	SD2: Flow measurement	2	Mr. Samson	Sewerman
2023/4/4	SD2: Flow measurement	2	Mr. Nauman	Pump Operator
2023/4/4	SD2: Flow measurement	2	Mr. Tanvir	Sewerman

Date	Module Name	Batch	Name of Trainee	Designation
2023/4/4	SD2: Flow measurement	2	Mr. Faryad	Sewerman
2023/4/4	SD2: Flow measurement	2	Mr. Haseeb	Supervisor
2023/4/4	SD2: Flow measurement	2	Mr. Sarmad Waheed	Assistant Director
2023/6/14	SD2: Flow measurement	3	Mr. Zain	Sub Engineer
2023/6/14	SD2: Flow measurement	3	Mr. Asif	Clerk
2023/6/14	SD2: Flow measurement	3	Mr. Jabbar	Sub Engineer
2023/6/14	SD2: Flow measurement	3	Mr. Qaiser	work charge
2023/6/14	SD2: Flow measurement	3	Mr. Haseeb	Clerk
2023/6/14	SD2: Flow measurement	3	Mr. Khurram	Electrical Incharge
2023/6/14	SD2: Flow measurement	3	Mr. Khurram	Supervisor
2023/6/14	SD2: Flow measurement	3	Mr. Adnan	Sewerman
2023/6/14	SD2: Flow measurement	3	Mr. Younus	Sewerman
2022/10/14	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Ali Hasnain	Assistant Director
2022/10/14	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Waqar Sarwar	Sub Engineer
2022/10/14	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Tanzeel Javed	Sub Engineer
2022/10/14	LC1: Replacement planning using mWater and QGIS	pilot	Mr. Hamza Ali	Work Charge
2022/11/23	LC1: Replacement planning using mWater and QGIS	1	Amir Shahzad	Clerk
2022/11/23	LC1: Replacement planning using mWater and QGIS	1	Zeeshan	Clerk
2022/11/23	LC1: Replacement planning using mWater and QGIS	1	Mr. Kashan Hafeez Butt	Director
2022/11/23	LC1: Replacement planning using mWater and QGIS	1	Abdul Wahab	Deputy Director
2022/11/23	LC1: Replacement planning using mWater and QGIS	1	M. Iftikhar	Assistant Director
2022/11/23	LC1: Replacement planning using mWater and QGIS	1	Shakeel Ahmed	Sr. Sub Engineer
2023/6/14	LC1: Replacement planning using mWater and QGIS	2	Mr.Kamran Munir	Sub Engineer
2023/6/14	LC1: Replacement planning using mWater and QGIS	2	Mr.Waqar Sarwar	Sub Engineer
2023/6/14	LC1: Replacement planning using mWater and QGIS	2	Mr.Umar Rasheed	Sub Engineer
2023/6/14	LC1: Replacement planning using mWater and QGIS	2	Mr.Nadeem Arif	Sub Engineer
2023/6/14	LC1: Replacement planning using mWater and QGIS	2	Mr.Qasir Mehmood	Sub Engineer
2023/6/14	LC1: Replacement planning using mWater and QGIS	2	Mr.Tanzil Javaid	Sub Engineer

Date	Module Name	Batch	Name of Trainee	Designation
2023/6/14	LC1: Replacement planning using mWater and QGIS	2	Mr.Farhan Naeem	Computer Operator
2023/3/2	LC2: Distribution Pipe	pilot	Mr. Tariq	Helper
2023/3/2	LC2: Distribution Pipe	pilot	Mr. Nauman	Assistant Pump Operator
2023/3/2	LC2: Distribution Pipe	pilot	Mr. Sarmad Waheed	Assistant Director
2023/3/2	LC2: Distribution Pipe	pilot	Mr. Jabbar Aftab	Sub Engineer
2023/3/2	LC2: Distribution Pipe	pilot	Mr. Amir Shahzad	Electrical Clerk
2023/3/2	LC2: Distribution Pipe	pilot	Mr. Javed	Plumber
2023/3/2	LC2: Distribution Pipe	pilot	Mr. Haneeq	Helper
2023/6/1	LC2: Distribution Pipe	1	Mr. Usman	Plumber
2023/6/1	LC2: Distribution Pipe	1	Mr. Tariq	Plumber
2023/6/1	LC2: Distribution Pipe	1	Mr. Kevel	Helper plumber
2023/6/1	LC2: Distribution Pipe	1	Mr. Shan	Helper plumber
2023/6/1	LC2: Distribution Pipe	1	Mr. Waris	Mason
2023/6/1	LC2: Distribution Pipe	1	Mr. Yaqoob	Mason
2023/6/1	LC2: Distribution Pipe	1	Mr. Baber	Mason
2023/8/8	LC2: Distribution Pipe	2	Mr. Farhan Naeem Butt	Daily Wages
2023/8/8	LC2: Distribution Pipe	2	Mr. Ahsan Khan	Assistant Pump Operator (APO)
2023/8/8	LC2: Distribution Pipe	2	Mr. Abdul Ghafoor	Clerk
2023/8/8	LC2: Distribution Pipe	2	Mr. Hanooq Masih	Sewerman
2023/8/8	LC2: Distribution Pipe	2	Mr. Tariq Masih	Sewerman
2023/8/8	LC2: Distribution Pipe	2	Mr. Numan Ijaz	Assistant Pump Operator (APO)
2023/8/8	LC2: Distribution Pipe	2	Mr. Javaid	Plumber
2023/8/8	LC2: Distribution Pipe	2	Mr. Sarmad	Sub Engineer
2023/9/6	LC2: Distribution Pipe	3	Mr. Ameer Hamza	Work Charge
2023/9/6	LC2: Distribution Pipe	3	Mr. Alyan Azhar	Work charge/ plumber
2023/9/6	LC2: Distribution Pipe	3	Mr. Sajid Shoukat	Work Charge
2023/9/6	LC2: Distribution Pipe	3	Mr. Shakeel Ahmad	Senior Sub Engineer
2023/11/23	LC2: Distribution Pipe	4	Mr. Hanook	Helper
2023/11/23	LC2: Distribution Pipe	4	Mr. Sajid Shoukat	Helper
2023/11/23	LC2: Distribution Pipe	4	Mr. Waqas	Sewerman

Date	Module Name	Batch	Name of Trainee	Designation
2023/11/23	LC2: Distribution Pipe	4	Mr. Tariq Mehmood	Disposal Driver
2023/11/23	LC2: Distribution Pipe	4	Mr. Idrees	Helper
2023/11/23	LC2: Distribution Pipe	4	Mr. Tariq Bashir	Helper
2023/11/23	LC2: Distribution Pipe	4	Mr. Javaid	Plumber
2023/11/23	LC2: Distribution Pipe	4	Mr. Muhammad Abbas	Naib Qasid
2023/1/26	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Farhan	Operator
2023/1/26	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Haneeq	Sewerage (Field Staff)
2023/1/26	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Qaiser Salim	Operator
2023/1/26	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Tariq	Plumber
2023/1/26	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Javed	Plumber
2023/1/26	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Jabbar	Supervisor
2023/3/30	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Jabbar Aftab	Sub Engineer
2023/3/30	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Ghulam Dastagir Butt	Supervisor
2023/3/30	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Sarmad Waheed	Assistant Director
2023/3/30	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Qaiser Mehmood	Sub Engineer
2023/3/30	LC3: Leakage control and plumbing with Service Pipe	1	Mr. Qaiser Saleem	Sub Engineer
2023/8/3	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Hanooq Masih	Sewerman
2023/8/3	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Farhan Naeem Butt	Daily Wages
2023/8/3	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Tariq Masih	Sewerman
2023/8/3	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Abdul Ghafoor	Clerk
2023/8/3	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Ahsan Khan	Assistant Pump Operator
2023/8/3	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Nouman Ijaz	Assistant Pump Operator
2023/8/3	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Javaid	Plumber
2023/8/3	LC3: Leakage control and plumbing with Service Pipe	2	Mr. sarmad	Sub Engineer
2023/11/8	LC3: Leakage control and plumbing with Service Pipe	3	Mr. Hanooq	Plumber Helper
2023/11/8	LC3: Leakage control and plumbing with Service Pipe	3	Mr. Nouman	Tube Well Operator
2023/11/8	LC3: Leakage control and plumbing with Service Pipe	3	Mr. Shan	Plumber
2023/11/8	LC3: Leakage control and plumbing with Service Pipe	3	Mr. Sajid	Plumber

Date	Module Name	Batch	Name of Trainee	Designation
2023/11/8	LC3: Leakage control and plumbing with Service Pipe	3	Mr. Tariq	Plumber
2023/11/8	LC3: Leakage control and plumbing with Service Pipe	3	Mr. Jabbar	Sub Engineer

List of participants for in-house training at WASA Rawalpindi

Date	Module Name	Batch No.	Name of Trainee	Designation
2022/2/3	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Yamin	Supervisor
2022/2/3	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Amir Shah	Sub Engineer
2022/2/3	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Arif	Mechanic (Tube well)
2022/2/3	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Nauman	
2022/2/3	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Arif	Fitter
2022/2/3	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Kausar Mehmood	Supervisor
2022/2/3	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Nasir Shah	Helper
2022/2/3	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Khalil	Fitter
2022/2/3	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Waseem	TW Operator
2022/2/3	ME1: Energy Audit (Mech. & Electrical)	pilot	Sheikh Arsalan	Operator
2022/2/3	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Ata Niazi	Supervisor
2022/2/3	ME1: Energy Audit (Mech. & Electrical)	pilot	Mr. Nadeem Kiyani	Helper
2022/12/8	ME1: Energy Audit (Mech. & Electrical)	1	Yasrab khan	Supervisor
2022/12/8	ME1: Energy Audit (Mech. & Electrical)	1	M. Ilyas	Helper
2022/12/8	ME1: Energy Audit (Mech. & Electrical)	1	M. Yamin	Supervisor
2022/12/8	ME1: Energy Audit (Mech. & Electrical)	1	M. Azam khan	Supervisor
2022/12/8	ME1: Energy Audit (Mech. & Electrical)	1	Asim Nawaz	Naib Qasid
2022/12/8	ME1: Energy Audit (Mech. & Electrical)	1	Iftikhar Ahmed	Supervisor
2022/12/8	ME1: Energy Audit (Mech. & Electrical)	1	Abdul Hamid	Supervisor
2022/12/8	ME1: Energy Audit (Mech. & Electrical)	1	M. Ramzan khan	Tube well operator
2022/12/8	ME1: Energy Audit (Mech. & Electrical)	1	M. Saeed	Tube well inspector
2022/12/8	ME1: Energy Audit (Mech. & Electrical)	1	Danish Ramzan	Pipe fitter
2023/5/15	ME1: Energy Audit (Mech. & Electrical)	2	Mr.Amir Shah	Sub Engineer
2023/5/15	ME1: Energy Audit (Mech. & Electrical)	2	Mr.Yamin	Supervisor
2023/5/15	ME1: Energy Audit (Mech. & Electrical)	2	Mr.Nisar Ahmed	Lab Assistant
2023/5/15	ME1: Energy Audit (Mech. & Electrical)	2	Mr.Yasir	Plant Operator
2023/5/15	ME1: Energy Audit (Mech. & Electrical)	2	Mr.Muhammad Waqar	Plant Operator
2023/5/15	ME1: Energy Audit (Mech. & Electrical)	2	Mr.Asad Ullah	Tube well Operator
2023/5/15	ME1: Energy Audit (Mech. & Electrical)	2	Mr.Muhmmad Ali	Sub Engineer
2023/5/15	ME1: Energy Audit (Mech. & Electrical)	2	Mr.Abdul Rehman	Sub Engineer
2023/5/15	ME1: Energy Audit (Mech. & Electrical)	2	Mr.Ishtiaq	Sub Engineer
2023/8/9	ME1: Energy Audit (Mech. & Electrical)	3	M. Ijaz	
2023/8/9	ME1: Energy Audit (Mech. & Electrical)	3		
2023/8/9	ME1: Energy Audit (Mech. & Electrical)	3		
2023/8/9	ME1: Energy Audit (Mech. & Electrical)	3		
2023/8/9	ME1: Energy Audit (Mech. & Electrical)	3		
2023/8/9	ME1: Energy Audit (Mech. & Electrical)	3	Abdul Ghaffar	
2023/8/9	ME1: Energy Audit (Mech. & Electrical)	3	M. Ali	
2023/10/25	ME1: Energy Audit (Mech. & Electrical)	4	Mr.Rizwan Samar Shah	Supervisor
2023/10/25	ME1: Energy Audit (Mech. & Electrical)	4	Mr.Muhammad Waseem	Operator
2023/10/25	ME1: Energy Audit (Mech. & Electrical)	4	Mr.Faheem Saeed	Operator
2023/10/25	ME1: Energy Audit (Mech. & Electrical)	4	Mr.Yasir Jahangir	Operator
2023/10/25	ME1: Energy Audit (Mech. & Electrical)	4	Mr.Anees ur Rehman	Operator
2022/7/6	ME2: O&M of Pump (Mech.)	pilot	Asad Ullah	Helper
2022/7/6	ME2: O&M of Pump (Mech.)	pilot	Mr. Nadeem Kiyani	Helper
2022/7/6	ME2: O&M of Pump (Mech.)	pilot	Mr. Yamin	Supervisor
2022/7/6	ME2: O&M of Pump (Mech.)	pilot	Nauman	Helper
2022/7/6	ME2: O&M of Pump (Mech.)	pilot	Mr. Amir Shah	Sub Engineer
2022/7/6	ME2: O&M of Pump (Mech.)	pilot	Mehfooz Kiyani	Supervisor

Date	Module Name	Batch No.	Name of Trainee	Designation
2022/7/6	ME2: O&M of Pump (Mech.)	pilot	Nasir Shah	Helper
2022/12/7	ME2: O&M of Pump (Mech.)	1	Amir shah	Sub Engineer
2022/12/7	ME2: O&M of Pump (Mech.)	1		AD
2022/12/7	ME2: O&M of Pump (Mech.)	1	Haseeb	Sub Engineer
2022/12/7	ME2: O&M of Pump (Mech.)	1	M. Umair	Sub Engineer
2022/12/7	ME2: O&M of Pump (Mech.)	1	M. Ali	Supervisor
2022/12/7	ME2: O&M of Pump (Mech.)	1	Samran Zahid	Supervisor
2022/12/7	ME2: O&M of Pump (Mech.)	1	Mumraiz Akhtar	Supervisor
2022/12/7	ME2: O&M of Pump (Mech.)	1		
2022/12/7	ME2: O&M of Pump (Mech.)	1		
2022/12/7	ME2: O&M of Pump (Mech.)	1		
2023/5/15	ME2: O&M of Pump (Mech.)	2	Mr.Nisar Ahmed	Lab Assistant
2023/5/15	ME2: O&M of Pump (Mech.)	2	Mr.Muhammad Ishtiaq	Sub Engineer
2023/5/15	ME2: O&M of Pump (Mech.)	2	Mr.Abdul Rehman	Sub Engineer
2023/5/15	ME2: O&M of Pump (Mech.)	2	Mr.Muhammad Ali	Sub Engineer
2023/5/15	ME2: O&M of Pump (Mech.)	2	Mr.Amir Shah	Sub Engineer
2023/5/15	ME2: O&M of Pump (Mech.)	2	Mr.Yamin	Supervisor
2023/5/15	ME2: O&M of Pump (Mech.)	2	Mr.Yasir	Plant Operator
2023/5/15	ME2: O&M of Pump (Mech.)	2	Mr.Muhammad Waqar	Plant Operator
2023/5/15	ME2: O&M of Pump (Mech.)	2	Mr.Asad Ullah	Tube well Operator
2023/8/10	ME2: O&M of Pump (Mech.)	3	M. Ijaz	
2023/8/10	ME2: O&M of Pump (Mech.)	3		
2023/8/10	ME2: O&M of Pump (Mech.)	3		
2023/8/10	ME2: O&M of Pump (Mech.)	3		
2023/8/10	ME2: O&M of Pump (Mech.)	3	Abdul Ghaffar	
2023/8/10	ME2: O&M of Pump (Mech.)	3		
2023/8/10	ME2: O&M of Pump (Mech.)	3	M. Ali	
2023/10/25	ME2: O&M of Pump (Mech.)	4	Mr.Muhammad Waseem	Operator
2023/10/25	ME2: O&M of Pump (Mech.)	4	Mr.Faheem Saeed	Operator
2023/10/25	ME2: O&M of Pump (Mech.)	4	Mr.Yasir Jahangir	Operator
2023/10/25	ME2: O&M of Pump (Mech.)	4	Mr.Anees ur Rehman	Operator
2023/10/25	ME2: O&M of Pump (Mech.)	4	Mr.Rizwan Samar Shah	Supervisor
2022/12/8	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	M. Yamin	Supervisor
2022/12/8	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	Iftikhar Ahmed	Supervisor
2022/12/8	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	Abdul Hamid	Supervisor
2022/12/8	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	M. Ramzan khan	Tube well operator
2022/12/8	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	M. Saeed	Tube well inspector
2022/12/8	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	Asad Khan	Tube well operator
2022/12/8	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	Yasrab khan	Supervisor
2022/12/8	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	Asim Nawaz	Naib Qasid
2022/12/8	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	M. Azam	Supervisor

Date	Module Name	Batch No.	Name of Trainee	Designation
2022/12/8	ME3: Electrical Panel, MCU and wiring (Elect.)	pilot	Umer Kaleem	Assistant Director/ Daily wages
2023/2/24	ME3: Electrical Panel, MCU and wiring (Elect.)	1	M. Jahangir	Electrical Supervisor
2023/2/24	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Farrukh Imran	Tube well Supervisor
2023/2/24	ME3: Electrical Panel, MCU and wiring (Elect.)	1	M. Nawazish	Mechanic
2023/2/24	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Aamir Manzoor	Helper
2023/2/24	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Imran Akram	Helper
2023/2/24	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Sajjad Ali	Helper
2023/2/24	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Nauman Yonus	Wall man
2023/2/24	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Asad Khan	Tube well operator
2023/2/24	ME3: Electrical Panel, MCU and wiring (Elect.)	1	M. Yamin	Supervisor
2023/2/24	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Iftikhar Ahmed	Supervisor
2023/2/24	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Nadeem	Helper
2023/2/24	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Israr Shah	Supervisor
2023/2/24	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Abdul Rasheed	Supervisor
2023/2/24	ME3: Electrical Panel, MCU and wiring (Elect.)	1	Yasrab Khan	Supervisor
2023/2/24	ME3: Electrical Panel, MCU and wiring (Elect.)	1	M. Azeem	Electrician
2022/12/17	SD1: Cleaning of sewerage and drainage pipelines	pilot	Irshad Hussain	Sub Engineer
2022/12/17	SD1: Cleaning of sewerage and drainage pipelines	pilot	Ahmad Hussain	Sub Engineer
2022/12/17	SD1: Cleaning of sewerage and drainage pipelines	pilot	Mehfooz Kiyani	Supervisor
2022/12/17	SD1: Cleaning of sewerage and drainage pipelines	pilot	Waris Sothra	Supervisor
2022/12/17	SD1: Cleaning of sewerage and drainage pipelines	pilot	Hanif	Supervisor
2022/12/17	SD1: Cleaning of sewerage and drainage pipelines	pilot	Nadeem Kiyani	Helper
2022/12/17	SD1: Cleaning of sewerage and drainage pipelines	pilot	Ali Gulraiz	Sub Engineer
2023/3/22	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Muzamil	Tube well Operator
2023/3/22	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Nawaz	Helper
2023/3/22	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Waris	Supervisor
2023/3/22	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Bota Masih	Sewerman
2023/3/22	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Pervaiz	Maid
2023/3/22	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Fazal Wadood	Senior Clerk
2023/3/22	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Ahmad Hassan	SE

Date	Module Name	Batch No.	Name of Trainee	Designation
2023/3/22	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Irshad Hussain	SE
2023/3/22	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Ali Gulraiz	SE
2023/3/22	SD1: Cleaning of sewerage and drainage pipelines	1	Mr. Afzal Khan	AD
2022/12/17	SD2: Flow measurement	pilot	Zohaib	Sub Engineer
2022/12/17	SD2: Flow measurement	pilot	Haseeb	Sub Engineer
2022/12/17	SD2: Flow measurement	pilot	Touseef	Dirctor
2022/12/17	SD2: Flow measurement	pilot	Saleem Ashraf	DMD
2022/12/17	SD2: Flow measurement	pilot	Irshad Hussain	Sub Engineer
2023/3/22	SD2: Flow measurement	1	Mr. Muzamil	Tube well Operator
2023/3/22	SD2: Flow measurement	1	Mr. Nawaz	Helper
2023/3/22	SD2: Flow measurement	1	Mr. Waris	Supervisor
2023/3/22	SD2: Flow measurement	1	Mr. Bota Masih	Sewerman
2023/3/22	SD2: Flow measurement	1	Mr. Pervaiz	Maid
2023/3/22	SD2: Flow measurement	1	Mr. Fazal Wadood	Senior Clerk
2023/3/22	SD2: Flow measurement	1	Mr. Ahmad Hassan	SE
2023/3/22	SD2: Flow measurement	1	Mr. Irshad Hussain	SE
2023/3/22	SD2: Flow measurement	1	Mr. Ali Gulraiz	SE
2023/3/22	SD2: Flow measurement	1	Mr. Afzal Khan	AD
2022/12/7	LC1: Replacement planning using mWater and QGIS	pilot	Amir shah	Sub Engineer
2022/12/7	LC1: Replacement planning using mWater and QGIS	pilot	M. Umair	Sub Engineer
2022/12/7	LC1: Replacement planning using mWater and QGIS	pilot	M. Ali	Supervisor
2022/12/7	LC1: Replacement planning using mWater and QGIS	pilot	Samran Zahid	Supervisor
2022/12/7	LC1: Replacement planning using mWater and QGIS	pilot	Mumraiz Akhtar	Supervisor
2022/12/7	LC1: Replacement planning using mWater and QGIS	pilot		Assistant director
2022/12/7	LC1: Replacement planning using mWater and QGIS	pilot	Khaleeq Afzal	Assistant director
2023/3/16	LC1: Replacement planning using mWater and QGIS	1	Mr.Ishtiaq Khokar	Sub Engineer
2023/3/16	LC1: Replacement planning using mWater and QGIS	1	Mr.Noshad Aslam	Sub Engineer
2023/3/16	LC1: Replacement planning using mWater and QGIS	1	Mr.Saad Ullah Faiz	Sub Engineer
2023/3/16	LC1: Replacement planning using mWater and QGIS	1	Mr.Muhammad Shoaib	Sub Engineer
2023/6/8	LC1: Replacement planning using mWater and QGIS	2	Mr.Haseeb Siddique	Supervisor
2023/6/8	LC1: Replacement planning using mWater and QGIS	2	Mr.Adeel Hameed	Supervisor
2023/6/8	LC1: Replacement planning using mWater and QGIS	2	Mr.Syed Rizwan	Supervisor
2023/6/8	LC1: Replacement planning using mWater and QGIS	2	Mr.Muhammad Abdullah	Supervisor
2023/6/8	LC1: Replacement planning using mWater and QGIS	2	Mr.Muhammad Saqib	Junior Clerk
2023/6/8	LC1: Replacement planning using mWater and QGIS	2	Mr.Naseer ullah Babar	Supervisor
2023/6/8	LC1: Replacement planning using mWater and QGIS	2	Mr.Muhammad Salahudin	Junior Clerk
2023/6/8	LC1: Replacement planning using mWater and QGIS	2	Mr.Noor ul Hassan	Operator

