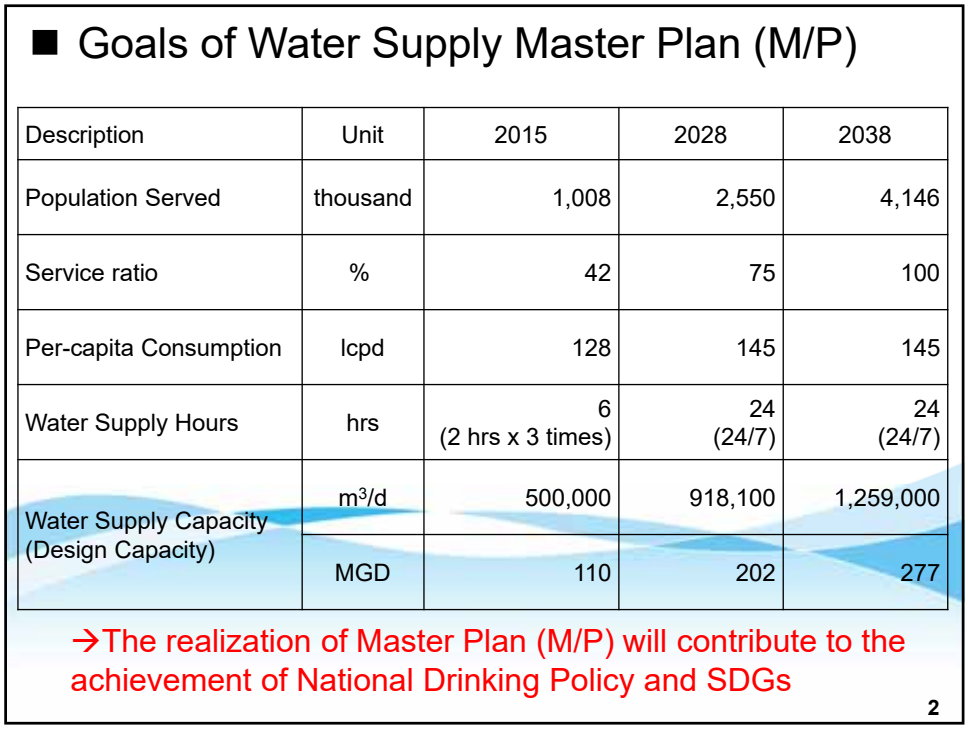
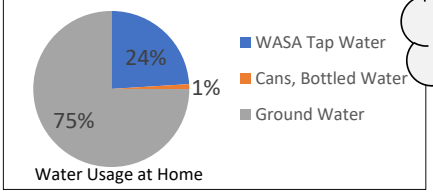
APPENDIX FOR CHAPTER B1 INTRODUCTION

AB1.1 Direction of Water Supply Master Plan



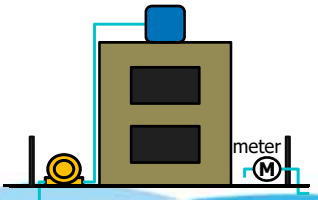
■ WASA's Service Improvement

Result of Interview Survey by JMT in 2016

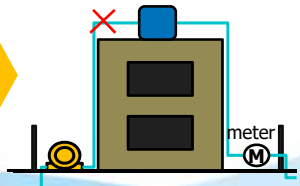


Service Improvement by WASA-F is absolutely essential.

Future WASA-F's Water Supply Service



Improvement
- Pressure
- Quantity
- Quality



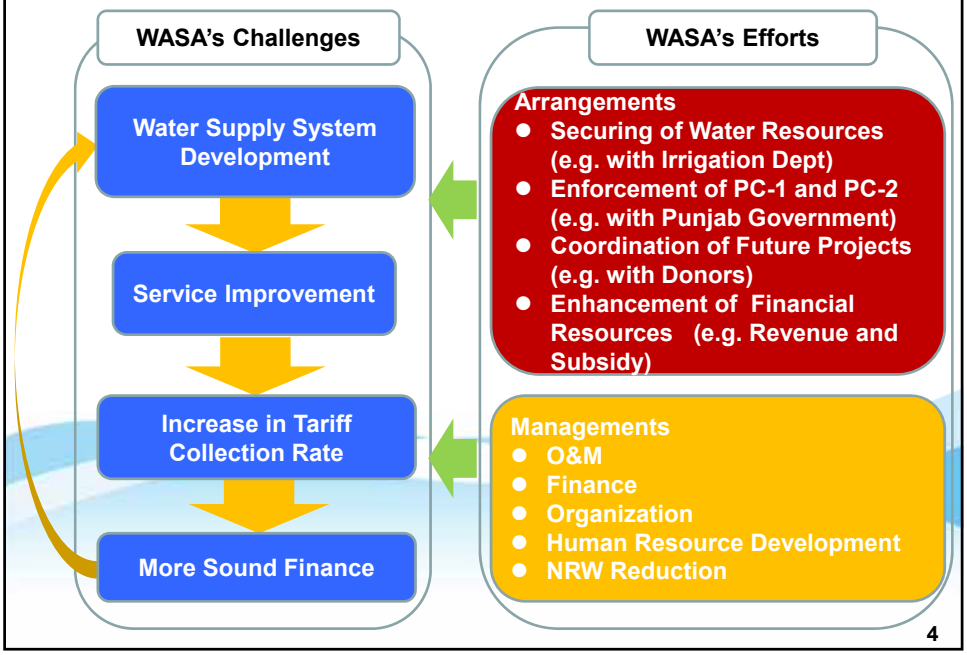
	Current (137 lpcd)
WASA tap water	33
Bottled water	1
Groundwater	103

	Future (146 lpcd)
WASA tap water	145
Bottled water	1
Groundwater	0

Note: JMT is JICA Mission Team

3

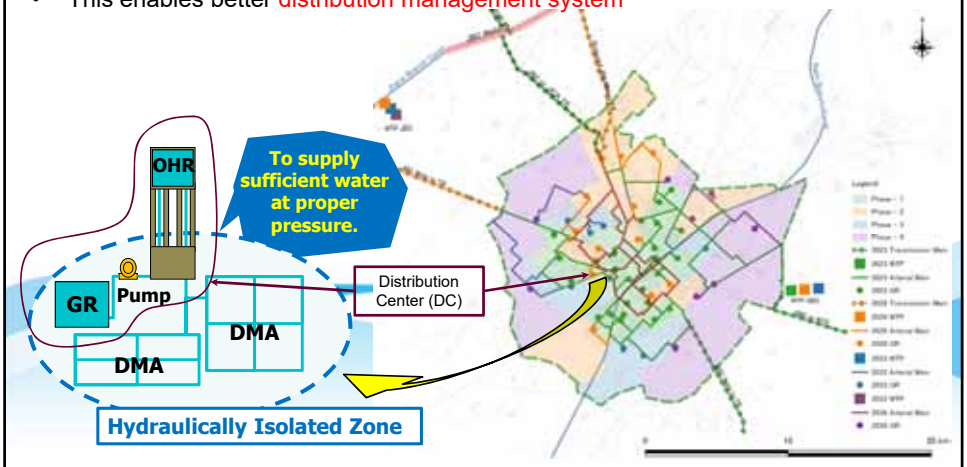
■ Directions of M/P



4

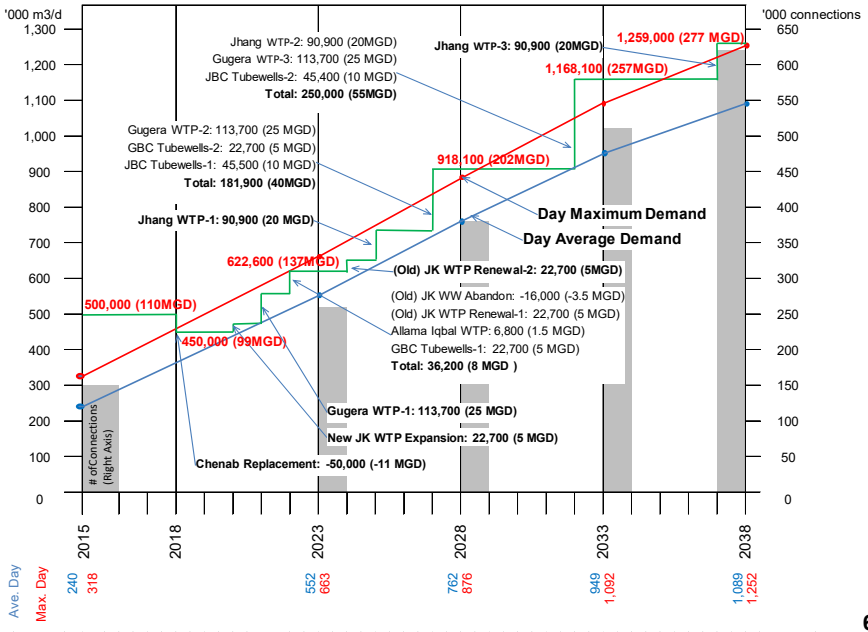
■ Phased Development Plan

- Implementation is phased, from current service area to future expansion area.
- Arterial Mains and Distribution Centers (DCs) are built for separation of distribution system from transmission system.
- A DC supply water to a hydraulically isolated zone consisting of serval DMAs.
- This enables better distribution management system



5

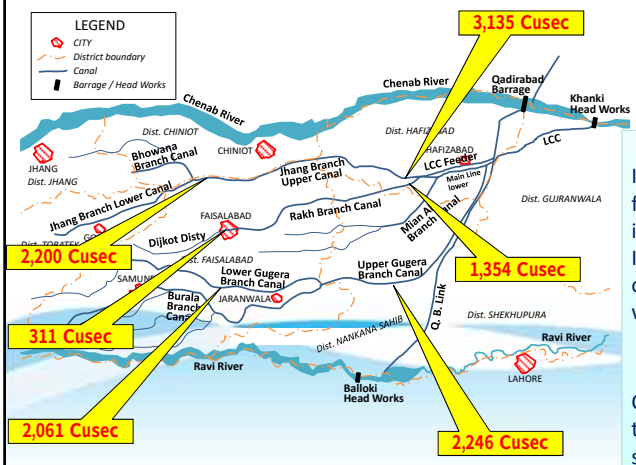
■ Water Demand & Sources Development Plan



6

■ Considerations on Water Source Development

Canal	Upstream End	Downstream End	Required Intake by 2038 in M/P
JBC	1,740MGD, 3,135 Cusec	1,220MGD, 2,200 Cusec	60MGD, 108 Cusec (approx. 4%)
RBC	750MGD, 1,354 Cusec	170MGD, 311 Cusec	25MGD, 45 Cusec (approx. 9%)
GBC	1,250MGD, 2,246 Cusec	1,150MGD 2,061 Cusec	75MGD, 135 Cusec (approx. 6%)
Total	3,740MGD, 6,735 Cusec	2,540MGD, 4,572 Cusec	160MGD, 288 Cusec(approx.5%)



Water Rights Permit

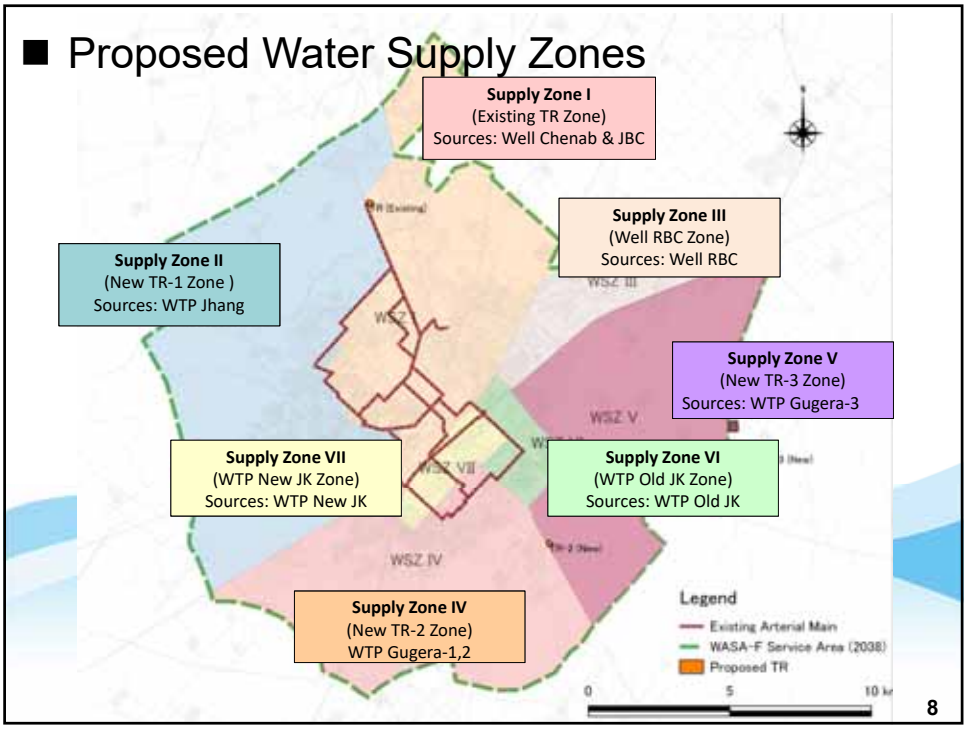
Intakes from irrigation canals for future water sources are planned; it requires discussion with Irrigation Dept. including an idea of trade-off, return of treated wastewater to irrigation canal.

Canal Closure

Coordination with Irrigation Dept. to avoid multiple canal closing at same time and to shorten the closure period .

7

■ Proposed Water Supply Zones



8

■ Environmental & Social Considerations

Considerations on Water Source Development

Water Rights

o Intake from irrigation canals for water source and, in return, discharging treated wastewater is proposed by WASA-F

o This idea of trade-off requires further discussion and mutual understanding between WASA-F and Irrigation Dept. (e.g. Time flame of development of water supply system and sewerage system are different.)

Canal Closure

o Coordination with Irrigation Dept. to avoid multiple canal closing at same time and to shorten the closure period

o Construction of raw water reservoir (RWR) with adequate capacity to reserve water during canal closure is recommended

Future Water Source

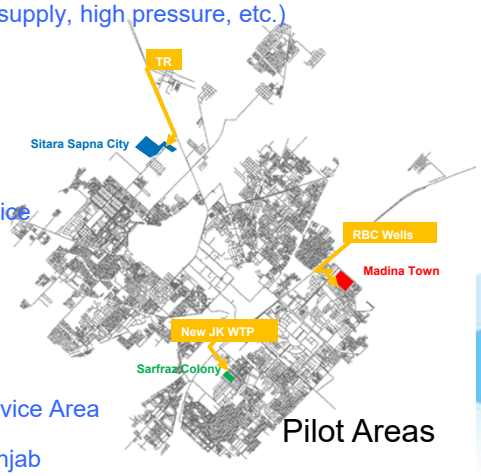
o Intake water from Chenab River as an alternative water source (e.g. after 2038.)

o Realization of Chiniot Dam project shall be followed up by WASA-F and water intake rights to be negotiated with WAPDA when project is realized

9

■ Outline of Pilot Project

- Activities of Pilot Project
  - Hydraulically isolation of Pilot Areas selected (DMA)
  - Supply management (continuous supply, high pressure, etc.)
  - Promotion of meter installation
  - Leakage detection and repair
- Building good practice
  - Improvement of water supply service
  - Reduction of NRW
  - Increase of billing collection rate
- Future spread to other areas
  - Spread throughout WASA-F's Service Area
  - Spread out to other WASAs in Punjab



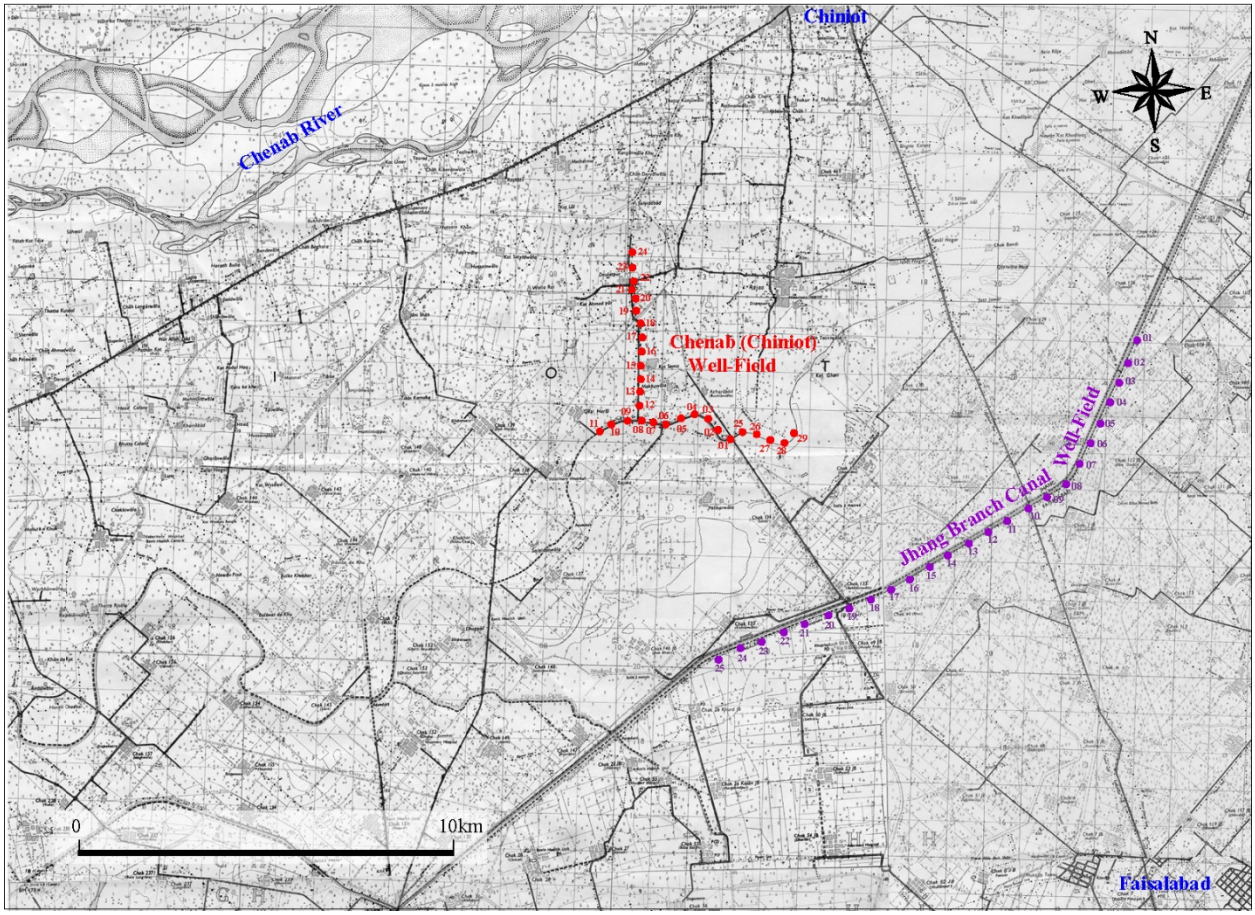
Pilot Areas

Note: WTP is Water Treatment Plant, and TR is Terminal Reservoir

10

APPENDIX FOR CHAPTER B2 WATER SOURCES

AB2.1 Current Groundwater Situation



SOURCE: JICA Mission Team

Figure AB2.1.1 Location of tubewells in Chenab (Chiniot) and JBC Well Fields

(1) Chenab (Chiniot) Well Field

Location of tubewells in Chenab (Chiniot) Well Field is shown in **Figure AB2.1.1** with their serial tubewells numbers. In the Figure, another main Well Field for water supply to Faisalabad, JBC Well Field, is also shown.

In both 2014-2015 and 2015-2016 fiscal years, the Energy Audit Report mentioned the discharging capacities of tubewells in Chenab (Chiniot) Well Field.

It shows as follows.

- 2014-2015 fiscal year: 137,990 m^3/day[1]
- 2015-2016 fiscal year: 148,097 m^3/day[2]

Table AB2.1.1 Total Discharging Capacity in Chenab Well Field mentioned in Energy Audit Report of FY 2014-2015

[1] Energy Audit Report Of Water Supply Schemes And Disposal Station Of Water And Sanitation Agency Faisalabad; Engr. Bilal Bashir Deputy Director (Electric Cell) WASA Faisalabad

[2] Energy Audit & Energy Efficiency Improvement Program for WASAs in Punjab: March 2016

Tubewell No.		TW-01	TW-02	TW-03	TW-04	TW-05	TW-06	TW-07	TW-08	TW-09	TW-10	TW-11	TW-12	TW-13	TW-14	TW-15
Discharge	L/sec	87	101	109	NA	NA	111	96	119	76	118	95	NA	27	79	91
	m^3/hr	313	364	392	NA	NA	400	346	428	274	425	342	NA	97	284	328

Tubewell No.		TW-16	TW-17	TW-18	TW-19	TW-20	TW-21	TW-22	TW-23	TW-24	TW-25	TW-26	TW-27	TW-28	Total
Discharge	L/sec	68	101	NA	106	106	87	73	NA	115	NA	111	143	110	2,129
	m^3/hr	245	364	NA	383	382	313	263	NA	414	NA	400	515	396	7,666

Average working hours per day is 18 hours: 137,990 m^3/day

SOURCE: ENERGY AUDIT REPORT OF WATER SUPPLY SCHEMES AND DISPOSAL STATION OF WATER AND SANITATION AGENCY FAISALABAD; Engr. Bilal Bashir Deputy Director (Electric Cell) WASA-F

Table AB2.1.2 Total Discharging Capacity in Chenab Well Field mentioned in Energy Audit Report of FY 2015-2016

Tubewell No.		TW-01	TW-02	TW-03	TW-04	TW-05	TW-06	TW-07	TW-08	TW-09	TW-10	TW-11	TW-12	TW-13	TW-14	TW-15
Discharge	Cusec	3.22	3.40	-	3.55	3.37	4.36	3.03	3.72	-	2.85	4.04	2.44	4.38	3.13	3.34
	m^3/hr	328	347	-	362	344	444	309	379	-	291	412	249	447	319	340

Tubewell No.		TW-16	TW-17	TW-18	TW-19	TW-20	TW-21	TW-22	TW-23	TW-24	TW-25	TW-26	TW-27	TW-28	Total
Discharge	Cusec	1.79	3.38	3.24	3.35	3.49	3.80	2.53	3.45	2.69	3.53	-	-	4.63	80.71
	m^3/hr	182	345	330	342	356	387	258	352	274	360	-	-	472	8,228

Average working hours per day is 18 hours: 148,097 m^3/day

SOURCE: Energy Audit & Energy Efficiency Improvement Program for WASAs in Punjab: March 2016

Out of 28tubewellss, six tubewells TW-04, 05, 12, 18, 23, and 25 are in non-operational condition at the time of the inspection in 2014-2015 FY, then the working is only 22 tubewells, and four tubewells TW-03, 09, 26, and 27 is in a non-operational condition, working 24 in 2015-2016 FY. Comparing with the total discharging rate, which per one is average 6,170 ~ 6,270 $m^{3/}$day.

Operating hours per day for each well are 18-20 hours in working condition, but it was reported 18 hours in average because some of them do not work sometimes.

The depth of tubewells in Chenab Well Field is 120 to 140 m. The tubewells were drilled into the alluvial aquifer of the basin at intervals of nearly 400 m.

The characteristics of the 25 tubewells constructed in 1992 are as follows. First, drilling diameter is 24 inches (600 mm). Second, housing casing diameter is 16 inches (406 mm). Last, screen and blind casings diameters are 10 inches (256 mm).

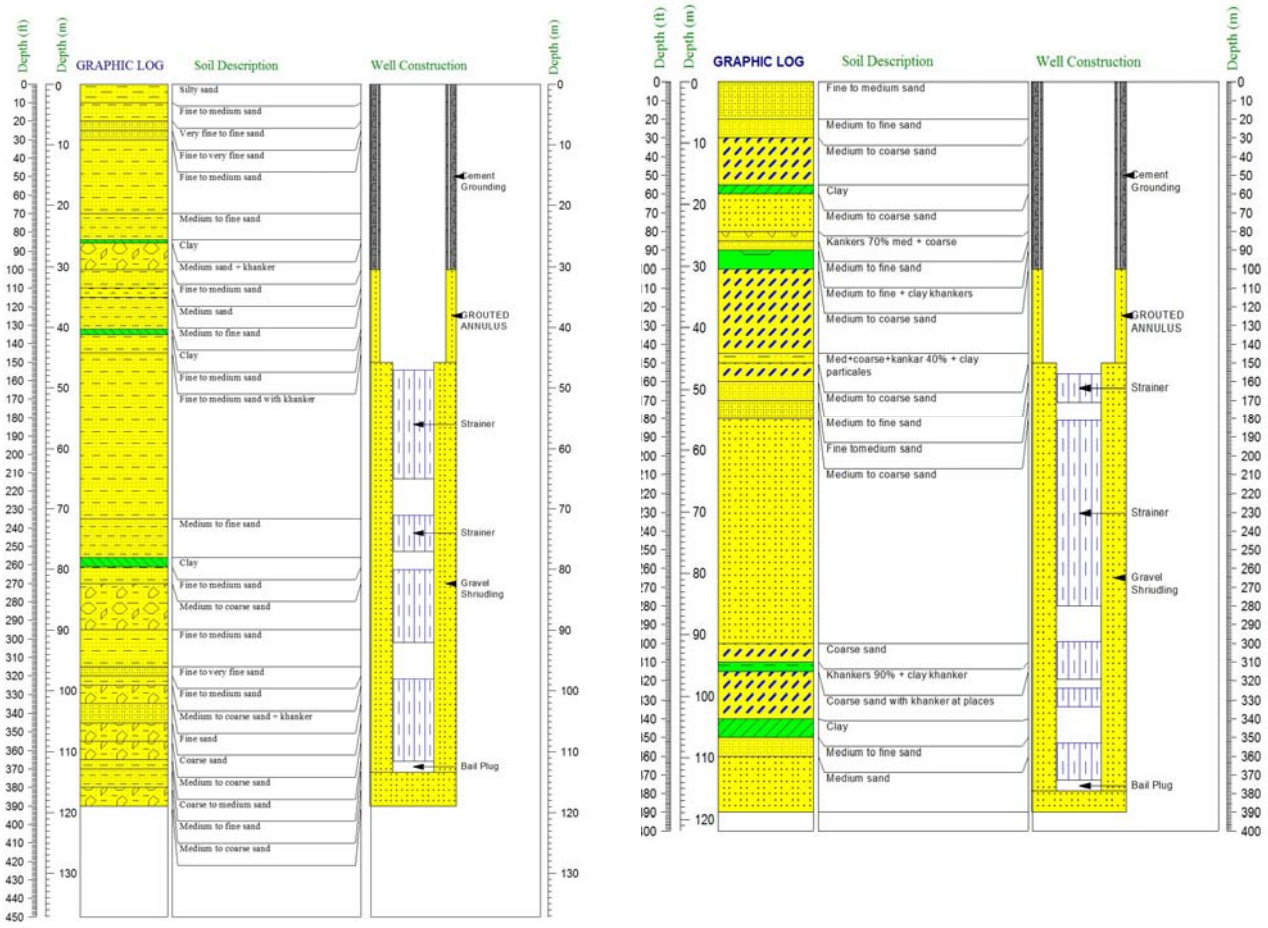
In the **Table AB2.1.3**, list of drilling depth, depth of screen, TDS, etc. of 25tubewellss constructed in 1992 are shown. However, the data of additional tubewells constructed in 2000 by Punjab government is not mentioned because it was not available.

Table AB2.1.3 Detail of Tubewells in Chenab Well Field

TW No.	GL (m)	SWL (GL.-m)	Depth (m)							Permeability (m/sec)	Specific Yield	TDS (ppm)	EC (μS/cm)	pH
			Drilling	Casing	Housing	Screen1	Screen2	Screen3	Screen4					
1	179.200	2.88	125	119.8	45.4	49.3 61.4	65.5 73.1	80.2 86.3	93.4 117.8	1.24E-03	0.15	304	590	7.67
2	179.226	2.54	119	113.4	45.7	47.0 65.0	71.6 76.8	80.0 61.5	98.0 111.5	1.04E-03	0.10	679	980	7.80
3	178.597	1.72	123	117.7	41.1	42.7 60.7	71.6 77.4	85.3 100.3	103.6 115.8	1.03E-03	0.10	344	572	7.65
4	177.771	2.30	119	115.2	45.8	51.8 57.6	63.9 69.9	75.9 113.4		6.18E-04	0.08	766	936	7.18
5	178.008	2.54	119	115.4	45.7	47.5 52.0	55.0 85.1	91.1 101.6	107.6 113.4	9.52E-04	0.10	248	435	7.68
6	177.964	2.15	122	117.6	45.7	48.7 78.7	82.8 103.8	109.8 115.8		6.00E-04	0.07	246	430	7.74
7	178.273	2.69	116	104.7	32.6	33.5 54.6	66.8 71.2	86.3 95.2	98.2 104.0	1.65E-03	0.15	385	410	7.65
8	177.944	2.82	123	119.9	44.5	45.8 48.8	54.9 60.9	66.9 103.0	112.0 118.1	1.03E-03	0.12	600	740	7.85
9	177.996	3.55	128	124.8	45.7	49.3 55.3	64.0 70.0	79.4 103.5	111.2 123.0	8.24E-04	0.09	444	674	7.60
10	178.265	3.65	126	119.1	39.6	40.8 48.3	59.4 71.5	77.5 103.0	115.8 117.3	2.07E-03	0.18	379	530	7.44
11	178.028	no data	125	120.7	44.7	52.7 64.9	68.9 94.8	98.9 105.0	113.0 119.1	7.76E-04	0.09	392	572	7.70
12	179.528	4.52	128	123.2	45.7	55.0 61.0	79.4 121.4			4.44E-04	0.05	241	534	7.70
13	179.829	5.02	125	121.5	42.9	44.7 56.7	61.2 67.3	79.3 97.3	103.3 119.7	1.24E-03	0.10	314	426	7.42
14	179.811	4.77	134	129.8	42.9	44.5 51.9	76.0 106.0	109.1 118.0	125.0 127.6	8.24E-04	0.90	324	426	7.47
15	179.983	4.35	122	118.3	42.9	44.4 56.4	86.6 116.5			7.50E-04	0.06	490	650	7.18
16	180.381	5.54	131	125.3	45.1	45.7 53.1	64.0 67.0	84.6 123.4		7.50E-04	0.06	346	548	7.28
17	179.674	5.50	122	118.4	44.2	45.7 75.7	86.4 95.4	104.5 116.5		1.28E-03	0.11	304	no data	no data
18	181.019	3.22	131	126.2	44.2	46.1 58.1	76.3 103.7	118.3 124.3		8.00E-04	0.06	274	486	7.53
19	180.918	no data	134	128.9	45.7	48.8 55.6	62.0 68.6	84.9 114.9	124.1 127.1	9.81E-04	0.08	272	426	7.25
20	180.731	6.22	125	121.7	46.3	47.9 59.9	78.0 112.4	116.9 121.7		8.14E-04	0.07	374	462	7.67
21	180.882	5.30	125	120.2	45.8	47.2 59.2	62.3 68.3	82.3 92.5	100.3 115.9	4.09E-04	0.04	251	358	7.33
22	180.589	no data	140	135.3	41.5	56.4 60.9	65.5 68.5	82.0 118.1	127.4 133.4	4.43E-04	0.04	233	no data	no data
23	180.617	5.70	146	141.8	45.7	47.2 60.7	89.9 107.9	121.9 137.8		5.23E-04	0.05	352	500	7.60
24	180.702	6.00	125	120.5	44.7	45.7 66.7	84.1 91.7	97.7 118.3		1.03E-03	0.09	162	318	7.38
25	179.246	2.30	120	112.5	45.7	47.2 57.8	65.5 68.5	73.2 105.0	108.2 110.7	9.88E-04	0.08	562	730	7.13

SOURCE: JICA Mission Team (Compiled from the WASA-F data of tubewells in Chenab Well Field 1992)

The following shows the representative two lithological columns.



TW-2 TW-5

SOURCE: Modeling the Effects of Groundwater Pumping on Water table of a Faisalabad Water Supply Scheme: BY ABDUL KHALIQ, DOCTOR OF PHILOSOPHY IN AGRICULTURAL ENGINEERING; Department of Irrigation and Drainage Faculty of Agricultural Engineering and Technology UNIVERSITY OF AGRICULTURE, FAISALABAD (PAKISTAN) 2014

Figure AB2.1.2 Representative Lithological Columns in Chenab (Chiniot) Well Field[3]

The groundwater fluctuation of Chenab Well Field is compiled into the graph in the Main Report (**Figure B2.1.2**).

In the Figure, the fluctuation of the static water levels of each tubewell is shown as dotted lines on the upper portion in the graph. The dynamic water levels are on the lower portion. The average fluctuations are indicated by the solid line in red color for both the static and the dynamic water levels.

Looking at the trends of the average fluctuation, the static water level immediately after the start of the operation in July 1992 was about altitude 173m. It dropped 4m in the period of one-and-a-half years to near altitude 169m at January 1994. After that, although the pace of drawing down becomes gentle, it shows 2m decrease in the period of two-and-a-half years to altitude about 167m at July 1996.

Then, during the period of two-and-a-half years until January 1999, the water level fluctuation shows in stable condition, but later on, started again further downward trend, dropped to an altitude 165m at

[3] Modeling the Effects of Groundwater Pumping on Water Table of a Faisalabad Water Supply Scheme: BY ABDUL KHALIQ, DOCTOR OF PHILOSOPHY IN AGRICULTURAL ENGINEERING; Department of Irrigation and Drainage Faculty of Agricultural Engineering and Technology UNIVERSITY OF AGRICULTURE, FAISALABAD (PAKISTAN) 2014

January 2001.

After that, dropping to altitude 164m until May 2002 and subsequently dropping to an altitude of 162m in almost the same pace until June 2007, the amount of draw-down in the cumulative from the beginning of operation at July 1992 to June 2007 is about 11m.

Although the subsequent data are lacking, the data of monitoring wells starting measurement in 2016 shows 1 to 1.5m water level recovering when compared to the data of June 2007.

Though the amount of data of the dynamic water level is few comparing to the static water level and show somewhat large fluctuation of each datum, the average fluctuation of all tubewells has the same tendency as the static water level.

The difference between the static water level and the dynamic water level is around 7m.

As compared the fluctuation data with the discharge data in **Table B2.1.1** in the Main Report, it is possible to indicate the following consideration.

As of the time soon after pumping start, the horizontal groundwater flow from the vicinity outside of area into the Well Field area occurs hardly immediately until the groundwater level becomes from the original level to somewhat lower dynamic level, so that wells may discharge groundwater mainly from the stored in the aquifer surrounding area near tubewells, resulting relatively large draw-down occurs at this beginning stage. However later on approaching to the equilibrium condition, the supplemental groundwater flow horizontally from the outside into the Well Field area is gradually increase, then the pace of draw-down of groundwater level reduces and becomes gentle tendency.

Discharge from WASA-F tubewells in 1993 was 126,818 m^3/day, and the total discharge together with irrigation wells existing in the right side of JBC was nearly 200,000 m^3/day, while those in total (Tubewells of WASA-F and right side of JBC) during 1994 to 1996 was about 240,000 m^3/day. Though the former was less than the latter, the draw-down ratio of the former is rather larger than the latter. This is considered to be that hydro-geologically it was non-equilibrium condition in early stage soon after pumping had started. That is, groundwater didn't inflow so much from the outside to the Well Field area, so that the discharge may be mainly from the vicinity area causing larger draw-down of groundwater level around the area.

Passing the time and the draw-down of groundwater level reached approximately 6m from the original condition during 1997 to 1998, the fluctuation became stable that mean it was in equilibrium condition. In other words, the volume of groundwater inflow from the outside into the Well Field area was almost equal to the discharging volume by tubewells. During this period, the discharge of WASA-F tubewells was 142,000 ~ 149,000 m^3/day, and the total with that of irrigation wells in right side of JBC was 220,000 ~ 230,000 m^3/day.

However, the total discharge of WASA-F Well Field plus irrigation wells in the right side of JBC during 1999 to 2000 has increased up to 250,000~260,000 m^3/day (WASA-F was solely 150,000 ~ 160,000 m^3/day). Furthermore, after adding four tubewells since 2001, it has considerably increased up to 270,000 ~ 300,000 m^3/day (WASA-F was solely 160,000 ~ 170,000 m^3/day). Then, groundwater level has been falling down continuously as a result of over-discharge.

Although subsequent data is lacking, checking at the data of the Energy Audit Report of 2014-2015 and 2015-2016, the discharge of WASA-F Well Field becomes 138,000 ~ 148,000 m^3/day which is a little fewer than the volume during 1997-1998 at that time the fluctuation being stable. The discharge from irrigation wells in recent may probably be decreased moderately because rainfall may be rich relatively during this period. The groundwater level in this year is a little bit recovered compared to that in 2007.

Considering from the above mentioned actual data, optimum discharge rate from Chenab Well Field seems to be around 140,000 m^3/day. Furthermore, it is desirable that the discharge from irrigation wells in the right bank side of JBC also keep less than 80,000~90,000 m^3/day.

(2) JBC Well Field

The study for planning of water supply on the basis of the World Bank Master Plan had been conducted in the late 1900s. Then, the "Implementation Review Study on the Project for the Expansion of Water Supply System in Faisalabad" as JICA project was carried out from 2007. According to those studies, new well field along JBC was constructed in June to September 2011 and new water supply system was started.

Though the original plan was the expansion of existing Chenab (Chiniot) Well Field about 30 km northwest from Faisalabad city, there have been the problem in that area about remarkable groundwater level declining as a result of the large amount of continuous pumping from the existing Well Field. Because of that, private irrigation wells surrounding the area were influenced and difficult pumping cases occurred frequently, so that farmers came to fierce opposition action against further groundwater development in that area. To cope with this matter, provincial government and stakeholders discussed each other and carried out the feasibility study. As a result of that, new well field have been modified to construct along the left bank of JBC situating between Chenab River and Faisalabad city.

The main reason for this modification is that JBC is the boundaries of Faisalabad administrative area and the land along the Canal that belongs to the government. They think the facilities are better to install in the area of jurisdiction within the Faisalabad city. Right side of JBC was Chiniot District[4]. The locations of Tubewells in JBC Well Field are shown in **Figure AB2.1.1** with their Serial Nos. Design water supply and the number of tubewells of JBC Well Field is shown in the Table **AB2.1.4**.

Table AB2.1.4 Design Water Supply and The Number of Tubewells of JBC Well Field

Design Water Supply	90,900 m^3/day
No. of Tubewells	25 (among of them, 2 are the standbys)

SOURCE: Reference 4

Design discharge per one tubewells set finally about 200 m^3/hour as an economical amount of water to keep the water level falling to a minimum, from the fact that 4 Cusec (about 400 m^3/hour) discharge in Chenab Well Field has led to the groundwater level reduction in the whole area.[4]

Working hours per day of each tubewells was set as about 20 hours in reference to Chenab Well Field, then it needs 23 wells as shown in the following equation in order to get 90,900 m^3/day discharge, adding 2 tubewells as the standbys for maintenance resulting in total 25 tubewells being constructed.[4]

90,900 m^3/day/((200m^3/hour) x 20 hour) = 22.7 tubewells ≒ 23 tubewells

Standby tubewells are required for maintenance and repair. If 10% of the total number is assumed, it is 2 wells. As a result, the required number of tubewells totals "25".[4]

For deciding the interval of tubewells, considering the discharge should be less than the seepage volume from the bed of JBC in order to avoid the groundwater level declining of surrounding area. Since estimated seepage rate of JBC was considered to be 12,840m3/day/km (See the **Table B2.1.3** in the Main Report), a distance between two wells was set to be 600 m as a minimum requirement.[4]

[4] Implementing Review Study Report On The Project For The Expansion Of Water Supply System In Faisalabad In Islamic Republic Of Pakistan Japan International Cooperation Agency, Japan Techno Co., Ltd. March 2010

Actual available amount of water expected 90% considering safety factor about 10%, then: 12,840 m^3/day/km×0.9≒11,500 m^3/day/km.

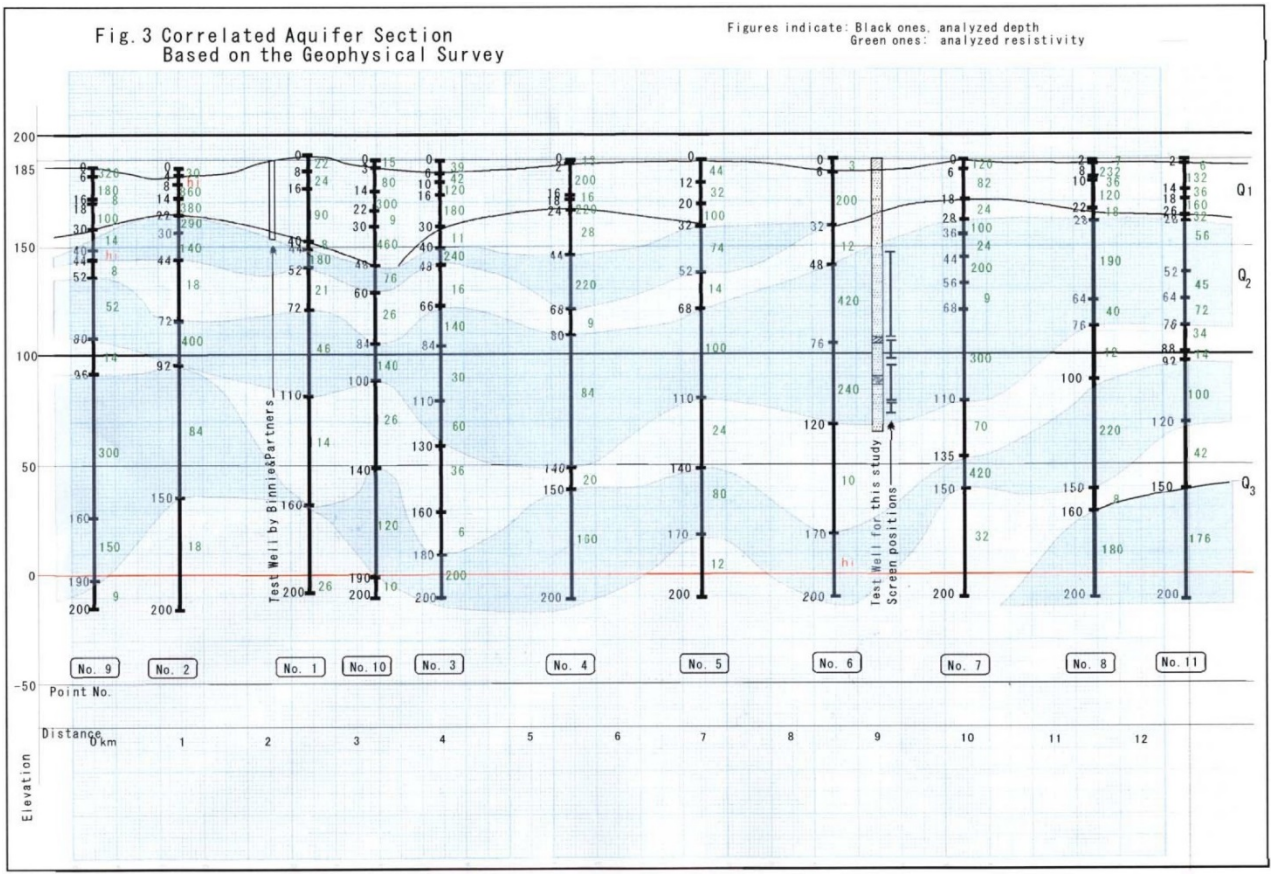
There are many irrigation wells in the surrounding area, and according to an estimate of JICA feasibility study it is expected to be about 5,200 m^3/day/km, then the rest is 6,300 m^3/day/km. In order to get Design Water Supply Capacity 90,900 m^3/day, it is necessary to distance of about 14.4 km.

Finally, the spacing between two tubewells is calculated as about 580m for setting the 25 wells in between 14.4 km, then considering some additional coverage it was decided as 600m.[4]

At the time of JICA study, resistivity survey in the target range along JBC was carried out. The cross-section are as shown in the **Figure AB2.1.3**.

Geophysical Prospection sounded until about the depth of 200m as shown the Figure. The layers of resistivity 50 ~ 400Ωm colored dark blue seems to be medium to coarse sand. Those of resistivity 8 ~ 40Ωm colored light blue seem to be silt or fine sand. Both layers may consist of aquifer and form an overall unconfined condition, though the layer of medium to coarse sand has higher groundwater discharging potential in general.

Since the elevation of ground level along JBC is 185 ~ 190m, tubewells were installed to intake groundwater mainly from the layers of resistivity 50 ~ 400Ωm existing in the depth 40 ~ 150m.



SOURCE: Reference 4

Figure AB2.1.3 Cross-Section of Resistivity Layers along JBC Well Field

Drilling diameter is 24-inch (600 mm). The diameter of casing is 16 inches (406 mm). The Screen and blind pipes in lower side is 10 inches (256mm) tube, which are the same as tubewells in the Chenab Well

Field.

Static water level, drilling depth, screen installation depth, permeability, specific capacity, and TDS of each well are as shown in the **Table AB2.1.5**.

Table AB2.1.5 Detail of Tubewells in JBC Well Field

Well No.	GL (m)	SWL (GL.-m)	Depth (m)								Perme-ability (m/sec)	Sc ($(m^3/h)/m$)	TDS (ppm)
			Drilling	Casing	Housing	Screen1	Screen2	Screen3	Screen4	Screen5			
TW-01	189.700	3.34	161.0	139.48	45.30	57.36 64.69	76.83 91.78	116.05 133.45			3.37E-04	54.9	192
TW-02	189.620	4.51	158.6	134.46	45.30	45.30 58.43	88.59 116.04	128.10 131.45			3.72E-04	68.5	192
TW-03	188.410	4.91	164.5	131.72	45.30	45.30 63.31	87.45 104.85	122.92 128.72			3.35E-04	56.8	192
TW-04	189.000	3.72	158.0	114.03	45.30	51.34 57.14	69.22 107.98				3.24E-04	59.7	192
TW-05	188.500	3.55	142.0	125.42	45.30	45.30 65.74	95.90 119.42				3.39E-04	61.9	192
TW-06	187.530	4.02	164.8	117.89	45.30	51.31 70.22	88.31 114.86				3.73E-04	71.4	196
TW-07	187.090	4.32	160.9	155.34	45.30	57.37 63.17	81.23 104.43	110.45 116.25	146.54 152.34		3.06E-04	50.6	192
TW-08	187.930	4.13	160.0	121.87	45.30	51.31 56.19	62.20 65.55	89.65 115.91			3.98E-04	56.5	192
TW-09	188.360	5.13	140.9	128.09	45.30	45.30 56.90	80.96 106.59	118.67 122.02			3.22E-04	53.5	192
TW-10	187.940	4.36	140.5	118.40	45.30	45.30 54.45	60.46 69.61	87.67 112.40			2.48E-04	42.6	192
TW-11	187.640	3.28	140.0	125.42	44.35	44.35 71.17	73.61 80.92	83.87 105.91	111.39 116.28		2.57E-04	65.6	192
TW-12	187.640	3.90	138.0	122.65	45.30	45.30 54.45	60.47 72.07	84.03 104.78	110.83 116.63		5.88E-04	124.2	192
TW-13	187.640	3.21	138.0	137.64	45.30	45.30 63.60	93.72 108.67	126.79 131.67			2.89E-04	44.2	192
TW-14	187.640	3.56	141.9	135.82	45.30	63.34 74.02	86.06 101.01	113.08 118.88	124.92 129.80		4.83E-04	74.1	474
TW-15	187.340	4.34	139.6	122.98	45.30	57.36 75.66	93.77 116.95				4.22E-04	74.1	700
TW-16	187.360	5.91	162.0	153.27	45.30	51.33 70.26	94.37 115.12	145.39 150.27			4.70E-04	90.5	202
TW-17	187.520	6.33	163.0	158.23	45.30	57.35 72.30	84.33 99.28	115.08 120.88	146.41 152.21		3.80E-04	65.8	147
TW-18	187.190	5.10	162.0	155.71	45.30	51.34 52.87	58.89 76.29	100.36 106.16	118.19 119.72	143.84 149.64	4.75E-04	63.3	198
TW-19	186.400	5.00	140.0	122.38	45.30	45.30 68.50	92.61 104.21	110.23 119.38			3.64E-04	66.9	440
TW-20	186.220	6.42	150.5	131.79	45.30	63.41 80.81	86.86 104.24	122.39 125.74			3.89E-04	61.5	168
TW-21	186.027	6.94	138.5	133.21	45.30	57.40 72.35	90.46 107.86	119.87 127.20			3.90E-04	64.5	184
TW-22	185.791	7.32	139.0	133.89	45.30	57.35 64.05	88.09 91.44	97.45 107.21	113.22 127.88		3.84E-04	54.2	206
TW-23	185.810	7.65	139.8	125.61	45.30	57.37 67.76	91.83 119.60				3.04E-04	46.9	190
TW-24	185.810	8.43	149.5	145.32	45.30	51.33 58.66	64.63 71.96	96.18 106.57	112.61 124.21	136.26 139.32	3.79E-04	62.5	188
TW-25	185.792	8.84	138.0	127.96	45.30	57.32 74.72	86.72 104.12	116.17 121.97			2.54E-04	41.2	178

Sc: Specific Capacity

SOURCE: JICA Mission Team (Compiled from the drilling data)

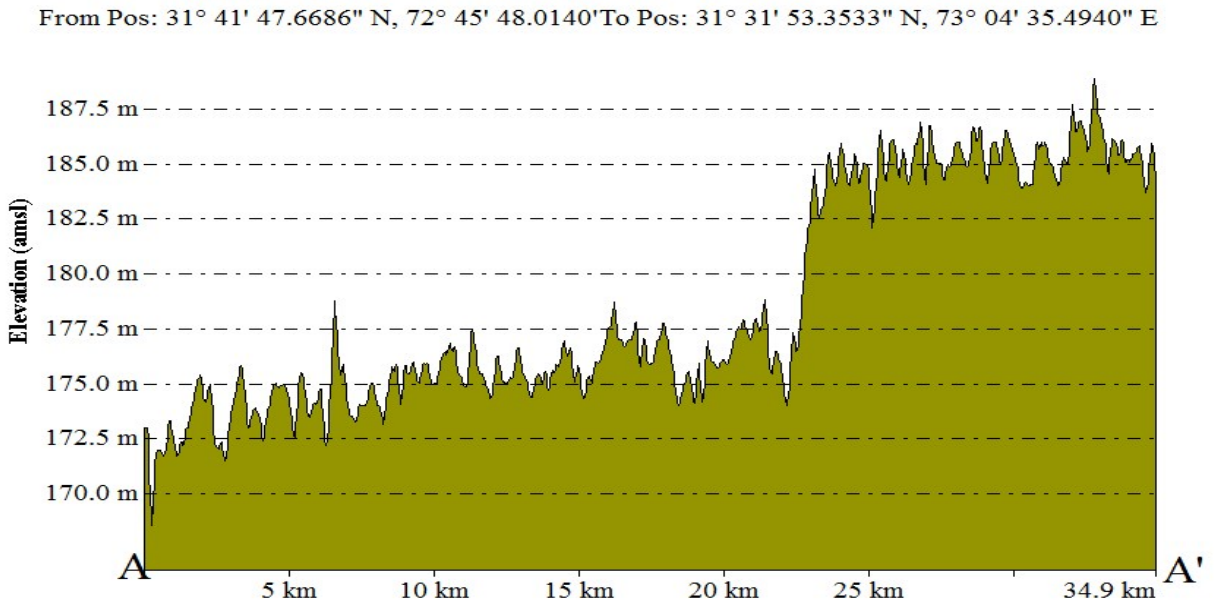
As shown in Location Map (**Figure AB2.1.1**), younger TW-number situates the side of upper-stream of the JBC.

Static water level of upstream side (from TW-01 to TW-15) is within the range of depth of 3.3 ~ 4.5m from the GL (Ground Level), but the case of downstream side (TW-16 to TW-25) becomes deeper showing from 5m to 8m or more.

This is due to the influence of the topography, the topographical cross-section from Chenab River to the center of Faisalabad city is as shown in the **Figure AB2.1.4** (Side-A is the direction toward Chenab River; altitude around 175m, Side-A' is toward the center of Faisalabad city; altitude around 185m), forming a terrace-like terrain.

At the time before construction of Chenab Well Field, groundwater level is between GL.-2 ~ 4m regardless of that it is in the lower side or the upper side of the terrace terrain, but it is going to rapidly decline from the upper terrace side to the lower terrace side parallel to topographical feature in the slope area of terrace cliff. Since the difference of ground elevation between the upper and the lower terrace terrain is about 10m, the difference between groundwater levels is also about 10m.

Currently, by discharging from Chenab Well Field, the groundwater level in the lower terrace is further going down resulting in a larger difference of groundwater level between both sides of terrace becomes much larger.



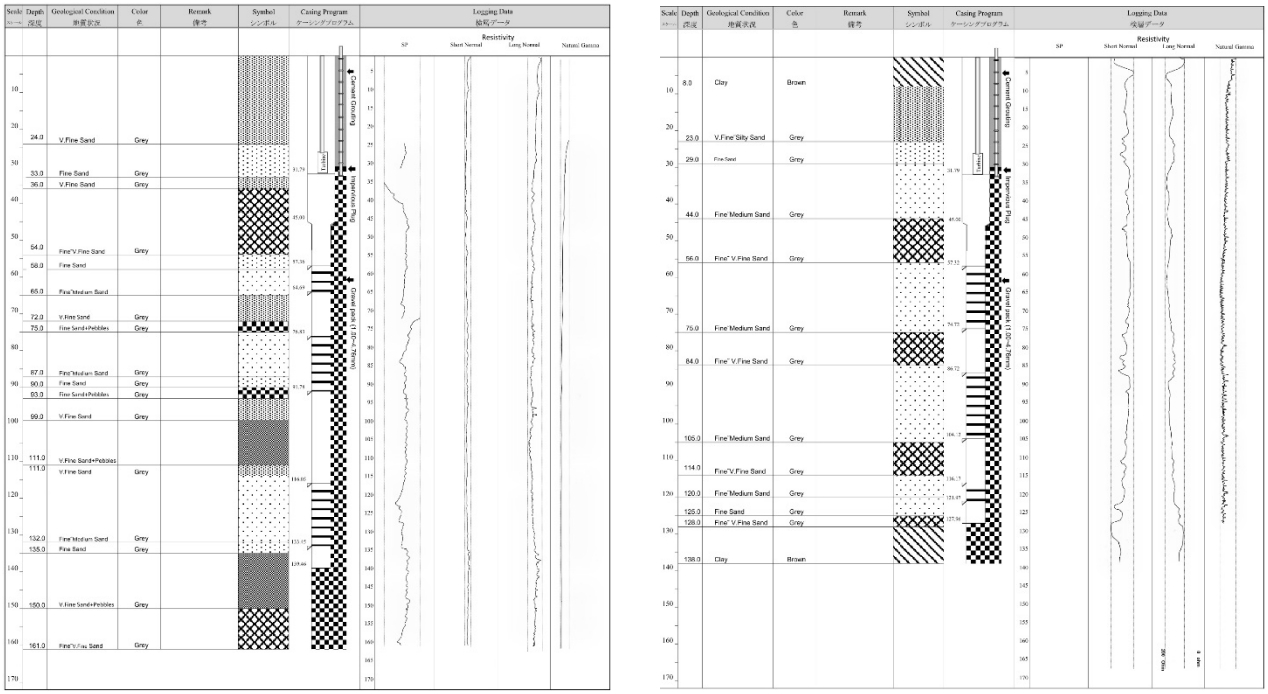
SOURCE: Modeling the Effects of Groundwater Pumping on Watertable of a Faisalabad Water Supply Scheme: BY ABDUL KHALIQ, DOCTOR OF PHILOSOPHY IN AGRICULTURAL ENGINEERING; Department of Irrigation and Drainage Faculty of Agricultural Engineering and Technology UNIVERSITY OF AGRICULTURE, FAISALABAD (PAKISTAN) 2014

FIGURE AB2.1.4 Topographical Cross-Section from Chenab River Side (Side A) to the Side of Faisalabad City (Side A') [6]

JBC is flowing through the upper side of the terrace terrain as a whole. Upper stream side of JBC Well Field situate relatively distant from terrace cliff, then groundwater level is in the depth of GL.-3 ~ 4m. But on the downstream side, those are relatively close to terrace cliff, in which the groundwater level is positioned in the range that is being declining from the upper side to the lower side of the terrace. As a result, groundwater level on the downstream side of JBC Well Field is in the depth of 5 ~ 8 m showing

deeper compared to the upper stream side.

The lithological columns TW-01 and TW-25 as the representatives are shown in the **Figure AB2.1.5**.



TW-01 TW-25

SOURCE: Construction Report of JBC in 2011

Figure AB2.1.5 Representative Lithological Columns of JBC Well Field

The upstream wells of JBC Well Field may be controlled by hydrogeological nature of the upper side of terrace terrain shown in the **Figure AB2.1.4**. The tendency of groundwater level fluctuation is considered to be caused by the balance of the discharge from tubewells in Well Field along JBC, the recharge mainly from JBC with the addition to the impact of the seasonal monsoon, and the flowing away to the side of Chenab Well Field.

On the other hand, the groundwater level of the Well Field on the downstream side is on the way from the upper side to the lower side of terrace terrain. It may be influenced by the hydrogeological nature of both the upper and lower sides of terrace terrain. According to that, the tendency of groundwater fluctuation may show a little different.

Groundwater level of lower terraces side may be influenced more strongly from Chenab River.

As mentioned above, groundwater level around Chenab Well Field is largely lowered. It is possible for groundwater level around JBC Well Field to be also influenced by Chenab Well Field because of their relative locational relationship. From the fact that the declining tendency of tubewells in upstream side continues, it is probable that the upstream side of JBC Well Field is more influenced from Chenab Well Field.

Energy Audit has been also carried out in 2014-2015 FY and 2015-2016 FY at JBC Well Field, and the result regarding the amount of water supply are shown in the **Table AB2.1.6** and **AB2.1.7.**

Table AB2.1.6 Total Discharging Capacity in JBC Well Field mentioned in Energy Audit Report of FY 2014-2015[5]

Tubewell No.		TW-01	TW-02	TW-03	TW-04	TW-05	TW-06	TW-07	TW-08	TW-09	TW-10	TW-11	TW-12	TW-13	TW-14
Discharge	m^3/hr	198	178	170	186	178	185	186	180	204	192	198	201	189	172

Tubewell No.		TW-15	TW-16	TW-17	TW-18	TW-19	TW-20	TW-21	TW-22	TW-23	TW-24	TW-25	Total
Discharge	m^3/hr	193	257	205	198	195	169	200	198	172	190	215	4,809

Average working hours per day is 15 hours: 72,135 m^3/day

SOURCE: ENERGY AUDIT REPORT OF WATER SUPPLY SCHEMES AND DISPOSAL STATION OF WATER AND SANITATION AGENCY FAISALABAD; Engr. Bilal Bashir Deputy Director (Electric Cell) WASA Faisalabad

Table AB2.1.7 Total Discharging Capacity in JBC Well Field mentioned in Energy Audit Report of FY 2015-2016[6]

Tubewell No.		TW-01	TW-02	TW-03	TW-04	TW-05	TW-06	TW-07	TW-08	TW-09	TW-10	TW-11	TW-12	TW-13	TW-14
Discharge	m^3/hr	-	-	168	-	164	166	188	160	175	210	193	204	183	178

Tubewell No.		TW-15	TW-16	TW-17	TW-18	TW-19	TW-20	TW-21	TW-22	TW-23	TW-24	TW-25	Total
Discharge	m^3/hr	174	253	175	174	174	159	183	199	156	172	177	3,988

Average working hours per day is 15 hours: 59,819 m^3/day

SOURCE: Energy Audit & Energy Efficiency Improvement Program for WASAs in Punjab: April 2016

According to the interviews to WASA-F Staffs and the operation record of August 2016, if tubewells in the JBC Well Field is working, it runs 15-20 hours per day. However, average running hours per day through the year is 14-16 hours because some tubewells are not working some days.

In the Energy Audit Report, it is said to be 15 hours.

Tables AB2.1.6 and **AB2.1.7** show that the discharge amount from all wells in the JBC Well Field in 2014-2015 FY is 4,809 m^3/hour. If tubewells runs 15 hours per day in average, it is 72,135 m^3/day and 26.33 million m^3/year.

While, it is 3,988 m^3/hour in 2015-2016 FY. In other words, it is 59,819 m^3/day and 24.08million m^3/year.

Looking at the water level fluctuation shown in the **Figure AB2.1.6**, static water level shows a downward trend consistent until the middle of 2015, but the second half of 2015 is fairly stable. In 2016, it shows a slight upward trend.

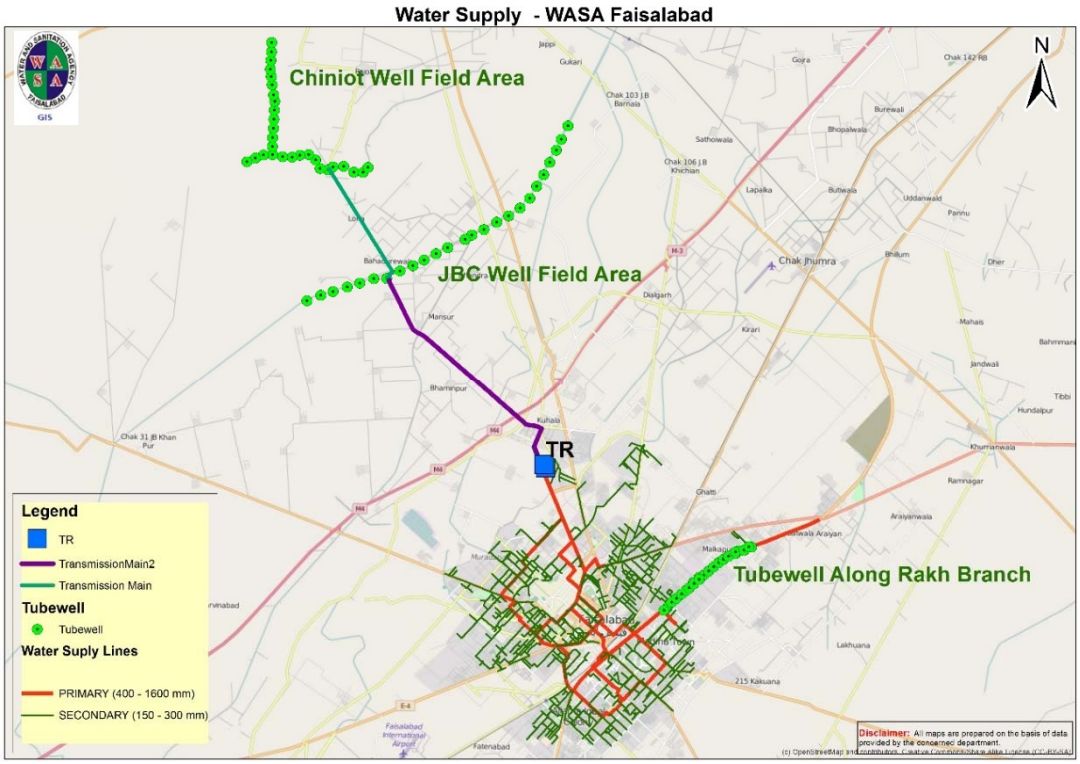
The comparison of these trends with the data of Energy Audit Report demonstrates that the discharge amount of 72,135 m^3/day is somewhat excessive pumping, but from the fact that the discharge amount of 59,819 m^3/day is showing slight static water level rise, it can be seen still afford somewhat.

According to the SCADA data for the period from January to August 2016 which shows the stable groundwater fluctuation, the average amount of water distributed from the JBC Well Field to the TR Inlet during this period is about 68,000 m^3/day, Even if there was some leakage on the way, the amount of pumped water at the Well Field seems to be less than 70,000 m^3/day, which is considered to be the proper discharge rate.

[5] Energy Audit Report Of Water Supply Schemes And Disposal Station Of Water And Sanitation Agency Faisalabad; Engr. Bilal Bashir Deputy Director (Electric Cell) WASA Faisalabad

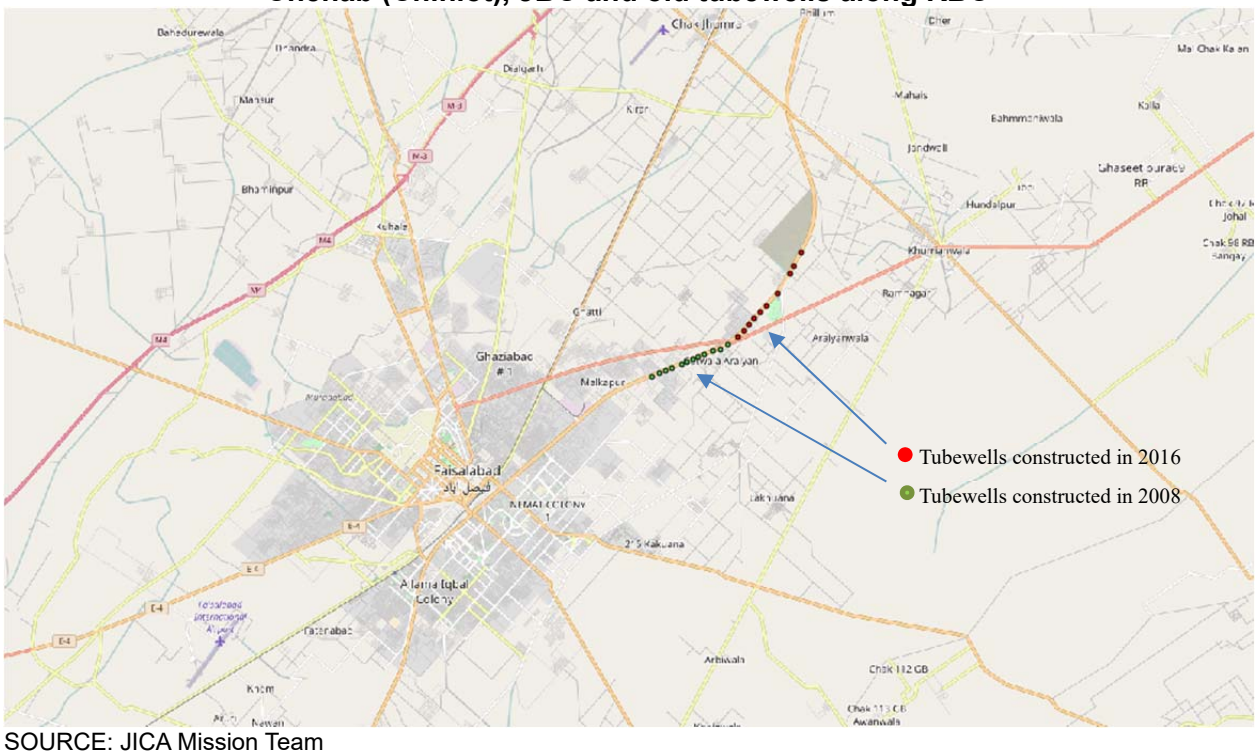
[6] Energy Audit & Energy Efficiency Improvement Program for WASAs in Punjab: March 2016

(3) Tubewells along RBC



SOURCE: WASA-F Presentation Material

Figure AB2.1.6 Locational Relation of WASA-F Well Field Area of Chenab (Chiniot), JBC and old tubewells along RBC



SOURCE: JICA Mission Team

Figure AB2.1.7 Location of New tubewells constructed in 2008 and 2016 along RBC

Locations of tubewells along RBC are shown in the **Figure AB2.1.6** and **AB2.1.7**.

