



NEC Consultants (Pvt.) Ltd.

Punjab Cities Governance Improvement Project

Energy Audit & Energy Efficiency Improvement Program for WASAs in Punjab



REPORT
Disposal Pumps- West Division, Faisalabad

March 2016



THE URBAN UNIT
Urban Sector Planning & Management Services EoU (Pvt.) Ltd.
A Public Sector Company.



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March 2016

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LIST OF ACRONYMS AND ABBREVIATIONS

Bhp	Brake Horsepower
Cusec	Cubic Feet per Second
Ehp	Electrical Horsepower
Gpm	Gallon Per Minute
Hp	Horsepower
kVA	Kilo Volt Ampere
kW	Kilo Watt
kWh	Kilo Watt Hour
LESCO	Lahore Electric Supply Company
m/s	Meter Per Second
m³/hr	Cubic Meter Per Hour
MCB	Fuses or Miniature Circuit Breaker
Mm	Millimeter
MS	Mild Steel
Psig	Pound Per Square Inch (Gauge)
RPM	Revolution Per Minute
TDH	Total Dynamic Head
VFD	Variable Frequency Drive
WASA	Water and Sanitation Agency
Whp	Water Horsepower

GLOSSARY

Discharge Pressure	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".
Brake Horsepower	The output horsepower of a motor to a pump; may also be used to refer to the required input horsepower to the pump itself.
Deep Well Turbine Pump	A turbine pump installed inside a well casing below the pumping water level in the well.
Discharge Head	Head measured above center line of pump discharge pipe.
Drawdown	The measured distance that a well's water level changes from standing/static level to operating pumping level during observed test conditions.
Dynamic Head	The sum of the pressure and the pumping head developed by a pump
Friction Head	The head required to overcome the fluid friction in a pipe or water system
Friction Losses	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.
GPM per Foot Drawdown	The ratio of capacity (GPM) to drawdown feet is useful in determining the well's performance.

Head	Alternate term for pressure. One pound per square inch (psi) = 2.31 feet of water head
Overall Plant or Pumping System Efficiency	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.
Pumping Water Level	The well's operating water level below center line of discharge pipe as observed during test condition
Static Water Level	The well's water level obtained when pumping plant is at rest.
Suction Head	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
Suction Lift	The distance between pump discharge head and water level.
Total Head	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.
Water Horsepower	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 **Disposal Pumps of West Division 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
Total	9.94	863,886	1,111,822	1,108	186	1,633

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 55 WASA wastewater disposal pumps in West Division 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 Disposal Pumps of West Division