Date	Module Name	Batch No.	Name of Trainee	Designation
2023/6/8	LC1: Replacement planning using mWater and QGIS	2	Mr.Anees-ur-Rehman	
2023/10/26	LC1: Replacement planning using mWater and QGIS	3	Mr.Mumraiz Akhtar	Tube well Inspector
2023/10/26	LC1: Replacement planning using mWater and QGIS	3	Mr.Rizwan Adeel	Assistant Director Electrical
2023/10/26	LC1: Replacement planning using mWater and QGIS	3	Mr.Muhammad Ali	Sub Engineer
2023/10/26	LC1: Replacement planning using mWater and QGIS	3	Mr.Muhammad Fakhar Ejaz	Sub Engineer
2023/10/26	LC1: Replacement planning using mWater and QGIS	3	Mr.Raja Muhammad Shoaib	Sub Engineer
2023/10/26	LC1: Replacement planning using mWater and QGIS	3	Mr.Muhammad Ishtiaq	Sub Engineer
2023/10/26	LC1: Replacement planning using mWater and QGIS	3	Mr.Anees ur Rehman	Tube well Operator
2023/10/26	LC1: Replacement planning using mWater and QGIS	3	Mr.Muhammad Yamin	Supervisor
2023/10/26	LC1: Replacement planning using mWater and QGIS	3	Mr.Syed Rizwan Samar	Supervisor
2023/10/26	LC1: Replacement planning using mWater and QGIS	3	Mr.Saad ullah Faiz	Sub Engineer
2023/5/12	LC2: Distribution Pipe	pilot	Mr. Nazakat Hussain	Supervisor
2023/5/12	LC2: Distribution Pipe	pilot	Mr. Adeel Azhar	Sub Engineer
2023/5/12	LC2: Distribution Pipe	pilot	Mr. Mansoor Qureshi	Sub Engineer
2023/5/12	LC2: Distribution Pipe	pilot	Mr. Shahzaib Nawab	Tubewell Operator
2023/5/12	LC2: Distribution Pipe	pilot	Mr. Waqar Akbar	Tubewell Operator
2023/5/12	LC2: Distribution Pipe	pilot	Mr. Rizwan Ahmed	Tubewell Operator
2023/5/12	LC2: Distribution Pipe	pilot	Mr. Kausar Mehmood	Supervisor
2023/6/7	LC2: Distribution Pipe	1	Mr. Shahzad	Fitter
2023/6/7	LC2: Distribution Pipe	1	Mr. Waqar	Supervisor
2023/6/7	LC2: Distribution Pipe	1	Mr. Arif	Supervisor
2023/6/7	LC2: Distribution Pipe	1	Mr. Sadiq	Store keeper
2023/6/7	LC2: Distribution Pipe	1	Mr. Mansoor Ali	Sub Engineer
2023/6/7	LC2: Distribution Pipe	1	Shahzeb	Helper
2023/6/7	LC2: Distribution Pipe	1	Fida Ullah	Pipe Fitter
2023/6/7	LC2: Distribution Pipe	1	Mr. Konain Ali	Supervisor
2023/6/7	LC2: Distribution Pipe	1	Mr. Danish	Supervisor
2023/6/7	LC2: Distribution Pipe	1	Mr. Javed Shah	Tube Well Inspector
2023/6/7	LC2: Distribution Pipe	1	Mr. Adeel	Sub Engineer
2023/6/7	LC2: Distribution Pipe	1	Mr. Shoaib	Sub Engineer

Date	Module Name	Batch No.	Name of Trainee	Designation
2023/6/7	LC2: Distribution Pipe	1	Mr. Ali	Sub Engineer
2023/6/7	LC2: Distribution Pipe	1	Mr. Kousar Mehmood	Supervisor
2023/6/7	LC2: Distribution Pipe	1	Mr. Ishtiaq	Helper
2023/8/17	LC2: Distribution Pipe	2	Mr. Muhammad Ali	Assistant Director
2023/8/17	LC2: Distribution Pipe	2	Mr. Salman Manzoor	Assistant Director
2023/8/17	LC2: Distribution Pipe	2	Mr. Adeel	Sub Engineer
2023/8/17	LC2: Distribution Pipe	2	Mr. Hasnain Ali Shah	Assistant Director
2023/8/17	LC2: Distribution Pipe	2	Mr. Rizwan Adeel	Assistant Director
2023/8/17	LC2: Distribution Pipe	2	Mr. Zeeshan Ashraf	Assistant Director
2023/11/30	LC2: Distribution Pipe	3	Mr. Ali	Sub Engineer
2023/11/30	LC2: Distribution Pipe	3	Mr. Adeel	Tube well Operator
2023/11/30	LC2: Distribution Pipe	3	Mr. Adnan	Tube Well Operator
2023/11/30	LC2: Distribution Pipe	3	Mr. Abid Hussain	Pipe Fitter
2023/11/30	LC2: Distribution Pipe	3	Mr. Zulfiqar Ali	Pipe Fitter
2023/11/30	LC2: Distribution Pipe	3	Mr. Yasir Arafat	Helper
2023/11/30	LC2: Distribution Pipe	3	Mr. Khalil Ahmed	Helper
2023/11/30	LC2: Distribution Pipe	3	Mr. Qadir Ahmed	Valveman
2023/11/30	LC2: Distribution Pipe	3	Mr. Israr Ahmed	Fitter
2023/2/16	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Nauman Yonus	Operator/Valve man
2023/2/16	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Rizwan Qayyum	Operator
2023/2/16	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Nadeem Kayani	Electrician/Helper
2023/2/16	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Yasir Khurshid	Operator
2023/2/16	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Nisar Ahmad	Lab assistant
2023/2/16	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Adeel Azhar	Sub Engineer
2023/2/16	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Khaleeq Afzal	Assistant Director
2023/2/16	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Mansoor Ahmed	Sub-Engineer
2023/2/16	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Muhammad Shoaib	Sub-Engineer
2023/2/16	LC3: Leakage control and plumbing with Service Pipe	pilot	Mr. Muhammad Yamin	Supervisor
2023/3/15	LC3: Leakage control and plumbing with Service Pipe	1	Saqib Elahi	Deputy Director
2023/3/15	LC3: Leakage control and plumbing with Service Pipe	1	M. Ishtiaq	Sub Engineer
2023/3/15	LC3: Leakage control and plumbing with Service Pipe	1	M. Ali	Sub Engineer
2023/3/15	LC3: Leakage control and plumbing with Service Pipe	1	M. Fakhar Ejaz	Sub Engineer
2023/3/15	LC3: Leakage control and plumbing with Service Pipe	1	Irshad Hussain	Sub Engineer
2023/3/15	LC3: Leakage control and plumbing with Service Pipe	1	M. Tufail	Sub Engineer

Date	Module Name	Batch No.	Name of Trainee	Designation
2023/3/15	LC3: Leakage control and plumbing with Service Pipe	1	M. Umair	Sub Engineer
2023/3/15	LC3: Leakage control and plumbing with Service Pipe	1	Shoaib Mansoor	Sub Engineer
2023/8/16	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Salman Manzoor	Assistant Director
2023/8/16	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Mansoor Qureshi	Sub Engineer
2023/8/16	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Muhammad Ali	Assistant Director
2023/8/16	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Zeeshan Ashraf	Assistant Director
2023/8/16	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Rizwan Adeel	Assistant Director
2023/8/16	LC3: Leakage control and plumbing with Service Pipe	2	Mr. Hasnain Ali	Assistant Director
2023/11/16	LC3: Leakage control and plumbing with Service Pipe	3	Mr. Javaid	Daily Wages
2023/11/16	LC3: Leakage control and plumbing with Service Pipe	3	Mr. Naveed Hameed	Helper
2023/11/16	LC3: Leakage control and plumbing with Service Pipe	3	Mr. Qadeer	operator
2023/11/16	LC3: Leakage control and plumbing with Service Pipe	3	Mr. Chanzaib	Clerk
2023/11/16	LC3: Leakage control and plumbing with Service Pipe	3	Mr. Jamil	Valveman
2023/11/16	LC3: Leakage control and plumbing with Service Pipe	3	Mr. Adil Azhar	Sub Engineer
2023/11/16	LC3: Leakage control and plumbing with Service Pipe	3	Mr. Ikram Ullah Khan	Daily Wages

Annex 5.4.2 Survey on Outcome by In-house Training at 4WASAs

Results of the Survey on Outcomes of In-House Training in WASAs

1. Survey Objective and Method

(1) Survey Objective
The survey aims to receive feedback from the training participants on the in-house training course they attended.

(2) Survey Method

1) Questionnaire

a) Target Respondents
The questionnaires were administered to all the participants of in-house training conducted from January 2022 to September 2023 for 4 WASAs and October 2023 for WASA Lahore, except for those who only attended the pilot training (the first batch for each module) in the course.

b) Number of Questionnaires
Each trainee filled out one questionnaire for each course attended.

c) Number of Respondents
The number of respondents shown in the tables and graphs below is accumulated as one person attended more than one training course in some cases.

2) Semi-Structured Interview

a) Interviewees
Interviewees were sampled from the trainees who answered the questionnaire.

(3) Survey Period
4 WASAs: October – November 2023
WASA Lahore: November 2023

2. Results of the Questionnaire Survey for 4WASAs

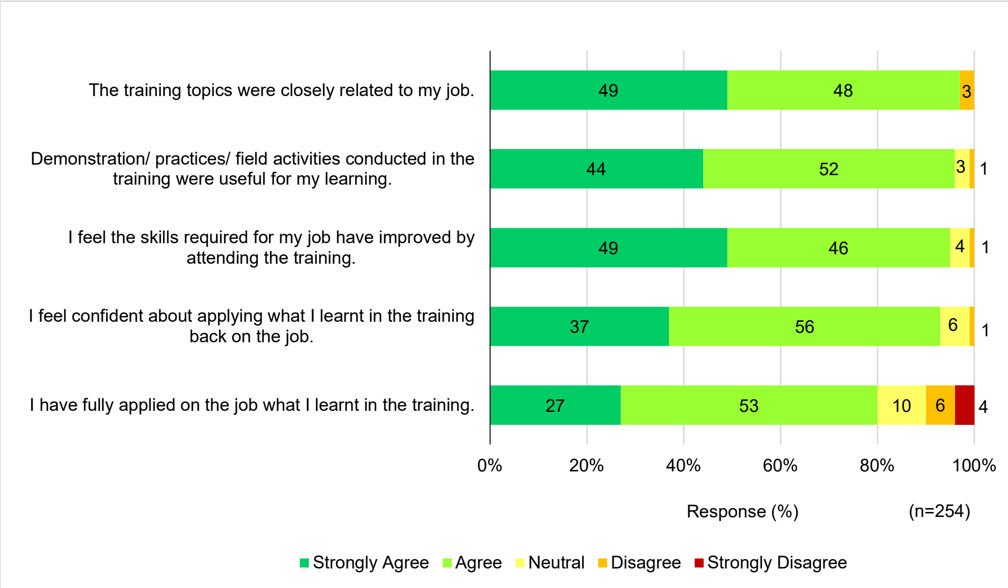
(1) Distribution of Respondents by WASA and BPS

	Work Charge	BPS 1-10	BPS 11-16	BPS 17 & above	Total
4 WASAs	**55**	**88**	**79**	**32**	**254**
O&M ME	25	35	20	3	83
O&M SD	3	18	18	5	44
LCPPRP	27	35	41	24	127
WASA Faisalabad	**30**	**34**	**18**	**11**	**93**
O&M ME	17	13	3	3	36
O&M SD	0	7	7	1	15
LCPPRP	13	14	8	7	42
WASA Multan	**4**	**31**	**21**	**13**	**69**
O&M ME	1	10	4	0	15
O&M SD	1	7	2	3	13
LCPPRP	2	14	15	10	41
WASA Gujranwala	**19**	**13**	**18**	**1**	**51**
O&M ME	5	5	5	0	15
O&M SD	2	4	6	0	12
LCPPRP	12	4	7	1	24

	Work Charge	BPS 1-10	BPS 11-16	BPS 17 & above	Total
WASA Rawalpindi	**2**	**10**	**22**	**7**	**41**
O&M ME	2	7	8	0	17
O&M SD	0	0	3	1	4
LCPPRP	0	3	11	6	20

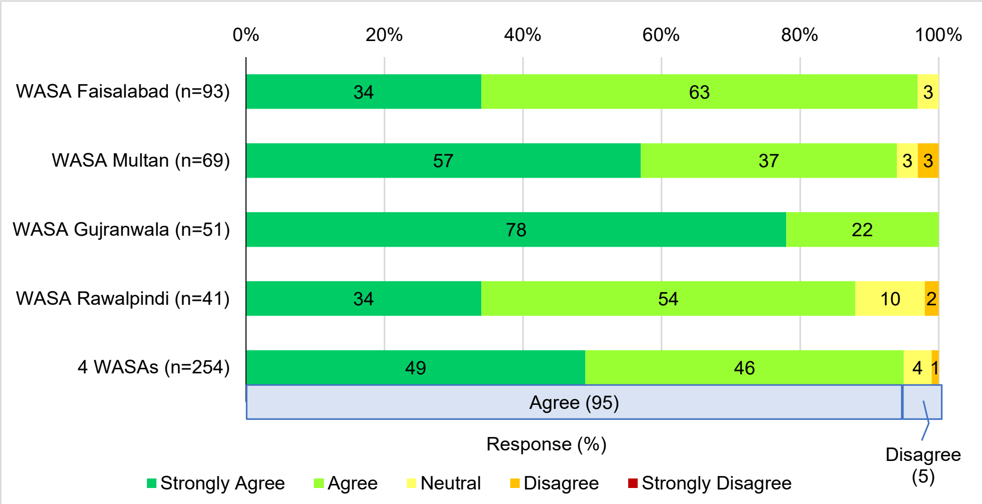
Note: The figures in the table show valid responses.

(2) All Questions on Perceptions of the Respondents on In-House Training (4WASAs)

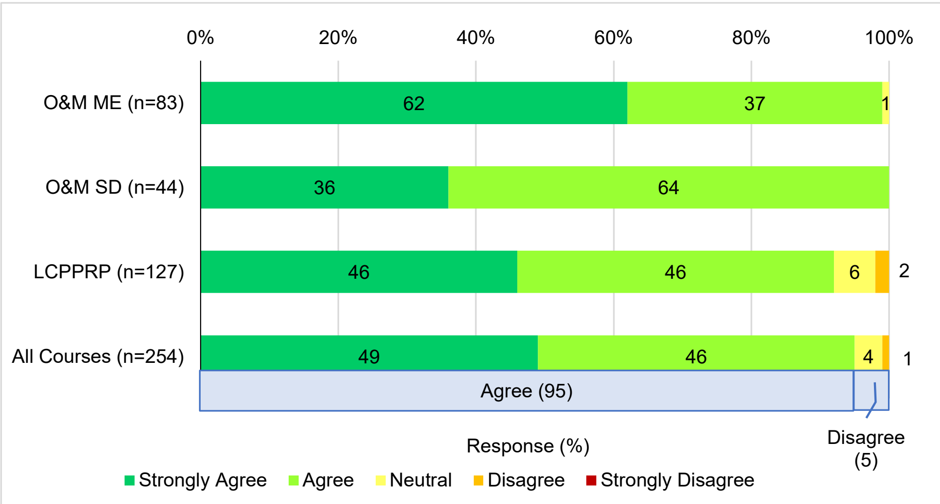


(3) Question: "I feel the skills required for my job have improved by attending the training."

1) Proportion of Responses by WASAs



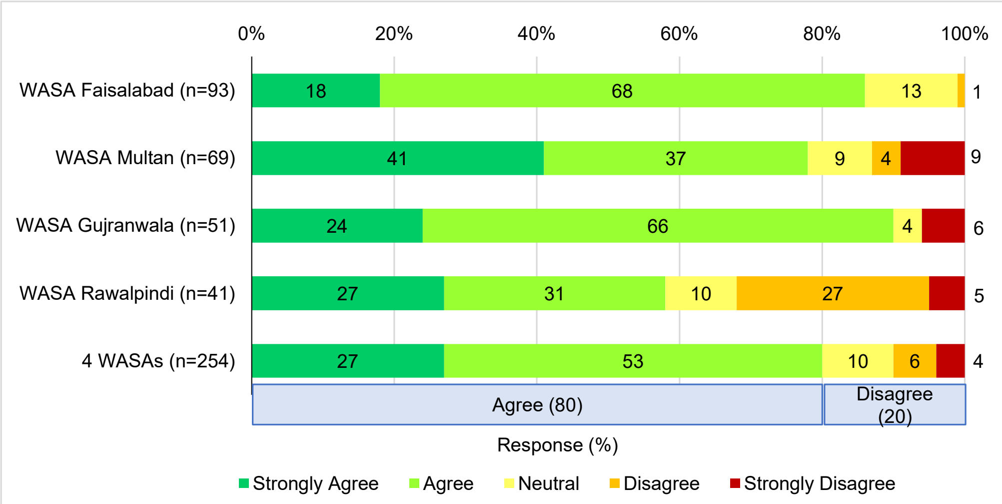
2) Proportion of Responses by Training Courses



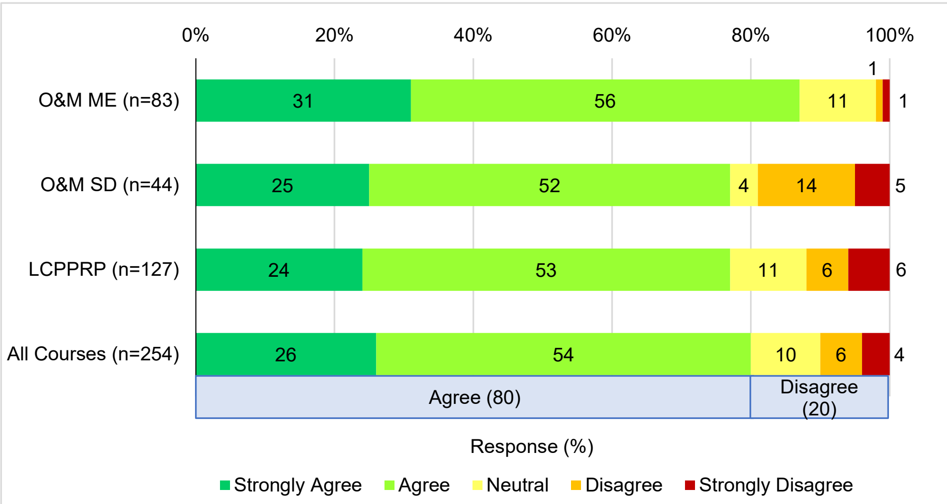
Note:
O&M ME: O&M of Mechanical & Electrical Equipment
O&M SD: O&M on Sewerage and Drainage
LCPPRP: Leakage Control, Plumbing and Pipe Replacement Plan

(4) Question: "I have fully applied on the job what I learned in the training."

1) Proportion of Responses by WASAs



2) Proportion of Responses by Training Courses



(4) Reasons Why the Respondents Could not Apply What They Learned (4 WASAs)
Question: What were the reasons why you could not apply what you learned on the job?

- I don't think what I learned will work.
- I do not clearly understand what is expected of me.
- The training did not give me the confidence to apply what I learned.
- I have other higher priorities in my job.
- I do not have the support to apply what I learned.
- I do not have the necessary tools/equipment to apply what I learned.
- The training content was not directly related to my current duties.

Note: Number of Respondents (27)

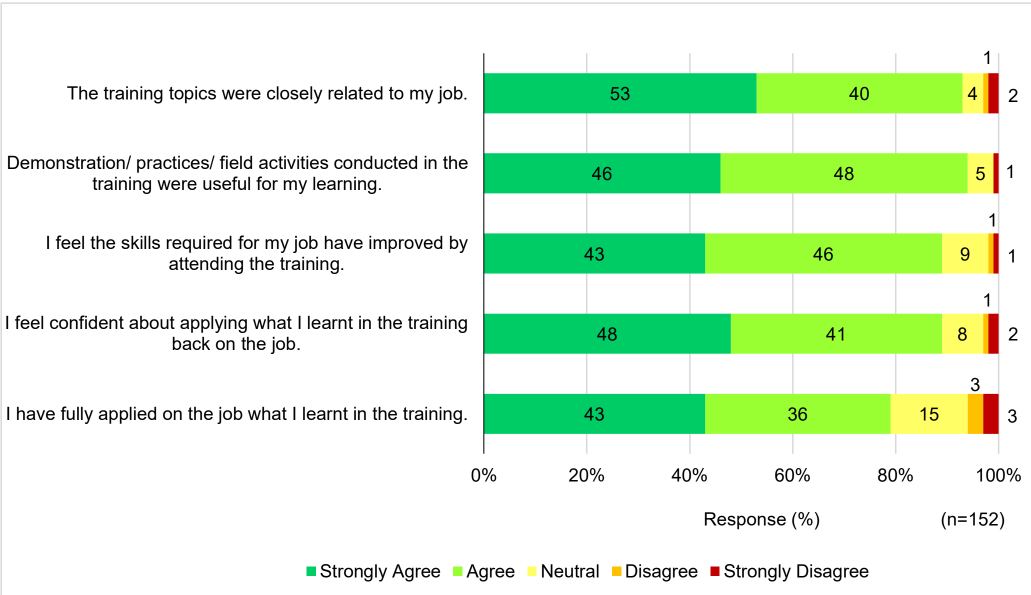
3. Results of the Questionnaire Survey for WASA Lahore

(1) Distribution of Respondents by BPS

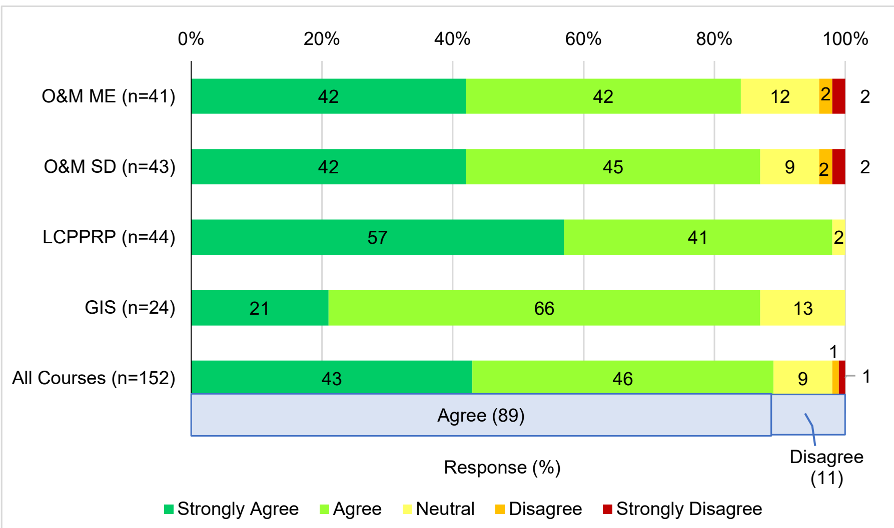
	BPS 1-10	BPS 11-16	BPS 17 & above	Total
O&M ME	0	22	19	41
O&M SD	0	24	19	43
LCPPRP	0	33	11	44
GIS	0	1	23	24
All Courses	0	80	72	152

Note: The figures in the table show valid responses.

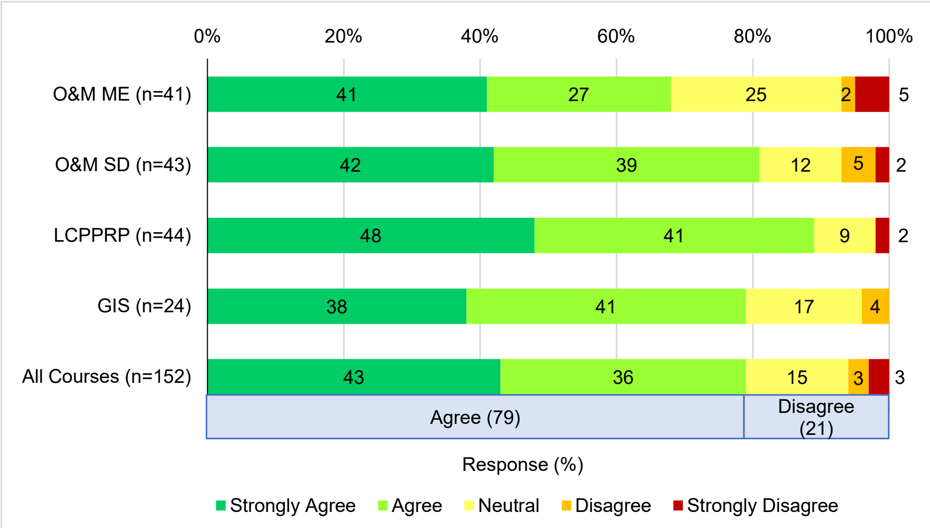
(2) All Questions on Perceptions of the Respondents on In-House Training



(3) Question 1: "I feel the skills required for my job have improved by attending the training." (Proportion of Responses by Training Courses)



(4) Question 2: "I have fully applied on the job what I learned in the training." (Proportion of Responses by Training Courses)



(5) Reasons Why the Respondents Could not Apply What They Learned
What were the reasons why you could not apply what you learned on the job?

Đ I do not have adequate knowledge and skills.
Đ I have other higher priorities in my job.
Ɨ I do not have the support to apply what I learned.
Đ The training content was not directly related to my current duties.

