



NEC Consultants (Pvt.) Ltd.

Punjab Cities Governance Improvement Project

## Energy Audit & Energy Efficiency Improvement Program for WASAs in Punjab



**REPORT**  
**Over Head Reservoir (OHR) & City Area Tube Wells**  
**Faisalabad**

**March 2016**



**THE URBAN UNIT**  
Urban Sector Planning & Management Services Unit (P) Ltd.  
A Public Sector Company.



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# Energy Audit & Energy Efficiency Improvement Program for WASAs in Punjab

March 2016

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## LIST OF ACRONYMS AND ABBREVIATIONS

<b>Bhp</b>	Brake Horsepower
<b>Cusec</b>	Cubic Feet per Second
<b>Ehp</b>	Electrical Horsepower
<b>Gpm</b>	Gallon Per Minute
<b>Hp</b>	Horsepower
<b>kVA</b>	Kilo Volt Ampere
<b>kW</b>	Kilo Watt
<b>kWh</b>	Kilo Watt Hour
<b>LESCO</b>	Lahore Electric Supply Company
<b>m/s</b>	Meter Per Second
<b>m<sup>3</sup>/hr</b>	Cubic Meter Per Hour
<b>MCB</b>	Fuses or Miniature Circuit Breaker
<b>Mm</b>	Millimeter
<b>MS</b>	Mild Steel
<b>Psig</b>	Pound Per Square Inch (Gauge)
<b>RPM</b>	Revolution Per Minute
<b>TDH</b>	Total Dynamic Head
<b>VFD</b>	Variable Frequency Drive
<b>WASA</b>	Water and Sanitation Agency
<b>Whp</b>	Water Horsepower

## GLOSSARY

<b>Discharge Pressure</b>	The pressure obtained at center line of pump discharge pipe using a calibrated gauge (psig). Discharge pressure is converted to feet and expressed as "Discharge Head".
<b>Brake Horsepower</b>	The output horsepower of a motor to a pump; may also be used to refer to the required input horsepower to the pump itself.
<b>Deep Well Turbine Pump</b>	A turbine pump installed inside a well casing below the pumping water level in the well.
<b>Discharge Head</b>	Head measured above center line of pump discharge pipe.
<b>Drawdown</b>	The measured distance that a well's water level changes from standing/static level to operating pumping level during observed test conditions.
<b>Dynamic Head</b>	The sum of the pressure and the pumping head developed by a pump
<b>Friction Head</b>	The head required to overcome the fluid friction in a pipe or water system
<b>Friction Losses</b>	Energy losses associated with moving water against rough surfaces. In water pumping applications, it is the water pressure lost as a result of contact between moving water and a pipeline or open channel.
<b>GPM per Foot Drawdown</b>	The ratio of capacity (GPM) to drawdown feet is useful in determining the well's performance.

<b>Head</b>	Alternate term for pressure. One pound per square inch (psi) = 2.31 feet of water head
<b>Overall Plant or Pumping System Efficiency</b>	The ratio of the water horsepower (the overall output of the plant) to input horsepower (the power input). The overall output can also be defined as the amount of horsepower required to deliver the measured capacity (water gallons per minute) and the measured total head.
<b>Pumping Water Level</b>	The well's operating water level below center line of discharge pipe as observed during test condition
<b>Static Water Level</b>	The well's water level obtained when pumping plant is at rest.
<b>Suction Head</b>	Head measured above center line of pump suction intake. Most often obtained with calibrated bourdon tube pressure gauge (suction pressure) and converted to feet by conversion factor 2.31 ft. water/psi
<b>Suction Lift</b>	The distance between pump discharge head and water level.
<b>Total Head</b>	The sum of the water head above and below the center line of the pump discharge pipe. For well applications, the Total Head is the sum of the Discharge Head and the Pumping Water Level. Total head is used in determination of water horsepower and pump performance.
<b>Water Horsepower</b>	The output horsepower of a water pump. It is the combination of flow rate and pressure.