#	WASA Station	No. of Wastewater Disposal Pumps Installed	Installed Capacity (Cusec)	Actual Discharge (Cusec)
1	BawaChowk PS30 Pump-01	01	13.0	12.30
2	BawaChowk PS30 Pump-02	01	13.0	11.27
3	BawaChowk PS30 Pump-03	01	13.0	12.71
4	BawaChowk PS30 Pump-04	01	25.0	13.54
5	Chenab Club Pump-01	01	2.0	2.05
6	Chenab Club Pump-02	01	4.0	2.07
7	Dhandla 66 Pump-01	01	4.0	3.23
8	Dhandla 66 Pump-02	01	4.0	3.78
9	Dhandla 66 Pump-05	01	4.0	4.09
10	GirjaGhar Disposal Pump-02	01	4.0	3.03
11	Gulistan New Pump-01	01	6.0	5.78
12	Gulistan New Pump-02	01	4.0	4.01
13	Gulistan New Pump-04	01	6.0	4.41
14	Gulshan Colony Pump-02	01	1.0	1.81
15	Johar Colony	01	2.22	2.25
16	Masjid Ismail PS38 Pump-01	01	15.0	19.11
17	Masjid Ismail PS38 Pump-03	01	15.0	18.72
18	Masjid Ismail PS38 Pump-04	01	15.0	15.78
19	Masjid Ismail PS38 Pump-05	01	15.0	17.74
20	Masjid Ismail PS38 Pump-06	01	25.0	24.01
21	Mahmood Abad Disposal-01	01	4.0	3.37
22	Millat Town Disposal-001	01	2.0	1.76
23	Naseer Abad-001	01	1.0	1.17
24	Naseer Abad-02	01	4.0	3.43
25	Noorpur Disposal New PS28-01	01	8.0	7.66
26	Noorpur Disposal New PS28-02	01	15.0	14.10
27	Noorpur Disposal New PS28-03	01	15.0	13.99
28	PS3 Chokerra Disposal-01	01	40.0	26.81
29	PS3 Chokerra Disposal-02	01	25.0	21.29
30	PS3 Chokerra Disposal-03	01	25.0	24.0
31	PS3 Chokerra Disposal-04	01	40.0	33.82
32	PS3 Chokerra Disposal-05	01	25.0	14.22
33	PS3 Chokerra Disposal-06	01	25.0	9.65
34	PS19 BhaiWala Disposal-02	01	15.0	13.28
35	PS19 BhaiWala Disposal-03	01	15.0	14.03
36	PS19 BhaiWala Disposal-04	01	15.0	13.71
37	Railway Station	01	2.0	2.09
38	Kanak Basti Disposal-01	01	1.67	2.25
39	Kanak Basti Disposal-02	01	1.67	2.20
40	Sher Singh Wala Disposal-01	01	2.0	0.50
41	Weaver Colony Disposal	01	1.0	0.49
42	100 JB PS-27 Pump-001	01	6.0	4.56

43	100 JB PS-27 Pump-002	01	6.0	4.05
44	100 JB PS-27 Pump-003	01	6.0	5.0
45	Metro Pool Disposal-01	01	4.0	4.65
46	Metro Pool Disposal-03	01	1.12	2.47
47	Gulshan Colony Disposal	01	1.66	2.89
48	Akbar Abad Disposal-02	01	4.0	3.91
49	Akbar Abad Disposal-03	01	6.0	5.78
50	Akbar Abad Disposal-04	01	4.0	3.03
51	Shadman Pump-02	01	4.0	2.69
52	Shadman Pump-03	01	6.0	5.0
53	Shadman Pump-04	01	6.0	4.65
54	Shadab Colony-03	01	5.0	4.01
55	Shadab Colony-04	01	4.0	3.57
Total		55	536.34	461.77

The installed capacity of WASA disposal pumps of West Zone of Faisalabad city is 239.61 million m³ per annum whereas actual discharge is 206.30 million m³ per annum, for average 12 hours per day operation and 365 days per year. This actual discharge is about 14% 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

