## APPENDIX 13.4

## RECOMMENDED MINIMUM OPERATION AND MAINTENANCE STAFF PATTERN SURFACE SOURCE: TYPICAL STAFF PATTERN (FOR 50 TO 75 MLD SYSTEM) WITH CONVENTIONAL TREATMENTS

| System component as per flow line | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| | | Pump house | Raw water rising main | Treatment works and clear water pump | Clear water rising main | Service reservoir | Gravity main | Distribution system |
| Sl. No. | Category of staff | | | | | | | |
| 1 | Superintendent Manager (A.E.E) | - | - | 1 | - | - | - | - |
| 2 | Supervisor/ Asstt Manager(A.E) | - | - | 1 | - | - | - | - |
| 3 | Assistant Supervisor/Junior Manager. | - | - | 1 | - | - | - | - |
| 4 | Operators | 7 | - | 7 | - | - | - | - |

| System component as per flow line | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| | | Pump house | Raw water rising main | Treatment works and clear water pump | Clear water rising main | Service reservoir | Gravity main | Distribu-tion system |
| 5 | Helpers/ Fitters | 6 | 1* (for every 8Km.) | 6+2(Lab.) | 1* (for every 8 Km.) | - | - | Fitter –1<br>Helper –2<br>(for every 10-15 Km.) |
| 6 | Electrician/ Mechanic | - | - | 3<br>Electrician –1<br>Mechanic –2 | | - | - | - |
| 7 | Watchman | 1 | - | 3 | 1 | 1 | - | - |

Note : 1. The above staffing pattern does not include personnel for billing, collection and accounting for water charges.

2. Above staffing pattern includes the operating staff required for one off-day in a week for staff. Suitable adjustments may have to be made between personnel in pump House and Treatment works.

3. From among three categories of personnel indicated at S1.1, 2, & 3 at least one should be from the Electrical & Mechanical Engg. disciplines.

4. *In case the total length of the pipe line has been less than 8 Km. Under 2 and 4 one Helper/Fitter would be adequate.

## APPENDIX 13.5

## RECOMMENDED MINIMUM OPERATION AND MAINTENANCE STAFF

## PATTERN ABOVE 75 MLD UPTO 150 MLD

| System component as per flow line | | 1 Intake works | 2 Raw water Pump House | 3 Raw water rising main or Gravity main | 4 Treatment works and clear water pump House | 5 Clear water rising main | 6 Clear water reservoir | 7 Gravity main | 8 Distribution system |
|---|---|---|---|---|---|---|---|---|---|
| Sl. No. | Category of staff | | | | | | | | |
| 1 | Superintendent Manager<br>Dy. Exe. Engr. | - | - | - | 1 | - | - | - | - |
| 2 | Supervisor/ Asstt Manager(A.E.E) | 1 | - | 1 | 4 | 1 | 1 | 1 | - |
| 3 | Assistant Supervisor/Junior Manager. | - | - | - | 4 | - | - | - | - |
| 4 | Operators | - | 4 | - | 12+4 | - | - | - | - |

| System component as per flow line | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| | | Intake works | Raw water Pump House | Raw water rising main or Gravity main | Treatment works and clear water pump House | Clear water rising main | Clear water reservoir | Gravity main | Distribution system |
| 5 | Helpers/Fitters | - | 4 | 2 | 16 ( for every 6 Km) | 2 (for every 6 kms) | 4 | 2 ( for every 6 kms) | Fitter –1 Helper –2 (for every 10-16 Km.) |
| 6 | Electrician | - | 1 | - | 4 | - | - | - | - |
| 7 | Mechanic | - | 1 | - | 1 | - | - | - | - |
| 8 | Electrical Helper | - | 4 | - | 4 | - | 1 | - | - |
| 9 | Watchman | - | 4 | - | 4 | - | 4 | - | - |

Note : 1. The above staffing pattern does not include personnel for billing, collection and accounting for water charges.

2. Above staffing pattern includes the operating staff required for one off-day in a week for staff. Suitable adjustments may have to be made between personnel in pump House and Treatment works.

3. From among three categories of personnel indicated at Sl 1, 2, & 3 at least one should be from the Electrical & Mechanical Engg. disciplines.

4. In case the total length of the pipe line has been less than 6 Km. Under 5 one Helper/Fitter would be adequate.

5. Separate staff may be provided for sub-stations(on the pattern of respective Electricity Boards) if there are owned and maintained by the waterworks authority.

