Draft Report

Performance of Merado Suction Pumps in Danida assisted Integrated Rural Sanitation & Water Supply Project in coastal Tamil Nadu

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Performance of Merado Suction Pumps in coastal Tamil Nadu*

1. Background :

About 150 Merado Suction pumps were installed in the Danida assisted Integrated Rural Sanitation & Water Supply Project in the blocks of Portonovo and Marakkanam, of South Arcot and Villupuram districts of coastal Tamil Nadu during 1993-94.

The first batch of 50 of these pumps were installed under a special agreement between Tamil Nadu Water Supply & Drainage Board - TWAD Board and MERADO - Mechanical Engineering Research & Development Organisation, a research organisation of the Government of India. The agreement required MERADO to install the pumps on a turn-key basis, and maintain the pumps for a period of one year after installation.

The choice of Merado suction pumps was made on the basis of a number of considerations:

- In the coastal sandy tracts of Portonovo and Marakkanam blocks, fresh water occurs at shallow depths only, in the range of 4 m to 6 m below ground level, below which there is brackish or saline water. This situation is ideally suited for supporting low withdrawal rate of water, such as for domestic water needs, through suction pumps.

- The traditional groundwater exploitation technique for domestic water supply consisted of a hand-augured hole about 5 m deep, fitted with a brass filter, galvanised steel pipes and a "Kumar" cast iron suction pump. The Kumar pump is quite similar to the "No. 6" design, with similar maintenance problems mainly due to poor manufacturing standards. Hence, an alternative suction pump design was worth considering.

- During 1991-93, under assistance from UNICEF, TWAD Board had installed 130 Tara Direct Action pumps in Portonovo block. A number of these pumps showed operational problems since the depth of wells were shallow and the real advantage of buoyancy of pump rods of the Tara pump was not available. The operational problems were further aggravated by the field-level adjustments that had to be made to Tara below-ground components to install the pump cylinders in shallow wells.

- The Merado design had some significant strengths, especially in its valve configurations and pivot designs. It also used nitrile rubber cup washers, which have proven superior to leather cup washers in other pumps.

- The Merado suction pump design was under consideration for standardisation by the Bureau of Indian Standards.

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The following performance analysis of Merado Suction pumps is based on the monthly monitoring reports of maintenance needs of the 50 pumps, as documented by MERADO, Madras. The period of monitoring started during November 1993, when all the 50 pumps had been installed and continued till November 94.

2. Conclusions:

2.1 Overall Performance :

When the overall need for maintenance is analysed from Annexure 1, it emerges that the Average Nos. of Service per Pump per Year was 3.54 events of maintenance, i.e., one event every 3 to 4 months for every pump, for an average installed life of 1.3 years.

This is an extremely high maintenance need.

The information on Date of Service, presented in Annexures 1 and 2, is summarised in Fig. 1: Frequency of DoS.

It shows that all 50 pumps needed interventions, usually 2 to 4 times, through their average life of 1.3 years. Five pumps needed 1 intervention each; ten pumps needed 2 interventions each, thirteen pumps needed 3 interventions each and ten pumps needed 4 interventions each. One pump showed as high 10 instances of maintenance.

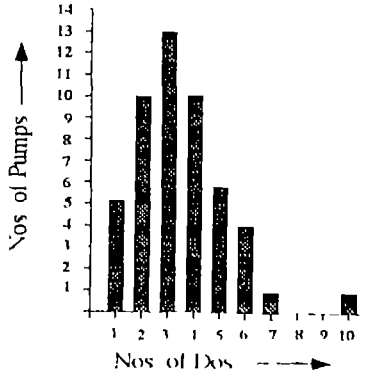

Fig. 1 : Frequency of Dates of Service

2.2 Performance of Components :

The records for replacement of components of the Merado pumps are listed in detail in Annexure 2 and the summarsied later in this report in Tables 4 and 5. The computations of performance indices, Intervention Index and Age Index, from Table 5 are discussed below in Tables 1 and 2.

Table 1 represents the computations of Intervention Index and Age Index that show favourable performance, i.e., with Intervention Index< 25% and Age Index > 50%.

The setting of the Intervention Index< 25% as an acceptable limit for favourable performance for a particular component, implies that less than 25% of the pumps needed replacement of that component during the monitoring period.