Figure AB2.1.6 shows the locational relation of WASA-F Well Field Area of Chenab (Chiniot), JBC, and RBC tubewells along RBC in this Figure show the old ones as of 2007. New ones constructed in 2008 and 2016 by WASA-F and AFD, respectively are shown in the **Figure AB2.1.7**.

The entire water supply for Faisalabad city used to rely on tubewells installed alongside the RBC running across the east side of the city until the completion of the Chenab Well Field in 1992. In the early 1990s, the number of wells alongside totaled more than 50.[4]

WASA-F used to concentrate tubewells in this zone since the quality of groundwater along the narrow strips on the both sides of the canal was acceptable. On the contrary, those in other areas of the city where TDS was well over 2,000 ppm were unacceptable for drinking mainly due to salinity.[4]

The wellfield located in the downtown area had thus been overly developed, and resulted in shutdown of many of the tubewells due to lowering of groundwater level and degradation of water quality.[4]

The World Bank's Master Plan suggested to limit the total discharge in this strip to a range of the seepage amount from the canal to preserve proper quality and quantity. In compliance with this recommendation, WASA-F rehabilitated the existing tubewells by 2002 by the provincial annual development budget. As a result, 16 tubewells in total were in operation at that time. [4]

Tubewells in Chenab Well Field is a deep structure of an average 150m depth to intake freshwater in alluvium, and design discharge is about 400 m^3/hour. On the other hand, the maximum depth is only around 50m, and design discharge is only about 100 m^3/hour along RBC. [4]

Tubewells along RBC are set to be positioned as an auxiliary water source. [4]

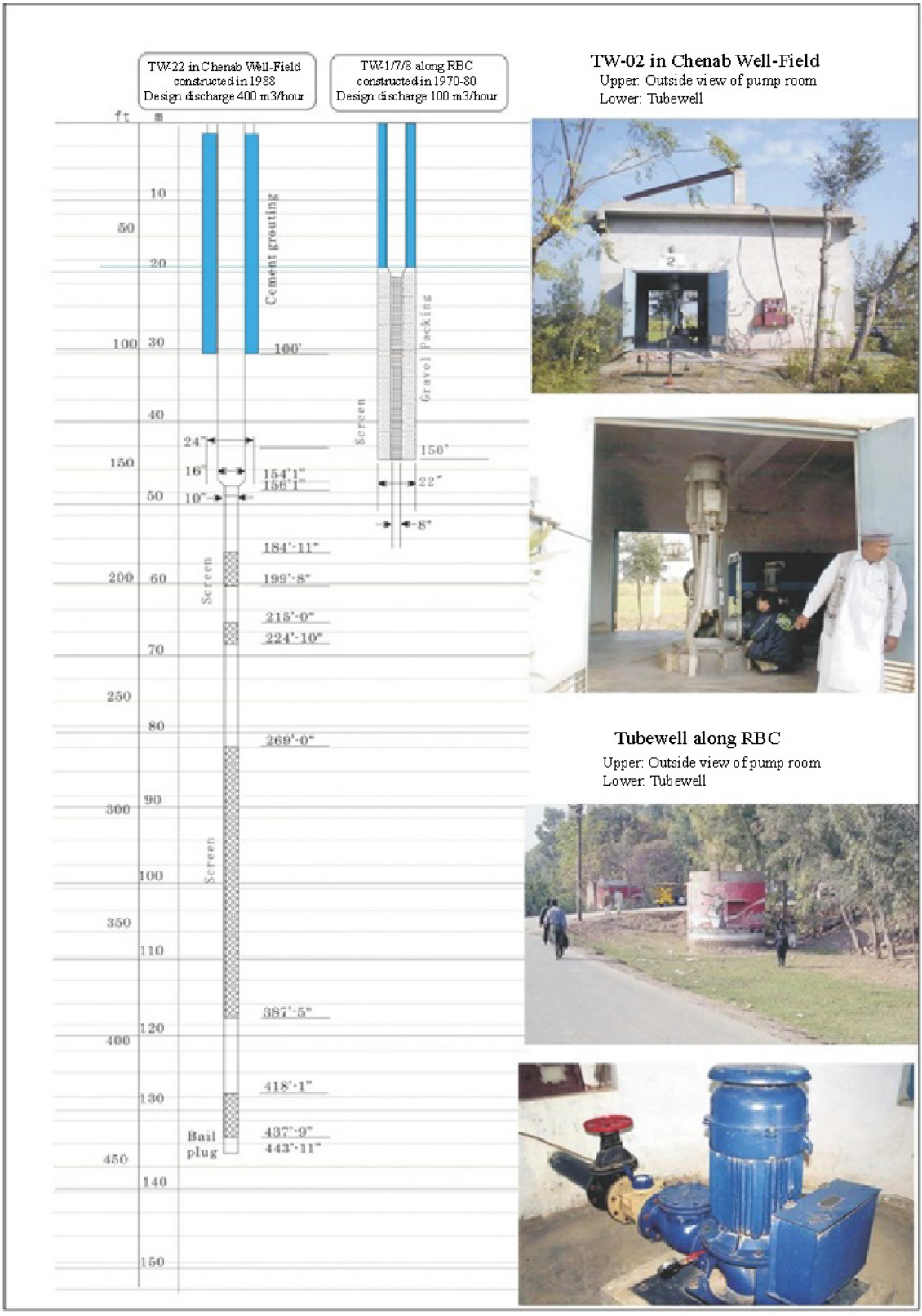
Design flow rates etc. of JBC and RBC are as shown in the **Table AB2.1.8**.

Table AB2.1.8 Main Specification of JBC and RBC in the Target Area

		JBC	RBC
Design Flow Rate		3,000 Cusec (85 m^3/sec)	1,140 Cusec (32.3 m^3/sec)
Average Actual Flow Rate		3,400 Cusec(108 m^3/sec)	1,200 Cusec (40 m^3/sec)
Command Area		348,500 ha	122,000 ha
Unit Supply Rate (*)		2.84 Cusec/1000 acre (=about 0.03 m^3/hour/m^2)	Same as the left
Closing Period	Design	27 December to 13 January (18 days)	13 January to 31 January (19 days)
	Actual	About 30 days	About 30 days

Note (*): Distribution to each farmer is allocated according to land ownership area, and it is done once a week by water distribution time.
SOURCE: Reference 4

The structural difference between the tubewells in Chenab water Well Field and along RBC is shown in **Figure AB2.1.8**.



SOURCE: Reference 4

Figure AB2.1.8 Structural Comparison of Tubewells in Chenab Well Field and along RBC

In 2008, WASA-F completed the construction of new additional 12tubewellss as the re-development along RBC. Design discharge is 1 Cusec (about 100 m^3/hour) and to be running six hours a day in total, the amount of water supply is 7,200 m^3/day.

As mentioned above, old tubewells more than 50 were reduced into 16 in 2001. However, since two of them are currently out of order, they are excluded from the water supply plan at present. Because of designed discharge capacity being 1cusec per one tubewells and operating for 6 hours a day, 14 tubewells supply water volume 8,400 m^3/day. Then, combined with 12tubewellss constructed in 2008, total discharge becomes 15,600 m^3/day.

WASA-F aims also to supply water for 24 hours in the future, so that the water supply target from tubewells along RBC is set to be 59,000 m^3/day.

Further as describing below, further 10tubewellss have been installed in 2016 on the further upstream side by the financial aid of AFD. The design discharge of each tubewells is 100 m^3/day and working for 8 hours a day, resulting 10tubewellss can supply water 8,000 m^3/day, but WASA-F also set their target water supply volume at 23,000 m^3/day through 24-hour water supply plan.

Therefore, the discharge from tubewells along RBC by EASA-F plan is 82,000 m^3/day in total.

Table AB2.1.9 Detail of Ttubewellss constructed in 2008 along RBC

Well No.	SWL	Depth (m)				Permeability	Sc	TDS	pH
	(GL.-m)	Drilling	Casing	Housing	Screen	(m/sec)	(m^3/h)/m)	(ppm)	
TW No.01	10.19	48.8	46.48	25.91	26.97 45.26	5.32E-04	40.3	162	7.60
TW No.02	9.88	48.8	46.48	25.91	26.97 45.26	4.57E-04	34.0	189	7.60
TW No.03	9.22	48.8	46.48	25.91	26.97 45.26	6.50E-04	50.3	204	7.60
TW No.04	8.36	48.8	46.48	25.91	26.97 45.26	4.85E-04	36.3	472	7.60
TW No.05	8.05	48.8	46.48	25.91	26.97 45.26	6.44E-04	49.8	149	7.60
TW No.06	7.70	48.8	46.48	25.91	26.97 45.26	5.71E-04	43.5	154	7.60
TW No.07	7.92	48.8	46.48	25.91	26.97 45.26	5.40E-04	41.0	149	7.60
TW No.08	8.10	48.8	46.48	25.91	26.97 45.26	6.31E-04	48.8	158	7.60
TW No.09	7.01	48.8	46.48	25.91	26.97 45.26	5.80E-04	44.4	151	7.60
TW No.10	6.40	48.8	46.48	25.91	26.97 45.26	5.09E-04	38.4	155	7.60
TW No.11	6.78	48.8	46.48	25.91	26.97 45.26	6.13E-04	47.2	163	7.60
TW No.12	6.10	48.8	46.48	25.91	26.97 45.26	6.24E-04	48.1	222	7.60

Sc: Specific Capacity

SOURCE: JICA Mission Team（Compiled from the data of respective lithological columnar shown in the document of CONSTRUCTION OF 12 NO WATER SUPPLY TUBEWELLS ALONG RAKH BRANCH CANAL, FAISALABAD, WASA-F, October 2008）

As it is shown in **Table AB2.1.9**, static water level is in the range of 6 ~ 10m, the coefficient of permeability is in between 4.5 ~ 6.5 E-4 m/sec and average 5.7 E-4 m/sec, TDS is lower than 500ppm in every tubewells, and pH is uniformly 7.6 been weak alkaline. Representative lithological column of tubewells is as the **Figure AB2.1.9**.

DEPTH IN FEET	GRAPHIC LOG	THICKNESS (FEET) FROM	TO)	FORMATION DESCRIPTION
		0	10	V. FINE SAND + KANKERS
20		10	30	V. FINE TO FINE SAND
40				FINE TO V. FINE SAND
60		30	07	
80		70	80	FINE TO V. FINE + KANKERS
100		80	100	FINE SAND + KANKERS
120		100	120	FINE TO MEDIUM SAND + KANKERS
140				FINE SAND + KANKERS BETWEEN 120-130
160		120	160	

SOURCE: CONSTRUCTION OF 12 NO WATER SUPPLY TUBEWELLS ALONG RAKH BRANCH CANAL, FAISALABAD, WASA-F, October 2008

Figure AB2.1.9 Representative Lithological Column of Tubewells constructed in 2008

Before construction of tubewells, geophysical survey (resistivity prospection) was conducted to check the boundary depth of freshwater deriving from the seepage of RBC and brackish groundwater existing naturally in deep portion (by WAPDA).[7]

Criterion of that is as follows.

1. Resistivity 0-30Ωm:Low Resistivity Zone ; clay/silt or alternate layers of clay & sand with saline water (expected EC above 1,500 μS/cm)
2. Resistivity 31-100Ωm: Medium Resistivity Zone ; alternate layers of clay and sand with fresh water (expected EC below 1,500 μS/cm)
3. Resistivity Above 100Ωm: High Resistivity Zone ; Dry strata above water table

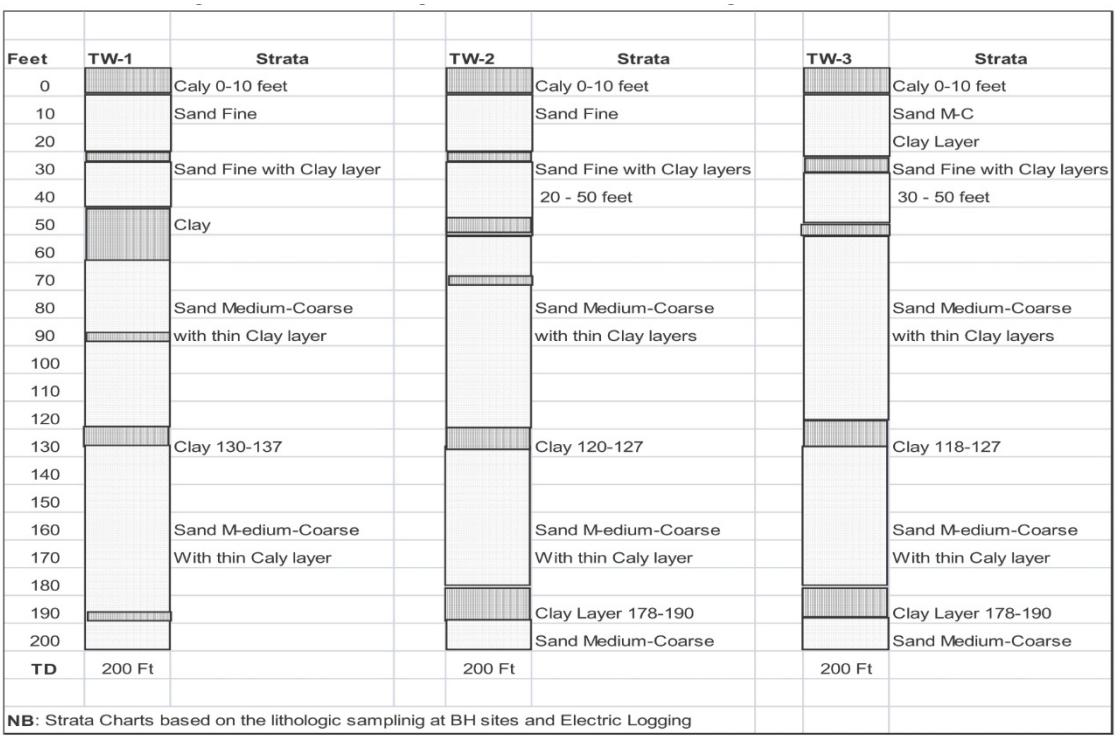
As a result of the survey, the boundary depth of the resistivity 30Ωm along RBC is around 60m. According to that, dimensions of all tubewells constructed in 2008 were decided uniformly as drilling depth 50m, the casing depth 46.5m, drilling diameter 22 inches (559 mm), the diameter of housing pipe 12 inches (305mm) with length 20m, and the diameters of screen and blind pipes 8 inches (203mm).

[7] Electrical Resistivity Studies For Ground Water Investigations From City School Bridge To Gatwala Bridge Along Rakh Branch Canal Faisalabad By Muhammad Ismail, Akbar Habibi: Hydrogeology Directorate, Wapda, Lahore. July, 2008

Static water level of each tubewells, drilling depth, screen installation depth, the coefficient of permeability, specific capacity, and TDS are as shown in the **Table AB2.1.9**.

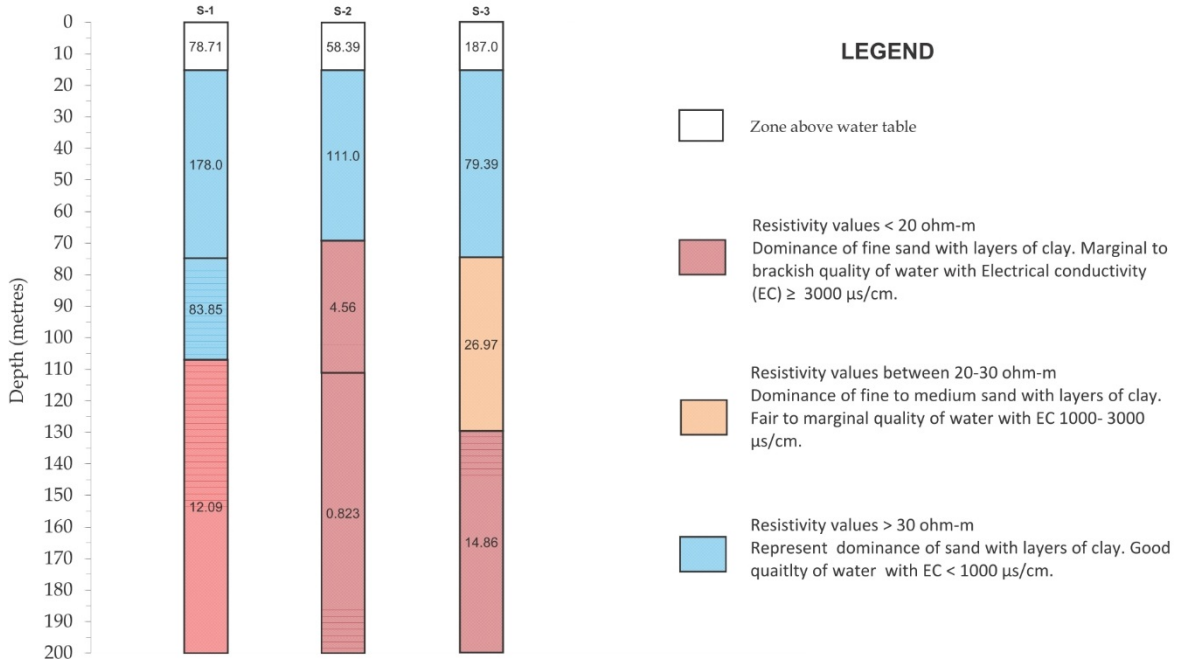
Furthermore, 10 tubewells have been constructed in 2016 in the upstream side of RBC by French loan support project being undertaken from 2008. These started operation on 20 February 2016, and conduit about distance 12 km to Jhal Khanuana Water Treatment Plant.

The condition of lithology and resistivity in the area of RBC are as shown in the **Figure AB2.1.10** from the data at the time of test drilling supported by France.



SOURCE: Project: Extension of Water Resources for Faisalabad City Phase I: Phase 2: Surveying and Measuring Operational Tubewells Results, WASA-F, September 2014

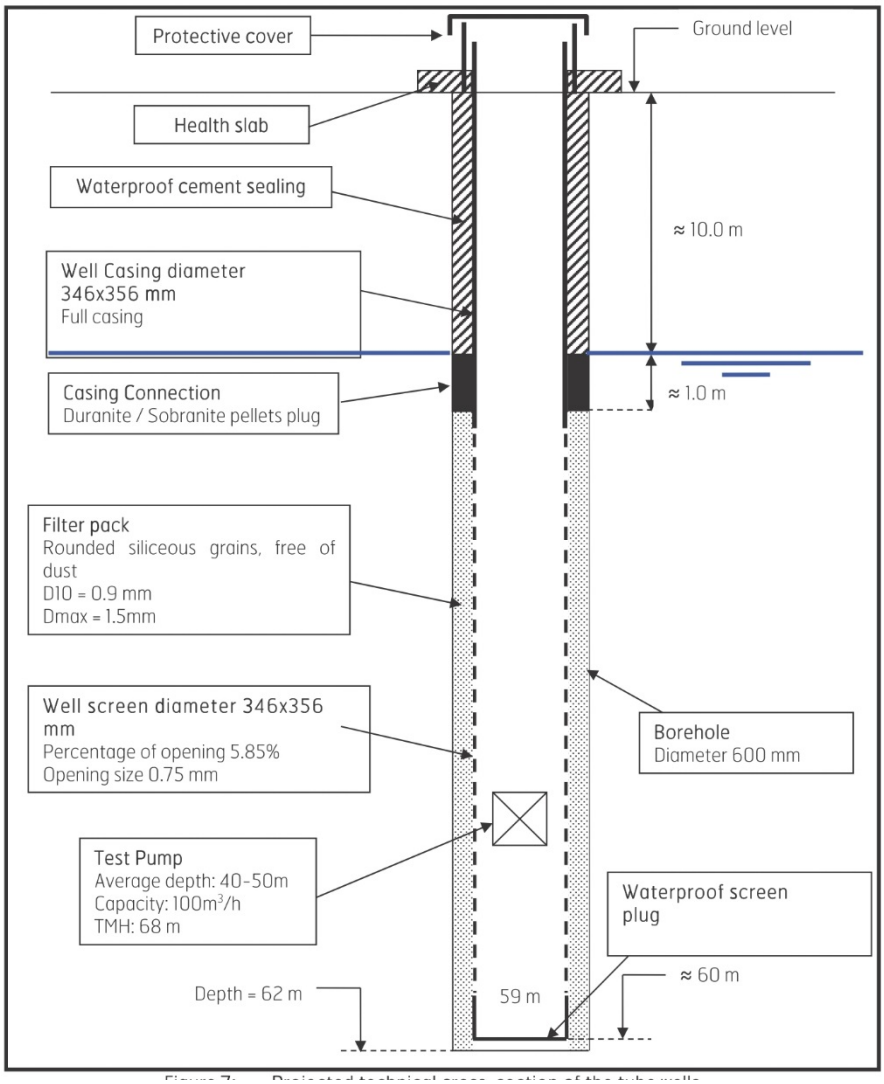
Figure AB2.1.10 Representative Lithological Columns along RBC in AFD Support Project Area (Test Drilling Result in 2014)



SOURCE: Project: Extension of Water Resources for Faisalabad City Phase I: Phase 2: Surveying and Measuring Operational Tubewells Results, WASA-F, September 2014

Figure AB2.1.11 Resistivity Condition at the point of Test Drilling in AFD Support Project Area in 2014

Tubewell structure is as shown in the **Figure AB2.1.12**.



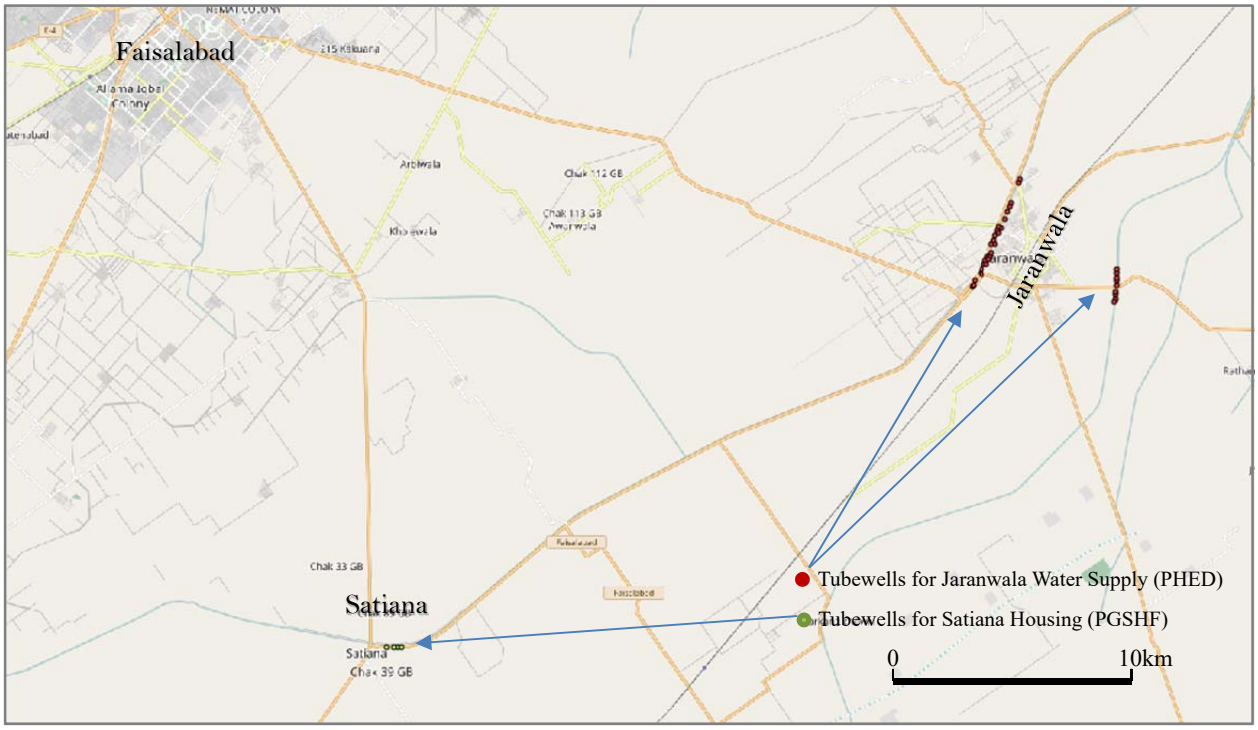
SOURCE: Project: Extension of Water Resources for Faisalabad City Phase I: Phase 2: Surveying and Measuring Operational Tubewells Results, WASA-F, September 2014

Figure AB2.1.12 Tubewell structure of AFD Support Project

Design discharge of one tubewells is 100 m^3/hour and running 8 hours a day, then total of tentubewells become 8,000 m^3/day. Working hours are 4 hours from 7:30 a.m. to 11:30 a.m. and 4hours from 1:30 p.m. to 5:30 pm in the afternoon.

However, as mentioned above, WASA-F sets the target discharge to 23,000 m^3/day for the target of 24-hour water supply.

(4) Tubewells along GBC



SOURCE: JICA Mission Team

Figure AB2.1.13 Location of tubewells along GBC (partly those along Burara Branch Canal)

Pink circles shown in the **Figure AB2.1.13** are the tubewells constructed by PHED and managed by TMA of Jaranwala.

Tubewells for water supply to Jaranwala town center exist not only along GBC but also along Burara Branch Canal which is flowing in the east side of GBC. Those are in total of 29 tubewells along GBC (18 in the left bank side, and 11in the right bankside), and 9 along Burara Branch Canal.

The spacing of respective tubewells is basically 500 Feet (about 150m).

Design discharge is 0.75 Cusec (about 75 m^3/hour), then they have the discharge capacity 2,175 m^3/hour from 29 tubewells along the GBC (total 2,850 m^3/hour if including those along Burara Branch Canal).

But, it depends on TMA how working which tubewells and running how many hours per day. They say it is out of control of PHED.

According to the Punjab Design Criteria[8], for the case of the population 160,000, water consumption is 50 gallon (227 L) per capita per day. As a result, water supply to Jaranwala town center is required about 36,400 m^3/day. In order to satisfy the criteria, it needs to run a little bit less than 13 hours a day in a condition of all tubewells operation. In that condition, discharge from one tubewell is 975 m^3/day in average.

In the design at the time of construction in 2004, since the annual population growth rate is 3.31% for the population of 128,208at that time in Jaranwala town center then, targeting 170,645 people ten years later

[8] Technical and Service Delivery Standards for Water Supply and Sanitation Sectors: April 2008, Punjab Devolved Social Services Programme ;Govt. of the Punjab, 79-Bridge Colony, Lahore

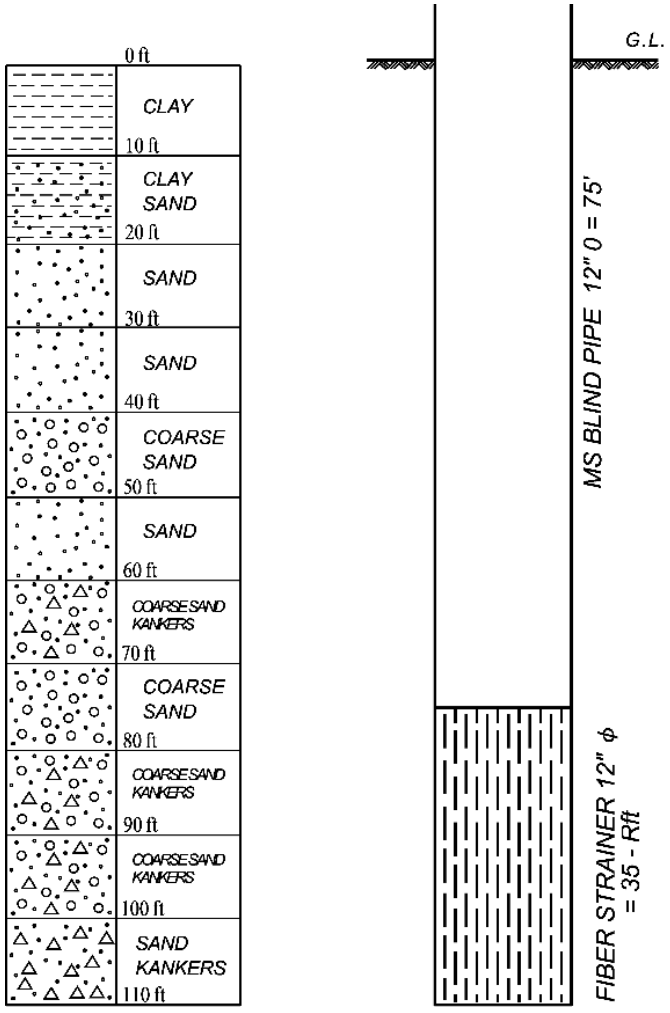
(2014), it aimed 38,600 m^3/day water supply in average. Maximum daily water demand was set a 50% raise of the average and reducing the existent water sources, running hours per day was set 16 hours in design.

However, according to the interview to TMA Jaranwala, current situation is only 4.5 hours working a day due to the piped water coverage ratio and the budget for electric fees. The piped water coverage ratio in the Jaranwala town center is said to be only 30%.

Specification of tubewells is uniform in every point as follows. The drilling depth is 110 Feet (33.5m). The lengths of housing pipe and screen & blind casing are 75 Feet (22.8m) and 35 Feet (10.7m) respectively. The drilling diameter is 22 inches (559mm), and diameter of casing pipes is 12 inches (306 mm).

Water qualities from those tubewells satisfy the drinking water standards.

Figure AB2.1.14 shows the representative lithological column and tubewellstructure constructed by PHED.



SOURCE: Data of PHED

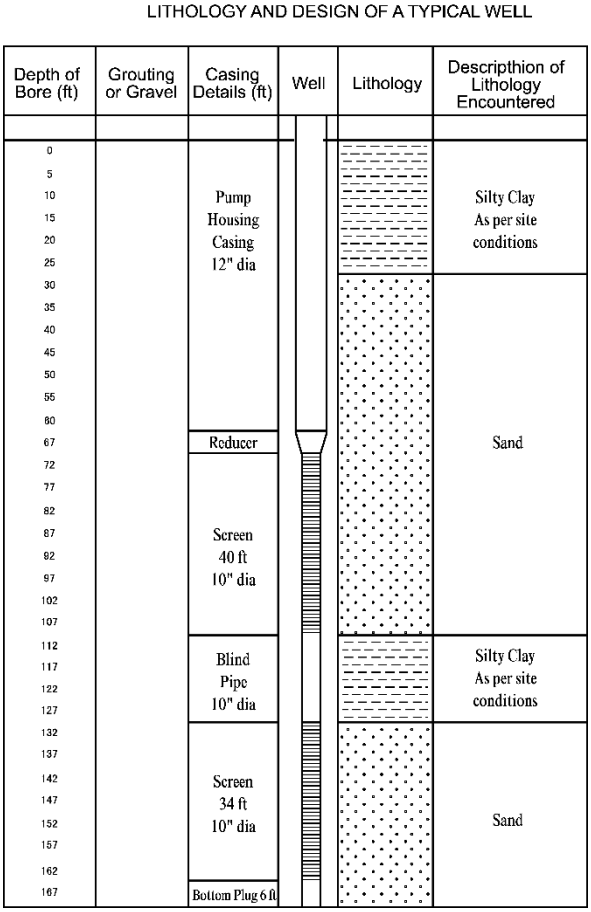
Figure AB2.1.14 Representative Lithological Column and Structure of Tubewells constructed by PHED along GBC for water supply to Jaranwala

As it is shown in the **Figure AB2.1.13**, there are some other tubewells existing along the GBC except the tubewells constructed by PHED. Among them 4 tubewells at Satiana indicated by the red circles belong to PGSHF (Punjab Government Servants Housing Foundation). They are used to supply water to the

housing for provincial staffs under construction along Faisalabad-Satiana Road.

These tubewells were constructed by WASA-F, and handed over to PGSHF.

Lithology and design of a typical well is shown in the following **Figure AB2.1.15**.



SOURCE: Punjab Government Servants Housing Scheme at Satiana Road, Faisalabad, Tubewells and Force Main Design Calculations, PGSHF Faisalabad, March 2008[9]

Figure AB2.1.15 Lithology and design of a typical well of PGSHF at Satiana along GBC

They say there are also tubewells for supplying water to small villages in the vicinity constructed by the PHED. In that case, CBO (Community Board Organization) manages their operation, and its design discharge of each tubewells is 0.5 Cusec.

Groundwater salinity along GBC is that only around the area near Satiana is found EC being less than 1,500 μS/cm, in other areas is a brackish unsuitable to supply as drinking water. However, the seepage water from GBC is fresh showing TDS being 200 ppm or less as shown in the water quality test results for Jaranwala water supply. Although the data is not obtained yet regarding the boundary depth of freshwater and brackish water along GBC, it seems to be the same as RBC, then inferred to be around 60 m.

Therefore, the potential quantity for development of drinking water from the area along GBC is determined by seepage amount from GBC as resource.

Discharging more than the amount of the resource causes deterioration of water quality by drawing

[9] Punjab Government Servants Housing Scheme at Satiana Road, Faisalabad, Tubewells and Force Main Design Calculations, PGSHF Faisalabad, March 2008

brackish groundwater existing in the deeper and the surroundings. Eventually, it may become impossible to use it as drinking water.

The simulation of the seepage amount from GBC has been published in INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY in 2009 as "Simulating Seepage from Branch Canal under Crop, Land and Water Relationships" by MUHAMMAD ARSHAD, NIAZ AHMAD1 AND M. USMAN, Department of Irrigation and Drainage & Water Management Research Centre, University of Agriculture Faisalabad.[10]

According to this simulation, recharge-flowrate relationship is that seepage (S) in $m^3/s/million\text{-}m^2$ and the flow rate (Q) in m^3/s through the canal was developed as presented in the following equation:

$S = 0.006 \times Q^{1.446}$

1 million-m^2 is 1 km^2.

According to the longitudinal section of GBC of Irrigation Department Punjab, the flow rate (Q) of GBC in the section is about 1,900 Cusec (55.3 m^3/sec).
If substituting this value in the above equation;

S = 1.97 $m^3/sec/km^2$ (170,300 $m^3/day/km^2$).

The bottom width of GBC as seepage section in the area is about 30m.

As a result, the seepage per 1 km distance of the canal is a little larger than 5,000 $m^3/day/km$ from the above obtained formula.

Based on the above, we will try to consider the suitability of tubewells constructed by PHED for water supply to Jaranwala.

Design discharge per one tubewells is 0.75 Cusec (76 $m^3/hour$). The spacing of tubewells is 150 m, so that 6.7 tubewells are present in 1 km.

Therefore, the discharge is 507 $m^3/hour/km$.

If the running is 10 hours, it will be balanced between the seepage from the canal and the discharge from tubewells.

In the case of Satiana, 4 tubewells are set by the spacing 150 m.

Total distance is 0.6 km. For this reason, the seepage is 3,000 m^3/day.

Design discharge of Satiana is in total 3.18 Cusec (324 $m^3/hour$) from 4tubewellss. If the running is 9.5 hours per day, it will be balanced between the seepage from the canal and the discharge fromtubewellss.

In case new tubewells are considered along GBC, it cannot be expected more than now in the surrounding Jaranwala and Satiana due to the existing already densely.

Considering the other area that is not so densely constructed, it still has the possibility.

In that case, design discharge must be set within 5,000 $m^3/day/km$ together with irrigation wells and the

[10] INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY "Simulating Seepage from Branch Canal under Crop, Land and Water Relationships" MUHAMMAD ARSHAD, NIAZ AHMAD1 AND M. USMAN: Department of Irrigation and Drainage, and Water Management Research Centre, University of Agriculture Faisalabad, 2009

other existing wells.

(5) Consideration of Groundwater Usage in Faisalabad City Area

Obtaining the SRTM (Shuttle Radar Topography Mission) satellite image released by the National Aeronautics and Space Administration (NASA) USA on the Website which has altitude data, we have tried to decipher the terrain in the range from Chenab River by way of Faisalabad City to Ravi River.

As the area is generally flat and poor relieved, clear contour lines did not appear in available SRTM satellite images. However, connecting the central part by one contour line in a region where a certain range shows a similar height, the contour map of the entire outline is written as shown in **Figure AB2.1.16**.

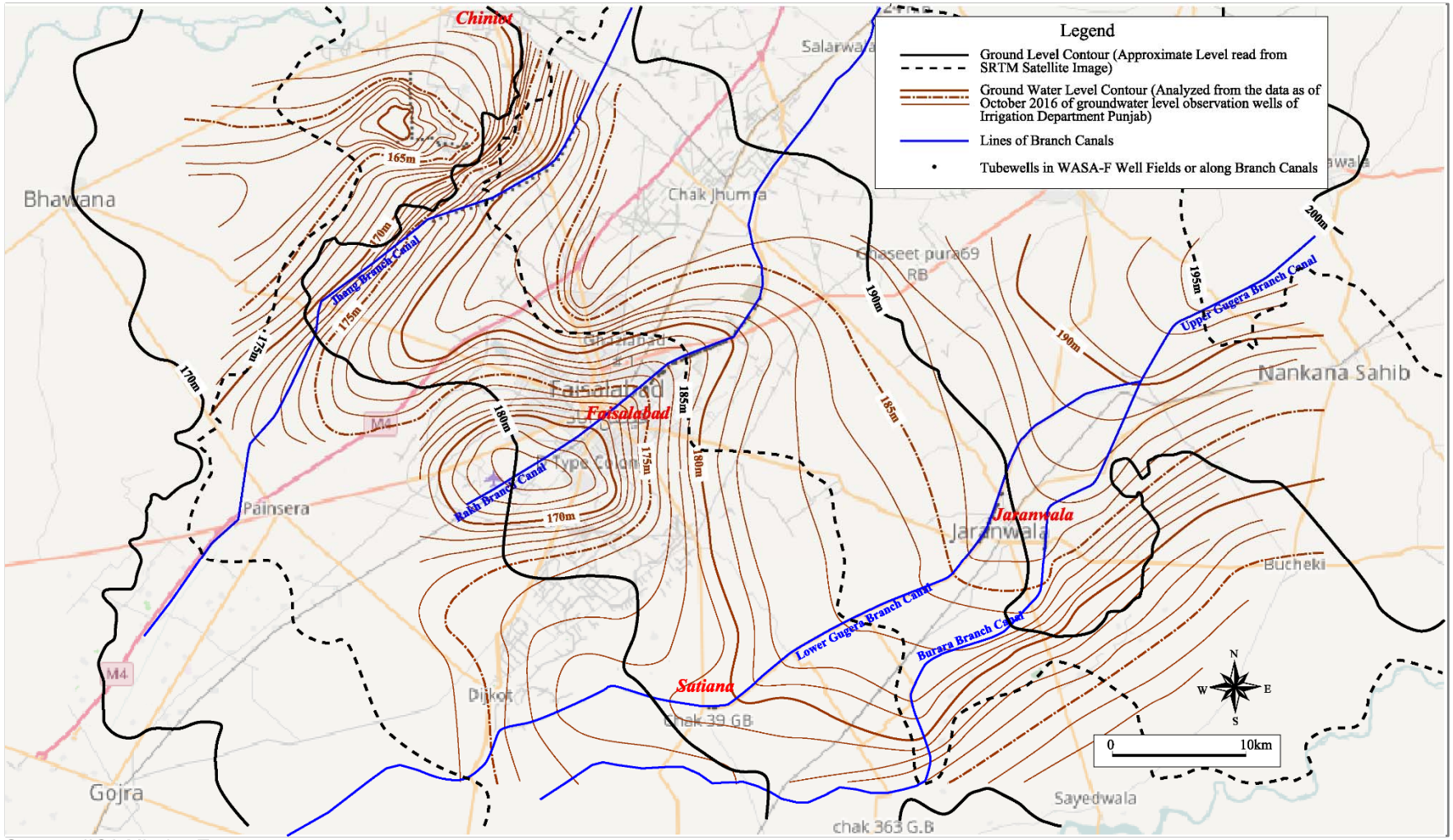
In addition, the Punjab Provincial Irrigation Department has arranged many observation wells around the area, and measures groundwater level twice a year. Selecting the data of October 2016 among of them, and combining the groundwater fluctuation data of Chenab (Chiniot) and JBC Well Fields, we attempted to create a groundwater level contour map in the area. The results are also shown in the **Figure AB2.1.16**.

As shown in the figure, except for the area of Chenab (Chiot) Well Field and the surrounding area of Faisalabad city, the Groundwater Level Contour basically slopes from northeast to southwest so as to match the Ground Level Contour (inclination, 1/200 to 1/300). Because there are terrace cliff sloping gently in the direction of Chenab River and Ravi River side, the groundwater level contour in these area is also inclined toward the river side matching with Ground Level Contours.

River side from the terrace cliff are an old river flood plain. Groundwater in these floodplains are usually freshwater, whereas groundwater inside the terrace terrains, where Faisalabad city situating in it, is brackish water. In the old floodplain on the side of the Chenab River, there are places where the groundwater level forms hollow as conical shape. This is due to the discharging groundwater at Chenab (Chiniot) Well Field of WASA-F. It can be read from this Figure to form the bottom of the conical shape slightly downstream from the area actually discharging.

Also noteworthy is that in the Faisalabad city area shows groundwater level contours forming hollow like cone that is bigger than the case around Chenab (Chiniot) Well Field. This depression begins around the area existing tubewells along RBC and forms the bottom of conical shape on the southwest side of Faisalabad city.

Based on the idea that Ground Level Contours and Groundwater Level Contours show similar trends in case not discharging groundwater from that area, and to judge how tubewells along RBC influences the decline in groundwater level, the same shape of ground level contour nearest to the site has been setting as overlapping to some groundwater level contour and will be compared to the groundwater level. If that contour shape is set to the 180 m contour line of groundwater level contour and considering this line being the 180 m of the original groundwater level, the difference of both elevations is considered to be the result of depression. At the intersecting point of this line and RBC line, its difference shows 2.5 to 3m, then it can be considered the discharge from tubewells along RBC causes the groundwater level depression 2.5 to 3 m. In addition, the fact that the groundwater level around Faisalabad city shows also conical shape means that a large amount of groundwater is also discharged from the area of Faisalabad city.



Source: JICA Mission Team

Figure AB2.1.16 Groundwater Level Contours and Ground Level Contours in the area from Chenab River by way of Faisalabad City to Ravi River

From the interview regarding the water usage in private homes in Faisalabad city, it is understood that it is common they use both WASA-F supplying water and groundwater discharged from the well inside the private house. In the actual interview, the usage of water per household consisting 6 to 7 persons is 1 tank of 30 liters in winter and 2 tanks in summer per day from the tap supplied from WASA-F (see the photo below). While the groundwater is stored in a tank sized a radius of 4 ft (1.2 m) × a height of 6 ft (1.8 m) (see also the photo below), that is, about 2 m^3 (2,000 L) and used. It was not confirmed how much volume was used in a day. WASA-F's water is usually used for beverages and meals, and groundwater is for showering, cleaning and car washing because it is brackish.

Tank for storing WASA-F water

Tank for storing discharged water from Well

Figure AB2.1.17 Typical Water Storage Methods

They say the depth of each groundwater discharging well is about 30 m. They also say there were many places where the groundwater was also fresh water in the past, but recently it becomes brackish. At the place where groundwater is still fresh, they use it also for the vegetable garden inside the house. It is also considered that there are many industries in Faisalabad city area discharging a lot of groundwater. It is thought that the bottom of the conical-shaped groundwater level contours situating on the downstream side (southwest side) of the central city area of Faisalabad is the same situation as the case of Chenab (Chiniot) Well Field.

According to the result of customer survey in the WASA-F service area carried out in this study, the usage ratio of WASA-F water and groundwater discharge in each household is about 1: 3.

The actual water supply volume of WASA-F is 200,000 m^3/day from Chenab and JBC Well Fields, about 7,000 m^3/day from tubewells along RBC and about 50,000 m^3/day from surface water treatment plant, then total about 257,000 m^3/day. Assuming that the leakage is around 10%, total water supply to every households from WASA-F is around 230,000 m^3/day. If the discharge from private well is three times of WASA-F water, it becomes 690,000 m^3/day. Finally, total groundwater discharge in the area of Faisalabad city is 690,000 m^3/day + the discharge of Industrial/Commercial well.

AB2.2 Management of Groundwater

In considering the management of groundwater, first mentions the authorizing system when developing and using groundwater.

It was once regulated in the law "THE PUNJAB SOIL RECLAMATION ACT, 1952 (Punjab Act XXI of 1952)". By this Act, the board of directors for regulation were composed of the Chairman and Secretaries to Government [of the Punjab] in the Departments of Finance, Irrigation, Agriculture, Co-operation, Basic Democracies, and Pursuant to Local Government, the Chairman of WAPDA, and the Chairman of the Agricultural Department. Those who intend to set up tubewells have been obligated to notify and register to the board of directors and must obtain a license. In addition, in the event that some influence happened by the establishment of tubewells, the board is authorized to make them compensate for the influence, and to stop the use of tubewells. The regulation how to use groundwater by discharging from tubewells would be determined under the control of the board of directors at the time of notification of the installation plan. Regarding the tubewells for domestic and livestock uses, it is usually not dominated by such rules, but there is some possibilities to be subject to such rules depending upon time and occasion.

In 1976, "THE PUNJAB DEVELOPMENT OF CITIES ACT, 1976 (Punjab Act XIX of 1976)" was in effect. Under this law, the Development Authority of each city has a strong right regarding the groundwater resources in the area. None of all should construct tubewells for commercial purpose without the authority of the board of directors, and if it was permitted, they must be charged for groundwater uses. According to this law, the billing system for groundwater use is as follows according to the revised fee of 2016. However, there is no accounting system for domestic wells. Those are only for industrial/commercial uses.

Table AB2.2.1 Aquifer Charges (Fees on tubewells)

S.No	Units/Factories etc. (per Cusec/per Month)	Propose Rate (per Cusec)
i	Industrial Units which are getting water through tubewells (Rate will be charged according to the discharge size of the tubewells/pumps motors etc.	PKR 19,320
ii	Textile Processing and Hosiery units getting water through tubewells/pumps motors etc.	PKR 13,000
iii	Government, Semi-Government, Corporations, irrigation Departments Semi/Independent Organizations, local Body if Units which are getting water through tubuwell (Rate will be charged according to the discharge size of the tubewells/pumps motors	PKR 13,000

Note:

(i) Only those tubewells will be considered standby which are sealed by WASA and be connected with the single delivery system according to the approved. Paying discharges size, if any unit wants to use standby turbine after breaking the seal. That unit must inform WASA within 24 hours, otherwise it will be penalized.

(ii) Aquifer charges are applicable on Pumpstubewells of on 2" and above capacity,

In addition, for the illegal installation of Tubewell etc., the following provisions are established.

REGULARIZATION OF UN-AUTHORIZED ILLEGAL WATER SUPPLY CONNECTION AND INSTALLATION OF COMMERCIAL INDUSTRIAL TUBEWELLS AQUIFER CHARGES FOR COMMERCIAL PURPOSES (Regularization fees)

a. Commercial Equal to 6-month charge.
b. Industrial Equal to 6-month charge.

Note:-

i. No user is authorized to install water pump/motor on with WASA water supply network.
ii. In case a regular consumer is detected committing any irregularity, the regularization fees shall be charged equal to 6-month charges.

Furthermore, "PUNJAB PRIVATE HOUSING SCHEMES AND LAND SUBDIVISION RULES 2010" decide that in the case of planning to install tubewells in Housing Schemes, and/or Farm Housing Scheme,

etc., and in case WASA or other agencies request, it is supposed to inform those agencies the details such as quantity, capacity, design, connection/distribution method, drilling record and installation machinery, etc.

Next, describes about the discharging condition of groundwater, the monitoring system of water quality, the discharging regulation, etc.

The Well Fields of WASA-F are three such as Chenab (Chiniot), JBC and RBC. Records of pumping volume, pumping time and electricity usage in each Well Field are as follows.

· JBC Well Field: It is recorded by the operator on the Log Books every day from January 1, 2013. Further, it is also managed by the SCADA system since January 2016, and is recorded daily as Inlet and Outlet of TR from JBC Well Field Reservoir.

· Chenab (Chiniot) Well Field: We have not confirmed the operation records of individual wells such as Log Books. In the SCADA system, it is recorded daily from January 2016 as Inlet and Outlet of TR from Well Field.

· Tubewells along RBC: Log Book is recorded only on the operating hours since March 1 2017. There are some old records from February 2011 to May 2015 (basically only record of working hours).

For JBC Well Field, groundwater level monitoring is conducted on a regular basis every month, and new monitoring system may start from 2017.

Chenab (Chiniot) Well Field was also regularly carried out every month from the time immediately after construction to June 2007, but after this time due to changing the rising pipe into the flange type in 2007, it has been impossible to measure groundwater level directly in tubewells because there is no space to put water level gauge into them. New piezometers/observation wells have been installed in 2016 at Inline Tubewells No. 2, 3, 8, 9, 13, 14, 22, 23 and further piezometers are planned to be installed at Tubewells No. 1, 6, 10, 15, 16, 20, 22, 24, 25, 28, 29 for resuming groundwater monitoring.

In the tubewells along RBC, there is no measurement of the groundwater level.

Regarding the details on the historical fluctuation of groundwater level in Chenab (Chiniot) and JBC Well Fields, those are as described in the **previous section**. By checking whether the water level is stable or decreasing trends confirming through the record of the groundwater level monitoring in a certain area, it is possible to determine whether the groundwater usage in the area is proper or excessive.

When thinking about management of groundwater use in some special area, it is an important index in considering whether to develop further groundwater or to prioritize conservation by regulating discharge in that area from those data. In addition to the record of the groundwater level monitoring in the WASA-F Well Fields mentioned above, there are many observation wells in this area to monitor the groundwater level arranged by Punjab Irrigation Department which play an important role in irrigation system when using groundwater. We have got these data and grasped the tendency of groundwater level fluctuation in each area.

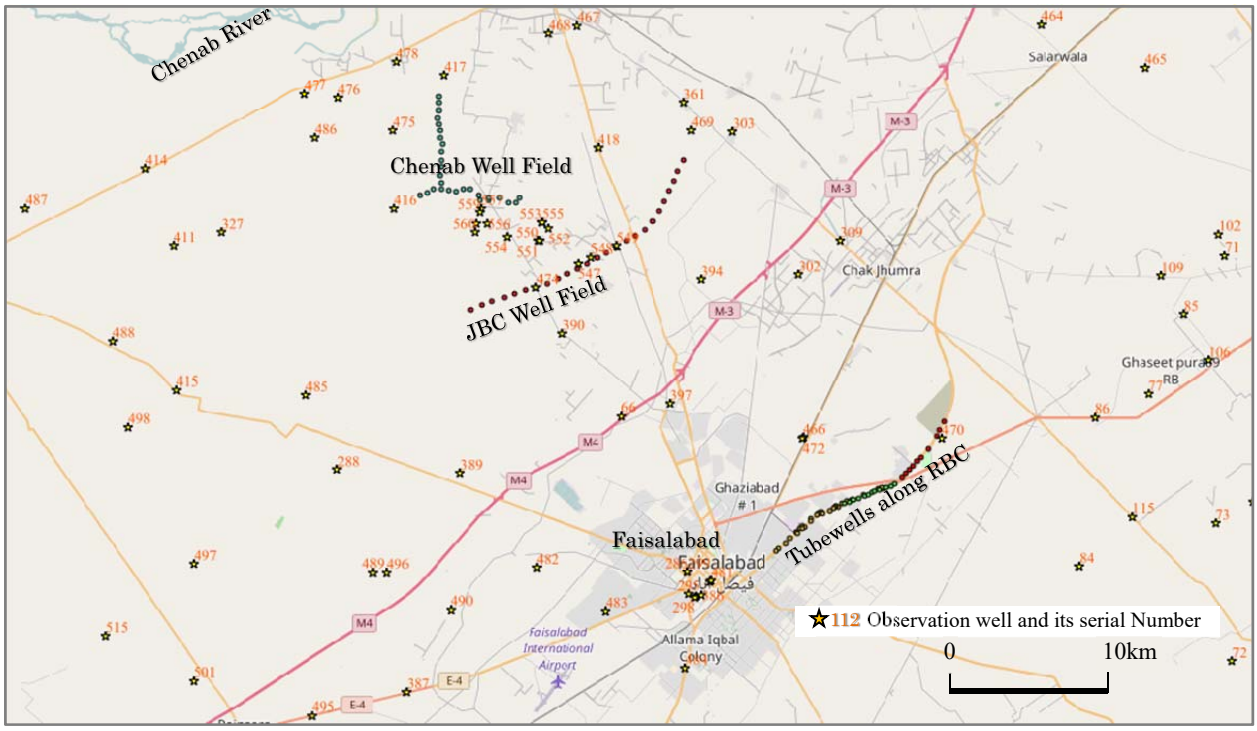
Monitoring of observation wells has been carried out twice a year (Pre-Monsoon: June, and Post-Monsoon; October) regarding the groundwater level fluctuation and 3 items of water quality (EC: Electric Conductivity, SAR: Sodium Absorption Ratio, and RSC: Residual Sodium Carbonate).

In this study, we can collect those data during 13 years from 2003 to 2015.

The graphs describing the fluctuation of groundwater level has been made by selecting the data between

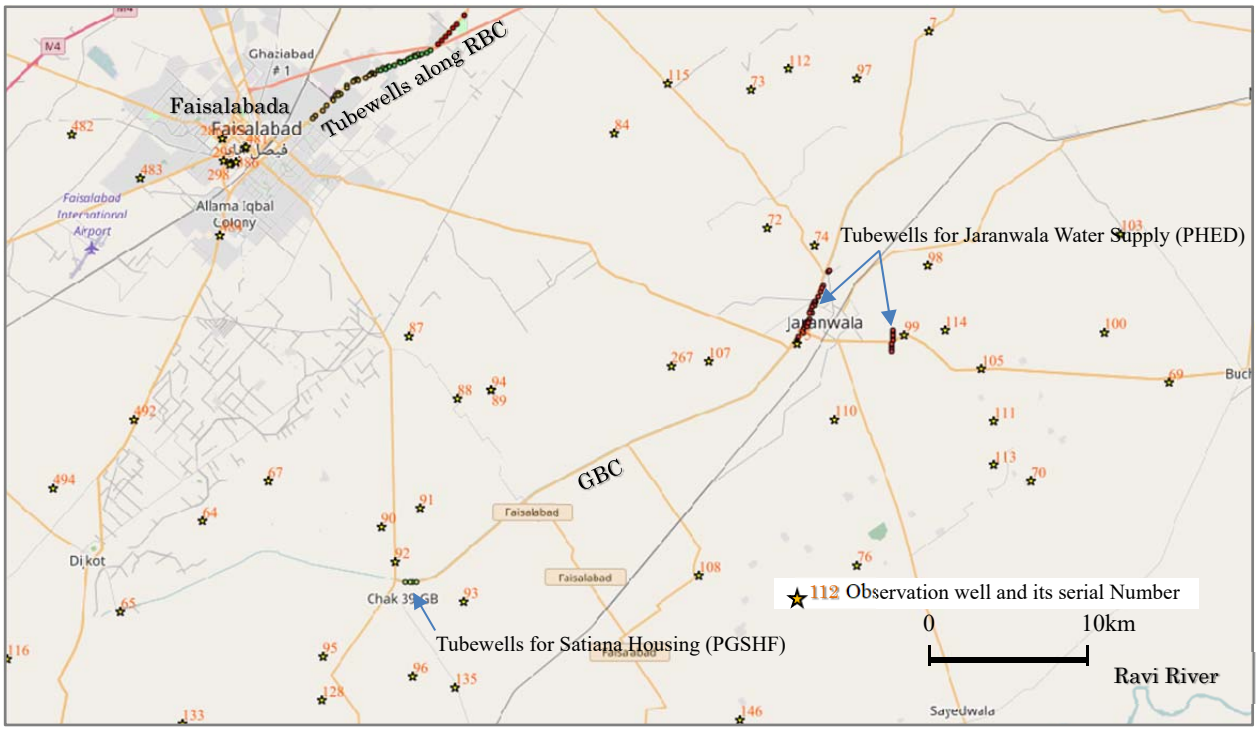
Well Fields (Chenab, JBC, and RBC) which are supplying water to Faisalabad, and between Faisalabad and GBC taking into account the groundwater development potential.

The location of tubewells in Chenab (Chiniot) and JBC Well Fields, tubewells along RBC and GBC, and observation wells of Irrigation Department distributed in the area between Chenab River, Faisalabad, and GBC are shown in the **Figure AB2.2.1** and **AB2.2.2**. Tubewells for water supply are indicated by round circles with various color. Observation wells are indicated by red star marks with the Serial Number.



SOURCE: JICA Mission Team

FIGURE AB2.2.1 Location of Observation wells with Serial Number of Irrigation Department between Chenab River and Faisalabad together with Well Fields for supplying water to Faisalabad



SOURCE: JICA Mission Team

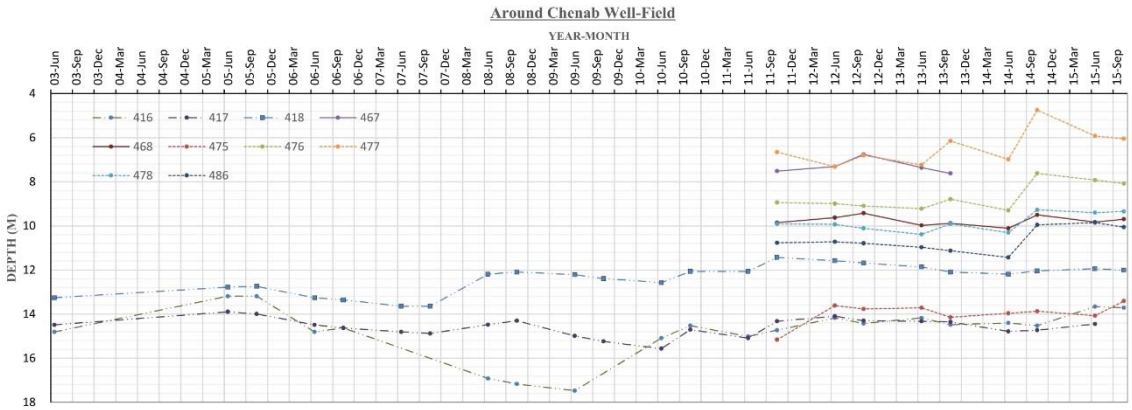
Figure AB2.2.2 Location of Observation wells with Serial Number of Irrigation Department between Faisalabad and GBC

Figure AB2.2.3 shows the fluctuation of groundwater level around the Chenab Well Field.

At the point 1 to 2 km away from Chenab Well Field (Sr.No.416 and 417), though groundwater level tended to decline from 2006 to 2009, it recovered thereafter and became stable. But, the water level situates deep position of around 14 meters.

Sr. No.418 is located several kilometers away from Chenab Well Field. However, its groundwater level is situated in deep position probably because of the influence of Chenab Well Field. Although there is a slight declining trend for a while, it shows overall upward trend after 2003.

Other observation wells have been installed after 2011 and there are some ups and downs for each season, but the water level is stable or some are showing a tendency to rise.



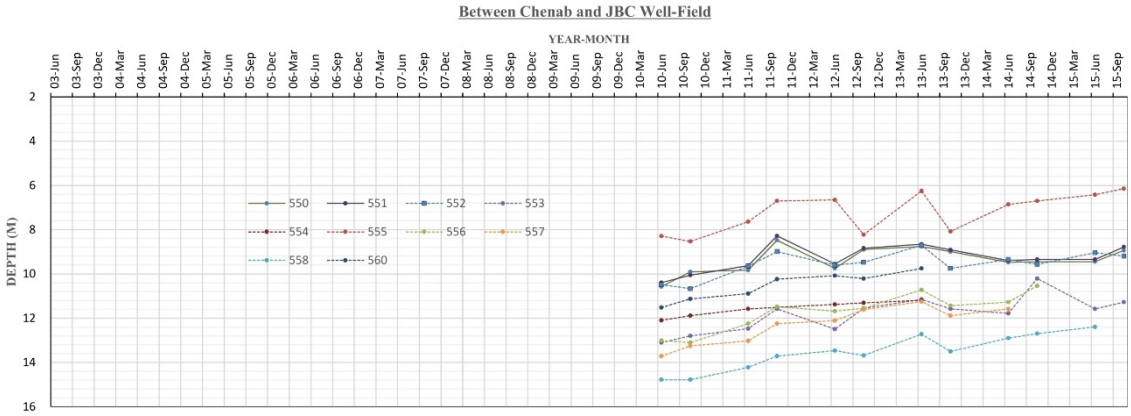
SOURCE: JICA Mission Team

Figure AB2.2.3 Fluctuation of Groundwater Level around Chenab Well Field

Figure AB2.2.4 shows the fluctuation of groundwater level between Chenab and JBC Well Fields. In this area, only data after 2010 has been obtained.

Except for seasonal up-down, the groundwater level shows an overall upward trend. However, only two points closest to JBC (Sr.No.550 and 551, a little more than 2 km away from JBC Well Field, 2.5 km away from Chenab Well Field) shows a downward trend since 2013. From this time, discharging from JBC Well Field may be in full working. Therefore, there is a possibility that it may be influenced. From these cases, it is estimated that the influence radius of the JBC Well Field is 2 km or more.

The other wells are positioned closer to the Chenab Well Field. However, they shows an upward trend. For this reason, it is considered that they have not been influenced by Chenab Well Field since 2010.



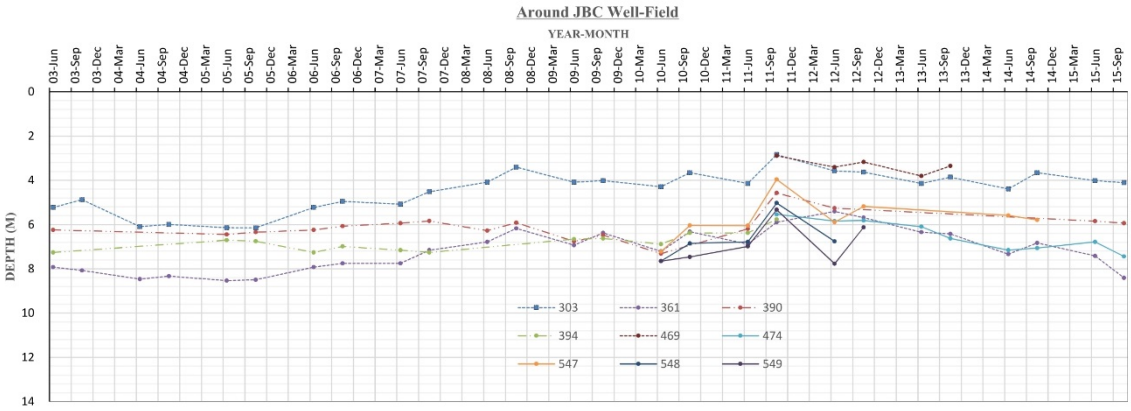
SOURCE: JICA Mission Team

Figure AB2.2.4 Fluctuation of Groundwater Level between Chenab and JBC Well Fields

Figure AB2.2.5 shows the fluctuation of groundwater level along JBC Well Field (solid line), around the upstream side of JBC Well Field (dotted line), and from JBC to Faisalabad side (two-dot chain line).

Although the groundwater level is stable or rising till 2011, it shows a downward trend since 2011 when the JBC Well Field was constructed.

Sr. No 390 is 2.7 km away from JBC tubewells which shows a declining trend after 2011. It seems that the influence of JBC tubewells extends to this distance.

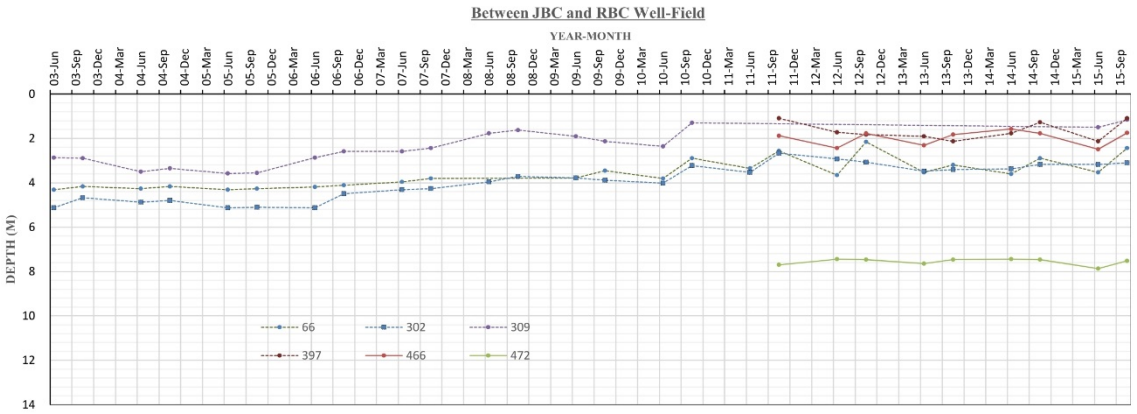


SOURCE: JICA Mission Team

Figure AB2.2.5 Fluctuation of Groundwater Level along JBC Well Field, around Upstream Side of JBC Well Field, and from JBC to Faisalabad Side

Figure AB2.2.6 shows the fluctuation of groundwater from the area more than 7 km away from JBC to RBC.