Note: Number of Respondents (8)

4. Application of What was Learned in Training to Daily Operations and Suggestions on Training (Results of Semi-Structured Interview with Trainees)

(1) Question: How and in what area did you apply what you learned in the training to your job?

Training Course	Designation	BPS	Summary of Responses
O&M ME	Sub Engineer	14	- Two operators under my supervision also attended the same training with me. After the training, we trained other operators in our zone on the same topics. - I managed to identify a failure of an MCU relay after training.
O&M ME	Sub-Engineer	14	I use what I learned in the training in my daily routine tasks. There are 11 operators and 15 helpers under my supervision. One-third of those operators were also trained and working properly using knowledge gained in training.

Training Course	Designation	BPS	Summary of Responses
O&M ME	Sub Engineer	14	-Energy audit: I did an energy audit at 5-6 tube wells after training. Although I faced difficulties in my first attempt, I am now managing it. I am working with one of my colleagues, a sub-engineer, to conduct the energy audit by dividing areas. - O&M of pump: After training, I have utilized what I learned in daily O&M of the disposal station and managed to overcome vibration issues once. Also, we found one motor was consuming too much electricity at one of the tube wells. It was overcome by checking the condition of the motor with the equipment we learned how to use in the training.
O&M ME	Sub Engineer	14	After the training, I trained electricians on the same topics, and they checked the facilities' conditions as they were trained. Electricians checked sparking issues at the MCU, found problems, and fixed them at one of the disposal stations. Before training, Sub-Engineers did not have much knowledge of MCU and electrical panels. After training, Sub-Engineers can instruct electricians properly.
O&M ME	Supervisor	7	- I have been using an ultrasonic flow meter to check water flow after training. Before attending the training, the equipment had been kept in the office without being used. - Based on what I learned in training, I also keep maintenance records of machinery, such as backwashing, blowers, flash mixture, and generators.
O&M ME	Supervisor	N/A	After attending the training, I have been using equipment to collect and record data for energy audits. The data is submitted to an Assistant Director. In addition, I am trying to ensure that the field staff will also follow the SOP for O&M of pumps. More field staff (pump operators) should also be trained.
O&M ME	Lab Assistant	6	I referred to information on chlorination mentioned in the training for my work. I am also using the mWater App to record water quality test results at our lab.
O&M ME	Plant Operator	6	Using the knowledge I gained in the training, I conducted the calibration of chlorinators at filtration plants.
O&M ME	Work Charge	N/A	After attending training, I managed to detect problems on a pump by using a vibration meter at one of the pump houses.
O&M ME	Mechanic	N/A	- Energy audit: After training, I conducted data collection for an energy audit using a water level indicator, ultrasonic flow meter, water pressure gauge, and other tools. Twenty five tube wells were checked. Facilities are working well. - O&M of pump: I identified problems on bearing at two tube wells and fixed them.
O&M ME	Electrician	N/A	- Energy audit: Data on 25 tube wells were collected with the equipment and recorded in mWater. The topics we learned are mostly applied to our work. - O&M of pump: I work with operators and give them instructions about the O&M of pumps. The Operators keep the maintenance log of pumps.
O&M SD	Senior Sub Engineer	16	We can give instructions to field staff on using suction and jetting machines in a proper way. Our routine work in the maintenance of sewer lines has been improved.

Training Course	Designation	BPS	Summary of Responses
O&M SD	Sub-Engineer	14	We conduct cleaning of trunk sewer lines more frequently compared to before training. Also, more staff have been deployed to clean sewer lines after training.
O&M SD	Sub-Engineer	14	The knowledge I obtained in training about the sewerage system and how to maintain the system safely is part of the foundation for my daily work operation.
LCPPRP	Deputy Director	18	Working with the master trainers, we created a consumer data collection form after training. Information on the consumers will be collected with a mWater survey form, and the data will be transformed into Excel for management and administration in our directorate. Defaulters' data (disconnections) form could also be developed newly.
LCPPRP	Deputy Director	18	The utilization of the mWater for data collection/recording has been fully implemented after training.
LCPPRP	Assistant Director	17	I prepared a survey form for the disposal station and am also using the form for leakage points.
LCPPRP	Sub Engineer	14	I applied knowledge of the use of a butt fusion machine and specifications in the work. Also, I worked on air valves utilizing the knowledge obtained in the training on the function of air valves. Although I had knowledge and skills relating to training topics on plumbing before training, I can see improvement in the way I handle work.
LCPPRP	Sub Engineer	14	I am the only one using the mWater App in the office where I am stationed. I use the mWater survey form to record leakage points where I have attended repair. The mWater is useful for my work as it can collect different types of data for both water supply and sewerage. I suggest that the App be used for recording manhole cover locations, sewer blockage, and consumer surveys.
LCPPRP	Sub Engineer	N/A	I have been using mWater to record the points whenever I find leakages.
LCPPRP	Supervisor	N/A	Leakages found on site are now recorded in mWater. The use of mWater has been facilitated in our workplace under the initiative of the master trainer for the mWater, whom I report to. Other Supervisors and field staff were also trained in mWater. We have seen the benefit of the mWater for planning of pipe replacement.
LCPPRP	Tube Well Operator	5	I utilized the knowledge gained from the training when performing maintenance on a sluice valve. There were not many cases where I needed to apply what I learned in the training to my daily tasks so far because facilities were in good condition.
LCPPRP	Lineman	N/A	I use the mWater App in my daily routine. Complaints about water leakage are lodged by water users every day. Receiving complaints, I go to the field and record leakage points. We have uploaded about 160 complaints to mWater after training. Before training, I dealt with paper-based complaint records. I would recommend that other staff take mWater training.

N/A: Work Charge

(2) Question: Could you tell us the background behind your response on the reason(s) why you could not apply what was learned to your work?

Training Course	Designation	BPS	Summary of Responses
O&M ME	Sub Engineer	14	Although the training was useful in understanding the procedures for data collection of tube wells for the energy audit, it is not being implemented due to other priorities in my job. The implementation of data collection for the energy audit has not been instructed by our supervisor.
O&M ME	Tube Well Operator	8	Each staff member has many tasks, and many junior staff members cannot read or write, which makes it difficult to implement data collection on tube wells using mWater. Data collection with mWater should be assigned to a specific staff member/team.
O&M ME	Electrician	2	I do not use the equipment introduced in the training because there are no such instructions or opportunities.
O&M SD	Assistant Director	17	We do not have equipment for sampling wastewater to check water quality.
O&M SD	Assistant Director	17	As we do not have a velocity meter, we have not conducted flow measurements of drainage. Once we procure the equipment, we can conduct flow measurements as we did during training.
O&M SD	Senior Sub Engineer	16	As we do not have a sewer inspection camera, we have not applied the procedures for inspecting sewer lines in the way introduced in the training. Without the camera, we use conventional methods with jetting machines and bamboo sticks.
O&M SD	Sub Engineer	14	We have been implementing most of what was addressed in the training topics. However, since we do not have a sewer inspection camera, we cannot apply activities to check blockages and gas in sewer lines using the inspection camera.
LCPPRP	Sub Engineer	14	It is difficult to record leakage data in the mWater due to the workload for other tasks. I only take pictures/videos of leakage with my phone without entering information into the mWater survey form. There is not enough time to use the form for data entry. Also, we have a limited number of field staff who can use data collection Apps, such as the mWater, on smartphones.
LCPPRP	Supervisor	11	The mWater App has not been used in my workplace as there was no instruction from our supervisor and management. Application of work procedures/techniques introduced in training should be supported by the organization.

N/A: Work Charge

(3) Suggestions on the Topics Which Should be Considered in In-House Training in the Future

Organization	Training Course	Training Topics Suggested
WASA Faisalabad	O&M ME	Ð Electrical faults and ground leakage on tube wells
	O&M SD	Ð Basic capacity building for Senior Sub Engineer, Sub Engineer, and Supervisor on safety measures Ð Awareness raising and training for sewer men and other field staff on the proper procedures for maintenance activities of sewer lines
WASA Multan	LCPPRP	Ð Data management Ð Application of design software Ð Proper cost estimation Ð Implementation of water supply and sewerage development based on master plan
WASA Multan	O&M SD	Ð Safety measures for field staff in the Sewerage Directorate Ð Proper O&M of jetting and suction machines

Organization	Training Course	Training Topics Suggested
		Ð Design of sewer lines (how to properly design sewer lines to avoid crown failure) Ɨ O&M of disposal station machinery
	LCPPRP	Ð Examples of presentation of maps on QGIS for easier decision-making Ð How to conduct data mining Ð Utilization of tools for data mining which can be used for clustering areas to show points based on different subject
WASA Gujranwala		No particular comments
WASA Rawalpindi	O&M ME	Ð Procedures for water treatment plant operation for the plant staff Ð Water quality testing at a lab Ɨ Detail process of chlorination
	LCPPRP	Ð New techniques/ technologies of leakage detection that suit the local conditions (noisy environment) in Pakistan Ð Assembling and reassembling pumps Ð Installing a miniature model to demonstrate different types of valves
WASA Lahore	GIS (mWater)	Ð Different use cases of mWater

(4) Suggestions for Improving the Training Delivery

Organization	Training Course	Suggestions
WASA-F	O&M ME	Ð More pump operators should be trained.
	O&M SD	Ð Through the training, we learned how to check the conditions of sewer lines using a sewerage inspection camera, which is also useful to find some signs of crown failures. WASA needs the sewerage inspection camera to utilize it in O&M of the sewerage system. Ð The number of trainees for the S&D course should be increased to facilitate the application of improved work processes in our workplace more efficiently.
WASA-M	O&M SD	Ð Sewermen cannot handle the sewer camera. Sub-Engineers should handle the equipment. Ð The equipment for sampling wastewater should be made available, and the staff needs to be trained in the use of the equipment. Also, a sampling mechanism should be prepared.
	O&M ME	Ð Training should be conducted on a scheduled basis for staff, including the field staff. Once a month will be fine.
	LCPPRP	Ð Training should cover all departments and be conducted separately for each department based on the job descriptions of the staff.
WASA-G	O&M ME	Ð We would like to attend in-house training two to three times per month. Long intervals between training sessions would make it difficult for us to retain what we learned. Ð We wish to have the equipment (ultrasonic flow meter, vibration meter, power analyzer, etc.) for each Zone so that we can check the facilities quickly with the equipment whenever it is required. Ð Trainees should be selected from the staff who are directly involved in the related field of training topics so that training experience can be fully utilized. Ð When staff are trained, those who are trained need to train their subordinates on the same topics to make it institutionalized. Supervisors should monitor the implementation.
WASA-R	O&M ME	Ð More Supervisors in our zone should also be trained in the use of equipment for O&M of pumps. Ɨ More plant operators should be trained.
	LCPPRP	Ð The frequency of in-house training should be increased to be held once a month. Ð A formal letter should be issued to the head of the section from which staff is sent to in-house training so that the section head releases the nominated staff to attend the training on time.

Annex 5.5.1 Business Continuity Plan for 4 WASAs

Islamic Republic of Pakistan

The Project for Improving the Capacity of WASAs in Punjab Province Phase 2

Business Continuity Plan (BPC) WASA Faisalabad

July 2023

Business Continuity Plan (BPC)

1. Purpose

Due to the spread of Covid -19 in Faisalabad the pace of the ongoing JICA project for " Improving the Capacity of WASAs in Punjab Province Phase 2" (hereinafter referred to as "Phase 2" or "Project") also suffered in terms of training programs and practical training, therefore, the countermeasure has developed to write down the strategy to continue the training program as much as possible during this type of pandemic situation.

This may be done keeping in view the availability of staff for essential services for the public by WASA like water supply tube wells operation; Public complaints address system, bill distribution and collection system and maintenance of disposal and tube-wells etc. and working in the most possible safe environment with an adaptation of safety measures. This document will cover the pre-pandemic situation and possible safety measures for field staff during emergencies and devise strategies to continue training programs.

2. Situation before emergency

2.1 Field installations

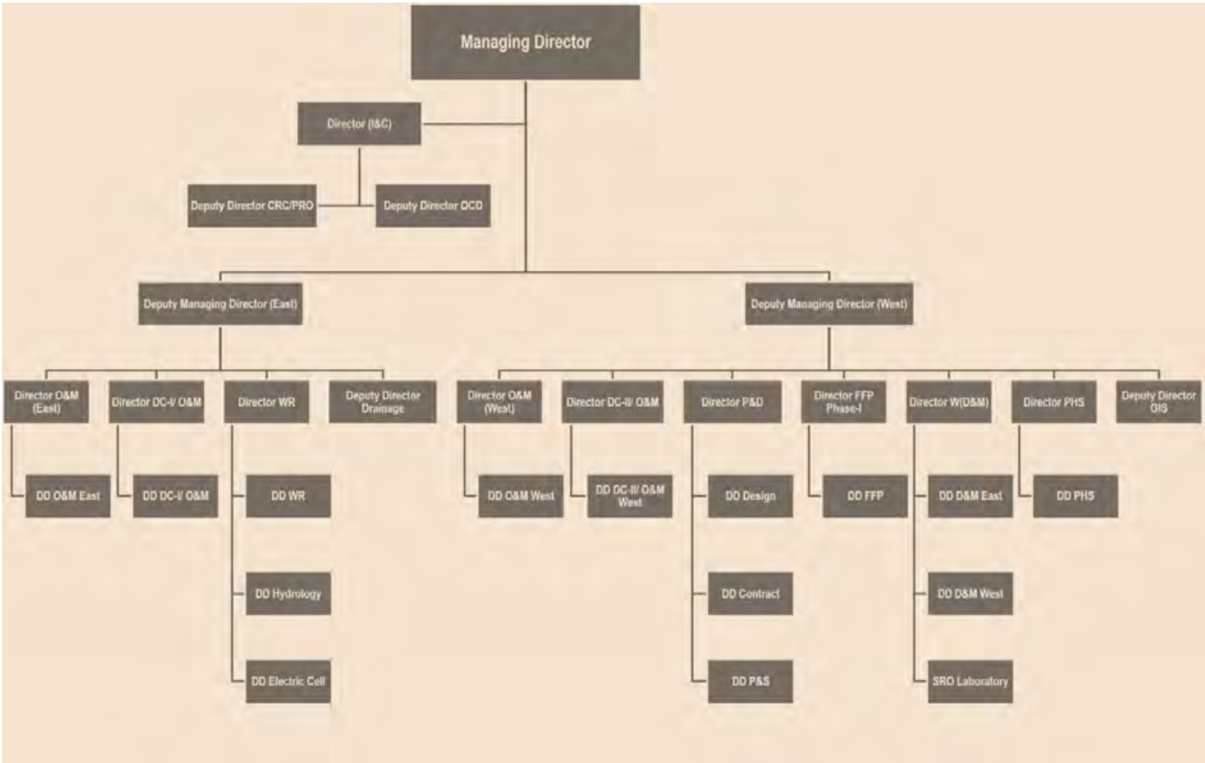
There are 86 groundwater/seepage water tube wells and 10 MGD Surface Treatment Plant in Faisalabad WASA, which are operated daily to provide drinking water to the citizens of Faisalabad. There are 38 disposal pump stations for sewage disposal from the city.

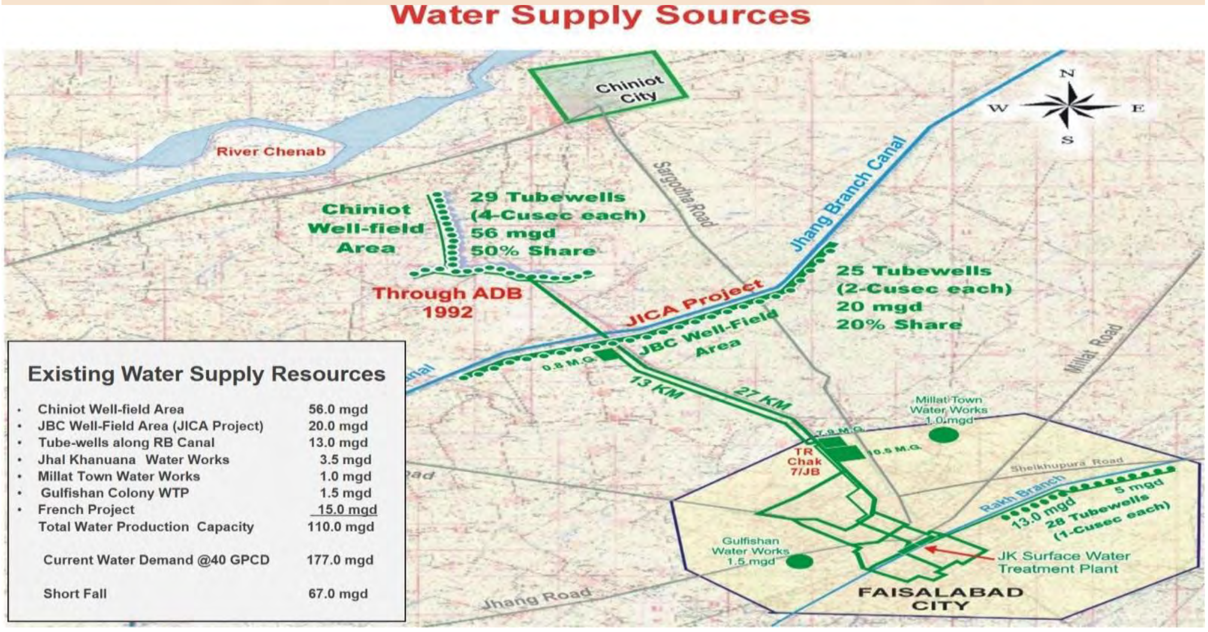
2.2 Operational field offices

There are 10 O&M directorate subdivisions in WASA Faisalabad and 04 Water Distribution directorate subdivisions in WASA Faisalabad. 1 Directorate of operations comprises 2-3 subdivisions where WASA field staff deals with the public regarding their complaints of water, sewerage, broken/ missing manhole slabs, covers etc. P&D directorate and Quality Control Division QCD involve approval and quality checking of new water and sewerage schemes respectively.

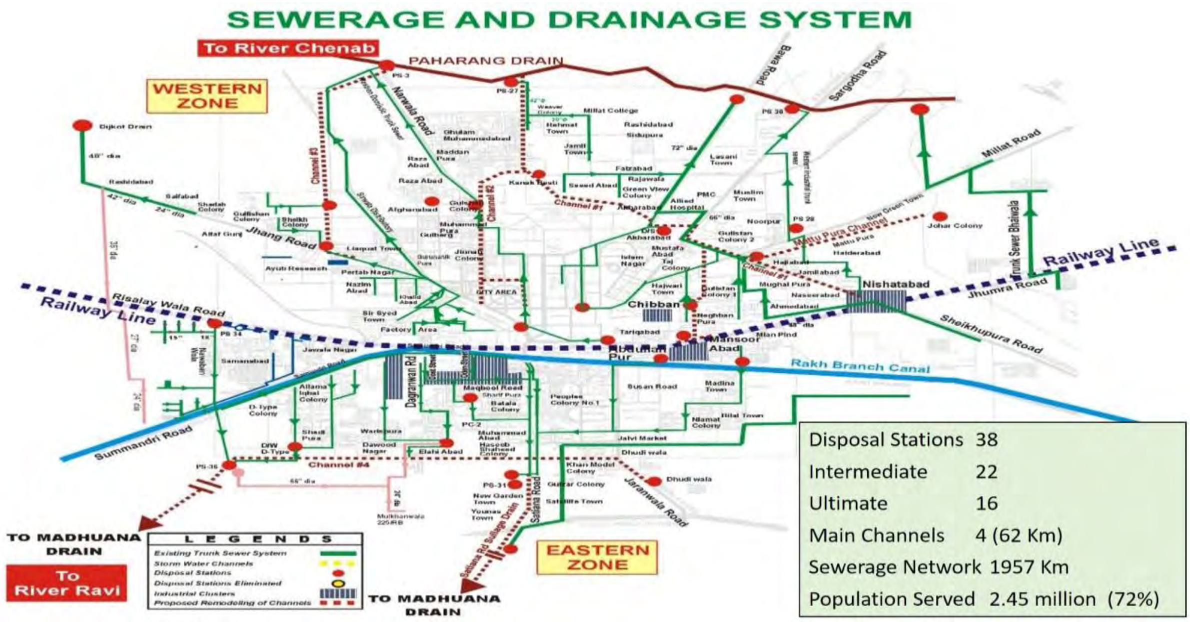
2.3 Operation of tube wells and disposal/lift stations

Water supply tube wells, Water Treatment Plant of 10 MGD and Disposal pump stations are operated day and night to give water supply to the city. A total of about 260 pump operators operate these pumps around the clock as per their scheduled timings. The shortage of operators is met with a deputation of daily wage staff which is around 500-600 in number. Now WASA is arranging for a third-party firm for outsourcing daily wage staff.





WASA Water Supply Map



WASA Disposal Pumping Station Map

2.4 Customer service/bill distribution

There are 8 public dealing offices of the Revenue Directorate in various areas of the City. The staff deals with the public regarding their complaints about billing. Field operators distribute bills to 3,00,000 customers' residential addresses, Industrial 1200 and Commercial 24000 each month. These offices also ensure the payment of bills therefore dated collection progress is monitored continuously the whole month.

3. Training requirement

WASA Faisalabad has its Training Center at 49 JB, Munda Pind

In-house training have been conducted in three categories under this Project. It is also mentioned that training content was made after consultation between WASA and JICA.

- O&M of Mechanical and Electrical equipment
- O&M of Sewerage and Drainage
- Leakage control, Plumbing and pipe replacement.

4. Action after the emergency situation confirms

4.1.Action when the Government announces lockdown

- ✓ WASA official staff of non-critical sections to work from home
- ✓ WASA may distribute Personal Protective Equipment's (PPEs) to operators.
- ✓ Front line workers like pump operators, Sewer men, and field operators to perform duty with precautionary measures:
- ✓ Wear Face Masks provided by WASA.
- ✓ To sanitize their hands before the start of work with sanitizers to be provided by WASA and continue hand sanitization in small intervals.
- ✓ Avoid touching their eyes and nose
- ✓ Avoid handshake with others

- ✓ Anybody feeling a temperature or cough should immediately leave the site after entering the details to the concerned section
- ✓ WASA to depute operator in place of sick one from their work charge staff or allow overtime to other operators to avoid interruption in the water supply.
- ✓ WASA may facilitate the public with the availability of online duplicate bills and collection systems, online complaint registries and posting updates so that in case of interruption in bill distribution the bills are in excess of consumers and payment is easy through credit cards.
- ✓ Don't take any eatable from others.

4.2. Action when working is allowed with certain precautions and safety measures

- Continue the culture of wearing Face Masks
- Keep sanitizing hands repeatedly
- Avoid handshake
- Keep a safe distance from others
- Avoid meetings in the rooms
- Promote a culture of online meetings with high officials

5. Training strategy

No Training is possible during a lockdown situation however training sessions may be arranged with precautionary measures during the non-lockdown/working periods.
Training with precautionary measures may be in two ways:

- Online training sessions through Zoom: Selected officers having laptops may attend such sessions
- Training sessions in WASA Training Center with the following precautions:

  - ✓ Only Deputy Directors and Assistant Directors will be invited for training who will train lower formations
  - ✓ Keep the training class strength below 15
  - ✓ Wear Face masks
  - ✓ Sanitize hands before the start of a session
  - ✓ Sit by maintaining a safe distance
  - ✓ Avoid handshake
  - ✓ Keep the windows open
  - ✓ Avoid serving tea/coffee
  - ✓ Avoid grouping during practical training.

Islamic Republic of Pakistan

The Project for Improving the Capacity of WASAs in Punjab Province Phase 2

BUSINESS CONTINUITY PLAN (BPC)
WASA MULTAN

June 2023

Business Continuity Plan (BPC)

1. **Purpose**

Water and Sanitation Agency (WASA) Multan was established in April 1992 as a subsidiary of MDA under the Development of Cities Act 1976. The compulsory element of its mandate is to provide a safe, reliable and efficient Water Supply, Sewerage and Drainage System to satisfy the needs of the 2.5 million inhabitants of Multan City. The jurisdiction area of WASA Multan spans over 584 Square Kilometer

The spread of the Covid-19 Pandemic in Multan negatively affected the pace of the ongoing JICA project for **" Improving the Capacity of WASAs in Punjab Province Phase 2"** (hereinafter referred to as "Phase 2" or "Project") also suffers in terms of training programs and practical training. The countermeasures have been developed to write down the strategy to continue the training program as much as possible during this type of pandemic situation.