## APPENDIX 13.6

## RECOMMENDED MINIMUM STAFFING PATTERN FOR OPERATION AND MAINTENANCE

## SOURCE : BATTERY OF BOREWELLS/TUBEWELLS, OPENWELLS

## (EACH WELL YIELDS 5000 GPH MAXIMUM)

| System component as per flow line | | 1 | | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| | | Water Works | | Pump House | Rising main | Service reservoir | Gravity main | Distribution system |
| | | Less than 10 wells | 10 wells & above | | | | | |
| Sl. No. | Category of staff | | | | | | | |
| 1 | Supervisor | - | 1 | - | - | - | - | - |
| 2 | Asst. Supervisor | 1 | 1 for every additional 10 wells | - | - | - | - | - |
| 3 | Operators | - | - | 1 for every 5 wells/shift | - | - | - | - |

| System component as per flow line | | 1 | | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| | | Water Works | | Pump House | Rising main | Service reservoir | Gravity main | Distribut-ion system |
| | | Less than 10 wells | 10 wells & above | | | | | |
| 4 | Helpers Fitters | - | - | 1(for every 5 wells/shift) | 1* ( for every 8 Km.) | - | 1* ( for every 8 Km.) | 3 nos. Fitter –1 Helper –2 (for every 10-15 Km.) |
| 5 | Electrician/ Mechanic | - | - | 1 | - | - | - | - |
| 6 | Chowkidar/ Watchman | - | - | 3 | - | 1 | - | - |
| 7 | Chemist | 1 | 1 | - | - | - | - | - |
| 8 | Lab. Assistant | 1 | 1 | - | - | - | - | - |

Note : 1. The above staffing pattern does not include personnel for billing, collection and accounting for water charges.

2. Suitable additional operating staff to be included for one off-day/week for staff.

3. *In case the total length of the pipe line is less than 8 Km. Under 3 and 5 one helper/Fitter would be adequate.

## APPENDIX 13.7

## RECOMMENDED MINIMUM STAFFING PATTERN FOR OPERATION AND MAINTENANCE

## SOURCE : LARGE DIA, HIGH YIELDING TUBEWELL

| System component as per flow line | | 1 | | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| | | Water Works | | Pump House | Rising main | Service reservoir | Gravity main | Distribution system |
| | | Less than 5 wells | 5 wells & above | | | | | |
| Sl. No. | Category of staff | | | | | | | |
| 1 | Supervisor | - | 1 | - | - | - | - | - |
| 2 | Asst. Supervisor | 1 | 1 for every additional 5 wells | - | - | - | - | - |
| 3 | Operators | - | - | 1 for every 5 wells/shift | - | - | - | - |

| System component as per flow line | | 1 | | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| | | Water Works | | Pump House | Rising main | Service reservoir | Gravity main | Distribution system |
| Sl. No. | Category of staff | Less than 5 wells | 5 wells & above | | | | | |
| 4 | Helpers Fitters | - | - | 1(for every 5 wells/shift) | 1* ( for every 8 Km.) | - | 1* ( for every 8 Km.) | 3 nos. Fitter –1 Helper –2 (for every 10-15 Km.) |
| 5 | Electrician/ Mechanic | - | 1(for every 5 wells) | - | - | - | - | - |
| 6 | Chowkidar/ Watchman | - | - | 1(for each well) | - | 1(for each well) | - | - |
| 7 | Chemist | 1 | 1 | - | - | - | - | - |
| 8 | Lab. Assistant | 1 | 1 | - | - | - | - | - |

Note : 1. The above staffing pattern does not include personnel for billing, collection and accounting for water charges.

2. Suitable additional operating staff to be included for one off-day/week for staff.

3. *In case the total length of the pipe line is less than 8 Km. Under 3 and 5 one helper/Fitter would be adequate.