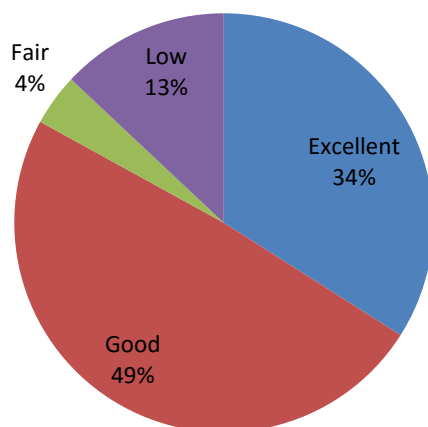
WASA Station	Motor Load	Pumping System Efficiency (%)	Pumping System Efficiency Rating
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	(%)		
Chenab Club Pump-02	39	77	EXCELLENT
Dhandla 66 Pump-02	69	76	EXCELLENT
GirjaGhar Disposal Pump-02	42	75	EXCELLENT
Gulistan New Pump-02	69	65	EXCELLENT
Masjid Ismail PS38 Pump-01	75	70	EXCELLENT
Naseer Abad-001	49	70	EXCELLENT
Naseer Abad-02	51	69	EXCELLENT
Noorpur Disposal New PS28-02	68	80	EXCELLENT
Noorpur Disposal New PS28-03	78	66	EXCELLENT
PS3 Chokerra Disposal-01	93	72	EXCELLENT
PS3 Chokerra Disposal-02	50	79	EXCELLENT
PS3 Chokerra Disposal-03	56	83	EXCELLENT
PS3 Chokerra Disposal-04	99	82	EXCELLENT
100 JB PS-27 Pump-001	81	72	EXCELLENT
100 JB PS-27 Pump-003	84	77	EXCELLENT
Akbar Abad Disposal-04	59	68	EXCELLENT
Shadman Pump-04	71	63	EXCELLENT
Shadab Colony-03	77	71	EXCELLENT
Shadab Colony-04	58	74	EXCELLENT
BawaChowk PS30 Pump-01	73	65	GOOD
BawaChowk PS30 Pump-02	59	63	GOOD
BawaChowk PS30 Pump-03	51	64	GOOD
Chenab Club Pump-01	61	62	GOOD
Dhandla 66 Pump-01	65	61	GOOD
Dhandla 66 Pump-05	89	60	GOOD
Gulistan New Pump-01	67	62	GOOD
Gulshan Colony Pump-02	42	60	GOOD
Johar Colony	95	63	GOOD
Masjid Ismail PS38 Pump-03	76	67	GOOD
Masjid Ismail PS38 Pump-04	66	61	GOOD
Masjid Ismail PS38 Pump-05	71	66	GOOD
Masjid Ismail PS38 Pump-06	100	67	GOOD
Mahmood Abad Disposal-01	41	61	GOOD
Noorpur Disposal New PS28-01	83	60	GOOD
PS19 BhaiWala Disposal-02	80	64	GOOD
PS19 BhaiWala Disposal-04	83	63	GOOD
Railway Station	55	62	GOOD
Kanak Basti Disposal-01	58	59	GOOD
Kanak Basti Disposal-02	52	59	GOOD
100 JB PS-27 Pump-002	88	59	GOOD
Metro Pool Disposal-01	119	60	GOOD
Metro Pool Disposal-03	64	60	GOOD
Gulshan Colony Disposal	78	60	GOOD
Akbar Abad Disposal-02	73	61	GOOD
Akbar Abad Disposal-03	79	60	GOOD
Shadman Pump-03	60	61	GOOD
Millat Town Disposal-001	60	54	FAIR
PS19 BhaiWala Disposal-03	96	50	FAIR
BawaChowk PS30 Pump-04	78	38	LOW
Gulistan New Pump-04	67	44	LOW
PS3 Chokerra Disposal-05	75	56	LOW
PS3 Chokerra Disposal-06	73	37	LOW
Sher Singh Wala Disposal-01	61	11	LOW
Weaver Colony Disposal	54	28	LOW

Shadman Pump-02	66	42	LOW
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About 83% of the disposal pumps are under excellent and good category of pumping system efficiency whereas 17% 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 disposal pumps is given in Table-5.

Table-5: Detail of Water Discharge and Electricity Consumption

#	WASA Station	Annual Water Discharge (m ³)	Annual Electricity Consumption (kWh)	Unit Electricity Consumption (kWh/m ³)
1	BawaChowk PS30 Pump-01	3,664,600	190,818	0.05
2	BawaChowk PS30 Pump-02	4,197,500	194,487	0.05
3	BawaChowk PS30 Pump-03	4,734,050	139,444	0.03
4	BawaChowk PS30 Pump-04	5,040,650	256,870	0.05
5	Chenab Club Pump-01	766,500	50,151	0.07
6	Chenab Club Pump-02	773,800	42,812	0.06
7	Dhandla 66 Pump-01	1,927,200	113,512	0.06
8	Dhandla 66 Pump-02	2,254,240	121,340	0.05
9	Dhandla 66 Pump-05	2,441,120	156,568	0.06
10	GirjaGhar Disposal Pump-02	2,263,000	136,997	0.06
11	Gulistan New Pump-01	3,014,900	193,509	0.06
12	Gulistan New Pump-02	2,095,100	131,860	0.06
13	Gulistan New Pump-04	2,299,500	191,796	0.08
14	Gulshan Colony Pump-02	1,350,500	136,997	0.10
15	Johar Colony	1,007,400	93,941	0.09
16	Masjid Ismail PS38 Pump-01	4,270,500	153,388	0.04
17	Masjid Ismail PS38 Pump-03	4,182,900	157,058	0.04
18	Masjid Ismail PS38 Pump-04	3,525,900	135,774	0.04
19	Masjid Ismail PS38 Pump-05	3,963,900	146,049	0.04