This may be done keeping in view the availability of staff for essential services for the public by WASA like water supply tube wells operation; Public complaints address system, bill distribution and collection system and maintenance of disposal and tube-wells etc. and working in the most possible safe environment with an adaptation of safety measures. This document will cover the pre-pandemic situation and possible safety measures for field staff during emergencies and devise strategies for possible ways and means of continuation of training programs.

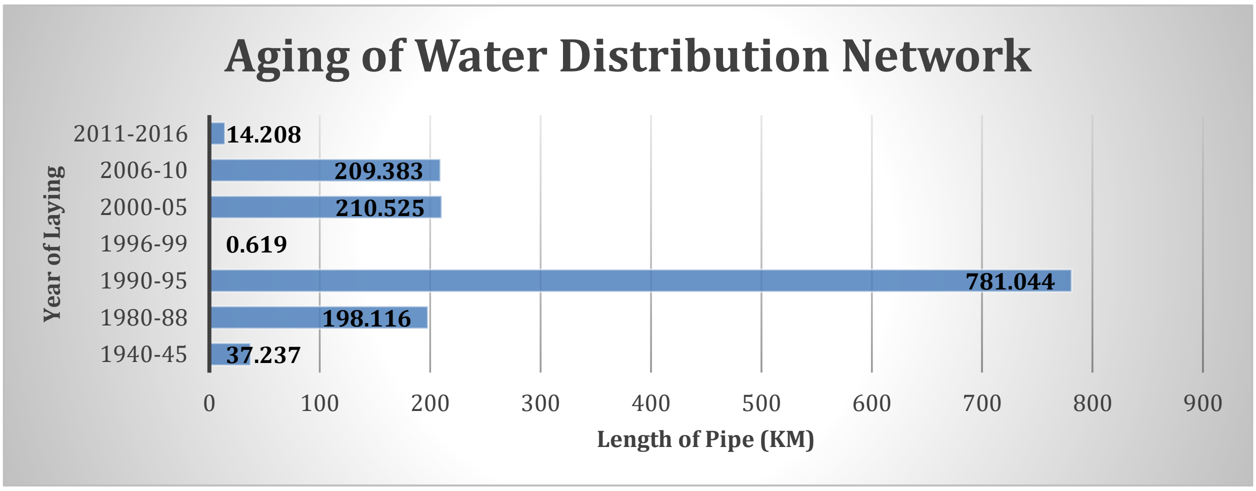
2. Situation before emergency

2.1 Field installations

WASA Multan is providing Water Supply facilities to 55% population of Multan City with the help of 1,448 Km Water Supply Network, 84 Tube Wells and 66 water filtration plants. At the moment, deep well Tube wells are the only source of water supply for the city. The major problem with the water distribution system is that almost 1,016 Km of water supply is overaged out of 1448 Km. The ageing of the water distribution network is shown in the below table and graph. All the water distribution networks, tube wells, Overhead reservoirs and water filtration plants are marked on GIS-based maps along with attribute tables.

YEAR OF LAYING	LENGTH OF WATER PIPE (KM)	CONDITION
1940-45	37.237	OVEAGED

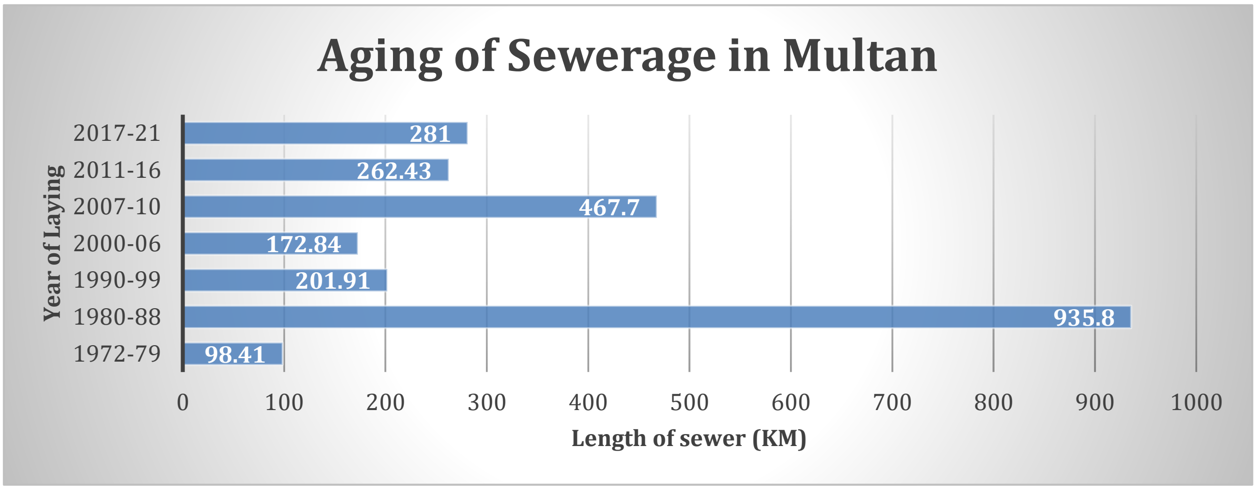
1980-88	198.116	OVEAGED
1990-95	781.044	OVEAGED
1996-99	0.619	OVEAGED
2000-05	210.525	SATISFACTORY
2006-10	209.383	GOOD
2011-2016	14.208	EXCELLENT



Similarly, the Agency is providing sewage facilities to 65% population of the city with the help of 2,055 KM sewerage network (Trunk Sewer 265 Km & Lateral Sewer 1,790 Km), 15 Disposal Stations and 10 Lift stations. The major problem with the sewerage system is that almost 1,236 Km of sewer is overaged out of 2055 Km. A number of crown failures are observed frequently on these overaged sewers. The Aging of the available sewerage in Multan City is shown in the table and graph below. All the sewerage network, Disposal Stations and Lift stations are marked on GIS-based maps along with attribute tables.

YEAR OF LAYING	LENGTH OF SEWER(KM)	CONDITION
1972-1979	98.41	OVEAGED
1980-1988	935.80	OVEAGED
1990-1999	201.91	OVEAGED

2000-2006	172.84	SATISFACTORY
2007-2010	467.70	GOOD
2011-2016	262.43	EXCELLENT
2017-2021	281.00	EXCELLENT



WASA Multan has also established a Wastewater Treatment Plant with a capacity of 59 MGD to treat wastewater collected from the Northern side of the City. This Wastewater Treatment Plant is based on Waste Stabilization Ponds (Anaerobic & Facultative). On the same analogy, WASA Multan has proposed a Wastewater Treatment Plant with a capacity of 316 MGD to treat wastewater collected from the Southern & Central Zones of the city.

2.2 Operational field offices

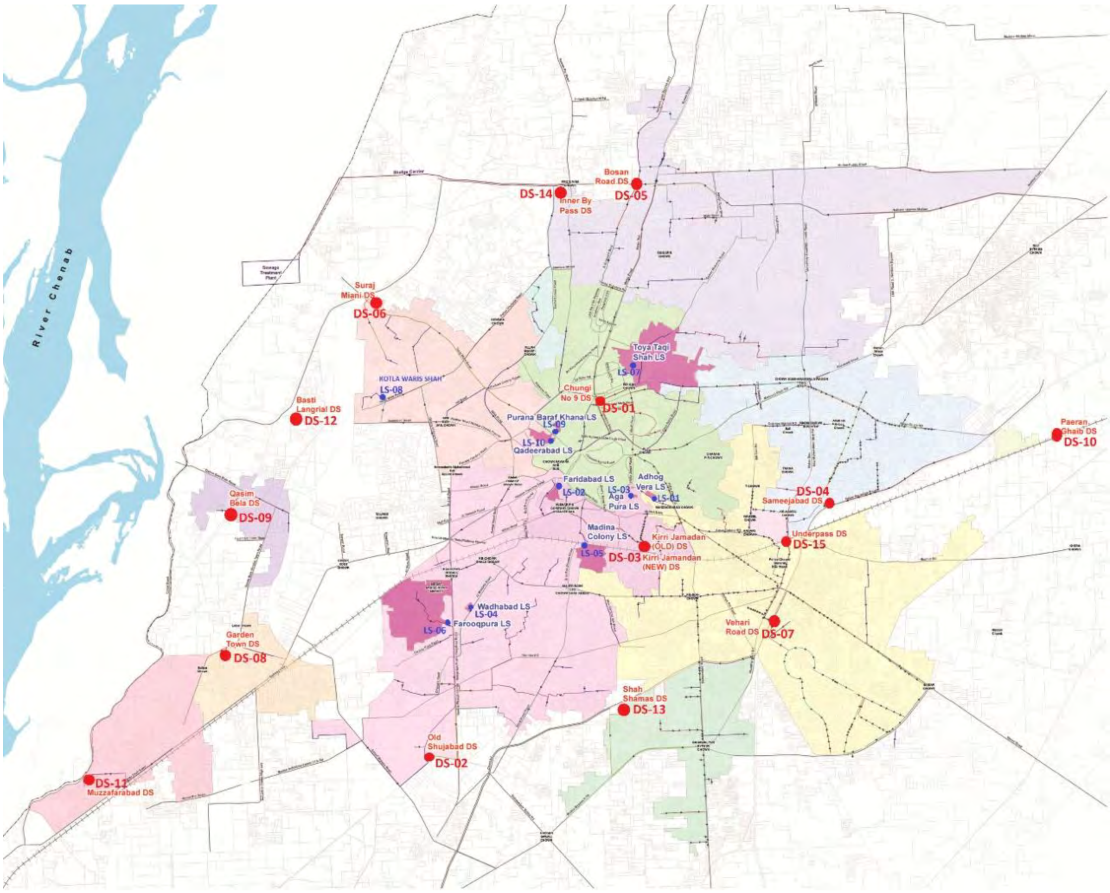
There are nine (09) operation subdivisions of sewerage, three (03) subdivisions of water supply and three subdivisions of disposal stations in WASA Multan to manage field activities where WASA field staff under the supervision of Sub-divisional Officers deals with the public regarding their complaints about water supply leakage, Tube wells operation, sewerage overflowing, sewer blockages and broken/missing manhole covers etc. Public dealing continues round the clock 24/7 and field staff remains busy for rectifying the public complaints.

2.3 Operation of tube wells and disposal/lift stations

Drinking water supply tube wells and disposal stations/lift stations falling in the jurisdiction of each sub-division are operated by pump operators in three shifts. A total of about 105 pump operators operate these pumps around the clock as per their scheduled timings on Tube wells and Disposal Stations. The shortage of operators is met with a deputation of daily wage operators. The details of WASA field offices are as below:

Name of Directorate	Concerned Deputy Director (Division)	Name of Sub Divisions
Director Engineering	**Deputy Director Water Supply**	Water Works Sub Division
		North Sub Division (Gulgasht)
		South & Central Sub Division (Aam Khas Bagh Chowk Daulat Gate)
Director Works	**Deputy Director Sewerage South**	Hassan Parwana Sub Division
		Willayatabad Sub Division
		Garden Town Sub Division
	Deputy Director Sewerage Central	Mumtazabad Sub Division
		Qasim Pur Sub Division
		New Multan Sub Division
	Deputy Director Sewerage North	Gulgasht Sub Division
		Eid Gah Sub Division
		Suraj Miani Sub Division
	Deputy Director Disposal Station	North Sub Division (Chungi No. 09)
		Central Sub Division (Sameejabad)
		South Sub Division (Old Shujabad Road)

Divisions and subdivisions in WASA Multan



Map showing Disposal and Lift Stations and their respective catchment areas

2.4 Maintenance Directorate

The operation of tube wells is the responsibility of the Director Engineering and operations of disposal stations & lift stations are the responsibility of the Director Works. They are responsible to keep the tube wells and pump stations in a satisfactory running condition. They attend the breakdown complaints round the clock; therefore, the staff remains in the field for at least 2 shifts.

2.5 Customer service/bill distribution

There are almost more than 20 public dealing offices of the Revenue Directorate in various areas of Multan City. The staff deals with the public regarding their complaints, bill distribution and modification. Field inspectors and bill distributors distribute bills to 293,670 customers (residential, Commercial, Industrial) addresses each month. These offices also ensure the payment of bills therefore dated collection progress is monitored continuously the whole month.

3. Training requirement

The capacity of WASA Multan Training Center is required to be enhanced in two ways:

I. To improve the capacity for planning and conducting training for staff.

II. To strengthen the capacity of staff on conducting in-house training programs.

Overall, In house training is required in three categories:

I. O&M of Mechanical and Electrical equipment

II. O&M of Sewerage and Drainage

III. Leakage control, Plumbing and pipe replacement.

WASA, Multan requires that training may be given to their four levels of officers:

I. Executive Engineers

II. Sub-divisional Officers

III. Sub Engineer

IV. Other O&M staff

4. Action after the emergency situation confirms

4.1. Action when the Government announces lockdown

- WASA Multan official staff of non-critical sections to work from home
- Precautionary instructions regarding safety will be issued to all staff working in the field
- WASA may distribute Personal Protective Equipment (PPEs) to operators/Inspectors/supervisors.
- Front line workers like pump operators, Sewer men, and field operators to perform duty with precautionary measures:
- Wear Face Masks provided by WASA-M.
- To sanitize their hands up to 20 seconds before the start of work

with sanitisers to be provided by WASA-M and continue hand sanitization in small intervals.

- Avoid touching their eyes and nose
- Avoid handshake with others
- Anybody feeling a temperature or cough should immediately leave the site by informing his supervisor and directly visit the hospital and act according to the advice of Doctors i.e. Quarantine at home or admit in hospital.
- WASA-M to depute operator in place of sick one from their work charge staff or allow overtime or additional charge to other operators to avoid interruption in the water supply.
- WASA-M may facilitate the public with the availability of online complaint registration and posting updates so that in case of interruption in bill distribution the bills are in access of consumers and payment is easy through online means.
- Don't take any eatable from others.

4.2. Action when working is allowed with certain precautions and safety measures

- Strictly ensure the culture of wearing Face Masks
- Keep sanitizing hands repeatedly
- Avoid handshake
- Keep the proper distance from others
- Avoid meetings in the rooms
- Promote a culture of online meetings with high officials

4.3. Emergency Contact

For centralized information, please contact Deputy Director Planning and Design Department.

5. Training strategy

Training will not be possible during a lockdown situation however few training sessions may be arranged with precautionary measures during the non-lockdown/working periods during the pandemic.

Training with precautionary measures may be in two ways:

- Online training sessions through Zoom: Selected officers having laptops and smartphones may attend such sessions
- Training sessions in WASA Training Center with the following precautions:

    - Only XENs, SDOs or Sub Engineers will be invited for training
    - Keep the training class strength below 10
    - Wear Face masks
    - Sanitize hands before the start of a session
    - Sit by maintaining a safe distance
    - Avoid handshake
    - Keep the windows open
    - Avoid serving tea/coffee
    - Avoid grouping during practical training

Islamic Republic of Pakistan

The Project for Improving the Capacity of WASAs in Punjab Province Phase 2

Business Continuity Plan (BCP)
WASA Gujranwala

July 2023

Business Continuity Plan (BCP)

1. Purpose

Due to the spread of Covid -19 in Gujranwala, the pace of the ongoing JICA project for " Improving the Capacity of WASAs in Punjab Province Phase 2" (hereinafter referred to as "Phase 2" or "Project") also suffered in terms of training programs and practical training, therefore, the countermeasures have developed to chalk out the strategy to continue the training program as much as possible during this type of pandemic situation.

This may be done keeping in view the availability of staff for essential services for the public by WASA like water supply tube wells operation; Public complaints address system, bill distribution and collection system and maintenance of disposal and tube-wells etc. and working in the most possible safe environment with an adaptation of safety measures. This document will cover the pre-pandemic situation and possible safety measures for field staff during emergencies and devise strategies for possible ways and means of continuation of training programs.

2. Situation before emergency

2.1 Field installations

There are 67 groundwater tube wells in Gujranwala WASA which are operated regularly in three shifts to provide drinking water for 10-12 hours per day to the resident. Similarly, there are 31 disposal pump stations and 9 lift stations for sewerage disposal, which are also operated by pump operators.

2.2 Operational field offices

There are 6 operation subdivisions in WASA Gujranwala where WASA field staff under the supervision of Assistant Director deals with the public regarding their complaints about water supply leakage, Tube wells operation, sewerage overflowing and broken/missing manhole covers etc.

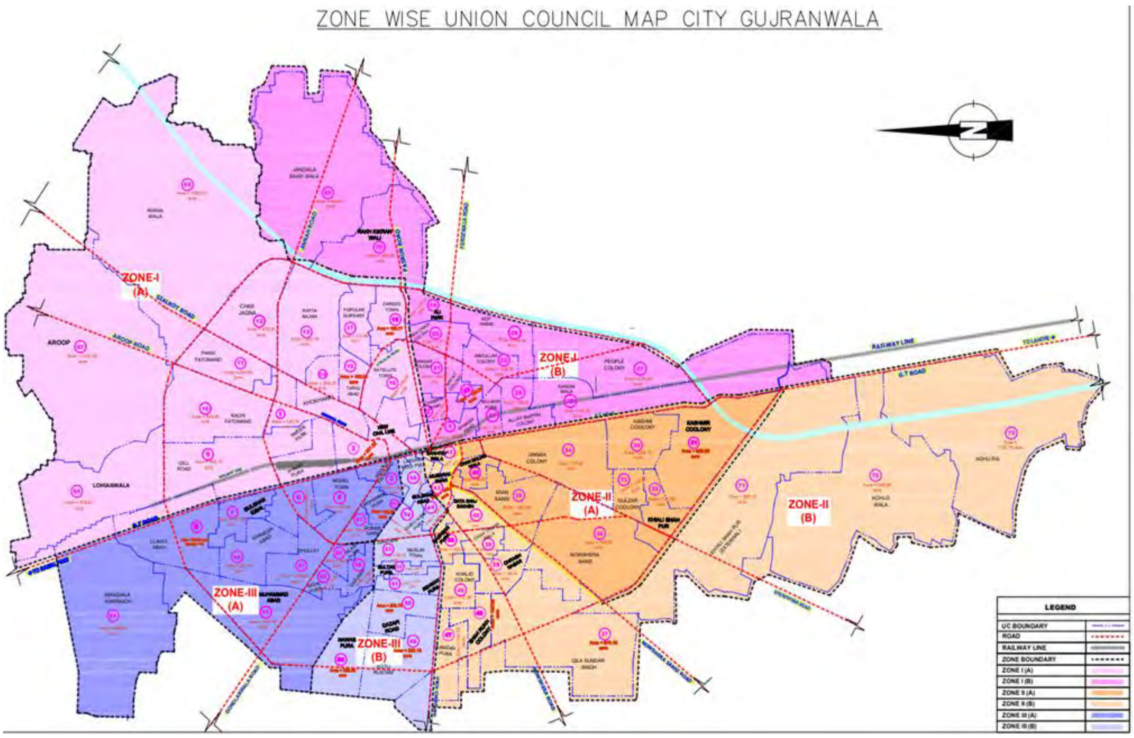
Public dealing also involves the approval and installation of new water and sewerage connections. Public dealing continues the whole day and field staff remains busy rectifying the complaints.

2.3 Operation of tube wells and disposal/lift stations

Drinking water supply tube wells and disposal stations/lift stations falling in the jurisdiction of each sub-division are operated by a pump operated in three shifts. There is a provision of standby operators for the weekly rest of the regular operators. For this purpose, 3.5 operators per tube well are employed. A total of about 175 pump operators round the clock as per their scheduled timings. The shortage of operators is met with a deputation of daily wage operators which are 115 in number.

<u>Zones and subdivisions in WASA</u>

Sr. No.	Directorate	Zone Office	Deputy Director (Development and O&M)	Name of Sub Division
1	Director Engineering	Zone I. Liaqat Bagh	Deputy Director	Sector I A
				Sector II B
2		Zone II. Sheranwala Bagh	Deputy Director	Sector II A
				Sector II B
3		Zone III Model Town	Deputy Director	Sector III A
				Sector III B



2.4 Maintenance Directorate

The operation of tube wells and disposal stations is the responsibility of Operation Directorates but maintenance is also carried out by Operation Directorate. They are responsible to keep the tube wells and pump stations in a satisfactory running condition. They attend to the breakdown complaints during office hours, and the main head office (Peoples Colony) receives the complaints round the clock in case of emergency. Field staff and the concerned supervisor remain in the fields.

2.5 Customer service/bill distribution

There are 3 public dealing offices of the Revenue Directorate in 3 WASA Zones. The staff deals with the public regarding their complaints about billing. Bill distribution system has been outsourced in WASA Gujranwala. These offices ensure and updated the progress of daily collection and monitored continuously the whole month.

3. Training requirement

The capacity of WASA Gujranwala Training Center is required to be enhanced in two ways:

- To improve the capacity for planning and conducting training for staff.
- To strengthen the capacity on conducting in-house training programs.

Overall, In house training is required in three categories:

- O&M of Mechanical and Electrical equipment
- O&M of Sewerage and Drainage
- Leakage control, Plumbing and pipe replacement.

WASA, Gujranwala demands that training may be given to their Four levels of officers:

- Directors, Deputy Directors & Engineers
- Sub-divisional Officers
- Sub Engineers
- Field Staff

4. Action after the emergency situation confirms

4.1. Action when the Government announces lockdown

- WASA official staff of non-critical sections to work from home
- WASA distribute Personal Protective Equipment's (PPEs) to operators.
- Front line workers like pump operators, Sewer men, and field operators to perform duty with precautionary measures:
  - ✓ Wear Face Masks provided by WASA.

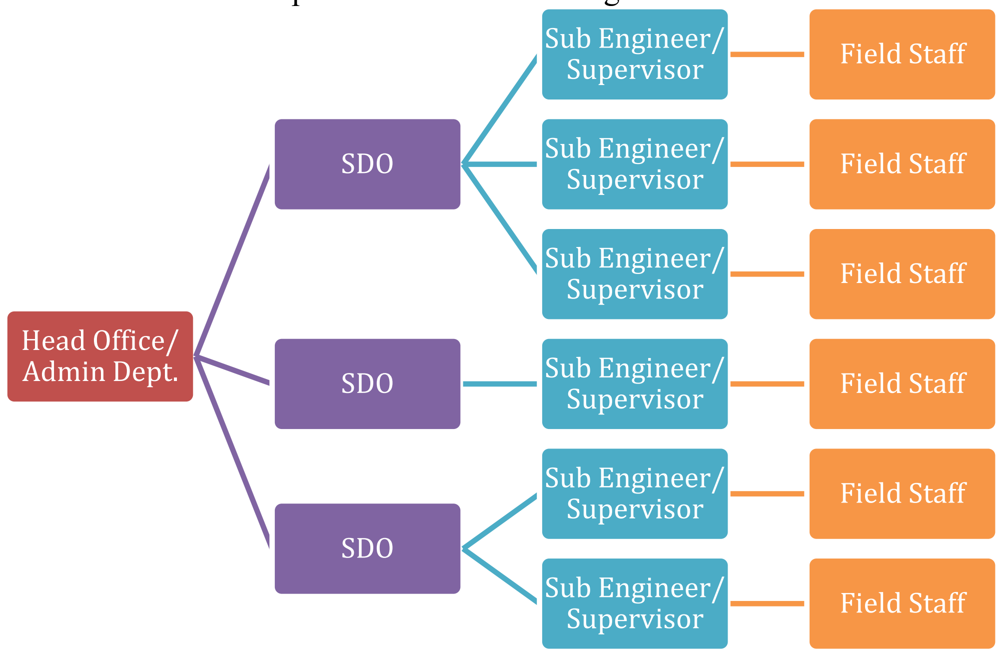
- ✓ To sanitize their hands before the start of work with sanitizers to be provided by WASA and continue hand sanitization in small intervals.
- ✓ Avoid touching their eyes and nose
- ✓ Avoid handshake with others
- ✓ Don't take any eatable from others.
- ✓ Anybody feeling a temperature or cough should immediately leave the site after entering the details of his/her illness and directly visit the hospital and act according to doctors' advice, i.e., Quarantine at home or admit to the hospital.
- ✓ WASA to replace operators in place of sick ones from their work charge staff or other operators to avoid interruption in the water supply.

4.2. Action when working is allowed with certain precautions and safety measures

- Continue the culture of wearing Face Masks
- Keep sanitizing hands repeatedly
- Avoid handshake
- Keep safe distancing from others
- Avoid meetings in the rooms
- Promote a culture of online meetings with high officials

4.3. Emergency Contact

The admin department is responsible to compile information about the staff. Each SDO office is responsible to collect the data from the field and share with the admin department. The tabular explanation of the same is given below.