It shows a slight upward trend until around 2010, and after that it has stabilized.

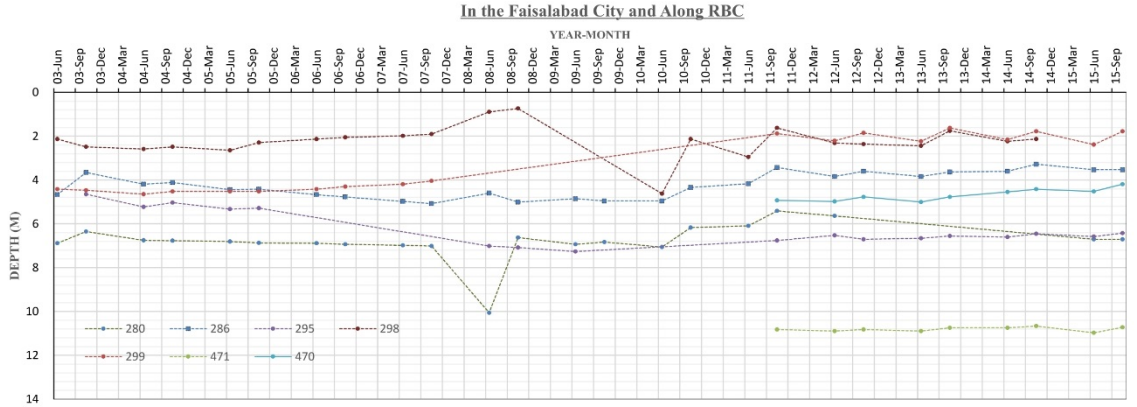


SOURCE: JICA Mission Team

Figure AB2.2.6 Fluctuation of Groundwater Level from the Area more than 7 km away from JBC to RBC

Figure AB2.2.7 shows the fluctuation of groundwater level in Faisalabad city and the area upstream side of RBC tubewells (Sr. No.470; solid line) before the construction of AFD well. Overall water level is stable or slightly rising.

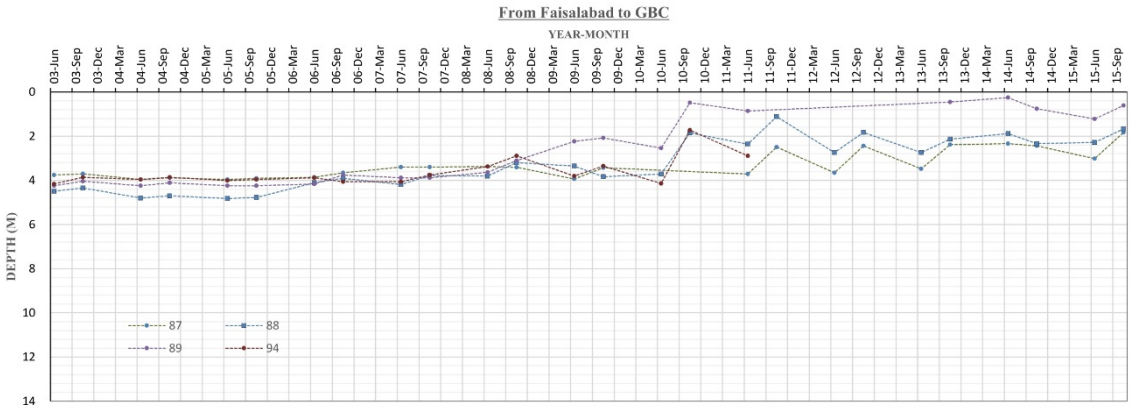
Only Sr. No.280 shows a downward trend since October 2011. There is a possibility that a new well was constructed in the vicinity.



SOURCE: JICA Mission Team

Figure AB2.2.7 Fluctuation of Groundwater Level in Faisalabad City and Upstream side of RBC tubewells

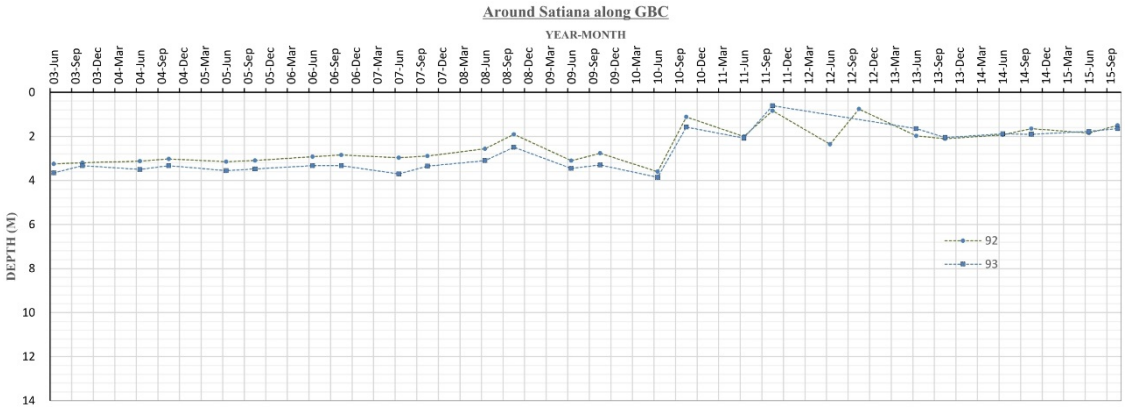
Figure AB2.2.8 shows the fluctuation of groundwater level between Faisalabad and GBC.
It shows an upward trend overall.



SOURCE: JICA Mission Team

Figure AB2.2.8 Fluctuation of Groundwater Level between Faisalabad and GBC

Figure AB2.2.9 shows the fluctuation of groundwater level near Satiana along GBC.
It shows an overall upward trend. Because tubewells of PGSHF were constructed in this year, their influence is not shown in the Figure.



SOURCE: JICA Mission Team

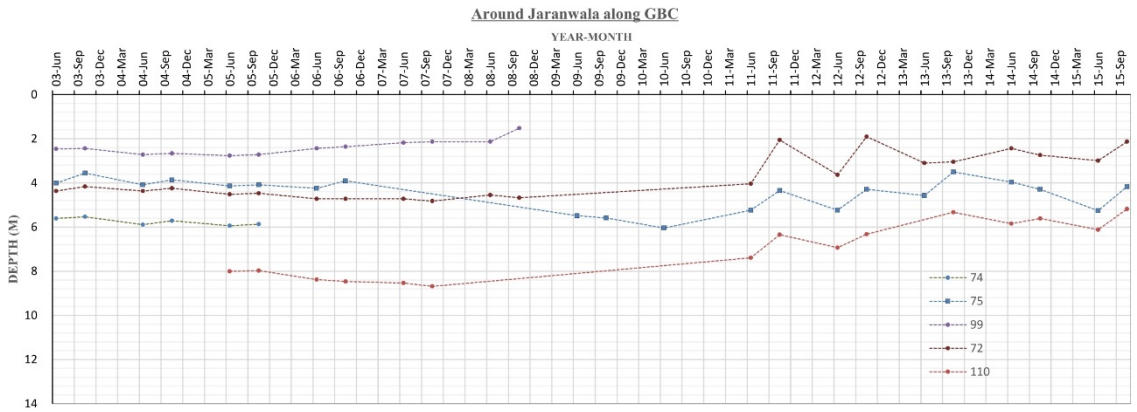
Figure AB2.2.9 Fluctuation of Groundwater Level near Satiana along GBC

Figure AB2.2.10 shows the fluctuation of groundwater level near Jaranwala around GBC.

From October 2013 to June 2015, the groundwater level tended to decrease at some observation wells, but it shows a slight upward trend as a whole.

There are tubewells constructed by PHED at Jaranwala along GBC.

It is thought to be excessive discharging due to the temporary lowering of groundwater level. But the groundwater level shows an upward trend on average; thus it seems that there is still some room for discharging water.



SOURCE: JICA Mission Team

Figure AB2.2.10 Fluctuation of Groundwater Level near Jaranwala around GBC

From the above and as indicated in the previous section, in the case of Chenab Well Field, groundwater level in peripheral area has been dropped significantly from the original level as of the time of construction. The drawdown is approximately 11m in average until 2007. However, if comparing the current groundwater level to that of 2007, it is in the stable condition or slightly upward trend keeping deep level.

We can say that the current discharging rate is 138,000 ~ 148,000 m^3/day from the data of Energy Audit Report of 2014-2015 FY and 2015-2016 FY. Because at this discharge rate the groundwater level stops declining or shows a slight upward trend, if average daily discharge from Chenab Well Field is set below the above-discussed amount, it seems like groundwater level from now on will keep stable.

In addition, we must consider also the discharge from irrigation wells.

At the time when groundwater kept stable during 1997 and 1998, the discharging rate from Chenab Well Field was 142,000 ~ 149,000 m^3/day. The discharging rate from irrigation wells in the right side of JBC during that period was around 80,000 m^3/day. Consequently, the total discharging rate amounted to 220,000 ~ 230,000 m^3/day.

Therefore, it is considered appropriate to set the total discharge in this area to this amount or less.

In conducting a groundwater management, it is considered necessary not only to control the discharge from the Well Field, but also to perform the discharge control of irrigation wells, in cooperation with stakeholders relating agriculture.

Considering that depends on the discharge of irrigation wells in the control of other organizations, first, the discharge from the Well Field shall be kept below about 140,000 m^3/day in average which is about 60% of the design discharge. Then, it is necessary to adopt appropriate management so that discharging capacity for agriculture can be suppressed to 80,000 m^3/day or less

Regarding JBC Well Field, from the trend of groundwater fluctuation, it is also considered to be the state of excessive discharge until the first half of 2015.The analysis of **Figure AB2.2.5** demonstrates that their influence radius is likely to have reached to more than 2 to 2.7 km.

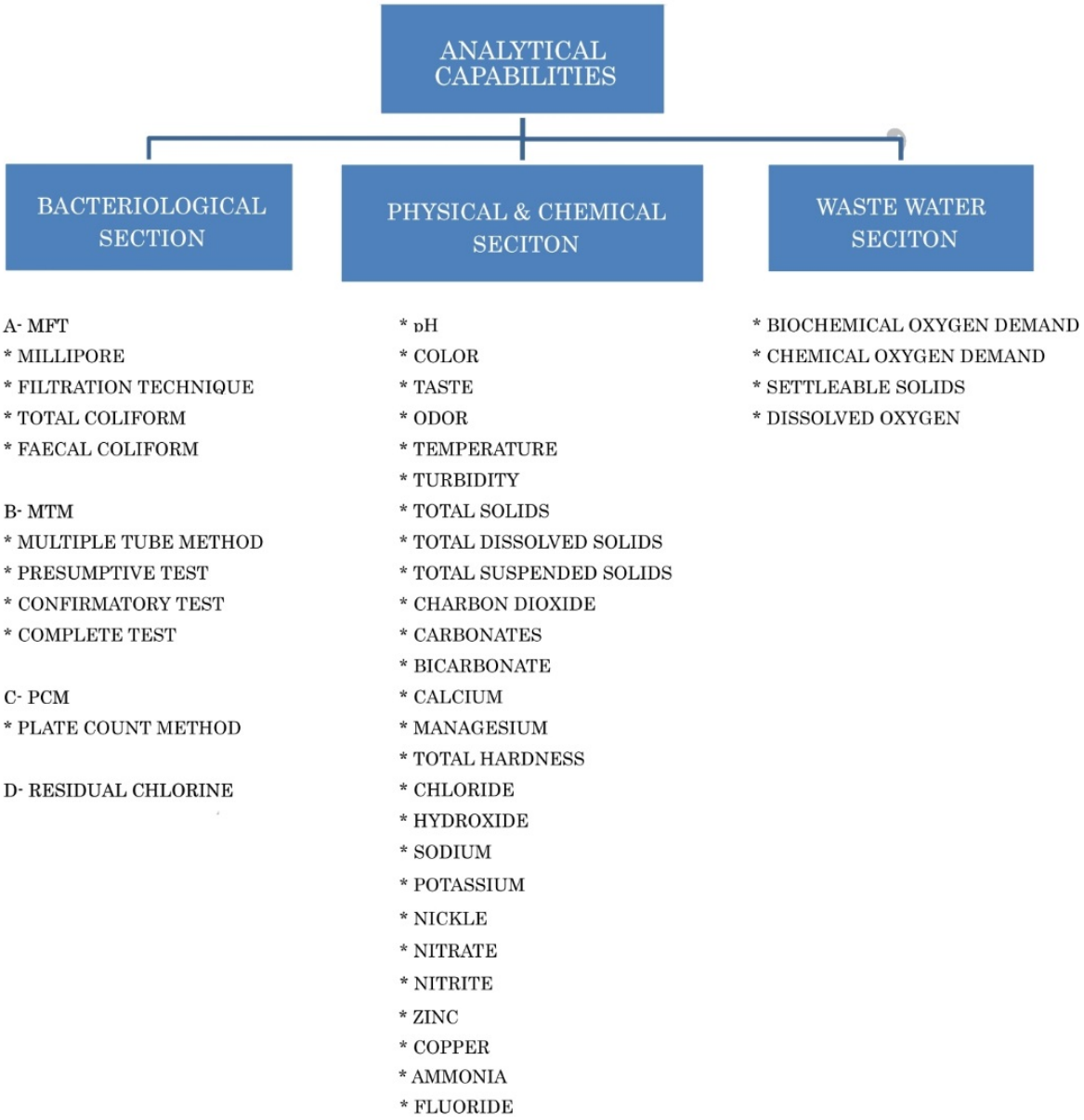
However, from the fact that it shows a recovery trend in 2016, it is better for the management of groundwater to make sure that the appropriate discharge for balancing to water resource that is the seepage from JBC comparing the discharge of 2015 and 2016.

The seepage from the JBC as a water resource at the time of the design study for JBC Well Field has

become excessive than the simulation results carried out subsequently by University of Agriculture Faisalabad[11]. Therefore, it is necessary to estimate the appropriate potential of water resources again.

According to the Energy Audit Report, the actual discharge in 2014-2015 FY is 72,000 m^3/day and in 2015-2016 FY is 60,000 m^3/day. It shows somewhat excessive in the former and some of the surplus in the latter.

Regarding water quality, WASA-F has prepared WASA Research Laboratory in 1978 and it is compatible.



Source: ANNUAL WATER QUALITY & ASSISMENT REPORT FOR THE YEAR-2016: WASA Research Laboratory

Figure AB2.2.11 Water Quality Test Items able to carry out at WASA-F Laboratory

Sampling frequency is in accordance with WHO guidelines. Water quality checks to the samples of Chenab and Jhang Well Fields, and tubewells along RBC are carried out every month. In addition, the test

[11] Modeling the Effects of Groundwater Pumping on Water Table of a Faisalabad Water Supply Scheme: BY ABDUL KHALIQ, DOCTOR OF PHILOSOPHY IN AGRICULTURAL ENGINEERING; Department of Irrigation and Drainage Faculty of Agricultural Engineering and Technology UNIVERSITY OF AGRICULTURE, FAISALABAD (PAKISTAN) 2014

to the samples of TR is conducted five times a week. There is no restriction on pumping to the tubewells in Chenab and JBC Well Fields, and along RBC. The operator of each tubewells is always operating according to the request from TR corresponding to the water demand.

Actual discharge in the present situation is about 60 to 75% of the designed amount. This is done by comparing the water demand and the budget for electricity on the TR side. It does not mean being conscious of the balance with water resource.

Tubewells along RBC are in operation for 6 hours a day, but this does not mean being conscious of the balance with resources, but it is operating so that water can be supplied almost at the same time according to the TR's water supply time zone .

AB2.3 Problem in Groundwater

EC distribution of groundwater in target area and location of main tubewells is shown in the Main Report (See the Figure B2.1.6).

The areas colored in blue group are underlain by groundwater with EC less than 1,500 μS/cm, while those colored in brown group are underlain by groundwater with EC higher than 1,500 μS/cm.

The average relationship between EC and TDS is EC (μS/cm) = 1.5 TDS (ppm). According to NSDWQ (National Standards for Drinking Water Quality) TDS is less than 1,000 ppm. Therefore, EC 1,500 μS/cm can be used as a measure whether groundwater is drinkable or not.

The EC of groundwater around Chenab Well Field is almost 1 to 1.25 dS/m (1,000 to 1,250 μS/cm) that is drinkable, but JBC Well Field is situated along the borderline between the areas underlain by the groundwater of 1.25 to 1.5 dS/m (1,250 to 1,500 μS/cm) and 1.5 to 2 dS/m (1,500 to 2,000 μS/cm).

RBC is in a zone of 3 dS/m (3,000 μS/cm) or more. Groundwater in this area is not suitable for drinking.

In the case of GBC, the Jaranwala area is in the zone of 1.5 to 3 dS/m (1,500 to 3,000 μS/cm).

Along the GBC, it is the zone of brackish groundwater. Only surrounding Satiana area is in the spot-like zone of 1.25 to 1.5 dS/m (1,250 to 1,500 μS/cm).

As mentioned above, the groundwater in Faisalabad city area consists of brackish water which is generally not suitable for drinking. In the past, water was supplied only by seepage water of RBC. But in order to supply water to Faisalabad city with a population of more than 2 million, there was no choice but to seek in the freshwater area along the Chenab River in Jhang District (Chiniot District at present), which is outside the administrative area of Faisalabad (Chenab Well Field).

After that, in order to respond to supply of water to the increasing population, an additional well field was planned in the freshwater groundwater distribution area along the Chenab River as well. However, due to large-scale pumping from the previously established Chenab Well Field, a serious impact on the irrigation wells in Chiniot area caused a massive opposition movement from the residents. As a result, the alternative well field was constructed along JBC in the administrative boundary between Faisalabad and Chiniot.

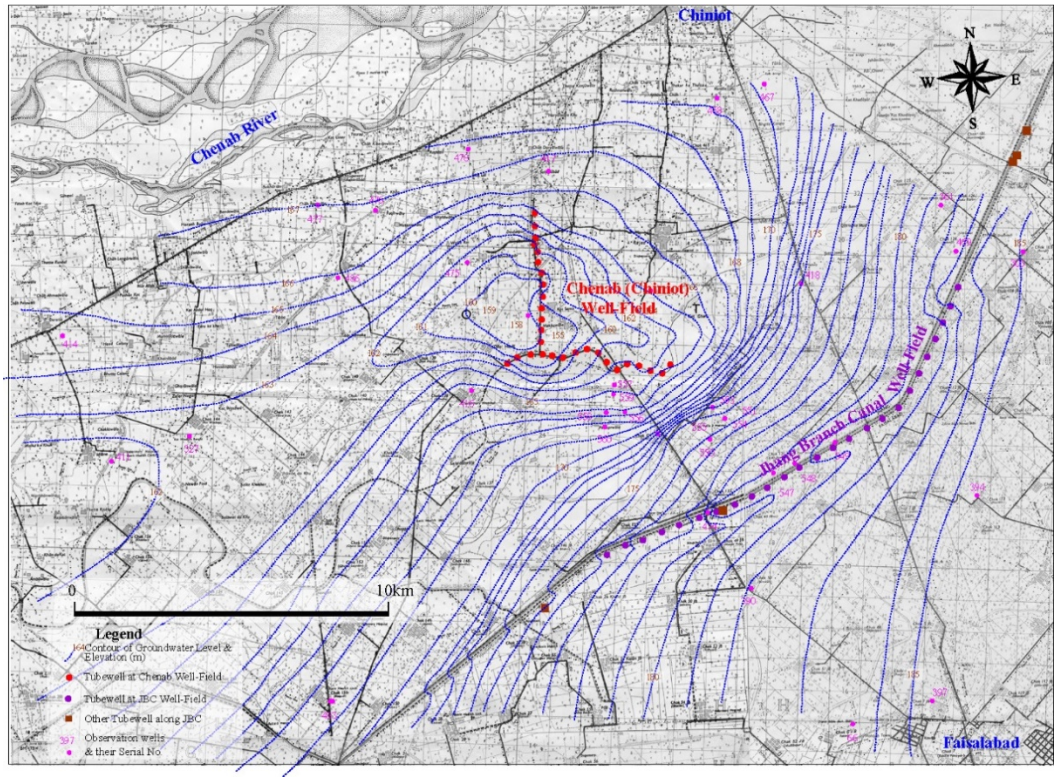
JBC Well Field is located at the boundary of the area of freshwater and brackish water as described above. Since there is a possibility of pumping up brackish groundwater not suitable for drinking, the discharge is designed to be equivalent to the seepage from JBC based on the result of the infiltration test of the irrigation canal carried out in the past.

Therefore, if over-pumping is carried out, brackish water distributed in the deep portion can be drawn in. For this reason, there is a possibility that water quality will deteriorate.
If the design seepage from the irrigation canal from the past infiltration test result is larger than the actual seepage, the same concern will occur.

In addition, as mentioned above, since the discharge from Chenab Well Field is large, it has caused excessive pumping. As a result, the groundwater level continues to decline year after year. From 1992 when it started to operate until June 2007, groundwater level monitoring was continued. According to those data, monitored groundwater level decreased by 15 meters at maximum, and 13 meters on average. All riser pipes of tubewells were replaced to the flange pipes in 2008 and the spacing between casing pipes and flanges have been not enough to hang the gauge inside the well. Moreover, there is no subsequent measurement data. This year, several observation wells were established, and it became possible to confirm a part of the current groundwater level. If comparing groundwater level in past and at present, current level shows almost the same as the last measured data in June 2007 or a slight recovery trend. To sum up, under the current situation the groundwater recharge, discharge from tubewells, and flowing away from the area are balanced well.

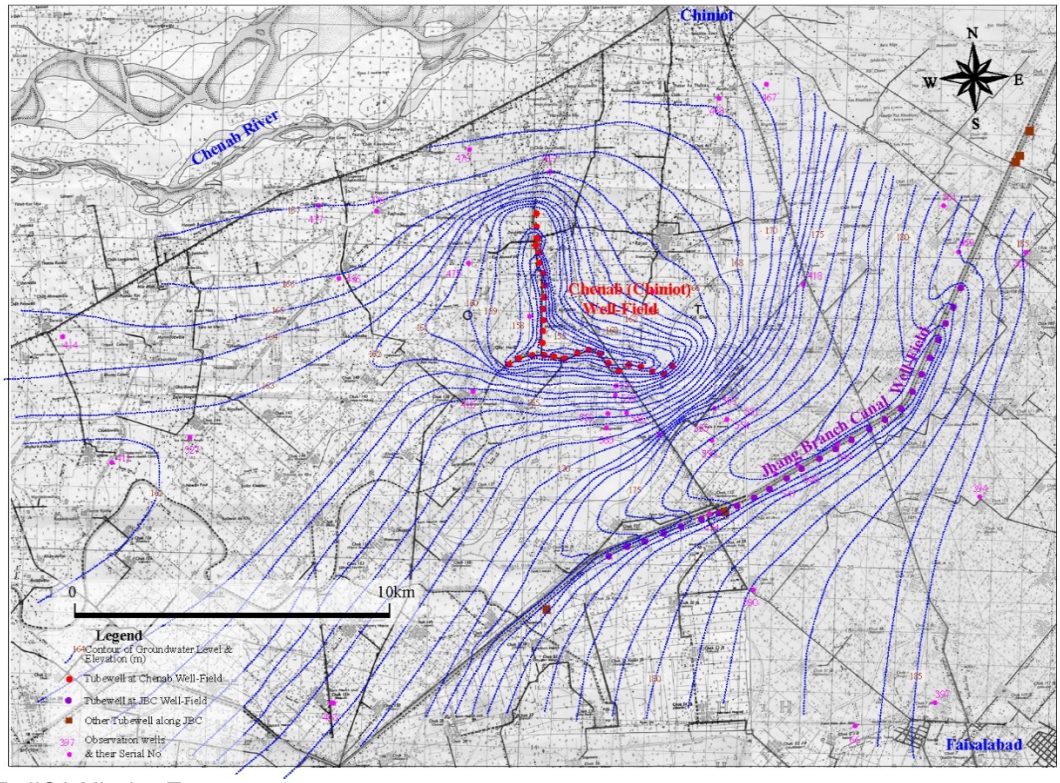
Since JBC Well Field have started operating since 2012, it is necessary to consider also their influence.

Figures AB2.3.1 and **AB2.3.2** show the contour of the groundwater level as of October 2015 (the former is the static water level and the latter is the pumped water level).



SOURCE: JICA Mission Team

Figure AB2.3.1 Groundwater Contour Map of Static Water Level within the Area between Chenab River and Faisalabad (As of October 2015)



SOURCE: JICA Mission Team

Figure AB2.3.2 Groundwater Contour Map of Pumping Water Level within the Area between Chenab River and Faisalabad (As of October 2015)

Even without pumping, the groundwater table declines greatly as the mortar-shaped to the bottom around Chenab Well Field. This tendency becomes extremely significant because of pumping. The flow of groundwater to Chenab Well Field is not only recharged from Chenab River but also from the direction of JBC and Faisalabad city which is the brackish groundwater distribution area. Therefore, if the amount of recharge from Chenab River is lowered, the quality of water at the Chenab Well Field may also deteriorate somewhat. Between JBC and Chenab Well Field, there is a gently sloping terrace cliff with an altitude difference of about 10 m; thus the groundwater table is influenced by this topographical feature. Especially from the mid- to up-stream side of JBC to eastern end-side of Chenab Well Field, it is shown that hydraulic gradient of water table is considerably steep in this area. That is to say considerable amount of groundwater flows from JBC side to Chenab Well Field as perpendicular direction to the contours. Perhaps part of the seepage water from JBC is also pulled toward Chenab Well Field. Since it is assumed that JBC Well Field uses only seepage water from JBC as a target resource, if the seepage amount of JBC Well Field discharge portion is insufficient, it would result in excessive pumping of JBC Well Field itself. Considering the interval density of the contour of groundwater table, its influence will appear largely especially in the tubewells installed in mid- to up-stream side of JBC Well Field.

In groundwater quality aspect, issues are summarized below.

1) TDS concentration of groundwater in Rakh Well-field shows higher level especially for Madina Town Scheme where the TDS concentration of 2015 is as high as 2,584 mg/L. Consequently, drinking-water becomes significantly and increasingly unpalatable because TDS levels have greatly exceeded drinking water standards (1,000 mg/L). The presence of high levels of TDS may also be objectionable to consumers, owing to excessive scaling in water pipes, heaters, boilers and household appliances.

2) Potential risk of high concentration in groundwater,it is recommended to continue the monitoring of arsenic in groundwater with high analysis accuracy.

AB2.4 Rainwater Harvesting and Utilization

Regarding rainwater harvesting and utilization, the following is mentioned in "Punjab Sector Development Plan 2014 - 2024 (Water, Sanitation & Hygiene), 2015":

- Rainfall provides significant recharge to ground water in irrigated agricultural areas which varies from 10% to 24% of the total annual rainfall.
- Rainwater offers an available source of water that can be stored for future use and also be utilized to recharge groundwater in declining urban aquifers. There is presently very little if any utilization of rainwater runoff in urban areas, which in most cases ends up in sewer or storm drains.
- By adopting suitable building bye laws and redesigning landscape of parks, roads and other public as well as private buildings, considerable part of rainfall can be harvested and ultimately recharged to groundwater by diverting it to specifically designed open wells. If at least one fourth of the annual rainfall run-off can be harvested, declining groundwater trends in cities can be reversed *(This description is based on a result of an analysis in Lahore area).*
- There is need to amend building by laws and enforce these for private and public buildings to achieve the maximum rainwater harvesting feasible to save groundwater and recharge groundwater aquifers.

As mentioned above, rainwater utilization in the Punjab Province is promoted to use for groundwater recharge, whereas possibility to provide water for domestic use (cleaning, watering, washing etc.) is also mentioned. It can be found as an example that University of Agriculture, Faisalabad (UAF) researches rainwater harvesting system for groundwater recharge for sustainability of the aquifer.

(1) Rainwater harvesting model established by UAF

UAF established a rainwater harvesting model in their campus in 2015 and is carrying out the experiment. The model consists of a roof with 627m^2 (11.5m x 54.5m), water collector pipes at the roof, two water tanks with each capacity of 1000 gallon (4,546 liter), concrete pits and wells for recharge as shown in pictures below. Rainwater to fall to the roof is collected to the tanks through the water collector pipes at the roof, then the collected water of the tanks is sent to the concrete pits. Finally, water is recharged from the wells in the concrete pits.

Water collector pipe and intake port

Pipe, tanks and concrete pits

SOURCE: JICA Mission Team

Figure AB2.4.1 Rainwater Harvesting Model in UAF

Tanks and concrete pits

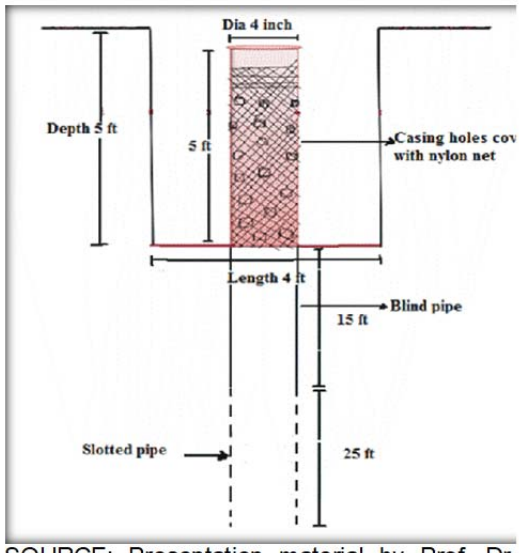
Recharge well in concrete pit

SOURCE: JICA Mission Team

Figure AB2.4.2 Rainwater Harvesting Model in UAF

UAF set three different types of wells, which are type 1) 15ft blind pipe and 10ft gravels, type 2) 15ft blind pipe and 20ft slotted pipe, and type 3) 15ft blind pipe and 25ft slotted pipe. **Figure AB2.4.3** shows a structural drawing of the type 3), which resulted in the highest average recharge rate of 52.2 liter/minute among the above three types. Soil property of surface layer in and around Faisalabad city is generally silt and/or clay with 3-5 m thickness, and sand layer lies down under the surface layer. In addition, groundwater level around UAF is about 18 m. Therefore, parts of wells for groundwater recharge like gravels of type 1) or slotted pipes of type 2) and 3) are installed in about 6 to 14m depth (20 to 45ft depth) from ground level.

According to the interview to the professor and a researcher of UAF, threshold rainfall intensity is about 1.7mm/hour for rainwater to start to pool to the tanks, and around 50% of annual rainfall is expected to recharge to the ground using this model.



SOURCE: Presentation material by Prof. Dr. Allah Bakhsh Dean, Faculty of Agricultural engineering and Technology, UAF

Figure AB2.4.3 Groundwater Recharge Well

(2) Possibility of utilization of rainwater

Average annual rainfall amount in the Project area is about 350-400 mm and number of days with rainfall amount of more than 10mm/day is about 10 days, while number of rain/drizzle days is 40-50 days. In case of 2015, number of days with more than 1.7mm of hourly rainfall is about 30 days. Considering its amount and frequency, it can be said that it may be difficult to expect to use harvesting rainwater for ordinary domestic use, but it may be suitable to use the rainwater for groundwater recharge to install system to public/private facilities with certain degree of roof area size.

Table AB2.5.1 List of Major Letters for Getting Approval on Irrigation Water

Phase-I for Direct Intake of Canal Water from Rakh Branch Canal

No.	Date	Theme of Letter	From		To		Contents	Note
1	2006/2/24	Requirement of 40 cusec Canal Water from Rakh Branch Canal	WASA	Managing Director	Irrigation, I&P Department, Lahore	The Chief Engineer	Request on arrangements for 40 cusec canal water from Rakh Branch at Jhal Khanuana	Under F/S stage
2	2007/10/19	Rehabilitation of Rakh Branch Canal and Provision of Raw Water for Future needs	City District Nazim, Faisalabad	-	The Chief Engineer Irrigation, Faisalabad	-	Request on enhancement of capacity for at least another 100 cusec.	
3	2009/8/7	Supply of 40 cusecs canal water	WASA	Deputy Managing Director	Irrigation Department, Faisalabad	The Chief Engineer	Request on 40 Cfs including 20 Cfs for the existing treatment works and 20 Cfs for the new water treatment plant.	
4	2011/11/5	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	WASA	Project Director	Irrigation Department, Faisalabad	The Chief Engineer	Request on approval for use of 20 cusec canal water form Rakh Branch	Actual start
5	2011/12/2	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	WASA	The Manager Director	Request on having a meeting between LCCW and WASA	
6	2012/1/25	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	WASA	Project Director	Hafizabad Division, LCCW, Irrigation Department, Faisalabad	The Executive Engineer	Explanation of background of the Project and Request on arrangements for 20 cusec canal water for 10MGD treatment plant	
7	2012/4/19	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	WASA	The Project Director	Request to provide funds of Rs. 33.754 million for raising free board in sections through the city area to supply 20 cusec.	
8	2012/5/2	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	Lower Chenab Canal West Circle, Faisalabad	The Superintending Engineer	WASA	The Project Director	Request to provide funds of Rs. 33.754 million for raising free board in sections through the city area to supply 20 cusec.	
9	2012/5/14	Requirement of Water from Rakh Branch Canal for the Project	WASA	Director Finance	WASA	The Project Director	Submission of a cheque for hand over to the Irrigation department	
10	2012/5/23	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	WASA	Project Director	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	To hand over the cheque, and request to arrange allocation of 20 cusec and to issue NOC (No Objection Certificate)	
11	2012/5/25	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	WASA	The Project Director	Notice to receive the cheque	
12	2012/8/1	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	WASA	Project Director	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	Request of issuance of NOC	
13	2012/8/8	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	Lower Chenab Canal West Circle, Faisalabad	The Superintending Engineer	Faisalabad Irrigation Zone, Faisalabad	The Chief Engineer	Request of confirmation and necessary action	
14	2012/8/17	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	Chief Engineer Irrigation, Faisalabad	Executive Engineer	Government of the Punjab, Irrigation Department, Lahore	The Secretary	Request of necessary advice for Granting NOC	
15	2012/10/16	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	Hafizabad Division, LCCW, Faisalabad	Executive Engineer	WASA	The Project Director	Request of 12.50 % departmental supervision charges of Rs. 3,853 million	
16	2012/10/31	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	WASA	Project Director	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	Remind of request of formal approval for NOC of 20 cusec	
17	2012/12/8	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	Lower Chenab Canal West Circle, Faisalabad	The Superintending Engineer	Request of submission of detailed drawings	
18	2013/1/15	Office Order	Lower Chenab Canal West Circle, Faisalabad	The Superintending Engineer	-	-	Accordance of sanction, and Instruction to execute necessary agreement for 20 Cs for three years using the rates approved by the Government	Issue of NOC
19	2013/10/30	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	WASA	Project Director	Hafizabad Division, LCCW, Irrigation Department, Faisalabad	The Executive Engineer	Request of perusal of drawings for location plan for water treatment plant	
20	2013/10/31	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	WASA	Project Director	Indication and instruction regarding changing intake point	

Table AB2.5.2 List of Major Letters for Getting Approval on Irrigation Water

No.	Date	Theme of Letter	From		To		Contents	Note
21	2013/11/11	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	WASA	Project Director	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	Submission of detail drawing and request to accord approval of drawing	
22	2013/12/18	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	Uqbana Sub Division LCC W Faisalabad	The Sub Divisional Officer	Direction to check the drawing of proposed site of taking point	
23	2013/12/21	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	Uqbana Sub Division, Faisalabad	Sub Divisional Officer	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	Comment of necessary conditions for granting approval	
24	2013/12/26	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	Lower Chenab Canal West Circle, Faisalabad	The Superintending Engineer	Report regarding issuance of revised sanction of canal water	
25	2014/12/31	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	WASA	Project Director	Request of deposit Rs. 91.024 million for concrete lining and additional free board of Dijkot Disty	
26	2014/1/2	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	WASA	Project Director	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	Explanation of background and request to allow to do civil work	
27	2014/1/4	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	Lower Chenab Canal West Circle, Faisalabad	The Superintending Engineer	Report for revising sanction point of 20 cusec with deposit Rs. 91.205 million for concrete lining and maintaining free board of Dijkot Disty	
28	2014/1/10	Requirement of Canal Water from Rakh Branch Canal for French Funded Project	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	WASA	Project Director	Submission of detailed estimate for concrete lining of bed and maintaining fee board	
29	2014/1/10	Office Order	Lower Chenab Canal West Circle, Faisalabad	The Superintending Engineer	-	-	Accordance of sanction by revised condition and Instruction to execute necessary agreement for 20 Cs for three years using the rates approved by the Government	Issue of revised NOC
30	2015/10/5	Agreement for Supply of Water in Bulk	WASA	Project Director	Hafizabad Division, LDDW, Faisalabad	The Executive Engineer	Proposal on request to irrigation department to confirm the amount for deposit of Rs. 63,072,000 as an advance payment for one year of 20 cusec.	
31	2015/10/6	Agreement for Supply of Water in Bulk	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	Lower Chenab Canal West Circle, Faisalabad	The Superintending Engineer	Request to extend advice to initiate agreement on rates for local bodies and other public bodies for drinking and domestic uses	
32	2015/10/9	Agreement for Supply of Water in Bulk	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	WASA	Project Director	Instruction to execute the agreement for deposit of the advance amount for one year of Rs. 1,921,173 (Rs.30.46 per 10,000 cusec.)	
33	2015/10/14	Agreement for Supply of Water in Bulk	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	WASA	Project Director	Submission of cheque amounting Rs.1,921,173	
34	2016/1/8	Agreement for Supply of 20 Cs canal water supply to WASA	Lower Chenab Canal West Circle, Faisalabad	The Superintending Engineer	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	Notice that the agreement for supply of 20 Cs is returned un-approved, and request to carry out all the outstanding dues by WASA and FDA	
35	2016/1/19	Agreement for Supply of 20 Cs canal water supply to WASA	WASA	The Deputy Managing Director	WASA	Director (Finance)	Request of providing the details of calculations to clear the liability for water supply charges to Irrigation Department	

Table AB2.5.3 List of Major Letters for Getting Approval on Irrigation Water

Phase-I for Intake from Tubewells installed along Rakh Branch Canal

No.	Date	Theme of Letter	From		To		Contents	Note
1	2013/2/15	Requirement of NOC for Installation of Tubewells at upstream of RD 240+200 along Rakh Branch Canal Well Field Area	WASA	Project Director	Hafizabad Division, LCCW, Irrigation Department, Faisalabad	The Executive Engineer	Request to issue of NOC for the installation of 10 Nos. Tubewells along Rakh Branch Canal Well Field area	
2	2013/3/9	Requirement of Information regarding Rakh Branch Canal Well Field Area	Hafizabad Division, LCCW, Faisalabad	The Executive Engineer	WASA	Project Director	Request of submission of required information/data	
3	2014/10/10	Request for NOC for the Installation of 10 No. Tubewells along Rakh Branch Canal for the Project	WASA	Project Director	Hafizabad Division, LCCW, Irrigation Department, Faisalabad	The Executive Engineer	Request to issue NOC for installation of 10 no. tubewells along the Rakh Branch canal	
4	2015/1/17	Request for NOC for the Installation of 10 No. Tubewells along Rakh Branch Canal for the Project	Hafizabad Division, LCCW, Irrigation Department, Faisalabad	The Executive Engineer	Lower Chenab Canal West Circle, Faisalabad	The Superintending Engineer	Report regarding issuance of NOC	
5	2015/2/9	Request for NOC for the Installation of 10 No. Tubewells along Rakh Branch Canal for the Project	Hafizabad Division, LCCW, Irrigation Department, Faisalabad	The Executive Engineer	Lower Chenab Canal West Circle, Faisalabad	The Superintending Engineer	Report regarding issuance of NOC	Issue of NOC

Phase-II for Direct Intake of Canal Water from Lower Gugera Branch Canal

No.	Date	Theme	From		To		Contents	Note1
1	2014/12/20	Requirement of canal water from Lower Gogera Branch for Proposed French Project "Phase-II"	WASA	Project Director	Lower Chenab Canal (LCC), Irrigation Deptt, Faisalabad	The Superintending Engineer	Request of 40cusec from Lower Gogera Branch	
2	2014/12/24	Requirement of canal water from Lower Gogera Branch for Proposed French Project "Phase-II"	WASA	Managing Director	Faisalabad Zone, Irrigation Deptt, Faisalabad	The Chief Engineer	Request of 40cusec from Lower Gogera Branch	
3	2015/2/9	Requirement of canal water from Lower Gugera Branch for Proposed French Project "Phase-II"	LCC East Circle, Irrigation Deptt, Faisalabad	The Superintending Engineer	WASA	Project Director	To provide 40Cs is un-able unless and until the allocation of additional supply of 40Cs, at head of Lower Gugera Branch Canal	
4	2015/3/19	MoM regarding Review of Mega Development Projects of Faisalabad	Additional Secretary to Chief Minister		Gov. of the Punjab, HUD&PHE Department, Lahore Gov. of the Punjab, LG&CD Department, Lahore Faisalabad WASA	The Secretary The Secretary The District Co-ordination Officer The Managing Director	Approval of the concept of the project of extensionof water resource Faisalabad city Phase-II (French funded)	
5	2015/3/27	Extension of Water Resources for Faisalabad City (Phase-II) French Funded Project	WASA	Managing Director	Gov. of the Punjab, HUD&PHE Department, Lahore	The Secretary	Request to take up the matter at higher levels of Irrigation Department, for according approval of 40 cusec	
6	2016/6/8	PC-I for Project "Extension of Water Resources for Faisalabad City Phase-II"	UD	Section Officer	WASA	Managing Director	Comments to the Project	
7	2016/8/18	PC-I for Project "Extension of Water Resources for Faisalabad City Phase-II"	UD	Section Officer	Government of the Punjab, Irrigation Department	The Secretary	Request to intervene and accord approval of 40 cusec of canal water from Lower Gugera Branch	

APPENDIX FOR CHAPTER B3 EXISTING WATER SUPPLY SYSTEM

AB3.1 Existing Equipment Lists

Equipment List of Pumping Station and Tube-wells (Chenab line and JBC line)

1. Tube-wells at Chenab Well-Fields
2. Inline Booster Pumping Station (BPS)
3. Old Terminal Reservoir Pumping Station (TRPS)
4. Tube-wells at JBC
5. JBC Booster Pumping Station (BPS)
6. JICA Terminal Reservoir Pumping Station (TRPS)

1. Tube-wells at Chenab Well-Fields

4 Cusec Capacity Pump (1 to 8)

Sr. No	Description		Specification/ Size	Make/ Model	Remarks
1	Pump	Total Head	38 M	KSB	
		Speed	1450 RPM		
		Capacity	116 Ltr/ sec		
2	Motor	Power	100 hp	Siemens	
		Voltage	380 V		
		Frequency	50 Hz		
		Ampere	139 Amp		
		Speed	1480 RPM		
3	Air Release Valve		3 inch Dia	HSN	
4	Flow Meter		300 mm Dia	Schlumberger	
5	Butterfly Valve		300 mm Dia		

Transformer

Sr. No	Description		Specification/ Size	Make/ Model	Remarks
1		1 No.	200 KVA	PEL	

4 Cusec Capacity Pump (9 to 24)

Sr. No	Description		Specification/ Size	Make/ Model	Remarks
1	Pump	Total Head	42 M	KSB	
		Speed	1450 RPM		
		Capacity	126 Ltr/ sec		
2	Motor	Power	125 hp	Siemens	
		Voltage	380 V		
		Frequency	50 Hz		
		Ampere	174.5 Amp		
		Speed	1485 RPM		
3	Air Release Valve		3 inch Dia	HSN	
4	Flow Meter		300 mm Dia	Schlumberger	
5	Butterfly Valve		300 mm Dia		

Transformer

Sr. No	Description		Specification/ Size	Make/ Model	Remarks
1		1 No.	200 KVA	PEL	

4 Cusec Capacity Pump (25 to 29)

Sr. No	Description		Specification/ Size	Make/ Model	Remarks
1	Pump	Total Head	38 M	KSB	
		Speed	1450 RPM		
		Capacity	116 Ltr/ sec		
2	Motor	Power	100 hp	Siemens	
		Voltage	380 V		
		Frequency	50 Hz		
		Ampere	139 Amp		
		Speed	1480 RPM		
3	Air Release Valve		3 inch Dia	HSN	
4	Non Return Valve		300 mm Dia	Schlumberger	

Transformer

Sr. No	Description		Specification/ Size	Make/ Model	Remarks
1		1 No.	200 KVA	PEL	

2. Inline Booster Pumping Station (BPS)

32 Cusec Capacity Pump (Inline) (4 Nos)

Sr. No	Description		Specification/ Size	Make/ Model	Region	Remarks
1	Butterfly Valve		750 mm	DEZURIK	USA	
2	Pump		600 x 600 mm	TORISHIMA	JAPAN	
		Total Head	18.3 M			
		Speed	735RPM			
		Capacity	895 L/S			
3	Motor	Power	400 HP	Siemens	Germany	
		Voltage	3300 V Star			
		Frequency	50 Hz			
		Ampere	69 Amp			
		Speed	735 RPM			
4	Discharge Valve		750 mm	DEZURIK	USA	
5	Check Valve		750 mm	NBS	Japan	
6	Butterfly Valve		750 mm	DEZURIK	USA	

16 Cusec Capacity Pump (Inline) (3 Nos)

Sr. No	Description		Specification/ Size	Make/ Model	Region	Remarks
1	Butterfly Valve		500 mm	DEZURIK	USA	
2	Pump		400 x 400 mm	TORISHIMA	Japan	
		Total Head	20 M			
		Speed	965 RPM			
		Capacity	450 L/S			
3	Motor	Power	175 HP	Siemens	Germany	
		Voltage	400 V Delta			
		Frequency	50 Hz			
		Ampere	235 Amp			
		Speed	965 RPM			
4	Discharge Valve		500 mm	DEZURIK	USA	
5	Check Valve		500 mm	NBS	Japan	
6	Butterfly Valve		500 mm	DEZURIK	USA	

Priming System (Inline)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	Vacuum Pump	2 No	Double Suction	NVD	USA	
		Max Vacuum	660 mm Hg			
		Max Vacuum	3.5 m^3/min			
		Speed	1455 RPM			
		Power	10 Hp			
2	Compressor	2 No				
		Pressure	200 PSI			
		R. P. M	800			
		Motor	20 hp			

Utility Generator (Inline)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	Generator	1 No.	37 KVA	DENYO		

Over Head Crane (Inline)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	Crane	1 No	10 Ton			

Automatic Chlorinator (Inline)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	Chlorinator	1 No.	40 Kg/Hr			

Transformers (Inline)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	For 400 HP motor	2 No.	1500KVA 11 Kv to 3.3 Kv 78.7/262.4 Amp	Siemens		
2	For 400 HP motor	2 No.	500 KVA 11 Kv to 400 Volt 26.2/721.7 Amp	Siemens		

3. Old Terminal Reservoir Pumping Station (TRPS)

22 Cusec Capacity Pump (Old TR) (7 Nos)

Sr. No	Description		Specification/ Size	Make/ Model	Region	Remarks
1	Butterfly Valve		500 mm	DEZURIK	USA	
2	Pump		500 x 400 mm	TORISHIMA	JAPAN	
		Total Head	45.12 M			
		Speed	982 RPM			
		Capacity	625 L/S			
3	Priming System					
4	Motor	Power	700 HP/522kw	Siemens	Germany	
		Voltage	3300 V			
		Frequency	50 Hz			
		Ampere	116 Amp			
		Speed	982 RPM			
5	Discharge Valve		750 mm	DEZURIK	USA	
6	Check Valve		750 mm	NBS	Japan	
7	Butterfly Valve		750 mm	DEZURIK	USA	

16 Cusec Capacity Pump (Old TR) (3 Nos)

Sr. No	Description		Specification/ Size	Make/ Model	Region	Remarks
1	Butterfly Valve		500 mm	DEZURIK	USA	
2	Pump		500 x 350 mm	TORISHIMA	JAPAN	
		Total Head	45.12 M			
		Speed	978 RPM			
		Capacity	456 L/S			
3	Priming System					
4	Motor	Power	450 HP/336kw	Siemens	Germany	
		Voltage	3300 V			
		Frequency	50 Hz			
		Ampere	76 Amp			
		Speed	978 RPM			
5	Discharge Valve		500 mm	DEZURIK	USA	
6	Check Valve		500 mm	NBS	Japan	
7	Butterfly Valve		500 mm	DEZURIK	USA	

Priming System (Old TR)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	Vacuum Pump	2 No	Double Suction	NVD		
		Max Vacuum	660 mm Hg			
		Max Vacuum	3.5 m^3/min			
		Speed	1455 RPM			
		Power	10 Hp			
2	Compressor	2 No				
		Pressure	200 PSI			
		R. P. M	800			
		Motor	20hp			

Utility Generator (Old TR)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	Generator	1 No.	37 KVA	DENYO		

Over Head Crane (Old TR)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	Crane	1 No.	8 Ton			

Automatic Chlorinator (Old TR)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	Chlorinator	1 No.	25 Gallon/Hr	Superior	USA	

Diesel Engines (Old TR)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	Engine	3 No.		MWM	Germany	
		Cylinders	12			
		Power	378 Kw			
		Speed	2200 RPM			
		Fuel Average	80 L/Hr			
		Tank Capacity	600 Liters			

Transformers (Old TR)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	Main	2 No.	5000 KVA	Siemens		
			11 KV to 3.3 KV			
			262.4/874.8 Amp			
2	Auxiliary	1 No.	100 KVA	Siemens		
			11 KV to 400 Volt			
			5.25/144.3 Amp			

Reservoir (Old TR)

Sr. No	Description		Specification/ Size	Remarks
1		1 No.	46,000 m3	

4. Tube-wells at JBC

2 Cusec Capacity Pump (1 to 6)

Sr. No	Description		Specification/ Size	Make/ Model	Remarks
1	Pump	Total Head	66.5 M	KSB	
		Speed	1475 RPM		
		Capacity	200 m^3/ hr		
2	Motor	Power	80 hp	Siemens	
		Voltage	415 V		
		Frequency	50 Hz		
		Ampere	104 Amp		
		Speed	1485 RPM		
3	Air Release Valve		80 mm Dia	SCI	
4	Non Return Valve		200 mm Dia	SCI	
5	Ball Valve		200 mm Dia	WCB	
	Flow Meter	Range	0-250 m^3/hr	K-T	

Transformer

Sr. No	Description		Specification/ Size	Make/ Model	Remarks
1		1 No.	200 KVA	PEL	

2 Cusec Capacity Pump (7 to 11 and 23 to 25)

Sr. No	Description		Specification/ Size	Make/ Model	Remarks
1	Pump	Total Head	53.5 M	KSB	
		Speed	1470 RPM		
		Capacity	200 m^3/hr		
2	Motor	Power	60 hp	Siemens	
		Voltage	415 V		
		Frequency	50 Hz		
		Ampere	79 Amp		
		Speed	1480 RPM		
3	Air Release Valve		80 mm Dia	SCI	
4	Non Return Valve		200 mm Dia	SCI	
5	Ball Valve		200 mm Dia	WCB	
	Flow Meter	Range	0-250 m^3/hr	K-T	

Transformer

Sr. No	Description		Specification/ Size	Make/ Model	Remarks
1		1 No.	200 KVA	PEL	

2 Cusec Capacity Pump (12 to 22)

Sr. No	Description		Specification/ Size	Make/ Model	Remarks
1	Pump	Total Head	40.5 M	KSB	
		Speed	1470 RPM		
		Capacity	200 m^3/ hr		
2	Motor	Power	50 hp	Siemens	
		Voltage	415 V		
		Frequency	50 Hz		
		Ampere	64.8 Amp		

		Speed	1475 RPM		
3	Air Release Valve		80 mm Dia	SCI	
4	Non Return Valve		200 mm Dia	SCI	
5	Ball Valve		200 mm Dia	WCB	
6	Flow Meter	Range	0-250 m^3/hr	K-T	

Transformer

Sr. No	Description		Specification/ Size	Make/ Model	Remarks
1		1 No.	200 KVA	PEL	

5. JBC Booster Pumping Station (BPS)

15 Cusec Capacity Pump (JBC) 4 Nos

Sr. No	Description		Specification/ Size	Make/ Model	Region	Remarks
1	Butterfly Valve		450 mm	SAMBO	Korea	
2	Pump	Size	450 x 350 mm	KUBOTA	JAPAN	
		Total Head	33 M			
		Speed	990 RPM			
		Capacity	25.3 m^3/min			
3	Motor	Power	200 KW	HYOSUNG	Korea	
		Voltage	3300 V			
		Frequency	50 Hz			
		Ampere	44.7 Amp			
		Speed	990 RPM			
4	Check Valve		450 mm	SCI	Thailand	
5	Roto Valve		450 mm	DMW	Japan	

Utility Generator (JBC)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	Generator	1 No.	65 KVA	DENYO		

Over Head Crane (JBC)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	Crane	1 No	5 Ton			

Automatic Chlorinator (JBC)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	Chlorinator	1 No.	6 kg/Hr	Okamura	Japan	

Transformers (JBC)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	Main	1 No.	1250 KVA	PEL		
			11 KV to 3.3 KV			
			65.61/218.69 Amp			

Reservoir (JBC)

Sr. No	Description		Specification/ Size	Remarks
1		1 No.	4,000 m3	

6. JICA Terminal Reservoir Pumping Station (TRPS)

37 Cusec Capacity Pump (JICA TR) 3 Nos

Sr. No	Description		Specification/ Size	Make/ Model	Region	Remarks
1	Butterfly Valve		800 mm	SAMBO	USA	
2	Pump	Size	600 x 450 mm	KUBOTA	JAPAN	
		Total Head	45.12 M			
		Speed	990 RPM			
		Capacity	63.2 m^3/min			
3	Motor	Power	620 KW	HYOSUNG	Korea	
		Voltage	3300 V			
		Frequency	50 Hz			
		Ampere	137.2 Amp			
		Speed	990 RPM			
4	Check Valve		700 mm	SCI	Thailand	
5	Rotate Valve		700 mm	DMW	Japan	

19 Cusec Capacity Pump (JICA TR) 2 Nos

Sr. No	Description		Specification/ Size	Make/ Model	Region	Remarks
1	Butterfly Valve		600 mm	SAMBO	USA	
2	Pump		450 x 300 mm	KUBOTA	JAPAN	
		Total Head	46.12 M			
		Speed	990 RPM			
		Capacity	31.6 m^3/min			
3	Motor	Power	330 KW	HYOSUNG	Korea	
		Voltage	3300 V			
		Frequency	50 Hz			
		Ampere	73 Amp			
		Speed	990 RPM			
4	Check Valve		500 mm	SCI	Thailand	
5	Roto Valve		500 mm	DMW	Japan	

Utility Generator (JICA TR)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	Generator	1 No.	50 KVA	DENYO		

Over Head Crane (JICA TR)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	Crane	1 No.	7.5 Ton			

Transformers (JICA TR)

Sr. No	Description		Specification/ Size	Make/Model	Region	Remarks
1	Main	1 No.	3500 KVA	PEL		
			11 KV to 3.3 KV			
			183.70/612.34 Amp			

Reservoir (JICA TR)

Sr. No	Description		Specification/ Size	Remarks
1		1 No.	36,000 m3	

AB3.2 List of Performance and Efficiency of Pump and Motor of Tubewells

Performance and Efficiency

of

Pump and Motor of Tubewells

in

Chenab Well Field

(2014 ~ 2016)

Table B3.3.1 List of Performance and Efficiency of Pump and Motor of Tubewells in Chenab Well Field at the time of 2014—2015 Fiscal Year

No	Pump Data				Motor Data					Measured Data												%age Pump Efficiency Qm/Qd	Power		
	Drive Rating (HP)	Pump Type	Head (m)	Capacity Q (L/s)	Capacity (HP)	Volt	Current (Amp)	RPM	PF	Volt			Current (Amp)			Power Factor			Q (l/s)	RPM		KVA	KW	KVAR
										VRY	VYB	VRB	Ia	Ib	Ic	Θ	Θ	Θ						
T-CWA-001	75.8	B12 F/5	38	116	100	380	139.4	1480	0.87	416.2	416.2	403.6	91.4	111	102.2	0.81	0.8	0.9	87	1486	74.9	72.4	60.6	39.8
T-CWA-002	80.4	B12 F/5	30	124	100	380	139	1480	0.87	392.5	388.2	394.6	113.1	103.6	110.2	0.82	0.83	0.87	101	1485	81.5	74	62.2	40
T-CWA-003	80.4	B12 F/5	30	127	100	380	139	1480	0.87	397.3	401.5	400.5	102.7	96.8	101.1	0.85	0.86	0.83	109	1486	85.9	69.4	58.7	36.9
T-CWA-004	80.4	B12 F/6	30	127	100	380	139	1480	0.87	386.8	386.2	387	112.6	110.8	105.5	0.84	0.86	0.86	NA	1476	NA	73.4	62.6	38.3
T-CWA-005	80.4	B12 F/7	30	124	100	380	139	1480	0.87	393	394	397	114	117	119	0.86	0.86	0.87	NA	1481	NA	79.8	68.9	40.2
T-CWA-006	80.4	B12 F/8	30	124	100	380	139	1480	0.87	357	368	363	137	123	125	0.88	0.86	0.87	111	1481	89.5	80.6	70.1	39.7
T-CWA-007	80	B12 F/9	30	124	100	380	139	1480	0.87	NA	NA	NA	NA	NA	NA	NA	NA	NA	96	1482	77.2	NA	NA	NA
T-CWA-008	87.3	x	41	123	125	380	175	1485	0.86	397.7	398.6	399.4	104.6	81	81.9	0.83	0.81	0.82	119	1490	97.1	61.5	50.5	35.1
T-CWA-009	91.6	B12 F/5	42	126	125	380	175	1485	0.86	398.4	399.5	398.9	199.5	117.4	115.2	0.86	0.85	0.86	76	1448	60.1	99.5	85.3	51.2
T-CWA-010	89.4	NA	44	119	125	380	175	1485	0.86	399.1	400.5	392.9	115	129.3	123.8	0.86	0.85	0.91	118	1491	99.2	84.5	73.8	41.2
T-CWA-011	89.5	NA	46	115	125	380	175	1485	0.86	402.5	407.7	409.5	112.2	113.1	111.7	0.84	0.85	0.86	95	1491	82.6	79.1	67.2	41.7
T-CWA-012		NA			125	380	175	1485	0.86	407.3	407.1	407.8	107.1	101.6	99.2	0.83	0.84	0.86	NA	1491	NA	72.4	61	39
T-CWA-013	94.9	NA	47	119	125	380	175	1485	0.86	393.2	393.8	393.2	109	107.2	103.9	0.83	0.83	0.83	27	1496	23	72.7	60.3	40.6
T-CWA-014	95.8	NA	46	121	125	380	175	1485	0.86	379.6	382.8	380	122.2	122	122.2	0.84	0.84	0.84	79	1496	65	80.6	67.7	43.7
T-CWA-015	NA	NA	NA	121	125	400	162	1470	0.86	374.5	376.5	379.3	135.3	131.7	137.6	0.91	0.91	0.91	91	1474	75.5	88	80.1	36.5
T-CWA-016	95.8	B12 F/6	46	121	125	380	175	1485	0.86	389.2	390.3	387	108.7	108.5	102.6	0.88	0.85	0.87	68	1486	56.1	71.8	62.2	35.8
T-CWA-017	95.4	B12 F/6	46	121	125	380	175	1485	0.86	372.8	376.3	378.1	135.3	131.5	137.5	0.9	0.88	0.9	101	1494	83.9	87.7	78.4	39.4
T-CWA-018	95.4	B12 F/6	46	121	125	380	175	1485	0.86	424.4	437	419.7	105.2	131.1	146.1	0.89	0.73	0.88	NA	1486	NA	94.2	78.2	52.6
T-CWA-019	105.4	B12 F/6	44	133	125	380	175	1485	0.86	421.5	426.1	424.3	112.2	119.4	116.9	0.87	0.87	0.85	106.5	1490	80.1	85.3	73.6	43
T-CWA-020	106.9	B12 F/6	44	133	125	380	175	1485	0.86	407.1	411.4	409.3	123	122.1	117.2	0.88	0.85	0.86	106	1494	79.9	85.6	73.9	43.2
T-CWA-021	106.9	NA	44	133	125	380	175	1485	0.86	402.7	405.7	409.7	115.3	119	117.1	0.86	0.85	0.83	87	1492	65.2	82.4	69.7	43.8
T-CWA-022	106.9	B12 F/6	x	133	125	380	175	x	x	x	x	x	x	x	x	x	x	x	73	1494	54.6	NA	NA	NA
T-CWA-023	x	B12 F/6	x	136	125	380	175	1485	0.86	413.9	410.2	410.7	126.5	126.1	128.1	0.86	0.85	0.87	NA	1489	NA	90.5	77.8	46.2
T-CWA-024	106.8	B12 F/6	x	136	125	380	175	1485	0.86	419.5	422.8	424	122.1	128.3	129.5	0.84	0.86	0.82	115	1489	84.5	92.6	77.8	50.2
T-CWA-025	75.8	B12 F/5	38	115	100	380	139	1480	0.87	400.9	399.6	403.3	98.2	93.6	98.1	0.8	0.83	0.84	NA	1486	NA	67.2	55.3	38.1
T-CWA-026	85.6	x	x	115	100	380	140	1480	0.87	407.1	405.1	407.1	111.1	108.8	108.4	0.76	0.79	0.75	111	1489	96.4	77	59.1	49.5
T-CWA-027	x	x	x	115	100	380	140	1480	0.87	322.1	367.8	400.8	115.6	118.4	117	0.82	0.92	0.89	143	1499	123.9	73.7	64.8	35
T-CWA-028	x	x	x	115	100	380	140	1480	0.87	400.6	402.9	402.3	120.1	113.5	117	0.85	0.83	0.84	110	1483	95.6	81.4	68.4	44.1

SOURCE: ENERGY AUDIT REPORT OF WATER SUPPLY SCHEMES AND DISPOSAL STATION OF WATER AND SANITATION AGENCY FAISALABAD; Engr. Bilal Bashir Deputy Director (Electric Cell) WASA Faisalabad[18]

Table B3.3.2 List of Performance and Efficiency of Pump and Motor of Tubewells in Chenab Well Field at the time of 2015—2016 Fiscal Year

WASA Station	Installed Capacity (Cusec)	Actual Discharge (Cusec)	Annual Water Discharge (m3)	Annual Electricity Consumption (kWh)	Unit Electricity Consumption (kWh/m3)	Motor Load (%)	Pumping System Efficiency (%)	Pumping System Efficiency Rating
T-CWA-001	4.10	3.22	2,154,960	409,766	0.19	83	49	LOW
T-CWA-002	4.38	3.40	2,279,790	416,195	0.18	84	47	LOW
T-CWA-003	-	-	-	-	-	-	-	-
T-CWA-004	4.12	3.55	2,378,340	439,908	0.18	89	45	LOW
T-CWA-005	4.10	3.37	2,260,080	438,367	0.19	88	44	LOW
T-CWA-006	4.07	4.36	2,923,650	429,824	0.15	87	64	GOOD
T-CWA-007	4.41	3.03	2,030,130	428,129	0.21	86	42	LOW
T-CWA-008	4.34	3.72	2,490,030	524,015	0.21	85	56	LOW
T-CWA-009	-	-	-	-	-	-	-	-
T-CWA-010	4.20	2.85	1,911,870	452,458	0.24	73	41	LOW
T-CWA-011	5.40	4.04	2,704,212	458,183	0.17	74	79	EXCELLENT
T-CWA-012	5.40	2.44	1,635,930	417,230	0.26	67	40	LOW
T-CWA-013	4.20	4.38	2,936,790	499,135	0.17	81	64	GOOD
T-CWA-014	4.27	3.13	2,094,976	471,173	0.22	76	55	LOW
T-CWA-015	4.27	3.34	2,234,457	483,283	0.22	78	53	LOW
T-CWA-016	4.27	1.79	1,062,880	377,721	0.36	69	29	LOW
T-CWA-017	4.27	3.38	2,265,205	462,366	0.2	75	67	GOOD
T-CWA-018	4.59	3.24	2,168,100	530,620	0.24	86	45	LOW
T-CWA-019	4.70	3.35	2,122,110	467,870	0.22	80	55	LOW
T-CWA-020	4.70	3.49	2,338,920	440,349	0.19	71	82	EXCELLENT
T-CWA-021	4.00	3.80	2,825,100	545,543	0.19	79	65	GOOD
T-CWA-022	4.00	2.53	1,695,060	433,743	0.26	70	52	LOW
T-CWA-023	4.00	3.45	2,312,640	528,418	0.23	85	58	FAIR
T-CWA-024	4.00	2.69	1,804,122	451,357	0.25	73	51	LOW
T-CWA-025	4.06	3.53	2,365,200	352,279	0.15	57	65	GOOD
T-CWA-026	-	-	-	-	-	-	-	-
T-CWA-027	-	-	-	-	-	-	-	-
T-CWA-028	4.00	4.63	3,101,040	440,349	0.14	89	81	EXCELLENT
Total	**103.85**	**80.71**	**54,095,592**	**10,898,281**	**0.21**			

SOURCE: Energy Audit & Energy Efficiency Improvement Program for WASAs in Punjab: April 2016[18]

Performance and Efficiency

of

Pump and Motor of Tubewells

in

JBC Well Field

(2014 ~ 2016)

Table B3.3.3 List of Performance and Efficiency of Pump and Motor of Tubewells in JBC Well Field at the time of 2014—2015 Fiscal Year