## APPENDIX 13.8

## SCHEDULE OF PREVENTIVE MAINTENANCE

## CLARIFLOCCULATORS & THEIR DRIVE

| Sl. No. | Name of section or part to be attended | Maintenance to be carried out | Frequency/time interval at which inspection & maintenance to be done | Remarks |
|---|---|---|---|---|
| 1 | Trolley Wheels | Lubrication(greasing) | One Month | |
| 2 | Reduction Gear Box | Checking & topping of oil level | Three Months | |
| 3 | Turn Table Mechanism | Checking & topping the oil level | Three Months | |
| 4 | Verticalslip Ring Motor | Dust blowing checking of carbon brushes bearings etc. | Four Months | |
| 5 | Rail/Track | Adjustment of gap between two rails & its aligning etc. | Four Months | |
| 6 | Reduction Gear Box | Checking of helical or spurgears condition | Six Months | |
| 7 | Rubber Type Wheels<br>Iron Wheels | Checking of wear & tear alignment & its positioning | Six Months | More frequently in the old installations |
| 8 | M./S. Scrapers | Tightening of nuts & bolts, replacement of broken parts | Year | |
| 9 | Turn Table Mechanism | Checking of its sprockets chains, steel balls, gear boxes etc. | Two year | |

## APPENDIX 14.1

## SUGGESTED STAFFING PATTERN FOR SUPERVISORY ENGINEERING DIVISION (WORKLOAD RS. 200 LAKHS ANNUALLY 1988) AND SUBDIVISION (WORKLOAD RS. 50 LAKHS ANNUALLY 1988) FOR O. & M. OF WATERWORKS

| Sl. No. | Category of Staff | Division Office | Sub-Division Office |
|---|---|---|---|
| **A) Engineering** | | | |
| 1 | Ex. Engineer | 1 | - |
| 2 | Dy. Engineer (Civil) | - | 1 |
| 3 | Dy. Engineer (Elec. Mech.) | 1* | - |
| 4 | Junior Engineer (Civil) | | |
| | a) Diploma holders | 2 | 3 |
| | b) Degree holders | 2 | 2 |
| 5 | Junior Engineer (Elec. Mech.) | 2* | 1* |
| 6 | Draughtsman | 1 | - |
| 7 | Tracer | 2 | 1 |
| **B) Correspondence & Estt. Section** | | | |
| 8 | Head Clerk | 1 | - |
| 9 | Senior Clerk | 4 | 1 |
| 10 | Junior clerk/Typist | 4 | 2 |
| **C) Account Section** | | | |
| 11 | Senior Accountant | 1 | - |
| 12 | Junior Accountant | 4 | 1 |
| 13 | Store-keeper | 1 | - |
| 14 | Assistant Store-keeper | - | 1 |
| **D) Class IV** | | | |
| 15 | Peons | 6 | 3 |
| 16 | Chowkidars | As required | As required |
| | | 32[c] | 16[c] |

* Preferably with degree in Elec. & Mech. Engineering

C Excluding posts of chowkidars

## APPENDIX 14.2

## REQUIREMENT OF STAFF FOR - O & M

| | | |
|---|---|---|
| 1. | Operation & Maintenance | Recommended Staffing pattern for operation & maintenance of water works for various capacities is given in Appendix 13.1 to 13.7 in the chapter on Operation & Maintenance of waterworks. |
| 2. | Billing & Collecting | |
| | Water charges | |
| | a) Meter Reader | One for every 500 connections to be read monthly or a minimum of one if less than Bill 500 connections (includes leave reserve/shift duty also) |
| | b) Bill Clerk | |
| | c) Water Rate collectors | One for every 1500 monthly billed connections |
| | d) Water rate superintendent | One for every 6000 billed connections monthly. |
| | e) Meter repairer | One for every 80 meters per month to be repaired. |
| | f) Assistant meter repairer | -do- |
| 3. | Laboratory Personnel | Recommended laboratory personnel is suggested in Chapter 15. |

## APPENDIX 15.1

## MINIMUM STAFF RECOMMENDED FOR WATER WORKS LABORATORIES

| | Greater than 7.5 mld | upto 7.5 mld |
|---|---|---|
| (i) Water Analyst (Chemist) | 1 | - |
| (ii) Water Analyst (Bacteriologist) | 1 | - |
| (iii) Water analyst | - | 1 |
| (iv) Laboratory Technician | 3 | 1 |
| (v) Typist-cum clerk | 1 | - |
| (vi) Sample takers | 3 | 1 |
| (vii) Laboratory cleaners | 3 | 2 |