## 1.0 Introduction

### 1.1 Background

Government of the Punjab, Pakistan with financial assistance from the World Bank, is implementing “Punjab Cities Governance Improvement Project (PCGIP)” for strengthening systems for improved planning, resource management, and accountability in five large cities of Punjab i.e. Lahore, Faisalabad, Multan, Gujranwala and Rawalpindi.

The project utilizes a result-based approach and, consistent with this focus, the disbursement decisions to the city and its entities are based on achievement of pre-specified results, referred to as Disbursement linked Indicators (DLIs) which reflect priority elements in furthering the Government’s urban agenda, critical at the provincial level, within the existing legislative, regulative and policy framework of the Government. DLIs includes intermediate outcomes, incremental steps and results contributing to improved efficiency, effectiveness, accountability and service delivery during and beyond the project life by building capacities, system and processes.

Disbursement Linked Indicator 4 (DLI -4) aims for improvements in own source revenue collection system that encourages the City Local Government (CDGs), Development Authorities (DAs) and Service providers (WASAs) to bring improved systems for revenue enhancement. This DLI is linked with the initiative of WASAs to carry out the Energy Audit for resources conservation and efficiency to improved service delivery, accountability and own source revenue.

One of the proposed actions & initiatives to enhance revenue was to conduct energy audit of WASAs to reduce the power cost by various systematic analysis of the energy use and finding out the energy management opportunities. WASAs each year incur significant cost. It was **Rs. 4,697 million** in 2014 year for energy/Electricity bills, with an installed capacity of approximately 131 MW for 5,663 Million Gallons per Day (water management), which can be reduced through detailed energy audit and implementing its findings.

In the context of existing scenario energy audit of WASAs is a technical and efficient way to obtain energy analysis and savings through improvements that optimize pumping systems of tube well stations and disposal stations to operate efficiently with significant cost saving.

The Urban Planning and Management Services Unit, Pvt. Ltd. has assigned NEC Consultants Pvt. Ltd to conduct energy audits of WASAs in Punjab in five major cities of Lahore, Rawalpindi, Faisalabad, Multan and Gujranwala.

This is the energy audit report of **Over Head Reservoir (OHR) & City Area Tube Wells of Faisalabad city.**

### 1.2 Methodology

The primary and secondary sources were used to collect data for different WASAs and pumps installed there. The Urban Unit provided information and contact detail of all the WASAs. An energy audit report template was developed to collect field data from each WASA subdivision. Prior to start the on field measurements of each subdivision, meetings were conducted with the respective WASA management and briefed them about the activity. The technical team then collected data by on field measurements of each pump and recorded in their energy audit report template. On the basis of this energy audit report template, The Urban Unit also developed Android based software to record data of each pump online. This data was also recorded on line in this Android based application.

On the basis of field measurements, efficiency of the pumping system was calculated and energy efficiency opportunities were identified.

### 1.3 Scope

The scope of the this assignment is to conduct energy audits of about 1,600 fresh water supply and wastewater disposal pumps installed at different WASA stations in five major cities of Lahore, Rawalpindi, Multan, Faisalabad and Gujranwala. The detail of these pumps is given in Table-1.

**Table-1: Detail of WASAs Pumps**

WASA	Population Served (Million)	Total Water Connections	Total Sewerage Connections	Total Supply Stations	Total Disposal Stations	Total No. of Pump Sets
WASA Lahore	5.48	587,595	583,532	491	99	776
WASA Gujranwala	0.54	29,375	97,236	66	23	112
WASA Faisalabad	1.55	110,452	217,002	87	43	222
WASA Multan	1.2	43,996	175,615	102	21	161
WASA Rawalpindi	1.17	92,468	38,437	362	-	362
<b>Total</b>	<b>9.94</b>	<b>863,886</b>	<b>1,111,822</b>	<b>1,108</b>	<b>186</b>	<b>1,633</b>

The efficiency of each pumping system was evaluated and energy efficiency improvement opportunities were identified for those pumping systems whose efficiencies were not at required level. The detail of reports prepared is as under:

- The energy audit report of each pump was prepared.
- On the basis of each pump report, summary report of findings of each WASA subdivision/zone was prepared.
- On the basis of each subdivision/zone summary report, one consolidated report of each city for energy efficiency improvement opportunities of the WASAs was prepared.