No	Pump Data				Motor NPD Data																					
	Drive Rating (HP)	Pump Type	Head (m)	Capacity Q (L/s)	Capacity		Volt	Current (Amp)	RPM	PF	Volt			Current (Amp)			Power Factor			Q (m3/hr)	RPM	Pump	KVA	KW	KVAR
					HP	KW					VRY	VYB	VRB	Ia	Ib	Ic	Θ	Θ	Θ						
T-JBC-J-01	60.95	B12 B/5	66.5	200	80	59.68	415±10%	104	1475	0.85	402.5	405.3	404.2	70.72	67.77	56.61	0.98	0.97	0.94	198	1493	99	45.5	43.91	11.95
T-JBC-J-02	60.95	B12 B/5	66.5	200	80	59.68	415±10%	104	1485	0.85	399.6	400.6	401.9	66.87	66.53	66.82	0.97	0.97	0.97	178	1485	89.17	46.32	44.93	11.26
T-JBC-J-03	60.95	B12 B/5	66.5	200	80	59.68	415±10%	104	1485	0.85	394.6	395.8	395.3	68.17	66.83	67.7	0.97	0.97	0.97	170	1486	84.83	46.25	44.87	11.24
T-JBC-J-04	60.95	B12B/5	66.5	200	80	59.68	415±10%	104	1485	0.85	383.5	384.5	385.8	68.84	71.91	69.25	0.97	0.97	0.96	186	1484	92.83	46.63	45.08	11.93
T-JBC-J-05	60.95	B12 B/5	66.5	200	80	59.68	415±10%	104	1485	0.85	391.6	393.2	391.2	65.7	77.1	63.7	0.83	0.84	0.83	178	1485	89.17	46.74	38.97	25.81
T-JBC-J-06	60.95	B12 B/5	66.5	200	80	59.68	415±10%	104	1485	0.85	389.7	392.6	391.4	79.83	78.41	79.62	0.84	0.83	0.83	185	1499	92.33	53.73	44.77	29.7
T-JBC-J-07	49.13	B12 B/4	53.5	200	60	44.76	415±10%	79	1480	0.85	390.2	392.9	392.9	66.2	66.2	66.3	0.85	0.87	0.86	186	1472	93	44.97	38.68	22.95
T-JBC-J-08	49.13	B12 B/4	53.5	200	60	44.76	415±10%	79	1480	0.85	393.9	94.9	393.5	57.55	54.46	55.74	0.94	0.94	0.94	180	1480	90	28.74	27.01	9.8
T-JBC-J-09	49.13	B12 B/4	53.5	200	60	44.76	415±10%	79	1480	0.85	401.2	404.2	403.7	53.57	55.36	54.74	0.99	0.99	0.99	204	1488	102.17	38.09	37.71	5.37
T-JBC-J-10	49.13	B12 B/4	53.5	200	60	44.76	415±10%	79	1480	0.85	397.2	399.6	399.3	46.2	57.3	56.9	0.99	0.99	0.99	192	1480	95.83	36.93	36.56	5.21
T-JBC-J-11	49.13	B12 B/4	53.5	200	60	44.76	415±10%	79	1480	0.85	381.4	383.1	381.2	56.03	65.41	65.71	0.86	0.87	0.86	198	1484	99.15	41.27	35.63	20.81
T-JBC-J-12	37.43	B12 B/3	40.5	200	50	37.3	415±10%	64.08	1475	0.86	389.7	391.8	391.6	50.2	48.7	49.5	0.82	0.82	0.83	201	1480	100.28	33.5	27.58	19.01
T-JBC-J-13	37.43	B12 B/3	40.5	200	50	37.3	415±10%	64.08	1475	0.86	385.9	387.7	388.5	42.55	44.29	43.59	0.95	0.95	0.94	189	1475	94.45	29.17	27.61	9.4
T-JBC-J-14	37.43	B12 B/3	40.5	200	50	37.3	415±10%	64.08	1475	0.86	398.3	401.5	399.3	36.1	47.8	36.8	0.95	0.95	0.92	172	1492	86	27.87	26.22	9.44
T-JBC-J-15	37.43	B12 B/3	40.5	200	50	37.3	415±10%	64.08	1475	0.86	397.4	399.6	399.2	51.63	53.47	51.63	0.84	0.81	0.84	193	1492	96.5	36.08	29.94	20.14
T-JBC-J-16	37.43	B12 B/3	45.5	200	50	37.3	415±10%	64.08	1475	0.86	402.7	406.9	405.8	42.2	45.96	45.32	0.91	0.88	0.93	257	1477	128.33	31.23	28.3	13.19
T-JBC-J-17	37.43	B12 B/3	40.5	200	50	37.3	415±10%	64.08	1475	0.86	427.4	430.7	429.9	51.78	50.94	51.4	0.78	0.8	0.78	205	1488	102.67	38.2	30.05	23.59
T-JBC-J-18	37.43	B12 B/3	40.5	200	50	37.3	415±10%	64.08	1475	0.86	410.3	417.5	412.8	45.18	41.26	46.11	0.96	0.94	0.94	198	1473	99	31.64	29.95	10.18
T-JBC-J-19	37.43	B12 B/3	40.5	200	50	37.3	415±10%	64.08	1475	0.85	410.6	413.9	412.3	36.24	42.66	43.89	0.95	0.95	0.95	195	NA	97.51	29.23	27.77	9.13
T-JBC-J-20	37.43	B12 B/3	40.5	200	50	37.3	415±10%	64.08	1475	0.86	414.6	416.8	415.5	33.42	42.7	47.5	0.95	0.95	0.94	169	1477	84.74	29.67	28.07	9.6
T-JBC-J-21	37.43	B12 B/3	40.5	200	50	37.3	415±10%	64.08	1475	0.86	419.4	421.6	420.6	33.2	42.7	41.4	0.93	0.94	0.93	200	NA	100	28.49	26.6	10.2
T-JBC-J-22	37.43	B12 B/3	40.5	200	50	37.3	415±10%	64.08	1475	0.86	424.7	424.7	427.9	39.63	41.93	41.22	0.93	0.95	0.93	198	1490	98.83	30.18	28.27	10.56
T-JBC-J-23	49.13	B12 B/4	53.5	200	60	44.76	415±10%	79	1480	0.85	393.7	396.6	394.2	51.39	64.99	59.88	0.84	0.85	0.84	172	1484	86	40.19	33.91	21.57
T-JBC-J-24	49.13	B12 B/4	53.5	200	60	44.76	415±10%	79	1480	0.85	391.4	391.8	390.8	59.38	58.35	59.87	0.95	0.95	0.93	190	1500	94.83	40.13	37.85	13.32
T-JBC-J-25	49.13	B12 B/4	53.5	200	60	44.76	415±10%	79	1480	0.85	393.9	396.5	397.7	56.3	58.68	57.19	0.94	0.93	0.91	215	1470	107.33	39.37	36.48	14.81

SOURCE: ENERGY AUDIT REPORT OF WATER SUPPLY SCHEMES AND DISPOSAL STATION OF WATER AND SANITATION AGENCY FAISALABAD; Engr. Bilal Bashir Deputy Director (Electric Cell) WASA Faisalabad

Table B3.3.4 List of Performance and Efficiency of Pump and Motor of Tubewells in JBC Well Field at the time of 2015—2016 Fiscal Year

WASA Station	Installed Capacity (Cusec)	Actual Discharge (Cusec)	Annual Water Discharge (m3)	Annual Electricity Consumption (kWh)	Unit Electricity Consumption (kWh/m3)	Motor Load (%)	Pumping System Efficiency (%)	Pumping System Efficiency Rating
TW No.01	-	-	-	-	-	-	-	-
TW No.02	-	-	-	-	-	-	-	-
TW No.03	1.96	1.65	1,042,440	294,238	0.28	79	81	EXCELLENT
TW No.04	-	-	-	-	-	-	-	-
TW No.05	1.96	1.61	897,900	250,999	0.28	76	82	EXCELLENT
TW No.06	1.96	1.63	848,260	274,508	0.32	89	66	GOOD
TW No.07	1.96	1.84	960,680	202,071	0.21	87	74	EXCELLENT
TW No.08	1.96	1.57	876,000	203,661	0.23	82	67	EXCELLENT
TW No.09	1.96	1.72	957,249	216,505	0.23	87	64	GOOD
TW No.10	1.96	2.06	1,839,600	365,049	0.2	92	82	EXCELLENT
TW No.11	1.96	1.89	1,056,675	216,138	0.2	87	79	EXCELLENT
TW No.12	1.96	2.00	1,191,360	180,054	0.15	82	85	EXCELLENT
TW No.13	1.96	1.80	1,068,720	174,182	0.16	79	81	EXCELLENT
TW No.14	1.96	1.75	1,039,520	177,314	0.17	81	77	EXCELLENT
TW No.15	1.96	1.71	1,016,160	176,139	0.17	80	74	EXCELLENT
TW No.16	1.96	2.48	1,477,520	184,046	0.12	84	81	EXCELLENT
TW No.17	1.96	1.72	1,022,000	185,925	0.18	84	67	EXCELLENT
TW No.18	1.96	1.71	1,079,670	190,475	0.18	81	78	EXCELLENT
TW No.19	1.96	1.71	1,073,465	191,307	0.18	82	80	EXCELLENT
TW No.20	1.96	1.56	1,044,630	189,350	0.18	76	79	EXCELLENT
TW No.21	1.96	1.80	1,000,064	158,159	0.16	77	86	EXCELLENT
TW No.22	1.96	1.95	1,089,525	162,929	0.15	79	84	EXCELLENT
TW No.23	1.96	1.53	854,100	211,092	0.25	85	69	EXCELLENT
TW No.24	1.96	1.69	941,700	217,954	0.23	88	74	EXCELLENT
TW No.25	1.96	1.74	969,075	210,817	0.22	85	79	EXCELLENT
Total	**43.12**	**39.12**	**23,346,313**	**4,632,912**	**0.20**			

SOURCE: Energy Audit & Energy Efficiency Improvement Program for WASAs in Punjab: April 2016

Performance and Efficiency

of

Pump and Motor of Tubewells

in

RBC Well Field

(2015 ~ 2016)

Table B3.3.5 List of Performance and Efficiency of Pump and Motor of Tubewells in RBC Well Field at the time of 2015—2016 Fiscal Year

WASA Station		Installed Capacity (Cusec)	Actual Discharge (Cusec)	Annual Water Discharge (m3)	Annual Electricity Consumption (kWh)	Unit Electricity Consumption (kWh/m3)	Motor Load (%)	Pumping System Efficiency (%)	Pumping System Efficiency Rating
Tube Well No:01	Mana Wala	1.00	1.03	231,352	41,026	0.18	99	62	EXCELLENT
Tube Well No:01	Mansoor Abad	1.00	0.65	146,730	23,933	0.16	58	50	FAIR
Tube Well No:02	Madina Town	1.50	1.62	361,350	65,722	0.18	100	59	GOOD
Tube Well No:02	Mana Wala	1.00	1.05	235,206	41,760	0.18	84	60	GOOD
Tube Well No:03	Madina Town	1.00	1.14	256,230	41,261	0.16	100	68	EXCELLENT
Tube Well No:03	Mansoor Abad	1.00	1.24	278,130	40,930	0.15	99	73	EXCELLENT
Tube Well No:04	Mansoor Abad	1.00	1.30	485,450	67,153	0.14	98	70	EXCELLENT
Tube Well No:04	Madina Town	1.00	0.83	186,150	70,896	0.38	107	23	LOW
Tube Well No:05	Mansoor Abad	1.00	0.57	127,020	26,113	0.21	63	40	LOW
Tube Well No:06	Mansoor Abad	1.00	1.27	284,700	45,752	0.16	92	61	GOOD
Tube Well No:07	Mansoor Abad	1.00	1.36	304,410	40,600	0.13	98	83	EXCELLENT
Tube Well No:08	Mansoor Abad	1.00	1.55	348,210	42,971	0.12	87	81	EXCELLENT
Tube Well No:09	Mansoor Abad	1.00	1.36	304,410	40,897	0.13	99	76	EXCELLENT
Tube Well No:17	Malik Pur	1.00	0.85	190,180	47,631	0.25	96	41	LOW
Total		**14.5**	**15.82**	**3,739,528**	**636,645**	**0.18**			

SOURCE: Energy Audit & Energy Efficiency Improvement Program for WASAs in Punjab: April 2016

AB3.3 Daily Working Hours of Pumps

Daily Working Hour (Inline BPS)

(2015, August ~ 2016, July)

Daily Working Hour (Inline BPS)

Aug-15

Date	Pump No.1 32 Cusec	Pump No.2 32 Cusec	Pump No.3 32 Cusec	Pump No.4 32 Cusec	Pump No.5 16 Cusec	Pump No.6 16 Cusec	Pump No.7 16 Cusec
1	19:23	0:00	19:18	0:00	3:00	0:00	0:00
2	19:18	0:00	19:13	0:00	0:00	0:00	0:00
3	19:12	0:00	19:13	0:00	7:30	0:00	0:00
4	19:18	0:00	19:10	0:00	0:00	0:00	0:00
5	19:18	0:00	19:12	0:00	0:00	0:00	0:00
6	19:18	0:00	19:12	0:00	0:00	0:00	0:00
7	19:14	0:00	19:13	0:00	6:40	0:00	0:00
8	19:13	0:00	19:12	0:00	0:00	0:00	0:00
9	19:18	0:00	19:13	0:00	0:00	0:00	0:00
10	19:14	0:00	19:18	0:00	8:39	0:00	0:00
11	18:59	0:00	18:13	0:00	0:00	0:00	0:00
12	19:09	0:00	19:14	0:00	0:00	0:00	0:00
13	5:21	0:00	5:18	0:00	0:00	0:00	0:00
14	19:15	0:00	19:07	0:00	0:00	0:00	0:00
15	19:12	0:00	19:14	0:00	0:00	0:00	0:00
16	19:03	0:00	19:04	0:00	3:00	0:00	0:00
17	19:18	0:00	19:13	0:00	0:00	0:00	0:00
18	19:13	0:00	19:14	0:00	3:00	0:00	0:00
19	19:18	0:00	19:13	0:00	0:00	0:00	0:00
20	19:03	0:00	18:00	0:00	6:35	0:00	0:00
21	19:12	0:00	19:14	0:00	6:15	0:00	0:00
22	19:14	0:00	19:11	0:00	0:00	0:00	0:00
23	19:13	0:00	19:12	0:00	3:45	0:00	0:00
24	19:16	0:00	19:10	0:00	11:00	0:00	0:00
25	19:04	0:00	19:03	0:00	0:00	0:00	0:00
26	19:05	0:00	19:03	0:00	0:00	0:00	0:00
27	19:11	0:00	19:14	0:00	0:00	0:00	0:00
28	19:14	0:00	19:12	0:00	0:00	0:00	0:00
29	19:11	0:00	19:14	0:00	0:00	0:00	0:00
30	19:13	0:00	19:11	0:00	0:00	0:00	0:00
31	19:12	0:00	19:18	0:00	0:00	0:00	0:00
Total (day)	31	0	31	0	10	0	0
Average (hour)	18.8	0.0	18.7	0.0	5.9	0.0	0.0

Daily Working Hour (Inline BPS)

Sep-15

Date	Pump No.1 32 Cusec	Pump No.2 32 Cusec	Pump No.3 32 Cusec	Pump No.4 32 Cusec	Pump No.5 16 Cusec	Pump No.6 16 Cusec	Pump No.7 16 Cusec
1	19:37	0:00	19:35	0:00	0:00	0:00	0:00
2	19:22	0:00	19:28	0:00	0:00	0:00	0:00
3	19:24	0:00	19:22	0:00	0:00	0:00	0:00
4	19:24	0:00	19:28	0:00	0:00	0:00	0:00
5	19:27	0:00	19:28	0:00	2:05	0:00	0:00
6	19:20	0:00	19:25	0:00	7:45	0:00	0:00
7	19:20	0:00	19:28	0:00	2:34	0:00	0:00
8	19:23	0:00	19:23	0:00	2:05	0:00	0:00
9	19:20	0:00	19:27	0:00	2:05	0:00	0:00
10	19:18	0:00	19:23	0:00	1:43	0:00	0:00
11	17:21	0:00	19:23	0:00	0:00	0:00	0:00
12	19:22	0:00	19:28	0:00	0:00	0:00	0:00
13	19:28	0:00	19:25	0:00	0:00	0:00	0:00
14	16:31	0:00	19:26	0:00	17:44	0:00	0:00
15	19:23	0:00	19:18	0:00	6:20	0:00	0:00
16	19:19	0:00	19:22	0:00	3:00	0:00	0:00
17	19:23	0:00	8:06	0:00	2:05	0:00	0:00
18	19:23	0:00	19:22	0:00	0:00	0:00	0:00
19	19:23	0:00	19:20	0:00	0:00	0:00	0:00
20	19:23	0:00	19:20	0:00	0:00	0:00	0:00
21	19:25	0:00	19:23	0:00	6:00	0:00	0:00
22	12:54	0:00	19:19	0:00	0:00	0:00	0:00
23	15:57	0:00	17:44	0:00	0:00	0:00	0:00
24	17:44	0:00	17:44	0:00	0:00	0:00	0:00
25	17:44	0:00	17:44	0:00	0:00	0:00	0:00
26	17:44	0:00	17:44	0:00	6:00	0:00	0:00
27	17:44	0:00	19:18	0:00	3:10	0:00	0:00
28	11:20	0:00	19:23	0:00	0:00	0:00	0:00
29	19:20	0:00	19:19	0:00	0:00	0:00	0:00
30	19:17	0:00	17:46	0:00	0:00	0:00	0:00
Total (day)	30	0	30	0	13	0	0
Average (hour)	18.4	0.0	18.7	0.0	4.8	0.0	0.0

Daily Working Hour (Inline BPS)

Oct-15

Date	Pump No.1 32 Cusec	Pump No.2 32 Cusec	Pump No.3 32 Cusec	Pump No.4 32 Cusec	Pump No.5 16 Cusec	Pump No.6 16 Cusec	Pump No.7 16 Cusec
1	19:23	0:00	19:23	0:00	0:00	0:00	0:00
2	16:20	0:00	13:09	0:00	3:00	0:00	0:00
3	19:23	0:00	19:22	0:00	0:00	0:00	0:00
4	19:38	0:00	19:18	0:00	0:00	0:00	0:00
5	19:17	0:00	19:19	0:00	0:00	0:00	0:00
6	19:12	0:00	19:45	0:00	0:00	0:00	0:00
7	19:23	0:00	19:23	0:00	0:00	0:00	0:00
8	19:23	0:00	19:23	0:00	0:00	0:00	0:00
9	19:19	0:00	19:18	0:00	0:00	0:00	0:00
10	19:13	0:00	19:20	0:00	0:00	0:00	0:00
11	19:20	0:00	19:19	0:00	0:00	0:00	0:00
12	17:09	0:00	17:08	0:00	0:00	0:00	0:00
13	18:54	0:00	18:57	0:00	0:00	0:00	0:00
14	19:19	0:00	19:19	0:00	0:00	0:00	0:00
15	19:18	0:00	19:22	0:00	0:00	0:00	0:00
16	19:13	0:00	19:18	0:00	0:00	0:00	0:00
17	19:20	0:00	16:07	3:10	0:00	0:00	0:00
18	19:18	0:00	19:20	0:00	0:00	0:00	0:00
19	19:13	0:00	19:17	0:00	0:00	0:00	0:00
20	18:54	0:00	19:00	0:00	0:00	0:00	0:00
21	16:33	0:00	12:13	0:00	0:00	0:00	0:00
22	19:18	0:00	19:19	0:00	0:00	0:00	0:00
23	19:20	0:00	19:21	0:00	0:00	0:00	0:00
24	18:43	0:00	18:46	0:00	0:00	0:00	0:00
25	17:29	0:00	19:08	0:00	0:00	0:00	0:00
26	19:23	0:00	11:54	0:00	0:00	0:00	0:00
27	19:17	0:00	19:20	0:00	0:00	0:00	0:00
28	19:19	0:00	19:20	0:00	0:00	0:00	0:00
29	19:21	0:00	19:18	0:00	0:00	0:00	0:00
30	19:19	0:00	19:18	0:00	0:00	0:00	0:00
31	19:22	0:00	19:18	0:00	0:00	0:00	0:00
Total (day)	31	0	31	1	1	0	0
Average (hour)	19.0	0.0	18.5	3.2	3.0	0.0	0.0

Daily Working Hour (Inline BPS)

Nov-15

Date	Pump No.1 32 Cusec	Pump No.2 32 Cusec	Pump No.3 32 Cusec	Pump No.4 32 Cusec	Pump No.5 16 Cusec	Pump No.6 16 Cusec	Pump No.7 16 Cusec
1	19:18	0:00	19:20	0:00	0:00	0:00	0:00
2	17:44	0:00	17:44	0:00	0:00	0:00	0:00
3	15:55	3:39	10:34	2:00	0:00	0:00	0:00
4	19:25	19:26	0:00	0:00	0:00	0:00	0:00
5	19:17	19:19	0:00	0:00	0:00	0:00	0:00
6	19:23	19:19	0:00	0:00	0:00	0:00	0:00
7	13:54	12:18	0:00	0:00	0:00	0:00	0:00
8	19:00	18:58	0:00	0:00	0:00	0:00	0:00
9	16:21	19:15	0:00	0:00	0:00	0:00	0:00
10	17:14	17:15	0:00	0:00	0:00	0:00	0:00
11	14:05	16:39	0:00	0:00	8:05	0:00	0:00
12	19:14	17:39	0:00	0:00	0:00	0:00	0:00
13	17:44	19:17	0:00	0:00	0:00	0:00	0:00
14	9:47	14:09	9:25	0:00	9:40	0:00	0:00
15	19:15	17:07	0:00	0:00	2:03	0:00	0:00
16	17:44	17:44	0:00	0:00	0:00	0:00	0:00
17	17:35	19:18	17:44	0:00	9:02	0:00	0:00
18	19:20	19:19	0:00	0:00	0:00	0:00	0:00
19	19:16	19:18	0:00	0:00	0:00	0:00	0:00
20	17:44	17:44	0:00	0:00	2:24	0:00	0:00
21	13:49	15:35	4:37	4:16	9:03	0:00	0:00
22	17:52	18:05	0:00	0:00	0:00	0:00	0:00
23	17:44	17:44	0:00	0:00	0:00	0:00	0:00
24	19:17	19:19	0:00	0:00	0:00	0:00	0:00
25	19:18	19:17	0:00	0:00	0:00	0:00	0:00
26	19:28	19:23	0:00	0:00	0:00	0:00	0:00
27	19:20	19:23	0:00	0:00	0:00	0:00	0:00
28	19:18	19:19	0:00	0:00	0:00	0:00	0:00
29	19:17	19:18	0:00	0:00	0:00	0:00	0:00
30	17:44	17:44	0:00	0:00	0:00	0:00	0:00
Total (day)	30	28	6	2	6	0	0
Average (hour)	17.7	17.6	13.2	3.1	6.7	0.0	0.0

Daily Working Hour (Inline BPS)

Dec-15

Date	Pump No.1 32 Cusec	Pump No.2 32 Cusec	Pump No.3 32 Cusec	Pump No.4 32 Cusec	Pump No.5 16 Cusec	Pump No.6 16 Cusec	Pump No.7 16 Cusec
1	16:44	16:44	0:00	0:00	7:00	0:00	0:00
2	2:14	19:03	0:00	0:00	0:00	0:00	0:00
3	19:03	18:58	0:00	0:00	2:20	0:00	0:00
4	19:01	19:03	0:00	0:00	0:00	0:00	0:00
5	8:39	8:37	0:00	0:00	0:00	0:00	0:00
6	18:58	18:56	0:00	0:00	2:17	0:00	0:00
7	16:44	16:44	0:00	0:00	0:00	0:00	0:00
8	13:55	13:45	0:00	0:00	2:20	0:00	0:00
9	16:44	16:44	0:00	0:00	7:20	0:00	0:00
10	19:03	16:44	0:00	0:00	2:10	0:00	0:00
11	18:58	18:56	0:00	0:00	2:14	0:00	0:00
12	19:16	19:18	0:00	0:00	2:20	0:00	0:00
13	19:24	19:19	0:00	0:00	1:00	0:00	0:00
14	19:53	19:48	0:00	0:00	1:37	0:00	0:00
15	11:09	13:04	0:00	0:00	8:27	0:00	0:00
16	19:23	19:21	0:00	0:00	2:36	0:00	0:00
17	19:18	19:13	0:00	0:00	3:40	0:00	0:00
18	19:16	16:44	0:00	0:00	4:10	0:00	0:00
19	19:18	19:16	0:00	0:00	4:03	0:00	0:00
20	19:23	19:18	0:00	0:00	5:20	0:00	0:00
21	16:59	16:58	0:00	0:00	1:00	0:00	0:00
22	16:23	16:29	0:00	2:31	0:00	0:00	0:00
23	21:52	17:28	0:00	2:31	9:00	0:00	0:00
24	19:18	16:44	0:00	4:34	3:00	0:00	0:00
25	19:18	16:44	0:00	2:35	7:00	0:00	0:00
26	16:44	16:44	0:00	0:00	9:14	0:00	0:00
27	16:44	19:23	0:00	0:00	9:05	0:00	0:00
28	16:09	16:09	0:00	2:16	7:15	0:00	0:00
29	18:34	15:55	0:00	0:00	8:00	0:00	0:00
30	16:44	16:44	0:00	4:20	5:25	0:00	0:00
31	13:59	6:09	0:00	2:35	0:00	0:00	0:00
Total (day)	31	31	0	7	25	0	0
Average (hour)	17.1	16.9	0.0	3.1	4.7	0.0	0.0

Daily Working Hour (Inline BPS)

Jan-16

Date	Pump No.1 32 Cusec	Pump No.2 32 Cusec	Pump No.3 32 Cusec	Pump No.4 32 Cusec	Pump No.5 16 Cusec	Pump No.6 16 Cusec	Pump No.7 16 Cusec
1	19:20	19:23	0:00	8:05	0:00	0:00	0:00
2	19:23	19:19	0:00	0:00	9:10	0:00	0:00
3	19:37	19:36	0:00	0:00	9:20	0:00	0:00
4	19:23	16:44	0:00	2;24	6:10	0:00	0:00
5	19:26	19:26	0:00	0:00	0:00	0:00	0:00
6	19:23	19:18	0:00	2:30	6:55	0:00	0:00
7	19:22	19:20	0:00	1;21	8:10	0:00	0:00
8	19:23	19:19	0:00	2;20	7:37	0:00	0:00
9	19:20	19:18	0:00	3:00	6:15	0:00	0:00
10	19:18	19:19	0:00	0:00	9:10	0:00	0:00
11	16:44	16:44	0:00	2:30	7:05	0:00	0:00
12	16:19	14:42	0:00	0:00	2:18	0:00	0:00
13	2:34	19:23	0:00	2:01	1:30	0:00	0:00
14	19:23	19:18	0:00	2:34	0:00	0:00	0:00
15	16:29	15:32	0:00	4:20	0:00	0:00	0:00
16	18:44	17:51	0:00	5:15	3:45	0:00	0:00
17	2:32	2:34	0:00	3:00	1:10	0:00	0:00
18	19:34	19:15	0:00	6:22	2:30	0:00	0:00
19	19:17	19:20	0:00	9:35	0:00	0:00	0:00
20	16:40	16:40	0:00	0:00	0:00	0:00	0:00
21	0:00	3:30	0:00	0:00	0:00	0:00	0:00
22	10:06	7:31	0:00	5:32	0:00	0:00	0:00
23	17:06	19:20	0:00	0:00	10:40	0:00	0:00
24	19:19	9:20	0:00	0:00	8:25	0:00	0:00
25	19:23	19:20	0:00	2:23	7:10	0:00	0:00
26	20:16	20:18	0:00	8:25	0:00	0:00	0:00
27	19:28	19:14	0:00	0:00	0:00	0:00	0:00
28	19:10	19:05	0:00	4:36	5:10	0:00	0:00
29	20:23	19:18	0:00	5:16	4:59	0:00	0:00
30	19:14	19:16	0:00	3:30	1:05	0:00	0:00
31	19:17	19:16	0:00	4:35	5:05	0:00	0:00
Total (day)	30	31	0	18	21	0	0
Average (hour)	17.5	17.0	0.0	4.6	5.9	0.0	0.0

Daily Working Hour (Inline BPS)

Feb-16

Date	Pump No.1 32 Cusec	Pump No.2 32 Cusec	Pump No.3 32 Cusec	Pump No.4 32 Cusec	Pump No.5 16 Cusec	Pump No.6 16 Cusec	Pump No.7 16 Cusec
1	11:49	11:54	0:00	1:25	7:05	0:00	0:00
2	19:18	19:23	0:00	2:40	0:00	0:00	0:00
3	19:16	19:23	0:00	4:10	5:00	0:00	0:00
4	19:19	19:18	0:00	4:00	5:10	0:00	0:00
5	19:20	19:18	0:00	5:20	4:05	0:00	0:00
6	19:20	19:18	0:00	4:10	5:05	0:00	0:00
7	19:16	19:23	0:00	2:20	5:05	0:00	0:00
8	18:24	18:24	0:00	5:20	0:00	0:00	0:00
9	18:15	8:02	0:00	5:30	0:00	0:00	0:00
10	19:18	19:20	0:00	4:10	4:59	0:00	0:00
11	19:23	19:17	0:00	4:05	4:55	0:00	0:00
12	16:03	3:58	0:00	0:50	5:05	0:00	0:00
13	16:30	16:32	0:00	0:50	5:05	0:00	0:00
14	19:18	19:15	0:00	4:20	5:00	0:00	0:00
15	19:23	19:18	0:00	6:00	3:20	0:00	0:00
16	19:23	18:25	0:00	4:05	5:20	0:00	0:00
17	19:16	19:18	0:00	4:05	0:00	0:00	0:00
18	14:44	14:46	0:00	3:31	0:00	0:00	0:00
19	19:18	19:16	0:00	0:00	9:25	0:00	0:00
20	19:19	19:18	0:00	0:00	9:30	0:00	0:00
21	19:23	19:19	0:00	4:40	5:20	0:00	0:00
22	19:18	21:50	0:00	4:20	5:20	0:00	0:00
23	19:19	19:18	0:00	0:00	1:03	0:00	0:00
24	19:20	19:18	0:00	8:00	6:00	0:00	0:00
25	16:44	19:33	0:00	3:25	6:02	0:00	0:00
26	19:18	19:20	0:00	2:00	6:00	0:00	0:00
27	0:00	19:23	0:00	6:28	10:35	0:00	0:00
28	0:00	19:19	0:00	19:17	10:30	0:00	0:00
29	0:00	16:44	0:00	16:44	9:20	0:00	0:00
Total (day)	25	29	0	26	24	0	0
Average (hour)	18.7	17.8	0.0	5.1	6.0	0.0	0.0

Daily Working Hour (Inline BPS)

Mar-16

Date	Pump No.1 32 Cusec	Pump No.2 32 Cusec	Pump No.3 32 Cusec	Pump No.4 32 Cusec	Pump No.5 16 Cusec	Pump No.6 16 Cusec	Pump No.7 16 Cusec
1	0:00	19:18	0:00	19:17	10:05	0:00	0:00
2	0:00	19:16	0:00	19:18	11:25	0:00	0:00
3	0:00	19:18	0:00	19:16	11:35	0:00	0:00
4	0:00	0:00	0:00	1:34	11:33	0:00	0:00
5	1:34	0:00	19:18	19:18	11:30	0:00	0:00
6	19:13	0:00	19:13	17:39	0:00	0:00	0:00
7	17:40	0:00	19:14	19:14	0:00	0:00	0:00
8	10::34	0:00	0:00	19:18	0:00	0:00	0:00
9	19:20	0:00	4:40	19:23	12:57	0:00	0:00
10	1:34	0:00	0:00	19:18	7:00	0:00	0:00
11	19:19	0:00	0:00	19:19	4:30	0:00	0:00
12	17:41	0:00	0:00	19:17	0:00	0:00	0:00
13	0:00	0:00	19:36	18:39	8:30	0:00	0:00
14	7:30	0:00	17:44	13:25	6:02	0:00	0:00
15	11:25	0:00	19:20	19:18	0:00	0:00	0:00
16	6:49	0:00	1:35	19:19	0:00	0:00	0:00
17	19:17	0:00	19:18	0:00	7:35	0:00	0:00
18	17:44	0:00	19:20	0:00	0:00	0:00	0:00
19	0:00	0:00	19:17	19:20	14:04	0:00	0:00
20	0:00	0:00	19:23	19:18	0:00	0:00	0:00
21	0:00	0:00	18:44	18:44	12:05	0:00	0:00
22	0:00	0:00	19:23	19:18	11:15	0:00	0:00
23	0:00	0:00	1:39	19:19	0:00	0:00	0:00
24	0:00	0:00	17:44	17:44	11:40	0:00	0:00
25	0:00	0:00	19:28	18:04	0:00	0:00	0:00
26	12:45	0:00	0:00	19:23	11:54	0:00	0:00
27	13:50	0:00	0:00	13:50	6:04	0:00	0:00
28	19:23	0:00	0:00	17:44	17:44	0:00	0:00
29	19:21	0:00	0:00	0:00	0:00	0:00	0:00
30	1:34	0:00	0:00	1:33	0:00	0:00	0:00
31	19:23	0:00	0:00	19:20	0:00	0:00	0:00
Total (day)	18	3	17	28	18	0	0
Average (hour)	13.6	19.3	16.2	17.4	10.4	0.0	0.0

Daily Working Hour (Inline BPS)

Apr-16

Date	Pump No.1 32 Cusec	Pump No.2 32 Cusec	Pump No.3 32 Cusec	Pump No.4 32 Cusec	Pump No.5 16 Cusec	Pump No.6 16 Cusec	Pump No.7 16 Cusec
1	19:18	0:00	0:00	19:23	0:00	0:00	0:00
2	19:23	0:00	0:00	19:20	6:25	0:00	0:00
3	19:18	0:00	0:00	19:18	1:00	0:00	0:00
4	17:44	0:00	0:00	17:44	0:00	0:00	0:00
5	19:18	0:00	0:00	17:44	1:05	0:00	0:00
6	19:23	0:00	0:00	19:18	0:00	0:00	0:00
7	19:18	0:00	0:00	17:44	1:20	0:00	0:00
8	19:17	0:00	0:00	19:18	4:10	0:00	0:00
9	19:18	0:00	0:00	19:18	6:30	0:00	0:00
10	19:18	0:00	0:00	19:18	0:00	0:00	0:00
11	19:18	0:00	0:00	19:18	0:00	0:00	0:00
12	19:23	0:00	0:00	19:18	0:00	0:00	0:00
13	19:18	0:00	0:00	19:20	0:00	0:00	0:00
14	19:17	0:00	0:00	19:20	0:00	0:00	0:00
15	19:18	0:00	0:00	19:23	0:00	0:00	0:00
16	19:20	0:00	0:00	19:18	0:00	0:00	0:00
17	18:34	0:00	0:00	18:29	1:05	0:00	0:00
18	19:18	0:00	0:00	19:18	9:00	0:00	0:00
19	17:44	0:00	0:00	19:18	0:00	0:00	0:00
20	19:18	0:00	0:00	15:44	0:00	0:00	0:00
21	15:45	0:00	0:00	15:40	5:06	0:00	0:00
22	19:18	0:00	0:00	19:22	0:00	0:00	0:00
23	19:18	0:00	0:00	19:21	2:20	0:00	0:00
24	19:19	0:00	0:00	19:18	0:00	0:00	0:00
25	17:44	0:00	0:00	17:44	0:00	0:00	0:00
26	19:18	0:00	0:00	19:23	0:00	0:00	0:00
27	17:44	0:00	0:00	17:44	0:00	0:00	0:00
28	19:17	0:00	0:00	19:19	13:00	0:00	0:00
29	19:18	0:00	0:00	19:23	3:00	0:00	0:00
30	19:23	0:00	0:00	19:44	5:38	0:00	0:00
Total (day)	30	0	0	30	13	0	0
Average (hour)	19.0	0.0	0.0	18.8	4.6	0.0	0.0

Daily Working Hour (Inline BPS)

May-16

Date	Pump No.1 32 Cusec	Pump No.2 32 Cusec	Pump No.3 32 Cusec	Pump No.4 32 Cusec	Pump No.5 16 Cusec	Pump No.6 16 Cusec	Pump No.7 16 Cusec
1	19:17	0:00	0:00	19:20	7:25	0:00	0:00
2	17:35	0:00	0:00	17:35	5:06	0:00	0:00
3	17:44	0:00	0:00	17:44	0:00	0:00	0:00
4	19:18	0:00	0:00	19:20	8:00	0:00	0:00
5	19:18	0:00	0:00	19:17	0:00	0:00	0:00
6	19:23	0:00	0:00	19:20	0:00	0:00	0:00
7	19:18	0:00	0:00	16:44	0:00	0:00	0:00
8	19:21	0:00	0:00	18:18	0:00	0:00	0:00
9	19:28	0:00	0:00	19:28	0:00	0:00	0:00
10	19:19	0:00	0:00	19:18	0:00	0:00	0:00
11	18:51	0:00	0:00	19:05	8:00	0:00	0:00
12	19:23	0:00	0:00	19:18	0:00	0:00	0:00
13	9:30	0:00	0:00	9:30	0:00	0:00	0:00
14	10:18	0:00	0:00	10:04	5:14	0:00	0:00
15	19:18	0:00	0:00	17:44	0:00	0:00	0:00
16	18:49	0:00	0:00	17:05	1:10	0:00	0:00
17	19:19	0:00	0:00	19:19	0:00	0:00	0:00
18	14:39	0:00	0:00	15:54	0:00	0:00	0:00
19	19:23	0:00	0:00	19:20	0:00	0:00	0:00
20	19:18	0:00	0:00	19:20	0:00	0:00	0:00
21	19:20	0:00	0:00	19:18	5:00	0:00	0:00
22	19:47	0:00	0:00	19:48	4:16	0:00	0:00
23	15:47	0:00	0:00	15:47	5:34	0:00	0:00
24	4:49	0:00	0:00	4:44	0:00	0:00	0:00
25	6:20	0:00	0:00	1:36	0:00	0:00	0:00
26	12:38	0:00	0:00	19:00	4:40	0:00	0:00
27	14:12	0:00	0:00	14:02	5:33	0:00	0:00
28	17:44	0:00	0:00	19:19	0:00	0:00	0:00
29	19:38	0:00	0:00	19:40	0:00	0:00	0:00
30	14:05	0:00	0:00	19:05	0:00	0:00	0:00
31	17:44	0:00	0:00	10:30	5:00	0:00	0:00
Total (day)	31	0	0	31	12	0	0
Average (hour)	16.8	0.0	0.0	16.6	5.4	0.0	0.0

Daily Working Hour (Inline BPS)

Jun-16

Date	Pump No.1 32 Cusec	Pump No.2 32 Cusec	Pump No.3 32 Cusec	Pump No.4 32 Cusec	Pump No.5 16 Cusec	Pump No.6 16 Cusec	Pump No.7 16 Cusec
1	12:34	0:00	0:00	11:15	2:15	0:00	0:00
2	1:34	0:00	0:00	1:45	4:36	0:00	0:00
3	19:30	0:00	0:00	19:28	3:45	0:00	0:00
4	19:19	0:00	0:00	19:16	4:00	0:00	0:00
5	19:23	0:00	0:00	19:18	5:00	0:00	0:00
6	18:04	0:00	0:00	18:00	5:00	0:00	0:00
7	3:33	0:00	0:00	3:33	0:00	0:00	0:00
8	17:44	0:00	0:00	17:44	0:00	0:00	0:00
9	6:56	0:00	0:00	6:53	5:20	0:00	0:00
10	19:32	0:00	0:00	19:34	0:00	0:00	0:00
11	20:18	0:00	0:00	20:20	1:32	0:00	0:00
12	20:24	0:00	0:00	18:49	0:34	0:00	0:00
13	20:23	0:00	0:00	20:18	0:00	0:00	0:00
14	19:20	0:00	0:00	19:23	0:00	0:00	0:00
15	0:32	0:00	0:00	0:34	0:00	0:00	0:00
16	19:54	0:00	0:00	19:56	0:00	0:00	0:00
17	20:17	0:00	0:00	19:23	0:00	0:00	0:00
18	20:17	0:00	0:00	20:18	3:45	0:00	0:00
19	20:18	0:00	0:00	20:17	6:00	0:00	0:00
20	18:44	0:00	0:00	18:49	2:00	0:00	0:00
21	20:21	0:00	0:00	20:23	0:00	0:00	0:00
22	6:33	0:00	0:00	0:56	0:00	0:00	0:00
23	19:59	0:00	0:00	19:27	0:00	0:00	0:00
24	20:18	0:00	0:00	20:20	0:00	0:00	0:00
25	20:18	0:00	0:00	20:16	0:00	0:00	0:00
26	21:18	0:00	0:00	20:11	0:00	0:00	0:00
27	18:44	0:00	0:00	18:28	0:00	0:00	0:00
28	20:20	0:00	0:00	20:18	0:00	0:00	0:00
29	20:18	0:00	0:00	20:20	0:00	0:00	0:00
30	19:38	0:00	0:00	18:09	0:00	0:00	0:00
Total (day)	30	0	0	30	12	0	0
Average (hour)	16.9	0.0	0.0	16.5	3.6	0.0	0.0

Daily Working Hour (Inline BPS)

Jul-16

Date	Pump No.1 32 Cusec	Pump No.2 32 Cusec	Pump No.3 32 Cusec	Pump No.4 32 Cusec	Pump No.5 16 Cusec	Pump No.6 16 Cusec	Pump No.7 16 Cusec
1	20:20	0:00	0:00	20:18	0:00	0:00	0:00
2	20:18	0:00	0:00	20:20	0:00	0:00	0:00
3	14:34	0:00	0:00	14:32	0:00	0:00	0:00
4	20:18	0:00	0:00	20:18	0:00	0:00	0:00
5	20:18	0:00	0:00	20:18	0:00	0:00	0:00
6	18:44	0:00	4:20	18:44	0:00	0:00	0:00
7	11:35	0:00	2:20	11:35	6:00	0:00	0:00
8	0:00	0:00	2:00	18:44	0:00	0:00	0:00
9	11:06	0:00	11:01	9:27	0:00	0:00	0:00
10	20:18	0:00	18:44	3:56	0:00	0:00	0:00
11	18:44	0:00	0:00	20:18	0:00	0:00	0:00
12	20:23	0:00	18:44	20:19	2:30	0:00	0:00
13	20:17	0:00	0:00	20:19	0:00	0:00	0:00
14	18:31	0:00	0:00	5:00	12:15	0:00	0:00
15	20:20	0:00	0:00	20:23	2:30	0:00	0:00
16	20:23	0:00	0:00	20:18	2:41	0:00	0:00
17	15:58	0:00	0:00	15:57	10:17	0:00	0:00
18	15:16	0:00	2:20	15:29	9:25	0:00	0:00
19	20:19	0:00	0:00	20:23	3:30	0:00	0:00
20	19:33	0:00	0:00	19:25	0:00	0:00	0:00
21	18:44	0:00	0:00	20:18	3:05	0:00	0:00
22	18:08	0:00	0:00	18:08	3:04	0:00	0:00
23	21:07	0:00	0:00	20:18	2:34	0:00	0:00
24	20:18	0:00	0:00	20:16	7:20	0:00	0:00
25	20:18	0:00	0:00	20:18	0:00	0:00	0:00
26	19:33	0:00	0:00	19:32	4:08	0:00	0:00
27	20:20	0:00	0:00	20:18	0:00	0:00	0:00
28	16:12	0:00	0:00	3:54	11:25	0:00	0:00
29	21:09	0:00	0:00	21:04	3:20	0:00	0:00
30	18:30	0:00	0:00	18:36	2:20	0:00	0:00
31	20:18	0:00	0:00	20:18	0:00	0:00	0:00
Total (day)	30	0	7	31	16	0	0
Average (hour)	18.7	0.0	8.5	17.4	5.4	0.0	0.0

Daily Working Hour (Old TRPS)

(2015, August ~ 2016, July)

Daily Working Hour (OLD TRPS)

Aug-15

Date	Pump No.1 22 Cusec	Pump No.2 22 Cusec	Pump No.3 22 Cusec	Pump No.4 22 Cusec	Pump No.5 22 Cusec	Pump No.6 22 Cusec	Pump No.7 22 Cusec	Pump No.8 16 Cusec	Pump No.9 16 Cusec	Pump No.10 16 Cusec
1	0:00	2:04	6:09	0:00	0:00	0:00	3:57	0:00	2:01	5:53
2	0:00	0:00	4:05	4:03	0:00	0:00	5:55	0:00	2:02	5:53
3	0:00	0:00	6:09	4:00	0:00	0:00	3:57	0:00	2:02	5:53
4	0:00	0:00	6:09	4:00	0:00	0:00	3:57	0:00	2:02	5:53
5	0:00	0:00	6:09	4:02	0:00	0:00	3:57	0:00	2:02	5:53
6	0:00	0:00	6:09	4:02	0:00	0:00	1:58	0:00	4:00	5:53
7	0:00	0:00	4:04	2:01	0:00	0:00	3:57	0:00	4:01	5:52
8	0:00	2:03	2:01	4:02	0:00	0:00	3:57	0:00	0:00	3:52
9	0:00	2:03	4:05	4:02	0:00	0:00	1:58	0:00	2:02	5:53
10	0:00	2:03	4:05	0:00	0:00	0:00	1:58	0:00	2:04	3:56
11	0:00	0:00	2:04	0:00	0:00	0:00	0:00	0:00	2:04	2:01
12	0:00	0:00	2:04	4:01	0:00	0:00	3:57	0:00	0:00	5:50
13	0:00	2:03	4:00	4:02	0:00	0:00	5:51	0:00	3:48	4:34
14	0:00	4:00	4:05	4:02	0:00	0:00	1:58	0:00	4:01	5:53
15	0:00	2:03	4:05	4:02	0:00	0:00	6:00	0:00	2:02	5:53
16	0:00	2:05	6:08	0:00	0:00	0:00	1:58	0:00	4:01	5:49
17	0:00	0:00	4:05	4:02	0:00	0:00	3:56	0:00	2:02	5:53
18	0:00	2:04	6:03	4:02	0:00	0:00	1:58	0:00	2:02	5:55
19	0:00	2:03	6:05	4:02	0:00	0:00	1:58	0:00	2:02	5:53
20	0:00	2:03	4:04	4:02	0:00	0:00	1:58	0:00	4:01	2:51
21	0:00	2:03	4:05	4:02	0:00	0:00	1:58	0:00	4:01	5:53
22	0:00	4:06	6:08	4:04	0:00	0:00	1:58	0:00	2:02	5:53
23	0:00	0:00	6:08	0:00	0:00	0:00	1:58	0:00	4:01	5:54
24	0:00	2:03	4:05	4:02	0:00	0:00	1:58	0:00	4:00	5:48
25	0:00	2:03	2:01	4:02	0:00	0:00	4:04	0:00	4:01	5:48
26	0:00	2:03	4:00	4:02	0:00	0:00	2:02	0:00	4:42	5:01
27	0:00	2:04	4:05	4:01	0:00	0:00	1:58	0:00	5:57	1:59
28	0:00	2:03	6:08	4:01	0:00	0:00	3:55	0:00	5:57	0:00
29	0:00	2:03	6:08	4:01	0:00	0:00	2:01	0:00	5:54	0:00
30	0:00	0:00	4:00	6:04	0:00	0:00	4:04	0:00	5:56	0:00
31	0:00	2:03	4:00	6:04	0:00	0:00	2:02	0:00	3:55	0:00
Total (day)	0	20	31	26	0	0	30	0	29	27
Average (hour)	0.0	2.3	4.6	4.1	0.0	0.0	3.1	0.0	3.4	5.2

Daily Working Hour (OLD TRPS)

Sep-15

Date	Pump No.1 22 Cusec	Pump No.2 22 Cusec	Pump No.3 22 Cusec	Pump No.4 22 Cusec	Pump No.5 22 Cusec	Pump No.6 22 Cusec	Pump No.7 22 Cusec	Pump No.8 16 Cusec	Pump No.9 16 Cusec	Pump No.10 16 Cusec
1	0:00	2:03	4:00	4:02	0:00	0:00	6:03	0:00	5:56	0:00
2	0:00	0:00	6:02	4:02	0:00	0:00	6:02	0:00	5:53	0:00
3	0:00	2:04	6:01	4:02	0:00	0:00	4:03	0:00	5:53	0:00
4	0:00	2:03	6:01	4:02	0:00	0:00	4:04	0:00	5:53	0:00
5	0:00	2:03	4:00	4:02	0:00	0:00	6:03	0:00	5:53	0:00
6	0:00	0:00	6:01	4:02	0:00	0:00	6:02	0:00	5:53	0:00
7	0:00	2:03	2:00	4:02	0:00	0:00	4:02	0:00	3:55	0:00
8	0:00	0:00	6:00	4:02	0:00	0:00	6:02	0:00	3:58	0:00
9	0:00	0:00	6:00	4:02	0:00	0:00	6:03	2:04	3:51	0:00
10	0:00	2:04	6:01	4:02	0:00	0:00	4:03	2:02	3:58	0:00
11	0:00	2:03	4:00	2:01	0:00	0:00	6:02	2:05	3:58	0:00
12	0:00	2:03	6:01	4:02	0:00	0:00	4:03	2:05	3:58	0:00
13	0:00	2:03	6:01	2:02	0:00	0:00	4:03	2:05	3:58	0:00
14	0:00	1:33	5:58	4:02	0:00	0:00	4:03	2:05	3:27	0:00
15	0:00	4:06	6:02	4:02	0:00	0:00	4:10	2:04	3:58	0:00
16	0:00	0:00	6:01	4:02	0:00	0:00	4:03	2:05	5:53	0:00
17	0:00	0:00	3:09	1:08	0:00	0:00	2:02	0:00	2:56	0:00
18	0:00	2:03	4:01	6:04	0:00	0:00	4:03	0:00	5:53	0:00
19	0:00	2:03	6:01	4:02	0:00	0:00	4:03	0:00	5:53	0:00
20	0:00	2:03	2:01	6:04	0:00	0:00	2:46	0:00	4:41	0:00
21	0:00	2:03	6:01	4:02	0:00	0:00	4:00	0:00	5:50	0:00
22	0:00	1:33	6:01	4:02	0:00	0:00	4:01	0:00	5:21	0:00
23	0:00	1:20	6:01	4:02	0:00	0:00	4:03	0:00	5:10	0:00
24	0:00	2:03	6:01	4:32	0:00	0:00	4:03	0:00	5:52	0:00
25	0:00	2:03	6:01	4:00	0:00	0:00	4:02	0:00	5:50	0:00
26	0:00	2:03	6:01	4:02	0:00	0:00	4:03	0:00	5:52	0:00
27	0:00	2:03	6:01	4:02	0:00	0:00	4:02	0:00	5:52	0:00
28	0:00	2:03	6:01	4:00	0:00	0:00	4:02	0:00	5:52	0:00
29	0:00	2:03	6:01	4:00	0:00	0:00	4:02	0:00	5:52	0:00
30	0:00	2:03	6:01	4:00	0:00	0:00	4:02	0:00	5:52	0:00
Total (day)	0	24	30	30	0	0	30	8	30	0
Average (hour)	0.0	2.1	5.4	4.0	0.0	0.0	4.4	2.1	5.1	0.0

Daily Working Hour (OLD TRPS)

Oct-15

Date	Pump No.1 22 Cusec	Pump No.2 22 Cusec	Pump No.3 22 Cusec	Pump No.4 22 Cusec	Pump No.5 22 Cusec	Pump No.6 22 Cusec	Pump No.7 22 Cusec	Pump No.8 16 Cusec	Pump No.9 16 Cusec	Pump No.10 16 Cusec
1	0:00	0:00	6:01	4:02	0:00	0:00	4:02	0:00	1:55	0:00
2	0:00	0:00	4:20	4:02	0:00	0:00	4:15	0:00	4:12	0:00
3	0:00	0:00	2:05	4:02	0:00	0:00	4:00	0:00	5:53	0:00
4	0:00	2:03	6:05	4:02	0:00	0:00	4:00	0:00	5:53	0:00
5	0:00	2:04	6:05	4:02	0:00	0:00	4:00	0:00	5:51	0:00
6	0:00	2:04	6:05	4:00	0:00	0:00	4:00	0:00	5:50	0:00
7	0:00	0:00	6:05	4:01	0:00	0:00	6:00	0:00	5:52	0:00
8	0:00	2:03	6:05	4:01	0:00	0:00	3:56	0:00	5:52	0:00
9	0:00	2:03	6:05	4:01	0:00	0:00	4:56	0:00	5:51	0:00
10	0:00	0:00	6:05	4:01	0:00	0:00	6:02	0:00	5:51	0:00
11	0:00	0:00	6:05	4:02	0:00	0:00	4:00	0:00	3:56	0:00
12	0:00	2:04	6:05	4:02	0:00	0:00	4:03	0:00	5:51	0:00
13	0:00	2:04	6:05	6:05	0:00	0:00	3:58	0:00	5:51	0:00
14	0:00	2:03	6:05	4:02	0:00	0:00	3:53	0:00	5:42	0:00
15	0:00	2:03	6:05	4:02	0:00	0:00	5:58	0:00	3:52	0:00
16	0:00	2:03	6:05	4:00	0:00	0:00	4:00	0:00	5:54	0:00
17	0:00	4:06	6:05	4:00	0:00	0:00	3:40	0:00	4:57	0:00
18	0:00	0:00	6:05	4:02	0:00	0:00	4:00	0:00	5:51	0:00
19	0:00	4:04	6:05	4:02	0:00	0:00	2:02	0:00	5:58	0:00
20	0:00	4:04	6:05	6:04	0:00	0:00	2:01	0:00	5:51	0:00
21	0:00	4:05	6:05	4:02	0:00	0:00	0:00	0:00	5:47	0:00
22	0:00	2:04	6:05	6:04	0:00	0:00	0:00	0:00	5:51	0:00
23	0:00	4:06	6:05	2:01	0:00	0:00	0:00	0:00	5:52	0:00
24	0:00	4:07	6:05	4:02	0:00	0:00	0:00	0:00	5:53	0:00
25	0:00	4:05	6:05	4:02	0:00	0:00	0:00	0:00	5:53	0:00
26	0:00	4:06	6:05	4:02	0:00	0:00	0:00	0:00	2:59	0:00
27	0:00	2:33	6:05	6:04	2:00	0:00	0:00	0:00	7:00	0:00
28	0:00	2:03	6:05	6:04	0:00	0:00	0:00	0:00	5:49	0:00
29	0:00	2:03	6:05	6:04	0:00	0:00	0:00	0:00	3:55	0:00
30	0:00	0:00	6:05	6:04	1:59	0:00	0:00	0:00	5:52	0:00
31	0:00	2:04	6:05	6:04	0:00	0:00	0:00	0:00	1:59	0:00
Total (day)	0	23	31	31	2	0	20	0	31	0
Average (hour)	0.0	2.8	5.9	4.5	2.0	0.0	4.1	0.0	5.3	0.0

Daily Working Hour (OLD TRPS)

Nov-15

Date	Pump No.1 22 Cusec	Pump No.2 22 Cusec	Pump No.3 22 Cusec	Pump No.4 22 Cusec	Pump No.5 22 Cusec	Pump No.6 22 Cusec	Pump No.7 22 Cusec	Pump No.8 16 Cusec	Pump No.9 16 Cusec	Pump No.10 16 Cusec
1	0:00	2:09	6:05	6:04	0:00	0:00	0:00	0:00	3:54	0:00
2	0:00	2:09	6:05	6:04	2:00	0:00	0:00	0:00	3:56	0:00
3	0:00	4:05	6:05	6:04	1:50	0:00	0:00	0:00	3:49	0:00
4	0:00	0:00	6:05	4:02	1:59	0:00	0:00	0:00	3:56	0:00
5	0:00	2:09	4:04	4:02	4:00	0:00	0:00	0:00	3:56	0:00
6	0:00	2:09	6:10	6:04	0:00	0:00	0:00	0:00	5:54	0:00
7	0:00	0:00	2:04	2:01	0:00	0:00	0:00	0:00	1:59	0:00
8	0:00	2:09	6:05	4:02	2:00	0:00	0:00	0:00	5:34	0:00
9	0:00	2:04	4:02	4:02	4:01	0:00	0:00	0:00	1:57	1:53
10	0:00	2:04	4:09	6:04	1:59	0:00	0:00	0:00	0:00	3:56
11	0:00	2:07	6:03	2:01	2:00	0:00	0:00	0:00	1:59	1:57
12	0:00	2:03	4:05	4:02	2:00	0:00	0:00	0:00	1:57	3:56
13	0:00	2:03	0:00	6:02	0:00	0:00	0:00	0:00	0:00	5:53
14	0:00	2:03	2:01	4:02	2:00	0:00	0:00	2:02	0:00	3:55
15	0:00	2:03	6:04	4:02	2:00	0:00	0:00	0:00	1:57	3:56
16	0:00	2:03	6:04	6:04	0:00	0:00	0:00	0:00	1:57	3:56
17	0:00	2:03	6:04	6:04	0:00	0:00	0:00	0:00	0:00	5:53
18	0:00	2:03	2:01	6:04	2:01	0:00	0:00	2:02	0:00	3:54
19	0:00	2:03	6:09	4:02	2:00	0:00	0:00	2:01	0:00	3:53
20	0:00	2:03	4:01	6:04	2:01	0:00	0:00	2:02	0:00	3:53
21	0:00	2:04	4:04	4:02	2:01	0:00	0:00	2:02	0:00	3:53
22	0:00	2:04	6:05	4:02	3:58	0:00	0:00	2:02	0:00	3:53
23	0:00	2:04	4:01	6:04	2:01	0:00	0:00	2:02	0:00	3:53
24	0:00	2:03	4:03	4:02	2:00	0:00	0:00	2:02	0:00	3:53
25	0:00	2:03	6:09	4:02	4:02	0:00	0:00	2:02	0:00	1:57
26	0:00	2:03	6:01	2:01	0:00	0:00	3:58	2:01	0:00	5:52
27	0:00	0:00	6:03	4:02	4:00	0:00	0:00	2:02	0:00	3:53
28	0:00	0:00	4:03	6:04	1:58	0:00	2:01	0:00	0:00	5:50
29	0:00	2:04	4:09	2:00	6:00	0:00	0:00	2:02	0:00	3:53
30	0:00	0:00	2:03	6:04	5:07	0:00	0:00	2:02	2:58	1:57
Total (day)	0	25	29	30	23	0	2	13	14	22
Average (hour)	0.0	2.2	4.8	4.6	2.7	0.0	3.0	2.0	3.3	3.9

Daily Working Hour (OLD TRPS)

Dec-15

Date	Pump No.1 22 Cusec	Pump No.2 22 Cusec	Pump No.3 22 Cusec	Pump No.4 22 Cusec	Pump No.5 22 Cusec	Pump No.6 22 Cusec	Pump No.7 22 Cusec	Pump No.8 16 Cusec	Pump No.9 16 Cusec	Pump No.10 16 Cusec
1	0:00	2:03	4:01	4:02	2:00	0:00	0:00	2:02	0:00	1:57
2	0:00	2:03	6:01	4:02	2:01	0:00	0:00	2:02	0:00	3:54
3	0:00	0:00	6:04	4:02	4:00	0:00	0:00	2:02	0:00	3:54
4	0:00	2:03	4:04	4:02	4:00	0:00	1:59	2:02	0:00	3:54
5	0:00	0:00	2:03	2:00	4:02	0:00	1:59	2:02	0:00	3:54
6	0:00	0:00	0:00	6:09	4:00	0:00	4:00	4:05	0:00	1:57
7	0:00	0:00	4:07	6:04	2:00	0:00	2:01	0:00	0:00	5:52
8	0:00	2:00	6:09	2:01	2:01	0:00	6:01	2:02	0:00	3:54
9	0:00	0:00	0:00	4:02	0:00	0:00	4:02	2:02	0:00	1:57
10	0:00	2:03	0:00	4:02	2:01	0:00	6:00	2:02	0:00	3:58
11	0:00	0:00	6:09	6:04	0:00	0:00	2:24	2:02	0:00	3:54
12	0:00	0:00	0:00	6:04	4:01	0:00	6:00	2:02	0:00	3:54
13	0:00	2:03	0:00	4:02	0:00	0:00	6:00	2:07	0:00	3:54
14	0:00	2:19	0:00	6:09	0:00	0:00	6:02	4:07	0:00	1:57
15	0:00	2:03	2:03	6:04	2:01	0:00	6:00	4:05	0:00	1:57
16	0:00	0:00	1:59	4:02	2:01	0:00	4:01	2:02	0:00	3:54
17	0:00	0:00	2:03	6:04	0:00	0:00	6:00	2:02	0:00	5:54
18	0:00	0:00	0:00	4:02	2:00	0:00	4:00	0:00	0:00	1:57
19	0:00	0:00	0:00	6:04	2:01	0:00	6:01	2:02	0:00	3:54
20	0:00	2:03	2:03	4:02	0:00	0:00	6:00	2:02	0:00	3:54
21	0:00	0:00	2:03	4:02	5:01	0:00	1:59	4:05	0:00	1:57
22	0:00	2:03	2:03	2:00	4:00	0:00	3:59	2:02	0:00	1:57
23	0:00	0:00	2:03	4:00	2:00	0:00	6:00	4:05	0:00	1:57
24	0:00	0:00	2:03	4:00	0:00	0:00	6:07	2:02	0:00	3:54
25	0:00	2:03	2:01	4:02	2:00	0:00	6:00	4:05	0:00	1:57
26	0:00	2:03	2:03	4:02	4:03	0:00	4:00	4:05	0:00	1:57
27	0:00	2:03	2:01	4:02	0:00	0:00	4:00	2:02	0:00	3:54
28	0:00	0:00	2:01	4:02	2:02	0:00	4:00	4:05	0:00	1:57
29	0:00	4:03	2:03	4:02	2:00	0:00	4:02	2:02	0:00	3:54
30	0:00	4:02	0:00	6:04	2:01	0:00	4:00	0:00	0:00	3:54
31	0:00	0:00	4:06	0:00	1:58	0:00	4:01	2:02	0:00	0:00
Total (day)	0	15	22	30	23	0	28	28	0	30
Average (hour)	0.0	2.3	3.1	4.4	2.7	0.0	4.5	2.6	0.0	3.3

Daily Working Hour (OLD TRPS)

Jan-16

Date	Pump No.1 22 Cusec	Pump No.2 22 Cusec	Pump No.3 22 Cusec	Pump No.4 22 Cusec	Pump No.5 22 Cusec	Pump No.6 22 Cusec	Pump No.7 22 Cusec	Pump No.8 16 Cusec	Pump No.9 16 Cusec	Pump No.10 16 Cusec
1	2:33	2:01	2:03	0:00	2:00	0:00	4:01	4:05	0:00	1:57
2	0:00	2:00	0:00	4:02	2:02	0:00	6:01	4:05	0:00	1:57
3	0:00	6:03	5:01	0:00	2:01	0:00	2:08	2:02	0:00	3:54
4	0:00	2:01	4:07	2:01	0:00	1:58	4:01	2:02	0:00	3:54
5	0:00	2:02	2:03	0:00	2:03	2:01	6:01	2:02	0:00	5:50
6	0:00	4:04	2:01	4:02	2:01	0:00	3:57	2:02	0:00	3:52
7	0:00	2:03	4:04	2:02	1:58	2:01	4:00	4:05	0:00	3:05
8	0:00	2:03	0:00	6:01	4:00	0:00	5:58	0:00	1:56	3:52
9	0:00	0:00	2:03	6:04	1:58	4:03	3:57	0:00	0:00	3:52
10	0:00	2:01	4:06	0:00	6:00	0:00	6:08	0:00	0:00	3:52
11	0:00	0:00	2:03	2:01	4:04	6:00	3:57	0:00	0:00	1:55
12	0:00	2:03	2:01	2:01	0:00	1:58	1:58	0:00	1:56	1:55
13	0:00	2:03	2:01	4:01	4:01	4:00	3:56	0:00	1:56	0:00
14	0:00	0:00	2:03	4:02	4:00	2:00	4:00	0:00	0:00	5:46
15	0:00	0:00	0:00	1:29	0:00	1:16	1:13	1:11	0:00	0:00
16	1:30	0:00	0:00	1:52	1:41	3:58	3:39	2:04	0:00	3:31
17	0:00	0:00	2:03	1:20	1:18	1:05	4:19	2:02	0:00	2:16
18	0:00	0:00	0:00	3:10	0:00	1:23	2:06	2:03	0:00	2:12
19	1:36	0:00	0:00	2:09	1:00	1:33	4:07	1:32	0:00	0:55
20	4:32	0:00	0:00	6:02	0:00	2:00	1:57	2:03	0:00	1:57
21	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
22	0:00	0:00	0:00	4:00	0:00	4:00	3:57	4:06	0:00	0:00
23	0:00	0:00	2:03	0:00	2:00	2:01	5:02	3:03	0:00	0:00
24	2:33	0:00	2:03	4:02	0:00	2:00	4:00	5:05	0:00	0:00
25	4:36	0:00	0:00	0:00	0:00	4:02	4:00	6:08	0:00	0:00
26	4:07	0:00	2:01	2:00	0:00	2:01	4:00	6:08	0:00	0:00
27	2:03	0:00	0:00	2:00	0:00	2:00	4:02	2:02	0:00	1:55
28	2:07	0:00	0:00	4:00	0:00	2:01	4:00	6:08	0:00	0:00
29	4:07	0:00	0:00	2:00	0:00	2:01	6:00	4:05	0:00	1:56
30	2:07	4:00	0:00	0:00	0:00	2:01	3:59	6:07	0:00	0:00
31	4:05	0:00	0:00	4:00	0:00	4:00	2:01	4:06	0:00	1:57
Total (day)	12	12	16	23	16	24	30	23	3	21
Average (hour)	3.0	2.7	2.6	3.2	2.6	2.6	3.9	3.4	1.9	3.0

Daily Working Hour (OLD TRPS)