20	Masjid Ismail PS38 Pump-06	5,365,500	329,527	0.06
21	Mahmood Abad Disposal-01	1,255,600	45,258	0.04
22	Millat Town Disposal-001	394,200	19,816	0.05
23	Naseer Abad-001	262,800	24,219	0.09
24	Naseer Abad-02	1,277,500	55,777	0.04
25	Noorpur Disposal New PS28-01	4,566,880	182,011	0.04
26	Noorpur Disposal New PS28-02	8,403,760	369,893	0.04
27	Noorpur Disposal New PS28-03	8,333,680	428,606	0.05
28	PS3 Chokerra Disposal-01	14,974,125	842,167	0.06
29	PS3 Chokerra Disposal-02	13,477,260	623,827	0.05
30	PS3 Chokerra Disposal-03	15,196,045	700,558	0.05
31	PS3 Chokerra Disposal-04	12,593,595	730,245	0.06
32	PS3 Chokerra Disposal-05	10,592,300	613,552	0.06
33	PS3 Chokerra Disposal-06	7,190,500	600,342	0.08
34	PS19 BhaiWala Disposal-02	989,150	44,035	0.04
35	PS19 BhaiWala Disposal-03	1,045,360	52,548	0.05
36	PS19 BhaiWala Disposal-04	1,021,270	45,649	0.04
37	Railway Station	932,940	54,310	0.06
38	Kanak Basti Disposal-01	1,007,400	95,409	0.09
39	Kanak Basti Disposal-02	985,500	85,134	0.09
40	Sher Singh Wala Disposal-01	187,975	50,151	0.27
41	Weaver Colony Disposal	164,250	19,816	0.12
42	100 JB PS-27 Pump-001	2,041,080	106,990	0.05
43	100 JB PS-27 Pump-002	1,808,940	115,371	0.06
44	100 JB PS-27 Pump-003	2,233,800	110,850	0.05
45	Metro Pool Disposal-01	1,560,375	146,416	0.09
46	Metro Pool Disposal-03	827,820	79,263	0.10
47	Gulshan Colony Disposal	969,075	77,061	0.08
48	Akbar Abad Disposal-02	1,310,715	90,271	0.07
49	Akbar Abad Disposal-03	1,938,150	146,416	0.08
50	Akbar Abad Disposal-04	1,018,350	72,658	0.07
51	Shadman Pump-02	1,806,750	162,929	0.09
52	Shadman Pump-03	3,350,700	222,376	0.07
53	Shadman Pump-04	3,120,750	173,938	0.06
54	Shadab Colony-03	2,394,400	168,311	0.07
55	Shadab Colony-04	2,131,600	127,212	0.06
	Total	190,503,355	10,556,283	0.06

Total annual energy cost of West Zone disposal pumps is about Rs. 137 million. The unit electricity consumption trend for each WASA disposal pump is illustrated in Fig-2 & 3.