## 2.0 Energy Audit Findings

There are 33 WASA water supply stations in Over Head Reservoir (OHR) & City Area Tube Wells of Faisalabad city. The detail of these stations along with pumps installed capacity and actual discharge is given in Table-2:

**Table-2: Detail of Over Head Reservoir (OHR) & City Area Tube Wells**

#	WASA Station	No. of Water Supply Pumps Installed	Installed Capacity (Cusec)	Actual Discharge (Cusec)
1	Chamra Mandi P-035	01	1.0	0.78
2	Chamra Mandi P-036	01	2.0	1.08
3	Dogar Basti P-001	01	4.0	4.79
4	Fateh Abad P-01	01	2.0	1.47
5	Fateh Abad P-02	01	3.0	2.94
6	Gokhu Wala Noor UI Amin P-001	01	0.55	1.57
7	Gokhu Wala Noor UI Amin P-002	01	0.55	1.62
8	Ghulam Muhammad Abad P-001	01	2.0	1.70
9	Ghulam Muhammad Abad P-002	01	2.0	1.27
10	Gulistan Colony 2 P-001	01	3.0	2.30
11	Gulistan Colony 2 P-004	01	3.0	2.15
12	Gulistan Colony 2 P-008	01	3.0	2.39
13	Gulfishan Colony P-003	01	2.0	1.27
14	Gulistan Colony 1 G Block P-001	01	2.0	2.17
15	Gulistan Colony 1 G Block P-002	01	2.0	2.25
16	Gulistan Colony 1 G Block P-003	01	2.0	2.30
17	Jinnah Garden P-002	01	0.92	0.99
18	Johar Colony P-002	01	1.0	1.08
19	Johar Colony P-003	01	2.0	1.66
20	Karkhana Bazar P-002	01	2.0	1.27
21	Karkhana Bazar P-001	01	2.0	0.77
22	Karkhana Bazar P-003	01	2.0	1.66
23	Nazim Abad P-039	01	2.0	0.85
24	Nazim Abad P-040	01	2.0	1.29
25	Nazim Abad P-041	01	2.0	1.27
26	People Colony No-01 P-148	01	3.0	3.41
27	People Colony-02, Batala Chowk, P-119	01	2.0	1.76
28	People Colony-02, Batala Chowk, P-120	01	2.0	1.17
29	People Colony-02, Batala Chowk, P-121	01	1.0	1.97
30	Samanabad Police Chowki P-040	01	2.0	1.22
31	Waris Pura P-123	01	2.0	1.67
32	Waris Pura P-124	01	1.0	0.93
33	Waris Pura P-125	01	2.0	1.63
<b>Total</b>		<b>33</b>	<b>65.02</b>	<b>56.65</b>

The installed capacity of WASA tube wells of Over Head Reservoir (OHR) & City Area Tube Wells is 9.68 million m<sup>3</sup> per annum whereas actual discharge is 8.43 million m<sup>3</sup> per annum, for

average 4 hours per day operation and 365 days per year. This actual discharge is about 13% lesser than the installed capacity.

## 2.1 Pumping System Efficiency

Pumping plant performance can be classified as “Low”, “Fair”, “Good”, or “Excellent” by referring to the following table, which is based upon the results of thousands of pump tests conducted by Pacific Gas & Electric Company, USA. This classification is used to categorize WASA pumps.