Feb-16

Date	Pump No.1 22 Cusec	Pump No.2 22 Cusec	Pump No.3 22 Cusec	Pump No.4 22 Cusec	Pump No.5 22 Cusec	Pump No.6 22 Cusec	Pump No.7 22 Cusec	Pump No.8 16 Cusec	Pump No.9 16 Cusec	Pump No.10 16 Cusec
1	2:03	0:00	0:00	0:00	0:00	2:03	4:02	4:04	0:00	0:00
2	4:07	0:00	0:00	4:01	2:00	2:01	2:01	4:05	0:00	0:00
3	6:09	0:00	0:00	4:01	2:01	0:00	2:00	4:06	1:58	0:00
4	4:05	0:00	0:00	4:01	0:00	4:01	1:59	6:07	0:00	0:00
5	6:10	0:00	0:00	2:00	0:00	2:01	4:00	6:08	0:00	0:00
6	6:09	0:00	0:00	2:00	2:00	0:00	6:00	6:08	0:00	0:00
7	4:05	2:01	0:00	4:01	0:00	0:00	2:08	2:02	0:00	3:52
8	2:04	0:00	0:00	6:04	2:00	2:00	1:58	2:02	0:00	1:55
9	4:05	0:00	0:00	6:04	0:00	1:31	1:59	2:02	0:00	3:24
10	4:10	0:00	0:00	4:02	0:00	2:01	4:00	2:02	0:00	5:49
11	4:06	2:01	0:00	4:00	0:00	2:00	1:59	2:02	0:00	1:55
12	4:06	0:00	0:00	6:04	2:01	0:00	5:53	2:02	0:00	1:57
13	4:06	0:00	0:00	2:00	0:00	0:00	1:59	2:02	0:00	1:57
14	4:06	0:00	0:00	2:00	0:00	2:01	4:00	6:07	0:00	1:33
15	4:06	0:00	0:00	0:00	2:01	1:59	6:01	0:00	0:00	5:50
16	4:06	0:00	0:00	4:00	0:00	2:01	4:00	2:02	0:00	3:52
17	6:10	0:00	0:00	4:00	0:00	0:00	4:00	2:02	0:00	3:52
18	4:06	2:03	0:00	4:00	0:00	2:01	4:00	2:02	0:00	3:52
19	4:06	0:00	0:00	6:04	0:00	0:00	4:00	2:02	0:00	3:54
20	4:06	0:00	0:00	6:04	0:00	0:00	4:00	2:02	0:00	3:52
21	4:06	0:00	0:00	6:04	0:00	2:01	4:00	2:02	0:00	3:52
22	4:06	0:00	0:00	6:02	0:00	1:59	2:00	2:02	0:00	3:52
23	4:06	0:00	0:00	6:04	2:01	1:55	1:59	2:02	0:00	3:57
24	6:10	0:00	0:00	4:02	2:00	3:57	3:54	4:05	0:00	3:51
25	4:09	0:00	0:00	4:00	0:00	0:00	3:59	2:02	0:00	3:52
26	4:09	0:00	0:00	6:09	0:00	2:01	1:59	2:02	0:00	3:52
27	4:09	0:00	0:00	6:09	0:00	2:01	6:01	2:02	1:58	3:54
28	4:09	0:00	0:00	2:00	0:00	2:01	4:00	2:02	0:00	3:52
29	4:09	0:00	0:00	4:00	0:00	1:59	2:00	2:02	0:00	3:52
Total (day)	29	3	0	27	8	20	29	28	2	23
Average (hour)	4.3	2.0	0.0	4.4	2.0	2.2	3.4	2.9	2.0	3.6

Daily Working Hour (OLD TRPS)

Mar-16

Date	Pump No.1 22 Cusec	Pump No.2 22 Cusec	Pump No.3 22 Cusec	Pump No.4 22 Cusec	Pump No.5 22 Cusec	Pump No.6 22 Cusec	Pump No.7 22 Cusec	Pump No.8 16 Cusec	Pump No.9 16 Cusec	Pump No.10 16 Cusec
1	4:06	0:00	0:00	6:02	0:00	1:59	2:01	2:02	0:00	3:52
2	4:06	0:00	0:00	2:01	0:00	2:01	6:00	2:02	0:00	3:52
3	4:06	0:00	0:00	4:01	0:00	1:59	2:01	2:02	0:00	3:52
4	4:06	0:00	0:00	1:26	0:00	2:01	5:56	2:02	0:00	3:47
5	4:06	0:00	0:00	4:01	0:00	2:01	4:00	2:04	0:00	3:52
6	6:10	0:00	0:00	4:01	0:00	2:01	3:57	2:02	0:00	3:52
7	4:06	0:00	0:00	6:01	0:00	1:59	1:59	2:00	0:00	3:51
8	4:06	0:00	0:00	2:01	0:00	0:00	6:00	2:02	0:00	3:54
9	4:06	0:00	0:00	2:01	0:00	2:01	6:01	2:02	0:00	3:54
10	6:10	0:00	0:00	2:01	0:00	2:01	4:00	2:02	0:00	3:54
11	4:06	0:00	0:00	4:01	0:00	1:56	3:56	2:02	0:00	3:59
12	6:10	0:00	0:00	2:01	0:00	2:01	4:00	1:58	0:00	3:52
13	4:06	0:00	0:00	4:03	0:00	2:01	4:00	1:58	0:00	3:52
14	6:10	0:00	0:00	4:27	0:00	0:00	6:50	1:58	0:00	4:42
15	4:06	0:00	0:00	2:01	0:00	3:02	7:01	1:58	0:00	5:52
16	3:03	0:00	0:00	3:33	0:00	3:02	6:32	1:58	0:00	4:29
17	4:06	0:00	0:00	2:02	0:00	3:02	6:01	1:59	0:00	3:54
18	4:06	2:03	0:00	4:05	0:00	4:02	6:00	1:58	0:00	3:54
19	4:06	0:00	0:00	4:04	0:00	2:01	6:00	1:58	0:00	3:54
20	4:06	0:00	0:00	0:00	0:00	2:01	3:59	1:58	0:00	1:57
21	4:06	0:00	0:00	2:01	0:00	1:55	6:54	1:59	0:00	3:48
22	4:06	0:00	0:00	2:01	0:00	2:01	6:00	1:58	0:00	3:54
23	4:06	0:00	0:00	2:01	4:00	0:00	6:05	1:58	0:00	3:54
24	4:06	2:01	0:00	2:01	0:00	0:00	6:00	1:58	0:00	3:54
25	4:06	2:01	0:00	2:01	0:00	0:00	6:00	1:58	0:00	3:54
26	4:06	0:00	0:00	2:01	0:00	0:00	6:02	1:58	0:00	3:54
27	4:06	2:01	0:00	2:01	0:00	0:00	4:00	1:58	0:00	1:56
28	4:06	0:00	0:00	2:01	0:00	4:01	6:01	0:00	0:00	3:54
29	4:06	0:00	0:00	0:00	0:00	0:00	6:01	1:58	0:00	3:54
30	4:06	0:00	0:00	2:01	0:00	2:01	6:01	1:58	0:00	3:54
31	2:03	0:00	0:00	2:03	0:00	2:01	6:01	1:58	0:00	3:54
Total (day)	31	4	0	29	1	23	31	30	0	31
Average (hour)	4.3	2.0	0.0	2.9	4.0	2.3	5.2	2.0	0.0	3.9

Daily Working Hour (OLD TRPS)

Apr-16

Date	Pump No.1 22 Cusec	Pump No.2 22 Cusec	Pump No.3 22 Cusec	Pump No.4 22 Cusec	Pump No.5 22 Cusec	Pump No.6 22 Cusec	Pump No.7 22 Cusec	Pump No.8 16 Cusec	Pump No.9 16 Cusec	Pump No.10 16 Cusec
1	4:05	0:00	0:00	6:04	0:00	0:00	4:01	1:58	0:00	3:54
2	4:05	2:00	0:00	2:01	0:00	0:00	6:00	0:00	1:58	3:54
3	4:05	0:00	0:00	2:01	0:00	0:00	5:58	0:00	0:00	3:52
4	4:05	0:00	0:00	6:01	0:00	0:00	4:00	1:58	0:00	3:54
5	4:05	0:00	0:00	2:01	0:00	2:01	6:00	0:00	0:00	5:52
6	4:05	0:00	0:00	4:01	0:00	2:01	4:00	0:00	0:00	5:52
7	4:05	0:00	0:00	2:01	0:00	0:00	4:00	0:00	0:00	3:55
8	4:05	0:00	0:00	2:01	2:01	1:59	0:00	0:00	0:00	3:55
9	4:05	0:00	0:00	6:02	0:00	2:01	4:00	0:00	0:00	5:52
10	4:05	0:00	0:00	2:01	0:00	2:01	6:00	0:00	0:00	5:52
11	4:06	0:00	0:00	4:05	0:00	2:01	4:00	1:58	0:00	3:56
12	4:06	0:00	0:00	6:04	0:00	1:59	4:00	0:00	0:00	5:52
13	4:06	0:00	0:00	2:01	0:00	1:59	4:00	0:00	0:00	5:58
14	4:06	0:00	0:00	2:00	2:01	1:59	4:00	0:00	0:00	5:52
15	2:03	2:01	0:00	2:01	0:00	2:01	6:00	0:00	0:00	5:52
16	2:03	0:00	0:00	2:03	0:00	2:01	4:00	0:00	0:00	3:55
17	4:06	2:01	0:00	4:01	2:00	2:00	0:00	0:00	0:00	5:52
18	2:09	0:00	0:00	4:03	0:00	2:01	6:05	0:00	0:00	5:52
19	4:06	0:00	0:00	2:01	0:00	2:01	6:00	0:00	0:00	5:52
20	4:06	0:00	0:00	4:01	0:00	2:01	5:47	0:00	0:00	3:42
21	4:06	0:00	0:00	5:55	2:00	1:56	2:00	0:00	0:00	4:47
22	2:03	0:00	0:00	0:00	2:01	1:59	4:01	0:00	0:00	5:52
23	2:03	2:03	0:00	4:02	0:00	1:59	3:01	0:00	0:00	5:52
24	2:03	0:00	0:00	2:01	2:03	2:01	6:00	0:00	0:00	5:52
25	4:06	0:00	0:00	4:02	0:00	1:59	4:01	1:58	0:00	3:54
26	6:10	0:00	0:00	0:00	0:00	2:01	6:00	1:58	0:00	3:54
27	4:06	0:00	0:00	4:02	2:01	1:59	2:00	0:00	0:00	5:52
28	4:06	0:00	0:00	2:01	2:00	1:59	4:01	1:58	0:00	3:54
29	6:10	0:00	0:00	2:00	0:00	1:59	4:08	3:57	0:00	3:52
30	6:10	0:00	0:00	6:01	0:00	2:01	3:56	1:58	0:00	3:52
Total (day)	29	4	0	27	8	25	27	7	1	29
Average (hour)	3.9	2.0	0.0	3.4	2.0	2.0	4.6	2.3	2.0	4.9

Daily Working Hour (OLD TRPS)

May-16

Date	Pump No.1 22 Cusec	Pump No.2 22 Cusec	Pump No.3 22 Cusec	Pump No.4 22 Cusec	Pump No.5 22 Cusec	Pump No.6 22 Cusec	Pump No.7 22 Cusec	Pump No.8 16 Cusec	Pump No.9 16 Cusec	Pump No.10 16 Cusec
1	4:06	0:00	0:00	6:06	0:00	4:02	3:58	0:00	0:00	5:56
2	2:03	0:00	0:00	4:04	0:00	4:00	0:00	0:00	0:00	1:58
3	2:03	0:00	0:00	2:00	2:03	2:01	6:00	1:58	0:00	3:56
4	2:03	4:03	0:00	2:01	0:00	1:58	1:59	0:00	0:00	1:58
5	2:03	0:00	0:00	6:04	0:00	0:00	4:00	2:00	0:00	3:54
6	2:03	0:00	0:00	2:03	0:00	2:01	6:00	1:58	0:00	3:54
7	4:06	0:00	0:00	4:01	0:00	1:59	4:01	1:58	0:00	3:54
8	4:06	0:00	0:00	1:57	0:00	2:01	6:00	0:00	0:00	5:52
9	2:03	0:00	0:00	4:04	0:00	2:01	6:01	1:58	0:00	3:54
10	7:02	0:00	0:00	4:01	0:00	1:59	3:54	1:58	0:00	3:54
11	4:06	0:00	0:00	4:01	0:00	1:59	6:00	1:58	0:00	3:54
12	4:06	0:00	0:00	4:01	0:00	0:00	4:01	1:58	0:00	3:54
13	4:06	2:01	0:00	2:01	0:00	0:00	4:00	1:58	0:00	3:54
14	2:03	2:04	1:59	2:01	0:00	0:00	6:02	1:58	0:00	3:56
15	4:06	0:00	0:00	2:01	0:00	2:01	6:00	2:02	0:00	3:54
16	4:06	0:00	0:00	4:00	0:00	1:59	4:02	2:02	0:00	3:53
17	2:03	0:00	0:00	4:04	0:00	0:00	6:08	1:58	0:00	3:54
18	4:03	0:00	2:01	2:00	0:00	1:59	4:02	2:00	0:00	3:54
19	4:06	0:00	0:00	2:00	0:00	1:59	6:01	1:58	0:00	3:54
20	4:06	0:00	0:00	0:00	0:00	2:01	6:00	1:58	0:00	3:54
21	4:06	0:00	0:00	4:03	0:00	2:01	4:00	1:58	0:00	4:24
22	4:33	2:31	0:00	4:32	0:00	0:00	4:32	1:58	0:00	4:54
23	4:33	0:00	0:00	2:30	2:31	2:31	4:32	1:58	0:00	4:59
24	0:00	0:00	0:00	0:00	2:31	0:00	0:00	0:00	0:00	0:00
25	2:03	0:00	0:00	5:03	0:00	2:01	4:30	1:58	0:00	4:54
26	4:33	0:00	0:00	0:00	0:00	2:31	7:00	1:58	0:00	4:54
27	0:00	2:07	2:01	2:31	0:00	4:01	6:58	0:00	0:00	2:27
28	2:02	0:00	0:00	4:33	0:00	0:00	2:31	1:58	0:00	4:55
29	2:06	0:00	0:00	4:59	0:00	2:27	7:01	0:00	0:00	4:54
30	4:06	0:00	0:00	4:02	0:00	1:58	2:30	1:58	0:00	2:27
31	4:31	0:00	0:00	2:27	0:00	2:28	2:01	1:58	0:00	4:54
Total (day)	28	5	3	27	3	22	28	24	0	29
Average (hour)	3.5	2.6	2.0	3.4	2.4	2.3	4.8	2.0	0.0	4.0

Daily Working Hour (OLD TRPS)

Jun-16

Date	Pump No.1 22 Cusec	Pump No.2 22 Cusec	Pump No.3 22 Cusec	Pump No.4 22 Cusec	Pump No.5 22 Cusec	Pump No.6 22 Cusec	Pump No.7 22 Cusec	Pump No.8 16 Cusec	Pump No.9 16 Cusec	Pump No.10 16 Cusec
1	2:33	0:00	0:00	2:29	2:01	2:27	0:00	1:58	0:00	4:24
2	0:00	0:00	0:00	7:01	0:00	5:56	0:00	1:58	0:00	4:54
3	2:33	0:00	0:00	2:32	2:33	2:30	0:00	1:58	0:00	4:54
4	2:04	0:00	0:00	0:00	0:00	5:00	0:00	1:59	0:00	4:54
5	6:09	0:00	0:00	7:01	0:00	4:59	0:00	1:58	0:00	4:54
6	4:06	0:00	0:00	7:03	2:01	4:06	0:00	1:58	0:00	4:11
7	6:09	0:00	0:00	4:03	2:01	1:59	0:00	3:00	0:00	3:58
8	4:06	0:00	0:00	4:02	0:00	1:59	0:00	2:00	0:00	3:58
9	9:06	0:00	0:00	6:01	0:00	1:59	0:00	3:19	0:00	3:54
10	4:06	0:00	0:00	6:02	0:00	1:59	0:00	3:58	0:00	3:58
11	6:09	0:00	0:00	6:01	0:00	1:59	0:00	1:58	0:00	3:58
12	0:00	0:00	0:00	6:02	0:00	1:59	0:00	3:01	0:00	3:54
13	4:06	0:00	0:00	3:54	0:00	1:50	0:00	2:02	0:00	3:48
14	6:09	0:00	0:00	6:02	2:01	1:59	0:00	3:02	0:00	3:54
15	6:09	0:00	0:00	2:00	2:01	3:56	0:00	1:05	0:00	5:51
16	6:09	0:00	0:00	2:00	0:00	0:00	2:01	3:04	0:00	3:54
17	4:04	0:00	0:00	4:01	2:00	1:59	0:00	1:06	0:00	1:57
18	6:09	0:00	0:00	4:33	0:00	1:59	0:00	3:34	0:00	3:54
19	6:09	0:00	0:00	6:03	0:00	1:59	0:00	3:04	0:00	3:54
20	6:09	0:00	0:00	6:33	0:00	1:59	0:00	1:58	0:00	4:21
21	6:09	0:00	0:00	7:01	1:58	1:59	0:00	3:28	0:00	4:21
22	4:32	0:00	0:00	5:01	0:00	0:00	0:00	4:27	0:00	4:15
23	4:32	0:00	0:00	7:01	0:00	1:59	2:30	3:04	0:00	4:24
24	6:34	0:00	0:00	6:47	0:00	1:59	0:00	0:55	0:00	4:08
25	2:34	0:00	0:00	5:01	0:00	0:00	0:00	3:31	0:00	2:24
26	6:34	2:01	0:00	4:11	0:00	1:59	0:00	0:00	0:00	4:12
27	6:34	0:00	0:00	7:03	0:00	3:58	0:00	0:00	0:00	6:49
28	2:34	0:00	0:00	6:33	0:00	0:00	2:30	3:33	0:00	4:22
29	2:34	0:00	0:00	4:02	0:00	1:59	0:00	2:28	0:00	1:57
30	2:34	0:00	0:00	6:33	0:00	1:59	2:30	2:28	0:00	4:24
Total (day)	28	1	0	29	8	26	4	28	0	30
Average (hour)	4.9	2.0	0.0	5.3	2.1	2.6	2.4	2.6	0.0	4.2

Daily Working Hour (OLD TRPS)

Jul-16

Date	Pump No.1 22 Cusec	Pump No.2 22 Cusec	Pump No.3 22 Cusec	Pump No.4 22 Cusec	Pump No.5 22 Cusec	Pump No.6 22 Cusec	Pump No.7 22 Cusec	Pump No.8 16 Cusec	Pump No.9 16 Cusec	Pump No.10 16 Cusec
1	4:00	0:00	4:00	6:30	2:00	1:59	2:30	2:30	0:00	4:30
2	6:00	0:00	0:00	6:30	0:00	3:42	2:31	4:30	0:00	3:58
3	6:00	0:00	0:00	6:38	0:00	1:59	0:00	4:30	0:00	4:24
4	6:30	0:00	0:00	6:38	0:00	0:00	0:00	4:30	0:00	2:27
5	5:00	0:00	0:00	5:00	0:00	0:00	0:00	4:30	0:00	0:00
6	7:00	0:00	0:00	6:30	0:00	4:31	0:00	2:30	0:00	4:00
7	6:30	0:00	0:00	6:30	0:00	6:30	0:00	0:00	0:00	4:23
8	7:00	0:00	0:00	4:30	0:00	6:29	2:31	0:00	0:00	4:23
9	4:30	0:00	0:00	3:30	2:00	4:31	5:30	1:00	0:00	2:25
10	7:00	0:00	0:00	6:30	0:00	4:27	2:30	2:30	0:00	3:27
11	7:00	0:00	0:00	6:30	0:00	1:59	4:57	2:30	0:00	4:23
12	7:00	0:00	0:00	6:30	0:00	0:00	4:56	2:30	0:00	2:25
13	4:00	0:00	0:00	4:30	0:00	1:59	4:52	2:30	0:00	4:23
14	6:30	0:00	0:00	6:30	0:00	1:59	4:57	2:30	0:00	4:23
15	6:30	0:00	0:00	6:30	0:00	1:59	4:57	2:30	0:00	4:20
16	6:30	0:00	0:00	6:30	0:00	1:59	4:57	2:30	0:00	1:57
17	6:30	2:00	0:00	6:30	0:00	0:00	2:28	2:30	0:00	1:57
18	4:30	0:00	0:00	5:00	0:00	1:59	2:30	1:00	0:00	1:57
19	6:30	0:00	0:00	4:30	0:00	1:59	5:00	2:30	0:00	1:57
20	6:30	0:00	0:00	6:30	0:00	0:00	2:27	2:30	0:00	1:57
21	6:30	0:00	0:00	4:30	2:00	0:00	6:47	2:30	0:00	1:57
22	6:30	0:00	0:00	2:30	0:00	1:59	4:59	2:30	0:00	1:57
23	6:30	0:00	0:00	4:30	2:00	0:00	4:56	2:30	0:00	1:57
24	6:30	0:00	0:00	2:00	0:00	2:09	6:57	2:30	0:00	1:57
25	4:30	0:00	0:00	6:30	0:00	1:59	4:58	2:30	0:00	1:57
26	6:30	0:00	0:00	0:00	2:00	1:59	4:57	2:30	0:00	1:57
27	6:30	0:00	0:00	6:30	0:00	1:59	4:58	2:30	0:00	1:57
28	5:30	0:00	0:00	2:00	0:00	0:00	3:29	2:30	0:00	1:57
29	6:30	0:00	0:00	6:30	0:00	0:00	5:00	2:30	0:00	1:57
30	6:30	0:00	0:00	4:30	2:00	1:59	3:24	2:30	0:00	1:57
31	6:30	0:00	0:00	6:30	0:00	0:00	2:28	0:00	0:00	1:57
Total (day)	31	1	1	30	6	21	26	28	0	30
Average (hour)	6.1	2.0	4.0	5.5	2.0	2.9	4.2	2.7	0.0	2.8

Daily Working Hour (JBC BPS)

(2015, August ~ 2016, July)

Daily Working Hour (JBC BPS)

Aug-15

Date	Pump No.1 15 Cusec	Pump No.2 15 Cusec	Pump No.3 15 Cusec	Pump No.4 15 Cusec
1	0:00	0:00	17:25	17:53
2	0:00	0:00	17:53	17:48
3	0:00	0:00	17:50	17:50
4	0:00	0:00	17:55	17:50
5	0:00	0:00	17:48	17:44
6	0:00	0:00	17:17	17:13
7	0:00	0:00	17:33	17:27
8	0:00	0:00	17:54	17:53
9	0:00	0:00	18:25	17:45
10	0:00	0:00	15:45	16:19
11	0:00	0:00	17:51	17:46
12	0:00	0:00	17:47	17:42
13	0:00	0:00	19:53	19:41
14	0:00	0:00	18:05	18:03
15	0:00	0:00	17:55	17:50
16	0:00	0:00	17:25	17:18
17	0:00	0:00	18:24	18:20
18	0:00	0:00	17:24	17:25
19	0:00	0:00	18:10	18:08
20	0:00	0:00	17:55	17:50
21	0:00	0:00	17:55	17:50
22	0:00	0:00	17:50	17:50
23	0:00	0:00	17:50	17:45
24	0:00	0:00	17:52	17:47
25	0:00	0:00	17:52	17:53
26	0:00	0:00	17:45	17:40
27	0:00	0:00	17:43	17:42
28	0:00	0:00	18:00	18:02
29	0:00	0:00	18:00	17:01
30	0:00	0:00	17:12	17:10
31	0:00	0:00	18:04	17:03
Total (day)	0	0	30	30
Average (hour)	0.0	0.0	18.4	18.3

Daily Working Hour (JBC BPS)

Sep-15

Date	Pump No.1 15 Cusec	Pump No.2 15 Cusec	Pump No.3 15 Cusec	Pump No.4 15 Cusec
1	0:00	0:00	16:52	16:46
2	0:00	0:00	17:01	17:05
3	0:00	0:00	16:50	16:46
4	0:00	0:00	16:55	16:48
5	0:00	0:00	16:59	17:00
6	0:00	0:00	17:17	17:15
7	0:00	0:00	17:11	17:09
8	0:00	0:00	17:50	17:46
9	0:00	0:00	17:00	16:07
10	0:00	0:00	16:22	16:22
11	0:00	0:00	17:12	17:11
12	0:00	0:00	17:15	17:14
13	0:00	0:00	17:39	17:41
14	0:00	0:00	17:48	16:45
15	0:00	0:00	17:25	17:23
16	0:00	0:00	17:45	17:43
17	0:00	0:00	7:03	7:05
18	0:00	0:00	17:27	17:25
19	0:00	0:00	16:54	16:53
20	0:00	0:00	17:36	17:35
21	0:00	0:00	17:25	17:31
22	0:00	0:00	15:40	15:38
23	0:00	0:20	16:45	16:45
24	0:00	0:00	17:46	17:47
25	0:00	0:00	16:52	16:53
26	0:00	0:00	16:40	16:25
27	0:00	0:00	17:24	17:27
28	0:00	0:00	17:27	17:26
29	0:00	0:00	17:25	17:20
30	0:00	0:00	16:27	16:22
Total (day)	0	1	29	29
Average (hour)	0.0	0.3	17.4	17.3

Daily Working Hour (JBC BPS)

Oct-15

Date	Pump No.1 15 Cusec	Pump No.2 15 Cusec	Pump No.3 15 Cusec	Pump No.4 15 Cusec
1	0:00	0:00	17:35	17:32
2	0:00	0:00	17:36	17:32
3	0:00	0:00	17:22	17:24
4	0:00	0:00	17:25	17:27
5	0:00	0:00	11:00	11:14
6	0:00	0:00	17:22	17:25
7	0:00	0:00	17:20	13:22
8	0:00	0:00	17:22	17:25
9	0:00	0:00	17:22	17:25
10	0:00	0:00	17:31	17:40
11	0:00	0:00	17:00	17:20
12	0:00	0:20	11:00	11:00
13	0:00	1:00	17:33	17:20
14	0:00	0:00	17:36	17:37
15	0:00	0:00	16:32	16:07
16	0:00	0:00	17:10	17:08
17	0:00	0:00	16:50	16:51
18	0:00	0:00	17:37	17:25
19	0:00	0:00	16:47	16:41
20	0:00	0:00	17:24	17:25
21	0:00	0:00	18:35	18:25
22	0:00	0:00	17:34	17:28
23	0:00	0:00	17:22	17:27
24	0:00	0:00	17:11	17:07
25	0:00	0:00	17:22	17:27
26	0:00	0:00	17:30	17:25
27	0:00	0:00	17:16	17:22
28	0:00	0:00	17:20	17:25
29	0:00	0:00	17:35	17:30
30	0:00	0:00	17:21	17:25
31	0:00	0:00	17:26	17:22
Total (day)	0	2	31	31
Average (hour)	0.0	0.7	17.0	16.8

Daily Working Hour (JBC BPS)

Nov-15

Date	Pump No.1 15 Cusec	Pump No.2 15 Cusec	Pump No.3 15 Cusec	Pump No.4 15 Cusec
1	0:00	0:00	17:21	17:25
2	0:00	0:00	17:27	17:27
3	0:00	0:00	17:27	14:39
4	0:00	0:00	15:10	15:08
5	0:00	0:00	17:22	17:25
6	0:00	0:00	17:30	17:31
7	0:00	0:00	19:27	19:36
8	0:00	0:00	16:48	16:49
9	0:00	0:00	17:20	17:27
10	0:00	0:50	16:41	16:38
11	0:00	0:00	11:22	17:23
12	0:00	0:00	17:22	17:25
13	0:00	0:00	17:40	17:35
14	0:00	0:00	13:52	17:05
15	0:00	0:00	17:25	17:22
16	0:00	0:00	17:17	17:15
17	0:00	0:00	17:11	13:20
18	0:00	0:00	17:12	17:07
19	0:00	0:00	17:06	17:10
20	0:00	0:00	16:34	16:35
21	0:00	0:00	16:37	17:38
22	0:00	0:00	16:25	16:18
23	0:00	0:00	16:00	16:55
24	0:00	0:00	16:45	16:42
25	0:00	0:00	16:31	16:45
26	0:00	0:00	16:45	16:35
27	0:00	0:00	16:34	16:40
28	0:00	0:00	16:42	16:36
29	0:00	0:00	16:36	16:40
30	0:00	0:00	13:34	13:30
Total (day)	0	1	30	30
Average (hour)	0.0	0.8	16.6	16.8

Daily Working Hour (JBC BPS)

Dec-15

Date	Pump No.1 15 Cusec	Pump No.2 15 Cusec	Pump No.3 15 Cusec	Pump No.4 15 Cusec
1	0:00	0:00	15:50	15:48
2	0:00	0:00	15:40	15:38
3	0:00	1:45	15:21	15:27
4	0:00	0:00	15:24	15:25
5	0:00	0:00	13:08	15:40
6	0:00	1:55	15:03	15:55
7	0:00	0:45	15:48	15:43
8	0:00	0:00	13:47	13:52
9	0:00	0:00	10:50	11:58
10	0:00	0:00	15:37	15:38
11	0:00	0:00	15:30	15:30
12	0:00	0:00	15:06	15:07
13	0:00	0:00	15:10	15:25
14	0:00	1:04	15:25	15:27
15	0:00	0:00	15:15	15:12
16	0:00	0:00	15:35	15:30
17	0:00	0:00	15:26	15:26
18	0:00	1:11	15:28	15:31
19	0:00	0:00	15:24	15:25
20	0:00	0:00	15:23	15:27
21	0:00	3:25	16:45	16:53
22	0:00	5:25	12:24	12:52
23	0:00	0:00	13:20	13:24
24	0:00	0:00	13:42	15:42
25	0:00	0:00	13:47	13:45
26	0:00	0:00	14:12	14:07
27	0:00	0:00	14:01	14:00
28	0:00	3:43	13:45	13:41
29	0:00	0:00	15:17	14:45
30	0:00	0:00	14:15	14:07
31	0:00	3:21	15:15	15:17
Total (day)	0	9	31	31
Average (hour)	0.0	2.5	14.7	15.0

Daily Working Hour (JBC BPS)

Jan-16

Date	Pump No.1 15 Cusec	Pump No.2 15 Cusec	Pump No.3 15 Cusec	Pump No.4 15 Cusec
1	0:00	0:00	14:13	14:06
2	0:00	0:00	14:31	14:25
3	0:00	0:00	14:18	14:25
4	0:00	0:55	14:16	14:20
5	0:00	0:00	14:12	14:18
6	0:00	0:50	14:23	14:20
7	0:00	0:00	14:40	14:40
8	0:00	2:00	14:16	14:20
9	0:00	0:00	14:24	14:26
10	0:00	0:00	14:35	14:36
11	0:00	0:00	14:43	13:52
12	0:00	0:00	13:45	14:38
13	0:00	1:25	9:49	9:46
14	0:00	1:15	14:37	14:35
15	0:00	1:17	12:30	14:23
16	0:00	0:56	14:06	14:10
17	0:00	0:00	14:40	14:36
18	0:00	0:00	12:30	13:37
19	0:00	0:00	12:22	13:40
20	0:00	1:03	13:47	13:51
21	0:00	0:00	0:00	0:00
22	0:00	2:00	1:00	8:40
23	0:00	0:15	12:00	12:03
24	0:00	0:00	13:57	15:40
25	0:00	0:00	14:38	14:39
26	0:00	3:20	14:38	15:47
27	0:00	2:00	9:25	10:42
28	0:00	0:00	14:21	14:21
29	0:00	0:00	14:18	14:15
30	0:00	0:00	14:40	14:46
31	0:00	0:00	13:40	14:43
Total (day)	0	12	30	30
Average (hour)	0.0	1.4	13.3	13.9

Daily Working Hour (JBC BPS)

Feb-16

Date	Pump No.1 15 Cusec	Pump No.2 15 Cusec	Pump No.3 15 Cusec	Pump No.4 15 Cusec
1	0:00	1:50	16:56	16:55
2	0:00	0:00	15:31	15:35
3	0:00	0:00	14:37	14:35
4	0:00	0:00	14:58	14:00
5	0:00	0:00	14:37	14:40
6	0:00	0:00	15:00	11:52
7	0:00	0:00	14:37	14:30
8	0:00	0:00	13:51	13:45
9	0:00	4:27	17:02	17:00
10	0:00	0:47	14:52	14:56
11	0:00	1:25	14:56	14:53
12	0:00	0:00	17:52	18:01
13	0:00	3:40	17:26	17:23
14	0:00	0:00	14:27	14:24
15	0:00	0:00	14:35	14:39
16	0:00	0:00	15:33	15:35
17	0:00	0:54	15:09	15:09
18	0:00	5:20	15:33	15:26
19	0:00	0:00	15:00	15:00
20	0:00	0:00	14:53	14:52
21	0:00	0:00	14:50	15:00
22	0:00	0:00	14:57	15:00
23	0:00	2:05	15:02	14:43
24	0:00	0:00	14:09	15:11
25	0:00	0:00	15:22	15:18
26	0:00	2:00	14:27	14:22
27	0:00	0:00	15:26	15:28
28	0:00	0:00	15:22	15:26
29	0:00	0:00	15:00	15:00
Total (day)	0	9	29	29
Average (hour)	0.0	2.5	15.2	15.1

Daily Working Hour (JBC BPS)

Mar-16

Date	Pump No.1 15 Cusec	Pump No.2 15 Cusec	Pump No.3 15 Cusec	Pump No.4 15 Cusec
1	0:00	0:00	13:50	18:00
2	0:00	0:00	17:41	0:00
3	0:00	0:00	17:38	17:20
4	0:00	0:00	16:20	16:45
5	0:00	0:00	16:40	17:30
6	0:00	0:00	15:51	16:48
7	0:00	0:00	15:48	16:52
8	0:00	0:00	15:22	16:22
9	0:00	0:00	15:55	16:28
10	0:00	0:00	16:05	17:30
11	0:00	0:00	16:04	16:10
12	0:00	0:00	16:29	16:26
13	0:00	0:00	20:17	20:45
14	0:00	4:05	15:26	15:30
15	0:00	3:15	20:08	20:07
16	0:00	4:15	16:46	16:34
17	0:00	3:05	13:10	13:19
18	0:00	3:50	14:00	14:10
19	0:00	3:30	15:25	17:28
20	0:00	0:00	11:47	16:34
21	0:00	3:40	16:12	16:15
22	0:00	2:00	13:22	13:25
23	0:00	4:55	15:28	15:18
24	0:00	4:35	15:08	15:04
25	0:00	3:33	15:10	15:02
26	0:00	0:00	14:01	15:01
27	0:00	4:45	21:49	21:50
28	0:00	5:05	11:55	11:48
29	0:00	9:45	16:48	16:40
30	0:00	0:00	16:41	16:32
31	0:00	0:00	17:12	17:12
Total (day)	0	14	31	30
Average (hour)	0.0	4.3	16.0	16.5

Daily Working Hour (JBC BPS)

Apr-16

Date	Pump No.1 15 Cusec	Pump No.2 15 Cusec	Pump No.3 15 Cusec	Pump No.4 15 Cusec
1	0:00	0:00	17:53	17:45
2	0:00	0:00	17:10	17:05
3	0:00	0:00	17:23	17:20
4	0:00	0:00	17:45	17:40
5	0:00	0:00	17:08	17:10
6	0:00	0:00	17:25	17:24
7	0:00	0:00	16:59	17:02
8	0:00	0:00	16:33	16:25
9	0:00	0:00	17:24	17:25
10	0:00	0:00	17:45	17:45
11	0:00	0:00	17:36	17:40
12	0:00	0:00	17:47	17:38
13	0:00	0:00	17:46	17:36
14	0:00	0:00	17:26	17:22
15	0:00	0:00	17:43	17:25
16	0:00	0:00	17:43	17:36
17	0:00	0:00	17:38	17:40
18	0:00	0:00	17:46	17:37
19	0:00	0:00	17:45	17:37
20	0:00	0:00	17:36	17:37
21	0:00	0:00	18:12	18:17
22	0:00	0:00	17:56	17:56
23	0:00	0:00	17:48	17:49
24	0:00	0:00	17:36	17:40
25	0:00	0:00	18:03	18:02
26	0:00	0:00	17:45	17:42
27	0:00	0:00	17:30	17:29
28	0:00	0:00	17:42	17:40
29	0:00	0:00	18:42	18:40
30	0:00	0:00	16:59	18:42
Total (day)	0	0	30	30
Average (hour)	0.0	0.0	17.6	17.6

Daily Working Hour (JBC BPS)

May-16

Date	Pump No.1 15 Cusec	Pump No.2 15 Cusec	Pump No.3 15 Cusec	Pump No.4 15 Cusec
1	0:00	0:00	18:38	17:40
2	0:00	0:00	24:45:00 (*)	24:10:00 (*)
3	0:00	0:00	13:02	13:41
4	0:00	3:00	18:32	11:55
5	0:00	0:00	19:22	16:20
6	0:00	0:00	18:25	17:20
7	0:00	0:00	18:34	17:57
8	0:00	0:00	19:27	17:39
9	0:00	0:00	18:57	17:50
10	0:00	0:00	19:30	17:39
11	0:00	0:00	19:35	19:30
12	0:00	0:00	17:25	17:25
13	0:00	0:00	19:22	15:53
14	0:00	0:00	19:55	17:47
15	0:00	0:00	19:52	17:16
16	0:00	1:05	19:12	19:15
17	0:00	0:00	19:28	19:30
18	0:00	0:00	16:35	17:25
19	0:00	0:00	19:36	17:32
20	0:00	0:00	19:32	17:30
21	0:00	2:32	19:26	17:25
22	0:00	0:00	17:47	17:35
23	0:00	0:00	19:35	17:35
24	0:00	0:00	22:16	23:11
25	0:00	0:00	16:11	16:07
26	0:00	0:00	19:20	17:15
27	0:00	0:00	19:52	17:51
28	0:00	0:00	19:37	17:38
29	0:00	0:00	19:43	17:46
30	0:00	12:25	19:37	17:38
31	0:00	0:00	19:46	17:43
Total (day)	0	4	31	31
Average (hour)	0.0	4.8	19.1	17.7

* Operation time of the next date was included.

Daily Working Hour (JBC BPS)

Jun-16

Date	Pump No.1 15 Cusec	Pump No.2 15 Cusec	Pump No.3 15 Cusec	Pump No.4 15 Cusec
1	0:00	0:00	24:25:00 (*)	22:30
2	0:00	0:00	14:28	11:26
3	0:00	0:00	19:49	17:48
4	0:00	0:00	17:56	17:38
5	0:00	0:00	19:41	15:51
6	0:00	0:00	19:01	17:42
7	0:00	0:00	17:57	18:48
8	0:00	0:00	20:30	15:14
9	0:00	0:00	17:38	18:39
10	0:00	0:00	15:46	18:56
11	0:00	0:00	18:28	18:06
12	0:00	0:00	8:38	18:45
13	0:00	0:00	20:02	18:51
14	0:00	0:00	18:03	18:38
15	0:00	0:00	19:49	18:47
16	0:00	0:00	17:55	7:21
17	0:00	10:27	20:45	18:42
18	0:00	0:00	18:16	18:43
19	0:00	0:00	20:35	16:19
20	0:00	0:00	16:05	18:38
21	0:00	0:00	17:52	18:38
22	0:00	0:00	14:42	8:43
23	0:00	0:00	17:20	18:28
24	0:00	0:00	24:40:00 (*)	18:45
25	0:00	0:00	22:46	20:45
26	0:00	0:00	19:00	18:50
27	0:00	0:00	16:45	16:40
28	0:00	0:00	21:04	18:10
29	0:00	10:50	20:49	18:45
30	0:00	11:57	20:51	18:11
Total (day)	0	3	29	30
Average (hour)	0.0	11.1	18.9	17.4

* Operation time of the next date was included.

Daily Working Hour (JBC BPS)

Jul-16

Date	Pump No.1 15 Cusec	Pump No.2 15 Cusec	Pump No.3 15 Cusec	Pump No.4 15 Cusec
1	0:00	0:00	20:45	18:40
2	0:00	9:18	18:43	18:33
3	0:00	16:22	20:42	18:44
4	0:00	6:04	20:42	14:55
5	0:00	1:58	20:47	15:42
6	0:00	4:44	20:07	18:52
7	0:00	0:00	20:37	18:40
8	0:00	1:25	16:42	18:10
9	0:00	2:23	14:11	12:07
10	0:00	0:00	20:24	18:25
11	0:00	0:00	19:37	18:39
12	0:00	0:00	19:03	18:04
13	0:00	0:00	17:53	18:15
14	0:00	0:00	19:11	18:06
15	0:00	1:56	18:12	18:42
16	0:00	2:49	18:21	18:16
17	0:00	0:00	20:03	19:03
18	0:00	3:00	19:37	18:41
19	0:00	2:30	17:21	18:13
20	0:00	1:05	20:43	19:10
21	0:00	5:42	19:45	18:40
22	0:00	0:00	21:30	20:27
23	0:00	3:40	21:26	20:36
24	0:00	3:23	19:27	18:32
25	0:00	2:47	19:40	18:42
26	0:00	3:30	19:46	19:08
27	0:00	10:01	20:19	19:35
28	0:00	1:20	15:25	17:05
29	0:00	2:45	21:06	21:00
30	0:00	11:41	20:42	20:37
31	0:00	0:00	19:44	19:45
Total (day)	0	21	31	31
Average (hour)	0.0	4.7	19.4	18.5

Daily Working Hour (JICA TRPS)

(2015, August ~ 2016, July)

Daily Working Hour (JICA TRPS)

Aug-15

Date	Pump No.1 19 Cusec	Pump No.2 19 Cusec	Pump No.3 37 Cusec	Pump No.4 37 Cusec	Pump No.5 37 Cusec
1	0:00	2:00	6:00	4:00	4:00
2	2:00	0:00	6:00	4:00	4:00
3	0:00	2:00	6:00	4:00	4:00
4	2:00	0:00	6:00	4:00	4:00
5	0:00	2:00	6:00	4:00	4:00
6	2:00	0:00	6:00	4:00	4:00
7	2:00	0:00	6:00	4:00	4:00
8	2:00	0:00	6:00	4:00	4:00
9	2:00	0:00	6:00	4:00	4:00
10	0:00	2:00	6:00	4:00	4:00
11	2:00	0:00	6:00	4:00	4:00
12	0:00	2:00	6:00	4:00	4:00
13	2:00	2:00	6:00	6:00	6:00
14	0:00	2:00	6:00	4:00	4:00
15	0:00	2:00	6:00	4:00	4:00
16	0:00	2:00	6:00	4:00	4:00
17	2:00	0:00	6:00	4:00	4:00
18	0:00	2:00	6:00	4:00	4:00
19	0:00	2:00	6:00	4:00	4:00
20	0:00	2:00	6:00	4:00	4:00
21	2:00	0:00	6:00	4:00	4:00
22	2:00	0:00	6:00	4:00	4:00
23	0:00	2:00	6:00	4:00	4:00
24	2:00	0:00	6:00	4:00	4:00
25	0:00	2:00	4:00	4:00	4:00
26	2:00	0:00	6:00	4:00	4:00
27	2:00	0:00	6:00	4:00	4:00
28	0:00	2:00	6:00	4:00	4:00
29	2:00	0:00	6:00	4:00	4:00
30	0:00	2:00	6:00	4:00	4:00
31	2:00	0:00	6:00	4:00	4:00
Total (day)	16	16	31	31	31
Average (hour)	2.0	2.0	5.9	4.1	4.1

Daily Working Hour (JICA TRPS)

Sep-15

Date	Pump No.1 19 Cusec	Pump No.2 19 Cusec	Pump No.3 37 Cusec	Pump No.4 37 Cusec	Pump No.5 37 Cusec
1	0:00	2:00	6:00	4:00	4:00
2	2:00	0:00	6:00	4:00	4:00
3	0:00	2:00	6:00	4:00	4:00
4	2:00	0:00	6:00	4:00	4:00
5	0:00	2:00	6:00	4:00	4:00
6	2:00	0:00	6:00	4:00	4:00
7	0:00	2:00	6:00	4:00	4:00
8	2:00	0:00	4:00	4:00	6:00
9	2:00	0:00	6:00	4:00	4:00
10	0:00	2:00	6:00	4:00	4:00
11	2:00	0:00	6:00	4:00	4:00
12	0:00	2:00	6:00	4:00	4:00
13	0:00	2:00	6:00	4:00	4:00
14	2:00	0:00	4:00	6:00	4:00
15	0:00	2:00	6:00	4:00	4:00
16	2:00	0:00	6:00	4:00	4:00
17	2:00	0:00	6:00	4:00	4:00
18	2:00	0:00	6:00	4:00	4:00
19	0:00	2:00	6:00	4:00	4:00
20	2:00	2:00	6:00	4:00	4:00
21	2:00	2:00	6:00	4:00	4:00
22	2:00	0:00	6:00	4:00	4:00
23	2:00	0:00	6:00	4:00	4:00
24	0:00	2:00	4:00	4:00	6:00
25	2:00	2:00	6:00	4:00	4:00
26	2:00	2:00	6:00	4:00	4:00
27	2:00	2:00	6:00	4:00	4:00
28	2:00	2:00	6:00	4:00	4:00
29	0:00	2:00	6:00	4:00	4:00
30	2:00	0:00	6:00	4:00	4:00
Total (day)	19	17	30	30	30
Average (hour)	2.0	2.0	5.8	4.1	4.1

Daily Working Hour (JICA TRPS)

Oct-15

Date	Pump No.1 19 Cusec	Pump No.2 19 Cusec	Pump No.3 37 Cusec	Pump No.4 37 Cusec	Pump No.5 37 Cusec
1	2:00	0:00	4:00	6:00	6:00
2	2:00	0:00	4:00	6:00	6:00
3	2:00	0:00	4:00	6:00	6:00
4	2:00	0:00	4:00	6:00	6:00
5	0:00	2:00	6:00	6:00	4:00
6	2:00	0:00	6:00	6:00	2:00
7	2:00	0:00	6:00	6:00	2:00
8	0:00	2:00	6:00	6:00	4:00
9	2:00	0:00	6:00	6:00	4:00
10	0:00	2:00	6:00	6:00	4:00
11	0:00	4:00	4:00	4:00	2:00
12	2:00	0:00	6:00	6:00	4:00
13	0:00	2:00	6:00	6:00	4:00
14	2:00	0:00	6:00	6:00	4:00
15	0:00	2:00	2:00	2:00	0:00
16	0:00	4:00	6:00	6:00	4:00
17	0:00	4:00	6:00	6:00	4:00
18	0:00	4:00	6:00	6:00	4:00
19	0:00	4:00	6:00	6:00	4:00
20	0:00	4:00	6:00	6:00	4:00
21	2:00	0:00	6:00	6:00	4:00
22	0:00	2:00	6:00	6:00	4:00
23	2:00	0:00	6:00	6:00	4:00
24	0:00	2:00	6:00	6:00	4:00
25	0:00	2:00	6:00	6:00	4:00
26	0:00	2:00	6:00	6:00	4:00
27	0:00	2:00	6:00	6:00	4:00
28	2:00	0:00	6:00	6:00	4:00
29	0:00	2:00	6:00	6:00	4:00
30	2:00	0:00	6:00	6:00	4:00
31	0:00	2:00	6:00	6:00	4:00
Total (day)	13	18	31	31	30
Average (hour)	2.0	2.7	5.5	5.8	4.1

Daily Working Hour (JICA TRPS)

Nov-15

Date	Pump No.1 19 Cusec	Pump No.2 19 Cusec	Pump No.3 37 Cusec	Pump No.4 37 Cusec	Pump No.5 37 Cusec
1	0:00	2:00	2:00	2:00	2:00
2	2:00	0:00	6:00	6:00	4:00
3	0:00	0:00	6:00	6:00	4:00
4	0:00	2:00	6:00	6:00	4:00
5	0:00	2:00	6:00	6:00	4:00
6	2:00	0:00	6:00	6:00	4:00
7	6:00	4:00	6:00	6:00	6:00
8	0:00	2:00	6:00	6:00	4:00
9	0:00	2:00	6:00	6:00	4:00
10	0:00	2:00	6:00	6:00	4:00
11	0:00	2:00	6:00	6:00	4:00
12	2:00	0:00	6:00	6:00	4:00
13	0:00	2:00	6:00	6:00	4:00
14	0:00	2:00	2:00	2:00	2:00
15	0:00	2:00	2:00	2:00	2:00
16	0:00	2:00	6:00	6:00	4:00
17	0:00	2:00	6:00	6:00	4:00
18	0:00	2:00	6:00	6:00	4:00
19	0:00	0:00	6:00	6:00	4:00
20	0:00	2:00	6:00	6:00	4:00
21	0:00	2:00	6:00	6:00	4:00
22	0:00	2:00	6:00	6:00	4:00
23	0:00	2:00	6:00	6:00	4:00
24	0:00	2:00	6:00	6:00	4:00
25	2:00	0:00	6:00	6:00	4:00
26	2:00	0:00	6:00	6:00	4:00
27	2:00	0:00	6:00	6:00	4:00
28	2:00	0:00	6:00	6:00	4:00
29	2:00	0:00	6:00	6:00	4:00
30	0:00	0:00	5:00	5:00	4:00
Total (day)	9	19	30	30	30
Average (hour)	2.4	2.1	5.6	5.6	3.9

Daily Working Hour (JICA TRPS)

Dec-15

Date	Pump No.1 19 Cusec	Pump No.2 19 Cusec	Pump No.3 37 Cusec	Pump No.4 37 Cusec	Pump No.5 37 Cusec
1	2:00	0:00	6:00	6:00	4:00
2	2:00	0:00	6:00	6:00	4:00
3	2:00	0:00	6:00	6:00	4:00
4	2:00	0:00	6:00	6:00	4:00
5	3:00	0:00	5:00	5:00	3:30
6	2:00	0:00	6:00	6:00	4:00
7	2:00	0:00	6:00	6:00	4:00
8	2:00	0:00	6:00	6:00	4:00
9	0:00	0:00	4:00	4:00	4:00
10	2:00	0:00	6:00	6:00	4:00
11	2:00	0:00	6:00	6:00	4:00
12	2:00	0:00	6:00	6:00	4:00
13	2:00	0:00	6:00	6:00	4:00
14	2:00	0:00	6:00	6:00	4:00
15	2:00	0:00	6:00	6:00	4:00
16	2:00	0:00	6:00	6:00	4:00
17	2:00	0:00	6:00	6:00	4:00
18	2:00	0:00	6:00	6:00	4:00
19	2:00	0:00	6:00	6:00	4:00
20	2:00	0:00	6:00	6:00	4:00
21	2:00	0:00	6:00	6:00	4:00
22	0:00	0:00	6:00	6:00	4:00
23	2:00	0:00	6:00	6:00	4:00
24	2:00	0:00	6:00	6:00	4:00
25	2:00	0:00	6:00	6:00	4:00
26	2:00	0:00	6:00	6:00	4:00
27	2:00	0:00	6:00	6:00	4:00
28	2:00	0:00	6:00	6:00	4:00
29	2:00	0:00	6:00	6:00	4:00
30	2:00	0:00	6:00	6:00	4:00
31	2:00	0:00	6:00	6:00	4:00
Total (day)	29	0	31	31	31
Average (hour)	2.0	0.0	5.9	5.9	4.0

Daily Working Hour (JICA TRPS)

Jan-16

Pump No.1 19 Cusec	Pump No.1 19 Cusec	Pump No.2 19 Cusec	Pump No.3 37 Cusec	Pump No.4 37 Cusec	Pump No.5 37 Cusec
1	2:00	0:00	6:00	6:00	4:00
2	2:00	0:00	6:00	6:00	4:00
3	2:00	0:00	6:00	6:00	4:00
4	2:00	0:00	6:00	6:00	4:00
5	2:00	0:00	6:00	6:00	4:00
6	4:00	0:00	6:00	6:00	4:00
7	4:00	0:00	6:00	6:00	0:00
8	2:00	0:00	6:00	6:00	0:00
9	4:00	0:00	6:00	6:00	0:00
10	4:00	0:00	6:00	6:00	0:00
11	4:00	0:00	6:00	6:00	0:00
12	2:00	0:00	4:00	4:00	0:00
13	6:00	0:00	6:00	6:00	0:00
14	4:00	0:00	6:00	6:00	0:00
15	4:00	4:00	4:00	4:00	4:00
16	4:00	0:00	6:00	6:00	4:00
17	4:00	4:00	6:00	6:00	6:00
18	2:00	0:00	6:00	6:00	4:00
19	2:00	0:00	6:00	6:00	4:00
20	6:00	2:00	6:00	6:00	4:00
21	4:00	0:00	4:00	4:00	0:00
22	6:00	0:00	6:00	6:00	4:00
23	2:00	0:00	6:00	6:00	4:00
24	2:00	0:00	6:00	6:00	4:00
25	2:00	0:00	6:00	6:00	4:00
26	2:00	0:00	6:00	6:00	4:00
27	0:00	0:00	6:00	6:00	4:00
28	2:00	0:00	6:00	6:00	4:00
29	2:00	0:00	6:00	6:00	4:00
30	2:00	0:00	6:00	6:00	4:00
31	2:00	0:00	6:00	6:00	4:00
Total (day)	30	3	31	31	22
Average (hour)	3.1	3.3	5.8	5.8	4.1

Daily Working Hour (JICA TRPS)

Feb-16

Date	Pump No.1 19 Cusec	Pump No.2 19 Cusec	Pump No.3 37 Cusec	Pump No.4 37 Cusec	Pump No.5 37 Cusec
1	2:00	1:00	6:00	6:00	6:00
2	4:00	2:00	6:00	6:00	2:00
3	2:00	0:00	6:00	6:00	4:00
4	2:00	0:00	6:00	6:00	4:00
5	2:00	0:00	6:00	6:00	4:00
6	2:00	0:00	6:00	6:00	4:00
7	2:00	0:00	6:00	6:00	4:00
8	2:00	0:00	6:00	6:00	4:00
9	3:00	1:00	6:00	6:00	4:00
10	2:00	0:00	6:00	6:00	4:00
11	2:00	0:00	6:00	6:00	4:00
12	4:00	2:00	6:00	6:00	4:00
13	2:00	0:00	6:00	6:00	4:00
14	2:00	0:00	6:00	6:00	4:00
15	4:00	4:00	6:00	6:00	4:00
16	4:00	0:00	6:00	6:00	4:00
17	2:00	0:00	6:00	6:00	4:00
18	2:00	0:00	6:00	6:00	4:00
19	2:00	0:00	6:00	6:00	4:00
20	2:00	0:00	6:00	6:00	4:00
21	2:00	0:00	6:00	6:00	4:00
22	2:00	0:00	6:00	6:00	4:00
23	2:00	0:00	6:00	6:00	4:00
24	2:00	0:00	4:00	4:00	2:00
25	2:00	0:00	6:00	6:00	4:00
26	2:00	0:00	6:00	6:00	4:00
27	2:00	0:00	6:00	6:00	4:00
28	2:00	0:00	6:00	6:00	4:00
29	null	null	null	null	null
		Note : No data was recorded on 29 Feb.			
Total (day)	28	5	28	28	28
Average (hour)	2.3	6.8	5.9	5.9	3.9

Daily Working Hour (JICA TRPS)

Feb-16

Date	Pump No.1 19 Cusec	Pump No.2 19 Cusec	Pump No.3 37 Cusec	Pump No.4 37 Cusec	Pump No.5 37 Cusec
1	2:00	1:00	6:00	6:00	6:00
2	4:00	2:00	6:00	6:00	2:00
3	2:00	0:00	6:00	6:00	4:00
4	2:00	0:00	6:00	6:00	4:00
5	2:00	0:00	6:00	6:00	4:00
6	2:00	0:00	6:00	6:00	4:00
7	2:00	0:00	6:00	6:00	4:00
8	2:00	0:00	6:00	6:00	4:00
9	3:00	1:00	6:00	6:00	4:00
10	2:00	0:00	6:00	6:00	4:00
11	2:00	0:00	6:00	6:00	4:00
12	4:00	2:00	6:00	6:00	4:00
13	2:00	0:00	6:00	6:00	4:00
14	2:00	0:00	6:00	6:00	4:00
15	4:00	4:00	6:00	6:00	4:00
16	4:00	0:00	6:00	6:00	4:00
17	2:00	0:00	6:00	6:00	4:00
18	2:00	0:00	6:00	6:00	4:00
19	2:00	0:00	6:00	6:00	4:00
20	2:00	0:00	6:00	6:00	4:00
21	2:00	0:00	6:00	6:00	4:00
22	2:00	0:00	6:00	6:00	4:00
23	2:00	0:00	6:00	6:00	4:00
24	2:00	0:00	4:00	4:00	2:00
25	2:00	0:00	6:00	6:00	4:00
26	2:00	0:00	6:00	6:00	4:00
27	2:00	0:00	6:00	6:00	4:00
28	2:00	0:00	6:00	6:00	4:00
29	null	null	null	null	null
Total (day)	28	5	28	28	28
Average (hour)	2.3	6.8	5.9	5.9	3.9

Note : No data was recorded on 29 Feb.

Daily Working Hour (JICA TRPS)

Mar-16

Date	Pump No.1 19 Cusec	Pump No.2 19 Cusec	Pump No.3 37 Cusec	Pump No.4 37 Cusec	Pump No.5 37 Cusec
1	2:00	0:00	6:00	6:00	4:00
2	2:00	0:00	6:00	6:00	4:00
3	2:00	0:00	6:00	6:00	4:00
4	2:00	0:00	6:00	6:00	4:00
5	2:00	0:00	6:00	6:00	4:00
6	2:00	0:00	6:00	6:00	4:00
7	2:00	0:00	6:00	6:00	4:00
8	2:00	0:00	6:00	6:00	4:00
9	2:00	0:00	6:00	6:00	4:00
10	2:00	0:00	6:00	6:00	4:00
11	2:00	0:00	6:00	6:00	4:00
12	2:00	0:00	6:00	6:00	4:00
13	2:00	0:00	6:00	6:00	4:00
14	2:00	0:00	6:00	6:00	4:00
15	3:00	0:00	7:00	7:00	4:00
16	2:00	0:00	5:30	5:30	4:30
17	2:00	0:00	6:00	6:00	4:30
18	2:00	0:00	6:00	6:00	4:30
19	2:00	0:00	6:00	6:00	4:30
20	2:00	0:00	6:00	6:00	4:30
21	2:00	0:00	6:00	6:00	4:30
22	2:00	0:00	6:00	6:00	4:30
23	2:00	0:00	6:00	6:00	4:30
24	2:00	0:00	6:00	6:00	4:30
25	2:00	0:00	6:00	6:00	4:30
26	0:00	0:00	6:00	6:00	4:30
27	2:00	2:00	6:00	6:00	4:30
28	2:00	0:00	6:00	6:00	4:30
29	2:00	0:00	6:00	6:00	4:30
30	2:00	0:00	6:00	6:00	4:30
31	2:00	0:00	6:00	6:00	4:30
Total (day)	30	1	31	31	31
Average (hour)	2.0	2.0	6.0	6.0	4.3

Daily Working Hour (JICA TRPS)

Apr-16

Date	Pump No.1 19 Cusec	Pump No.2 19 Cusec	Pump No.3 37 Cusec	Pump No.4 37 Cusec	Pump No.5 37 Cusec
1	2:00	0:00	6:00	6:00	4:00
2	2:00	0:00	6:00	6:00	4:00
3	2:00	0:00	6:00	6:00	4:00
4	2:00	0:00	6:00	6:00	4:00
5	2:00	0:00	6:00	6:00	4:00
6	2:00	0:00	6:00	6:00	4:00
7	2:00	0:00	6:00	6:00	4:00
8	2:00	0:00	6:00	6:00	4:00
9	2:00	0:00	6:00	6:00	4:00
10	2:00	0:00	6:00	6:00	4:00
11	2:00	0:00	6:00	6:00	4:00
12	2:00	0:00	6:00	6:00	4:00
13	2:00	0:00	6:00	6:00	4:00
14	2:00	0:00	6:00	6:00	4:00
15	2:00	0:00	6:00	6:00	4:00
16	2:00	0:00	6:00	6:00	4:00
17	2:00	0:00	6:00	6:00	4:00
18	2:00	0:00	6:00	6:00	4:00
19	2:00	0:00	6:00	6:00	4:00
20	2:00	0:00	6:00	6:00	4:00
21	2:00	2:00	6:00	6:00	4:00
22	2:00	0:00	6:00	6:00	4:00
23	2:00	0:00	6:00	6:00	4:00
24	2:00	0:00	6:00	6:00	4:00
25	2:00	0:00	6:00	6:00	4:00
26	2:00	0:00	6:00	6:00	4:00
27	2:00	0:00	6:00	6:00	4:00
28	2:00	0:00	6:00	6:00	4:00
29	2:00	0:00	6:00	6:00	4:00
30	4:00	0:00	6:00	6:00	4:00
Total (day)	30	1	30	30	30
Average (hour)	2.1	2.0	6.0	6.0	4.0

Daily Working Hour (JICA TRPS)

May-16

Date	Pump No.1 19 Cusec	Pump No.2 19 Cusec	Pump No.3 37 Cusec	Pump No.4 37 Cusec	Pump No.5 37 Cusec
1	4:00	0:00	6:00	6:00	4:00
2	4:00	2:00	6:00	6:00	4:00
3	2:00	0:00	6:00	6:00	4:00
4	2:00	0:00	6:00	6:00	4:00
5	2:00	0:00	6:00	6:00	4:00
6	2:00	0:00	6:00	6:00	4:00
7	2:00	0:00	6:00	6:00	4:00
8	2:00	0:00	6:00	6:00	4:00
9	2:00	0:00	6:00	6:00	4:00
10	2:00	0:00	6:00	6:00	4:00
11	2:00	0:00	6:00	6:00	4:00
12	2:30	0:00	6:30	6:30	4:00
13	2:00	2:00	6:00	6:00	4:00
14	2:00	0:00	6:00	6:00	4:00
15	2:00	0:00	6:00	6:00	4:00
16	2:00	0:00	6:00	6:00	4:00
17	2:00	0:00	6:00	6:00	4:00
18	2:00	0:00	6:00	6:00	4:00
19	2:00	0:00	6:00	6:00	4:00
20	2:30	0:00	6:30	6:30	4:00
21	2:30	0:00	6:30	6:30	0:00
22	2:30	0:00	6:30	6:30	4:30
23	2:30	0:00	7:00	7:00	4:30
24	4:30	4:30	4:30	4:30	4:30
25	2:30	0:00	7:00	7:00	4:30
26	2:30	0:00	7:00	7:00	4:30
27	2:00	2:00	6:30	6:30	4:30
28	2:00	0:00	7:00	7:00	4:30
29	2:30	0:00	7:00	7:00	4:30
30	0:00	0:00	7:00	7:00	7:00
31	2:30	0:00	7:00	7:00	4:30
Total (day)	30	4	31	31	30
Average (hour)	2.4	2.6	6.3	6.3	4.3

Daily Working Hour (JICA TRPS)

Jun-16

Date	Pump No.1 19 Cusec	Pump No.2 19 Cusec	Pump No.3 37 Cusec	Pump No.4 37 Cusec	Pump No.5 37 Cusec
1	2:30	0:00	7:00	7:00	5:00
2	2:00	0:00	6:00	6:00	4:00
3	2:00	0:00	6:30	6:30	4:30
4	2:30	0:00	7:00	7:00	4:30
5	2:30	0:00	7:00	7:00	4:30
6	2:30	0:00	7:00	7:00	4:30
7	2:30	0:00	7:00	7:00	4:30
8	2:30	0:00	7:00	7:00	4:30
9	2:30	0:00	7:00	7:00	4:30
10	2:00	0:00	6:00	6:00	4:00
11	2:00	0:00	6:00	6:00	4:00
12	2:00	0:00	6:00	6:00	4:00
13	2:00	0:00	6:00	6:00	4:00
14	2:00	0:00	6:00	6:00	4:00
15	4:00	2:00	6:00	6:00	4:00
16	2:00	0:00	6:00	6:00	4:00
17	2:00	2:00	6:00	6:00	4:00
18	2:00	0:00	6:30	6:30	4:30
19	2:00	0:00	6:00	6:00	4:00
20	2:00	0:00	7:00	7:00	5:00
21	2:00	0:00	7:00	7:00	5:00
22	0:00	0:00	7:00	7:00	7:00
23	2:00	0:00	7:00	7:00	5:00
24	2:00	0:00	7:00	7:00	5:00
25	2:30	2:30	5:00	5:00	5:00
26	2:00	0:00	7:00	7:00	5:00
27	2:00	0:00	7:00	7:00	5:00
28	2:00	0:00	7:00	7:00	5:00
29	2:00	0:00	7:00	7:00	5:00
30	2:00	0:00	7:00	7:00	5:00
Total (day)	29	3	30	30	30
Average (hour)	2.2	2.2	6.6	6.6	4.6

Daily Working Hour (JICA TRPS)

Jul-16

Date	Pump No.1 19 Cusec	Pump No.2 19 Cusec	Pump No.3 37 Cusec	Pump No.4 37 Cusec	Pump No.5 37 Cusec
1	2:00	0:00	6:30	6:30	4:30
2	2:00	0:00	5:30	5:30	4:30
3	2:00	0:00	6:30	6:30	4:30
4	2:30	0:00	7:00	7:00	5:00
5	5:30	0:00	7:00	7:00	5:00
6	4:30	2:30	0:00	7:00	7:00
7	4:30	2:30	0:00	7:00	7:00
8	4:30	2:30	0:00	7:00	7:00
9	4:30	2:30	0:00	7:00	7:00
10	4:30	2:30	0:00	7:00	7:00
11	4:30	0:00	2:30	7:00	7:00
12	4:30	0:00	2:30	7:00	7:00
13	5:00	0:00	0:00	5:00	5:00
14	7:00	0:00	0:00	7:00	7:00
15	7:00	0:00	0:00	7:00	7:00
16	4:30	0:00	2:30	7:00	7:00
17	2:00	0:00	7:00	7:00	7:00
18	2:00	0:00	7:00	7:00	7:00
19	2:00	0:00	7:00	7:00	5:00
20	2:00	0:00	7:00	7:00	5:00
21	2:00	0:00	7:00	7:00	5:00
22	2:00	0:00	7:00	7:00	5:00
23	2:00	0:00	7:00	7:00	5:00
24	2:00	0:00	7:00	7:00	5:00
25	2:00	0:00	7:00	5:00	7:00
26	2:00	0:00	7:00	7:00	5:00
27	2:00	0:00	7:00	7:00	5:00
28	0:00	0:00	5:00	5:00	5:00
29	2:00	0:00	7:00	7:00	5:00
30	2:00	0:00	7:00	7:00	5:00
31	2:00	0:00	7:00	7:00	5:00
Total (day)	30	5	23	31	31
Average (hour)	3.2	2.5	6.2	6.7	5.8

APPENDIX FOR CHAPTER B5 WATER SUPPLY PLANNING AND DESIGN BASIS

AB5.1 Population and Water Demand Distribution

Appendix AB5.1 is composed of distribution of population, population served, water consumption and water demand as follows.

1. Population Distribution

Popilation of Peri-Urban Area is distributed into Union Councils (UCs) in Key Years firstly with put population of FDA City based on population estimated in six towns of Chak Jhumra, Jarranwara, Iqbal, Jinnah, Lyallpur and Madina towns. The result of population distribution is presented in Table AB5.1-1.1.

Population of FDA City is assumed to be developed from 2023 up to 2038. The planned population in 2038 is estimated at 75,000 from the FDA's plan. Population within Faisalabad MC is assumed to migrate to FDA City with leane growth from 2023 up to 2038. Population is estimated at 18,750.