## APPENDIX 15.2

## PARTICULARS TO BE SUPPLIED WITH THE SAMPLES

1. Name and address of person requesting the examination.
2. Date and time of collection and despatch.
3. Purpose of examination.
4. Source of water and its location (well, tubewell, stream, river etc.).
5. Exact place and depth below surface from which sample was taken.
6. Weather at the time of collection and particulars of recent rainfall, if any.
7. Does the water become affected in taste or odour after rainfall or under any particular circumstances.
8. Are there any complaints from the consumer? If so, the nature of the complaint.
9. Character of surroundings, and proximity to drains, cess pools, cattlesheds, manure heaps, grave yard, bathing ghats and other sources of pollution.
10. Methods of purification and disinfection if any, details, dose of chemicals and points of applications.
11. If from a dug well or a bore well.
    (a) Whether an old source or newly constructed.
    (b) Whether open or covered: nature and material of cover.
    (c) Nature of steining or casing and depth to which constructed and whether it is in good condition
    (d) Height and condition of parapet and apron.
    (e) Method of pumping or other means of raising water.
    (f) Depth of well and of water surface from ground level.
    (g) Whether the water is clear as it flows out of tubewell and remains clear if exposed to air (4-6 hours) or becomes discoloured and turbid.
12. If from a river or stream.
    (a) Nature of flow and weather floods are common or rare.
    (b) Whether level of water is above or below normal.
    (c) Is there any bathing ghat, boat jetty, burial ground or sewer outfall If upstream, give distance from sampling point.

13. If from lakes, impounded reservoirs and tanks.
    (a) How supplied (channel, stream, rain).
    (b) Nature of catchment, whether conserved or not.
    (c) Nature of extent of weed growth.
14. Size and number of service reservoirs.
    (a) Whether open or covered.
    (b) How often cleaned and method of cleaning.
    (c) Date of last cleaning.
15. Number of hydrants and sewers on the distribution system.
16. Hours of pumping and supply.
17. Population served.
18. Any other particulars.

*Station*

*Signature and name in block letters of the person Collecting and forwarding the samples.*

*Date*

## APPENDIX 15.3

## SPECIMEN FORM FOR SHORT PHYSICAL AND CHEMICAL EXAMINATION

Name and Address
of the Laboratory:

Name and Address
of Sender

Sender's No.

Laboratory Ref. No.

Date of
Collection.....

Date and time of
receipt at laboratory .....

Date and time of
commencing of examination
.....

1. Raw water
2. Coagulated water
3. Filtered water
4. Water after specific treatment
5. Distribution system.

| Time of collection of sample | | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| | Physical | Expressed as | | | | | |
| 1 | Temperature | $^0$C | | | | | |
| 2 | Turbidity | JTU/NTU | | | | | |
| 3 | Colour | Units of Pt-Co- scale | | | | | |
| 4 | Taste & odour | Qualitative | | | | | |
| Chemical | | | | | | | |
| 5 | PH | | | | | | |
| 6 | Conductivity | Micromhos/cm | | | | | |



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| Time of collection of sample | | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| 7 | Free $CO_2$ | ( mg/l) $CO_2$ | | | | | |
| 8 | Alkalinity | ( mg/l) $CaCO_3$ | | | | | |
| | a) Phenolphthalein | | | | | | |
| | b) Total | | | | | | |
| 9 | Chlorides | (mg/l) Cl | | | | | |
| 10 | Nitrites | (Qualitative) | | | | | |
| 11 | Dissolved Oxygen | (mg/l) $O_2$ | | | | | |
| 12 | Hardness | (mg/l) $CaCO_3$ | | | | | |
| | Carbonate | | | | | | |
| | Non-Carbonate | | | | | | |
| | Total | | | | | | |
| 13 | Iron | (mg/l) Fe | | | | | |
| 14 | Fluorides | (mg/l) F | | | | | |
| 15 | Residual Chlorine | (mg/l) $Cl_2$ | | | | | |
| 16 | Alumina in Alum | (%) $Al_2O_3$ | | | | | |
| 17 | Available chlorine in Bleaching Powder | (%) $Cl_2$ | | | | | |
| 18 | Coagulant Dose-Jar Test | (mg/l) | | | | | |
| 19 | Chlorine Demand | (mg/l) $Cl_2$ | | | | | |

*Remarks:*

*Date:*

*Officer-in-charge*

## APPENDIX 15.4

## SPECIMEN FORM FOR COMPLETE PHYSICAL, CHEMICAL AND BIOLOGICAL EXAMINATION

Name and Address
of the Laboratory:

Name and Address of Sender

Sender's No.

Date of Collection.....

Date and time of receipt at laboratory .....

Laboratory Ref. No.

Date and time of commencing of examination .....