**Table-3: Typical Overall Pumping System Efficiency Classification**

Motor HP	Low	Fair	Good	Excellent
3-7.5	<44.0	44-49.9	50-54.9	>54.9
10	<46.0	46-52.9	53-57.9	>57.9
15	<47.1	48-53.9	54-59.9	>59.9
20-25	<48.0	50-56.9	57-60.9	>60.9
30-50	<52.1	52.1-58.9	59-61.9	>61.9
60-75	<56.0	56-60.9	61-65.9	>65.9
100	<57.3	57.3-62.9	63-66.9	>66.9
150	<58.1	58.1-63.4	63.5-68.9	>68.9
200	<59.1	59.1-63.8	63.9-69.4	>69.4
250	<59.1	59.1-63.8	63.9-69.4	>69.4
300	<60	60-64.0	64.1-69.9	>69.9

Source: Pacific Gas & Electric Company, USA

The detail of pumping system efficiency and motor loading of each WASA station is given in Table-4. The calculations for the efficiency determination are given in the energy audit report of each pump in **Annexure-1**.

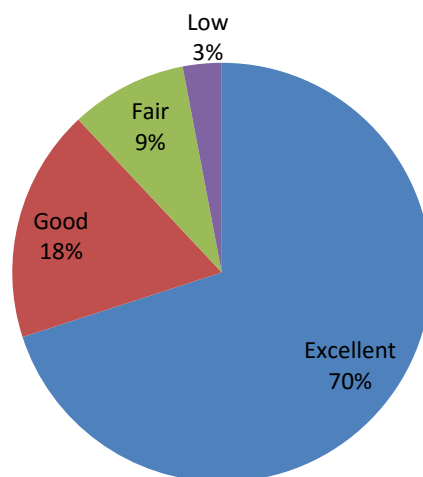
**Table-4: Detail of Motor Loading and Pumping System Efficiency**

WASA Station	Motor Load (%)	Pumping System Efficiency (%)	Pumping System Efficiency Rating
Chamra Mandi P-035	60	62	EXCELLENT
Chamra Mandi P-036	91	67	EXCELLENT
Dogar Basti P-001	77	66	EXCELLENT
Fateh Abad P-01	63	77	EXCELLENT
Fateh Abad P-02	78	68	EXCELLENT
Gokhu Wala Noor UI Amin P-001	87	66	EXCELLENT
Gokhu Wala Noor UI Amin P-002	84	70	EXCELLENT
Ghulam Muhammad Abad P-002	67	80	EXCELLENT
Gulistan Colony 1 G Block P-001	93	73	EXCELLENT
Gulistan Colony 1 G Block P-002	91	62	EXCELLENT
Gulistan Colony 1 G Block P-003	92	68	EXCELLENT
Jinnah Garden P-002	112	72	EXCELLENT
Johar Colony P-002	89	74	EXCELLENT
Johar Colony P-003	84	78	EXCELLENT
Karkhana Bazar P-002	77	66	EXCELLENT
Karkhana Bazar P-003	84	86	EXCELLENT
Nazim Abad P-040	80	76	EXCELLENT
Nazim Abad P-041	81	80	EXCELLENT
People Colony-02, Batala Chowk, P-119	82	80	EXCELLENT

Samanabad Police Chowki P-040	86	79	EXCELLENT
Waris Pura P-123	89	75	EXCELLENT
Waris Pura P-125	83	80	EXCELLENT
Karkhana Bazar P-001	30	65	EXCELLENT
People Colony-02, Batala Chowk, P-121	89	60	GOOD
Ghulam Muhammad Abad P-001	78	59	GOOD
Gulistan Colony 2 P-001	81	61	GOOD
Nazim Abad P-039	61	66	GOOD
People Colony No-01 P-148	105	64	GOOD
People Colony-02, Batala Chowk, P-120	46	61	GOOD
Gulistan Colony 2 P-004	86	54	FAIR
Gulfishan Colony P-003	98	51	FAIR
Waris Pura P-124	75	54	FAIR
Gulistan Colony 2 P-008	78	40	LOW

About 88% of the tube wells are under excellent and good category of pumping system efficiency whereas 12% are under fair and low category as illustrated in Fig-1.