Based on the above assumption, Population distributed in Table AB5.1-1.1 is adjusted and ahown in Table AB5.2-1.2.

From the above two table, Table AB5.1-1.3 summarize the administrative area, population after FDA City Development and population density.

2. Distribution of Population Served

Service area in each key year is estimated using population density shown in Table AB5.1-1.3, where UCs which population density exceed 30 p/ha is included in the service area. In addition, such UCs located between two adjacent UCs will be included in the service area when it is considered as appropriate. Other conditions such as WASA's requirement will be also included in the service area in respective key years.

Based on the above assumption, the service area in each key year and population in service area are determined. Using service ratio estimated in each key year, population served is obtained. Table AB5.1-2 presents population in service area and population served by UCs in key years.

3. Water Consumption

Water consumption is composed of domestic and non-domestic consumptions. Non-domestic consumption is estimated as the percentage of a total consumption. Table AB5.1-3 shows consumptions of each UC in key years.

Assessment is made to estimated present non-domesticand potential consumptions, which presented in Attachment of Table AB5.1-3.

4. Distribution of Water Demand

Day average demand is the sum of consumption and physical loss. Day maximum demand is obtained by multiply the day maximum factor. Table AB5.1-4 presents Physical loss, day average demand and day maximum demand of each UC in key years.

Assessment of present physical loss is made using available data and presented in Attachment of Table AB5.1.4.

Table AB5.1-1.1 Population Distribution in Ucs - 1

		Area	Population in Administrative Area					
Town	**UC No.**	**sq. Kms**	**1998**	**2015**	**2023**	**2028**	**2033**	**2038**
JHUMRA TOWN								
Urban	12	11.3383	16,411	22,240	23,630	24,500	25,360	26,230
	13	5.2182	15,700	21,276	22,600	23,430	24,260	25,090
	2	16.5564	32,111	43,516	46,230	47,930	49,620	51,320
Rural	7	46.4396	14,812	17,519	18,560	19,220	19,870	20,520
	8	37.1721	13,924	16,469	17,450	18,060	18,680	19,290
	9	32.7075	22,482	26,591	28,180	27,240	27,580	31,150
	10	36.4350	16,875	19,959	21,150	21,890	22,640	23,380
	11	35.2830	16,343	19,330	20,480	21,200	21,920	22,640
	14	14.9435	14,753	17,449	18,490	19,140	19,790	20,440
	15	17.7766	18,776	22,207	23,530	24,360	25,180	26,010
Total of	7	220.7572	117,965	139,524	147,840	151,110	155,660	163,430
Jhumura	**9**	**237.31**	**150,076**	**183,040**	**194,070**	**199,040**	**205,280**	**214,750**
JARANWALA TOWN								
Urban	20	11.1717	15,722	21,306	23,870	27,700	34,580	28,680
	21	6.9663	14,305	19,366	21,690	23,150	24,600	26,060
	2	18.1380	30,027	40,672	45,560	50,850	59,180	54,740
Rural	19	19.0468	22,143	27,862	30,470	32,090	33,720	35,350
	22	34.6633	16,603	20,915	22,870	24,090	25,310	26,530
	33	31.4722	21,816	27,451	30,020	34,190	39,960	34,830
	34	3.4041	18,261	22,978	25,120	26,470	27,810	29,150
	35	65.2062	22,995	28,934	31,640	33,330	35,020	36,710
Total of	5	153.7926	101,818	128,140	140,120	150,170	161,820	162,570
Jaranwala	**8**	**171.93**	**131,845**	**168,812**	**185,680**	**201,020**	**221,000**	**217,310**
Peri-Urban	**17**	**409.24**	**281,921**	**351,852**	**379,750**	**400,060**	**426,280**	**432,060**

Table AB5.1-1.1 Population Distribution in Ucs – 2

Town	UC No.	Area sq. Kms	Population in Administrative Area 1998	2015	2023	2028	2033	2038
Fsd-Municipal Corporation								
IQBAL TOWN								
Urban	182	23.7446	17,394	29,457	32,970	35,170	37,360	39,560
	234	0.9436	17,355	23,519	26,320	28,080	29,830	31,580
	235	0.6334	16,640	22,550	25,240	26,920	28,600	30,280
	236	0.9093	15,530	21,046	23,560	25,120	26,690	28,260
	237	1.1077	17,641	23,907	26,760	28,540	30,320	32,100
	240	1.4300	22,765	30,851	34,530	40,020	49,890	41,430
	241	0.6820	18,681	25,316	28,340	30,220	32,110	34,000
	242	2.5352	15,080	20,436	22,870	24,390	25,920	27,440
	243	1.1366	21,063	28,544	32,990	36,130	39,260	42,720
	244	0.4892	18,488	25,055	25,060	25,060	25,060	25,060
	245	0.5412	20,091	27,227	27,230	27,230	27,230	27,230
	246	0.6428	21,538	29,188	32,670	32,670	32,670	32,670
	247	0.9326	20,786	28,169	32,570	35,680	38,790	42,220
	248	0.8698	21,122	28,624	33,070	36,220	39,370	42,830
	250	7.4426	16,126	21,854	24,460	26,090	27,720	29,350
	251	1.4172	20,460	27,727	31,030	33,100	35,160	37,230
	252	1.4780	19,611	26,576	29,750	31,730	33,710	35,690
	253	0.6169	18,768	25,434	28,470	30,360	32,260	32,260
	254	1.1784	15,648	21,206	23,740	25,320	26,900	28,480
	255	2.7722	17,821	24,151	27,030	28,830	30,630	32,430
	256	1.0888	17,227	23,346	26,130	27,870	29,610	31,350
	257	1.0771	18,239	24,717	28,700	31,560	34,410	37,580
	258	1.2083	16,623	22,527	25,210	26,890	28,570	30,250
	259	0.8413	16,321	22,118	25,800	28,450	31,110	34,090
	260	0.6033	16,879	22,874	25,600	27,310	29,010	30,720
	261	0.9009	23,114	31,324	36,090	39,440	42,800	46,450
	262	5.7540	18,302	24,803	27,760	29,610	31,460	33,310
	27	62.98	499,313	682,546	763,950	818,010	876,450	916,570
Rural	147	20.8476	15,127	25,618	30,570	33,660	36,760	39,850
	148	35.5553	18,342	31,062	37,060	40,820	44,570	48,320
	149	22.1901	15,838	26,822	32,010	35,250	38,490	41,730
Total of	3	78.59	49,307	83,502	99,640	109,730	119,820	129,900
Eqbal Town	**30**	**141.57**	**548,620**	**766,048**	**863,590**	**927,740**	**996,270**	**1,046,470**

Table AB5.1-1.1 Population Distribution in Ucs – 3

		Area	Population in Administrative Area					
Town	UC No.	sq. Kms	1998	2015	2023	2028	2033	2038
JINNAH TOWN								
Urban	187	1.0127	21,692	29,397	32,810	36,070	39,330	42,580
	263	1.4624	21,192	28,719	33,490	37,350	41,200	45,060
	264	0.4843	18,375	24,901	24,900	24,900	24,900	24,900
	265	0.4870	17,673	23,950	26,730	26,730	26,730	26,730
	266	0.9697	16,970	22,997	26,330	28,410	30,490	32,580
	267	2.3303	15,054	20,401	23,430	25,340	27,230	29,120
	268	1.2559	16,243	22,012	24,570	26,170	27,760	29,360
	269	0.4061	16,847	22,831	22,830	22,830	22,830	22,830
	270	2.8135	16,365	22,178	25,410	27,440	29,460	31,480
	271	1.6228	19,473	26,389	30,110	32,450	34,770	37,110
	272	2.4358	15,905	21,554	24,060	25,620	27,190	28,750
	273	1.9375	21,885	29,658	33,460	36,040	38,640	41,230
	274	5.6490	25,357	34,363	38,350	40,840	43,340	45,830
	275	3.3843	21,683	29,295	32,700	34,820	36,950	39,070
	276	0.6636	22,836	30,947	34,540	34,540	34,540	34,540
	277	0.8364	21,451	29,070	32,440	35,680	38,910	42,140
	278	0.6964	18,433	24,980	27,880	29,690	31,510	33,320
	279	0.8851	15,615	21,161	23,980	25,940	27,920	29,890
	280	1.4646	19,186	26,001	29,380	31,700	34,020	36,350
	281	0.2291	15,809	21,424	21,420	21,420	21,420	21,420
	282	0.6354	18,170	24,642	27,500	29,290	31,080	32,870
	283	1.3583	21,944	29,738	33,550	36,140	38,730	41,330
	284	0.4666	15,422	20,900	23,330	23,330	23,330	23,330
	285	0.6670	18,172	24,626	27,840	30,060	32,280	34,510
	286	1.2726	22,665	30,715	34,630	37,300	39,970	42,640
	287	0.8514	22,396	30,351	34,230	36,870	39,510	42,150
	288	0.9412	22,713	30,780	34,350	36,580	38,820	41,050
	289	1.7415	22,220	30,112	35,050	39,010	42,970	46,920
	28	38.96	541,746	734,092	819,300	872,560	925,830	979,090
Rural	180	2.8328	15,658	25,179	26,330	27,060	27,780	28,500
	181	2.9324	25,404	40,851	42,730	43,900	45,070	46,240
	155	9.1600	18,502	29,753	31,120	31,970	32,830	33,680
	156	12.2370	23,424	37,667	39,390	40,470	41,550	42,630
	157	21.3137	21,719	34,926	36,530	37,530	38,530	39,530
	158	20.6838	16,053	25,814	27,000	27,740	28,480	29,220
	159	28.5986	20,871	33,562	35,100	36,060	37,030	37,990
Total of	7	97.76	141,631	227,752	238,200	244,730	251,270	257,790
Jinnah Town	**35**	**136.72**	**683,377**	**961,844**	**1,057,500**	**1,117,290**	**1,177,100**	**1,236,880**

Table AB5.1-1.1 Population Distribution in Ucs – 4

		Area	Population in Administrative Area					
Town	UC No.	sq. Kms	1998	2015	2023	2028	2033	2038
LYALLPUR TOWN								
Urban	183	0.9526	19,188	26,003	29,100	31,040	32,980	34,920
	184	3.2228	17,512	23,732	26,560	28,330	30,100	31,870
	185	5.4311	16,000	21,683	24,270	25,890	27,500	29,120
	186	5.0156	17,948	24,323	27,220	29,040	30,850	32,660
	188	1.7958	17,070	23,133	25,890	27,610	29,340	31,060
	189	7.4805	19,328	26,193	29,320	31,270	33,220	35,170
	190	3.1633	19,141	24,940	27,910	29,770	31,630	33,490
	191	4.1174	17,463	23,666	26,490	28,250	30,020	31,780
	192	9.3513	20,494	27,773	31,090	33,160	35,230	37,300
	193	5.5215	17,799	24,121	27,000	28,790	30,590	32,390
	194	2.3577	16,784	22,745	25,460	27,150	28,850	30,540
	195	2.6645	23,527	31,883	37,680	41,310	44,930	49,290
	196	2.8628	19,402	26,293	29,430	31,390	33,350	35,310
	208	1.1430	18,619	25,232	30,240	33,370	36,510	40,370
	209	0.7192	21,820	29,570	33,100	35,300	37,510	37,510
	210	1.3377	18,728	25,380	30,410	33,550	36,690	40,570
	211	0.3969	18,455	25,010	25,010	25,010	25,010	25,010
	212	0.4086	18,711	25,357	25,360	25,360	25,360	25,360
	231	3.0372	18,821	25,506	31,160	34,680	39,910	45,140
	232	0.5363	16,861	22,850	25,570	27,280	27,280	27,280
	233	0.4040	16,111	21,833	21,830	21,830	21,830	21,830
	21	61.92	389,782	527,226	590,100	629,380	668,690	707,970
Rural	179	7.8612	17,311	26,258	30,220	32,700	35,180	37,660
	162	21.5332	18,923	28,703	33,040	35,740	38,450	41,160
	163	26.1276	16,550	25,104	28,890	31,260	33,630	36,000
	164	28.1700	14,676	22,261	25,620	27,730	29,830	31,930
	165	13.2142	21,759	33,005	37,990	41,100	44,220	47,330
	166	11.9180	20,400	30,943	35,620	38,540	41,460	44,380
	167	18.0137	15,699	23,813	27,410	29,660	31,900	34,150
	168	9.7809	20,783	31,524	36,280	39,260	42,230	45,210
	169	22.7997	23,512	35,664	41,050	44,420	47,780	51,150
	170	24.2163	22,723	34,482	39,690	42,940	46,200	49,450
	171	50.6972	20,885	31,679	36,460	39,450	42,440	45,430
	172	27.4490	15,680	23,784	27,380	29,620	31,870	34,110
	173	19.1804	21,722	32,949	37,920	41,030	44,140	47,250
	174	6.5170	18,891	28,654	32,980	35,680	38,390	41,090
	175	20.1072	24,818	37,645	43,330	46,880	50,440	53,990
	176	6.7540	16,730	25,377	29,210	31,600	34,000	36,390
Total of	16	314.34	311,062	471,845	543,090	587,610	632,160	676,680
Lyallpur Town	**37**	**376.26**	**700,844**	**999,071**	**1,133,190**	**1,216,990**	**1,300,850**	**1,384,650**

Table AB5.1-1.1 Population Distribution in Ucs – 5

Town	UC No.	Area sq. Kms	Population in Administrative Area 1998	2015	2023	2028	2033	2038
MADINA TOWN								
Urban	177	9.5076	20,395	35,198	39,170	41,660	44,140	46,630
	197	0.9033	19,065	24,961	27,780	29,540	31,310	33,070
	198	1.9237	18,979	24,846	27,650	29,400	31,160	32,910
	199	3.3765	17,412	22,796	25,370	26,980	28,590	30,200
	200	4.7652	17,859	23,381	26,020	27,670	29,320	30,970
	201	3.4049	20,651	27,036	30,090	32,000	33,900	35,810
	202	4.3705	19,908	26,064	29,010	30,850	32,690	34,530
	203	2.2709	19,217	25,159	28,000	29,780	31,550	33,330
	204	0.9416	19,110	25,019	27,840	29,610	31,370	33,140
	205	0.8403	20,581	26,945	29,990	31,890	33,790	35,690
	206	1.4951	20,594	26,960	30,000	31,910	33,810	35,710
	207	0.9160	16,683	21,841	24,310	25,850	27,390	28,930
	213	2.1788	22,370	29,288	33,220	35,650	38,110	41,020
	214	0.6276	20,033	26,227	29,190	31,040	32,890	32,890
	215	1.1073	19,659	28,738	32,600	35,010	37,420	40,300
	216	0.7704	15,896	20,811	23,770	25,630	27,480	29,800
	217	0.2385	16,608	21,743	21,740	21,740	21,740	21,740
	218	0.9830	14,536	19,031	21,790	23,520	25,260	27,440
	219	4.8939	19,776	25,891	28,820	30,640	32,470	34,300
	220	7.8276	21,420	28,043	31,210	33,190	35,170	37,150
	221	2.3957	20,067	26,272	29,240	31,090	32,950	34,800
	222	2.2620	19,941	26,107	29,050	30,900	32,740	34,580
	223	1.1080	21,701	28,411	31,620	33,630	35,630	37,640
	224	1.1653	16,832	22,037	24,530	26,080	27,640	29,190
	225	2.5360	18,681	24,462	27,220	28,950	30,670	32,400
	226	1.5621	23,404	30,641	34,100	36,260	38,430	40,590
	227	2.4566	18,403	24,093	26,820	28,520	30,220	31,920
	228	1.3252	16,141	21,132	23,520	25,010	26,500	27,990
	229	1.1190	16,317	21,362	23,780	25,280	26,790	28,300
	230	3.0400	16,785	21,582	24,020	25,540	27,070	28,590
	239	0.9956	17,492	23,705	26,530	28,300	30,060	31,830
	31	73.31	586,516	779,782	868,000	923,120	978,260	1,033,390
Rural	238	1.3596	18,438	24,139	26,870	28,570	30,280	31,980
	178	3.3234	23,524	40,652	48,610	53,580	58,560	63,530
	249	6.2845	22,680	30,800	36,830	40,600	44,360	48,130
	143	34.6738	21,386	36,957	44,190	48,710	53,230	57,750
	144	24.8595	20,436	35,316	42,230	46,550	50,870	55,190
	145	22.5021	26,325	45,493	54,400	59,960	65,530	71,090
Total of	6	93.00	132,789	213,357	253,130	277,970	302,830	327,670
Madina Town	**37**	**166.31**	**719,305**	**993,139**	**1,121,130**	**1,201,090**	**1,281,090**	**1,361,060**
Total of F-MC	**139**	**820.86**	**2,652,146**	**3,720,102**	**4,175,410**	**4,463,110**	**4,755,310**	**5,029,060**
G.Total	**156**	**1230**	**2,934,067**	**4,071,954**	**4,555,160**	**4,863,170**	**5,181,590**	**5,461,120**

Table AB5.1-1.2 Population Re-distribution in Ucs – 1

		Population Distribution-adter re-distribution				
Town	**UC No.**	**2015**	**2023**	**2028**	**2033**	**2038**
Iqbal Town						
Urban	182	29,457	32,820	34,870	36,920	38,970
	234	23,519	26,200	27,840	29,480	31,110
	235	22,550	25,130	26,690	28,260	29,830
	236	21,046	23,450	24,910	26,370	27,840
	237	23,907	26,640	28,300	29,960	31,620
	240	30,851	34,370	39,680	49,300	40,810
	241	25,316	28,210	29,970	31,730	33,490
	242	20,436	22,770	24,190	25,620	27,030
	243	28,544	32,840	35,830	38,800	42,080
	244	25,055	24,960	24,860	24,770	24,700
	245	27,227	27,110	27,000	26,910	26,820
	246	29,188	32,520	32,400	32,280	32,180
	247	28,169	32,420	35,380	38,330	41,590
	248	28,624	32,920	35,920	38,900	42,190
	250	21,854	24,350	25,870	27,390	28,910
	251	27,727	30,890	32,820	34,740	36,670
	252	26,576	29,620	31,460	33,310	35,160
	253	25,434	28,340	30,100	31,880	31,780
	254	21,206	23,630	25,110	26,580	28,060
	255	24,151	26,910	28,590	30,270	31,950
	256	23,346	26,010	27,640	29,260	30,880
	257	24,717	28,570	31,290	34,000	37,020
	258	22,527	25,100	26,660	28,230	29,800
	259	22,118	25,680	28,210	30,740	33,580
	260	22,874	25,490	27,080	28,670	30,260
	261	31,324	35,930	39,110	42,290	45,760
	262	24,803	27,640	29,360	31,090	32,810
	27	682,546	760,520	811,140	866,080	902,900
Rural	147	25,618	30,440	33,390	36,330	39,260
	148	31,062	36,890	40,480	44,040	47,590
	149	26,822	31,870	34,950	38,030	41,110
	3	83,502	99,200	108,820	118,400	127,960
Subtotal	30	**766,048**	**859,720**	**919,960**	**984,480**	**1,030,860**

Table AB5.1-1.2 Population Re-distribution in Ucs – 2

Jinnah Tiwn						
Urban	187	29,397	32,660	35,770	38,860	41,940
	263	28,719	33,340	37,040	40,710	44,390
	264	24,901	24,790	24,690	24,610	24,530
	265	23,950	26,610	26,510	26,410	26,330
	266	22,997	26,210	28,170	30,130	32,090
	267	20,401	23,330	25,130	26,910	28,690
	268	22,012	24,460	25,950	27,430	28,920
	269	22,831	22,730	22,640	22,560	22,490
	270	22,178	25,300	27,210	29,110	31,010
	271	26,389	29,970	32,180	34,360	36,560
	272	21,554	23,950	25,400	26,870	28,320
	273	29,658	33,310	35,740	38,180	40,620
	274	34,363	38,180	40,490	42,830	45,150
	275	29,295	32,550	34,530	36,510	38,490
	276	30,947	34,380	34,250	34,130	34,020
	277	29,070	32,290	35,380	38,450	41,510
	278	24,980	27,750	29,440	31,140	32,820
	279	21,161	23,870	25,720	27,590	29,440
	280	26,001	29,250	31,430	33,620	35,810
	281	21,424	21,320	21,240	21,170	21,100
	282	24,642	27,380	29,040	30,710	32,380
	283	29,738	33,400	35,840	38,270	40,710
	284	20,900	23,240	23,130	23,060	22,990
	285	24,626	27,710	29,810	31,900	34,000
	286	30,715	34,470	36,990	39,500	42,000
	287	30,351	34,080	36,560	39,040	41,520
	288	30,780	34,200	36,270	38,360	40,440
	289	30,112	34,890	38,680	42,460	46,220
	28	734,092	815,620	865,230	914,880	964,490
Rural	180	25,179	26,210	26,830	27,460	28,080
	181	40,851	42,540	43,530	44,540	45,550
	155	29,753	30,980	31,700	32,440	33,180
	156	37,667	39,210	40,130	41,060	41,990
	157	34,926	36,370	37,210	38,070	38,940
	158	25,814	26,880	27,510	28,140	28,790
	159	33,562	34,940	35,760	36,590	37,420
	7	227,752	237,130	242,670	248,300	253,950
Subtotal	35	**961,844**	**1,052,750**	**1,107,900**	**1,163,180**	**1,218,440**

Table AB5.1-1.2 Population Re-distribution in Ucs – 3

		Population Distribution-adter re-distribution				
Town	**UC No.**	**2015**	**2023**	**2028**	**2033**	**2038**
Lyallpur Town						
Urban	183	26,003	28,970	30,780	32,590	34,400
	184	23,732	26,440	28,090	29,740	31,390
	185	21,683	24,160	25,670	27,170	28,690
	186	24,323	27,100	28,800	30,490	32,170
	188	23,133	25,770	27,380	28,990	30,600
	189	26,193	29,190	31,010	32,830	34,650
	190	24,940	27,780	29,520	31,260	32,990
	191	23,666	26,370	28,010	29,660	31,310
	192	27,773	30,950	32,880	34,810	36,740
	193	24,121	26,880	28,550	30,230	31,910
	194	22,745	25,350	26,920	28,510	30,080
	195	31,883	37,510	40,950	44,390	48,550
	196	26,293	29,300	31,130	32,960	34,780
	208	25,232	30,100	33,090	36,080	39,770
	209	29,570	32,950	35,000	37,070	36,950
	210	25,380	30,270	33,270	36,260	39,960
	211	25,010	24,900	24,800	24,710	24,640
	212	25,357	25,250	25,150	25,060	24,980
	231	25,506	31,020	34,390	39,440	44,470
	232	22,850	25,460	27,050	26,960	26,870
	233	21,833	21,730	21,650	21,570	21,510
	21	527,226	587,450	624,090	660,780	697,410
Rural	179	26,258	30,080	32,430	34,760	37,100
	162	28,703	32,890	35,440	38,000	40,550
	163	25,104	28,760	31,000	33,230	35,460
	164	22,261	25,500	27,500	29,480	31,450
	165	33,005	37,820	40,750	43,700	46,620
	166	30,943	35,460	38,220	40,970	43,720
	167	23,813	27,290	29,410	31,520	33,640
	168	31,524	36,120	38,930	41,730	44,540
	169	35,664	40,870	44,040	47,210	50,390
	170	34,482	39,510	42,580	45,650	48,710
	171	31,679	36,300	39,120	41,940	44,750
	172	23,784	27,260	29,370	31,490	33,600
	173	32,949	37,750	40,690	43,620	46,550
	174	28,654	32,830	35,380	37,940	40,480
	175	37,645	43,130	46,480	49,840	53,180
	176	25,377	29,080	31,330	33,600	35,850
	16	471,845	540,650	582,670	624,680	666,590
Subtotal	37	**999,071**	**1,128,100**	**1,206,760**	**1,285,460**	**1,364,000**

Table AB5.1-1.2 Population Re-distribution in Ucs – 4

		Population Distribution-adter re-distribution				
Town	**UC No.**	**2015**	**2023**	**2028**	**2033**	**2038**
Madina Town						
Urban	177	35,198	38,990	41,310	43,620	45,920
	197	24,961	27,660	29,290	30,940	32,580
	198	24,846	27,530	29,150	30,790	32,420
	199	22,796	25,260	26,750	28,250	29,750
	200	23,381	25,900	27,440	28,970	30,510
	201	27,036	29,950	31,730	33,500	35,280
	202	26,064	28,880	30,590	32,300	34,020
	203	25,159	27,870	29,530	31,180	32,830
	204	25,019	27,710	29,360	31,000	32,650
	205	26,945	29,860	31,620	33,390	35,160
	206	26,960	29,870	31,640	33,410	35,180
	207	21,841	24,200	25,630	27,070	28,500
	213	29,288	33,070	35,350	37,660	40,400
	214	26,227	29,060	30,780	32,500	32,400
	215	28,738	32,450	34,720	36,980	39,700
	216	20,811	23,660	25,410	27,150	29,360
	217	21,743	21,650	21,560	21,490	21,420
	218	19,031	21,690	23,320	24,960	27,030
	219	25,891	28,690	30,380	32,090	33,790
	220	28,043	31,070	32,910	34,750	36,600
	221	26,272	29,110	30,830	32,560	34,280
	222	26,107	28,920	30,640	32,350	34,060
	223	28,411	31,480	33,350	35,210	37,080
	224	22,037	24,420	25,860	27,310	28,750
	225	24,462	27,100	28,710	30,310	31,920
	226	30,641	33,950	35,960	37,980	39,980
	227	24,093	26,700	28,280	29,860	31,440
	228	21,132	23,410	24,800	26,190	27,570
	229	21,362	23,670	25,070	26,470	27,880
	230	21,582	23,910	25,330	26,750	28,160
	239	23,705	26,410	28,060	29,700	31,360
	31	779,782	864,100	915,360	966,690	1,017,980
Rural	238	24,139	26,750	28,330	29,920	31,500
	178	40,652	48,390	53,130	57,870	62,580
	249	30,800	36,660	40,260	43,840	47,410
	143	36,957	43,990	48,300	52,600	56,890
	144	35,316	42,040	46,160	50,270	54,370
	145	45,493	54,160	59,450	64,750	70,030
	6	213,357	251,990	275,630	299,250	322,780
Subtotal	37	**993,139**	**1,116,090**	**1,190,990**	**1,265,940**	**1,340,760**
FDA City		**0**	**18,750**	**37,500**	**56,250**	**75,000**
Total of						
F-MC		**3,720,102**	**4,175,410**	**4,463,110**	**4,755,310**	**5,029,060**

Table AB5.1-1.3 Administrative Area, Population and Population Density - 1

		Administrative	Population					Population Density (p/ha)				
Town	**UC No.**	**Area (sqkm)**	**2015**	**2023**	**2028**	**2033**	**2038**	**2015**	**2023**	**2028**	**2033**	**2038**
Outside Fsd-MC												
Jhumra Town												
Urban	12	11.34	22,240	23,630	24,500	25,360	26,230	19.6	20.8	21.6	22.4	23.1
	13	5.22	21,276	22,600	23,430	24,260	25,090	40.8	43.3	44.9	46.5	48.1
	2	16.56	43,516	46,230	47,930	49,620	51,320	**26.3**	**27.9**	**28.9**	**30.0**	**31.0**
Rural	7	46.44	17,519	18,560	19,220	19,870	20,520	3.8	4.0	4.1	4.3	4.4
	8	37.17	16,469	17,450	18,060	18,680	19,290	4.4	4.7	4.9	5.0	5.2
	9	32.71	26,591	28,180	27,240	27,580	31,150	8.1	8.6	8.3	8.4	9.5
	10	36.44	19,959	21,150	21,890	22,640	23,380	5.5	5.8	6.0	6.2	6.4
	11	35.28	19,330	20,480	21,200	21,920	22,640	5.5	5.8	6.0	6.2	6.4
	14	14.94	17,449	18,490	19,140	19,790	20,440	11.7	12.4	12.8	13.2	13.7
	15	17.78	22,207	23,530	24,360	25,180	26,010	12.5	13.2	13.7	14.2	14.6
	7	220.76	139,524	147,840	151,110	155,660	163,430	6.3	6.7	6.8	7.1	7.4
subtotal	9	**237.3**	**183,040**	**194,070**	**199,040**	**205,280**	**214,750**	**7.7**	**8.2**	**8.4**	**8.7**	**9.0**
Jaranwala Town												
Urban	20	11.17	21,306	23,870	27,700	34,580	28,680	19.1	21.4	24.8	31.0	25.7
	21	6.97	19,366	21,690	23,150	24,600	26,060	27.8	31.1	33.2	35.3	37.4
	2	18.14	40,672	45,560	50,850	59,180	54,740	22.4	25.1	28.0	32.6	30.2
Rural	19	19.05	27,862	30,470	32,090	33,720	35,350	14.6	16.0	16.8	17.7	18.6
	22	34.66	20,915	22,870	24,090	25,310	26,530	6.0	6.6	6.9	7.3	7.7
	33	31.47	27,451	30,020	34,190	39,960	34,830	8.7	9.5	10.9	12.7	11.1
	34	3.40	22,978	25,120	26,470	27,810	29,150	67.5	73.8	77.8	81.7	85.6
	35	65.21	28,934	31,640	33,330	35,020	36,710	4.4	4.9	5.1	5.4	5.6
	5	153.79	128,140	140,120	150,170	161,820	162,570	8.3	9.1	9.8	10.5	10.6
subtotal	7	**171.9**	**168,812**	**185,680**	**201,020**	**221,000**	**217,310**	**9.8**	**10.8**	**11.7**	**12.9**	**12.6**
Total		**409.2**	**351,852**	**379,750**	**400,060**	**426,280**	**432,060**	**8.6**	**9.3**	**9.8**	**10.4**	**10.6**

Table AB5.1-1.3 Administrative Area, Population and Population Density - 2

		Administrative	Population					Population Density (p/ha)				
Town	**UC No.**	**Area (sqkm)**	**2015**	**2023**	**2028**	**2033**	**2038**	**2015**	**2023**	**2028**	**2033**	**2038**
Fsd-Municipal Corporation												
Iqbal Town												
Urban	182	23.75	29,457	32,820	34,870	36,920	38,970	12.4	13.8	14.7	15.5	16.4
	234	0.94	23,519	26,200	27,840	29,480	31,110	249.1	277.5	294.9	312.3	329.6
	235	0.63	22,550	25,130	26,690	28,260	29,830	356.2	397.0	421.6	446.4	471.2
	236	0.91	21,046	23,450	24,910	26,370	27,840	231.5	258.0	274.0	290.1	306.3
	237	1.11	23,907	26,640	28,300	29,960	31,620	215.8	240.4	255.4	270.4	285.4
	240	1.43	30,851	34,370	39,680	49,300	40,810	215.7	240.3	277.5	344.8	285.4
	241	0.68	25,316	28,210	29,970	31,730	33,490	371.2	413.6	439.4	465.2	491.1
	242	2.54	20,436	22,770	24,190	25,620	27,030	80.6	89.8	95.4	101.1	106.6
	243	1.14	28,544	32,840	35,830	38,800	42,080	251.0	288.8	315.1	341.2	370.1
	244	0.49	25,055	24,960	24,860	24,770	24,700	512.4	510.4	508.4	506.5	505.1
	245	0.54	27,227	27,110	27,000	26,910	26,820	503.3	501.1	499.1	497.4	495.7
	246	0.64	29,188	32,520	32,400	32,280	32,180	453.9	505.8	503.9	502.0	500.5
	247	0.93	28,169	32,420	35,380	38,330	41,590	301.9	347.5	379.2	410.8	445.8
	248	0.87	28,624	32,920	35,920	38,900	42,190	329.0	378.4	412.9	447.1	484.9
	250	7.44	21,854	24,350	25,870	27,390	28,910	29.4	32.7	34.8	36.8	38.8
	251	1.42	27,727	30,890	32,820	34,740	36,670	195.7	218.0	231.6	245.2	258.8
	252	1.48	26,576	29,620	31,460	33,310	35,160	179.8	200.4	212.9	225.4	237.9
	253	0.62	25,434	28,340	30,100	31,880	31,780	412.2	459.3	487.8	516.7	515.1
	254	1.18	21,206	23,630	25,110	26,580	28,060	180.0	200.6	213.2	225.6	238.2
	255	2.77	24,151	26,910	28,590	30,270	31,950	87.1	97.1	103.1	109.2	115.3
	256	1.09	23,346	26,010	27,640	29,260	30,880	214.4	238.8	253.8	268.7	283.6
	257	1.08	24,717	28,570	31,290	34,000	37,020	229.5	265.3	290.5	315.7	343.7
	258	1.21	22,527	25,100	26,660	28,230	29,800	186.5	207.8	220.7	233.7	246.7
	259	0.84	22,118	25,680	28,210	30,740	33,580	263.0	305.4	335.4	365.5	399.3
	260	0.60	22,874	25,490	27,080	28,670	30,260	379.3	422.7	449.1	475.5	501.8
	261	0.90	31,324	35,930	39,110	42,290	45,760	347.7	398.8	434.1	469.4	507.9
	262	5.75	24,803	27,640	29,360	31,090	32,810	43.1	48.0	51.0	54.0	57.0
	27	63.0	682,546	760,520	811,140	866,080	902,900	108.4	120.8	128.8	137.5	143.4
Rural	147	20.85	25,618	30,440	33,390	36,330	39,260	12.3	14.6	16.0	17.4	18.8
	148	35.56	31,062	36,890	40,480	44,040	47,590	8.7	10.4	11.4	12.4	13.4
	149	22.19	26,822	31,870	34,950	38,030	41,110	12.1	14.4	15.8	17.1	18.5
	3	78.6	83,502	99,200	108,820	118,400	127,960	10.6	12.6	13.8	15.1	16.3
Subtotal	**30**	**141.6**	**766,048**	**859,720**	**919,960**	**984,480**	**1,030,860**	**54.1**	**60.7**	**65.0**	**69.5**	**72.8**

Table AB5.1-1.3 Administrative Area, Population and Population Density - 3

		Administrative	Population					Population Density (p/ha)				
Town	**UC No.**	**Area (sqkm)**	**2015**	**2023**	**2028**	**2033**	**2038**	**2015**	**2023**	**2028**	**2033**	**2038**
Jinnah Town												
Urban	187	1.01	29,397	32,660	35,770	38,860	41,940	290.2	322.4	353.1	383.6	414.0
	263	1.46	28,719	33,340	37,040	40,710	44,390	196.4	228.0	253.4	278.5	303.6
	264	0.48	24,901	24,790	24,690	24,610	24,530	514.5	512.2	510.1	508.5	506.8
	265	0.49	23,950	26,610	26,510	26,410	26,330	491.8	546.4	544.4	542.3	540.7
	266	0.97	22,997	26,210	28,170	30,130	32,090	237.1	270.2	290.4	310.6	330.8
	267	2.33	20,401	23,330	25,130	26,910	28,690	87.6	100.1	107.9	115.5	123.1
	268	1.26	22,012	24,460	25,950	27,430	28,920	175.3	194.7	206.6	218.4	230.3
	269	0.41	22,831	22,730	22,640	22,560	22,490	562.3	559.9	557.6	555.7	553.9
	270	2.81	22,178	25,300	27,210	29,110	31,010	78.8	89.9	96.7	103.4	110.2
	271	1.62	26,389	29,970	32,180	34,360	36,560	162.6	184.7	198.3	211.7	225.3
	272	2.44	21,554	23,950	25,400	26,870	28,320	88.5	98.3	104.3	110.3	116.3
	273	1.94	29,658	33,310	35,740	38,180	40,620	153.0	171.9	184.4	197.0	209.6
	274	5.65	34,363	38,180	40,490	42,830	45,150	60.8	67.6	71.7	75.8	79.9
	275	3.38	29,295	32,550	34,530	36,510	38,490	86.6	96.2	102.0	107.9	113.7
	276	0.66	30,947	34,380	34,250	34,130	34,020	466.1	517.8	515.8	514.0	512.3
	277	0.84	29,070	32,290	35,380	38,450	41,510	347.7	386.2	423.2	459.9	496.5
	278	0.70	24,980	27,750	29,440	31,140	32,820	358.9	398.7	423.0	447.4	471.6
	279	0.89	21,161	23,870	25,720	27,590	29,440	239.1	269.7	290.6	311.8	332.7
	280	1.47	26,001	29,250	31,430	33,620	35,810	177.5	199.7	214.5	229.5	244.4
	281	0.23	21,424	21,320	21,240	21,170	21,100	935.5	931.0	927.5	924.5	921.4
	282	0.64	24,642	27,380	29,040	30,710	32,380	388.1	431.2	457.3	483.6	509.9
	283	1.36	29,738	33,400	35,840	38,270	40,710	219.0	245.9	263.9	281.8	299.8
	284	0.47	20,900	23,240	23,130	23,060	22,990	447.5	497.6	495.3	493.8	492.3
	285	0.67	24,626	27,710	29,810	31,900	34,000	369.2	415.4	446.9	478.3	509.7
	286	1.27	30,715	34,470	36,990	39,500	42,000	241.3	270.8	290.6	310.3	329.9
	287	0.85	30,351	34,080	36,560	39,040	41,520	356.7	400.5	429.6	458.8	487.9
	288	0.94	30,780	34,200	36,270	38,360	40,440	327.1	363.4	385.4	407.7	429.8
	289	1.74	30,112	34,890	38,680	42,460	46,220	172.9	200.3	222.0	243.7	265.3
	28	39.0	734,092	815,620	865,230	914,880	964,490	188.4	209.3	222.1	234.8	247.6
Rural	180	2.83	25,179	26,210	26,830	27,460	28,080	88.9	92.5	94.7	96.9	99.1
	181	2.93	40,851	42,540	43,530	44,540	45,550	139.3	145.1	148.5	151.9	155.4
	155	9.16	29,753	30,980	31,700	32,440	33,180	32.5	33.8	34.6	35.4	36.2
	156	12.24	37,667	39,210	40,130	41,060	41,990	30.8	32.0	32.8	33.6	34.3
	157	21.31	34,926	36,370	37,210	38,070	38,940	16.4	17.1	17.5	17.9	18.3
	158	20.68	25,814	26,880	27,510	28,140	28,790	12.5	13.0	13.3	13.6	13.9
	159	28.60	33,562	34,940	35,760	36,590	37,420	11.7	12.2	12.5	12.8	13.1
	7	97.8	227,752	237,130	242,670	248,300	253,950	23.3	24.3	24.8	25.4	26.0
Subtotal	**35**	**136.7**	**961,844**	**1,052,750**	**1,107,900**	**1,163,180**	**1,218,440**	**70.4**	**77.0**	**81.0**	**85.1**	**89.1**

Table AB5.1-1.3 Administrative Area, Population and Population Density - 4

		Administrative	Population					Population Density (p/ha)				
Town	UC No.	Area (sqkm)	2015	2023	2028	2033	2038	2015	2023	2028	2033	2038
Lyallpur Town												
Urban	183	0.95	26,003	28,970	30,780	32,590	34,400	272.9	304.0	323.0	342.0	361.0
	184	3.22	23,732	26,440	28,090	29,740	31,390	73.6	82.0	87.2	92.3	97.4
	185	5.43	21,683	24,160	25,670	27,170	28,690	39.9	44.5	47.3	50.0	52.8
	186	5.02	24,323	27,100	28,800	30,490	32,170	48.5	54.0	57.4	60.8	64.1
	188	1.80	23,133	25,770	27,380	28,990	30,600	128.8	143.5	152.4	161.4	170.4
	189	7.48	26,193	29,190	31,010	32,830	34,650	35.0	39.0	41.5	43.9	46.3
	190	3.16	24,940	27,780	29,520	31,260	32,990	78.8	87.8	93.3	98.8	104.3
	191	4.12	23,666	26,370	28,010	29,660	31,310	57.5	64.1	68.0	72.0	76.1
	192	9.35	27,773	30,950	32,880	34,810	36,740	29.7	33.1	35.2	37.2	39.3
	193	5.52	24,121	26,880	28,550	30,230	31,910	43.7	48.7	51.7	54.7	57.8
	194	2.36	22,745	25,350	26,920	28,510	30,080	96.5	107.5	114.2	120.9	127.6
	195	2.67	31,883	37,510	40,950	44,390	48,550	119.6	140.8	153.7	166.6	182.2
	196	2.86	26,293	29,300	31,130	32,960	34,780	91.8	102.3	108.7	115.1	121.5
	208	1.14	25,232	30,100	33,090	36,080	39,770	220.8	263.3	289.5	315.7	347.9
	209	0.72	29,570	32,950	35,000	37,070	36,950	411.3	458.3	486.8	515.6	513.9
	210	1.34	25,380	30,270	33,270	36,260	39,960	189.7	226.2	248.7	271.0	298.7
	211	0.40	25,010	24,900	24,800	24,710	24,640	630.0	627.2	624.7	622.4	620.7
	212	0.41	25,357	25,250	25,150	25,060	24,980	620.0	617.4	614.9	612.7	610.8
	231	3.04	25,506	31,020	34,390	39,440	44,470	84.0	102.1	113.2	129.9	146.4
	232	0.54	22,850	25,460	27,050	26,960	26,870	426.3	475.0	504.7	503.0	501.3
	233	0.40	21,833	21,730	21,650	21,570	21,510	540.4	537.9	535.9	533.9	532.4
	21	61.9	527,226	587,450	624,090	660,780	697,410	85.1	94.9	100.8	106.7	112.6
Rural	179	7.86	26,258	30,080	32,430	34,760	37,100	33.4	38.3	41.3	44.2	47.2
	162	21.53	28,703	32,890	35,440	38,000	40,550	13.3	15.3	16.5	17.6	18.8
	163	26.13	25,104	28,760	31,000	33,230	35,460	9.6	11.0	11.9	12.7	13.6
	164	28.17	22,261	25,500	27,500	29,480	31,450	7.9	9.1	9.8	10.5	11.2
	165	13.21	33,005	37,820	40,750	43,700	46,620	25.0	28.6	30.8	33.1	35.3
	166	11.92	30,943	35,460	38,220	40,970	43,720	26.0	29.8	32.1	34.4	36.7
	167	18.01	23,813	27,290	29,410	31,520	33,640	13.2	15.1	16.3	17.5	18.7
	168	9.78	31,524	36,120	38,930	41,730	44,540	32.2	36.9	39.8	42.7	45.5
	169	22.80	35,664	40,870	44,040	47,210	50,390	15.6	17.9	19.3	20.7	22.1
	170	24.22	34,482	39,510	42,580	45,650	48,710	14.2	16.3	17.6	18.9	20.1
	171	50.70	31,679	36,300	39,120	41,940	44,750	6.2	7.2	7.7	8.3	8.8
	172	27.45	23,784	27,260	29,370	31,490	33,600	8.7	9.9	10.7	11.5	12.2
	173	19.18	32,949	37,750	40,690	43,620	46,550	17.2	19.7	21.2	22.7	24.3
	174	6.52	28,654	32,830	35,380	37,940	40,480	44.0	50.4	54.3	58.2	62.1
	175	20.11	37,645	43,130	46,480	49,840	53,180	18.7	21.5	23.1	24.8	26.4
	176	6.75	25,377	29,080	31,330	33,600	35,850	37.6	43.1	46.4	49.7	53.1
	16	314.3	471,845	540,650	582,670	624,680	666,590	15.0	17.2	18.5	19.9	21.2
Subtotal	**37**	**376.3**	**999,071**	**1,128,100**	**1,206,760**	**1,285,460**	**1,364,000**	**26.6**	**30.0**	**32.1**	**34.2**	**36.3**

Table AB5.1-1.3 Administrative Area, Population and Population Density - 5

		Administrative	Population					Population Density (p/ha)				
Town	**UC No.**	**Area (sqkm)**	**2015**	**2023**	**2028**	**2033**	**2038**	**2015**	**2023**	**2028**	**2033**	**2038**
Madina Town												
Urban	177	9.51	35,198	38,990	41,300	43,620	45,920	37.0	41.0	43.4	45.9	48.3
	197	0.90	24,961	27,660	29,290	30,940	32,580	276.4	306.3	324.4	342.6	360.8
	198	1.92	24,846	27,530	29,150	30,790	32,420	129.1	143.1	151.5	160.0	168.5
	199	3.38	22,796	25,260	26,750	28,250	29,750	67.5	74.8	79.2	83.7	88.1
	200	4.77	23,381	25,900	27,440	28,970	30,510	49.1	54.4	57.6	60.8	64.0
	201	3.41	27,036	29,950	31,730	33,500	35,280	79.4	88.0	93.2	98.4	103.6
	202	4.37	26,064	28,880	30,590	32,300	34,020	59.6	66.1	70.0	73.9	77.8
	203	2.27	25,159	27,870	29,530	31,180	32,830	110.8	122.7	130.0	137.3	144.6
	204	0.94	25,019	27,710	29,360	31,000	32,650	265.6	294.2	311.7	329.1	346.6
	205	0.84	26,945	29,860	31,620	33,390	35,160	320.8	355.5	376.4	397.5	418.6
	206	1.50	26,960	29,870	31,640	33,410	35,180	180.3	199.8	211.6	223.5	235.3
	207	0.92	21,841	24,200	25,630	27,070	28,500	238.4	264.2	279.8	295.5	311.1
	213	2.17	29,288	33,070	35,350	37,660	40,400	135.0	152.4	162.9	173.5	186.2
	214	0.63	26,227	29,060	30,780	32,500	32,400	417.6	462.7	490.1	517.5	515.9
	215	1.11	28,738	32,450	34,720	36,980	39,700	259.6	293.1	313.6	334.1	358.6
	216	0.77	20,811	23,660	25,410	27,150	29,360	270.3	307.3	330.0	352.6	381.3
	217	0.24	21,743	21,650	21,560	21,490	21,420	909.7	905.9	902.1	899.2	896.2
	218	0.98	19,031	21,690	23,320	24,960	27,030	193.6	220.7	237.2	253.9	275.0
	219	4.89	25,891	28,690	30,380	32,090	33,790	52.9	58.6	62.1	65.6	69.0
	220	7.83	28,043	31,070	32,910	34,750	36,600	35.8	39.7	42.0	44.4	46.8
	221	2.40	26,272	29,110	30,830	32,560	34,280	109.6	121.5	128.7	135.9	143.1
	222	2.26	26,107	28,920	30,640	32,350	34,060	115.4	127.9	135.5	143.0	150.6
	223	1.11	28,411	31,480	33,350	35,210	37,080	256.4	284.1	301.0	317.8	334.7
	224	1.17	22,037	24,420	25,860	27,310	28,750	189.2	209.6	222.0	234.4	246.8
	225	2.54	24,462	27,100	28,710	30,310	31,920	96.5	106.9	113.2	119.5	125.9
	226	1.56	30,641	33,950	35,960	37,980	39,980	196.2	217.3	230.2	243.1	256.0
	227	2.46	24,093	26,700	28,280	29,860	31,440	98.1	108.7	115.1	121.5	128.0
	228	1.33	21,132	23,410	24,800	26,190	27,570	159.5	176.7	187.2	197.7	208.1
	229	1.12	21,362	23,670	25,070	26,470	27,880	190.9	211.5	224.0	236.6	249.2
	230	3.04	21,582	23,910	25,330	26,750	28,160	71.0	78.7	83.3	88.0	92.6
	239	1.00	23,705	26,410	28,060	29,700	31,360	238.0	265.2	281.7	298.2	314.9
	31	73.3	779,782	864,100	915,350	966,690	1,017,980	106.4	117.9	124.9	131.9	138.9
Rural	238	1.36	24,139	26,750	28,330	29,920	31,500	177.5	196.7	208.3	220.0	231.6
	178	3.32	40,652	48,390	53,130	57,870	62,580	122.3	145.6	159.9	174.1	188.3
	249	6.29	30,800	36,660	40,260	43,840	47,410	49.0	58.3	64.1	69.8	75.4
	143	34.67	36,957	43,990	48,300	52,600	56,890	10.7	12.7	13.9	15.2	16.4
	144	24.86	35,316	42,040	46,160	50,270	54,370	14.2	16.9	18.6	20.2	21.9
	145	22.50	45,493	54,160	59,460	64,750	70,030	20.2	24.1	26.4	28.8	31.1
	6	93.0	213,357	251,990	275,640	299,250	322,780	22.9	27.1	29.6	32.2	34.7
Subtotal	**37**	**166.3**	**993,139**	**1,116,090**	**1,190,990**	**1,265,940**	**1,340,760**	**59.7**	**67.1**	**71.6**	**76.1**	**80.6**
Total	**139**	**820.9**	**3,720,102**	**4,156,660**	**4,425,610**	**4,699,060**	**4,954,060**	**45.3**	**50.6**	**53.9**	**57.2**	**60.4**
FDA City	-	-	**0**	**18,750**	**37,500**	**56,250**	**75,000**	-	-	-	-	-
Total of Peri-Urban Area		**820.9**	**4,071,954**	**4,555,160**	**4,863,170**	**5,181,590**	**5,461,120**	**49.6**	**55.5**	**59.2**	**63.1**	**66.5**

Table AB5.1-2 Distribution of Population in Service Area and Population Served – 1

		Adm. Area	Service Area (sq.km)					Population Distribution in Service Area					Distribution of Popolation Served				
Town	**UC No.**	**sq.km**	**2015**	**2023**	**2028**	**2033**	**2038**	**2015**	**2023**	**2028**	**2033**	**2038**	**2015**	**2023**	**2028**	**2033**	**2038**
														Service ratio			
													41.5%	60%	75%	90%	100%
Peri-Urban																	
JHUMRA TOWN																	
Urban	12	11.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	13	5.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	16.56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rural	7	46.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8	37.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9	32.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10	36.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11	35.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	14	14.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15	17.78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7	220.76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
subtotal	9	**237.3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
JALANWALA																	
Urban	20	11.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	21	6.97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	18.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rural	19	19.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	22	34.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	33	31.47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	34	3.40	-	-	-	-	3.40	-	-	-	-	29,150	-	-	-	-	29,150
	35	65.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	153.79	0	0	0	0	3.40	0	0	0	0	29,150	0	0	0	0	29,150
subtotal	7	**171.9**	**0**	**0**	**0**	**0**	**3.40**	**0**	**0**	**0**	**0**	**29,150**	**0**	**0**	**0**	**0**	**29,150**
Total	16	**409.2**	**0**	**0**	**0**	**0**	**3.40**	**0**	**0**	**0**	**0**	**29,150**	**0**	**0**	**0**	**0**	**29,150**
Fsd-Municipal Corporation																	
IQBAL TOWN																	
Urban	182	23.74	-	-	23.74	23.74	23.74	-	-	34,870	36,920	38,970	-	-	26,240	34,910	38,970
	234	0.94	0.94	0.94	0.94	0.94	0.94	23,519	26,200	27,840	29,480	31,110	9,760	15,270	20,950	27,870	31,110
	235	0.63	0.63	0.63	0.63	0.63	0.63	22,550	25,130	26,690	28,260	29,830	9,360	14,650	20,090	26,720	29,830
	236	0.91	0.91	0.91	0.91	0.91	0.91	21,046	23,450	24,910	26,370	27,840	8,740	13,670	18,740	24,930	27,840
	237	1.11	1.11	1.11	1.11	1.11	1.11	23,907	26,640	28,300	29,960	31,620	9,920	15,530	21,300	28,320	31,620
	240	1.43	1.43	1.43	1.43	1.43	1.43	30,851	34,370	39,680	49,300	40,810	12,800	20,030	29,860	46,610	40,810
	241	0.68	0.68	0.68	0.68	0.68	0.68	25,316	28,210	29,970	31,730	33,490	10,510	16,450	22,560	30,000	33,490
	242	2.54	2.54	2.54	2.54	2.54	2.54	20,436	22,770	24,190	25,620	27,030	8,480	13,270	18,200	24,230	27,030
	243	1.14	1.14	1.14	1.14	1.14	1.14	28,544	32,840	35,830	38,800	42,080	11,850	19,140	26,960	36,690	42,080
	244	0.49	0.49	0.49	0.49	0.49	0.49	25,055	24,960	24,860	24,770	24,700	10,400	14,550	18,720	23,430	24,700
	245	0.54	0.54	0.54	0.54	0.54	0.54	27,227	27,110	27,000	26,910	26,820	11,300	15,810	20,320	25,440	26,820
	246	0.64	0.64	0.64	0.64	0.64	0.64	29,188	32,520	32,400	32,280	32,180	12,110	18,960	24,380	30,520	32,180
	247	0.93	0.93	0.93	0.93	0.93	0.93	28,169	32,420	35,380	38,330	41,590	11,690	18,900	26,630	36,240	41,590
	248	0.87	0.87	0.87	0.87	0.87	0.87	28,624	32,920	35,920	38,900	42,190	11,880	19,190	27,030	36,780	42,190
	250	7.44	-	7.44	7.44	7.44	7.44	-	24,350	25,870	27,390	28,910	-	14,190	19,470	25,900	28,910
	251	1.42	1.42	1.42	1.42	1.42	1.42	27,727	30,890	32,820	34,740	36,670	11,510	18,000	24,700	32,850	36,670
	252	1.48	1.48	1.48	1.48	1.48	1.48	26,576	29,620	31,460	33,310	35,160	11,030	17,270	23,680	31,500	35,160
	253	0.62	0.62	0.62	0.62	0.62	0.62	25,434	28,340	30,100	31,880	31,780	10,560	16,520	22,660	30,140	31,780
	254	1.18	1.18	1.18	1.18	1.18	1.18	21,206	23,630	25,110	26,580	28,060	8,800	13,780	18,890	25,130	28,060
	255	2.77	2.77	2.77	2.77	2.77	2.77	24,151	26,910	28,590	30,270	31,950	10,020	15,690	21,510	28,620	31,950
	256	1.09	1.09	1.09	1.09	1.09	1.09	23,346	26,010	27,640	29,260	30,880	9,690	15,170	20,800	27,660	30,880
	257	1.08	1.08	1.08	1.08	1.08	1.08	24,717	28,570	31,290	34,000	37,020	10,260	16,650	23,550	32,150	37,020
	258	1.21	1.21	1.21	1.21	1.21	1.21	22,527	25,100	26,660	28,230	29,800	9,350	14,630	20,070	26,690	29,800
	259	0.84	0.84	0.84	0.84	0.84	0.84	22,118	25,680	28,210	30,740	33,580	9,180	14,970	21,230	29,070	33,580
	260	0.60	0.60	0.60	0.60	0.60	0.60	22,874	25,490	27,080	28,670	30,260	9,490	14,860	20,380	27,100	30,260
	261	0.90	0.90	0.90	0.90	0.90	0.90	31,324	35,930	39,110	42,290	45,760	13,000	20,320	29,430	39,980	45,760
	262	5.75	-	5.75	5.75	5.75	5.75	-	27,640	29,360	31,090	32,810	-	16,110	22,100	29,390	32,810
	27	63.0	26.04	39.23	62.98	62.98	62.98	606,432	727,700	811,140	866,080	902,900	251,690	423,580	610,450	818,870	902,900
Rural	147	20.85	-	-	-	-	-	-	-	-	-	-					
	148	35.56	-	-	-	-	35.56	-	-	-	-	47,590		0	0	0	47,590
	149	22.19	-	-	-	-	-	-	-	-	-	-					
	3	78.6	0	0	0	0	35.56	0	0		0	47,590	0	0	0	0	47,590
subtotal	30	**141.6**	**26.04**	**39.23**	**62.98**	**62.98**	**98.53**	**606,432**	**727,700**	**811,140**	**866,080**	**950,490**	**251,690**	**423,580**	**610,450**	**818,870**	**950,490**

Table AB5.1-2 Distribution of Population in Service Area and Population Served – 2

		Adm. Area	Service Area (sq.km)					Population Distribution in Service Area					Distribution of Popolation Served				
Town	UC No.	sq.km	2015	2023	2028	2033	2038	2015	2023	2028	2033	2038	2015	2023	2028	2033	2038
													Service ratio				
													41.5%	60%	75%	90%	100%
JINNAH TOWN															619,430	610,450	
	187	1.01	1.01	1.01	1.01	1.01	1.01	29,397	32,660	35,770	38,860	41,940	12,200	19,040	26,920	36,740	41,940
	263	1.46	1.46	1.46	1.46	1.46	1.46	28,719	33,340	37,040	40,710	44,390	11,920	19,430	27,880	38,490	44,390
	264	0.48	0.48	0.48	0.48	0.48	0.48	24,901	24,790	24,690	24,610	24,530	10,330	14,450	18,580	23,270	24,530
	265	0.49	0.49	0.49	0.49	0.49	0.49	23,950	26,610	26,510	26,410	26,330	9,940	15,520	19,950	24,970	26,330
	266	0.97	0.97	0.97	0.97	0.97	0.97	22,997	26,210	28,170	30,130	32,090	9,540	15,280	21,200	28,490	32,090
	267	2.33	2.33	2.33	2.33	2.33	2.33	20,401	23,330	25,130	26,910	28,690	8,480	13,600	18,910	25,440	28,690
	268	1.26	1.26	1.26	1.26	1.26	1.26	22,012	24,460	25,950	27,430	28,920	9,130	14,260	19,530	25,940	28,920
	269	0.41	0.41	0.41	0.41	0.41	0.41	22,831	22,730	22,640	22,560	22,490	9,470	13,250	17,040	21,330	22,490
	270	2.81	-	2.81	2.81	2.81	2.81	-	25,300	27,210	29,110	31,010	-	14,750	20,480	27,520	31,010
	271	1.62	1.62	1.62	1.62	1.62	1.62	26,389	29,970	32,180	34,360	36,560	10,950	17,470	24,220	32,480	36,560
	272	2.44	2.44	2.44	2.44	2.44	2.44	21,554	23,950	25,400	26,870	28,320	8,940	13,960	19,120	25,400	28,320
	273	1.94	1.94	1.94	1.94	1.94	1.94	29,658	33,310	35,740	38,180	40,620	12,310	19,420	26,900	36,100	40,620
	274	5.65	5.65	5.65	5.65	5.65	5.65	34,363	38,180	40,490	42,830	45,150	14,260	21,590	30,570	40,500	45,150
	275	3.38	3.38	3.38	3.38	3.38	3.38	29,295	32,550	34,530	36,510	38,490	12,160	18,980	25,990	34,520	38,490
	276	0.66	0.66	0.66	0.66	0.66	0.66	30,947	34,380	34,250	34,130	34,020	12,840	20,040	25,780	32,270	34,020
	277	0.84	0.84	0.84	0.84	0.84	0.84	29,070	32,290	35,380	38,450	41,510	12,060	18,820	26,630	36,360	41,510
	278	0.70	0.70	0.70	0.70	0.70	0.70	24,980	27,750	29,440	31,140	32,820	10,370	16,180	22,160	29,450	32,820
	279	0.89	0.89	0.89	0.89	0.89	0.89	21,161	23,870	25,720	27,590	29,440	8,780	13,910	19,360	26,090	29,440
	280	1.46	1.46	1.46	1.46	1.46	1.46	26,001	29,250	31,430	33,620	35,810	10,790	17,050	23,650	31,790	35,810
	281	0.23	0.23	0.23	0.23	0.23	0.23	21,424	21,320	21,240	21,170	21,100	8,890	12,430	15,990	20,020	21,100
	282	0.64	0.64	0.64	0.64	0.64	0.64	24,642	27,380	29,040	30,710	32,380	10,230	15,960	21,850	29,040	32,380
	283	1.36	1.36	1.36	1.36	1.36	1.36	29,738	33,400	35,840	38,270	40,710	12,340	19,470	26,970	36,180	40,710
	284	0.47	0.47	0.47	0.47	0.47	0.47	20,900	23,240	23,130	23,060	22,990	8,670	13,540	17,410	21,800	22,990
	285	0.67	0.67	0.67	0.67	0.67	0.67	24,626	27,710	29,810	31,900	34,000	10,220	16,160	22,440	30,160	34,000
	286	1.27	1.27	1.27	1.27	1.27	1.27	30,715	34,470	36,990	39,500	42,000	12,750	20,090	27,830	37,350	42,000
	287	0.85	0.85	0.85	0.85	0.85	0.85	30,351	34,080	36,560	39,040	41,520	12,600	19,870	27,510	36,920	41,520
	288	0.94	0.94	0.94	0.94	0.94	0.94	30,780	34,200	36,270	38,360	40,440	12,770	19,940	27,290	36,270	40,440
	289	1.74	1.74	1.74	1.74	1.74	1.74	30,112	34,890	38,680	42,460	46,220	12,500	20,340	29,110	40,140	46,220
	28	39.0	36	39	39	39	39	711,914	815,620	865,230	914,880	964,490	295,440	474,800	651,270	865,030	964,490
Rural	180	2.83	-	2.83	2.83	2.83	2.83	-	26,210	26,830	27,460	28,080		15,280	20,190	25,960	28,080
	181	2.93	-	2.93	2.93	2.93	2.93	-	42,540	43,530	44,540	45,550		24,050	32,870	42,120	45,550
	155	9.16	-	-	-	-	-	-	-	-	-	-					
	156	12.24	-	-	-	-	-	-	-	-	-	-					
	157	21.31	-	-	-	-	-	-	-	-	-	-					
	158	20.68	-	-	-	-	-	-	-	-	-	-					
	159	28.60	-	-	-	-	-	-	-	-	-	-					
	7	97.8	0.00	5.77	5.77	5.77	5.77	0	68,750	70,360	72,000	73,630	0	39,330	53,060	68,080	73,630
subtotal	35	**136.7**	**36.15**	**44.73**	**44.73**	**44.73**	**44.73**	**711,914**	**884,370**	**935,590**	**986,880**	**1,038,120**	**295,440**	**514,130**	**704,330**	**933,110**	**1,038,120**

Table AB5.1-2 Distribution of Population in Service Area and Population Served – 3

		Adm. Area	Service Area (sq.km)					Population Distribution in Service Area					Distribution of Popolation Served				
Town	UC No.	sq.km	2015	2023	2028	2033	2038	2015	2023	2028	2033	2038	2015	2023	2028	2033	2038
														Service ratio			
													41.5%	60%	75%	90%	100%
LYALLPUR TOWN															714,689	704,330	
Urban	183	0.95	0.95	0.95	0.95	0.95	0.95	26,003	28,970	30,780	32,590	34,400	10,790	16,890	23,170	30,810	34,400
	184	3.22	3.22	3.22	3.22	3.22	3.22	23,732	26,440	28,090	29,740	31,390	9,850	15,410	21,140	28,120	31,390
	185	5.43	5.43	5.43	5.43	5.43	5.43	21,683	24,160	25,670	27,170	28,690	9,000	14,090	19,320	25,690	28,690
	186	5.02	5.02	5.02	5.02	5.02	5.02	24,323	27,100	28,800	30,490	32,170	10,090	15,800	21,670	28,830	32,170
	188	1.80	1.80	1.80	1.80	1.80	1.80	23,133	25,770	27,380	28,990	30,600	9,600	15,020	20,610	27,410	30,600
	189	7.48	7.48	7.48	7.48	7.48	7.48	26,193	29,190	31,010	32,830	34,650	10,870	17,010	23,340	31,040	34,650
	190	3.16	3.16	3.16	3.16	3.16	3.16	24,940	27,780	29,520	31,260	32,990	10,350	16,200	22,220	29,550	32,990
	191	4.12	-	4.12	4.12	4.12	4.12	-	26,370	28,010	29,660	31,310	-	15,370	21,080	28,040	31,310
	192	9.35	-	9.35	9.35	9.35	9.35	-	30,950	32,880	34,810	36,740	-	18,040	24,740	32,910	36,740
	193	5.52	5.52	5.52	5.52	5.52	5.52	24,121	26,880	28,550	30,230	31,910	10,010	15,670	21,480	28,590	31,910
	194	2.36	2.36	2.36	2.36	2.36	2.36	22,745	25,350	26,920	28,510	30,080	9,440	14,780	20,260	26,960	30,080
	195	2.66	2.66	2.66	2.66	2.66	2.66	31,883	37,510	40,950	44,390	48,550	13,230	21,870	30,820	41,970	48,550
	196	2.86	2.86	2.86	2.86	2.86	2.86	26,293	29,300	31,130	32,960	34,780	10,910	17,080	23,430	31,160	34,780
	208	1.14	1.14	1.14	1.14	1.14	1.14	25,232	30,100	33,090	36,080	39,770	10,470	17,550	24,900	34,110	39,770
	209	0.72	0.72	0.72	0.72	0.72	0.72	29,570	32,950	35,000	37,070	36,950	12,270	19,210	26,420	35,050	36,950
	210	1.34	1.34	1.34	1.34	1.34	1.34	25,380	30,270	33,270	36,260	39,960	10,530	17,640	25,040	34,280	39,960
	211	0.40	0.40	0.40	0.40	0.40	0.40	25,010	24,900	24,800	24,710	24,640	10,380	14,520	18,670	23,370	24,640
	212	0.41	0.41	0.41	0.41	0.41	0.41	25,357	25,250	25,150	25,060	24,980	10,520	14,720	18,920	23,690	24,980
	231	3.04	3.04	3.04	3.04	3.04	3.04	25,506	31,020	34,390	39,440	44,470	10,580	18,080	25,880	37,290	44,470
	232	0.54	0.54	0.54	0.54	0.54	0.54	22,850	25,460	27,050	26,960	26,870	9,480	14,850	20,360	25,490	26,870
	233	0.40	0.40	0.40	0.40	0.40	0.40	21,833	21,730	21,650	21,570	21,510	9,070	12,670	16,310	20,400	21,510
	21	61.9	48.45	61.92	61.92	61.92	61.92	475,787	587,450	624,090	660,780	697,410	197,440	342,470	469,780	624,760	697,410
Rural	179	7.86	-	7.86	7.86	7.86	7.86	-	30,080	32,430	34,760	37,100		17,540	24,400	32,860	37,100
	162	21.53	-	-	-	-	-	-	-	-	-	-					
	163	26.13	-	-	-	-	-	-	-	-	-	-					
	164	28.17	-	-	-	-	-	-	-	-	-	-					
	165	13.21	-	-	-	-	-	-	-	-	-	-					
	166	11.92	-	-	-	-	-	-	-	-	-	-					
	167	18.01	-	-	-	-	18.01	-	-	-	-	33,640					33,640
	168	9.78	-	-	-	-	-	-	-	-	-	-					
	169	22.80	-	-	-	-	-	-	-	-	-	-					
	170	24.22	-	-	-	-	-	-	-	-	-	-					
	171	50.70	-	-	-	-	-	-	-	-	-	-					
	172	27.45	-	-	-	-	-	-	-	-	-	-					
	173	19.18	-	-	-	-	-	-	-	-	-	-					
	174	6.52	-	-	-	-	6.52	-	-	-	-	40,480					40,480
	175	20.11	-	-	-	-	-	-	-	-	-	-					
	176	6.75	-	-	-	-	6.75	-	-	-	-	35,850					35,850
	16	314.3	0.00	7.86	7.86	7.86	39.15	0	30,080	32,430	34,760	147,070	0	17,540	24,400	32,860	147,070
subtotal	37	**376.3**	**48.45**	**69.78**	**69.78**	**69.78**	**101.07**	**475,787**	**617,530**	**656,520**	**695,540**	**844,480**	**197,440**	**360,010**	**494,180**	**657,620**	**844,480**