Figure-2: Unit Electricity Consumption Trend (kWh/m³)

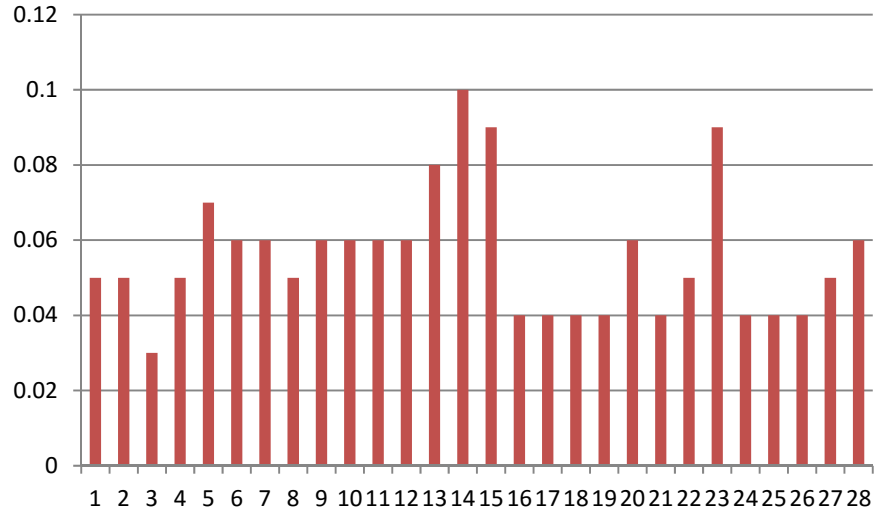
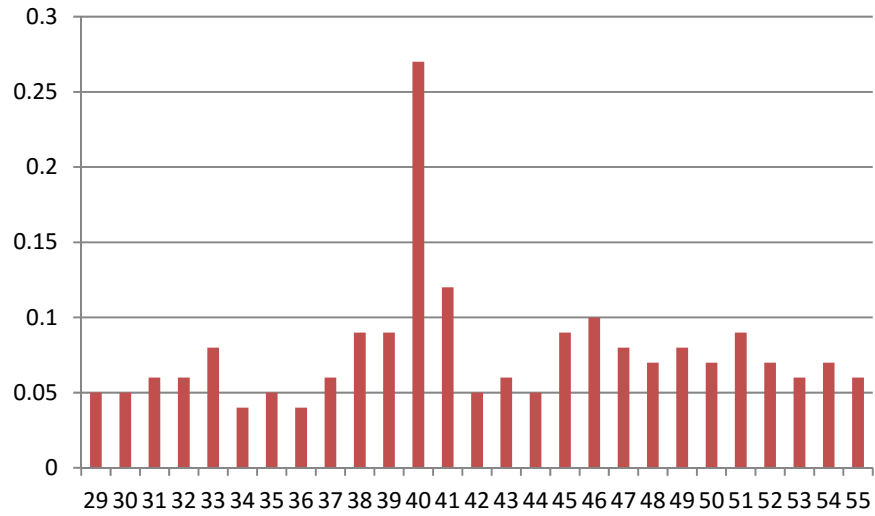


Figure-3: Unit Electricity Consumption Trend (kWh/m³)



2.3 Pumping System Efficiency Improvement Potential

The 09 disposal pumps 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		Imp .Adj	Rep & Main	Intervention	
			(kWh)	(Rs)			Motor Repl.	Pump Repl.
BawaChowk PS30 Pump-04	38	64	102,742	1,335,648	x	x		
Gulistan New Pump-04	44	62	56,006	728,076	x	x		
Millat Town Disposal-001	54	59	1,753	22,791	x			
PS3 Chokerra Disposal-05	56	69	115,662	1,503,612	x			
PS3 Chokerra Disposal-06	37	69	280,572	3,647,431	x	x		
PS19 BhaiWala Disposal-03	50	63	11,101	144,317	x			
Sher Singh Wala Disposal-01	11	57	40,191	522,482				x
Weaver Colony Disposal	28	54	9,364	121,730	x	x		
Shadman Pump-02	42	54	37,080	482,041	x	x		
			654,471	8,508,128				

2.4 Interventions for the Improvement of WASA Disposal Pumps

Energy audit activity of West Zone revealed that there are certain areas of electrical, mechanical and housekeeping which needs improvement. Table-7A, B & C presents detail of interventions and investment requirement in each WASA disposal pump for better, efficient and safe operation of WASA station.