**Figure-1: Pumping System Efficiency Category**



## 2.2 Electricity Consumption Trend

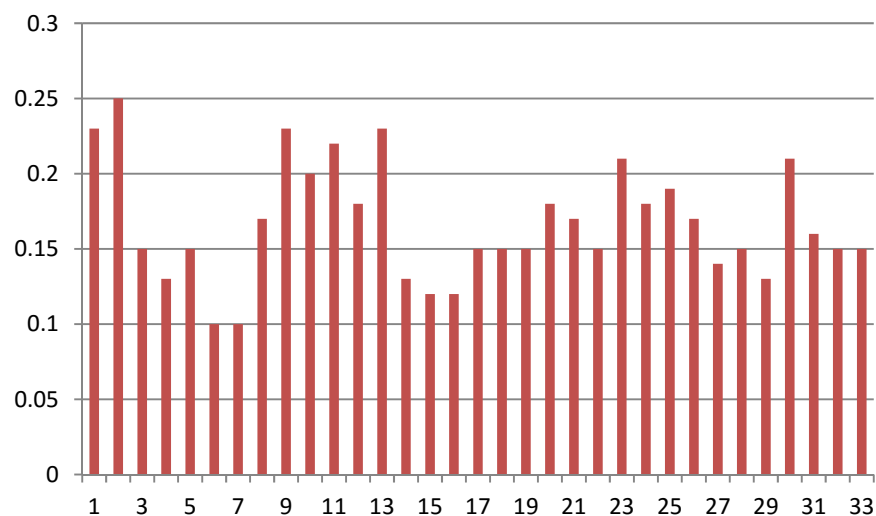
The detail of annual water discharge and correspondingly electricity consumption and unit electricity consumption of each WASA station is given in Table-5.

**Table-5: Detail of Water Discharge and Electricity Consumption**

#	WASA Station	Annual Water Discharge (m <sup>3</sup> )	Annual Electricity Consumption (kWh)	Unit Electricity Consumption (kWh/m <sup>3</sup> )
1	Chamra Mandi P-035	58,400	13,210	0.23
2	Chamra Mandi P-036	80,300	20,060	0.25
3	Dogar Basti P-001	1,070,910	159,259	0.15
4	Fateh Abad P-01	219,000	27,889	0.13
5	Fateh Abad P-02	437,708	64,095	0.15
6	Gokhu Wala Noor UI Amin P-001	58,400	5,994	0.10
7	Gokhu Wala Noor UI Amin P-002	60,225	5,749	0.10
8	Ghulam Muhammad Abad P-001	381,060	64,584	0.17
9	Ghulam Muhammad Abad P-002	189,800	44,524	0.23
10	Gulistan Colony 2 P-001	771,975	150,819	0.20
11	Gulistan Colony 2 P-004	722,700	159,626	0.22
12	Gulistan Colony 2 P-008	801,540	144,214	0.18
13	Gulistan Colony P-003	284,700	64,584	0.23
14	Gulistan Colony 1 G Block P-001	161,695	20,550	0.13
15	Gulistan Colony 1 G Block P-002	167,900	20,060	0.12
16	Gulistan Colony 1 G Block P-003	257,325	30,457	0.12
17	Jinnah Garden P-002	37,048	5,382	0.15
18	Johar Colony P-002	80,300	12,232	0.15
19	Johar Colony P-003	124,100	18,592	0.15
20	Karkhana Bazar P-002	47,450	8,440	0.18
21	Karkhana Bazar P-001	28,835	4,893	0.17
22	Karkhana Bazar P-003	62,050	9,296	0.15
23	Nazim Abad P-039	63,510	13,455	0.21
24	Nazim Abad P-040	96,718	17,614	0.18
25	Nazim Abad P-041	94,331	17,859	0.19
26	People Colony No-01 P-148	763,872	130,637	0.17
27	People Colony-02, Batala Chowk, P-119	197,100	27,155	0.14
28	People Colony-02, Batala Chowk, P-120	262,800	38,164	0.15
29	People Colony-02, Batala Chowk, P-121	441,241	58,713	0.13
30	Samanabad Police Chowki P-040	273,750	56,511	0.21
31	Waris Pura P-123	373,570	58,713	0.16
32	Waris Pura P-124	207,656	30,824	0.15
33	Waris Pura P-125	364,372	55,044	0.15
	<b>Total</b>	<b>9,242,341</b>	<b>1,559,198</b>	<b>0.17</b>