Table AB5.1-2 Distribution of Population in Service Area and Population Served – 4

		Adm. Area	Service Area (sq.km)					Population Distribution in Service Area					Distribution of Popolation Served				
Town	**UC No.**	**sq.km**	**2015**	**2023**	**2028**	**2033**	**2038**	**2015**	**2023**	**2028**	**2033**	**2038**	**2015**	**2023**	**2028**	**2033**	**2038**
														Service ratio			
													41.5%	60%	75%	90%	100%
MADINA TOWN															501,448	494,170	
Urban	177	9.51	-	-	9.51	9.51	9.51	-	-	41,300	43,620	45,920	-		31,090	41,240	45,920
	197	0.90	0.90	0.90	0.90	0.90	0.90	24,961	27,660	29,290	30,940	32,580	10,360	16,130	22,050	29,260	32,580
	198	1.92	1.92	1.92	1.92	1.92	1.92	24,846	27,530	29,150	30,790	32,420	10,310	16,050	21,930	29,110	32,420
	199	3.38	3.38	3.38	3.38	3.38	3.38	22,796	25,260	26,750	28,250	29,750	9,460	14,730	20,130	26,720	29,750
	200	4.77	4.77	4.77	4.77	4.77	4.77	23,381	25,900	27,440	28,970	30,510	9,700	15,100	20,650	27,390	30,510
	201	3.40	-	3.40	3.40	3.40	3.40	-	29,950	31,730	33,500	35,280	-	17,460	23,880	31,670	35,280
	202	4.37	4.37	4.37	4.37	4.37	4.37	26,064	28,880	30,590	32,300	34,020	10,820	16,840	23,020	30,540	34,020
	203	2.27	2.27	2.27	2.27	2.27	2.27	25,159	27,870	29,530	31,180	32,830	10,440	16,240	22,230	29,480	32,830
	204	0.94	0.94	0.94	0.94	0.94	0.94	25,019	27,710	29,360	31,000	32,650	10,380	16,160	22,100	29,310	32,650
	205	0.84	0.84	0.84	0.84	0.84	0.84	26,945	29,860	31,620	33,390	35,160	11,180	17,410	23,800	31,570	35,160
	206	1.50	1.50	1.50	1.50	1.50	1.50	26,960	29,870	31,640	33,410	35,180	11,190	17,410	23,810	31,590	35,180
	207	0.92	0.92	0.92	0.92	0.92	0.92	21,841	24,200	25,630	27,070	28,500	9,060	14,110	19,290	25,590	28,500
	213	2.18	2.18	2.18	2.18	2.18	2.18	29,288	33,070	35,350	37,660	40,400	12,150	19,280	26,600	35,600	40,400
	214	0.63	0.63	0.63	0.63	0.63	0.63	26,227	29,060	30,780	32,500	32,400	10,880	16,940	23,170	30,730	32,400
	215	1.11	1.11	1.11	1.11	1.11	1.11	28,738	32,450	34,720	36,980	39,700	11,930	18,920	26,130	34,960	39,700
	216	0.77	0.77	0.77	0.77	0.77	0.77	20,811	23,660	25,410	27,150	29,360	8,640	13,800	19,130	25,680	29,360
	217	0.24	0.24	0.24	0.24	0.24	0.24	21,743	21,650	21,560	21,490	21,420	9,020	12,620	16,240	20,330	21,420
	218	0.98	0.98	0.98	0.98	0.98	0.98	19,031	21,690	23,320	24,960	27,030	7,910	12,640	17,560	23,610	27,030
	219	4.89	4.89	4.89	4.89	4.89	4.89	25,891	28,690	30,380	32,090	33,790	10,740	16,720	22,870	30,340	33,790
	220	7.83	-	7.83	7.83	7.83	7.83	-	31,070	32,910	34,750	36,600	-	18,110	24,760	32,860	36,600
	221	2.40	2.40	2.40	2.40	2.40	2.40	26,272	29,110	30,830	32,560	34,280	10,900	16,970	23,200	30,780	34,280
	222	2.26	2.26	2.26	2.26	2.26	2.26	26,107	28,920	30,640	32,350	34,060	10,830	16,860	23,060	30,590	34,060
	223	1.11	1.11	1.11	1.11	1.11	1.11	28,411	31,480	33,350	35,210	37,080	11,790	18,350	25,100	33,290	37,080
	224	1.17	1.17	1.17	1.17	1.17	1.17	22,037	24,420	25,860	27,310	28,750	9,150	14,230	19,470	25,820	28,750
	225	2.54	2.54	2.54	2.54	2.54	2.54	24,462	27,100	28,710	30,310	31,920	10,150	15,800	21,600	28,660	31,920
	226	1.56	-	1.56	1.56	1.56	1.56	-	33,950	35,960	37,980	39,980	-	19,790	27,060	35,910	39,980
	227	2.46	-	2.46	2.46	2.46	2.46	-	26,700	28,280	29,860	31,440	-	15,560	21,280	28,230	31,440
	228	1.33	1.33	1.33	1.33	1.33	1.33	21,132	23,410	24,800	26,190	27,570	8,770	13,650	18,660	24,760	27,570
	229	1.12	1.12	1.12	1.12	1.12	1.12	21,362	23,670	25,070	26,470	27,880	8,870	13,800	18,860	25,020	27,880
	230	3.04	3.04	3.04	3.04	3.04	3.04	21,582	23,910	25,330	26,750	28,160	8,960	13,940	19,070	25,300	28,160
	239	1.00	1.00	1.00	1.00	1.00	1.00	23,705	26,410	28,060	29,700	31,360	9,840	15,400	21,120	28,080	31,360
	31	73.3	48.55	63.80	73.31	73.31	73.31	634,771	825,110	915,350	966,690	1,017,980	263,430	481,020	688,920	914,020	1,017,980
Rural	238	1.36	-	1.36	1.36	1.36	1.36	-	26,750	28,330	29,920	31,500		15,590	21,320	28,290	31,500
	178	3.32	-	-	-	-	3.32	-	-	-	-	62,580					62,580
	249	6.28	-	6.28	6.28	6.28	6.28	-	36,660	40,260	43,840	47,410		21,370	30,400	43,590	47,410
	143	34.67	-	-	-	-	-	-	-	-	-	-					
	144	24.86	-	-	-	-	24.86	-	-	-	-	54,370					54,370
	145	22.50	-	-	-	-	22.50	-	-	-	-	70,030					70,020
	6	93.0	0	7.64	7.64	7.64	58.33	0	63,410	68,590	73,760	265,890	0	36,960	51,720	71,880	265,880
subtotal	**37**	**166.3**	**48.55**	**71.44**	**80.95**	**80.95**	**131.64**	**634,771**	**888,520**	**983,940**	**1,040,450**	**1,283,870**	**263,430**	**517,980**	**740,640**	**985,900**	**1,283,860**
Total of																	
Fsd-MC	**139**	**820.9**	**159.18**	**225.18**	**258.44**	**258.44**	**375.96**	**2,428,904**	**3,118,120**	**3,387,190**	**3,588,950**	**4,116,960**	1,008,000	1,815,700	2,549,600	3,395,500	4,116,950
FDA City	-	-	-	-	-	-	-	**0**	**18,750**	**37,500**	**56,250**	**75,000**	**0**	**18,750**	**37,500**	**56,250**	**75,000**
G-Total	**155**	**1230.1**	**159.18**	**225.18**	**258.44**	**258.44**	**379.37**	**2,428,904**	**3,118,120**	**3,387,190**	**3,588,950**	**4,146,110**	**1,008,000**	**1,815,700**	**2,549,600**	**3,395,500**	**4,146,100**

Table AB5.1-3 Distribution of Water Consumption – 1

Towns	UC No.	Adm. Area	Domestic Consumption (m3/d)					Non-Domestic Consumption (m^3/d)					Total Consumption (m^3/d)				
			2015	2023	2028	2033	2038	2015	2023	2028	2033	2038	2015	2023	2028	2033	2038
			Percapita Consumption					Percentage to Total Consumption									
			128	133	145	145	145	10%	20%	30%	30%	30%					
Out of Fsd-MC																	
JHUMRA TOWN			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JALANWALA TOWN																	
	34	3.40	-	-	-	-	4,230	-	-	-	-	1,810	-	-	-	-	6,040
Total	1	3.4	**0**	**0**	**0**	**0**	**4,230**	**0**	**0**	**0**	**0**	**1,810**	**0**	**0**	**0**	**0**	**6,040**
Towns	**UC No.**	**Adm. Area**	**Domestic Consumption (m3/d)**					**Non-Domestic Consumption (m^3/d)**					**Total Consumption (m^3/d)**				
			2015	**2023**	**2028**	**2033**	**2038**	**2015**	**2023**	**2028**	**2033**	**2038**	**2015**	**2023**	**2028**	**2033**	**2038**
			Percapita Consumption					**Percentage to Total Consumption**									
			128	**133**	**145**	**145**	**145**	**10%**	**20%**	**30%**	**30%**	**30%**					
Fsd-Municipal Corporation																	
IQBAL TOWN																	
Urban	182	23.74	-	-	3,800	5,060	5,650	-	-	1,630	2,170	2,420	-	-	5,430	7,230	8,070
	234	0.94	1,250	2,030	3,040	4,040	4,510	140	510	1,300	1,730	1,930	1,390	2,540	4,340	5,770	6,440
	235	0.63	1,200	1,950	2,910	3,870	4,330	140	490	1,250	1,660	1,860	1,340	2,440	4,160	5,530	6,190
	236	0.91	1,120	1,820	2,710	3,610	4,040	140	460	1,160	1,550	1,730	1,260	2,280	3,870	5,160	5,770
	237	1.11	1,270	2,070	3,090	4,110	4,580	150	520	1,320	1,760	1,960	1,420	2,590	4,410	5,870	6,540
	240	1.43	1,640	2,660	4,330	6,760	5,920	190	660	1,860	2,900	2,540	1,830	3,320	6,190	9,660	8,460
	241	0.68	1,350	2,190	3,270	4,350	4,860	160	550	1,400	1,860	2,080	1,510	2,740	4,670	6,210	6,940
	242	2.54	1,090	1,770	2,640	3,510	3,920	130	440	1,130	1,500	1,680	1,220	2,210	3,770	5,010	5,600
	243	1.14	1,510	2,550	3,910	5,320	6,100	170	640	1,680	2,280	2,610	1,680	3,190	5,590	7,600	8,710
	244	0.49	1,330	1,940	2,710	3,400	3,580	150	490	1,160	1,460	1,530	1,480	2,430	3,870	4,860	5,110
	245	0.54	1,450	2,100	2,950	3,690	3,890	170	530	1,260	1,580	1,670	1,620	2,630	4,210	5,270	5,560
	246	0.64	1,550	2,520	3,540	4,430	4,670	180	630	1,520	1,900	2,000	1,730	3,150	5,060	6,330	6,670
	247	0.93	1,500	2,510	3,860	5,250	6,030	170	630	1,650	2,250	2,580	1,670	3,140	5,510	7,500	8,610
	248	0.87	1,520	2,550	3,920	5,330	6,120	170	630	1,680	2,280	2,620	1,690	3,180	5,600	7,610	8,740
	250	7.44	-	1,890	2,820	3,760	4,190	-	470	1,210	1,610	1,800	-	2,360	4,030	5,370	5,990
	251	1.42	1,470	2,390	3,580	4,760	5,320	170	600	1,530	2,040	2,280	1,640	2,990	5,110	6,800	7,600
	252	1.48	1,410	2,300	3,430	4,570	5,100	160	580	1,470	1,960	2,190	1,570	2,880	4,900	6,530	7,290
	253	0.62	1,350	2,200	3,290	4,370	4,610	160	550	1,410	1,870	1,980	1,510	2,750	4,700	6,240	6,590
	254	1.18	1,130	1,830	2,740	3,640	4,070	130	460	1,170	1,560	1,740	1,260	2,290	3,910	5,200	5,810
	255	2.77	1,280	2,090	3,120	4,150	4,630	150	520	1,340	1,780	1,980	1,430	2,610	4,460	5,930	6,610
	256	1.09	1,240	2,020	3,020	4,010	4,480	140	510	1,290	1,720	1,920	1,380	2,530	4,310	5,730	6,400
	257	1.08	1,310	2,210	3,410	4,660	5,370	150	550	1,460	2,000	2,300	1,460	2,760	4,870	6,660	7,670
	258	1.21	1,200	1,950	2,910	3,870	4,320	140	490	1,250	1,660	1,850	1,340	2,440	4,160	5,530	6,170
	259	0.84	1,180	1,990	3,080	4,220	4,870	150	500	1,320	1,810	2,090	1,330	2,490	4,400	6,030	6,960
	260	0.60	1,210	1,980	2,960	3,930	4,390	140	500	1,270	1,680	1,880	1,350	2,480	4,230	5,610	6,270
	261	0.90	1,660	2,700	4,270	5,800	6,640	190	670	1,830	2,490	2,850	1,850	3,370	6,100	8,290	9,490
	262	5.75	-	2,140	3,200	4,260	4,760	-	540	1,370	1,830	2,040	-	2,680	4,570	6,090	6,800
	27	62.98	32,220	56,350	88,510	118,730	130,950	3,740	14,120	37,920	50,890	56,110	35,960	70,470	126,430	169,620	187,060
Rural	147	20.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	148	35.56	-	-	-	-	6,900	-	-	-	-	2,960	-	-	-	-	9,860
	149	22.19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	78.59	0	0	0	0	6,900	0	0	0	0	2,960	0	0	0	0	9,860
Subtotal	30	141.6	**32,220**	**56,350**	**88,510**	**118,730**	**137,850**	**3,740**	**14,120**	**37,920**	**50,890**	**59,070**	**35,960**	**70,470**	**126,430**	**169,620**	**196,920**

Table AB5.1-3 Distribution of Water Consumption – 2

Towns	UC No.	Adm. Area	Domestic Consumption (m3/d)					Non-Domestic Consumption (m^3/d)					Total Consumption (m^3/d)				
			2015	2023	2028	2033	2038	2015	2023	2028	2033	2038	2015	2023	2028	2033	2038
			Percapita Consumption					Percentage to Total Consumption									
			128	133	145	145	145	10%	20%	30%	30%	30%					
JINNAH TOWN																	
	187	1.01	1,560	2,530	3,900	5,330	6,080	180	630	1,670	2,280	2,610	1,740	3,160	5,570	7,610	8,690
	263	1.46	1,530	2,580	4,040	5,580	6,440	180	650	1,730	2,390	2,760	1,710	3,230	5,770	7,970	9,200
	264	0.48	1,320	1,920	2,690	3,370	3,560	150	480	1,150	1,440	1,530	1,470	2,400	3,840	4,810	5,090
	265	0.49	1,270	2,060	2,890	3,620	3,820	150	520	1,240	1,550	1,640	1,420	2,580	4,130	5,170	5,460
	266	0.97	1,220	2,030	3,070	4,130	4,650	140	510	1,320	1,770	1,990	1,360	2,540	4,390	5,900	6,640
	267	2.33	1,090	1,810	2,740	3,690	4,160	130	450	1,170	1,580	1,780	1,220	2,260	3,910	5,270	5,940
	268	1.26	1,170	1,900	2,830	3,760	4,190	130	480	1,210	1,610	1,800	1,300	2,380	4,040	5,370	5,990
	269	0.41	1,210	1,760	2,470	3,090	3,260	140	440	1,060	1,330	1,400	1,350	2,200	3,530	4,420	4,660
	270	2.81	-	1,960	2,970	3,990	4,500	-	490	1,270	1,710	1,930	-	2,450	4,240	5,700	6,430
	271	1.62	1,400	2,320	3,510	4,710	5,300	160	580	1,500	2,020	2,270	1,560	2,900	5,010	6,730	7,570
	272	2.44	1,140	1,860	2,770	3,680	4,110	130	470	1,190	1,580	1,760	1,270	2,330	3,960	5,260	5,870
	273	1.94	1,580	2,580	3,900	5,230	5,890	180	650	1,670	2,240	2,520	1,760	3,230	5,570	7,470	8,410
	274	5.65	1,830	2,870	4,430	5,870	6,550	210	710	1,900	2,520	2,810	2,040	3,580	6,330	8,390	9,360
	275	3.38	1,560	2,520	3,770	5,010	5,580	180	630	1,620	2,150	2,390	1,740	3,150	5,390	7,160	7,970
	276	0.66	1,640	2,670	3,740	4,680	4,930	190	660	1,600	2,010	2,110	1,830	3,330	5,340	6,690	7,040
	277	0.84	1,540	2,500	3,860	5,270	6,020	180	630	1,650	2,260	2,580	1,720	3,130	5,510	7,530	8,600
	278	0.70	1,330	2,150	3,210	4,270	4,760	150	540	1,380	1,830	2,040	1,480	2,690	4,590	6,100	6,800
	279	0.89	1,120	1,850	2,810	3,780	4,270	140	460	1,200	1,620	1,830	1,260	2,310	4,010	5,400	6,100
	280	1.46	1,380	2,270	3,430	4,610	5,190	160	570	1,470	1,980	2,220	1,540	2,840	4,900	6,590	7,410
	281	0.23	1,140	1,660	2,330	2,900	3,060	130	420	1,010	1,250	1,310	1,270	2,080	3,340	4,150	4,370
	282	0.64	1,310	2,120	3,170	4,210	4,700	150	530	1,360	1,800	2,010	1,460	2,650	4,530	6,010	6,710
	283	1.36	1,580	2,590	3,910	5,250	5,900	180	650	1,680	2,250	2,530	1,760	3,240	5,590	7,500	8,430
	284	0.47	1,110	1,800	2,520	3,170	3,330	140	450	1,080	1,360	1,430	1,250	2,250	3,600	4,530	4,760
	285	0.67	1,310	2,150	3,250	4,370	4,930	150	540	1,390	1,870	2,110	1,460	2,690	4,640	6,240	7,040
	286	1.27	1,630	2,670	4,040	5,420	6,090	190	660	1,730	2,320	2,610	1,820	3,330	5,770	7,740	8,700
	287	0.85	1,610	2,640	3,990	5,350	6,020	180	660	1,710	2,290	2,580	1,790	3,300	5,700	7,640	8,600
	288	0.94	1,630	2,650	3,960	5,260	5,860	190	660	1,700	2,250	2,510	1,820	3,310	5,660	7,510	8,370
	289	1.74	1,600	2,710	4,220	5,820	6,690	180	670	1,810	2,490	2,870	1,780	3,380	6,030	8,310	9,560
	28	38.96	37,810	63,130	94,420	125,420	139,840	4,370	15,790	40,470	53,750	59,930	42,180	78,920	134,890	179,170	199,770
Rural	180	2.83	-	2,030	2,930	3,760	4,070	-	510	1,260	1,610	1,740	-	2,540	4,190	5,370	5,810
	181	2.93	-	3,200	4,770	6,110	6,600	-	800	2,040	2,620	2,830	-	4,000	6,810	8,730	9,430
	155	9.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	156	12.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	157	21.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	158	20.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	159	28.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7	97.76	0	5,230	7,700	9,870	10,670	0	1,310	3,300	4,230	4,570	0	6,540	11,000	14,100	15,240
Subtotal	35	136.7	**37,810**	**68,360**	**102,120**	**135,290**	**150,510**	**4,370**	**17,100**	**43,770**	**57,980**	**64,500**	**42,180**	**85,460**	**145,890**	**193,270**	**215,010**
LYALLPUR TOWN																	
Urban	183	0.95	1,380	2,250	3,360	4,470	4,990	160	560	1,440	1,920	2,140	1,540	2,810	4,800	6,390	7,130
	184	3.22	1,260	2,050	3,070	4,080	4,550	140	510	1,320	1,750	1,950	1,400	2,560	4,390	5,830	6,500
	185	5.43	1,150	1,870	2,800	3,730	4,160	140	470	1,200	1,600	1,780	1,290	2,340	4,000	5,330	5,940
	186	5.02	1,290	2,100	3,140	4,180	4,660	150	530	1,350	1,790	2,000	1,440	2,630	4,490	5,970	6,660
	188	1.80	1,230	2,000	2,990	3,970	4,440	140	500	1,280	1,700	1,900	1,370	2,500	4,270	5,670	6,340
	189	7.48	1,390	2,260	3,380	4,500	5,020	160	570	1,450	1,930	2,150	1,550	2,830	4,830	6,430	7,170
	190	3.16	1,320	2,150	3,220	4,280	4,780	150	540	1,380	1,830	2,050	1,470	2,690	4,600	6,110	6,830
	191	4.12	-	2,040	3,060	4,070	4,540	-	510	1,310	1,740	1,950	-	2,550	4,370	5,810	6,490
	192	9.35	-	2,400	3,590	4,770	5,330	-	590	1,540	2,040	2,280	-	2,990	5,130	6,810	7,610
	193	5.52	1,280	2,080	3,110	4,150	4,630	150	520	1,330	1,780	1,980	1,430	2,600	4,440	5,930	6,610
	194	2.36	1,210	1,970	2,940	3,910	4,360	140	490	1,260	1,680	1,870	1,350	2,460	4,200	5,590	6,230
	195	2.66	1,680	2,910	4,470	6,090	7,040	190	720	1,920	2,610	3,020	1,870	3,630	6,390	8,700	10,060
	196	2.86	1,400	2,270	3,400	4,520	5,040	160	570	1,460	1,940	2,160	1,560	2,840	4,860	6,460	7,200
	208	1.14	1,340	2,330	3,610	4,950	5,770	150	580	1,550	2,120	2,470	1,490	2,910	5,160	7,070	8,240
	209	0.72	1,570	2,550	3,830	5,080	5,360	180	640	1,640	2,180	2,300	1,750	3,190	5,470	7,260	7,660
	210	1.34	1,350	2,350	3,630	4,970	5,790	160	590	1,560	2,130	2,480	1,510	2,940	5,190	7,100	8,270
	211	0.40	1,330	1,930	2,720	3,390	3,570	150	480	1,170	1,450	1,530	1,480	2,410	3,890	4,840	5,100
	212	0.41	1,350	1,960	2,740	3,440	3,620	160	490	1,170	1,470	1,550	1,510	2,450	3,910	4,910	5,170
	231	3.04	1,350	2,400	3,750	5,410	6,450	160	590	1,610	2,320	2,760	1,510	2,990	5,360	7,730	9,210
	232	0.54	1,210	1,980	2,950	3,700	3,900	140	500	1,260	1,590	1,670	1,350	2,480	4,210	5,290	5,570
	233	0.40	1,160	1,690	2,360	2,970	3,120	140	420	1,020	1,280	1,340	1,300	2,110	3,380	4,250	4,460
	21	61.92	25,250	45,540	68,120	90,630	101,120	2,920	11,370	29,220	38,850	43,330	28,170	56,910	97,340	129,480	144,450
Rural	179	7.86	-	2,330	3,540	4,760	5,380	-	580	1,520	2,040	2,310	-	2,910	5,060	6,800	7,690
	162	21.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	163	26.13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	164	28.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	165	13.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	166	11.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	167	18.01	-	-	-	-	4,880	-	-	-	-	2,090	-	-	-	-	6,970
	168	9.78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	169	22.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	170	24.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	171	50.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	172	27.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	173	19.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	174	6.52	-	-	-	-	5,870	-	-	-	-	2,520	-	-	-	-	8,390
	175	20.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	176	6.75	-	-	-	-	5,200	-	-	-	-	2,230	-	-	-	-	7,430
	16	314.34	0	2,330	3,540	4,760	21,330	0	580	1,520	2,040	9,150	0	2,910	5,060	6,800	30,480
Subtotal	37	376.3	**25,250**	**47,870**	**71,660**	**95,390**	**122,450**	**2,920**	**11,950**	**30,740**	**40,890**	**52,480**	**28,170**	**59,820**	**102,400**	**136,280**	**174,930**

Table AB5.1-3 Distribution of Water Consumption – 3

Towns	UC No.	Adm. Area	Domestic Consumption (m3/d)					Non-Domestic Consumption (m^3/d)					Total Consumption (m^3/d)				
			2015	2023	2028	2033	2038	2015	2023	2028	2033	2038	2015	2023	2028	2033	2038
			Percapita Consumption					Percentage to Total Consumption									
			128	133	145	145	145	10%	20%	30%	30%	30%					
MADINA TOWN																	
Urban	177	9.51	-	-	4,510	5,980	6,650	-	-	1,930	2,560	2,850	-	-	6,440	8,540	9,500
	197	0.90	1,330	2,150	3,200	4,240	4,720	150	540	1,370	1,820	2,020	1,480	2,690	4,570	6,060	6,740
	198	1.92	1,320	2,130	3,180	4,220	4,700	150	530	1,360	1,810	2,010	1,470	2,660	4,540	6,030	6,710
	199	3.38	1,210	1,960	2,920	3,870	4,310	140	490	1,250	1,660	1,850	1,350	2,450	4,170	5,530	6,160
	200	4.77	1,240	2,010	2,990	3,970	4,420	140	500	1,280	1,700	1,890	1,380	2,510	4,270	5,670	6,310
	201	3.40	-	2,320	3,460	4,590	5,120	-	580	1,480	1,970	2,190	-	2,900	4,940	6,560	7,310
	202	4.37	1,380	2,240	3,340	4,430	4,930	160	560	1,430	1,900	2,110	1,540	2,800	4,770	6,330	7,040
	203	2.27	1,340	2,160	3,220	4,270	4,760	150	540	1,380	1,830	2,040	1,490	2,700	4,600	6,100	6,800
	204	0.94	1,330	2,150	3,200	4,250	4,730	150	540	1,370	1,820	2,030	1,480	2,690	4,570	6,070	6,760
	205	0.84	1,430	2,320	3,450	4,580	5,100	160	580	1,480	1,960	2,190	1,590	2,900	4,930	6,540	7,290
	206	1.50	1,430	2,320	3,450	4,580	5,100	160	580	1,480	1,960	2,190	1,590	2,900	4,930	6,540	7,290
	207	0.92	1,160	1,880	2,800	3,710	4,130	130	470	1,200	1,590	1,770	1,290	2,350	4,000	5,300	5,900
	213	2.18	1,550	2,560	3,860	5,160	5,860	180	630	1,650	2,210	2,510	1,730	3,190	5,510	7,370	8,370
	214	0.63	1,390	2,250	3,360	4,460	4,700	160	560	1,440	1,910	2,010	1,550	2,810	4,800	6,370	6,710
	215	1.11	1,530	2,520	3,790	5,070	5,760	180	620	1,620	2,170	2,470	1,710	3,140	5,410	7,240	8,230
	216	0.77	1,110	1,840	2,770	3,720	4,260	140	460	1,190	1,590	1,830	1,250	2,300	3,960	5,310	6,090
	217	0.24	1,150	1,680	2,360	2,950	3,110	130	420	1,020	1,270	1,330	1,280	2,100	3,380	4,220	4,440
	218	0.98	1,010	1,680	2,560	3,420	3,920	130	420	1,100	1,470	1,690	1,140	2,100	3,660	4,890	5,610
	219	4.89	1,370	2,220	3,320	4,400	4,900	160	560	1,420	1,890	2,100	1,530	2,780	4,740	6,290	7,000
	220	7.83	-	2,410	3,590	4,760	5,310	-	600	1,540	2,040	2,280	-	3,010	5,130	6,800	7,590
	221	2.40	1,400	2,260	3,360	4,460	4,970	160	570	1,440	1,910	2,130	1,560	2,830	4,800	6,370	7,100
	222	2.26	1,390	2,240	3,340	4,440	4,940	160	560	1,430	1,900	2,120	1,550	2,800	4,770	6,340	7,060
	223	1.11	1,510	2,440	3,640	4,830	5,380	170	600	1,560	2,070	2,310	1,680	3,040	5,200	6,900	7,690
	224	1.17	1,170	1,890	2,820	3,740	4,170	130	470	1,210	1,600	1,790	1,300	2,360	4,030	5,340	5,960
	225	2.54	1,300	2,100	3,130	4,160	4,630	150	530	1,340	1,780	1,980	1,450	2,630	4,470	5,940	6,610
	226	1.56	-	2,630	3,920	5,210	5,800	-	650	1,680	2,230	2,490	-	3,280	5,600	7,440	8,290
	227	2.46	-	2,070	3,090	4,090	4,560	-	520	1,320	1,750	1,950	-	2,590	4,410	5,840	6,510
	228	1.33	1,120	1,830	2,710	3,590	4,000	130	460	1,160	1,540	1,710	1,250	2,290	3,870	5,130	5,710
	229	1.12	1,140	1,840	2,730	3,630	4,040	130	460	1,170	1,560	1,730	1,270	2,300	3,900	5,190	5,770
	230	3.04	1,150	1,850	2,770	3,670	4,080	130	460	1,190	1,570	1,750	1,280	2,310	3,960	5,240	5,830
	239	1.00	1,260	2,050	3,060	4,070	4,550	140	510	1,310	1,740	1,950	1,400	2,560	4,370	5,810	6,500
	31	73.31	33,720	64,000	99,900	132,520	147,610	3,870	15,970	42,800	56,780	63,270	37,590	79,970	142,700	189,300	210,880
Rural	238	1.36	-	2,070	3,090	4,100	4,570	-	520	1,320	1,760	1,960	-	2,590	4,410	5,860	6,530
	178	3.32	-	-	-	-	9,070	-	-	-	-	3,890	-	-	-	-	12,960
	249	6.28	-	2,840	4,410	6,320	6,870	-	710	1,890	2,710	2,940	-	3,550	6,300	9,030	9,810
	143	34.67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	144	24.86	-	-	-	-	7,880	-	-	-	-	3,380	-	-	-	-	11,260
	145	22.50	-	-	-	-	10,150	-	-	-	-	4,350	-	-	-	-	14,500
	6	93.00	0	4,910	7,500	10,420	38,540	0	1,230	3,210	4,470	16,520	0	6,140	10,710	14,890	55,060
Subtotal	37	166.3	**33,720**	**68,910**	**107,400**	**142,940**	**186,150**	**3,870**	**17,200**	**46,010**	**61,250**	**79,790**	**37,590**	**86,110**	**153,410**	**204,190**	**265,940**
Total of Fsd-MC	139	820.9	**129,000**	**241,490**	**369,690**	**492,350**	**596,960**	**14,900**	**60,370**	**158,440**	**211,010**	**255,840**	**143,900**	**301,860**	**528,130**	**703,360**	**852,800**
Total (excluding FDA City)			**129,000**	**241,490**	**369,690**	**492,350**	**601,190**	**14,900**	**60,370**	**158,440**	**211,010**	**257,650**	**143,900**	**301,860**	**528,130**	**703,360**	**858,840**
FDA CITY (Bulk Supply)			**0**	**2,720**	**5,440**	**8,160**	**10,880**	**0**	**300**	**600**	**910**	**1,210**	**0**	**3,020**	**6,040**	**9,070**	**12,090**
G-Total	140	824.3	**129,000**	**244,210**	**375,130**	**500,510**	**612,070**	**14,900**	**60,670**	**159,040**	**211,920**	**258,860**	**143,900**	**304,880**	**534,170**	**712,430**	**870,930**

Table AB5.1-4 Distribution of Water Demand – 1

		Physical Loss					Day Average Demand (m^3/d)					Distribution of Water Demand Day Max. m^3/d)				
Towns	**UC No.**	**2015**	**2023**	**2028**	**2033**	**2038**	**2015**	**2023**	**2028**	**2033**	**2038**	2015	2023	2028	2033	2038
			Loss to Total Consumption													
		40%	**45%**	**30%**	**25%**	**20%**										
Out of Fsd-MC																
JHUMRA TOWN		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JALANWALA TOWN																
	34	-	-	-	-	1,510	-	-	-	-	7,550	-	-	-	-	8,680
Total	1	**0**	**0**	**0**	**0**	**1,510**	**0**	**0**	**0**	**0**	**7,550**	**0**	**0**	**0**	**0**	**8,680**
Fsd-Municipal Corporation																
IQBAL TOWN																
Urban	182	-	-	2,330	2,410	2,020	-	-	7,760	9,640	10,090	-	-	8,910	11,090	11,600
	234	930	2,080	1,860	1,920	1,610	2,320	4,620	6,200	7,690	8,050	3070	5540	7,130	8,850	9,260
	235	890	2,000	1,780	1,840	1,550	2,230	4,440	5,940	7,370	7,740	2960	5330	6,830	8,490	8,900
	236	850	1,870	1,660	1,720	1,440	2,110	4,150	5,530	6,880	7,210	2800	4980	6,360	7,920	8,290
	237	950	2,120	1,890	1,960	1,640	2,370	4,710	6,300	7,830	8,180	3140	5650	7,250	9,000	9,410
	240	1,220	2,720	2,650	3,220	2,120	3,050	6,040	8,840	12,880	10,580	4040	7240	10,160	14,810	12,170
	241	1,010	2,240	2,000	2,070	1,740	2,520	4,980	6,670	8,280	8,680	3340	5980	7,670	9,520	9,980
	242	820	1,810	1,620	1,670	1,400	2,040	4,020	5,390	6,680	7,000	2710	4820	6,200	7,690	8,050
	243	1,120	2,610	2,400	2,530	2,180	2,800	5,800	7,990	10,130	10,890	3710	6950	9,180	11,650	12,520
	244	990	1,990	1,660	1,620	1,280	2,470	4,420	5,530	6,480	6,390	3270	5300	6,360	7,460	7,350
	245	1,080	2,150	1,800	1,760	1,390	2,700	4,780	6,010	7,030	6,950	3570	5740	6,910	8,090	7,990
	246	1,150	2,580	2,170	2,110	1,670	2,880	5,730	7,230	8,440	8,340	3810	6880	8,300	9,710	9,590
	247	1,110	2,570	2,360	2,500	2,150	2,780	5,710	7,870	10,000	10,760	3680	6850	9,040	11,500	12,370
	248	1,130	2,600	2,400	2,540	2,180	2,820	5,780	8,000	10,150	10,920	3730	6930	9,190	11,670	12,560
	250	-	1,930	1,730	1,790	1,500	-	4,290	5,760	7,160	7,490	-	5150	6,620	8,240	8,610
	251	1,090	2,450	2,190	2,270	1,900	2,730	5,440	7,300	9,070	9,500	3610	6530	8,390	10,430	10,930
	252	1,050	2,360	2,100	2,180	1,820	2,620	5,240	7,000	8,710	9,110	3470	6290	8,040	10,020	10,480
	253	1,010	2,250	2,010	2,080	1,650	2,520	5,000	6,710	8,320	8,240	3340	6000	7,720	9,570	9,480
	254	850	1,870	1,680	1,730	1,450	2,110	4,160	5,590	6,930	7,260	2800	4990	6,430	7,980	8,350
	255	950	2,140	1,910	1,980	1,650	2,380	4,750	6,370	7,910	8,260	3150	5700	7,330	9,100	9,500
	256	920	2,070	1,850	1,910	1,600	2,300	4,600	6,160	7,640	8,000	3050	5520	7,080	8,800	9,200
	257	970	2,260	2,090	2,220	1,920	2,430	5,020	6,960	8,880	9,590	3220	6020	8,000	10,210	11,030
	258	900	2,000	1,780	1,840	1,540	2,240	4,440	5,940	7,370	7,710	2970	5330	6,830	8,490	8,870
	259	890	2,040	1,890	2,010	1,740	2,220	4,530	6,290	8,040	8,700	2950	5440	7,230	9,250	10,010
	260	900	2,030	1,810	1,870	1,570	2,250	4,510	6,040	7,480	7,840	2990	5410	6,950	8,610	9,020
	261	1,230	2,760	2,610	2,760	2,360	3,080	6,130	8,710	11,060	11,850	4080	7350	10,010	12,720	13,630
	262	-	2,190	1,960	2,030	1,700	-	4,870	6,530	8,120	8,500	-	5840	7,510	9,340	9,780
	27	24,010	57,690	54,190	56,540	46,770	59,970	128,160	180,620	226,170	233,830	79,460	153,760	207,630	260,210	268,930
Rural	147	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	148	-	-	-	-	2,460	-	-	-	-	12,320	-	-	-	-	14,170
	149	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	0	0	0	0	2,460	0	0	0	0	12,320	0	0	0	0	14,170
Subtotal	30	**24,010**	**57,690**	**54,190**	**56,540**	**49,230**	**59,970**	**128,160**	**180,620**	**226,170**	**246,150**	**79,460**	**153,760**	**207,630**	**260,210**	**283,100**

Table AB5.1-4 Distribution of Water Demand – 2

		Physical Loss					Day Average Demand (m^3/d)					Distribution of Water Demand Day Max. m^3/d)				
Towns	**UC No.**	**2015**	**2023**	**2028**	**2033**	**2038**	**2015**	**2023**	**2028**	**2033**	**2038**	2015	2023	2028	2033	2038
		Loss to Total Consumption														
		40%	**45%**	**30%**	**25%**	**20%**										
JINNAH TOWN																
	187	1,160	2,590	2,390	2,540	2,170	2,900	5,750	7,960	10,150	10,860	3840	6900	9,140	11,670	12,490
	263	1,140	2,640	2,470	2,660	2,300	2,850	5,870	8,240	10,630	11,500	3770	7040	9,470	12,220	13,230
	264	980	1,960	1,650	1,600	1,270	2,450	4,360	5,490	6,410	6,360	3240	5230	6,310	7,380	7,310
	265	950	2,110	1,770	1,720	1,370	2,370	4,690	5,900	6,890	6,830	3140	5630	6,790	7,930	7,850
	266	910	2,080	1,880	1,970	1,660	2,270	4,620	6,270	7,870	8,300	3010	5540	7,210	9,060	9,550
	267	820	1,850	1,680	1,760	1,490	2,040	4,110	5,590	7,030	7,430	2710	4930	6,430	8,090	8,540
	268	870	1,950	1,730	1,790	1,500	2,170	4,330	5,770	7,160	7,490	2880	5200	6,640	8,240	8,610
	269	900	1,800	1,510	1,470	1,170	2,250	4,000	5,040	5,890	5,830	2990	4800	5,800	6,780	6,700
	270	-	2,000	1,820	1,900	1,610	-	4,450	6,060	7,600	8,040	-	5340	6,970	8,750	9,250
	271	1,040	2,370	2,150	2,240	1,890	2,600	5,270	7,160	8,970	9,460	3440	6320	8,230	10,320	10,880
	272	860	1,910	1,700	1,750	1,470	2,130	4,240	5,660	7,010	7,340	2830	5090	6,510	8,070	8,440
	273	1,170	2,640	2,390	2,490	2,100	2,930	5,870	7,960	9,960	10,510	3880	7040	9,140	11,450	12,090
	274	1,360	2,930	2,700	2,790	2,330	3,400	6,510	9,030	11,180	11,690	4500	7800	10,370	12,860	13,440
	275	1,160	2,580	2,310	2,390	1,990	2,900	5,730	7,700	9,550	9,960	3840	6880	8,860	10,980	11,450
	276	1,220	2,720	2,290	2,230	1,760	3,050	6,050	7,630	8,920	8,800	4040	7250	8,770	10,260	10,120
	277	1,150	2,560	2,360	2,510	2,150	2,870	5,690	7,870	10,040	10,750	3800	6830	9,050	11,550	12,360
	278	990	2,200	1,970	2,030	1,700	2,470	4,890	6,560	8,130	8,500	3270	5870	7,540	9,350	9,780
	279	850	1,890	1,720	1,800	1,530	2,110	4,200	5,730	7,200	7,630	2800	5040	6,590	8,290	8,770
	280	1,030	2,320	2,100	2,200	1,850	2,570	5,160	7,000	8,790	9,260	3400	6190	8,050	10,110	10,650
	281	860	1,700	1,430	1,380	1,090	2,130	3,780	4,770	5,530	5,460	2830	4540	5,490	6,370	6,290
	282	970	2,170	1,940	2,000	1,680	2,430	4,820	6,470	8,010	8,390	3220	5780	7,440	9,220	9,650
	283	1,170	2,650	2,400	2,500	2,110	2,930	5,890	7,990	10,000	10,540	3880	7070	9,180	11,500	12,120
	284	840	1,840	1,540	1,510	1,190	2,090	4,090	5,140	6,040	5,950	2780	4910	5,910	6,960	6,840
	285	970	2,200	1,990	2,080	1,760	2,430	4,890	6,630	8,320	8,800	3220	5870	7,620	9,570	10,120
	286	1,210	2,720	2,470	2,580	2,180	3,030	6,050	8,240	10,320	10,880	4010	7260	9,470	11,870	12,510
	287	1,190	2,700	2,440	2,550	2,150	2,980	6,000	8,140	10,190	10,750	3950	7200	9,350	11,720	12,360
	288	1,210	2,710	2,430	2,500	2,090	3,030	6,020	8,090	10,010	10,460	4010	7210	9,290	11,510	12,030
	289	1,190	2,770	2,580	2,770	2,380	2,970	6,150	8,610	11,080	11,940	3930	7370	9,890	12,740	13,730
	28	28,170	64,560	57,810	59,710	49,940	70,350	143,480	192,700	238,880	249,710	93,210	172,130	221,510	274,820	287,160
Rural	180	-	2,080	1,800	1,790	1,450	-	4,620	5,990	7,160	7,260	-	5540	6,890	8,240	8,350
	181	-	3,270	2,920	2,910	2,350	-	7,270	9,730	11,640	11,780	-	8720	11,180	13,390	13,550
	155	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	156	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	157	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	158	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	159	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7	0	5,350	4,720	4,700	3,800	0	11,890	15,720	18,800	19,040	0	14,260	18,070	21,630	21,900
Subtotal	35	**28,170**	**69,910**	**62,530**	**64,410**	**53,740**	**70,350**	**155,370**	**208,420**	**257,680**	**268,750**	**93,210**	**186,390**	**239,580**	**296,450**	**309,060**
LYALLPUR TOWN																
Urban	183	1,030	2,300	2,060	2,130	1,780	2,570	5,110	6,860	8,520	8,910	3400	6130	7,890	9,800	10,250
	184	930	2,090	1,880	1,940	1,630	2,330	4,650	6,270	7,770	8,130	3090	5580	7,210	8,950	9,350
	185	870	1,910	1,710	1,780	1,490	2,160	4,250	5,710	7,110	7,430	2860	5100	6,570	8,190	8,540
	186	960	2,150	1,920	1,990	1,670	2,400	4,780	6,410	7,960	8,330	3180	5740	7,370	9,150	9,580
	188	910	2,050	1,830	1,890	1,590	2,280	4,550	6,100	7,560	7,930	3030	5460	7,020	8,700	9,120
	189	1,030	2,320	2,070	2,140	1,790	2,580	5,150	6,900	8,570	8,960	3420	6180	7,940	9,860	10,300
	190	980	2,200	1,970	2,040	1,710	2,450	4,890	6,570	8,150	8,540	3240	5870	7,560	9,370	9,820
	191	-	2,090	1,870	1,940	1,620	-	4,640	6,240	7,750	8,110	-	5570	7,180	8,920	9,330
	192	-	2,450	2,200	2,270	1,900	-	5,440	7,330	9,080	9,510	-	6530	8,420	10,440	10,940
	193	950	2,130	1,900	1,980	1,650	2,380	4,730	6,340	7,910	8,260	3150	5680	7,290	9,100	9,500
	194	910	2,010	1,800	1,860	1,560	2,260	4,470	6,000	7,450	7,790	3000	5360	6,900	8,580	8,960
	195	1,250	2,970	2,740	2,900	2,510	3,120	6,600	9,130	11,600	12,570	4130	7910	10,490	13,340	14,460
	196	1,040	2,320	2,080	2,150	1,800	2,600	5,160	6,940	8,610	9,000	3440	6190	7,980	9,900	10,350
	208	990	2,380	2,210	2,360	2,060	2,480	5,290	7,370	9,430	10,300	3280	6350	8,470	10,840	11,850
	209	1,170	2,610	2,340	2,420	1,920	2,920	5,800	7,810	9,680	9,580	3870	6950	8,970	11,130	11,020
	210	1,010	2,410	2,220	2,370	2,070	2,520	5,350	7,410	9,470	10,340	3340	6420	8,510	10,890	11,890
	211	990	1,970	1,670	1,610	1,280	2,470	4,380	5,560	6,450	6,380	3270	5260	6,390	7,430	7,340
	212	1,010	2,000	1,680	1,640	1,290	2,520	4,450	5,590	6,550	6,460	3340	5340	6,430	7,540	7,430
	231	1,010	2,450	2,300	2,580	2,290	2,520	5,440	7,660	10,310	11,500	3340	6520	8,800	11,860	13,230
	232	900	2,030	1,800	1,760	1,390	2,250	4,510	6,010	7,050	6,960	2990	5410	6,910	8,120	8,000
	233	880	1,730	1,450	1,420	1,120	2,180	3,840	4,830	5,670	5,580	2900	4610	5,550	6,530	6,420
	21	18,820	46,570	41,700	43,170	36,120	46,990	103,480	139,040	172,650	180,570	62,270	124,160	159,850	198,640	207,680
Rural	179	-	2,380	2,170	2,270	1,920	-	5,290	7,230	9,070	9,610	-	6350	8,300	10,430	11,050
	162	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	163	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	164	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	165	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	166	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	167	-	-	-	-	1,740	-	-	-	-	8,710	-	-	-	-	10,020
	168	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	169	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	170	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	171	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	172	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	173	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	174	-	-	-	-	2,100	-	-	-	-	10,490	-	-	-	-	12,060
	175	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	176	-	-	-	-	1,860	-	-	-	-	9,290	-	-	-	-	10,680
	16	0	2,380	2,170	2,270	7,620	0	5,290	7,230	9,070	38,100	0	6,350	8,300	10,430	43,810
Subtotal	37	**18,820**	**48,950**	**43,870**	**45,440**	**43,740**	**46,990**	**108,770**	**146,270**	**181,720**	**218,670**	**62,270**	**130,510**	**168,150**	**209,070**	**251,490**

Table AB5.1-4 Distribution of Water Demand – 3

		Physical Loss					Day Average Demand (m^3/d)					Distribution of Water Demand Day Max. m^3/d)				
Towns	**UC No.**	**2015**	**2023**	**2028**	**2033**	**2038**	**2015**	**2023**	**2028**	**2033**	**2038**	2015	2023	2028	2033	2038
		Loss to Total Consumption														
		40%	**45%**	**30%**	**25%**	**20%**										
MADINA TOWN																
Urban	177	-	-	2,750	2,840	2,380	-	-	9,190	11,380	11,880	-	-	10,560	13,090	13,660
	197	990	2,200	1,960	2,020	1,690	2,470	4,890	6,530	8,080	8,430	3270	5870	7,510	9,290	9,690
	198	980	2,180	1,950	2,010	1,680	2,450	4,840	6,490	8,040	8,390	3240	5810	7,460	9,250	9,650
	199	900	2,000	1,790	1,840	1,540	2,250	4,450	5,960	7,370	7,700	2980	5340	6,850	8,490	8,860
	200	920	2,050	1,830	1,890	1,580	2,300	4,560	6,100	7,560	7,890	3050	5470	7,020	8,700	9,070
	201	-	2,370	2,120	2,190	1,830	-	5,270	7,060	8,750	9,140	-	6320	8,110	10,060	10,510
	202	1,030	2,290	2,040	2,110	1,760	2,570	5,090	6,810	8,440	8,800	3400	6110	7,830	9,710	10,120
	203	990	2,210	1,970	2,030	1,700	2,480	4,910	6,570	8,130	8,500	3280	5890	7,560	9,350	9,780
	204	990	2,200	1,960	2,020	1,690	2,470	4,890	6,530	8,090	8,450	3270	5870	7,510	9,300	9,720
	205	1,060	2,370	2,110	2,180	1,820	2,650	5,270	7,040	8,720	9,110	3510	6320	8,090	10,030	10,480
	206	1,060	2,370	2,110	2,180	1,820	2,650	5,270	7,040	8,720	9,110	3510	6320	8,090	10,030	10,480
	207	860	1,920	1,710	1,770	1,480	2,150	4,270	5,710	7,070	7,380	2860	5120	6,570	8,140	8,490
	213	1,150	2,610	2,360	2,460	2,090	2,880	5,800	7,870	9,830	10,460	3810	6960	9,040	11,300	12,030
	214	1,030	2,300	2,060	2,120	1,680	2,580	5,110	6,860	8,490	8,390	3420	6130	7,890	9,760	9,650
	215	1,140	2,570	2,320	2,410	2,060	2,850	5,710	7,730	9,650	10,290	3770	6840	8,880	11,100	11,830
	216	840	1,880	1,700	1,770	1,520	2,090	4,180	5,660	7,080	7,610	2780	5020	6,510	8,150	8,750
	217	860	1,730	1,450	1,410	1,110	2,140	3,830	4,830	5,630	5,550	2830	4600	5,550	6,480	6,380
	218	760	1,720	1,570	1,630	1,400	1,900	3,820	5,230	6,520	7,010	2520	4580	6,010	7,510	8,060
	219	1,020	2,270	2,030	2,100	1,750	2,550	5,050	6,770	8,390	8,750	3380	6060	7,790	9,650	10,060
	220	-	2,460	2,200	2,270	1,900	-	5,470	7,330	9,070	9,490	-	6550	8,420	10,430	10,910
	221	1,040	2,320	2,060	2,120	1,780	2,600	5,150	6,860	8,490	8,880	3440	6180	7,890	9,760	10,210
	222	1,030	2,290	2,040	2,110	1,770	2,580	5,090	6,810	8,450	8,830	3420	6110	7,830	9,720	10,150
	223	1,120	2,490	2,230	2,300	1,920	2,800	5,530	7,430	9,200	9,610	3710	6630	8,530	10,580	11,050
	224	870	1,930	1,730	1,780	1,490	2,170	4,290	5,760	7,120	7,450	2880	5150	6,620	8,200	8,570
	225	970	2,150	1,920	1,980	1,650	2,420	4,780	6,390	7,920	8,260	3200	5740	7,350	9,110	9,500
	226	-	2,680	2,400	2,480	2,070	-	5,960	8,000	9,920	10,360	-	7140	9,190	11,410	11,910
	227	-	2,120	1,890	1,950	1,630	-	4,710	6,300	7,790	8,140	-	5650	7,250	8,970	9,360
	228	840	1,870	1,660	1,710	1,430	2,090	4,160	5,530	6,840	7,140	2780	4990	6,360	7,880	8,210
	229	860	1,880	1,670	1,730	1,440	2,130	4,180	5,570	6,920	7,210	2830	5020	6,410	7,970	8,290
	230	860	1,890	1,700	1,750	1,460	2,140	4,200	5,660	6,990	7,290	2840	5040	6,510	8,050	8,380
	239	930	2,090	1,870	1,940	1,630	2,330	4,650	6,240	7,750	8,130	3080	5580	7,180	8,920	9,350
	31	25,100	65,410	61,160	63,100	52,750	62,690	145,380	203,860	252,400	263,630	83,060	174,410	234,370	290,390	303,160
Rural	238	-	2,120	1,890	1,950	1,630	-	4,710	6,300	7,810	8,160	-	5650	7,250	8,990	9,380
	178	-	-	-	-	3,230	-	-	-	-	16,190	-	-	-	-	18,620
	249	-	2,900	2,700	3,010	2,450	-	6,450	9,000	12,040	12,260	-	7740	10,340	13,850	14,100
	143	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	144	-	-	-	-	2,810	-	-	-	-	14,070	-	-	-	-	16,180
	145	-	-	-	-	3,620	-	-	-	-	18,120	-	-	-	-	20,840
	6	0	5,020	4,590	4,960	13,740	0	11,160	15,300	19,850	68,800	0	13,390	17,590	22,840	79,120
Subtotal	37	**25,100**	**70,430**	**65,750**	**68,060**	**66,490**	**62,690**	**156,540**	**219,160**	**272,250**	**332,430**	**83,060**	**187,800**	**251,960**	**313,230**	**382,280**
Total of																
Fsd-MC	139	**96,100**	**246,980**	**226,340**	**234,450**	**213,200**	**240,000**	**548,840**	**754,470**	**937,820**	**1,066,000**	**318,000**	**658,460**	**867,320**	**1,078,960**	**1,225,930**
Total																
(excluding FDA City)		**96,100**	**246,980**	**226,340**	**234,450**	**214,710**	**240,000**	**548,840**	**754,470**	**937,820**	**1,073,550**	**318,000**	**658,460**	**867,320**	**1,078,960**	**1,234,610**
FDA CITY (Bulk Supply)		**0**	**760**	**1,510**	**2,270**	**3,020**	**0**	**3,780**	**7,550**	**11,340**	**15,110**	**0**	**4,540**	**8,680**	**13,040**	**17,380**
G-Total	140	**96,100**	**247,740**	**227,850**	**236,720**	**217,730**	**240,000**	**552,620**	**762,020**	**949,160**	**1,088,660**	**318,000**	**663,000**	**876,000**	**1,092,000**	**1,251,990**

AB5.2 Satellite Towns Water Supply Development Plan

Appendix AB5.2 is composed of Intake & Transmission Hydraulics, Distribution Primary Network Analysis and Cost Estimate of three towns of Chak Jhumura Town, Kurrianwala Municipal Corporation and Sadar City respectively.

AB5.2.1 Chak Jhumra Town

Water Demand

unit: m^3/d

Year	2015	2023	2028	2033	2038
Day Avegare demand	2,000	3,400	5,500	7,300	9,400
Day Maximum demand	2,300	3,900	6,300	8,400	10,800

1 Intake and Transmision

1.1 Tube Well

1) Water Source

seepage water of Rakh Branch Canal

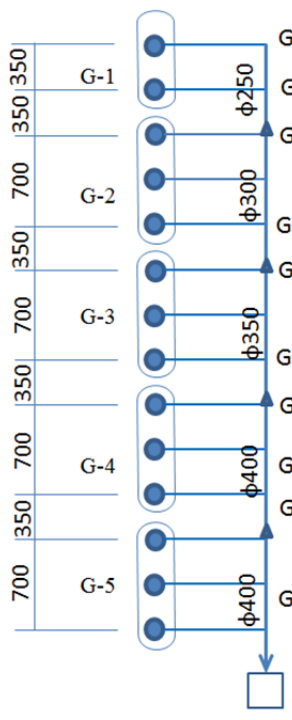
2) Exploitation of Well

rate		100 m^3/hr
		27.8 l/s
operation		8 hrs/d
well capacity		800 m^3/d
spacing of well construction		350 m
number of wells	operation	14 wells

3) Well Operation

Wells are grouped into 5 groupes each having three tube wells. The operation of well is planned three shifts operation of each well group per day.

1.2 Well Pump and Delivery Header



Maximum head loss

Section	Flow	Dia.	Length	velocity	h. gradient	head loss
	l/s	mm	m	m/s	‰	m
G-1.2~G2.1	27.8	250	700	0.57	1.48	1.0
G-2.1~G-3.1	55.6	300	1,050	0.79	2.19	2.3
G-3.1~G-4.1	83.3	350	1,050	0.87	2.19	2.3
G-4.1~G-5.1	111.1	400	1,050	0.88	1.95	2.0
G-5.1~BP	138.9	400	750	1.11	2.95	2.2
					Σhf	9.9

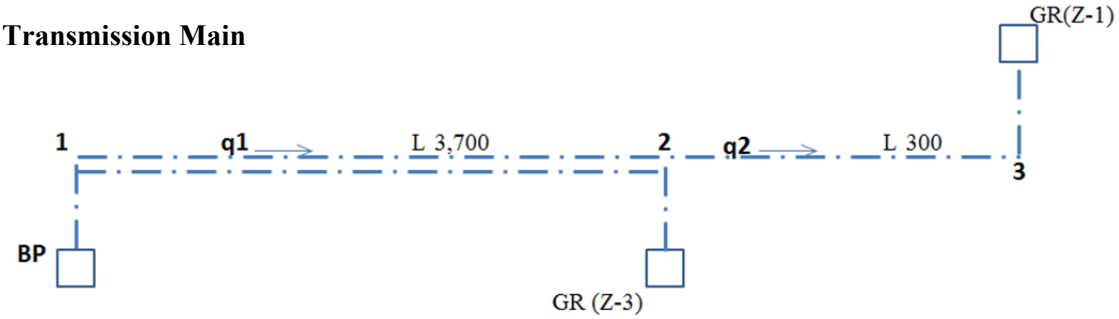
Minimum head loss

G-2.2~G3.2	27.8	300	700	0.39	0.61	0.4
	27.8	350	350	0.29	0.29	0.1
G-3.2~G-4.2	55.6	350	700	0.58	1.04	0.7
	55.6	400	350	0.44	0.54	0.2
G-4.2~G-5.2	83.3	400	700	0.66	1.14	0.8
	83.3	400	350	0.66	1.14	0.4
G5.2~BP	111.1	400	350	0.88	1.95	0.7
	111.1	400	50	0.88	1.95	0.1
					Σhf	3.4

1.3 Tube Well Pump

Type of pump			Submersible well pump
Pump capacity			100 m^3/hr
			1.67 m^3/min
Number of well pumps			15 units
Pump head	dinamic growundwater level	-15	
	booster pump well water level (HWL)	1.5	
	static head		16.5
	head loss piping around pump	1.0	
	head loss of delivery header	9.9	
	head loss of pipelines		10.9
	loss at booster pump station incl. loss of flow control		2.2
	Total		29.6 m
Dimensions of pump	$^{Q}1.67^{m3/min}$ x $^{H}30^{m}$ x $^{Pm}15^{kWH}$		

1.4 Transmission Main



Sizing Analysis

BP to DC1 Stage 1 (2028)

Flow:

Q = 6,300 m3/d

q (Z-3) = 1,850 m3/d q (Z-1&2) = 4,450 m3/d

section	flow	dia.	length	velocity	h, gradient	head loss
	l/s	mm	m	m/s	‰	m
BP ~ 1	72.9	400	100	0.58	0.89	0.1
1 ~ 2	72.9	300 *1	3,700	1.03	3.63	13.4
2 ~ 3	51.5	300 *1	300	0.73	1.91	0.6
	note *1: existing main					14.1

Stage 2 (2038)

Flow:

Q = 10,800 m3/d

q (Z-3) = 3,140 m3/d q (Z-1&2) = 7,660 m3/d

section	flow	dia.	length	velocity	h, gradient	head loss
	l/s	mm	m	m/s	‰	m
BP ~ 1	125.0	400	100	1.00	2.42	0.2
1 ~ 2	125.0	400 *2	3,700	1.00	2.42	9.0
2 ~ 3	88.7	250	300	1.81	12.66	3.8
	note *2: replaced by new main (400mm)					13.0

1.5 Booster Pump

Type of pumps			Horizontal Single Suction Centrifugal Pump	
Number of units		working	3	nos.
		standby	1	no.
Pump discharge			2.5	m3/min
Pump head	Static head: WL of Ground Reservoir Zone-1&3	0.0		
	LWL of Pump suction well	-2.5	2.5	
	Piping around pumps		1.5	
	Trandmission main		14.1	
	Residual head at GR incl. flow control loss		1.9	
	Total Head		20.0	m
		rounded		
Pump dimensions	$^{Q}2.5^{m3/min}$ x $^{H}20^{m}$ x 30^{kWH}			

1.6 Pump Suction Well and Pump cum Operation House

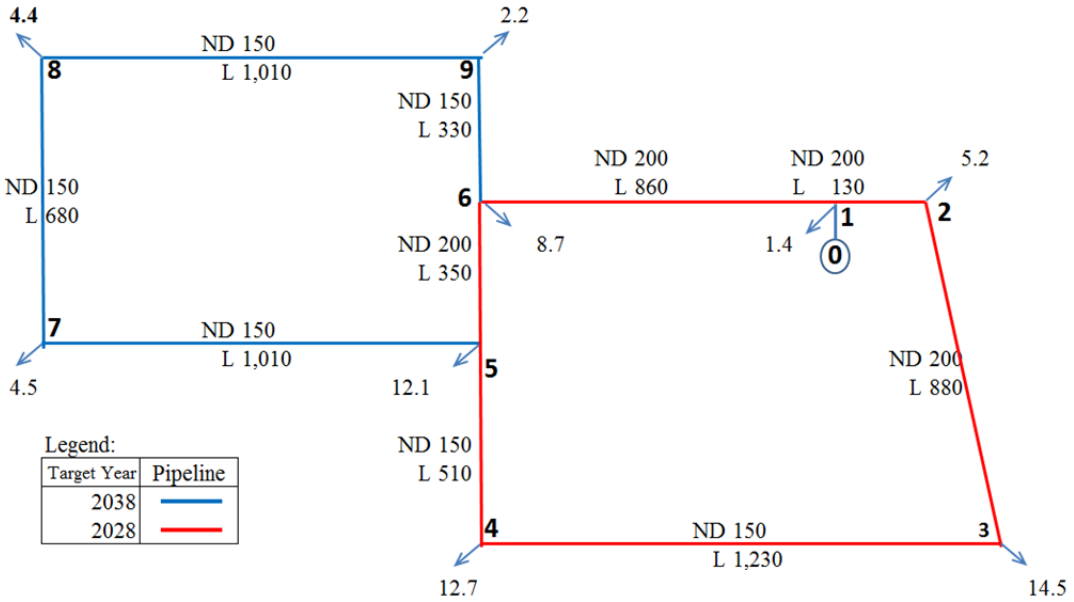
Pump Suction Well	Transmission Flow	10,800 m^3/d =	0.125	m^3/s
	Detention time		1.0	hr
	Volume		450	m3
	Dimensions	$^{W}7.5^{m}$ x $^{L}7.5^{m}$ x $^{H}4.0^{m}$ x $^{N}2$		
Pump House cum Operation House	Dimensions	$^{W}6.9^{m}$ x $^{L}15.0^{m}$ x $^{H}6.0^{m}$ (3.5^{m})		

2 Network Analysis of Distribution Primary Main

		Year	unit	Zone -1	Zone -2	Zone -3
Design Flow	Day Maximum Demand	2038	m^3/d	3,350	4,280	3,140
	Peak Houely Demand	2038	l/s	65.9	84.2	61.8

2.1 Supply Zone 1

Skelton of Network



Node Data

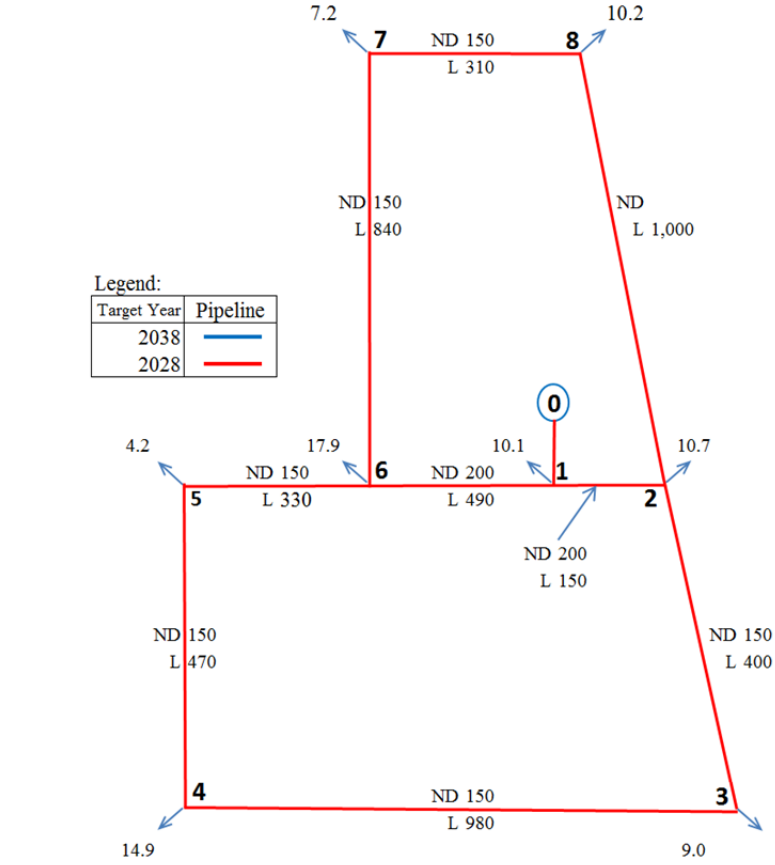
Node No.	Type	Discharge l/s	WL m	GL m	Eff. Head m
0		-65.9	214.00	189.00	25.00
1		1.4	213.50	189.00	24.50
2		5.2	212.62	189.00	23.62
3		14.5	209.25	189.00	20.25
4		12.7	205.80	189.00	16.80
5		12.2	205.99	189.00	16.99
6		8.8	206.87	189.00	17.87
7		4.5	205.45	189.00	16.45
8		4.4	205.46	189.00	16.46
9		2.2	206.32	189.00	17.32

Pipeline Data

Node Number Up-stream	Node Number Dn-stream	Dia. mm	Length m	Friction Co-efficient	Head Loss m	Flow l/s	Velocity m/s	H. gradient ‰
0	1	250	60	120	65.70	65.90	1.34	0.50
1	2	200	160	120	29.18	29.23	0.93	0.88
2	3	200	880	120	23.98	24.03	0.77	3.37
3	4	150	1,230	120	9.48	9.53	0.54	3.45
4	5	150	510	120	-3.22	-3.17	-0.18	-0.19
5	6	200	350	120	-19.21	-19.26	-0.61	-0.89
6	1	200	850	120	-35.12	-35.27	-1.12	-6.62
5	7	150	1,010	120	3.89	3.89	0.22	0.54
7	8	150	680	120	-0.61	0.62	-0.04	-0.01
8	9	150	1,010	120	-5.01	5.02	-0.28	-0.86
9	6	150	330	120	-7.21	7.22	-0.41	-0.55

2.2 Supply Zone 2

Skelton of Network



Node Data

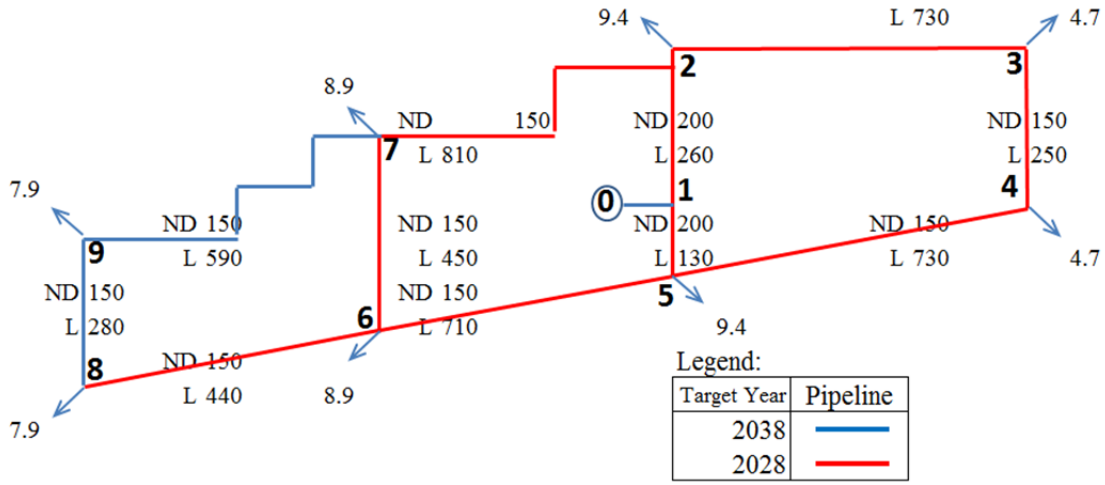
Node No.	Type	Discharge	WL	GL	Eff. Head
		l/s	m	m	m
0		-84.2	214.00	189.00	25.00
1		10.1	212.02	189.00	23.02
2		10.7	210.67	189.00	21.67
3		9.0	207.82	189.00	18.82
4		14.9	206.37	189.00	17.37
5		4.2	207.35	189.00	18.35
6		17.9	208.09	189.00	19.09
7		7.2	206.47	189.00	17.47
8		10.2	206.50	189.00	17.50

Pipeline Data

Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H. gradient
Up-stream	Dn-stream	mm	m	Co-efficient	m	l/s	m/s	‰
0	1	250	150	120	1.80	84.20	1.72	13.18
1	2	200	150	120	1.31	38.25	1.20	8.74
2	3	150	400	120	2.79	15.76	0.88	6.97
3	4	150	980	120	1.39	6.76	0.37	1.41
4	5	150	470	120	-1.02	-8.15	-0.47	-2.18
5	6	200	330	120	-0.38	-17.95	-0.40	-1.14
6	1	200	490	120	-4.08	-35.85	-1.17	-8.33
6	7	150	840	120	1.05	5.60	0.35	1.25
7	8	150	310	120	-0.01	-1.60	-0.06	-0.05
8	2	150	1,000	120	-3.81	11.80	-0.64	-3.81

2.3 Supply Zone 3

Skelton of Network



Node Data

Node No.	Type	Discharge	WL	GL	Eff. Head
		l/s	m	m	m
0		-61.8	214.00	189.00	25.00
1		0.0	213.00	189.00	23.89
2		9.4	211.49	189.00	22.49
3		4.7	211.16	189.00	22.16
4		4.7	211.17	189.00	22.17
5		9.4	211.99	189.00	21.99
6		8.9	205.68	189.00	16.68
7		8.9	205.68	189.00	16.67
8		7.9	204.68	189.00	15.67
9		7.9	204.67	189.00	15.67

Pipeline Data

Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H. gradient
Up-stream	Dn-stream	mm	m	Co-efficient	m	l/s	m/s	‰
0	1	250	150	120	1.12	61.80	1.26	7.43
1	2	200	260	120	1.39	28.82	0.92	5.36
2	3	150	730	120	0.34	3.58	0.20	0.46
3	4	150	250	120	-0.01	-1.12	-0.06	-0.05
4	5	150	730	120	-0.82	-5.82	-0.33	-1.12
5	1	200	130	120	-0.90	-32.98	-1.05	-6.89
5	6	150	710	120	6.31	17.77	1.01	8.89
6	7	150	450	120	0.00	0.35	0.02	0.01
7	2	150	810	120	-5.82	-15.83	-0.90	-7.18
6	8	150	440	120	1.00	8.52	0.48	2.28
8	9	150	280	120	0.01	0.62	0.04	0.02
9	7	150	590	120	-1.01	-7.28	-0.41	-1.70

3 Cost Estimate

3.1 Direct Cost

	Description	Q'ty	U. price '000Rs.	Cost mill Rs.	Note
1	Intake Wlll (Tube Well)				
1.1	Well and Rizing Main				
a.	Well Construction	14 nos.	4,024	56.3	incl. pump hpuse
b.	Well Pump Installation	14 units	2,104	29.5	incl. piping & electric panels
c.	Pump discharge header				
	ND250mm	700 m	13.1	9.2	
	ND300mm	1,050 m	15.7	16.5	
	ND350mm	1,050 m	18.3	19.2	
	ND400mm	1,800 m	22.6	40.7	
				85.6	
	subtotal			171.4	unit cost "12.24 milRs./well
1.2	Booster Pump Station				
a.	Pump Well	450 m^3	31	14.0	
b.	Pump House	74 m^2	100	7.4	
c.	Booster pump	15 kW	280	16.8	4 units
d.	Miscellaneous		10%	3.8	
	Subtotal			42.0	
1.3	Transmission Main				
a.	ND 400mm	3,700 m	22.6	83.6	BP ~ GR 2 (Z-3)
	ND 250mm	300 m	13.1	3.9	
	Subtotal			87.5	
b.	ND 300mm	630 m	15.7	9.9	GR 1 to OHR 2 (Z-2)
	Subtotal			97.4	
	Total of item 1			**310.8**	million Rs.
2	**Distribution Center**				
2.1	DC 1				
	GR 1	1,300 m3	30.0	40.0	in 2028 for 2038 demand
	OHR 1			-	use existing one
	Pump House	120 m2	100	12.0	
	Lift Pump	15 kW	280	16.8	4 units
	Rizing Pump (to OHR 2)	18.5 kW	280	20.7	4 units
	Lift pipe, etc.		10%	9	
	subtotal			98.5	
2.2	DC 2				
	GR			-	no GR
	OHR 2	300 m3	64.0	20.0	in 2028 for 2038 demand
	Pump House			-	no pump station
	subtotal			20.0	
2.3	DC 3				
	GR 2	600 m3	31.0	20.0	in 2028 for 2038 demand
	OHR 3	200 m3	66.0	13.2	
	Pump House	74 m2	100	7.4	
	Lift Pump	15 kW	280	16.8	4 units
	Lift pipe, etc.		10%	5.7	
	subtotal			63.1	
	Total of Item 2			**181.6**	million Rs.