About Rs. 56.60 million are required to improve WASA disposal pumps of West Zone of Faisalabad city.

Table-7A: Interventions & Investment Required in WASA Stations-West Division Disposal Pumps

WASA Interventions														
Interventions	BawaCh owk PS30 Pump- 01	BawaCh owk PS30 Pump- 02	BawaCh owk PS30 Pump- 03	BawaCh owk PS30 Pump- 04	Chenab Club Pump- 01	Chenab Club Pump- 02	Dhandla 66 Pump- 01	Dhandla 66 Pump- 02	Dhandla 66 Pump- 05	GirjaGh ar Disposal Pump- 02	Gulistan New Pump- 01	Gulistan New Pump- 02	Gulistan New Pump- 04	Gulshan Colony Pump- 02
Electrical														
Install VFD	x	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	x
Replace ampere meter	x	x	x		x	x	x	x	x	x	x			x
Replace volt meter	x	x	x		x	x	x	x		x	x		x	x
Replace over current relays	x	x	x		x	x	x	x	x		x		x	x
Replace over voltage relay	x	x	x		x	x	x	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					x					x				x
Improve wiring condition					x					x				x
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	x
Replace PFI HRC fuses														
Replace PFI display meter	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Correct date & time of electrical meter														
Replace/correct electrical meter														
Replace change over														

WASA Interventions														
Interventions	BawaCh owk PS30 Pump- 01	BawaCh owk PS30 Pump- 02	BawaCh owk PS30 Pump- 03	BawaCh owk PS30 Pump- 04	Chenab Club Pump- 01	Chenab Club Pump- 02	Dhandla 66 Pump- 01	Dhandla 66 Pump- 02	Dhandla 66 Pump- 05	GirjaGh ar Disposal Pump- 02	Gulistan New Pump- 01	Gulistan New Pump- 02	Gulistan New Pump- 04	Gulshan Colony Pump- 02
Replace main circuit breaker														
Mechanical														
Replace damaged/install new flow meter	x	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	x
Control gland leakage														
Make operational/install new chlorinator														
Maintain ratchet plate										x				
Adjust impeller				x									x	
Repair & maintenance of pump				x									x	
Replace existing pumping system														
Maintain/install new non return valve														
Housekeeping														
Improve general housekeeping	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Install shades on motor & pump														
Rain protection of motor & pump														
Fix panel properly														
Proper support of discharge pipeline														
Maintain monthly record of fuel consumption	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Station Wise Investment (M. Rs)	0.77	0.77	0.62	6.59	0.69	0.69	0.73	0.73	0.73	0.69	1.22	0.64	1.36	0.68
Annual Saving (M. Rs)	0.00	0.00	0.00	1.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.00
Payback (Year)	-	-	-	4.93	-	-	-	-	-	-	-	-	1.87	-

Table-7B: Interventions & Investment Required in WASA Stations-West Division Disposal Pumps

WASA Interventions														
Interventions	Johar Colony	KanakBasti Disposal -01	KanakBasti Disposal -02	Masjid Ismail PS38 Pump-01	Masjid Ismail PS38 Pump-03	Masjid Ismail PS38 Pump-04	Masjid Ismail PS38 Pump-05	Masjid Ismail PS38 Pump-06	Mahmod Abad Disposal -01	Millat Town Disposal -001	Naseer Abad-001	Naseer Abad-02	Noorpur Disposal New PS28-01	Noorpur Disposal New PS28-02
Electrical														
Install VFD	x	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	x
Replace ampere meter	x	x	x	x	x	x	x		x		x	x	x	
Replace volt meter	x	x	x	x	x	x	x		x		x	x	x	x
Replace over current relays	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Replace over voltage relay	x	x	x	x	x	x	x	x	x	x	x	x	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	x	x	x											
Improve panel condition						x					x	x	x	x
Improve wiring condition						x					x	x	x	x
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	x
Replace PFI HRC fuses														
Replace PFI display meter	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Correct date & time of electrical meter														
Replace/correct electrical meter														
Replace change over														