Similarly, the setting of the Age Index> 25% as an acceptable limit for favourable performance for a particular component, implies that replacement of that component was required after 50% of the average pump life was over.

The limits of Intervention Index< 25% and Age Index> 25% as indicators of favourable performance may be open to discussion, but they have been chosen

with a view to establish a quantitative definition of "good" performance as against "poor" or "bad" performance of a component.

Table 1 : Component with Intervention Index < 25% & Age Index > 50%

Component No.	Description	Numbers of Pumps	Events	Avg. Age	Interven. Index	Age Index
4	Upper Flange	2	4	254	8%	54%
5	Pump Body		-			
6	Base		-			
7	Bush		-			
8	Pin (Bush Bearing)	9	11	278	22%	59%
9	Ball Bearing	1	1	376	2%	80%
10	Pin (Ball Bearing)	8	10	268	20%	57%
13	Plunger Plate	2	2	259	4%	55%
15	Plunger Follower Plate	6	6	268	12%	57%
16	M10 x 1.5 mm Washer	2	2	259	4%	55%
17	Split Pin (2.5 ø x 25 mm)	2	2	259	4%	55%
18	Check Valve	2	2	256	4%	54%
20	Flap (Silicon)	11	12	343	24%	73%
22	M10 x 50 mm bolts	7	8	290	16%	61%

From Table 1, it is seen that the Merado design showed good performance of its some of its Valve (Plunger plate, Follower plate, Check valve, Flap), Pivot (Bush, Ball bearing, Pins) and Flange (Upper flange, Base) components.

Table 2 : Components with Intervention Index ≥25% & Age Index ≤50%

Component No	Description	Numbers of Pumps	Events	Avg. Age	Interven. Index	Age Index
1	Rod End	1	1	226	2%	48%
2	Handle	14	19	227	38%	48%
3	Cover	3	5	220	10%	47%
11	Plunger Rod	1	1	226	2%	48%
12	Flap (Silicon)	3	8	206	16%	44%
14	Cup Washer (Nitrile)	49	130	144	260%	31%
19	Rubber Ring (Nitrile)	13	19	241	38%	51%
21	M10 x 40 mm bolts	22	30	283	60%	60%
23	M10 x 1.5 mm nuts	22	33	267	66%	57%
24	M10 x 1.5 mm Pl. Cas'l nut	2	2	190	4%	40%
25	M12 x 1.5 mm Pl. Ch nut	9	10	168	20%	36%
26	M10 x 2 mm thick Washers	22	34	270	68%	57%

Components with Intervention Index ≥ 25 % or Age Index ≤ 50%

Components with Intervention Index ≥ 25 % and Age Index ≤ 50%

From Table 2 , it is seen that the Merado design showed poor performance(index values beyond acceptable limits, on either Intervention Index or Age Index) of its Plunger Rod components (Rod end, Rod, Cover), of the Plunger Flap valve, and its fastenings (various nuts, bolts, washers).

More significantly, on two very critical components, Handle and Cup Washers, the Merado pump shows "bad" performance, i.e., unacceptable index values on both Intervention Index and Age Index.

Based on the above, it is concluded that the Merado Suction Pump design does not provided a viable alternative design for application in the coastal blocks of the IRS & WS Project area in Tamil Nadu.

3. Basic Records :

Identity of a Pump : Every pump installed was identified by a description of its geographical location in a village or habitation.

Date of Installation (DoI) & Date of Closure (DoC) : DoI provided starting point of a pump's chronological performance record. For the purpose of analysis, a closing date of 31st. December 94 was set as the Date of Closure (DoC), after which date no further data was considered for analysis.

Age of Pumps - AgD & AgY: The calculation of age of a pump was done in days, AgD and in years, AgY, as the difference between the DoC and each pump's DoI.

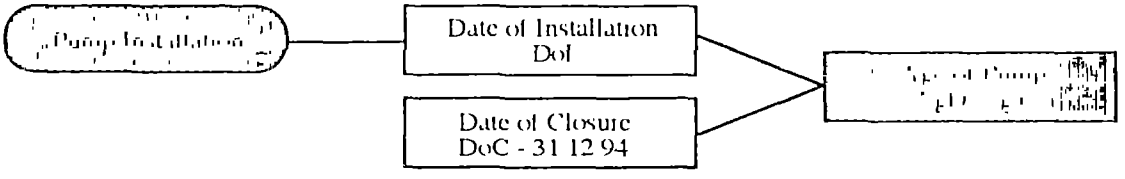

Fig. 2 : Pump Age Computation

Following the above procedure, the details of DoI and AgD for each pump are presented in Annexure 1. The information in Annexure 1 is summarised below Table 3.