1. Raw water
2. Coagulated water
3. Filtered water
4. Water after specific treatment
5. Distribution system.

| Time of collection of sample | | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| | Physical | Expressed as | | | | | |
| 1 | Temperature | $^0C$ | | | | | |
| 2 | Turbidity | JTU/NTU | | | | | |
| 3 | Colour | Units of Pt-Co- scale | | | | | |
| 4 | Taste & odour | Qualitative | | | | | |
| *Chemical* | | | | | | | |
| 5 | pH | | | | | | |
| 6 | Conductivity | Micromhos/cm | | | | | |
| 7 | Free $CO_2$ | ( mg/l) $CO_2$ | | | | | |

| Time of collection of sample | | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| 8 | Alkalinity | ( mg/l) $CaCO_3$ | | | | | |
| | c) Phenolphthalein | | | | | | |
| | d) Total | | | | | | |
| 9 | Chlorides | (mg/l) Cl | | | | | |
| 10 | Amonia | (mg/l)/N | | | | | |
| | a) Free and Saline | | | | | | |
| | b) Albuminoid | | | | | | |
| 11 | Nitrites | (mg/l) N | | | | | |
| 12 | Nitrates | (mg/l) N | | | | | |
| 13 | Dissolved oxygen | (mg/l) $O_2$ | | | | | |
| 14 | Oxygen absorbed at $27^0C$ | (mg/l) $O_2$ | | | | | |
| | a) 3 minutes | | | | | | |
| | b) 4 hours | | | | | | |
| 15 | C.O.D | (mg/l) $O_2$ | | | | | |
| 16 | B.O.D | (mg/l) $O_2$ | | | | | |
| 17 | Hardness | (mg/l) $CaCO_3$ | | | | | |
| | a) Carbonate | | | | | | |
| | b) Non-Carbonate | | | | | | |
| | c) Total | | | | | | |
| 18 | Iron | (mg/l) Fe | | | | | |
| 19 | Manganese | (mg/l) Mn | | | | | |
| 20 | Fluorides | (mg/l) F | | | | | |
| 21 | Calcium | (mg/l) Ca | | | | | |
| 22 | Magnesium | (mg/l) Mg | | | | | |
| 23 | Residual chloride | (mg/l) $Cl_2$ | | | | | |
| 24 | Sulphates | (mg/l) $SO_4$ | | | | | |
| 25 | Total solids | | | | | | |
| | a) Dissolved | | | | | | |
| | b) Suspended | | | | | | |
| | c) Volatile | | | | | | |

| Time of collection of sample | | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| 26 | Alumina in Alum | (%) $Al_2O_3$ | | | | | |
| 27 | Available chlorine in bleaching powder | (%) $Cl_2$ | | | | | |
| 28 | Coagulant Dose – Jar test | (mg/l) | | | | | |
| 29 | Langelier Index | (mg/l) | | | | | |
| 30 | Chlorine demand | (mg/l)$Cl_2$ | | | | | |
| 31 | Total silica | (mg/l) $SiO_2$ | | | | | |
| 32 | Phenolic compounds | (mg/l) Phenol | | | | | |
| 33 | Synthetic detergents | (mg/l) MBAS | | | | | |
| 34 | Sulphide | (mg/l) S | | | | | |
| 35 | Arsenic | (mg/l) As | | | | | |
| 36 | Cadmium | (mg/l) Cd | | | | | |
| 37 | Hexavalent Chromium | (mg/l) Cr | | | | | |
| 38 | Copper | (mg/l) Cu | | | | | |
| 39 | Cyanide | (mg/l) CN | | | | | |
| 40 | Lead | (mg/l) Pb | | | | | |
| 41 | Selenium | (mg/l) Se | | | | | |
| 42 | Zinc | (mg/l) Zn | | | | | |
| 43 | Mercury | (mg/l) Hg | | | | | |
| 44 | Oil and grease | (mg/l) | | | | | |
| 45 | Polynuclear Aromatic Hydrocarbon | (mg/l) PAH | | | | | |
| 46 | Radio activity | (pci/l) | | | | | |
| | a) Gross alpha Activity | | | | | | |
| | b) Gross Beta Activity | | | | | | |

| Time of collection of sample | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| BIOLOGICAL | | | | | | |
| 47 Total count of planktone | (Total count of SAU Organisms/ml) | | | | | |

*Remarks:*

*Date:*

*Officer-in-charge*