WASA Interventions														
Interventions	Johar Colony	KanakBasti Disposal -01	KanakBasti Disposal -02	Masjid Ismail PS38 Pump-01	Masjid Ismail PS38 Pump-03	Masjid Ismail PS38 Pump-04	Masjid Ismail PS38 Pump-05	Masjid Ismail PS38 Pump-06	Mahmood Abad Disposal -01	Millat Town Disposal -001	Naseer Abad-001	Naseer Abad-02	Noorpur Disposal New PS28-01	Noorpur Disposal New PS28-02
Replace main circuit breaker														
Mechanical														
Replace damaged/install new flow meter	x	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	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														
Housekeeping														
Improve general housekeeping	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Install shades on motor & pump														
Rain protection of motor & pump														
Fix panel properly														
Proper support of discharge pipeline														
Maintain monthly record of fuel consumption	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Station Wise Investment (M. Rs)	0.59	0.59	0.53	1.35	1.35	1.45	1.35	1.34	0.59	0.62	0.32	0.55	0.53	0.68
Annual Saving (M. Rs)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
Payback (Year)	-	-	-	-	-	-	-	-	-	26.98	-	-	-	-

Table-7C: Interventions & Investment Required in WASA Stations-West Division Disposal Pumps

WASA Interventions														
Interventions	Noorpur Disposal New PS28-03	PS3 Chokerra Disposal -01	PS3 Chokerra Disposal -02	PS3 Chokerra Disposal -03	PS3 Chokerra Disposal -04	PS3 Chokerra Disposal -05	PS3 Chokerra Disposal -06	PS19 BhaiWala Disposal -02	PS19 BhaiWala Disposal -03	PS19 BhaiWala Disposal -04	Railway Station	Sher Singh Wala Disposal -01	Weaver Colony Disposal	
Electrical														
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	x		x		x				x	x	x	
Replace volt meter	x		x	x	x			x		x	x	x	x	
Replace over current relays	x		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	x	x	x	x	x	x	x	x	x	x	x	x	x	
Correct date & time of electrical meter														

WASA Interventions														
Interventions	Noorpur Disposal New PS28-03	PS3 Chokerra Disposal -01	PS3 Chokerra Disposal -02	PS3 Chokerra Disposal -03	PS3 Chokerra Disposal -04	PS3 Chokerra Disposal -05	PS3 Chokerra Disposal -06	PS19 BhaiWala Disposal -02	PS19 BhaiWala Disposal -03	PS19 BhaiWala Disposal -04	Railway Station	Sher Singh Wala Disposal -01	Weaver Colony Disposal	
Replace/correct electrical meter														
Replace change over														
Replace main circuit breaker														
Mechanical														
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				x	
Repair & maintenance of pump							x						x	
Replace existing pumping system												x		
Maintain/install new non return valve														
Housekeeping														
Improve general housekeeping	x	x	x	x	x	x	x	x	x	x	x	x	x	
Install shades on motor & pump														
Rain protection of motor & pump														
Fix panel properly														
Proper support of discharge pipeline														
Maintain monthly record of fuel consumption	x	x	x	x	x	x	x	x	x	x	x	x	x	
Station Wise Investment (M. Rs)	0.68	0.86	1.15	1.13	1.33	0.83	1.01	0.83	0.91	0.84	0.65	3.49	0.73	
Annual Saving (M. Rs)	0.00	0.00	0.00	0.00	0.00	1.50	3.65	0.00	0.14	0.00	0.00	0.52	0.12	