Table 3 : Basic Information on Merado Pumps

Number of Pumps monitored	50
Average Age of pumps by 31st. Dec. 94	472 days, 1.3 years
Age of Oldest pump by 31st. Dec. 94	553 days, 1.5 years
Age of Most Recent pump by 31st. Dec. 94	338 days, 0.9 years

4. Maintenance Data - Definition of Terms :

Pump Component : The nature of a maintenance intervention was described by specifying the Component which was replaced. Fig. 3 shows the Components of the pump.

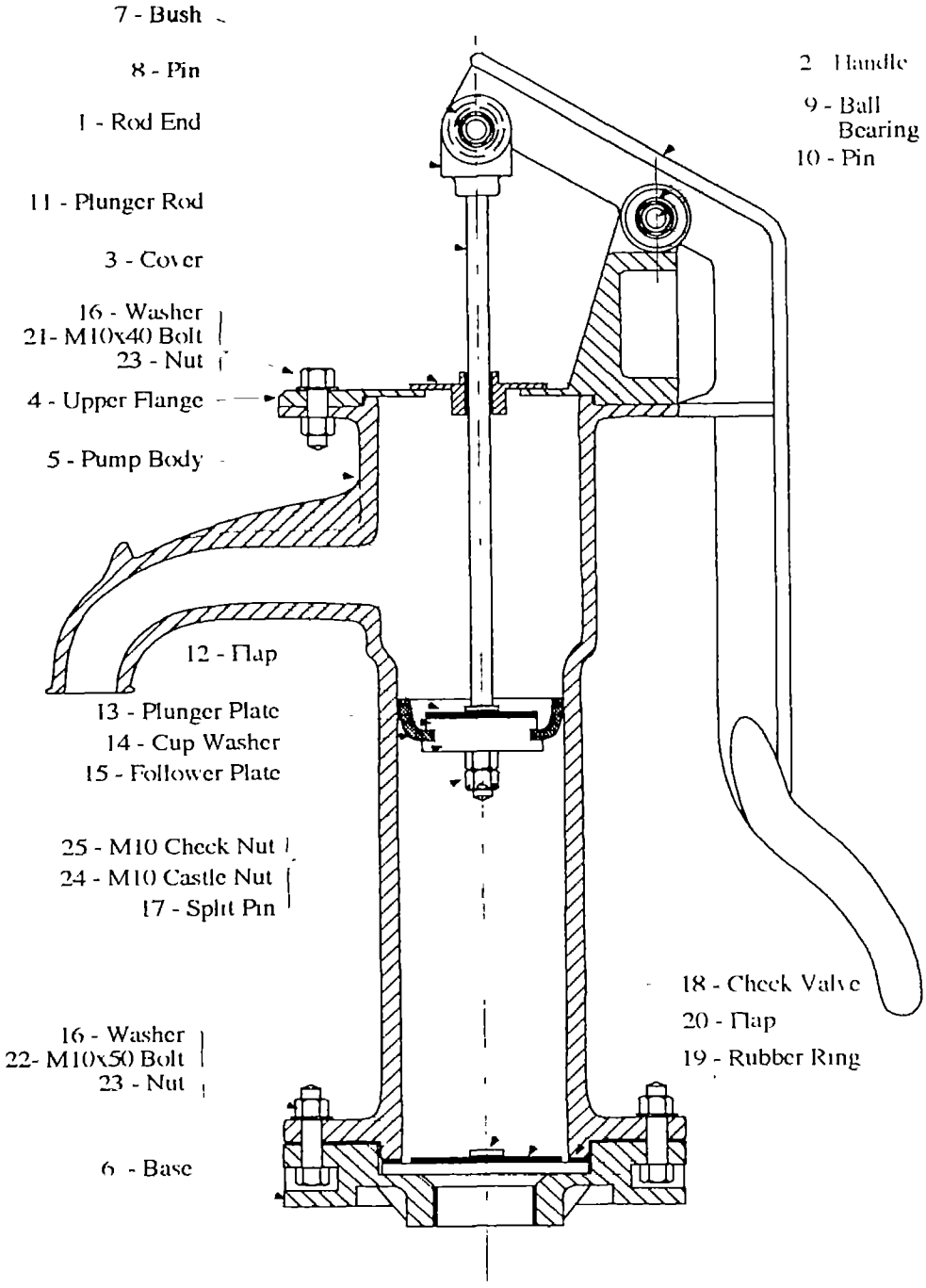

Fig. 3 : Components of the Merado Suction Pump

Maintenance Intervention : An Intervention to a pump was the event of a Components needing replacement or repair.

Date of Service (DoS) : DoS was the date on which a pump underwent a maintenance intervention. Since a pump could need repeated maintenance, a pump would have only one DoI, but could have more than one DoI.

Age of Intervention (AgI) : This was an age calculation, in days, for each Intervention. Since each Intervention had its DoS, the basic computation was similar to the computation of Age of Service, i.e., AgI = DoS-DoI.

However, AgI computations needed corrections for multiple Interventions of a particular type (i.e. the same pump needing the same Component replacement) occurring on different DoSs. After the first AgI computation (= DoS-DoI), subsequent AgIs were calculated as the difference between consecutive DoSs for the same pump.

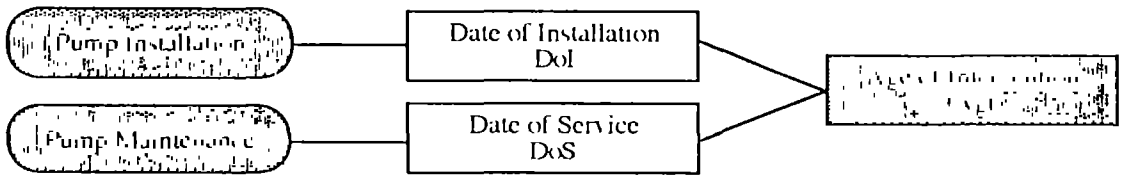

Fig. 4 : Date of Service & Age of Intervention

Maintenance Indices : The analysis of data on interventions have been expressed in terms of two indices - **Intervention Index** and **Age Index.**

Intervention Index for a component was the total number of interventions recorded for that component over all the pumps, expressed as a percentage of the total number of pumps. A low Intervention Index represented a low percentage of pumps needing maintenance, and hence, was a desirable attribute.