In case of an emergency (test positive or have symptoms), please contact Admin Office, located in the head office.

5. Training strategy

No Training is possible during a lockdown situation however training sessions may be arranged with precautionary measures during the non-lockdown/working periods.

Training with precautionary measures may be in two ways:

- Online training sessions through Zoom: Selected officers having laptops may attend such sessions
- Training sessions in WASA Training Center with the following precautions:
  - ✓ Only Deputy Directors, Assistant Directors or Sub Engineers will be invited for training
  - ✓ Keep the training class strength below 6
  - ✓ Wear Face masks
  - ✓ Sanitize hands before the start of a session
  - ✓ Sit by maintaining a safe distance
  - ✓ Avoid handshake
  - ✓ Keep the windows open

- ✓ Avoid serving tea/coffee
- ✓ Avoid grouping during practical training

Islamic Republic of Pakistan

The Project for Improving the Capacity of WASAs in Punjab Province Phase 2

Business Continuity Plan (BPC)

WASA Rawalpindi

June 2023

Business Continuity Plan (BPC)

1. Purpose

Due to the spread of Covid -19 in Rawalpindi, the pace of the ongoing JICA project for " Improving the Capacity of WASAs in Punjab Province Phase 2" (hereinafter referred to as "Phase 2" or "Project") also suffered in terms of training programs and practical training, the countermeasures have developed to chalk out the strategy to continue the training program as much as possible during this type of pandemic situation.

This may be done keeping in view the availability of staff for essential services for the public by WASA like water supply tube wells operation; Public complaints address system, bill distribution and collection system and maintenance of disposal and tube-wells etc. and working in the most possible safe environment with an adaptation of safety measures. This document will cover the pre-pandemic situation and possible safety measures for field staff during emergencies and devise strategies for possible ways and means of continuation of training programs.

2. Situation before emergency

2.1 Field installations

There are 490 groundwater tube wells in Rawalpindi WASA, which are operated regularly in two/three shifts to provide drinking water to the residents.

2.2 Operational field offices

There are 4 operation subdivisions in WASA Rawalpindi where WASA field staff under the supervision of Sub-divisional Officers deals with the public regarding their complaints about water supply leakage, Tube wells operation, sewerage overflowing and broken/missing manhole covers etc.

Public dealing also involves approving and installing new water and sewerage connections. Public dealing continues the whole day and field staff remains busy in rectifying the complaints.

2.3 Operation of tube wells and disposal/lift stations

Drinking water supply tube wells operated in two/three shifts. There is a provision of standby operators for the weekly rest of the regular operators. For this purpose, 3.5 operators per tube well are employed. Operators operate these pumps round the clock as per their scheduled timings. The shortage of operators is met with a deputation of daily wage operators.

Sr No	Zone	Sub Division
1	East	East zone-1 East zone-2
2	West	West zone-1 West zone-2

3	PP-12	PP-12
4	PP-13	PP-13
5	Filtration Plant	Filtration Plant

2.4 Maintenance Directorate

Engineering/Water Supply Directorate is responsible to keep the tube wells and pumping machinery in a satisfactory running condition. They attend the breakdown complaints round the clock; therefore, the staff remains in the field in 2/3 shifts.

2.5 Customer service/bill distribution

There are 3 public dealing offices of the Revenue Directorate in various areas of the City. The staff deals with the public regarding their complaints about billing. Field operators distribute bills to 145300 customers' residential addresses each month. These offices also ensure the payment of bills therefore dated collection progress is monitored continuously the whole month.

3. Training requirement

The capacity of WASA Rawalpindi Training Center is required to be enhanced in two ways:

- to improve the capacity for planning and conducting training for staff.
- to strengthen the capacity on conducting in-house training programs.

Overall, In house training is required in three categories:

- O&M of Mechanical and Electrical equipment
- O&M of Sewerage and Drainage
- Leakage control, Plumbing and pipe replacement.

WASA Rawalpindi requires that training may be given to their four levels of officers:

- Executive Engineers
- Sub-divisional Officers
- Sub Engineer
- Staff between BPS 1 and 11

4. Action after the emergency situation confirms

4.1.Action when the Government announces lockdown

- WASA official staff of non-critical sections to work from home
- WASA may distribute Personal Protective Equipment's (PPEs) to operators.
- Front line workers like pump operators, Sewer men, and field operators to perform duty with precautionary measures:
  - ✓ Wear Face Masks provided by WASA.
  - ✓ To sanitize their hands before the start of work
  - ✓ Sanitizers to be provided by WASA and continue hand sanitization in recommended intervals

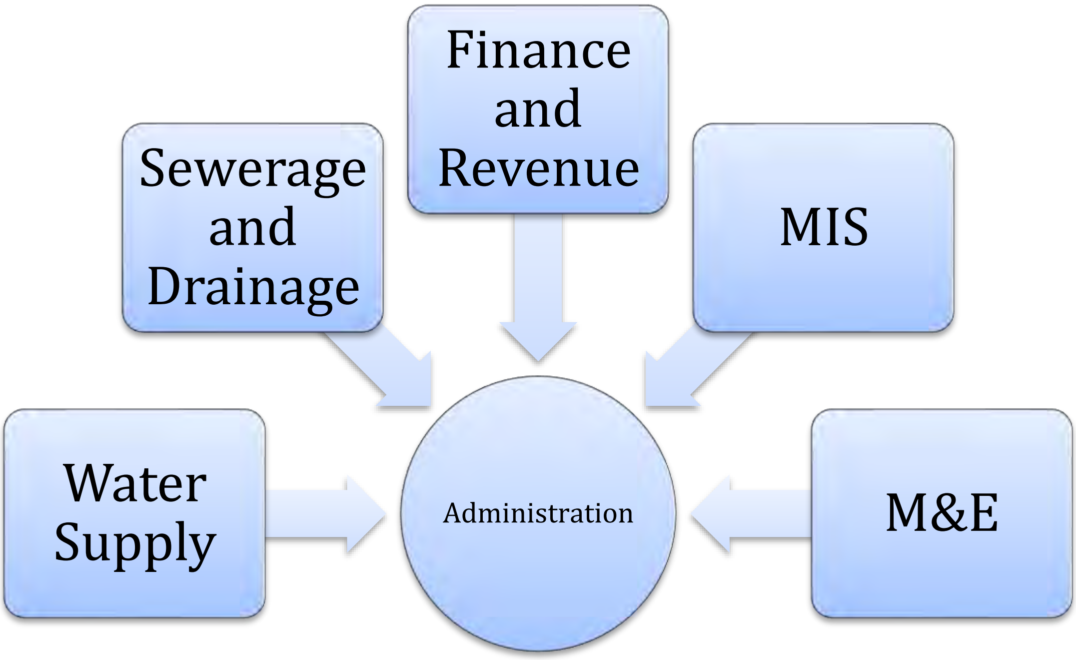
- ✓ Avoid touching their eyes and nose
- ✓ Avoid handshake with others
- ✓ Anybody feeling a temperature or cough should immediately leave the site after submitting applications via text message or WhatsApp message to the Assistant Director of the Administration Department about the details of his/her illness and directly visit the hospital and act according to the advice of Doctors i.e. Quarantine at home or admit in the hospital.
- ✓ WASA to depute operator in place of sick one from their work charge staff or allow overtime to other operators to avoid interruption in the water supply.
- ✓ WASA may facilitate the public with the availability of online duplicate bills and collection systems, online complaint registries and posting updates so that in case of interruption in bill distribution the bills are in excess of consumers and payment is easy through credit cards.
- ✓ Don't take any eatable from others.

4.2. Action when working is allowed with certain precautions and safety measures

- Continue the culture of wearing Face Masks
- Keep sanitizing hands repeatedly
- Avoid handshake
- Keep proper distance from others
- Avoid meetings in the rooms
- Promote a culture of online meetings with high officials

4.3. Emergency Contact

Each directorate is responsible for collecting information about their staff's health condition and communicating it to the admin department. The admin department is responsible for compiling all the directorates' information to keep a record of available and absent staff so a strategy if required, may be made to tackle the staff shortage. The flow of information should be as per the diagram below:



In case of an emergency (test positive or have symptoms), please contact Assistant Director, Administration Department.

5. Training strategy

No Training is possible during a lockdown situation however training sessions may be arranged with precautionary measures during the non-lockdown/working periods.
Training with precautionary measures may be in two ways:

- Online training sessions through Zoom: Selected officers having laptops may attend such sessions
- Training sessions in WASA Training Center with the following precautions:

  - ✓ Only XENs, SDOs or Sub Engineers will be invited for training
  - ✓ Keep the training class strength below 11
  - ✓ Wear Face masks
  - ✓ Sanitize hands before the start of a session
  - ✓ Sit by maintaining a safe distance
  - ✓ Avoid handshake
  - ✓ Keep the windows open
  - ✓ Avoid serving tea/coffee
  - ✓ Avoid grouping during practical training.

Annex 5.5.2 Letters for Transferring Ownership of Equipment in Term 2

Date: September 19, 2022
Ref # JAT/JICA-Aljazari/052

Mr. Abid Hussainy
The Principal,
Al-Jazari Academy,
Lahore.

Subject: **Transferring Ownership of Equipment**

Dear Mr. Hussainy,

JICA is transferring ownership of the equipment listed below to Al-Jazari Academy, Lahore. In the process, the following conditions between JICA and Al-Jazari Academy were agreed:

1) The equipment will be used exclusively for training activities related to the "Project for Improving the Capacity of WASAs in Punjab Province in Islamic Republic of Pakistan Phase 2"
2) After the project, Al-Jazari Academy will provide information (location, operation, condition, etc.) about the equipment at request.

Item No.	Description of Equipment	Quantity
1.	Velocity Meter	1 Unit

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NOBUYUKI SATO
Chief Advisor
(The Project for Improving the Capacity of WASAs in Punjab Province Phase 2)
Japan Techno Co Ltd
nsato@jat.co.jp

Received
20/09/2022

20/09/2022

PRINCIPAL
Al-Jazari Water &
Sanitation Academy

20/9/2022

Date: January 10, 2024
Ref # JAT/JICA-Aljazari/072

Ms. Fiza Anjum,
Deputy Director (P&E)
WASA Lahore.

Subject: **Transferring Ownership of Equipment**

Dear Ms. Anjum,

JICA is transferring ownership of the equipment listed below to Al-Jazari Academy, Lahore. In the process, the following conditions between JICA and Al-Jazari Academy were agreed:

1) The equipment will be used exclusively for training activities related to the "Project for Improving the Capacity of WASAs in Punjab Province in Islamic Republic of Pakistan Phase 2"
2) After the project, Al-Jazari Academy will provide information (location, operation, condition, etc.) about the equipment at request.

Item No.	Description of Equipment	Quantity
1.	Lenovo ThinkPad E15 Laptop Processor: Intel Core i7-10510U (10th Generation) RAM: 16GB DDR-4 2666MHz RAM Memory Storage: ITB Solid State Drive (SSD), Graphics 2GB Graphic Card, Display 15.6" Full HD LED Display, Features Wifi, Bluetooth, OS DOS Ser # PF2BAN3N, PF2BAFSC, PF2BADMI, PF2BAQ5R	4
2.	Lenovo Think Center M920s Branded Desktop Computer System Processor: Intel Core i5-8thGeneration, RAM 16GB DDR-4 RAM Memory, Storage 256GB Solid State Drive (SSD), HDD: ITB SATA Hard Drive, Lenovo USB Keyboard & Mouse, Os DOS with Power Cable & Driver CD's Ser# MJ09PKXE	1

Received.
Fiza Anjum
12-1-24

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NOBUYUKI SATO
Chief Advisor
(The Project for Improving the Capacity of WASAs in Punjab Province Phase 2)
Japan Techno Co Ltd
nsato@jat.co.jp

Cc: Managing Director, WASA Lahore

Annex 8.1.1 MM on 1st JCC held on 26th May, 2021

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MINUTES OF MEETING

1st Joint Coordination Committee Meeting for the Project Titled "The Project for Improving the Capacity of WASAs in Punjab Province Phase 2"

Lahore, 26th, May 2021.

Mr. Muhammad Shafique
Member, Social Infrastructure,
Planning and Development Board,
Government of the Punjab.

Muhammad Omar Masud
Chief Executive Officer,
The Urban Sector Planning and Management Services Unit Pvt. Ltd. (The Urban Unit),
Planning and Development Department,
Government of the Punjab.

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Dr. Nobuyuki Sato
Chief Technical Advisor,
JICA Expert Team

(Observer)

Mr. Yoichi Inoue
Director,
Water Resources Management Team 1,
Water Resources Group,
Global Environment Department, JICA

DY. Sec. Tech.
HUD & PHED.

Mr. Muhammad Tanveer.
D.M.D. (F.A&R)
WASA, Lahore.

MINUTES OF MEETING		
Subject:	1st Joint Coordination Committee Meeting for the Project Titled "The Project for Improving the Capacity of WASAs in Punjab Province Phase 2"	
Date:	May 26th, 2021	Time: 10:00 a.m.
Venue:	Planning and Development Board, Lahore	
Participants:	• Mr. Muhammad Shafique, Member Social Infrastructure, Planning and Development Board (Chair) • Mr. Muhammad Omar Masud, CEO The Urban Unit (Secretary to JCC) • Mr. Azhar Ali, Principal Al-Jazari Academy, The Urban Unit • Mr. Abid Hussainy, Senior Specialist Strategic Management, The Urban Unit • Mr. Jabbar Anwar, Managing Director, WASA Faisalabad • Mr. Nasir Iqbal, Managing Director, WASA Multan. • Mr. Raja Shaukat Mehmood, Managing Director WASA Rawalpindi. • Mr. Muhammad Tanveer, Dy. Managing Director, WASA Lahore. • Mr. Adnan Nisar Khan, Dy. Managing Director, WASA Faisalabad • Mr. Sohan Khalid, Deputy Secretary (Tech), HUD & PHED • Ms. Zaeema Aman, Dy. Director Training, WASA Lahore. • Mr. Azizullah, Deputy Director (P&D) / WASA Coordinator, Rawalpindi • Mr. Khurram Nabeel, Deputy Director (P&D) / WASA Coordinator, Gujranwala. **JICA Expert Team (Online)** • Mr. Yoichi Inoue, Director, JICA HQ • Mr. Ryuji Ogata, Senior Advisor, JICA HQ • Mr. Hironobu Nakayama, Technical Advisor, JICA HQ • Ms. Risa Aramaki, Representative, JICA Pakistan Office • Dr. Nobuyuki Sato, Chief Advisor, JICA Experts Team • Ms. Mikiko Azuma, JICA Experts Team • Mr. Tatsuo Tomidokoro, JICA Experts Team • Mr. Shuntaro Kinno, JICA Experts Team • Mr. Toshimichi Naganuma, JICA Experts Team • Mr. Yusaku Numajiri, JICA Experts Team • Mr. Tabusa Hiroyuki, JICA Experts Team	

	• Mr. Yasuhiro Matsuoka, JICA Experts Team
Background	Japanese International Cooperation Agency (JICA), in collaboration with Water and Sanitation Agencies (WASAs) of Punjab and The Urban Unit are working on phase-II of the project titled The Project for Improving the Capacity of WASAs in Punjab Province Phase-II which has officially commenced from 15th Feb 2021. As per request of the Chief Advisor JICA, Dr. Nobuyuki Sato the first JCC meeting was held on 26th May for approval of work plan and other related activities.

DISCUSSION AND DECISIONS

The Meeting started with opening remarks from Member SI.

- Mr. Azhar Ali, Principal Al Jazari academy gave a brief introduction on status of human resource at academy and budget,
  - i. It was stated that recruitment of staff on faculty positions is almost complete.
  - ii. Approved funds of PKR 30 million for Al Jazari Academy has been transferred to WASA Lahore and needs to be released to the Urban Unit.
- Representative of HUD&PHED ensured that the funds for Al-Jazari Academy to be released in two days' time.
- Dr. Sato, Chief Advisor, JICA Experts Team, explained project work plan and MOMs of PCC. JCC approved / agreed the following items.
  - i. Work Plan
  - ii. Table of Contents for Monitoring Sheet
  - iii. "Business Continuity Plan (BCP)" for "Activity on countermeasures against spread of COVID-19"
  - iv. Revision of terms (see Attachment 1)
  - v. Equipment provision as per record of discussion (sewer inspection camera: 1 unit, personal computers: 15 units, training tools: as necessary). However, there was a request for additional equipment and adding of new topic/courses for the training by PCC, that would be evaluated and finalized by 2nd JCC.
- Mr. Nakayama, JICA HQ, briefed the audience about the following items:
  - i. The commencement of the project from Japanese side is considered as February 15, 2021.
  - ii. During travel restriction for JICA experts to Pakistan due to COVID-19, remote systems such as Skype, Zoom to be used along with local JICA team for execution of the project.
  - iii. It was suggested to incorporate best practices of WASA-F and those acquired from other projects of JICA into the training materials and disseminate to other WASAs through this project.

iv. Collaboration with Grant Aid Project in Multan was also suggested.
v. Operational plan of Al-Jazari Academy to be prepared and presented i.e. operational model of academy after end of lease agreement between Urban Unit and WASA Lahore due in 2024. TAC to submit their suggestions on the same to PCC.
vi. Training needs assessment for new courses will be evaluated before 2nd JCC but JICA understands that new training courses are considered within a range that the current inputs can cover.
vii. Equipment procurement to be done by JICA is according to Record of Discussion. However JICA will review the request for additional equipment when proper justification is provided.

Pakistani side understood the briefing by Mr. Nakayama.

- Mr. Abid Hussainy, Senior Specialist, The Urban Unit suggested the following items,

  i. The team will be in coordination with WASA Multan regarding JICA Grant Aid Project.
  ii. The lease agreement of Al Jazari Academy was approved by the cabinet and is valid for 10 years (till November 2024) with an option of extension.
  iii. The equipment should be decided after need assessment of each WASA and Al-Jazari Academy.
  iv. The starting date of project from Pakistani side is to be 1 July 2020.
  v. Renovation of the Al Jazari Academy's main building to be completed on urgent basis and the building be handed over to the Urban Unit so as faculty and Japanese experts offices be shifted.

- It is agreed that the commencement of the Project from Pakistani and Japanese side is 1 July 2020 and 15th February, 2021, respectively.
- MD Faisalabad WASA appreciated support extended by JICA and the Urban Unit towards capacity building that is crucial for sustainable operations.

- CEO, Urban Unit, appreciated that there are no outstanding issues within the project. He thanked JICA for its participation in different projects in Pakistan particularly in Punjab, appreciated that all departments of Punjab Government are collaborating for this Project in particular MD's of all WASAs.

Attachment I

Comparison of Current and Revised Items

Item	Current PDM	Revised PDM	Reasons of Revision
Activity 1-10	Technical committee approves revised and updated professional training contents.	Technical advisory committee approves revised and updated professional training contents.	"advisory" is added because the right term is "Technical advisory committee".
Activity 1-12	Conduct trainings for how to conduct assessment (Needs study) for WASA coordinators	Conduct trainings for how to conduct assessment (Needs study) for WASA coordinators	The term of "WASA training coordinator" was changed to "WASA coordinator".
Activity 1-13	Organize semi-annual training coordinators meetings.	Organize semi-annual WASA coordinators meetings.	The term of "training coordinator" was changed to "WASA coordinator".
Activity 3-1	Notify training coordinator and training management group in each WASA.	Notify WASA coordinator in each WASA.	The term of "training coordinator" was changed to "WASA coordinator". "training management group" will not be formed because "WASA coordinator" with the other staff handles the role of "training management group".
Activity 3-2	Training coordinator and training management group conduct training assessment for in-house training needs and training capacity.	WASA coordinator conducts training assessment for in-house training needs and training capacity.	The term of "training coordinator" was changed to "WASA coordinator". "training management group" will not be formed because "WASA coordinator" with the other staff handles the role of "training management group".
Activity 3-3	Based on the results of assessment, the training management group identify	Based on the results of assessment, WASA coordinator identifies priority	"training management group" will not be formed because "WASA coordinator" with the other staff handles the role of

	priority areas and candidate trainers.	areas and candidate WASA trainers.	"training management group". The term of "trainer" was changed to "WASA trainer".
Activity 3-4	Training coordinator and training management group formulate in-house training plans semiannually.	WASA coordinator formulates in-house training plans semiannually.	The term of "training coordinator" was changed to "WASA coordinator". "training management group" will not be formed because "WASA coordinator" with the other staff handles the role of "training management group".
Activity 3-5	Training coordinator and training management group review implementation of in-house training plans and budget annually and revise the plans and budget if necessary.	WASA coordinator reviews implementation of in-house training plans and budget annually and revises the plans and budget if necessary.	The term of "training coordinator" was changed to "WASA coordinator". "training management group" will not be formed because "WASA coordinator" with the other staff handles the role of "training management group".
Activity 4-1	Based on the training plans formulated in Output 3, trainers produce in-house training contents and modules.	Based on the training plans formulated in Output 3, WASA trainers produce in-house training contents and modules.	The term of "trainer" was changed to "WASA trainer".
Activity 4-2	Trainers conduct pilot training at each WASA	WASA trainers conduct pilot training at each WASA	The term of "trainer" was changed to "WASA trainer".
Activity 4-3	Trainers and training coordinator review pilot in-house training and update the training contents and modules.	WASA trainers and WASA coordinator review pilot in-house training and update the training contents and modules.	The term of "trainer" was changed to "WASA trainer". The term of "training coordinator" was changed to "WASA coordinator".
Activity 4-4	Trainers conduct in-house training.	WASA trainers conduct in-house training.	The term of "trainer" was changed to "WASA trainer".

Annex 8.1.2 MM on 2nd JCC held on 1st November, 2021

MINUTES OF MEETING

2nd Joint Coordination Committee Meeting for the Project Titled "The Project for Improving the Capacity of WASAs in Punjab Province Phase 2"

Lahore, 1st November 2021.

m. Abdullah

Mr. Muhammad Abdullah Khan Sumbal
Chairman
Planning and Development Board,
Government of Punjab.

Omar Masud

Muhammad Omar Masud
Chief Executive Officer,
The Urban Sector Planning and Management Services Unit Pvt. Ltd. (The Urban Unit),
Planning and Development Department,
Government of the Punjab.

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Dr. Nobuyuki Sato
Chief Technical Advisor,
JICA Expert Team

Mr. Zahid Aziz
Managing Director,
Water and Sanitation Agency, Lahore.

MINUTES OF MEETING		
Subject:	2nd Joint Coordination Committee Meeting for the Project Titled "The Project for Improving the Capacity of WASAs in Punjab Province Phase 2"	
Date:	November 01, 2021	Time: 11:00 a.m.
Venue:	Auditorium at Planning and Development Board	
Participants:	Pakistani side • Mr. Muhammad Abdullah Khan Sumbal, Chairman Planning and Development (P&D) Board (Chairperson) • Mr. Mujahid Sherdil, Secretary Planning and Development Board • Mr. Omar Masud – Chief Executive Officer, The Urban Unit (Secretary JCC) • Mr. Zahid Aziz, MD WASA Lahore • Mr. Azhar Ali, Principal Al-Jazari Academy, The Urban Unit • Mr. Abid Hussainy, Senior Specialist Strategic Management , The Urban Unit • Mr. Jabbar Anwar, MD WASA Faisalabad • Mr. Yasir Mubeen, Chief (UD) Planning and Development Board • Mr. Shahid Iqbal, Assistant Chief, ECA II, P&D. • Mr. Souman Khalid, Deputy Secretary (Tech), HUD & PHED • Mr. Jawad Shahid, Vice Principal/ E&M Specialist, Al-Jazari Academy • Mr. Muhammad Ghufran, Deputy Managing Director O&M WASA Lahore • Ms. Mehtab, AC (UD) • Mr. Roohan Javaid, Deputy Director WASA Faisalabad • Mr. Farwa Ashraf – Senior Research Analyst, The Urban Unit • Mr. Amar Saleem, MD WASA Gujranwala • Mr. Kashan, DD WASA Gujranwala • Mr. Nasir Iqbal, MD WASA Multan • Mr. Ahmed Manzoor, Director WASA Rawalpindi • Mr. Noor Rabbani, Assistant Director WASA Rawalpindi Japanese side • Mr. Yoichi Inoue, Director, JICA HQ • Mr. Ryuji Ogata, Senior Advisor, JICA HQ • Mr. Hironobu Nakayama, Officer, JICA HQ • Ms. Risa Aramaki, Representative, JICA Pakistan Office	

	• Mr. Abrar Hayat Khan, Programme Officer, JICA Pakistan Office • Dr. Nobuyuki Sato, Chief Advisor, JICA Experts Team • Mr. Tatsuo Tomidokoro, Sewerage Pipe and Drainage Cleaning Specialist, JICA Expert Team • Mr. Yusaku Numajiri, Mechanical Engineer, JICA Expert Team • Mr. Tabusa Hiroyuki, Electrical Engineer, JICA Experts Team • Mr. Hiroyuki Morita, Leakage Control Specialist, JICA Experts Team • Mr. Muhammad Hafeez, JET Coordinator • Mr. Zain Hassan, JET Coordinator
Summary	Second JCC approved three courses as follows: i) O&M on sewerage and drainage, ii) O&M on mechanical and electrical equipment, and iii) Leakage control, plumbing, and pipe replacement plan In addition, Second JCC approved additional equipment required for the Project as follows: i) Velocity meter (1 unit), and ii) Vibration meters (6 units)

DISCUSSION AND DECISIONS

The Meeting started with opening remarks from Mr. Abdullah Khan Sumbal – Chairman P&D Board (chairman). He thanked JICA for assisting in the capacity building project.