Total annual energy cost of Over Head Reservoir (OHR) & City Area Tube Wells is about Rs. 20 million. The unit electricity consumption trend for each WASA station is illustrated in Fig-2.

**Figure-2: Unit Electricity Consumption Trend (Tube Well)**



### 2.3 Pumping System Efficiency Improvement Potential

The 04 tube wells having system efficiency in the category of FAIR to LOW, as given in Table-4, have the potential of efficiency improvement into the GOOD category. Table-6 gives detail of this efficiency improvement potential.

**Table-6: System Energy Efficiency Potential of Pumps**

WASA Station	Existing Pumping Efficiency (%)	Improved Pumping Efficiency (%)	Annual Saving (kWh)	Saving (Rs)	Intervention		
					Imp .Adj	Rep & Main	Pump Repl.
Gulistan Colony 2 P-004	54	61	18,215	236,790	x		
Gulistan Colony 2 P-008	40	61	48,009	624,123	x	x	
Gulfishan Colony P-003	51	61	11,082	144,062	x		
Waris Pura P-124	54	57	1,562	20,301	x		
<b>Total</b>			<b>78,868</b>	<b>1,025,276</b>			

### 2.4 Interventions for the Improvement of WASA Stations

Energy audit activity of Over Head Reservoir (OHR) & City Area Tube Wells revealed that there are certain areas of electrical, mechanical and housekeeping which needs improvement. Table-7A & B presents detail of interventions and investment requirement in each WASA station for better, efficient and safe operation of WASA station.

About Rs. 20.73 million are required to improve WASA stations of Over Head Reservoir & City Area Tube Wells of Faisalabad city.

**Table-7A: Interventions & Investment Required in WASA Stations-OHR and City Tube Wells**

Intervention	WASA Stations												
	Chamra Mandi P-035	Chamra Mandi P-036	DogarB asti P-001	Fateh Abad P-01	Fateh Abad P-02	Gokhu Wala Noor Ul Amin P-001	Gokhu Wala Noor Ul Amin P-002	Ghulam Muham mad Abad P-001	Ghula m Muha mmad Abad P-002	Gulistan Colony 2 P-001	Gulista n Colony 2 P-004	Gulistan Colony 2 P-008	Gulfishan ColonyP-003
<b>Electrical</b>													
Install VFD	x	x	x	x	x	x	x	x	x	x	x	x	x
Install hour meter	x	x	x	x	x	x	x	x	x	x	x	x	x
Replace ampere meter													
Replace volt meter						x	x		x				
Replace over current relays		x	x	x				x	x				
Replace over voltage relay		x	x	x				x	x				
Install/maintain PFI plant	x							x	x	x	x	x	x
Install/connect capacitors at PFI plant													
Install PFI control/relay													
Install/replace motor terminal box /Improve open and loose motor connection													
Improve panel condition													
Improve wiring condition													
Replace de-rated capacitors													
Relocate panel away from bore hole													
Replace electrical motor													
Install fan in the panel	x	x	x	x	x	x	x	x	x	x	x	x	x
Replace PFI HRC fuses													
Replace PFI display meter													
Correct date & time of electrical meter													
Replace/correct electrical meter													
Replace change over													