Age Index was the average age of each type of intervention expressed as a percentage of the average age of all the pumps by 31st. December, 94. A high Age Index indicated a relatively longer life of the component and hence was a favourable indicator.

5. Results of Data Analysis :

Monthly reports, from the service schedule established by MERADO, Madras, provided a record of maintenance needs of each pump. Chronological pump histories compiled from these reports are presented in Annexure 2.

5.1 Occurrence of Interventions :

The data on Interventions to each Component, from Annexure 2, was processed for AgI computations and occurrences of multiple interventions. This information is presented in Table 4.

Table 4 : Types, Numbers, Average Ages and Repetitions of Interventions

Component		Numbers of		Avg.	Repetitions of Interventations to Nos. of Pumps							
No.	Description	Pumps	Interven.	AgI	Single	Double	3 times	4 times	5 times	6 times	7 times	8 times
1	Rod End	1	1	226	1							
2	Handle	14	19	227	10	3	1					
3	Cover	3	5	220	2		1					
4	Upper Flange	2	4	254	1		1					
5	Pump Body		-									
6	Base		-									
7	Bush		-									
8	Pin (Bush Bearing)	9	11	278	7	2						
9	Ball Bearing	1	1	376	1							
10	Pin (Ball Bearing)	8	10	268	6	2						
11	Plunger Rod	1	1	226	1							
12	Flap (Silicon)	3	8	206		2		1				
13	Plunger Plate	2	2	259	2							
14	Cup Washer (Nitrile)	49	130	144	10	15	13	7	3			1
15	Plunger Follower Plate	6	6	268	6							
16	M10 x 1.5 mm Washer	2	2	259								
17	Split Pin (2.5 ø x 25 mm)	2	2	259								
18	Check Valve	2	2	256								
19	Rubber Ring (Nitrile)	13	19	241	10	2			1			
20	Flap (Silicon)	11	12	343	10	1						
21	M10 x 40 mm bolts	22	30	283	14	4	3		1			
22	M10 x 50 mm bolts	7	8	290	6	1						
23	M10 x 1.5 mm nuts	22	33	267	16	3	2		1			
24	M10 x 1.5 mm Pl. Castle nut	2	2	190	2							
25	M12 x 1.5 mm Pl. Check nut	9	10	168	8	1						
26	M10 x 2 mm thick Washers	22	34	270	16	3	2			1		