- Mr. Omer Masud – CEO Urban Unit, briefed the forum about the ongoing activities of the project.
- The Chief Advisor, JICA Experts Team, presented the progress of the Project including the training system.
- The Main items presented by Chief Advisor, JICA Experts Team, included:
    1. Briefing regarding PCC meeting held on 27th October, 2021
    2. Briefing activities from March to October 2021
    3. Approval of training courses assisted by the Project
        a. O&M on sewerage and drainage
        b. O&M on mechanical and electrical equipment
        c. Leakage control, plumbing, and pipe replacement plan
    4. Explanation of training topic
    5. Approval of additional equipment procured by the Project
    6. Upcoming activities

The following comments were part of discussion after presentation by the chief advisor.

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- CEO, The Urban Unit emphasized on the importance of energy audits and was of the view that business planning course should be added. Additionally, more equipment should be considered for the implementation of the trainings. He requested JICA to help making a list of additional equipment required for the project.
- Principal Al-Jazari Academy briefed the forum about the ongoing trainings and the status of the HR at the academy. It was told that most of the counterpart HR to JICA experts have already been hired. Hiring process on remaining posts will be pursued as per need in future.
- Chairman P&D emphasized to raise the profile of the project through effective media strategy and to reflect the good work done by JICA. He also asked JICA to provide linkages with other International Universities for similar long term training programs done under the project "Punjab Capacity Building Program", for Punjab Resource Mobilization Program.
- The Chairman directed Urban Unit to ensure all possible facilitation and coordination to JICA for this project, he further advised Chief (UD) P&D Board to coordinate with Principal Al-Jazari Academy to develop linkages with International Universities under PRM Program of P&D for long term degree programs and capacity building of WASA staff especially.
- Dr. Sato informed that assessment for the additional equipment has already been conducted. As a result of the assessment, six (06) vibration meters and one (01) velocity meter were added. The fields of experts agreed in Record of Discussion signed between Japanese and Pakistani side were selected in the expert team. The expert for the business planning was not included in Record of Discussion. Therefore, the current team working on the project does not have capacity to support the business planning course.
- Mr. Nakayama from JICA HQ informed that business planning specialist cannot be provided as per Record of Discussion signed between both Governments and Project Design Matrix. Similarly, because the additional equipment was assessed by JICA Experts Team, there is no need for further assessment of equipment. He further explained that under the "Technical cooperation project for WASA Faisalabad", JICA will provide technical assistance (TA) project to WASA Faisalabad for developing the capacity regarding business planning, and that it will be possible to share the lesson and learned of TA project in WASA Faisalabad to Al Jazari Academy. In addition, since the course was already developed in Phase 1, Al Jazari academy can provide the business planning training to WASAs.
- The forum suggested The Urban Unit to handle Business Planning course independently for Water Utility providers.
- Mr. Zahid Aziz, MD WASA Lahore emphasized on the importance of NRW reduction and explained NRW reduction is being dealt with another water meters projects. He further emphasized on the importance of technical and financial aspect of trainings. For long term trainings, he informed that two of his officers are already getting higher education in Tokyo.
- All items presented by Chief Advisor, JICA Experts Team were agreed by JCC and approved by the worthy Chairman.

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Decisions:

All agenda items presented by Chief Advisor, JICA Experts Team were approved by JCC.

The meeting ended with note of thanks from the Chairperson.

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Annex 8.1.3 MM on 3rd JCC held on 7th February, 2022

MINUTES OF MEETING

3rd Joint Coordination Committee Meeting for the Project Titled "The Project for Improving the Capacity of WASAs in Punjab Province Phase 2"

Lahore, 7th February 2022.

Mr. Muhammad Shafiq Ahmad
Member, Social Infrastructure,
Planning and Development Board,
Government of the Punjab.

Mr. Imran Ali Sultan
Chief Operating Officer,
The Urban Sector Planning and Management Services Unit Pvt. Ltd. (The Urban Unit),
Planning and Development Department,
Government of the Punjab.

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Dr. Nobuyuki Sato
Chief Technical Advisor,
JICA Expert Team

16.03.2022

Mr Muhammad Tanveer
Managing Director,
WASA , Lahore

MINUTES OF MEETING		
Subject:	3rd Joint Coordination Committee Meeting for the Project Titled "The Project for Improving the Capacity of WASAs in Punjab Province Phase 2"	
Date:	February 7th 2022	Time: 11:00 a.m.
Venue:	Planning and Development Board, Lahore	
Participants:	1) Mr. Muhammad Shafiq, Member Social Infrastructure, Planning and Development Board (Chair) 2) Mr. Imran Ali Sultan, COO, The Urban Unit 3) Mr. Abid Hussainy, Principal Aljazari Academy, The Urban Unit 4) Mr. Yasir Mubeen, Chief (UD) P&D Board. 5) Mr. Jabbar Anwar, Managing Director, WASA Faisalabad 6) Mr. Nasir Iqbal, Managing Director, WASA Multan. 7) Mr. Raja Shaukat Mehmood, Managing Director WASA Rawalpindi. 8) Mr. Muhammad Ghufran, Managing Director, WASA Lahore. 9) Mr. Jabbar Anwar, Managing Director, WASA Faisalabad 10) Mr. Soman Khalid, Deputy Secretary (Tech), HUD & PHED 11) Mr. Jawad Shahid, Vice Principal, Al-Jazari Water Academy, The Urban Unit. 12) Mr. Muhammad Irfan, Infrastructure Specialist, Al-Jazari, The Urban Unit 13) Ms. Rebia Suhail, Sr. Instructor, Al-Jazari Academy 14) Ms. Najam ul Sahar, Pedagogy Officer, Al-Jazari Academy 15) Mr. Azizullah, Deputy Director (P&D) / WASA Coordinator, Rawalpindi 16) Mr. Khurram Nabeel, Deputy Director (P&D) / WASA Coordinator, Gujranwala. **JICA Expert Team (Online)** 17) Mr. Yoichi Inoue, Director, JICA HQ 18) Mr. Ryuji Ogata, Senior Advisor, JICA HQ 19) Mr. Hironobu Nakayama, Officer, JICA HQ 20) Ms. Risa Aramaki, Representative, JICA Pakistan Office 21) Mr. Abrar Hayat Khan, Programme Officer, JICA Pakistan Office 22) Dr. Nobuyuki Sato, Chief Advisor, JICA Experts Team 23) Mr. Tatsuo Tomidokoro, JICA Experts Team 24) Mr. Toshimichi Naganuma, JICA Experts Team 25) Mr. Yusaku Numajiri, JICA Experts Team	

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.	26) Mr. Hiroyuki Tabusa, JICA Experts Team 27) Mr. Kazuhiro Kayanoma, JICA Experts Team 28) Mr. Shuntaro Kinno, JICA Experts Team
Background	Japanese International Cooperation Agency (JICA), in collaboration with Water and Sanitation Agencies (WASAs) of Punjab and The Urban Unit (Government of Punjab), Al Jazari Water & Sanitation Academy (AJWA) are working on JICA Phase-II of the Project titled as 'The Project for Improving the Capacity of WASAs in Punjab Province Phase-II' which was officially commenced from 15th Feb. 2021. 3rd JCC meeting was held on 7th February 2022 for the progress review, key decisions and proposals related to AJWA and Phase II.

DISCUSSION AND DECISIONS

The meeting started with opening remarks from Chair, Mr Muhammad Shafiq, Member SI, P&B Board, Govt of Punjab, The Chief Operating Officer (COO), The Urban Unit, Mr. Imran Ali Sultan briefed the forum about Project and the key decisions which were made during the 2nd JCC meeting

- Principal AJWA presented the progress of the Project which included:
  - i. Training courses held at AJWA
  - ii. Status of trainings conducted, so far
  - iii. Progress related to TA of AFD (France)
  - iv. Upcoming Project training calendar
  - v. Academy communication strategy
  - vi. Additional equipment proposal for WASAs and AJWA
  - vii. Proposal for Training in Japan under JICA Phase II
  - viii. National and International Training for WASAs
  - ix. HR of AJWA

Progress of AJWA

Principal AJWA , Abid Hussainy presented key highlights

- x. New Renovated AJWA Building is Operationalized
- xi. Development of Training Course Outline of JICA Phase II with JICA Experts & Finalization of course topics by AJWA
- xii. Offering of First Pedagogy Training for two days at AJWA
- xiii. Field visits to all 5 WASAs by AJWA Faculty with JICA Advisors for field assessment and advice of Master Trainers
- xiv. AFD Course Development & on-going support under TA by AFD

It was also reported that 104 field days were spend by AJWA Faculty with JICA experts in WASAs for advising and assisting Training of Trainers of WASAs.

Additional Equipment for AJWA and WASAs

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It was discussed and presented by Principal AJWA in 2nd JCC meeting, and CEO Urban Unit was the view that more equipment should be considered for implementation of trainings. He requested JICA to help in making a list of additional equipment required for the project.

It was shared by Principal AJWA that each WASA does not have these equipment, Computers and others facilities at AJWA are 7 years old etc. It was submitted that for Training long term sustainability, the additional equipment will make the training and its outreach more effective and deepen WASAs practical training. The equipment list was discussed with JICA Technical Advisor by AJWA Faculty. The proposed equipment and support is amounting to 30 Million Rs. This was proposed to be funded by Govt of Punjab, through PC I revision.

JICA Advisor commented that in the 2nd JCC meeting, it was informed by JICA that the need for additional equipment has been already assessed. As a result, 6 vibration meters and a velocity meter were approved in the same meeting. It was further informed by JICA HQ that no further assessment is required to evaluate the need of additional equipment

Training in Japan

Principal AJWA presented that due to difficulty for three visits to Japan, two visits were proposed with following scope by Pakistani side for 10 days duration.

- 2 batches of 16 Each participants in each Batch
- 32 in total numbers as per original MOM
- 50% below 16 Grade and 50% officers from WASAs
- UU AJWA and HUD&PHED relevant officials & Faculty
- Location : Yokohama Training Centre and Hiroshima
- Scope : Observation of Water and sewerage facilities and working exposure to operations and management of Yokohama Water Corporation & Hiroshima Water Corporation & JICA HQ visit

Following is composition for each Batch of 16 participants

- WASA Lahore – 4
- WASA Faisalabad -3
- WASA Multan, Gujranwala and Rawalpindi – 6
- HUD&PHED – 1
- AJWA/UU – 2

As JICA HQ explained, "JICA HQ could not inform the plan of schedule for the training in Japan because the training in Japan has been suspended due to COVID-19". In 3rd JCC, there were comments from WASA Multan and Gujranwala as the number of trainees should be the same as discussed in PCC.

Punjab Resource Management Program (PRMP) Collaboration

AJWA Collaboration with PRMP with following courses was proposed for Short Term 2 to 3 days Course to WASAs and Municipal Corporations (MCs) at AJWA.

- O&M of Water Supply

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- O&M of Sewerage Drainage
- O&M of Electrical Mechanical
- Leakage Detection
- Business Planning
- Quantity Estimation
- PC I
- Energy Audit
- Health, Safety & Environment (HSE)

Sustainability and Training Regime/ Mandatory Training

The following points were discussed in the meeting

- Deputy Secretary HUD & PHED, Mr. Souman Khalid emphasized on the importance of training to all WASAs . He said HUD&PHED has issued instructions to all WASAs to actively participate and have additional resource person for each in house training .
- Chair emphasized on the importance of a mix of all faculties to work on water sector as a whole including, Water Quality Testing, Wastewater Treatment, Energy and Health Safety and Environment (HSE).
- Chair instructed Chief (Urban Development) Mr. Yasir Mubeen to work with PRMP & Urban Unit on finalization of the capacity building proposal of Urban Unit.
- JICA HQ, inquired about the status of Al-Jazari Academy after end of lease term in November 2024 and advised for a sustainability model of the Academy.
- It was agreed by all members and endorsed by the Chair to discuss these trainings compulsory for all WASA Officers through their own governing bodies.
- Deputy Secretary, HUD & PHED (Gov. of Punjab) suggested an internal meeting with all stakeholders for sustainable future of AJWA.
- JICA HQ emphasized on the Training Regime for AJWA and WASAs regarding the training continuation with effective coordination after Phase II. In consideration of sustainable operation, a plan after Phase II shall be discussed and prepared. The Chair & COO and HUD PHED Representative all agreed on the need of the sustainability and training regime as very important aspect

AFD TA to AJWA

The AFD is supporting AJWA Urban Unit through TA for development of online courses on Energy Management, Asset Management and Pedagogy along with development of capacity of AJWA Faculty to deliver the courses to WASAs and City Managers

JICA HQ requested to share a MOU or similar document of AFD project. The purpose of the request is to understand AFD project and to avoid the repetition or overlapping of work.

JICA Phase II Progress by Chief Advisor

- Chief Advisor, JICA Experts Team, Dr. Sato presented the accomplishments of the Project from the Japanese side which included:
    i. Training accomplishment status

ii. Training plan for in house trainings in WASAs
iii. Equipment procurement for the Project

- Chief Advisor, JICA Experts Team, Dr. Sato requested the participants to submit the comments and queries on the Progress Report and Monitoring sheet by February 11th, 2022. The chair assigned the tasks to Mr. Saman Khalid, HUD&PHED to coordinate with all members and submit the comments, if any, by February 11th, 2022. If there are no major comments, it was agreed that JCC would approve the reports on 12th February.
- COO, The Urban Unit emphasized the need for international trainings and suggested for its completion after removal of COVID-19 restrictions.

Agreement of number of thematic areas in Indicator 1-1 and 4-1 of PDM

In Indicator 1-1 and 4-1, number of thematic areas shall be discussed and agreed at the end of 1st Year. The details are as follows.

Indicator 1-1
Current: ToT components are included in training contents/materials of (number) thematic areas.
Agreed: ToT components are included in training contents/materials of 3 thematic areas.

Indicator 4-1
Current: Each WASA achieves (number) of thematic areas that in-house training is conducted.
Agreed: Each WASA achieves 3 of thematic areas that in-house training is conducted.

Remarks
3 thematic areas:
i) O&M on mechanical and electrical equipment
ii) O&M on sewerage and drainage
iii) Leakage control, plumbing, and pipe replacement plan

Recommendation & Decisions

- Regarding training mandatory for WASAs, the chair asked Deputy Secretary HUD&PHED to discuss it internally with WASAs. Amendments in the service rules shall be submitted through respective governing bodies.
- Sustainability model to be prepared for AJWA by Urban Unit & HUD& PHED
- Additional equipment & Facilities for AJWA & WASAs to be considered by HUD&PHED
- The plan and schedule for the training in Japan are not able to be informed due to COVID-19.
- AJWA to take all measure for better coordination of TA of JICA and AFD by sharing information
- If there are no major comments on Progress Report and Monitoring sheet by February 11th, 2022, it was considered that JCC agrees an approval of the reports on 12th February.
- JCC agreed number of thematic areas in Indicator 1-1 and 4-1 of PDM as "3".

The meeting ended with note of thanks from the Chair.

Signed 16.03.2022

MD WASA Lahore

Chief Operating Officer Urban Unit

Dr Sato , JICA Chief Advisor 佐藤 伸幸

Chair

Member SI
P&D Board , Govt of Punjab

Annex 8.1.4 MM on 4th JCC held on 2nd August, 2022

MINUTES OF MEETING

4th Joint Coordination Committee (JCC) Meeting for the Project Titled 'The Project for Improving the Capacity of WASAs in Punjab Province Phase-II'

Lahore, 2nd August 2022

Dr. Muhammad Sohail Anwar
Secretary, (Chair)
Planning and Development Board,
Government of the Punjab.

Mr. Muhammad Omar Masud
Chief Executive Officer,
(Secretary JCC)
Urban Sector Planning and Management Services Unit (The Urban Unit),
Planning and Development Board
Government of the Punjab.

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Dr. Nobuyuki Sato
Chief Technical Advisor,
JICA Expert Team

Mr. Ghufran Ahmad
Managing Director,
WASA, Lahore

JCC MINUTES OF MEETING			
Subject	4th Joint Coordination Committee Meeting for the Project Titled "The Project for Improving the Capacity of WASAs in Punjab Province Phase-II"		
Date	2nd August, 2022	**Time**	02:00 P.M.~ 04:00 P.M.
Venue	4th Floor, Auditorium, Planning and Development Board, Lahore		
Participants	**Pakistani Side** **1)** Dr. Muhammad Sohail Anwar, Secretary, Planning and Development Board (Chair) **2)** Mr. Muhammad Shafiq, Member Social Infrastructure, Planning and Development Board **3)** Mr. Muhammad Omar Masud, CEO, The Urban Unit (Government of Punjab) **4)** Mr. Yasir Mubeen, Senior Chief (Social Infrastructure) P&D Board. **5)** Mr. Umar, Additional Secretary (Technical), HUD & PHED, (Government of Punjab) **6)** Mr. Abid Hussainy, Principal Al-Jazari Water and Sanitation Academy, The Urban Unit **7)** Mr. Muhammad Tanveer, Managing Director, WASA Rawalpindi. **8)** Mr. Abu Bakar Imran Managing Director, WASA Faisalabad **9)** Mr. Abdul Latif, Deputy Managing Director, WASA Lahore **10)** Mr. Barrister Bilal, Deputy Secretary LG & CD Department **11)** Mr. Jawad Shahid, Vice Principal, Al-Jazari Water and Sanitation Academy, The Urban Unit **12)** Mr. Muhammad Irfan, Infrastructure Specialist, Al-Jazari Water and Sanitation Academy, The Urban Unit **13)** Ms. Rebia Suhail, Sr. Instructor, Al-Jazari Water and Sanitation Academy **14)** Ms. Najam ul Sahar, Pedagogy Officer, Al-Jazari Water and Sanitation Academy **15)** Mr. Hisham Pervaiz, Director, WASA Lahore **16)** Ms. Zaemma Aman, Deputy Director Training, WASA Lahore **17)** Mr. Uzair, Deputy Director, WASA Lahore **18)** Mr. Azizullah, Deputy Director (P&D) / WASA Coordinator, Rawalpindi **19)** Mr. Kashan, Deputy Director (P&D) / WASA Coordinator, Gujranwala. **20)** Mr. Muhammad Nadeem, Deputy Director, WASA Multan **Japanese side** **21)**Dr. Nobuyuki Sato, Chief Advisor, JICA Experts Team		

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JCC MINUTES OF MEETING	
	22) Mr. Toshimichi Naganuma, JICA Experts Team **23)** Mr. Shuntaro Kinno, JICA Experts Team <On 0line> **24)** Mr. Yoichi Inoue, Director, JICA HQ **25)** Mr. Ryuji Ogata, Senior Advisor, JICA HQ **26)** Mr. Hironobu Nakayama, Officer, JICA HQ **27)** Ms. Risa Aramaki, Representative, JICA Pakistan Office **28)** Mr. Tatsuo Tomidokoro, JICA Experts Team **29)** Ms. Mikiko Azuma, JICA Experts Team **30)** Mr. Yusaku Numajiri, JICA Experts Team **31)** Mr. Hiroyuki Tabusa, JICA Experts Team **32)** Mr. Kazuhiro Kayanoma, JICA Experts Team **AGROPARISTECH (ONLINE)** **33)** Mr. Jean Antoine FABY, AgroParisTech, Director Chair Water for All, France
Background	Japan International Cooperation Agency (JICA), in collaboration with Water and Sanitation Agencies (WASAs) of Punjab and The Urban Unit (Government of Punjab), Al-Jazari Water & Sanitation Academy (AJWA) are implementing the Project titled as 'The Project for Improving the Capacity of WASAs in Punjab Province Phase-II' which was officially commenced from 15th February 2021. 4th JCC meeting was held on Tuesday 2nd August, 2022 for the progress review, Work Plan approval, progress review of AFD Technical Assistance (TA) and key decisions regarding sustainability of Al-Jazari Water and Sanitation Academy. **(For record all relevant PPTs are Annexed to this Minute of Meeting).**
DISCUSSION	
The meeting started with opening remarks from Chair, Dr. Muhammad Sohail Anwar, Secretary, Planning and Development Board, Government of Punjab and welcomed all participants including delegates from JICA and AgroParisTech (AFD). The agenda was presented as follow and briefed by CEO, The Urban Unit	

Sr. No.	JCC Agenda	
1.	Progress update on the role of Al-Jazari Academy in capacity building in Punjab: 1) Updates on the 3rd JCC Decision 2) Progress updates on Al-Jazari Academy Capacity Building	The CEO Urban Unit (Secretary to JCC)
2.	Explanation of Work Plan and Approval (Inception Report of Second Year)	Dr. Nobuyuki Sato (JICA Chief Advisor)
3.	Progress of Trainings at Al-Jazari Academy and WASAs Feedback regarding In-house Trainings	
4.	Information on Training Program in Japan Schedule and Criteria	
5.	Progress on Technical Assistance (TA) of AgroParisTech and AFD on the Project for capacity enhancement of WASAs and other public & private utilities in Punjab	Mr. Jean-Antoine Faby, (Director, AgroParisTech Water for All) France & CEO, Urban Unit
6.	Sustainability of Al-Jazari Academy & key recommendations	CEO, The Urban Unit

CEO, The Urban Unit also presented the status of 3rd JCC decisions. The action on agenda-1 by HUD&PHED is awaited on WASA service rules,

Sr. No	3rd JCC Decisions	Status
1	Regarding training mandatory for WASAs, the chair asked Deputy Secretary HUD&PHED to discuss it internally with WASAs. Amendments in the service rules shall be submitted through respective governing bodies.	Deputy Secretary HUD&PHED to brief JCC
2	Sustainability model to be prepared for AJWA by Urban Unit & HUD&PHED	Covered in Agenda 6 presented by CEO Urban Unit- meeting held with WASAs at HUD&PHED
3	Additional equipment and facilities for AJWA and WASAs to be considered by HUD&PHED	Revised PC-I (Rs 153 M) is submitted to HUD & PHED in April 2022 for additional equipment for WASAs & AJWA, additional class space, salaries and duration of project till June 2024
4	The plan and schedule for the training in Japan are not able to be informed due to COVID-19	Covered in Agenda 4 by Dr. Nobuyuki Sato
5	AJWA to take all measures for better coordination of TA of JICA and AFD by sharing information	Training program document, Contracts etc have been shared with JICA and JICA updates with AFD . AFD & Agro Paris Tech is invited in the meeting (regretted – On Vacation)
6	If there are no major comments on Progress Report and Monitoring sheet by February 11th, 2022, it was considered that JCC agrees on approval of the reports on 12th February 2022	Approved
7	JCC agreed number of thematic areas in Indicator 1-1 and 4-1 of PDM as "3"	Approved

PROGRESS UPDATE ON THE ROLE OF AL-JAZARI WATER AND SANITATION IN CAPACITY BUILDING IN PUNJAB PROVINCE

Chief Executive Officer, The Urban Unit, Mr. Muhammad Omar Masud briefed the forum about progress of the Project as under

1) Facilities at Al-Jazari Academy
2) Organizational structure of Al-Jazari Academy
3) International affiliations and experts of Al-Jazari Academy
4) Status of lease agreement between The Urban Unit and WASA Lahore
5) Equipment used for training
6) Potential training courses both technical and managerial for WASAs
7) Communication strategy of Al-Jazari Academy: updates as per 2nd JCC agenda
8) Results and feedback of first training cycle of JICA-I (2015~18)
9) Training completion status and field visit details by Al-Jazari Academy Faculty.