3	**Distribution Pipelines and Service Connections**				
3.1	Primary Main				
	in 2023 for demand 2028				
	ND250mm	380	m	13.1	5.0
	ND200mm	3,410	m	5.7	19.4
	ND150mm	10,240	m	3.8	38.9
		14,030	m		63.3
	in 2028 for demand 2038				
	ND250mm	0	m	13.1	0.0
	ND200mm	0	m	5.7	0.0
	ND150mm	4,090	m	3.8	15.5
		4,090	m		15.5
	subtotal	18,120	m		78.8
3.2	Service Main				total up to 2038
	New Mains				
	ND 100mm			1.11	33%
	ND 80mm			2.05	67%
	Subtotal	32,400	m	1.74	56.4
	Replacement				
	ND 100mm			1.11	33%
	ND 80mm			2.05	67%
	Subtotal	13,200	m	1.74	23.0
	Total				79.4
3.3	Service Connection				
	Domestic	5,400		10	54.0 15mm
	Non-domestic	222		20	4.4 25mm
	Total				58.4
3.4	Water Meter				
a.	<u>On Existing Connection</u>				
	Domestic	2,200		5.28	11.6
	Non-dom	8		10.56	0.1
	Subtotal				11.7
b.	<u>Routine replacement</u>				
	Domestic	7,020		2.57	18.0
	Non-dom	250		5.14	1.3
	Subtotal				19.3
	Total				31
3.5	Total of Item 3				**247.6** million Rs.
	Direct Cost Total				**740.0** million Rs.

3.2 Indirect Cost

Overhead and Management Cost	5%	37.0	
Consultancy Cost	10%	74.0	
Physical Contingency	2%	17	
Tax (VAD)	16%	138.9	
Indirect Cost Total		**266.9**	million Rs.

3.3 Total Project Cost (Base Cost in 2017) **1,006.9** million Rs.

3.4 Disbursement Schedule

	Description			2018~2023			2024~2028			2029~2033			2033~2038			Total		
				LC	FC	total	LC	FC	total	LC	FC	total	LC	FC	total	LC	FC	total
1	**Water Source Development**																	
1.1	Well/Pump Construction	Q'ty	unit			7			3			4						14
				40%	60%	42.9	40%	60%	18.4	40%	60%	24.5						
		Cost		17.2	25.7	42.9	7.4	11.0	18.4	9.8	14.7	24.5				34.4	51.4	85.8
1.2	Pump Discharge Header	Q'ty	ND x L(km)		400x1.8 + 350x0.35			350x0.7 + 300x0.35			300x0.7 + 250x0.7							
				35%	65%	47.1	35%	65%	18.3	35%	65%	20.2						
		Cost		16.5	30.6	47.1	6.4	11.9	18.3	7.1	13.1	20.2				30	55.6	85.6
1.3	Booster Pump Station	Q'ty				90%						10%						
				40%	60%					10%	90%							
		Cost		15.1	22.7	37.8	0	0	0	0.4	3.8	4.2	0	0	0	15.5	26.5	42.0
1.4	Transmission Main	Q'ty	ND x L (km)				400x3.7 + 250x0.3 + 300x0.63											
				35%	65%		35%	65%	97.4	35%	65%							
		Cost		0	0		34.1	63.3	97.4	0	0					34.1	63.3	97.4
	Total of Item 1			**48.8**	**79**	**127.8**	**47.9**	**86.2**	**134.1**	**17.3**	**31.6**	**48.9**	**0**	**0**	**0**	**114.0**	**196.8**	**310.8**
2	**Distribution Center**																	
2.1	DC 1	Q'ty							95%			5%						
		LC/FC					40%	60%	93.6	40%	60%	4.9						
		Cost					37.4	56.2	93.6	2	2.9	4.9				39.4	59.1	98.5
2.2	DC 2 (OHR)	Q'ty	m3						300									
							80%	20%										
		Cost					16.0	4.0	20.0							16.0	4.0	20.0
2.3	DC 3	Q'ty	m3/d						95%			5%						
							40%	60%	59.9	40%	60%	3.2						
		Cost					24	35.9	59.9	1.3	1.9	3.2				25.3	37.8	63.1
	Total of Item 2			**0**	**0**	**0**	**77.4**	**96.1**	**173.5**	**3.3**	**4.8**	**8.1**	**0**	**0**	**0**	**80.7**	**100.9**	**181.6**
3	Distribution Mains and Service Connection																	
3.1	Primary main (150~250)	Q'ty	km			14.0			4.1									14
			LC/FC	50%	50%		50%	50%		50%	50%							
		Cost		31.6	31.7	63.3	7.7	7.8	15.5	0	0		0	0	0	39.3	39.5	78.8
3.2	Service Main (80 & 100)																	
a.	New main	Q'ty	km			7.8			6.0			9.0			9.6			32.4
			LC/FC	50%	50%		50%	50%		50%	50%		50%	50%				
		Cost		6.8	6.8	13.6	5.2	5.2	10.4	7.8	7.9	15.7	8.3	8.4	16.7	28.1	28.3	56.4
b.	Replacement of Exist. main (80 & 100)	Q'ty	km			3.3			3.3			3.3			3.3			13.2
			LC/FC	50%	50%		50%	50%		50%	50%		50%	50%				
		Cost		2.8	2.9	5.7	2.9	2.9	5.8	2.9	2.9	5.8	2.8	2.9	5.7	11.4	11.6	23.0
	(new and replaced)	Q'ty	km			13.5			11.8			14.8	2.8		15.3			55.4
			LC/FC	50%	50%		50%			50%	50%		50%	50%				
		Cost		9.6	9.7	19.3	8.1	8.1	16.2	10.7	10.8	21.5	11.1	11.3	22.4	39.5	39.9	79.4
3.3	Service Connection																	
a.	Domestic	Q'ty	units			1,300			1,000			1,500			1,600			5,400
			LC/FC	50%	50%		50%	50%		50%	50%		50%	50%				
		Cost		6.5	6.5	13.0	5.0	5.0	10.0	7.5	7.5	15.0	8.0	8.0	16.0	27	27	54.0
b.	Non-Dom	Q'ty	units			102			30			40			50			222
			LC/FC	50%	50%		50%	50%		50%	50%		50%	50%		50%	50%	
		Cost		1.0	1.0	2.0	0.3	0.3	0.6	0.4	0.4	0.8	0.5	0.5	1.0	2.2	2.2	4.4
		Q'ty	units			1,402			1,030			1,540			1,650			5,622
	(Domestic & Non-Dom)		LC/FC	50%	50%		50%	50%		50%	50%		50%	50%				
		Cost		7.5	7.5	15.0	5.3	5.3	10.6	7.9	7.9	15.8	8.5	8.5	17.0	29.2	29.2	58.4
3.4	Water Meter (replacement)																	
a.	Install on Existing Connections																	
	Domestic	Q'ty	units			1,100			1,100			0			0			2,200
			LC/FC	20%	80%		20%	80%		20%	20%	80%	20%	80%		20%	80%	
		Cost		1.2	4.6	5.8	1.2	4.6	5.8	0.0	0.0	0	0.0	0.0	0	2.4	9.2	11.6
	Non-Dom	Q'ty	units						8									8
			LC/FC	20%	80%		20%	80%										
		Cost		0.0	0.0	0	0.0	0.1	0.1	0	0	0	0	0	0	0	0.1	0.1
b.	Routine Replacement		LC/FC															
	Domestic	Q'ty	units						960			2,280			3,780			7,020
			LC/FC	20%	80%		20%	80%		20%	80%		20%	80%				
		Cost		0.0	0.0	0	0.5	2.0	2.5	1.2	4.6	5.8	1.9	7.8	9.7	3.6	14.4	18.0
	Non-Dom	Q'ty	units						50			70			130			250
			LC/FC				20%	80%		20%	80%		20%	80%				
		Cost				0.0	0.1	0.2	0.3	0.1	0.3	0.4	0.1	0.5	0.6	0.3	1.0	1.3
	(On exist. main & Routing replace)	Q'ty	units															
			LC/FC															
		Cost		1.2	4.6	5.8	1.8	6.9	8.7	1.3	4.9	6.2	2.0	8.3	10.3	6.3	24.7	31.0
	Total of Item 3			**49.9**	**53.5**	**103.4**	**22.9**	**28.1**	**51.0**	**19.9**	**23.6**	**43.5**	**21.6**	**28.1**	**49.7**	**114.3**	**133.3**	**247.6**
	Total Direct Cost			**98.7**	**132.5**	**231.2**	**148.2**	**210.4**	**358.6**	**40.5**	**60.0**	**100.5**	**21.6**	**28.1**	**49.7**	**309.0**	**431.0**	**740.0**
4	**Indirect Cost**																	
4.1	Project Admnistration Cost		5%															37
4.2	Consultancy Cost		10%															74
4.3	Physical Contingency		2%															17
4.4	Tax (VAT)		16%															138.9
	Total of Indirect Cost			**35.6**	**47.8**	**83.4**	**53.5**	**75.9**	**129.4**	**14.6**	**21.6**	**36.2**	**7.8**	**10.1**	**17.9**	**111.5**	**155.4**	**266.9**
						83.4			129.3			36.2			17.9			
	Total Cost before Price Escalation			**134.3**	**180.3**	**314.6**	**201.7**	**286.3**	**488.0**	**55.1**	**81.6**	**136.7**	**29.4**	**38.2**	**67.6**	**420.5**	**586.4**	**1,006.9**
						31.2%			48.5%			13.6%			6.7%			100.0%
		price escaration %		22.1%	7.4%		55.1%	16.9%		91.1%	27.0%		149.2%	38.0%				
	Price Contingency			**29.7**	**13.3**	**43.0**	**111.1**	**48.4**	**159.5**	**50.2**	**22**	**72.2**	**43.9**	**14.5**	**58.4**	**234.9**	**98.2**	**333.1**
5	**Current Cost**			**164.0**	**193.6**	**357.6**	**312.8**	**334.7**	**647.5**	**105.3**	**103.6**	**208.9**	**73.3**	**52.7**	**126.0**	**655.4**	**684.6**	**1,340.0**

AB5.2.2 Khurrianwala Municipal Corporation

1. Intake and Transmission

Water Demand

unit: m^3/d

Year	2015	2023	2028	2033	2038
Day Avegare demand	900	1,900	3,700	6,100	8,260
Day Maximum demand	1,000	2,200	4,200	7,000	9,500

1.1 Tube Well

1) Water Source

seepage water of Rakh Branch Canal

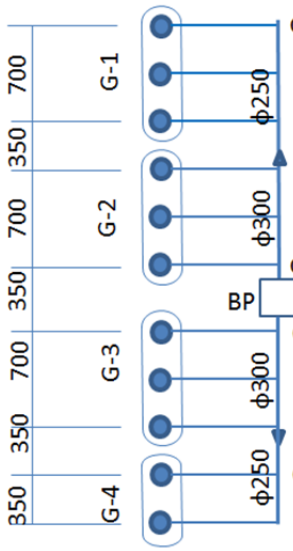
2) Exploitation of Well

rate		100 m^3/hr
operation		8 hrs/d
well capacity		800 m^3/d
spacing of well construction		350 m
number of wells	operation	12 wells

3) Well Operation

Wells are grouped into 5 groupes each having three tube wells. The operation of well is planned three shifts operation of each well group per day.

1.2 Well Pump Delivery Header



Maximum head loss

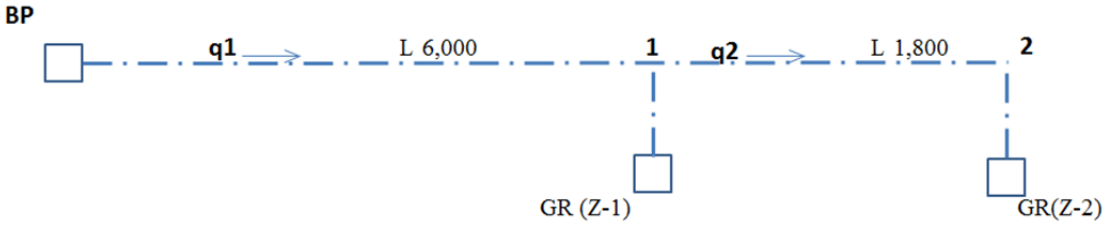
Section	Flow	Dia.	Length	velocity	h. gradient	head loss
	l/s	mm	m	m/s	‰	m
G1.1~G2.1	27.8	250	1,050	0.57	1.48	1.6
G2.1~BP	55.6	300	875	0.79	2.19	1.9
					Σhf1	3.5
					Σhf2	1.3
G3.3~BP	55.6	300	175	0.79	2.20	0.4
G4.3~G3.1	27.8	300	700	0.39	0.61	0.4
G4.3~G3.3	27.8	250	350	0.57	1.48	0.5

Minimum head loss

1.3 Tube Well Pump

Type of pump			Submersible well pump
Pump capacity			100 m^3/hr
			1.67 m^3/min
Number of well pumps			12 units
Pump head	dinamic growundwater level	-15	
	booster pump well water level (HWL)	1.5	
	static head		16.5
	head loss piping around pump	1.0	
	head loss of delivery header	9.0	
	head loss of pipelines		10.0
	loss at booster pump station incl. loss of flow control		3.4
	Total		29.9 m
Dimensions of pump	$^{Q}1.67^{m3/min}$ x $^{H}30^{m}$ x 15^{kWH}		

1.4 Transmission Main



Sizing Analysis

Stage 1 (2028)

Flow:

Q = 4,200 m3/d 2.9 m3/min

q (Z-1) = 2,600 m3/d q (Z-2) = 1,600 m3/d

section	flow l/s	dia. mm	length m	velocity m/s	h, gradient ‰	head loss m
BP ~ 1	48.6	250 *1	1,600	0.99	4.17	6.7
1 ~ 2	18.5	250 *2	4,400	0.38	0.70	3.1
						9.7

note *1: existing main

*2: new main

Stage 2 (2038) 0.396084

Flow:

Q = 9,500 m3/d 2.20 m3/min/pump

q (Z-1) = 5,900 m3/d q (Z-2) = 3,600 m3/d

section	flow l/s	dia. mm	length m	velocity m/s	h, gradient ‰	head loss m
BP ~ 1	110.0	350 *2	1,600	1.14	3.66	5.9
1 ~ 2	41.7	250	4,400	0.85	3.13	13.8
						19.6

note *2: existing main is replaced

1.5 Booster Pump

Type of pumps			Horizontal Single Suction Centrifugal Pump	
Number of units		working	3	nos.
		standby	1	no.
Pump discharge			2.2	m3/min
Pump head	Static head: WL of Ground Reservoir Zone-2	1.5		
	LWL of Pump suction well	-2.5	4.0	
	Piping around pumps		1.5	
	Trandmission main		19.6	
	residual head at GR incl. flow control loss		2.5	
	Total Head		27.6	m
Pump dimensions	$^{Q}2.2^{m3/min}$ x $^{H}30^{m}$ x 20^{kWH}			

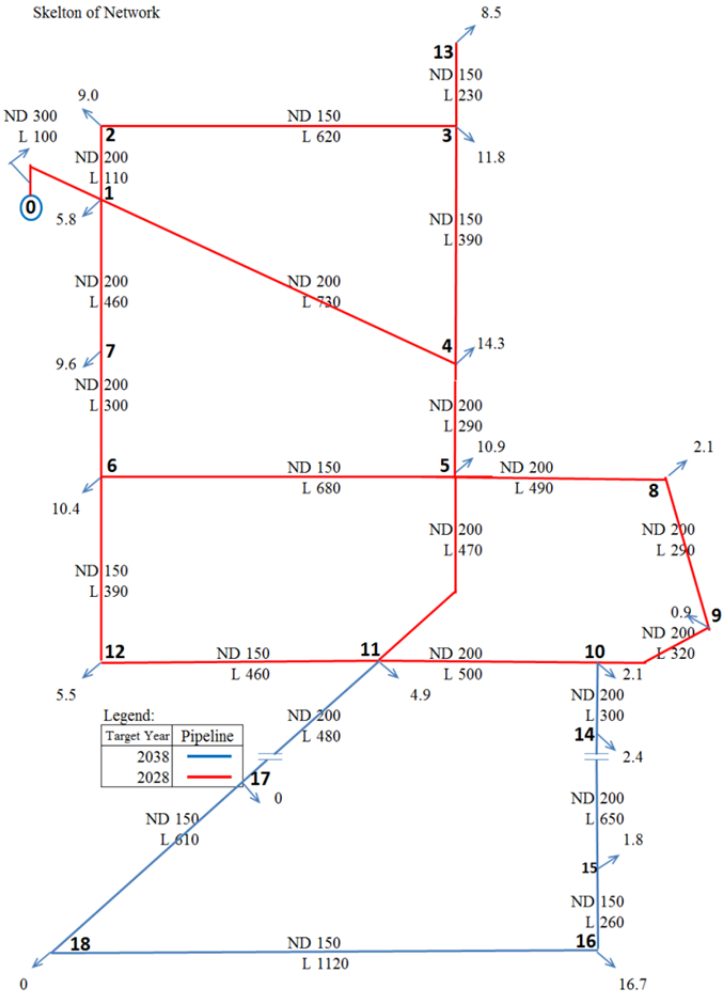
1.6 Pump Suction Well and Pump cum Operation House

Suction Well	Transmission Flow	9,500 m^3/d =	0.110	m^3/s
	Detention time		1.0	hr
	Volume		400	m3
	Dimensions	$^{W}7.0^{m}$ x $^{L}7.0^{m}$ x $^{H}4.0^{m}$ x $^{N}2$		
Pump House cum Operation House	Dimensions	$^{W}6.0^{m}$ x $^{L}15.0^{m}$ x $^{H}6.0^{m}$ $(3.5^{m})^{*3}$		
		note ^{*3}: height of electric room (GL)		

2. Network Analysis of Primary Main

		Year	unit	Zone -1	Zone -2
Design Flow	Day Maximum Demand	2038	m^3/d	5,910	3,590
	Peak Houely Demand	2038	l/s	116.3	70.6

2.1 Supply Zone 1



Node Data

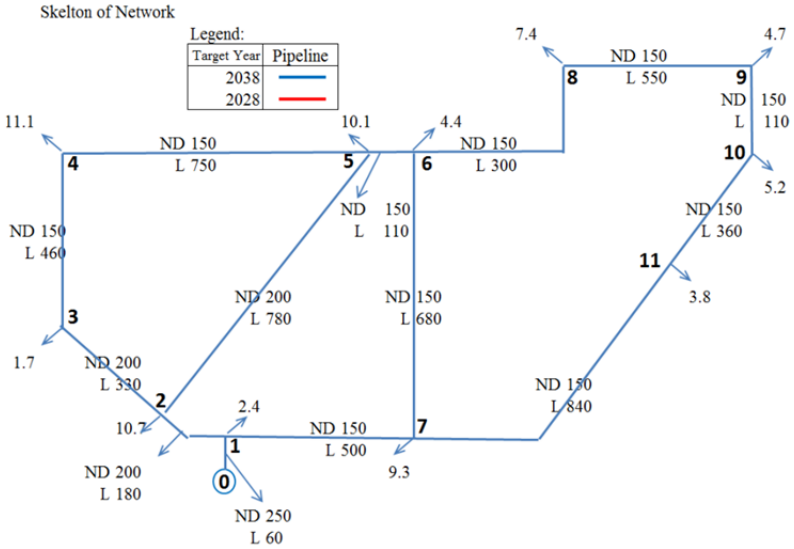
Node No.	Type	Discharge l/s	WL m	GL m	Eff. Head m
0		-116.3	214.00	189.00	25.00
1		5.8	213.01	189.00	24.01
2		9.0	212.48	189.00	23.48
3		11.7	206.63	189.00	17.63
4		14.2	206.68	189.00	17.68
5		10.8	205.79	189.00	16.79
6		10.4	208.61	189.00	19.61
7		9.6	211.06	189.00	22.06
8		2.1	205.35	189.00	16.35
9		0.9	205.18	189.00	16.18
10		2.1	205.018	189.00	16.02
11		4.9	205.338	189.00	16.34
12		5.5	206.38	189.00	17.38
13		8.5	206.105	189.00	17.11
14		2.4	204.538	189.00	15.54
15		1.8	203.785	189.00	14.79
16		16.6	202.867	189.00	13.87
17		0.0	204.801	189.00	15.80
18		0.0	204.119	189.00	15.12

Pipeline Data

Node Number Up-stream	Node Number Dn-stream	Dia. mm	Length m	Friction Co-efficient	Head Loss m	Flow l/s	Velocity m/s	H. gradient ‰
0	1	300	100	120	0.99	116.30	1.646	9.86
1	2	200	110	120	0.54	27.36	0.871	4.87
2	3	150	620	120	0.58	18.36	1.039	9.44
3	4	150	390	120	-0.05	-1.85	-0.104	-0.13
4	1	200	730	120	-6.34	-37.38	-1.190	-8.68
4	5	200	290	120	0.89	21.34	0.680	3.07
5	6	150	680	120	-2.82	-11.77	-0.666	4.15
6	7	200	300	120	-2.45	-36.16	-1.152	-8.16
7	1	250	460	120	-1.96	-45.76	-0.933	-4.26
5	8	200	490	120	0.44	10.95	0.349	0.89
8	9	200	290	120	0.18	8.85	0.282	0.60
9	10	200	320	120	0.16	7.95	0.253	0.49
10	11	200	500	120	-0.32	-9.15	-0.291	-0.64
11	5	200	470	120	-0.45	-11.36	-0.362	-0.96
11	12	150	460	120	-1.04	-8.49	-0.481	-2.27
12	6	150	390	120	-2.23	-13.99	-0.792	-5.71
3	13	150	230	120	0.52	8.50	0.481	2.27
10	14	200	300	120	0.48	15.00	0.478	1.60
14	15	200	650	120	0.75	12.60	0.401	1.16
15	16	150	260	120	0.92	10.80	0.611	3.53
11	17	150	480	120	0.54	5.80	0.328	1.12
17	18	150	610	120	0.68	5.80	0.328	1.12
18	16	150	1,120	120	1.25	5.80	0.328	1.12

2.2 Supply Zone 2.2

Skelton of Network



Node Data

Node No.	Type	Discharge l/s	WL m	GL m	Eff. Head m
0		-116.3	214.00	189.00	25.00
1		5.8	213.01	189.00	24.01
2		9.0	212.48	189.00	23.48
3		11.7	206.63	189.00	17.63
4		14.2	206.68	189.00	17.68
5		10.8	205.79	189.00	16.79
6		10.4	208.61	189.00	19.61
7		9.6	211.06	189.00	22.06
8		2.1	205.35	189.00	16.35
9		0.9	205.18	189.00	16.18
10		2.1	205.018	189.00	16.02
11		4.9	205.338	189.00	16.34
12		5.5	206.38	189.00	17.38
13		8.5	206.105	189.00	17.11
14		2.4	204.538	189.00	15.54
15		1.8	203.785	189.00	14.79
16		16.6	202.867	189.00	13.87
17		0.0	204.801	189.00	15.80
18		0.0	204.119	189.00	15.12

Pipeline Data

Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H. gradient
Up-stream	Dn-stream	mm	m	Co-efficient	m	l/s	m/s	‰
0	1	300	100	120	0.99	116.30	1.646	9.86
1	2	200	110	120	0.54	27.36	0.871	4.87
2	3	150	620	120	0.58	18.36	1.039	9.44
3	4	150	390	120	-0.05	-1.85	-0.104	-0.13
4	1	200	730	120	-6.34	-37.38	-1.190	-8.68
4	5	200	290	120	0.89	21.34	0.680	3.07
5	6	150	680	120	-2.82	-11.77	-0.666	4.15
6	7	200	300	120	-2.45	-36.16	-1.152	-8.16
7	1	250	460	120	-1.96	-45.76	-0.933	-4.26
5	8	200	490	120	0.44	10.95	0.349	0.89
8	9	200	290	120	0.18	8.85	0.282	0.60
9	10	200	320	120	0.16	7.95	0.253	0.49
10	11	200	500	120	-0.32	-9.15	-0.291	-0.64
11	5	200	470	120	-0.45	-11.36	-0.362	-0.96
11	12	150	460	120	-1.04	-8.49	-0.481	-2.27
12	6	150	390	120	-2.23	-13.99	-0.792	-5.71
3	13	150	230	120	0.52	8.50	0.481	2.27
10	14	200	300	120	0.48	15.00	0.478	1.60
14	15	200	650	120	0.75	12.60	0.401	1.16
15	16	150	260	120	0.92	10.80	0.611	3.53
11	17	150	480	120	0.54	5.80	0.328	1.12
17	18	150	610	120	0.68	5.80	0.328	1.12
18	16	150	1,120	120	1.25	5.80	0.328	1.12

3. Cost Estimate

3.1 Direct Cost

	Description	Q'ty	U. price '000Rs.	Cost mill Rs.	Note
1	Intake Wlll (Tube Well)				
1.1	Well and Rizing Main				
a.	Well Construction	12 nos.	4,024	48.3	incl. pump hpuse
b.	Well Pump Installation	12 units	2,104	25.2	incl. piping & electric panels
c.	Pump discharge header				
	ND250mm	1,050 m	13.1	13.8	
	ND300mm	1,050 m	15.7	16.5	
	ND350mm	1,050 m	18.3	19.2	
	ND350mm	750 m	18.3	13.7	
				63.2	
	subtotal			136.7	unit cost "11.67 milRs./well
1.2	Booster Pump Station				
a.	Pump Well	400 m^3	31	12.4	
b.	Pump House	74 m^2	100	7.4	
c.	Booster pump	20 kW	200	16.0	4 units
d.	Miscellaneous		10%	3.6	
	Subtotal			39.4	
1.3	Transmission Main				
a.	ND 350mm	6,000 m	18.3	109.8	BP ~ DC 1 (Z-1)
b.	ND 250mm	1,800 m	13.1	23.6	DC 1~ DC 2 (Z-2)
	Subtotal			133.4	
	Total of item 1			**309.5**	million Rs.
2	**Distribution Center**				
2.1	Zone 1 (Exist. DC)	1000	30.0	30.0	18
	GR 1 2028	500 m3	36.0	18.0	in 2033 for 2038 demand
	2033	500	24.0	12.0	
	OHR 1 2028	400	64.0	25.6	use existing one
	Pump House	60 m2	100	6.0	
	Lift Pump	22 kW	280	24.6	4 units
	Lift pipe, etc.		10%	8.6	
	subtotal			94.8	
2.2	Zone 2 (New DC)	600	31.0	18.6	11.2
	GR 2028	300	37.2	11.2	no GR
	2033	300	24.8	7.4	
	OHR 2	250 m3	64.0	20.0	in 2028 for 2038 demand
	Pump House	60 m2	100	6.0	
	Lift Pump	15 kW	280	16.8	4 units
	Lift pipe, etc.		10%	6.1	
	subtotal			67.5	
	Total of Item 2			**162.3**	million Rs.

3	**Distribution Pipelines and Service Connections**				
3.1	Primary Main				
	in 2019~23 for demand 2028				
	ND250mm	170	m	13.1	2.2
	ND200mm	5,510	m	5.7	31.4
	ND150mm	7,800	m	3.8	29.6
		13,480	m		63.2
	in 2024~28 for demand 2038				
	ND250mm	0	m	13.1	0.0
	ND200mm	1,500	m	5.7	8.6
	ND150mm	2,090	m	3.8	7.9
		3,590	m		16.5
	subtotal	17,070	m		79.7
3.2	Service Main				total up to 2038
	New Mains				
	ND 100mm			1.11	33%
	ND 80mm			2.05	67%
	Subtotal	34,680	m	1.74	60.3
	Replacement				
	ND 100mm			1.11	33%
	ND 80mm			2.05	67%
	Subtotal	3,120	m	1.74	5.4
	Total				65.7
3.3	Service Connection				
	Domestic	5,780		10	57.8 15mm
	Non-domestic	216		20	4.3 25mm
	Total				62.1
3.4	Water Meter				
a.	<u>On Existing Connection</u>				
	Domestic	520		5.28	2.7
	Non-dom	4		10.56	0.0
	Subtotal				2.7
b.	<u>Routine replacement</u>				
	Domestic	5,480		2.57	14.1
	Non-dom	187		5.14	1.0
	Subtotal				15.1
	Total				17.8
3.5	Total of Item 3				**225.3** million Rs.
	Direct Cost Total				**697.1** million

3.2 Indirect Cost

Overhead and Management Cost	5%	34.9
Consultancy Cost	10%	69.7
Physical Contingency	2%	16
Tax (VAD)	16%	130.8
Indirect Cost Total		**251.4** million Rs.

3.3 Total Project Cost (Base Cost in 2017)

948.5 million Rs.

3.4 Disbursement Schedule

	Description			2018~2023			2024~2028			2029~2033			2033~2038			Total		
				LC	FC	total	LC	FC	total	LC	FC	total	LC	FC	total	LC	FC	total
1	**Water Source Development**																	
1.1	Well/Pump Construction	Q'ty	unit	4			4					4						12
				40%	60%		40%	60%		40%	60%							
		Cost		9.8	14.7	24.5	9.8	14.7	24.5	9.8	14.7	24.5				29.4	44.1	73.5
1.2	Pump Discharge Header	Q'ty	ND x L(km)			350 x 1.1		350 x 700/300 x 700)			250 x 1050~300 x 350							
				35%	65%	20.0	35%	65%	23.8	35%	65%	19.4						63.2
		Cost		7.0	13.0	20.0	8.3	15.5	23.8	6.8	12.6	19.4				22.1	41.1	63.2
1.3	Booster Pump Station	Q'ty				80%			10%			10%						
				40%	60%		10%	90%		10%	90%							
		Cost		12.6	18.9	31.5	0.4	3.5	3.9	0.4	3.6	4.0				13.4	26	39.4
1.4	Transmission Main	Q'ty	ND x L (km)		(BP~DC 1)	350 x 6.0		(DC 1~2)	250 x 1.8									
				35%	65%		35%	65%										
		Cost		38.4	71.4	109.8	8.3	15.3	23.6							46.7	86.7	133.4
	Total of Item 1			**67.8**	**118**	**185.8**	**26.8**	**49.0**	**75.8**	**17**	**30.9**	**47.9**	**0**	**0**	**0**	**111.6**	**197.9**	**309.5**
2	**Distribution Center**																	
2.1	DC 1	Q'ty	percent						95%			5%						100%
		LC/FC					40%	60%	pump 3 nos.	20%	80%	pump 4 nos.						
		Cost					36.0	54.1	90.1	0.9	3.8	4.7				36.9	57.9	94.8
2.2	DC 2 (OHR)	Q'ty	percent						95%			5%						100%
		LC/FC					40%	60%	pump 3 nos.	20%	80%	pump 1 no.						
		Cost					25.6	38.5	64.1	0.7	2.7	3.4				26.3	41.2	67.5
	Total of Item 2			**0**	**0**	**0**	**61.6**	**92.6**	**154.2**	**1.6**	**6.5**	**8.1**	**0**	**0**	**0**	**63.2**	**99.1**	**162.3**
3	Distribution Mains and Service Connection																	
3.1	Primary main (150~250)	Q'ty	km		ND250~150	13.5		ND200~150	3.6									17.1
		LC/FC		50%	50%		50%	50%										
		Cost		31.6	31.6	63.2	8.2	8.3	16.5	0	0	0	0	0	0	39.8	39.9	79.7
3.2	Service Main (80 & 100)																	
	a. New main	Q'ty	km			7.62			7.26			10.98			8.82			34.68
			LC/FC	50%	50%		50%	50%		50%	50%		50%	50%				
		Cost		6.6	6.6	13.2	6.3	6.3	12.6	9.5	9.6	19.1	7.7	7.7	15.4	30.1	30.2	60.3
	b. Replacement of Exist.	Q'ty	km			0.78			0.78			0.78			0.78			3.12
	main (80 & 100)		LC/FC	50%	50%		50%	50%		50%	50%		50%	50%				
		Cost		0.7	0.7	1.4	0.6	0.7	1.3	0.7	0.7	1.4	0.6	0.7	1.3	2.6	2.8	5.4
	(new and replaced)	Q'ty	km			8.40			8.04			11.76	0.6		9.60			37.80
			LC/FC	50%	50%		50%			50%	50%		50%	50%				
		Cost		7.3	7.3	14.6	6.9	7	13.9	10.2	10.3	20.5	8.3	8.4	16.7	32.7	33	65.7
3.3	Service Connection																	
	a. Domestic	Q'ty	units			1,270			1,210			1,830			1,470			5,780
			LC/FC	50%	50%		50%	50%		50%	50%		50%	50%				
		Cost		6.3	6.4	12.7	6.0	6.1	12.1	9.1	9.2	18.3	7.3	7.4	14.7	28.7	29.1	57.8
	b. Non-Dom	Q'ty	units			56			50			60			50			216
			LC/FC	50%	50%		50%	50%		50%	50%		50%	50%		50%	50%	
		Cost		0.5	0.6	1.1	0.5	0.5	1.0	0.6	0.6	1.2	0.5	0.5	1.0	2.1	2.2	4.3
		Q'ty	units			1,326			1,260			1,890			1,520			5,996
	(Domestic & Non-Dom)		LC/FC	50%	50%		50%	50%		50%	50%		50%	50%				
		Cost		6.8	7.0	13.8	6.5	6.6	13.1	9.7	9.8	19.5	7.8	7.9	15.7	30.8	31.3	62.1
3.4	Water Meter (replacement)																	
	a. Install on Existing Connections																	
	Domestic	Q'ty	units			260			260			0			0			520
			LC/FC	20%	80%		20%	80%		20%	20%	80%	20%	80%		20%	80%	
		Cost		0.3	1.1	1.4	0.3	1.0	1.3	0.0	0.0	0.00	0.0	0.0	0.0	0.6	2.1	2.7
	Non-Dom	Q'ty	units			4			0									8
			LC/FC	20%	80%		20%	80%										
		Cost		0.0	0.1	0.1	0.0	0.0	0	0	0	0	0	0	0	0	0.1	0.1
	b. Routine Replacement		LC/FC															
	Domestic	Q'ty	units						614			1,500			2,844			4,958
			LC/FC	20%	80%		20%	80%		20%	80%		20%	80%				
		Cost		0.0	0.0	0	0.3	1.4	1.7	0.9	3.4	4.3	1.6	6.5	8.1	2.8	11.3	14.1
	Non-Dom	Q'ty	units						26			54			103			183
			LC/FC				20%	80%		20%	80%		20%	80%				
		Cost				0.0	0.0	0.1	0.1	0.1	0.2	0.3	0.1	0.5	0.6	0.2	0.8	1.0
	(On exist. main &	Q'ty	units															
	Routing replace)		LC/FC															
		Cost		0.3	1.2	1.5	0.6	2.5	3.1	1.0	3.6	4.6	1.6	7.0	8.6	3.6	14.3	17.8
	Total of Item 3			**46.0**	**47.1**	**93.1**	**22.2**	**24.4**	**46.6**	**20.9**	**23.7**	**44.6**	**17.7**	**23.3**	**41.0**	**106.9**	**118.5**	**225.3**
	Total Direct Cost			**113.8**	**165.1**	**278.9**	**110.6**	**166.0**	**276.6**	**39.5**	**61.1**	**100.6**	**17.7**	**23.3**	**41.0**	**281.7**	**415.5**	**697.1**
4	**Indirect Cost**																	
4.1	Project Admnistration Cost		5%															34.9
4.2	Consultancy Cost		10%															69.7
4.3	Physical Contingency		2%															16.0
4.4	Tax (VAT)		16%															130.8
	Total of Indirect Cost			**41.0**	**59.5**	**100.5**	**39.9**	**59.9**	**99.8**	**14.3**	**22.0**	**36.3**	**6.4**	**8.4**	**14.8**	**101.6**	**149.8**	**251.4**
	Total Cost before Price Escalation			**154.8**	**224.6**	**379.4**	**150.5**	**225.9**	**376.4**	**53.8**	**83.1**	**136.9**	**24.1**	**31.7**	**55.8**	**383.3**	**565.3**	**948.5**
		price escaration %		22.1%	7.4%		55.1%	16.9%		91.1%	27.0%		149.2%	38.0%				
	Price Contingency			**34.2**	**16.6**	**50.8**	**82.9**	**38.2**	**121.1**	**49**	**22.4**	**71.4**	**36**	**12**	**48.0**	**202.1**	**89.2**	**291.3**
5	**Current Cost**			**189.0**	**241.2**	**430.2**	**233.4**	**264.1**	**497.5**	**102.8**	**105.5**	**208.3**	**60.1**	**43.7**	**103.8**	**585.4**	**654.5**	**1,239.8**

AB5.2.3 Sadar City

Water Demand

unit: m^3/d

Year	2015	2023	2028	2033	2038
Day Avegare demand	200		3,890		7,300
Day Maximum demand	230		4,500		8,400

1. Intake and Transmission

1.1 Tube Well

1) Water Source

seepage water of Rakh Branch Cana

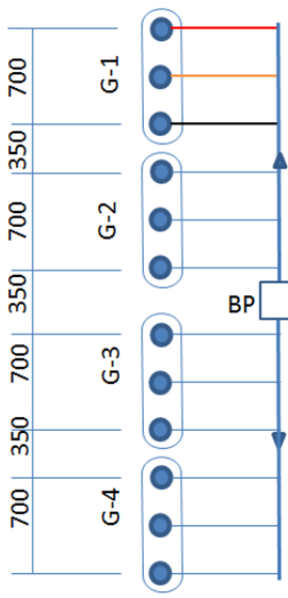
2) Exploitation of Well

rate		100 m^3/hr
operation		8 hrs/d
well capacity		800 m^3/d
spacing of well construction		350 m
number of wells	operation	11 wells

3) Well Operation

Wells are grouped into 5 groupes each having three tube wells. The operation of well is planned three shifts operation of each well group per day.

1.2 Well Pump and Delivery Header



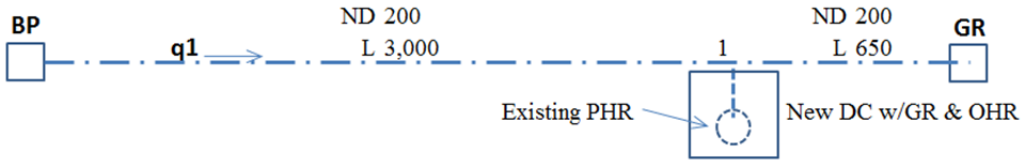
Well Pump Delivery Header

Section	Flow	Dia.	Length	velocity	h. gradient	head loss
	l/s	mm	m	m/s	‰	m
G1.1~G2.1	27.8	250	1,050	0.57	1.48	1.6
G2.1~BP	55.6	300	875	0.79	2.19	1.9
					Σhf1	3.5
					Σhf2	2.1
G3.3~BP	55.6	300	0	0.00	0.00	0.0
G4.3~G3.1	27.8	300	700	0.79	2.20	1.5
G4.3~G3.3	27.8	250	350	0.57	1.48	0.5

1.3 Tube Well Pump

Type of pump			Submersible well pump
Pump capacity			100 m^3/hr
			1.67 m^3/min
Number of well pumps			12 units
Pump head	dinamic growundwater level	-15	
	booster pump well water level (HWL)	1.5	
	static head		16.5
	head loss piping around pump	1.0	
	head loss of delivery header	3.5	
	head loss of pipelines		4.5
	loss at booster pump station incl. loss of flow control		3
	Total		24.0 m
		roundup	25 m
Dimensions of pump	$^{Q}1.67^{m3/min}$ x $^{H}25^{m}$ x 15^{kWH}		

1.4 Transmission Main



Sizing Analysis

Initial Phase (2019~2023)

Flow: Existing well pump:

Q = 3,000 m3/d

section	flow	dia.	length	velocity	h, gradient	head loss
	l/s	mm	m	m/s	‰	m
BP ~ 1	34.7	200 *1	3,000	1.11	6.63	19.9
1 ~ GR	17.4	150	650	1.97	7.46	4.9
	note *1: existing main is to be relaced					24.7

Stage 2 (2038)

Flow:

Q = 8,400 m3/d

section	flow	dia.	length	velocity	h, gradient	head loss
	l/s	mm	m	m/s	‰	m
BP ~ 1 (new GR)	97.2	300	3,000	1.38	6.18	18.5

note *2: additional main (300mm)

1.5 Booster Pump

Booster pump	Type of pumps		Horizontal Single Suction Centrifugal Pump		
	Number of units		working	3	nos.
			standby	1	no.
	Pump discharge			1.94	m3/min
	Pump head	Static head: WL of Ground Reservoir Zone-2	1.5		
		LWL of Pump suction well	-2.5	4.0	
		Piping around pumps		1.5	
		Trandmission main		18.5	
		residual head at GR incl. flow control loss		2.5	
		Total Head		26.5	m
			rounded	27	m
	Pump dimensions	$^{Q}2.0^{m3/min} \times {}^{H}27^{m} \times 15^{kWH}$			

1.6 Pump Suction Well and Pump cum Operation House

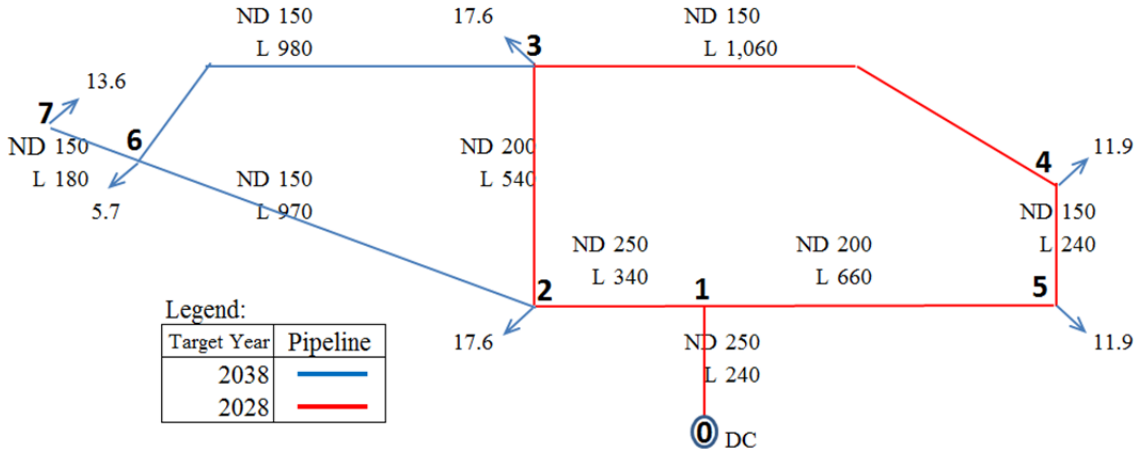
Suction Well	Transmission Flow	8,400 m^3/d =	0.097	m^3/s
	Detention time		1.0	hr
	Volume		350	m3
	Dimensions	$^{W}7.0^{m} \times {}^{L}7.0^{m} \times {}^{H}4.0^{m} \times {}^{N}2$		
Pump House cum Operation House	Dimensions	$^{W}6.0^{m} \times {}^{L}15.0^{m} \times {}^{H}6.0^{m}$ $(3.5^{m})^{*3}$		
		note ^{*3}: height of electric room (GL)		

2 Network Analysis of Distribution Primary Main

		Year	unit	Zone -1	Zone -2
Design Flow	Day Maximum Demand	2038	m^3/d	5,910	3,590
	Peak Houely Demand	2038	l/s	116.3	70.6

2.1 Supply Zone 1

Skelton of Network



Node Data

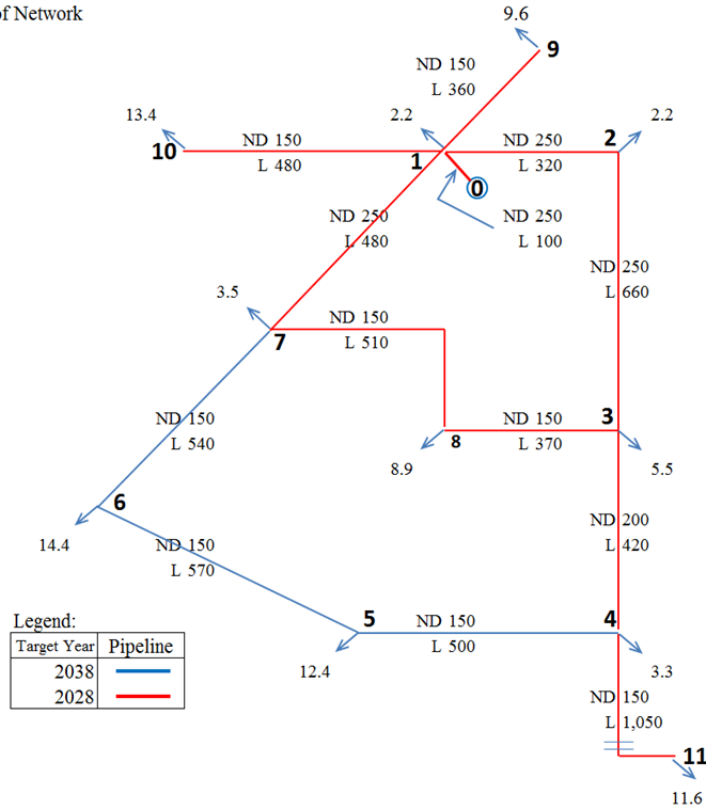
Node No.	Type	Discharge l/s	WL m	GL m	Eff. Head m
0		-78.30	214.00	189.00	25.00
1		0.0	213.01	189.00	22.29
2		17.6	212.48	189.00	20.41
3		17.6	206.63	189.00	18.40
4		11.9	206.68	189.00	18.52
5		11.9	205.79	189.00	18.66
6		5.7	208.61	189.00	16.52
7		13.6	211.06	189.00	16.55

Pipeline Data

Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H. gradient
Up-stream	Dn-stream	mm	m	Co-efficient	m	l/s	m/s	‰
0	1	250	240	120	2.71	78.30	1.596	11.52
1	2	250	340	120	1.89	53.30	1.086	5.65
2	3	200	540	120	2.01	24.09	0.767	3.85
3	4	150	1,060	120	-0.12	-1.20	-0.068	-0.06
4	5	150	240	120	-1.14	-13.10	-0.742	-5.05
5	1	200	660	120	-2.64	-25.00	-0.796	-4.12
2	6	150	970	120	3.88	11.61	0.657	4.04
6	3	150	980	120	-1.87	-7.69	-0.435	-1.88
6	7	150	180	120	0.98	13.60	0.770	5.42

2.2 Supply Zone 2

Skelton of Network



Node Data

Node No.	Type	Discharge	WL	GL	Eff. Head
		l/s	m	m	m
0		-87.00	214.00	189.00	25.00
1		2.2	212.60	189.00	23.60
2		2.2	211.86	189.00	22.86
3		5.5	210.51	189.00	21.51
4		3.3	208.79	189.00	19.79
5		12.4	207.25	189.00	17.25
6		14.4	207.37	189.00	18.37
7		3.5	211.68	189.00	22.68
8		8.9	210.51	189.00	21.51
9		9.6	211.58	189.00	22.58
10		13.4	210.07	189.00	21.07
11		11.6	204.55	189.00	15.55

Pipeline Data

Node Number		Dia.	Length	Friction	Head Loss	Flow	Velocity	H. gradient
Up-stream	Dn-stream	mm	m	Co-efficient	m	l/s	m/s	‰
0	1	250	100	120	1.40	87.00	1.77	14.00
1	2	250	320	120	0.74	32.84	0.67	2.30
2	3	250	660	120	1.34	30.64	0.62	2.03
3	4	200	420	120	1.72	24.90	0.79	4.09
4	5	150	500	120	1.53	10.00	0.57	3.07
5	6	150	570	120	-0.12	-2.40	-0.14	-0.22
6	7	150	510	120	-4.33	-16.80	-0.95	-8.01
7	1	250	480	120	-0.88	-28.96	-0.59	-1.83
7	8	150	510	120	1.20	8.66	0.49	2.35
8	3	150	370	120	-0.00	-0.24	-0.01	-0.00
1	9	150	360	120	1.02	9.60	0.54	2.84
1	10	150	480	120	2.53	13.40	0.76	5.27
4	11	150	1,050	120	4.24	11.60	0.66	4.04

3. Cost Estimate

3.1 Direct Cost

	Description	Q'ty	U. price '000Rs.	Cost mill Rs.	Note
1	Intake Wlll (Tube Well)				
1.1	Well and Rizing Main				
a.	Well Construction	14 nos.	4,024	56.3	incl. pump hpuse
b.	Well Pump Installation	14 units	2,104	29.5	incl. piping & electric panels
c.	Pump discharge header				
	ND250mm	700 m	13.1	9.2	
	ND300mm	1,050 m	15.7	16.5	
	ND350mm	1,050 m	18.3	19.2	
	ND400mm	1,800 m	22.6	40.7	
				85.6	
	subtotal			171.4	unit cost "12.24 milRs./well
1.2	Booster Pump Station				
a.	Pump Well	450 m^3	31	14.0	
b.	Pump House	74 m^2	100	7.4	
c.	Booster pump	15 kW	280	16.8	4 units
d.	Miscellaneous		10%	3.8	
	Subtotal			42.0	
1.3	Transmission Main				
a.	ND 400mm	3,700 m	22.6	83.6	BP ~ GR 2 (Z-3)
	ND 250mm	300 m	13.1	3.9	
	Subtotal			87.5	
b.	ND 300mm	630 m	15.7	9.9	GR 1 to OHR 2 (Z-2)
	Subtotal			97.4	
	Total of item 1			**310.8**	million Rs.
2	**Distribution Center**				
2.1	DC 1				
	GR 1	1,300 m3	30.0	40.0	in 2028 for 2038 demand
	OHR 1			-	use existing one
	Pump House	120 m2	100	12.0	
	Lift Pump	15 kW	280	16.8	4 units
	Rizing Pump (to OHR 2)	18.5 kW	280	20.7	4 units
	Lift pipe, etc.		10%	9	
	subtotal			98.5	
2.2	DC 2				
	GR			-	no GR
	OHR 2	300 m3	64.0	20.0	in 2028 for 2038 demand
	Pump House			-	no pump station
	subtotal			20.0	
2.3	DC 3				
	GR 2	600 m3	31.0	20.0	in 2028 for 2038 demand
	OHR 3	200 m3	66.0	13.2	
	Pump House	74 m2	100	7.4	
	Lift Pump	15 kW	280	16.8	4 units
	Lift pipe, etc.		10%	5.7	
	subtotal			63.1	
	Total of Item 2			**181.6**	million Rs.

3	**Distribution Pipelines and Service Connections**				
	Description	Q'ty	U. price '000Rs.	Cost mill Rs.	Note
3.1	Primary Main				
	in 2024~28 for demand 2033				
	ND250mm	2,250 m	13.1	29.5	
	ND200mm	1,700 m	5.7	9.7	
	ND150mm	4,990 m	3.8	19.0	
		8,940 m		58.2	
	in 2029~33 for demand 2038				
	ND250mm	0 m	13.1	0.0	
	ND200mm	0 m	5.7	0.0	
	ND150mm	3,930 m	3.8	14.9	
		3,930 m		14.9	
	subtotal	12,870 m		73.1	
3.2	Service Main				total up to 2038
	New Mains				
	ND 100mm		1.11		33%
	ND 80mm		2.05		67%
	Subtotal	21,720 m	1.74	37.8	
	Replacement				
	ND 100mm		1.11		33%
	ND 80mm		2.05		67%
	Subtotal	18,000 m	1.74	31.3	
	Total			69.1	
3.3	Service Connection				
	Domestic	5,140	10	51.4	15mm
	Non-domestic	176	20	3.5	25mm
	Total			54.9	
3.4	Water Meter				
a.	<u>On Existing Connection</u>				
	Domestic	775	5.28	4.1	
	Non-dom	1	10.56	0.0	
	Subtotal			4.1	
b.	<u>Routine replacement</u>				
	Domestic	4,450	2.57	11.4	
	Non-dom	145	5.14	0.7	
	Subtotal			12.1	
	Total			16.2	
3.5	Total of Item 3			**213.3**	million Rs.
	Direct Cost Total			**538.3**	million Rs.

3.2 Indirect Cost

Overhead and Management Cost	5%	26.9	
Consultancy Cost	10%	53.8	
Physical Contingency	2%	12.4	
Tax (VAD)	16%	101	
Indirect Cost Total		**194.1**	million Rs.

3.3 Total Project Cost (Base Cost in 2017)

732.4 million Rs.

3.4 Disbursement Schedule

	Description			2018~2023			2024~2028			2029~2033			2033~2038			Total		
				LC	FC	total	LC	FC	total	LC	FC	total	LC	FC	total	LC	FC	total
1	**Water Source Development**																	
1.1	Well/Pump Construction	Q'ty	unit			4			3			4						11
				40%	60%		40%	60%		40%	60%							
		Cost		9.8	14.7	24.5	7.4	11	18.4	9.8	14.7	24.5				27.0	40.4	67.4
1.2	Pump Discharge Header	Q'ty	ND x L(km)			300 x 1.05		300 x 0.7/250 x 0.35)				250 x 1.4)	50.4					
				35%	65%	16.5	35%	65%	15.6	35%	65%	18.3						50.4
		Cost		5.8	10.7	16.5	5.5	10.1	15.6	6.4	11.9	18.3				17.7	32.7	50.4
1.3	Booster Pump Station	Q'ty				80%			10%			10%						
				40%	60%		10%	90%		10%	90%							
		Cost		11.9	17.8	29.7	0.4	3.3	3.7	0.4	3.3	3.7				12.7	24.4	37.1
1.4	Transmission Main	Q'ty	ND x L (km)			300 x 3.0												
				35%	65%		35%	65%										
		Cost		16.5	30.6	47.1										16.5	30.6	47.1
	Total of Item 1			**44**	**73.8**	**117.8**	**13.3**	**24.4**	**37.7**	**16.6**	**29.9**	**46.5**	**0**	**0**	**0**	**73.9**	**128.1**	**202.0**
2	**Distribution Center**																	
2.1	DC 1	Q'ty	percent			95%			5%									5,910
		LC/FC		40%	60%	116.9	40%	60%	6.1	20%	80%							
		Cost		46.8	70.1	116.9	2.4	3.7	6.1	0	0					49.2	73.8	123.0
	Total of Item 2			**46.8**	**70.1**	**116.9**	**2.4**	**3.7**	**6.1**	**0.0**	**0.0**	**0.0**	**0**	**0**	**0**	**49.2**	**73.8**	**123.0**
3	Distribution Mains and Service Connection																	
3.1	Primary main (150~250)	Q'ty	km					ND250~150	8.9		ND200~150	3.9						
			LC/FC				50%	50%		50%	50%							
		Cost					29.1	29.1	58.2	7.4	7.5	14.9	0	0	0	36.5	36.6	73.1
3.2	Service Main (80 & 100)																	
a.	New main	Q'ty	km			0.7			2.6			10.2			8.2			21.70
			LC/FC	50%	50%		50%	50%		50%	50%		50%	50%				
		Cost		0.6	0.6	1.2	2.2	2.3	4.5	8.9	8.9	17.8	7.1	7.2	14.3	18.8	19	37.8
b.	Replacement of Exist. main (80 & 100)	Q'ty	km			4.5			4.5			4.5			4.5			18.00
			LC/FC	50%	50%		50%	50%		50%	50%		50%	50%				
		Cost		3.9	3.9	7.8	3.9	3.9	7.8	3.9	3.9	7.8	3.9	4.0	7.9	15.6	15.7	31.3
	(new and replaced)	Q'ty	km			0.00			0.00			0.00	3.9		0.00			0.00
			LC/FC	50%	50%		50%			50%	50%		50%	50%				
		Cost		4.5	4.5	9.0	6.1	6.2	12.3	12.8	12.8	25.6	11	11.2	22.2	34.4	34.7	69.1
3.3	Service Connection																	
a.	Domestic	Q'ty	units			960			920			1,820			1,440			5,140
			LC/FC	50%	50%		50%	50%		50%	50%		50%	50%				
		Cost		4.8	4.8	9.6	4.6	4.6	9.2	9.1	9.1	18.2	7.2	7.2	14.4	25.7	25.7	51.4
b.	Non-Dom	Q'ty	units			51			28			54			43			176
			LC/FC	50%	50%		50%	50%		50%	50%		50%	50%		50%	50%	
		Cost		0.5	0.5	1.0	0.3	0.3	0.6	0.5	0.6	1.1	0.4	0.4	0.8	1.7	1.8	3.5
		Q'ty	units			1,011			948			1,874			1,483			5,316
	(Domestic & Non-Dom)		LC/FC	50%	50%		50%	50%		50%	50%		50%	50%				
		Cost		5.3	5.3	10.6	4.9	4.9	9.8	9.6	9.7	19.3	7.6	7.6	15.2	27.4	27.5	54.9
3.4	Water Meter (replacement)																	
a.	Install on Existing Connections																	
	Domestic	Q'ty	units			385			390			0			0			775
			LC/FC	20%	80%		20%	80%		20%	20%	80%	20%	80%		20%	80%	
		Cost		0.4	1.6	2.0	0.4	1.7	2.1	0.0	0.0	0.00	0.0	0.0	0.00	0.8	3.3	4.1
	Non-Dom	Q'ty	units			1			0									8
			LC/FC	20%	80%		20%	80%										
		Cost		0.0	0.0	0	0.0	0.0	0	0	0	0	0	0	0	0	0	0.1
b.	Routine Replacement		LC/FC															
	Domestic	Q'ty	units						539			1,327			2,587			4,453
			LC/FC	20%	80%		20%	80%		20%	80%		20%	80%				
		Cost		0.0	0.0	0	0.3	1.1	1.4	0.7	2.7	3.4	1.3	5.3	6.6	2.3	9.1	11.4
	Non-Dom	Q'ty	units						22			41			82			145
			LC/FC				20%	80%		20%	80%		20%	80%				
		Cost				0.0	0.0	0.1	0.1	0.0	0.2	0.2	0.1	0.3	0.4	0.1	0.6	0.7
	(On exist. main & Routing replace)	Q'ty	units															
			LC/FC															
		Cost		0.4	1.6	2.0	0.7	2.9	3.6	0.7	2.9	3.6	1.4	5.6	7.0	3.2	13.0	16.2
	Total of Item 3			**10.2**	**11.4**	**21.6**	**40.8**	**43.1**	**83.9**	**30.5**	**32.9**	**63.4**	**20.0**	**24.4**	**44.4**	**101.5**	**111.8**	**213.3**
	Total Direct Cost			**101.0**	**155.3**	**256.3**	**56.5**	**71.2**	**127.7**	**47.1**	**62.8**	**109.9**	**20.0**	**24.4**	**44.4**	**224.6**	**313.7**	**538.3**
4	**Indirect Cost**																	
4.1	Project Admnistration Cost		5%															26.9
4.2	Consultancy Cost		10%															53.8
4.3	Physical Contingency		2%															12.4
4.4	Tax (VAT)		16%															101.0
	Total of Indirect Cost			**36.4**	**56**	**92.4**	**20.4**	**25.6**	**46.0**	**17.0**	**22.6**	**39.6**	**7.2**	**8.8**	**16.0**	**81.0**	**113.0**	**194.1**
	Total Cost before Price Escalation			**137.4**	**211.3**	**348.7**	**76.9**	**96.8**	**173.7**	**64.1**	**85.4**	**149.5**	**27.2**	**33.2**	**60.4**	**305.6**	**426.7**	**732.4**
		price escaration %		22.1%	7.4%		55.1%	16.9%		91.1%	27.0%		149.2%	38.0%				
	Price Contingency			**30.4**	**15.6**	**46.0**	**42.4**	**16.4**	**58.8**	**58.4**	**23.1**	**81.5**	**40.6**	**12.6**	**53.2**	**171.8**	**67.7**	**239.5**
5	**Current Cost**			**167.8**	**226.9**	**394.7**	**119.3**	**113.2**	**232.5**	**122.5**	**108.5**	**231.0**	**67.8**	**45.8**	**113.6**	**477.4**	**494.4**	**971.9**