5.2 Maintenance Indicies :

In Table 5, the data of Table 4 has been converted to relative terms of the two maintenance indices - **Intervention Index and Age Index.**

Table 5 : Intervention Index & Age Index Computations

Component No	Description	Numbers of Pumps	Events	Avg. Age	Interven Index	Age Index
1	Rod End	1	1	226	2%	48%
2	Handle	14	19	227	38%	48%
3	Cover	3	5	220	10%	47%
4	Upper Flange	2	4	254	8%	54%
5	Pump Body		-			
6	Base		-			
7	Bush		-			
8	Pin (Bush Bearing)	9	11	278	22%	59%
9	Ball Bearing	1	1	376	2%	80%
10	Pin (Ball Bearing)	8	10	268	20%	57%
11	Plunger Rod	1	1	226	2%	48%
12	Flap (Silicon)	3	8	206	16%	44%
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14	Cup Washer (Nitrile)	49	130	144	260%	31%
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17	Split Pin (2.5 ø x 25 mm)	2	2	259	4%	55%
18	Check Valve	2	2	256	4%	54%
19	Rubber Ring (Nitrile)	13	19	241	38%	51%
20	Flap (Silicon)	11	12	343	24%	73%
21	M10 x 40 mm bolts	22	30	283	60%	60%
22	M10 x 50 mm bolts	7	8	290	16%	61%
23	M10 x 1.5 mm nuts	22	33	267	66%	57%
24	M10 x 1.5 mm Pl. Castle nut		2	190	4%	40%
25	M12 x 1.5 mm Pl. Check nut	9	10	168	20%	36%
26	M10 x 2 mm thick Washers	22	34	270	68%	57%

The conclusions drawn from the above tables have been discussed earlier.