WASA Interventions														
Interventions	Noorpur Disposal New PS28-03	PS3 Chokerra Disposal -01	PS3 Chokerra Disposal -02	PS3 Chokerra Disposal -03	PS3 Chokerra Disposal -04	PS3 Chokerra Disposal -05	PS3 Chokerra Disposal -06	PS19 BhaiWala Disposal -02	PS19 BhaiWala Disposal -03	PS19 BhaiWala Disposal -04	Railway Station	Sher Singh Wala Disposal -01	Weaver Colony Disposal	
Payback (Year)	-	-	-	-	-	0.55	0.28	-	6.27	-	-	6.68	5.98	

Table-7D: Interventions & Investment Required in WASA Stations-West Division Disposal Pumps

WASA Interventions														
Interventions	100 JB PS-27 Pump-001	100 JB PS-27 Pump-002	100 JB PS-27 Pump-003	Metro Pool Disposal-01	Metro Pool Disposal-03	Gulshan Colony Disposal	Akbar Abad Disposal-02	Akbar Abad Disposal-03	Akbar Abad Disposal-04	Shadman Pump-02	Shadman Pump-03	Shadman Pump-04	Shadab Colony-03	Shadab Colony-04
Electrical														
Install VFD	x	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	x
Replace ampere meter				x	x		x	x	x	x	x	x	x	x
Replace volt meter				x			x	x	x	x	x	x	x	x
Replace over current relays				x	x		x	x	x	x	x	x	x	x
Replace over voltage relay				x	x		x	x	x	x	x	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				x								x	x	x
Improve panel condition							x	x	x	x	x	x	x	x
Improve wiring condition							x	x	x	x	x	x	x	x
Relocate panel away from bore														

WASA Interventions														
Interventions	100 JB PS-27 Pump-001	100 JB PS-27 Pump-002	100 JB PS-27 Pump-003	Metro Pool Disposal-01	Metro Pool Disposal-03	Gulshan Colony Disposal	Akbar Abad Disposal-02	Akbar Abad Disposal-03	Akbar Abad Disposal-04	Shadman Pump-02	Shadman Pump-03	Shadman Pump-04	Shadab Colony-03	Shadab Colony-04
hole														
Replace electrical motor				x										
Install fan in the panel	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Replace PFI HRC fuses														
Replace PFI display meter	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Correct date & time of electrical meter														
Replace/correct electrical meter														
Replace change over														
Replace main circuit breaker														
Mechanical														
Replace damaged/install new flow meter	x	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	x
Control gland leakage														
Make operational/install new chlorinator														
Maintain ratchet plate														
Adjust impeller										x				
Repair & maintenance of pump										x				
Replace existing pumping system														
Maintain/install new non return valve														
Housekeeping														
Improve general housekeeping	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Install shades on motor & pump														
Rain protection of motor & pump														

WASA Interventions														
Interventions	100 JB PS-27 Pump-001	100 JB PS-27 Pump-002	100 JB PS-27 Pump-003	Metro Pool Disposal-01	Metro Pool Disposal-03	Gulshan Colony Disposal	Akbar Abad Disposal-02	Akbar Abad Disposal-03	Akbar Abad Disposal-04	Shadman Pump-02	Shadman Pump-03	Shadman Pump-04	Shadab Colony-03	Shadab Colony-04
Fix panel properly														
Proper support of discharge pipeline														
Maintain monthly record of fuel consumption	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Station Wise Investment (M. Rs)	0.96	0.68	0.62	1.28	0.78	0.83	0.93	1.18	0.93	1.21	1.28	0.93	0.93	0.93
Annual Saving (M. Rs)	-	-	-	-	-	-	-	-	-	0.48	-	-	-	-
Payback (Year)	-	-	-	-	-	-	-	-	-	2.50	-	-	-	-
Total Investment (M. Rs)=56.6														

ANNEXURE-1

Energy Audit Reports