Intervention	WASA Stations												
	Chamra Mandi P-035	Chamra Mandi P-036	DogarB asti P-001	Fateh Abad P-01	Fateh Abad P-02	Gokhu Wala Noor UI Amin P-001	Gokhu Wala Noor UI Amin P-002	Ghulam Muhammad Abad P-001	Ghulam Muhammad Abad P-002	Gulistan Colony 2 P-001	Gulistan Colony 2 P-004	Gulistan Colony 2 P-008	Gulfishan Colony P-003
Replace main circuit breaker													
<b>Mechanical</b>													
Replace damaged/install new flow meter	x	x	x	x	x	x	x	x	x	x	x	x	x
Replace damaged/install new digital pressure gauge	x	x	x	x	x	x	x	x	x	x	x	x	x
Control gland leakage													
Make operational/install new chlorinator													
Maintain ratchet plate													
Adjust impeller											x	x	x
Repair & maintenance of pump												x	
Replace existing pumping system													
Maintain/install new non return valve	x		x	x	x	x	x	x	x				x
<b>Housekeeping</b>													
Improve general housekeeping													
Install shades on motor & pump													
Rain protection of motor & pump													
Fix panel properly													
Proper support of discharge pipeline													
Maintain monthly record of fuel consumption													
<b>Station Wise Investment (M. Rs)</b>	<b>0.545</b>	<b>0.545</b>	<b>0.695</b>	<b>0.545</b>	<b>0.595</b>	<b>0.46</b>	<b>0.46</b>	<b>0.605</b>	<b>0.66</b>	<b>0.775</b>	<b>0.855</b>	<b>0.855</b>	<b>0.685</b>
<b>Annual Saving (M. Rs)</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.24</b>	<b>0.62</b>	<b>0.09</b>
<b>Payback (Year)</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>3.61</b>	<b>1.37</b>	<b>7.29</b>

**Table-7B: Interventions & Investment Required in WASA Stations- OHR and City Tube Wells**

Intervention	WASA Stations												
	Gulistan Colony 1 G Block P-001	Gulistan Colony 1 G Block P-002	Gulistan Colony 1 G Block P-003	Jinnah Garden P-002	Johar Colony P-002	Johar Colony P-003	Karkhana Bazar P-002	Karkhana Bazar P-001	Karkhana Bazar P-003	Nazim Abad P-039	Nazim Abad P-040	Nazim Abad P-041	People Colony No-01 P-148
<b>Electrical</b>													
Install VFD	x	x	x	x	x	x	x	x	x	x	x	x	x
Install hour meter	x	x	x	x	x	x	x	x	x	x	x	x	x
Replace ampere meter	x							x					
Replace volt meter													
Replace over current relays	x							x					
Replace over voltage relay	x							x					
Install/maintain PFI plant	x	x	x		x	x	x	x	x				
Install/connect capacitors at PFI plant													
Install PFI control/relay													
Install/replace motor terminal box /Improve open and loose motor connection													
Improve panel condition								x					
Improve wiring condition								x					
Replace de-rated capacitors													
Relocate panel away from bore hole													
Replace electrical motor				x									x
Install fan in the panel	x	x	x	x	x	x	x	x	x	x	x	x	x
Replace PFI HRC fuses													
Replace PFI display meter													
Correct date & time of electrical meter													
Replace/correct electrical meter													
Replace change over													
Replace main circuit breaker													
<b>Mechanical</b>													