Annexure I : Locations of Merado Suction Pumps, Ages & Numbers of Interventions

Sl. No.	Merado Ref. No	Site/ Description	Date of Install-ation	AgD by 31.12.94	Nos. of Interventions by 31.12 94	Remarks
1	D-1	Ambuputtiya Palayam	15/11/93	411	4	
2	D-1	Anayankuppam	22/08/93	496	4	
3	D-1	Athimedu	13/08/93	505	2	
4	D-2	Athimedu	18/08/93	500	2	
5	D-1	Chakkaravalli Mandapam	15/11/93	411	3	
6	D-2	Chakkaravalli Mandapam	15/11/93	411	1	
7	D-1	Chidambaranadhan Pettai	24/11/93	402	6	
8	D-2	Chidambaranadhan Pettai	25/11/93	401	3	
9	D-1	Chinnakaramedu	27/08/93	491	3	
10	D-1	Chinnur Pudupettai - Shanmugam Nagar	22/08/93	496	4	
11	D-1	Gopalapuram	15/11/93	411	2	
12	D-1	Kaduvetti (Near IM2)	27/08/93	491	1	
13	D-2	Kaduvetti (Near IM2)	04/07/93	545	4	
14	D-1	Kamakkarapattu School	15/11/93	411	1	
15	D-1	Karikuppam Thoppu Iruppu	15/11/93	411	3	
16	D-1	Karikuppam-I	15/11/93	411	3	
17	D-1	Keela Thirukalai Palai (Near Pond)	03/07/93	546	2	
18	D-2	Keela Thirukalai Palai (Near Pond)	03/07/93	546	3	
19	D-1	Kothattai	15/11/93	411	2	
20	D-2	Kothattai	15/11/93	411	2	
21	D-1	Kuthan Palayam	20/08/93	498	5	
22	D-2	Kuthan Palayam	24/08/93	494	5	
23	D-1	Manikollai	05/11/93	421	5	
24	D-2	Manikollai (Near Bhai House)	06/11/93	420	3	
25	D-1	Meethikudi	26/06/93	553	7	Max Age
26	D-2	Meethikudi	26/06/93	553	5	Max. Age
27	D-3	Meethikudi	26/06/93	553	4	Max. Age
28	D-1	Melathirukalai Palai	30/06/93	549	2	
29	D-2	Melathirukalai Palai	11/07/93	538	5	
30	D-3	Melathirukalai Palai	02/07/93	547	4	
31	D-1	MGR Nagar	15/11/93	411	3	
32	D-1	Nanjamugathu Vazhkhai	27/01/94	338	10	Min. Age
33	D-1	Natarajapuram	25/08/93	493	3	
34	D-1	Natarajapuram(H) Vasaputhur	25/08/93	493	4	
35	D-2	Natarajapuram(H) Vasaputhur	25/08/93	493	4	
36	D-1	Nolandikuppam	23/08/93	495	6	
37	D-1	Pitchavaram	26/08/93	492	6	
38	D-3	Pitchavaram	26/08/93	492	4	
39	D-1	Puduchattiram Rly Stn.	05/07/93	544	6	
40	D-2	Puduchattiram Rly. Stn. (H)	10/07/93	539	3	
41	D-1	Sendrakillai	15/11/93	411	4	
42	D-1	Sillankuppam	19/08/93	499	2	
43	D-1	South Pitchavaram School	21/11/93	405	1	
44	D-1	Thatchakadu	23/08/93	495	5	
45	D-1	Thatchampalayam	15/11/93	411	3	
46	D-1	Vasaputhur	24/08/93	494	4	
47	D-4	Vasaputhur	26/08/93	492	2	
48	D-1	Velangipattu-I	15/11/93	411	3	
49	D-2	Velangipattu-II	15/11/93	411	3	
50	D-1	Velangirayan Pettai	04/07/93	545	1	
		Averages		472	3.54	

Annexure 2 : Pump Maintenance Histories

Sl. No.	Mer. Ref.	Site	Nos. Users	DoI	DoS	Component Number (Ref. Fig. 2)																						Remarks
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
1	D-1	Ambuputtiya Palayam	350	15/11/93	08/07/94														1												
					28/09/94		1												1												
					25/10/94								1		1															
					29/11/94														1												
2	D-1	Anayankuppam	300	22/08/93	12/05/94														1												
					04/07/94														1												
					31/08/94														1												
					18/10/94														1												Platform grouting shaking
3	D-1	Athimedu	300	13/08/93	16/06/94														1												Platform rectified in 93
					11/07/94														1												
4	D-2	Athimedu	20	18/08/93	30/08/94														1												
					22/09/94														1												Slightly saline
5	D-1	Chakkaravalli Mandapam	250	15/11/93	05/07/94		1																								
					31/08/94														1												Platform raised to road level
					08/10/94														1												
6	D-2	-do-	350	15/11/93	31/08/94														1												Platform filled with sand
7	D-1	Chidambaranadhan Pettai	250	24/11/93	12/12/93																										Platform rectified
					30/04/94														1										1		
					23/06/94														1												
					27/08/94														1												
					17/09/94														1							1		1		1	
					07/10/94														1												Slightly saline
8	D-2	Chidambaranadhan Pettai	175	25/11/93	12/12/93																										Platform rectified
					27/08/94														1												
					01/09/94														1	1											
9	D-1	Chinnakaramedu	300	27/08/93	02/07/94								1		1		1		1												
					06/09/94														1												
					06/12/94		1						1		1				1												