It was reported by CEO, Urban Unit that One Hundred and Eighty-Three (183) field days were spent by Al-Jazari Academy Faculty with JICA experts in WASAs of Punjab for advising and assisting Training of Trainers (TOT), the Field immersion was found to be very useful for implementation of learning in WASAs.

It was also noted that a total number of One Hundred and Forty-Four (144) officials from Government Departments received trainings at Al-Jazari Academy, Lahore in the Phase-II of JICA Project to date.

CEO, The Urban Unit also recommended the forum & HUD&PHED for extension in lease of Al-Jazari Academy Building /Facilities of WASA Lahore for the next 10 years and further approval for the AJWA to serve as a Training Institute for WASAs of Punjab and PHED to be notified for sustainability of Al-Jazari Academy.

JICA WORK PLAN, IN-HOUSE TRAININGS IN WASAS OF PUNJAB AND TRAININGS IN JAPAN

Chief Advisor JICA Experts Team Mr. Dr. Nobuyuki Sato presented the following points:

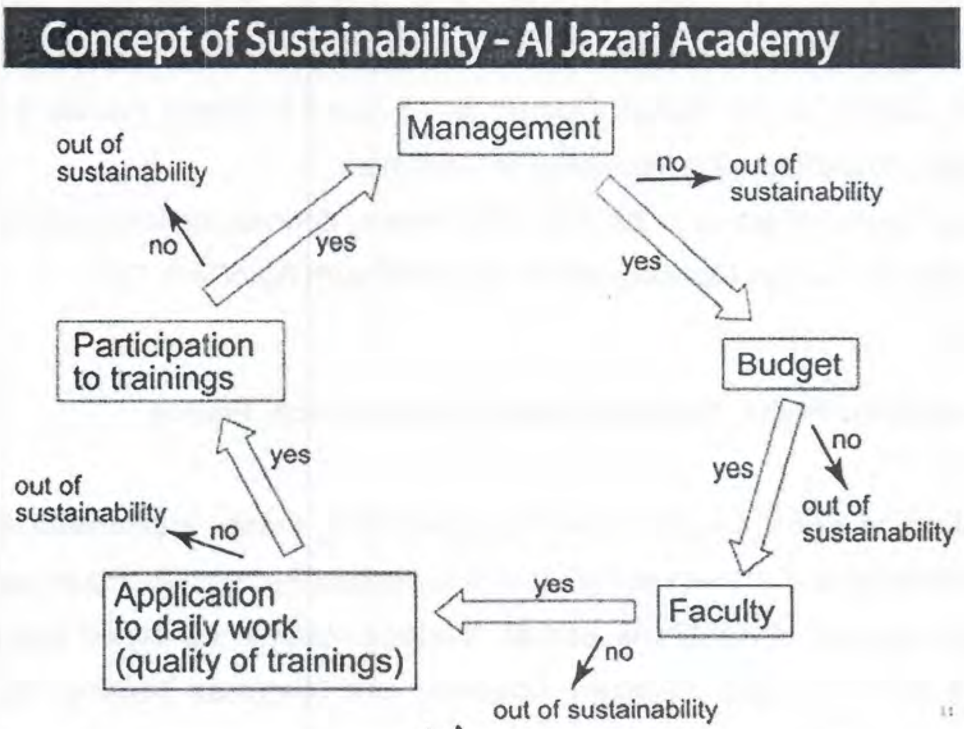
1) Work Plan (Term 2) and the progress for the second term of the Project
2) Three technical courses offered at Al-Jazari Academy supported by JICA
3) Concept and sustainability model for Al-Jazari Academy for Pakistani side decision
4) Training and learning outcomes

It was suggested to the forum to communicate any comments on Work Plan (Term 2) by 12th August 2022 otherwise Work Plan (Term 2) is considered as "approved".

While explaining a concept frame on Sustainability of Al-Jazari Academy, he emphasized that after JCC agreed on the parameters and responsibility, each parameter could be discussed in detail.

1) Management of Facility (Responsibility: Pakistani side)
2) Budget (Responsibility: Pakistani side)
3) Faculty (Responsibility: Pakistani side and JICA Expert Team)
4) Quality of Training and application of Training by WASA (Responsibility: Pakistani side and JICA Expert Team)
5) Participation of Training (Responsibility: Pakistani side)

See below:



For the training in Japan, Chief Advisor explained that 3 batches for the training in 2023 comprising of 12 members each and a duration of 10 days would be conducted but subjected to change due to COVID-19, etc.

Scheduled for In House Training 2022-23 at each WASA was presented by each respective WASA of WASA Lahore, WASA Faisalabad, WASA Gujranwala, WASA Rawalpindi and WASA Multan.

PROGRESS OF AFD, AGROPARISTECH TECHNICAL ASSISTANCE (TA)

CEO, The Urban Unit presented progress on technical assistance of AFD which included the followings:

1) Details of the technical assistance with AFD, France through AgroParisTech.
2) Completion of immersion training for faculty in France & UAE.
3) Translation of E learning modules and lectures into Urdu language.
4) Progress of E-Learning courses in the field of a) Energy Optimization and b) Asset management which to be offered from September 2022 and new course development of Waste Water Reuse by Dec 2022.
5) Importance for energy optimization for WASAs of Punjab.
6) Demonstration of video lectures of a) Energy Management and b) Asset Management translated into English and Urdu.
7) TA support for two Master Degree for Al-Jazari Academy Faculty & support for Digital Transformation Workshop in December
8) Next course of action in 2023 for AFD training courses implementation.
9) Phase II Concept Planning for TA from AFD with AgroParis Tech

MR. Jean Antoine FABY, Director Chair AgroParisTech, France

Mr. Jean Antoine FABY, Director Chair AgroParisTech, France appreciated the efforts of Al-Jazari Academy and expressed his resolve to support Al-Jazari Academy as a strategic partner and Campus of AgroParisTech as Strategic Partner. He stated that building on Phase-I of AFD TA with Al-Jazari Academy and overseas training for TOT, the implementation support and new emerging course in **a)** Leadership, **b)** Circular economy,

c) Digital transformation, and **d)** Waste Water will be proposed & planned for phase II for AFD TA as per needs of water sector in Punjab Province and Pakistan through Al-Jazari Academy. The potential Phase II for technical assistance of AFD in collaboration with Al-Jazari Academy will be significant for capacity building to eradicate water scarcity from Pakistan.

It was appreciated by Chair as a major area of technical support by AFD for the capacity building of WASAs and Al-Jazari Academy, he was of the view that the E-learning Modules and Capsules are of world class and will be useful for the overall water sector governance. He supported the continuity of support of AJWA and Capacity Building for WASAs through Phase II of AFD for consideration.

SUSTAINABILITY OF AL-JAZARI WATER AND SANITATION ACADEMY

CEO, The Urban Unit presented the final agenda item, the proposed sustainability model of Al-Jazari Academy, recommendations of the previous meetings held on 30th March 2022 and 7th July, 2022 at HUD & PHED were presented, the model is built on the JICA Sustainability Framework with following proposals:

Sr. No.	Sustainability Component	Proposal by Urban Unit
1	Management	▪ Lease of Al-Jazari Academy to be extended for 10 years i.e., from 2024 to 2034. ▪ The management of Al-Jazari Academy by The Urban Unit (Government of Punjab Province) ▪ Al-Jazari Academy to be notified as training facility for all WASAs of Punjab and PHED for Technical and Management Courses.
2	Budget	The permanent annual budget allocation for Al-Jazari Academy by Government of Punjab (HUDPHED) to The Urban Unit.
3	Faculty	Appointment and management of permanent and visiting faculty for Al-Jazari Academy by The Urban Unit.

4	Application of Daily Work and Quality of Training	▪ Quality Assurance Committee headed by Secretary HUD&PHED, ALL WASAs of Punjab, P&D Board and HUD PHED, LG&CDD and Private Sector ▪ Application of Training with strong on site and off-site support and evaluation mechanism by WASA and Al-Jazari Academy ▪ Training Annual Calendar to be approved by HUD&PHED as per proposal by Principal Al-Jazari Academy
5	Participation in Training	Training to me made essential for officials as per WASAs' service rules and notified by HUD&PHED from July, 2023 Local Government officials also participate in the training along with HUD&PHED
6	M&E	Strong M&E to Evaluate Annual Training Program

Additional Secretary (Technical) HUD & PHED, suggested for looking into all aspects for sustainability and operation of Al-Jazari Academy. He appreciated inclusion of WASAs in Governance and Quality Assurance of Academy Courses.

Additional Secretary, HUD & PHED also proposed the following items:

1) Budget will be allocated for Al-Jazari Academy and modalities will be ascertain in light of Secretary HUD&PHED advice
2) WASAs to be included in the governance of Al-Jazari Academy

CEO, The Urban Unit also presented proposed training regime for WASA based on technical and management courses developed by JICA, AFD and Al-Jazari Academy in face-to-face and e-learning mode.

Training Courses by AJWA

Grade 11	Grade 16	Grade 17	Grade 18	Grade 19&20
Induction Course	Induction Course	Induction Course		
3 Courses (Technical)	3 course (Technical)	2 Course technical	1 courses technical	1 courses technical
		2 courses management	2 courses management	1 courses management

Director WASA Lahore, Mr. Hisham Pervaiz appreciated the trainings opportunities at Al-Jazari Academy and JICA support. He suggested that the training shall not be linked with the promotion and made only mandatory to attend. This was supported by Managing Director WASA Faisalabad. CEO, The Urban Unit clarified that this proposal is not for the training to be tied to the promotion, and is that in each grade certain number of trainings to be mandatory attended and pass by the participant. The Principal Al-Jazari Academy also suggested that due to non-essential nature of trainings, the class participation is low and is only 50% to 60%, and some WASAs do not actively participate in Trainings.

It was proposed that for any budget allocation from WASA resource requires consent of respective WASA.

Managing Director WASA Faisalabad, Mr. Abu Bakar Imran appreciated the need of training, he commented that in Phase I of JICA Project, the quality of training provided by Al-Jazari Academy was not as par with the required standard, and he did not evaluate it "high". He viewed that the transfer of skills and knowledge needs more attention. He emphasized that WASAs are facing financial problems and issue of maintaining their financial sustainability is high so the budget allocation for Al-Jazari Academy will be challenging for them to allocate and proposed that Al-Jazari Academy to develop viable financial sustainability model for its sustainability as per last meeting of Al-Jazari Academy held with WASAs.

Managing Director WASA Rawalpindi Mr. Tanveer, appreciated the work done by Al-Jazari Academy and thanked JICA, The Urban unit and Al-Jazari Academy being very important for the technical sustainability of WASAs and the held training played very important role.

The Deputy Secretary, LG&CDD, recommended that the Punjab Local Government shall also be made part of this important capacity building initiative to support Local Government Capacity Building.

The Additional Secretary HUD&PHED responding to comments of MD WASA Faisalabad added that matter is under discussion in HUD&PHED and a couple of meetings have also been conducted on the said proposal. Decision on the proposal is expected shortly. He proposed JICA Technical Assistance (TA) support continuity for capacity building even for lower tiers.

The Secretary P&D (Chair) also remarked that Al-Jazari Academy needed to be funded and provided funds with by HUD&PHED or P&D Board as it is an important venture of Government of Punjab and Plays a major role in the capacity building of WASAs and Water Sector.

COMMENTS BY JICA, TOKYO

Mr. Nakayama from JICA HQ, Tokyo explained to the forum about completion date of this Project as February, 2024 and 1st training in Japan scheduled in February, 2023 but subject to change due to Covid-19. The final status will be updated two months before the commencement of training.

He further suggested to include

i) An evaluation of in-house trainings at each WASA, and

ii) A discussion about sustainability agenda of Al-Jazari Academy in the next JCC.

Regarding budget and training participation, the recommendation is more discussion between WASAs and Al Jazari Academy.

JCC MINUTES OF MEETING

RECOMMENDATIONS & DECISIONS

1. Al-Jazari Academy should be made sustainable by the HUD&PHED or P&D. Different options should be examined and reviewed as soon as possible.

2. The Urban Unit was advised to follow up and update Revised PC I of Al-Jazari Academy submitted to HUD&PHED for project timeline, additional facilities /equipment & Project objectives.

3. Work Plan (Term 2) is considered to be "approved" if there are any comments before 12th August 2022.

4. The WASAs presentation for in-house training was recognized as an important part for the transfer of skills and knowledge by Al-Jazari Academy & JET to WASAs and shall be institutionally continued, evaluated and supervised. The need for similar capacity building training centers like WASAs Lahore and WASA Faisalabad was acknowledged

5. It was informed by JICA that the Training in Japan is not confirmed yet due to COVID 19 and will be confirmed two months earlier as per planned schedule Jan/Feb 2023 by JICA Tokyo. CEO, The Urban Unit suggested that P&D Board & HUD&PHED shall also be included in the exposure visit to Japan.

6. The Sustainability framework was appreciated by the meeting Chair and CEO Urban Unit. Additional Secretary HUD&PHED, supported the sustainability framework and informed that HUD&PHED will consider the matter regarding extension in lease with WASA Lahore and decision in this regard will be taken after deliberation with all the stakeholders. Further, different proposals regarding funds allocation in the context of financial sustainability and training schedules are under consideration and need further deliberations.

7. AFD Technical Assistance for Phase-I for Al-Jazari Academy support for 3 E-learning courses, TOT in France and UAE, Moodle Platform, and Masters Scholarship Program & related capacity building activities was highly appreciated by the Chair and JCC Participants as one of the key intervention for effective capacity building through E-

learning .and for building the capacity of Al-Jazari Academy & WASAs by AgroParisTech.

8. It was resolved that the E-learning courses in a) Asset Management and b) Energy Optimization are very important courses and good initiative by Al-Jazari Academy with AgroParisTech. The E-courses are also being translated in Urdu language by Al-Jazari Academy. All stakeholders were requested to ensure full participation and HUD&PHED, WASA and LG&CDD to ensure attendance and participation of their nominees on continuous basis each term/year.

9. The Urban Unit was adviced to continue to work, engage and submit TA request for Phase II to AFD with AgroParis Tech for implementation support for E-learning and introducing face-to-face courses at Al-Jazari Academy in **a)** Leadership, **b)** Advance Asset Management, **c)** Energy Management, **d)** Circular Economy, **e)** Digital Transformation and **f)** TOT etc.

10. As per suggestion of JICA, HQ implementation by Pakistani side for:
    i. An evaluation of in-house trainings at each WASA and
    ii. Sustainability agenda of Al-Jazari Academy in the next JCC's agenda.

The meeting ended with note of thanks from the Chair.

ALJAZARI ACADEMY

JICA AFD The Urban Unit

4th JCC Meeting Agenda-1

Progress update on the Role of AJWA in Capacity Building in Punjab

Date: 2nd August 2022

Presentation To:

Chairman P&D Board

Presented By:

Muhammad Omar Masud, CEO, Urban Unit

S. No.	Agenda	
1	Progress update on the role of AJWA in capacity building in Punjab • Update on the 3rd JCC Decision • Progress update on AJWA Capacity Building	The CEO Urban Unit (Secretary to JCC)
2	Explanation of Work Plan and Approval (15 mins.) (Inception Report of Second Year, Copy Attached)	Dr Nobuyuki Sato JICA Chief Advisor & MD WASAs
3	Progress of Trainings at AJWA and WASAs Feedback regarding In-house Training	
4	Information on Training Program in Japan Schedule and Criteria	
5	Progress on Technical Assistance of AgroParisTech and AFD on the Project for capacity enhancement of WASAs and other public & private utilities in Punjab	The CEO Urban Unit/ Mr Jean-Antoine Faby, Director AgroParisTech Water for All
6	Sustainability of AJWA & key recommendations	The CEO Urban Unit
7	Comments and suggestions by the members/participants	AFD, JICA HQ, WASAs and HUD &PHED
8	Final comments and remarks	The Chairman P&D Board

Agenda

4th Joint Coordination Committee Meeting

The Project for Improving the Capacity of WASAs in Punjab Province Phase-II in Collaboration With JICA

Status on 3rd JCC Decisions

Sr. No	3rd JCC Decisions	Status
1	Regarding training mandatory for WASAs, the chair asked Deputy Secretary HUD&PHED to discuss it internally with WASAs. Amendments in the service rules shall be submitted through respective governing bodies.	Deputy Secretary HUD&PHED to brief JCC
2	Sustainability model to be prepared for AJWA by Urban Unit & HUD&PHED	Covered in **Agenda 6** presented by CEO Urban Unit- meeting held with WASAs at HUD&PHED
3	Additional equipment and facilities for AJWA and WASAs to be considered by HUD&PHED	Revised PC-I (Rs 153 M) is submitted to HUD & PHED in April 2022 for additional equipment for WASAs & AJWA, additional class space, salaries and duration of project till June 2024
4	The plan and schedule for the training in Japan are not able to be informed due to COVID-19	Covered in **Agenda 4** by Dr. Nobuyuki Sato
5	AJWA to take all measures for better coordination of TA of JICA and AFD by sharing information	Training program document, Contracts etc have been shared with JICA and JICA updates with AFD . AFD & Agro Paris Tech is invited in the meeting (regretted – On Vacation)
6	If there are no major comments on Progress Report and Monitoring sheet by February 11th, 2022, it was considered that JCC agrees on approval of the reports on 12th February 2022	Approved
7	JCC agreed number of thematic areas in Indicator 1-1 and 4-1 of PDM as "3"	Approved

ALJAZARI ACADEMY

ABOUT AJWA -UU

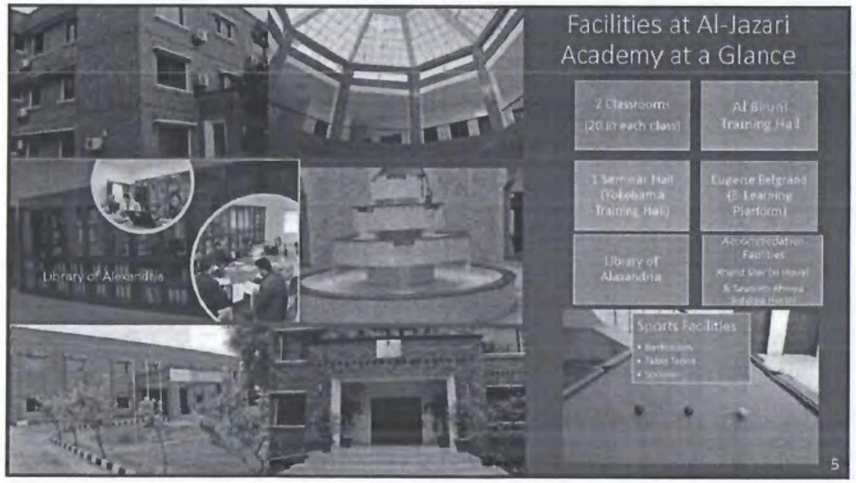
JICA AFD The Urban Unit

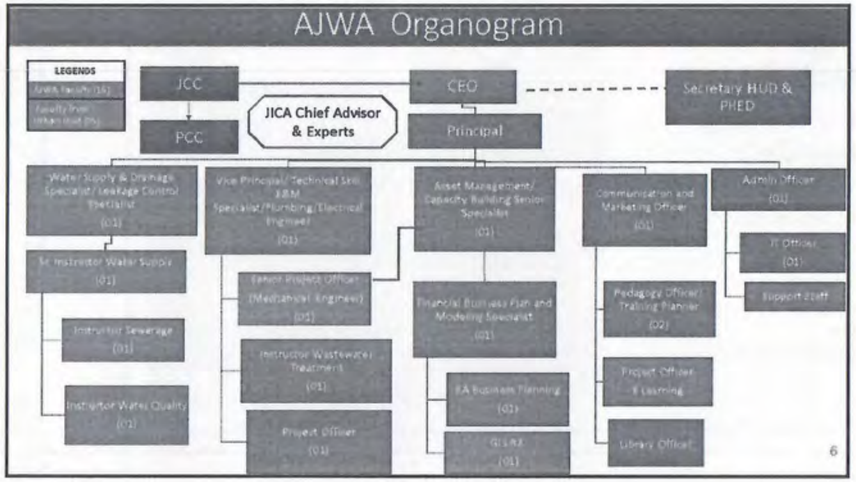
We aim to Transform water sector through leadership, innovation and result oriented trainings in Water & Sanitation sector in Pakistan

Through Trainings we Strives to improve water sector services through quality trainings, in-depth research and provision of diverse learning – Face to Face & E-Learning

Build Capacities of officials and staff of Water & Sanitation Agencies (WASAs) and Cities in Punjab and in Pakistan

We support WASAs in implementation of Training , Business Planning and acquiring knowledge, skills and values for better service delivery and improved governance


Facilities at Al-Jazari Academy at a Glance
2 Classrooms (20 in each class)
Al Biruni Training Hall
1 Seminar Hall (Yokohama Training Hall)
Eugene Belgrand (E-Learning Platform)
Library of Alaxandria
Accommodation Facilities
Sports Facilities
Library of Alexandria
5


AJWA Organogram
LEGENDS
JCC
PCC
JICA Chief Advisor & Experts
CEO
Principal
Secretary HUD & PHED
Admin Officer (01)
IT Officer (01)
Support Staff
Communication and Marketing Officer (01)
Pedagogy Officer/ Training Planner (02)
Project Officer E Learning
Library Officer
Asset Management/ Capacity Building Senior Specialist (01)
Financial Business Plan and Modeling Specialist (01)
EA Business Planning (01)
Senior Project Officer (Mechanical Engineer) (01)
Instructor Wastewater Treatment (01)
Project Officer (01)
Sr. Instructor Water Supply (01)
Instructor Sewerage (01)
Instructor Water Quality (01)
6


AJWA has Dedicated and Full time Faculty
Abid Hussainy
The Principal
Mr. Jawad Shahid
Vice Principal / Specialist Electro-Mechanical
Mr. Muhammad Irfan
Specialist Water & Sanitation
Mr. Muhammad Saud Arshad
Business Planning Specialist
Ms. Rebia Suhail
Sr. Instructor Water Supply
Mr. Farhan Riaz
Instructor Mechanical
Mr. Syed Fahad Hussain
Instructor Sewerage and Drainage
Mr. Haris Bin Khawar Instructor Wastewater
Mr. Uzair Safdar
Water Quality Instructor
Ms. Najm-ul-Saher Shoaib
Training Planner
Ms. Rabbia Naemat
Pedagogy Officer
Mr. Mujtaba Bashir
Project Officer Electromechanical Equipment
Mr. Farhan Khursheed
Communication and Marketing Officer
Ms. Sana Afzal
Project Officer E Learning
Mr. Mirza Waqas
Project Officer IT
Ms. Saba Raffay
Program Manager Environment
7


AJWA International Advisors / Experts / Trainers
Japanese Expert Team
Nobuyuki Sato
Chief Advisor- Water & Sewage Facility Management
Tatsuo Tomidokoro
Sewer Pipe & Drainage Cleaning Specialist
Kazuhiro Kayanoma
Electrical Expert
Yusaku Numajiri
Mechanical Expert
Mikiko Azuma
HR Development Specialist Training Planner
Hiroyuki Tabusa
Electrical Expert
Toshimichi Naganuma
Plumbing Specialist
JICA
Task Team Leader AFD
Desille Denis
AFD
AgroParis Tech
Jean Antoine Faby
Directeur de la Chaire
Maria Magana
Academic Manager
AgroParisTech
8

AJWA International Advisors & Experts/Trainers

Coaches/Trainers from SURECA -VEOLIA

Manon CHENEVOY, Coaching Coordinator
Rainer MOREL, Project Director
Arnaud DAVID, Head of Asset Management Team
Alexander Decambray, Project Engineer
Kolyan CHAKRAVERTY, Project Manager
Pascal, Plant Manager

SEURECA VEOLIA

WATURA Water Academy Advisors

Sebastien Rigal, CEO
Amandine Zalc, Chief Product Officer
Vincent Bourgoise, Pedagogy Expert - Diginnovative
Luc platon, Pedagogy Expert – Happy Learning

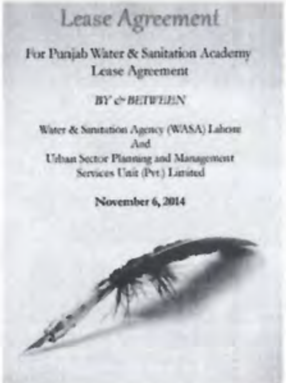
WATURA WATER ACADEMY

9

Lease Agreement b/w WASAL & Urban Unit

Academy Building transferred to Urban Unit for Management for a period of ten (10) years