Intervention	WASA Stations												
	Gulistan Colony 1 G Block P-001	Gulistan Colony 1 G Block P-002	Gulistan Colony 1 G Block P-003	Jinnah Garden P-002	Johar Colony P-002	Johar Colony P-003	Karkhana Bazar P-002	Karkhana Bazar P-001	Karkhana Bazar P-003	Nazim Abad P-039	Nazim Abad P-040	Nazim Abad P-041	People Colony No-01 P-148
Replace damaged/install new flow meter	x	x	x	x	x	x	x	x	x	x	x	x	x
Replace damaged/install new digital pressure gauge	x	x	x	x	x	x	x	x	x	x	x	x	x
Control gland leakage													
Make operational/install new chlorinator													
Maintain ratchet plate													
Adjust impeller								x					
Repair & maintenance of pump													
Replace existing pumping system													
Maintain/install new non return valve	x		x	x		x				x	x	x	
<b>Housekeeping</b>													
Improve general housekeeping													
Install shades on motor & pump													
Rain protection of motor & pump													
Fix panel properly													
Proper support of discharge pipeline													
Maintain monthly record of fuel consumption													
<b>Station Wise Investment (M. Rs)</b>	<b>0.65</b>	<b>0.525</b>	<b>0.645</b>	<b>0.535</b>	<b>0.45</b>	<b>0.545</b>	<b>0.57</b>	<b>0.82</b>	<b>0.585</b>	<b>0.545</b>	<b>0.545</b>	<b>0.545</b>	<b>1.575</b>
<b>Annual Saving (M. Rs)</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<b>Payback (Year)</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>

**Table-7C: Interventions & Investment Required in WASA Stations- OHR and City tube wells**

Intervention	WASA Stations										
	People Colony-02, BatalaChowk, P-119	People Colony-02, BatalaChowk, P-120	People Colony-02, BatalaChowk, P-121	Samana bad Police Chowki P-040	WarisPura P-123	WarisPura P-124	WarisPura P-125				
<b>Electrical</b>											
Install VFD	x	x	x	x	x	x	x				
Install hour meter	x	x	x	x	x	x	x				
Replace ampere meter			x								
Replace volt meter											
Replace over current relays		x				x	x				
Replace over voltage relay		x				x	x				
Install/maintain PFI plant	x	x	x			x	x				
Install/connect capacitors at PFI plant											
Install PFI control/relay											
Install/replace motor terminal box /Improve open and loose motor connection											
Improve panel condition											
Improve wiring condition											
Replace de-rated capacitors											
Relocate panel away from bore hole											
Replace electrical motor											
Install fan in the panel	x	x	x	x	x	x	x				
Replace PFI HRC fuses											
Replace PFI display meter											
Correct date & time of electrical meter											
Replace/correct electrical meter											
Replace change over											
Replace main circuit breaker											
<b>Mechanical</b>											

Intervention	WASA Stations												
	People Colony-02, BatalaChowk, P-119	People Colony-02, BatalaChowk, P-120	People Colony-02, BatalaChowk, P-121	Samana bad Police Chowki P-040	WarisPura P-123	WarisPura P-124	WarisPura P-125						
Replace damaged/install new flow meter	x	x	x	x	x	x	x						
Replace damaged/install new digital pressure gauge	x	x	x	x	x	x	x						
Control gland leakage													
Make operational/install new chlorinator													
Maintain ratchet plate													
Adjust impeller						x							
Repair & maintenance of pump													
Replace existing pumping system													
Maintain/install new non return valve					x								
<b>Housekeeping</b>													
Improve general housekeeping													
Install shades on motor & pump													
Rain protection of motor & pump													
Fix panel properly													
Proper support of discharge pipeline													
Maintain monthly record of fuel consumption													
<b>Station Wise Investment (M. Rs)</b>	<b>0.625</b>	<b>0.525</b>	<b>0.53</b>	<b>0.525</b>	<b>0.545</b>	<b>0.575</b>	<b>0.58</b>						
<b>Annual Saving (M. Rs)</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.02</b>	<b>0.00</b>						
<b>Pay Back (Yr)</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>28</b>	<b>-</b>						
<b>Total Investment (M.Rs) = 20.73</b>													

# ANNEXURE-1

## Energy Audit Reports