Annexure 2 : Pump Maintenance Histories

Sl. No	Mer Ref.	Site	Nos. Users	DoI	DoS	Component Number (Ref. Fig 2)																						Remarks
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
10	D-1	Chinnur Pudupettai Shanmugam Nagar	300	22/08/93	17/06/94												1														
					12/07/94														1												
					20/09/94														1												
					22/12/94														1						1	1		1			1	
11	D-1	Gopalapuram	500	15/11/93	05/05/94														1												
					30/08/94														1							1	1	1			1	
12	D-1	Kaduvetti (Near IM2)	250	27/08/93	28/01/94																										Pump missing
13	D-2	Kaduvetti (Near IM2)	400	04/07/93	06/02/94														1	1						1		1			1	
					19/04/94														1							1		1		1	1	6" Nipple
					02/07/94														1						1		1	1			1	
					13/10/94														1												
14	D-1	Kamakkarapattu School	300	15/11/93	28/05/94																										Pump missing
15	D-1	Karikuppam Thoppu Iruppu	325	15/11/93	12/07/94														1												
					01/08/94								1		1				1												
					26/10/94														1												
16	D-1	Karikuppam-I	400	15/11/93	17/06/94																										Platform slightly damaged
					13/10/94														1												
					23/11/94														1												
17	D-1	Keela Thirukalai Palai (Near Pond)	525	03/07/93	12/01/94														1				1		1		1	1			1	
					02/07/94																										Casing filled. Pump removed
18	D-2	Keela Thirukalai Palai (Near Pond)	400	03/07/93	12/01/94														1							1		1			1	
					21/06/94												1		1							1		1			1	
					05/12/94				1																	1		1			1	
19	D-1	Kothattai	600	15/11/93	23/09/94														1												
					25/11/94														1												
20	D-2	Kothattai	500	15/11/93	30/08/94																										Pipe Nipple replaced
					19/10/94														1												

Annexure 2 : Pump Maintenance Histories

Sl. No.	Mer. Ref.	Site	Nos. Users	DoI	DoS	Component Number (Ref. Fig. 2)																						Remarks
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
21	D-1	Kuthan Palayam	350	20/08/93	23/03/94														1												
					04/07/94		1																								
					31/08/94								1	1																	
					23/09/94		1																			1		1		1	
					08/11/94																					1		1		1	
22	D-2	Kuthan Palayam	500	24/08/93	05/02/94														1												
					12/05/94																									1	
					04/07/94		1	1											1												
					31/08/94														1												
					17/10/94																					1		1		1	
23	D-1	Manikollai	800	05/11/93	03/02/94																									1	
					31/05/94														1												
					09/07/94														1												
					19/09/94														1												
					28/11/94														1												
24	D-2	Manikollai (Near Bhai House)	150	06/11/93	31/05/94														1												
					29/08/94														1												
					24/10/94			1																							
25	D-1	Meethikudi	200	26/06/93	12/12/93																										Platform rectified
					29/01/94														1												
					07/02/94											1	1	1	1	1	1	1									
					15/03/94																									1	
					30/04/94														1												
					02/08/94														1												
					17/09/94																			1							

Annexure 2 : Pump Maintenance Histories

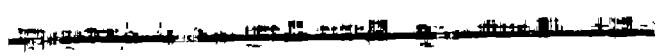
Sl No.	Mer. Ref.	Site	Nos Users	DoI	DoS	Component Number (Ref. Fig. 2)																						Remarks
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
26	D-2	Meethikudi	200	26/06/93	29/01/94																									Platform rectified
					29/01/94														1											
					23/06/94														1											
					05/07/94		1						1		1															
					05/11/94														1											
27	D-3	Meethikudi	200	26/06/93	14/04/94												1	1	1	1	1	1			1		1		1	
					23/06/94		1										1		1											
					17/09/94																			1						
					01/12/94														1											
28	D-1	Melathirukalai Palai	650	30/06/93	07/02/94														1	1					1		1		1	1
					08/10/94								1		1									1		1				1	Platform damaged
29	D-2	Melathirukalai Palai	300	11/07/93	30/01/94																									6" Nipple
					07/02/94		1												1					1		1		1	1	
					20/06/94		1																							
					01/07/94														1											
					19/10/94														1											
30	D-3	Melathirukalai Palai	300	02/07/93	30/01/94																									6" Nipple
					10/05/94														1											
					01/07/94														1											
					08/10/94														1											Drain damaged
31	D-1	MGR Nagar	300	15/11/93	03/02/94																			1						
					04/07/94														1											
					23/09/94														1											