Nov 2014-2024



Lease Agreement

For Punjab Water & Sanitation Academy
Lease Agreement

BY & BETWEEN

Water & Sanitation Agency (WASA) Lahore
And
Urban Sector Planning and Management Services Unit (Pvt.) Limited

November 6, 2014

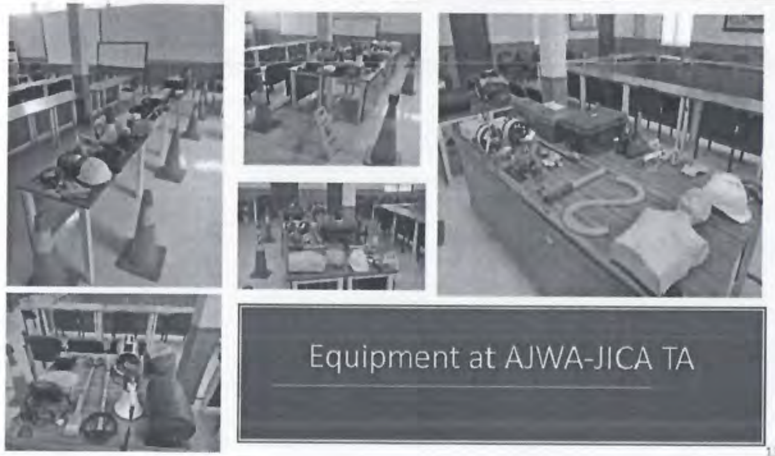
jica AFD The Urban Unit

11

Equipment Facility at AJWA

1. Portable Ultra-sonic Flowmeter
2. Power Analyzer
3. Insulation Tester
4. Vibration Meter
5. Earth resistance tester
6. Infrared temperature sensor
7. Pressure Recorder
8. Sewer Inspection Camera
9. Velocity Meter for Drains
10. Gas Detector
11. Non-Metalic Pipe Locator
12. Acoustic Bar
13. Leak Detector
14. Metal Detector
15. Wastewater Testing Kits (pH, BOD & DO)

12

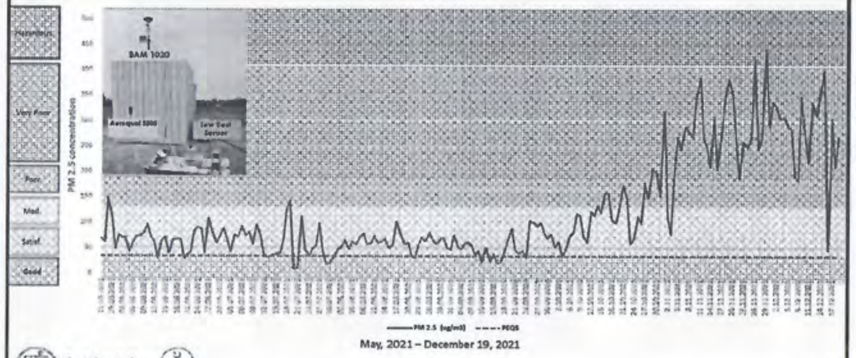


Equipment at AJWA-JICA TA

13

Establishment of Air Quality Monitoring Model

ALJAZARI ACADEMY



The Urban Unit

14

Our Training Areas since 2015- 2022

JICA AFD The Urban Unit

- Al-Jazari Academy is a leading training provider offering short training courses in:
- TECHNICAL
  1) O&M of Sewerage & Drainage System-JICA
  2) O&M of Electrical and Mechanical Equipment-JICA
  3) Leakage Detection & Repair-JICA
  4) Plumbing & Pipe Replacement-JICA
  5) Energy Optimization- AFD
  6) Occupational Health & Safety - AJWA
  7) GIS -UU

  MANAGEMENT
  1) Asset Management-AFD
  2) Business Planning-JICA
  3) Pedagogy –AFD
  4) Financial Management for Non Finance Managers –AJWA
  5) Estimating , Costing & PC-I -AJWA

AJWA Communication Strategy-As Per 2nd JCC

- Draft of Handbook 2022-2023 Prepared
- Newsletter Prepared Vol 3 Issue 01 January – February
- Up-Gradation of Website & Moodle Platform
- Social Media – Since May,2022

37 Followers

52 Followers

940 Likes

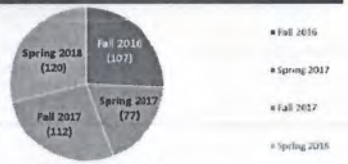
- **Facebook Page:** https://www.facebook.com/AljazariAcademy
- **Twitter :** https://twitter.com/AljazariLahore **(Jan,2022)**
- **Linked In:** https://www.linkedin.com/in/al-jazari-water-and-sanitation-academy-bb3583241-
- **Instagram** https://www.instagram.com/aljazariacademy

ALJAZARI ACADEMY

Project for Improving the Capacity of WASAs in Punjab Phase-1 with JICA

1. O&M of Tube Well & Pump Facility
2. Leak Detection & Repair
3. O&M of Sewerage & Storm Water Drainage System
4. O&M of Electrical & Mechanical Equipment
5. Asset Management
6. Business Planning

Total Participation = 416



Semester - Wise Participant 2016~2018

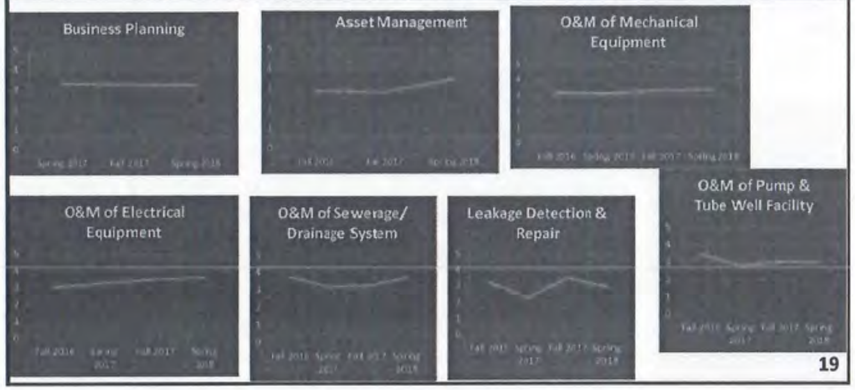
ALJAZARI ACADEMY

Course Evaluations by Participants

Sr. No.	Course Title	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Average
1	Business Planning	Not Scheduled	3.31	3.27	3.24	3.27
2	Asset Management	2.87	Not Scheduled	2.82	3.49	3.06
3	O&M of Mechanical Equipment	3.19	3.14	3.33	3.36	3.25
4	O&M of Electrical Equipment	3.06	3.30	3.52	3.60	3.37
5	O&M of Sewerage & Storm Water Drainage System	3.76	3.20	3.26	3.70	3.48
6	Leak Detection & Repair	3.25	2.29	3.51	2.99	3.01
7	O&M of Tube Well & Pump Facility	3.47	2.82	3.03	3.01	3.08

ALJAZARI ACADEMY

Course Evaluations in Graphical Form



ALJAZARI ACADEMY

Importance of Training

- According to "Implementation Completion and Results Report (ICR) Document for PCGIP Project by a Report of World Bank
  - The Urban Unit was Implementing Agency (TA for 150 million US$)

"The increased capacity of staff (2320) of city entities translates into annual gain in the range US$ 1.3 million to US$ 4.5 million and generates cumulative efficiency benefit (in present value) of US$ 27.5 over 10 years period"

WORLD BANK GROUP

10/5/2022

Project Objectives-Phase II JICA

The key objectives of the project are as under;

1. To **strengthen the capacity for Al-Jazari Academy** to conduct practical trainings to WASAs
2. To **improve the capacity of WASA Training center Lahore** to plan and conduct trainings.
3. To **enhance the capacity of 4 WASAs** (GRW, FSD, RWP & Multan) to formulate and implement training plans and conduct in-house trainings themselves
4. To **review and update new courses** for Water and Sanitation Sector on need basis to improve the service delivery of the sector
5. Assist WASAs in **establishment of On-Job-Training** in the field of O&M of water supply, sewerage, storm water system, electrical and mechanical machinery and leakage management.
6. **Continuous professional development** of Al-Jazari Academy faculty in training and assessment skills.

Description and Justification of the Project

Scope of JICA Project Phase-II (2020-23)

The project scope entails the various capacity building components such as

(i) exchange of skills and knowledge between Al Jazari Academy and WASAs;

(ii) conduct training of trainers (TOT) of 4 WASAs professionals at Academy;

(iii) implement inhouse training at each of four WASAs; and

(iv) execute professional trainings of 5 WASAs professionals at Aljazari Academy

Rs 100 Million Govt. of Punjab (PC-I)

Water and Sanitation Entities	Percentage of Participants
WASA Lahore	40%
WASA Gujranwala, Multan, Rawalpindi, Faisalabad (10-12% each)	50%
Other provinces (nominated by the JCC /PCC)	10%

Training modules designed in project phase-I will be assessed and updated deeply as per needs assessment with technical support from JICA

Counterpart personnel training at Japan (50% Field Staff)

Participants Details of Technical Courses under JICA Phase II

1. Advance Energy Audit
2. O&M Electro-Mechanical Equipment
3. O&M Sewerage and Drainage System

Total 17 Participants
Target Audience: Directors, XENs, SDOs
WASAs
- Lahore 4
- Faisalabad 2
- Gujranwala 2
- Rawalpindi 2
- Multan 2

- Urban Unit 2
- AJWA 2

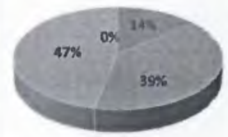
2-Days Course on "Advance Energy Audit"

Total 12 Participants
Target Audience: Directors, XENs, SDOs
WASAs
- Lahore 5
- Faisalabad 2
- Gujranwala 2
- Rawalpindi 3
- Multan Not Attended

2-Days training on O&M Electromechanical Equipment

Total 11 Participants
Target Audience: Directors, XENs, SDOs
WASAs
- Lahore 5
- Faisalabad 1
- Gujranwala 2
- Rawalpindi 1
- Multan 1
- LG Rajanpur 1

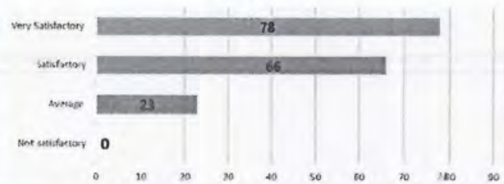
2-Days Course on "O&M Sewerage and Drainage System"



Out of 167 Responses of 13 Participants

Pedagogy : WASA & LG Training of Trainer

- **WASAs & Local Government** — **Total 13 Participants**
  - Lahore 4
  - Faisalabad 3
  - Gujranwala 2
  - Rawalpindi 2
  - Commissioner Sargodha 1
  - PLGA Lala Musa 1



Field Visit- JICA & AJWA Faculty (Nov 2021 to date)

OBJECTIVES OF FIELD TRAINING

- Hands on Training of **WASA Officials on use of Equipment provided by JICA**
- Implementation of SOPs **on Tubewell & Disposal Station**
- Inspection, Evaluation and Improvement **of Pumping Station**

WASA	No of Visits	Faculty days
Lahore	18	41
Faisalabad	10	28
Multan	8	46
Rawalpindi	8	47
Gujranwala	8	21
Total	**52**	**183**

VISIT Status of Faculty with JICA Experts (Nov,2021 to-date)

Sr.No.	Names	No. of days spent in the field
1	Jawad Shahid	25
2	Muhammad Irfan	12
3	Rebia Suhail	6
4	Fahad Hussain	42
5	Haris Bin Khawar	32
6	Najam ul Saher	7
7	Rabbia Naemat	7
8	Uzair Safdar	11
9	Farhan Riaz	8
10	Mujtaba Haral	33
		183

Summary of Training in Phase II by JICA

Sr. No.	Course Title	Spring 2022	Fall 2022	In-Field
1	Training of Trainers in Pedagogy (24th to 25th Jan 2022) AFD-JICA	13	–	–
2	Energy Audit (15th to 16th Feb 2022)	17	-	17
3	O&M of Sewerage and Drainage (13th to 15th June 2022)	-	11	36
4	O&M of Electrical and Mechanical Equipment (16th to 17th June 2022)	-	12	24
5	Leakage Control, Plumbing and Pipe Replacement Plan (TBD)	-	-	4
	Totals	**30**	**33**	**81**

Total 144 Officials from Government Departments under JICA Phase II

PARTICIPANT TRAINING SUMMARY UNDER PRMPU (AS PER 2ND JCC)

Sr. No.	Date	Course Title	Duration	No of Participants
1	29th -31st March, 2022	O&M of Electrical and Mechanical Equipment	3 days	8
2	18th – 20th July, 2022	Estimating & Costing Training	3 days	10
		Totals		**18**

Summary of All Trainings at AJWA under JICA & PRMPU & Al-Jazari in 2022

WASAs	In-Class	In-Field
• Lahore	48	17
• Faisalabad	9	18
• Gujranwala	13	12
• Rawalpindi	12	22
• Multan	6	12
• Kohat	2	

HUD & PHED – 1 Attended

Local Government Sargodha – 1 Attended

PLGA Lala Musa – 1 Attended

Local Government Rajanpur – 1 Attended

Total 175 Officials from Government Departments (94 in-Class Training and 81 in Field)

JICA Japan International Cooperation Agency

AFD AGENCE FRANÇAISE DE DÉVELOPPEMENT

AgroParisTech Talents d'une planète soutenable

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

WORLD BANK GROUP

Collaboration & Partnership

Annex 8.1.5 MM on 5th JCC held on 9th August, 2023

MINUTES OF MEETING

5th Joint Coordination Committee Meeting for the Project Titled "The Project for Improving the Capacity of WASAs in Punjab Province Phase 2"

Lahore, 9th August 2023.

Mr. Nadir Ali Chatha
Secretary,
Planning and Development Board,
Government of the Punjab.

Mr. Omar Masud
Chief Executive Officer,
The Urban Sector Planning and Management Services Unit Pvt. Ltd. (The Urban Unit),
Planning and Development Department,
Government of the Punjab.

Dr. Nobuyuki Sato
Chief Technical Advisor,
JICA Expert Team

Mr. Ghufran Ahmad
Managing Director.
WASA, Lahore.

MINUTES OF MEETING		
Subject:	5th Joint Coordination Committee Meeting for the Project Titled "The Project for Improving the Capacity of WASAs in Punjab Province Phase 2"	
Date:	August 9th 2023	Time: 11:00 a.m.
Venue:	Auditorium, Planning and Development Board, Lahore	
Participants:	• Mr. Ali Sarfraz Hussain, Chairman, Planning and Development Board (Chair) • Mr. Nadir Chatha, Secretary, Planning and Development Board • Mr. Omar Masud, CEO, The Urban Unit • Mr. Muhammad Shafiq Ahmad, Member SI, Planning and Development Board • Mr. Yasir Mubeen, Sr. Chief (SI) P&D Board. • Mr. Souman Khalid, Deputy Secretary (Tech), HUD & PHED • Mr. Aamer Aziz, MD WASA Faisalabad • Mr. Muhammad Tanveer, MD WASA Rawalpindi (online) • Syed Zahid Aziz, MD PMDFC • Mr. Abid Hussainy, Principal Al-Jazari Academy, The Urban Unit • Mr. Mian Muhammad Munir DMD (FA&R) WASA Lahore • Mr. Hisham Pervaiz Vaseer, Project Director Planning (LWWMP) / Focal Person (Foreign Trainings), WASA Lahore • Mr. Shahid Iqbal, AC (ECA-II) P&D Board • Ms. Zaeema Aman, Deputy Director Training, WASA Lahore • Mr. Ali Husnain, Deputy Director WASA Gujranwala • Mr. Aziz Ullah, Deputy Director P&D WASA Rawalpindi (online) • Mr. Abdul Moeed, Assistant Director WASA Multan (online) • Mr. Jawad Shahid, Faculty Al-Jazari Water Academy. • Ms. Rebia Suhail, Faculty, Al-Jazari Academy • Ms. Nida Shamim Tarar PO (ECA-II) P&D Board **JICA Expert Team** • Dr. Ryuji Ogata, Senior Advisor JICA HQ • Mr. Hajime Sakai, JICA HQ • Mr Hironaba Nakayama, Representative JICA Pakistan Office	

Rebia

	• Ms. Naila Almas, Senior Program Manager (Water and Transport), JICA Pakistan Office • Mr. Wataru Koyama, JICA HQ • Dr. Nobuyuki Sato, Chief Advisor, JICA Experts Team • Ms. Mikiko Azuma, JICA Experts Team (online) • Mr. Tatsuo Tomidokoro, JICA Experts Team (online) • Mr. Shuntaro Kinno, JICA Experts Team (online) • Mr. Ryo Yamane, JICA Experts Team (online) • Mr. Yusaku Numajiri, JICA Experts Team (online) • Mr. Kazuhiro Kayanoma, JICA Experts Team (online)
Background	Japan International Cooperation Agency (JICA), in collaboration with Water and Sanitation Agencies (WASAs) of Punjab and The Urban Unit are working on phase-II of the project titled "The Project for Improving the Capacity of WASAs in Punjab Province Phase-II" which officially commenced from 15th Feb 2021. As per the request of Dr. Nobuyuki Sato, Chief Advisor JICA Experts Team, 5th JCC meeting was held on 9th August for discussing the project progress so far and sustainability. Mr. Ali Sarfraz Hussain, Chairman P&D Board, chaired the meeting for Agenda No. 1 and rest of the meeting was chaired by Mr. Nadir Ali Chatha, Secretary P&D Board.

DECISIONS

1. JCC agreed on the progress according to the schedule.
2. The AJWA will be Training Academy under administrative control of HUD & PHED, which will decide sustainability model in consultation with all the relevant stakeholders.

DISCUSSION

The Meeting started with opening remarks from the Chairman P&D. The CEO, the Urban Unit briefed the agenda of the meeting which was as follows:

- Presentation by Dr. Nobuyuki Sato, Chief Advisor JICA on overall progress of the project
- Presentation by CEO, the Urban Unit - Progress of AJWA activities and Way forward
- Feedback
    - WASAs & HUD&PHED, LG&CDD and P&D
    - Views /feedback from JICA Mission
- Closing Remarks by the Secretary, Government of Punjab, P&D Board

Presentation by Dr. Nobuyuki Sato. Chief Advisor JICA

- Dr. Sato, Chief Advisor JICA Experts Team presented progress of WASA trainings, Database in WASAs, PCC recommendation on extension of Phase II and key element of AJWA sustainability.
- Chairman appreciated the support of JICA for AJWA and capacity building of WASAs. He commented and remarked that participation in training is important and thus participation of WASA's official at AJWA Training is to be ensured.
- Chairman inquired about sustainability of Al-Jazari Academy on which Deputy Secretary (Tech) HUD&PHED informed that various meetings have been held in this regard. It has been decided that AJWA will be placed under HUD&PHED after completion of the project with financial resources and SNE Mode will be considered after DG M&E evaluation. Principal AJWA will submit PC-IV to DG M&E for evaluation.
- Chairman P&D advised HUD&PHED to also consider permanency of AJWA with more effective model & flexibility for hiring and delivery of training services, which are difficult in SNE mode. He advised to consider transforming of AJWA as a permanent entity under HUD&PHED through enactment of an Act.
- Chairman P&D Board acknowledged that the participation in the training shall be mandatory and made part of the service rule of WASAs.
- Chairman also inquired about the duration of course at WASA and AJWA. He was informed that at WASA, the trainings are split to be covered as one module/topic per day, and at AJWA it is a 3-days continuous duration for Training of Trainers (TOT) and WASA officials who are trained at AJWA.
- Chairman also inquired about impact assessment and examination after trainings for which CEO, the Urban Unit informed that at this stage no Impact assessment and exam is being carried out and only pre and post assessment about the training is carried out regarding skills and knowledge acquired through the training.

Presentation by CEO, the Urban Unit

CEO, the Urban Unit presented progress of AJWA regarding JICA, AFD and AJWA Trainings including the evaluation of its courses.

- AJWA has a Purpose-Built facility with Training Halls, 3 Class rooms, 2 hostels at Township, Lahore, which was financed by Govt of Punjab through HUD&PHED in 2014.
- Facility is on Lease to the Urban Unit for 10 years (2014 - 2024) with the Urban Unit as implementing agency. The management, preparation of training plan, and its implementation are being carried out through AJWA.
- Phase I with 6 O&M Course for Water and Sanitation Services were implemented from 2015-2018.
- Phase II has 3 courses from Feb 2021 - Feb 2024.
- AFD Technical Assistance (TA) through AgroParis Tech is for 3 E-learning course and other capacity building activities for WASAs & AJWA- TA will end in December 2023.
- PC I Project will end in June 2024 and JICA activity will end in Feb 2024.
- Overview of courses being offered at AJWA is as follows:

Courses of Al-Jazari Academy Offering in 2023-2024

Technical Courses (7)

1- O&M of Sewerage and Drainage -JICA Phase-II

2- O&M of Electrical and Mechanical Equipment – JICA Phase-II

3. Leakage Control, Plumbing and Pipe Replacement-JICA Phase-II

4 - O&M of Water Supply–JICA Phase-I

5- Energy Audit and Circuits–JICA Phase-I

6- Health , Safety and Environment - AJWA

7- Costing and Estimating of Water Sanitation System - AJWA

Management Courses (07)

1- Business Planning-JICA Phase-I

2- GIS Mapping and Asset Management-JICA Phase-I

3- Smog Monitoring and Management-Urban Unit

4- Finance for Non-Finance Managers-AJWA

5 Pedagogy Training for Trainers – AFD & JICA II – Phase I

6 Heatwave Management Plan – Urban Unit

7- Monsoon Management Plan - AJWA

E-Learning Courses (03)

1-Asset Management-AFD

2-Energy Optimization - AFD

3- Wastewater Reuse - AFD

ALJAZARI ACADEMY

The Urban Unit

He presented summary of trainings Face to face & Field in AJWA i.e 748 official are trained to date. In JICA Trainings, officials trained are 331 and in AFD courses of E-learning officials' trained are 123.

Summary of All Trainings at AJWA under JICA & PRMPU & AJWA to-Date

- WASAs 231 In-Class 417 In-Field
- WSSC Queta, WSSP, Kohat, Peshawar, Mardan – 39 Attended
- HUD & PHED – 1 Attended
- Local Government &CD – 40 Attended
- LDA – 4 Attended
- Punjab Aab-E-Pak Authority- 12 Attended
- PICIP- 1 Attended
- EPD- 1 Attended
- P&D Board- 1 Attended
- PMDFC – 1 Attended

Total 748 officials from Government Departments (331 in-Class Training and 417 in Field)

CEO, the Urban Unit also presented a way forward for AJWA;

- AJWA as Training Academy- under administrative control of HUD & PHED
- Permanent Faculty having expertise - Technical, Management, Business Planning and Pedagogy is critical for training and sustainability.
- Funding by Government of Punjab/HUD&PHED
- Courses as per Annual Training Plan (Face to Face & E-Learning) for WASAs, HUD&PHED, and Local Government

- Attendance for training is mandatory and carries incentives.
- WASAs Training Centers and Coordinator Training to be linked with AJWA for Synergy and application of training and development of faculty.

Feedback from WASAs, LG&CDD and HUD&PHED

- WASA Lahore & other WASAs requested for Extension of Phase II project with new course/ topic & data-based development and its analysis.
- Syed Zahid Aziz, MD PMDFC on behalf of Local Government (LG) apprised the need for capacity building to LG staff through JICA's support.
- Mr. Souman Khalid, Deputy Secretary (Tech) HUD&PHED also requested to re-consider extension of the project. He also said that Principal AJWA will develop the transition plan and submit to HUD & PHED for discussion and approval.

Remarks by JICA HQ Mission

- Mr. Ruji Ogata, Mission Team Leader, JICA HQ informed JCC that Phase II extension is not possible as per JICA decision. They have already supported AJWA through Phase I and Phase II since 2015. JICA really appreciates Pakistani side request for extension. But the project is scheduled to end in Feb 2024.
- Sustainability of AJWA is important.
- JICA will continue long-term relationship with AJWA for its support.

- The Secretary P&D Board thanked JICA Mission and appreciated the project and its activities. He acknowledged the JICA support for AJWA & WASAs being crucial for training and service delivery improvement. He noted that the progress in AJWA Capacity Building project is important for improved service delivery.

The Meeting ended with note of thanks from the Chair.