Annexure 2 : Pump Maintenance Histories

Sl No.	Mer. Ref	Site	Nos. Users	DoI	DoS	Component Number (Ref. Fig. 2)																						Remarks
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
32	D-1	Nanja Mugathu Vazhkhai	4000	27/01/94	06/12/93														1												
					12/12/93		1										1							1			1			1	1	
					02/02/94																								1		
					21/02/94														1										1		
					04/05/94		1										1		1							1		1			1	
					08/07/94		1						1		1				1					1		1		1			1	
					24/09/94														1						1	1	1	1			1	
					15/10/94														1							1		1			1	
					19/11/94														1												
					29/11/94														1						1	1		1			1	
33	D-1	Natarajapuram	300	25/08/93	24/06/94		1																								
					06/08/94																				1						
					02/09/94		1												1	1						1		1			1	
34	D-1	Natarajapuram (H) Vasaputhur	150	25/08/93	24/06/94		1												1												
					15/08/94																				1						
					02/09/94														1					1		1		1			1	
					11/11/94																										Pump N/W, choked with sand
35	D-2	Natarajapuram (H) Vasaputhur	400	25/08/93	09/02/94														1												
					06/07/94														1												
					02/09/94														1					1		1		1			1	6" pipe nipple,
					02/12/94														1												Check valve removed
36	D-1	Nolandikuppam	300	23/08/93	02/06/94														1												
					07/07/94														1												
					29/08/94														1												Base loose, tightened
					07/09/94																		1	1						
					21/11/94														1												
					30/11/94														1					1		1		1			1	

Annexure 2 : Pump Maintenance Histories

Sl. No.	Mer. Ref.	Site	Nos. Users	DoI	DoS	Component Number (Ref. Fig. 2) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26	Remarks
37	D-1	Pitchavaram	300	26/08/93	09/02/94	25:1	
					08/06/94	14:1	
					13/07/94	3:1	
					02/09/94	3:1	Broken
					27/10/94	14:1 19:1 21:1 23:1 25:1	
					01/11/94	3:1	
38	D-3	Pitchavaram	400	26/08/93	06/07/94	14:1	6" Nipple
					02/09/94	14:1	
					27/10/94	14:1 19:1 21:1 23:1 25:1	
					01/11/94	14:1	
39	D-1	Puduchatturam Rly Stn	300	05/07/93	08/06/94	14:1	
					11/07/94	14:1 20:1	
					30/08/94	4:1	Reconditoned
					20/09/94	14:1	
					15/10/94	4:1	
					04/12/94	4:1 14:1 21:1 23:1 25:1	
40	D-2	Puduchatturam Rly. Stn. (H)	275	10/07/93	01/02/94	14:1	
					30/08/94	14:1	
					15/11/94	14:1	
41	D-1	Sendrakillai	300	15/11/93	03/02/94	19:1	
					29/08/94	14:1 19:2	Replaced 6" Nipple
					15/09/94	19:1	
					28/11/94	14:1 19:1 21:1 23:1	
42	D-1	Sillankuppam	525	19/08/93	05/02/94	21:1 23:1 25:1	
					31/08/94	14:1	Platform grouting shaking
43	D-1	S. Pitchavaram School	350	21/11.93	23/09/94	14:1	



Annexure 2 : Pump Maintenance Histories

Sl. No.	Mer. Ref	Site	Nos Users	DoI	DoS	Component Number (Ref. Fig 2)																						Remarks
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
44	D-1	Thatchakadu	30[illegible]	23/08/93	08/02/94		1												1												
					02/06/94														1												
					07/07/94														1				1	1							Check valve ring
					07/09/94														1												6" Pipe Nipple replaced
					10/10/94														1												
45	D-1	Thatchampalayam	1000	15/11/93	09/02/94														1												
					30/08/94														1												
					16/10/94														1												
46	D-1	Vasaputhur	275	24/08/93	28/01/94														1												
					24/06/94		1						1		1				1												
					11/10/94								1		1				1							1	1	1			1	
					01/12/94														1						1	1		1			1	Platform damaged
47	D-4	Vasaputhur	300	26/08/93	24/06/94														1												
					05/12/94														1						1						Yellowish water
48	D-1	Velangipattu-I	300	15/11/93	09/07/94														1												
					09/10/94														1												
					28/11/94														1												
49	D-2	Velangipattu-II	600	15/11/93	31/05/94		1						1		1																
					18/11/94														1												
					29/11/94														1						1		1		1		1	
50	D-1	Velangirayan Pettai	350	04/07/93	14/10/94														1												