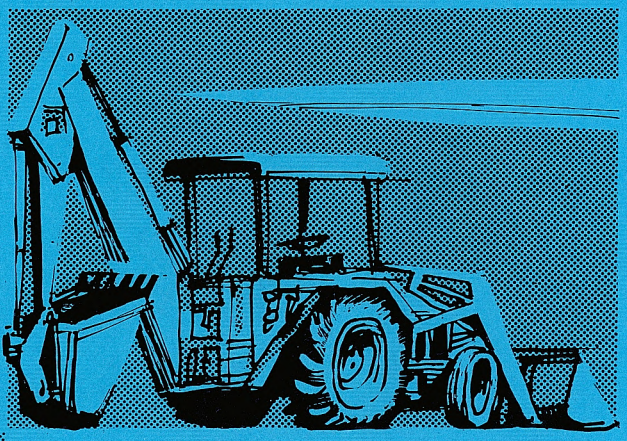
# BAND TECHNICAL PUBLICATIONS



COMMUNITY WELLS AND PUMP HOUSE
OPERATION AND MAINTENANCE

February 1984



Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada
Canada

# COMMUNITY WELLS AND PUMP HOUSE OPERATION AND MAINTENANCE

## TABLE OF CONTENTS

# COMMUNITY WELLS AND PUMPHOUSE OPERATION AND MAINTENANCE

## 1.0 INTRODUCTION

This publication provides operation and maintenance guidelines for Band staff responsible for community ground water supplies. It provides information on wells, pumps and pump houses and describes routine and preventive maintenance tasks, recommended protection programs and some common trouble shooting techniques.

For operation and maintenance guidelines for chlorination facilities located at a well site, refer to BTP-MS-4 Hypochlorination O&M Guideline.

BTP-MS-8 Water Wells and Ground Water Supplies covers individual wells.

## 2.0 PROBLEMS WITH WATER WELLS

### 2.1 Loss of Well Water Production

#### 2.1.1 Equipment Failure

If the equipment fails, read the manufacturer's instructions. Many common problems can be corrected by such things as replacing a blown fuse, adjusting pressure switches, or other simple maintenance operations. Most water-supply equipment dealers will supply pamphlets free of charge, giving "trouble shooting information" on their equipment.

See Appendix 1 for common trouble shooting procedures for a pump. Other problems may have to be referred to electricians, plumbers or well contractors.

#### 2.1.2 Well Failure

##### 2.1.2.1 Natural Lowering of the Water Table

Drought lowers ground water levels. Shallow wells are particularly susceptible to changes in precipitation. Even during a year of average rainfall a lowering of 3

to 6 m (10 to 20 ft.) can occur from the spring to the late fall. Wells and pumps should be able to withstand changes in water levels. If well pumps are not properly designed they may not be powerful enough to pump water from a lower depth, or the water level may drop below the pump intake.

If problems occur, the solution may involve the purchasing of a proper size pump, lowering the pump and/or deepening the well.

2.1.2.2 Artificial Lowering of the Water Table

The water level in most wells can be lowered artificially by the pumping of a nearby high capacity well or occasionally by the construction of sewers, drainage ditches and road cuts in the area.

If the water level in a well has been lowered, and you suspect that this has been caused artificially, contact the local authority or the Indian and Inuit Regional Office.

Where lowering is temporary, an alternate supply for the duration of the interference will be required.

Where the lowering is permanent, corrective action may be required similar to that in 2.1.2.1.

2.1.2.3 Encrustation of Well Screens

A well screen can sometimes be plugged by chemical deposits (magnesium or calcium carbonate, hydroxides, or iron), or by slime produced by iron bacteria. A bacterial and chemical analysis of the water can determine the probable cause of the deposits. These deposits cause encrustation, and result in a decrease in well yield. Encrustation may occur slowly over a long period of time.

If encrustation is caused by chemical deposits and it has not yet severely affected the pumping rate, it can be slowed down by lowering the pumping rate or contacting a well driller to see if developing the well can correct the problem. If the pumping rate is

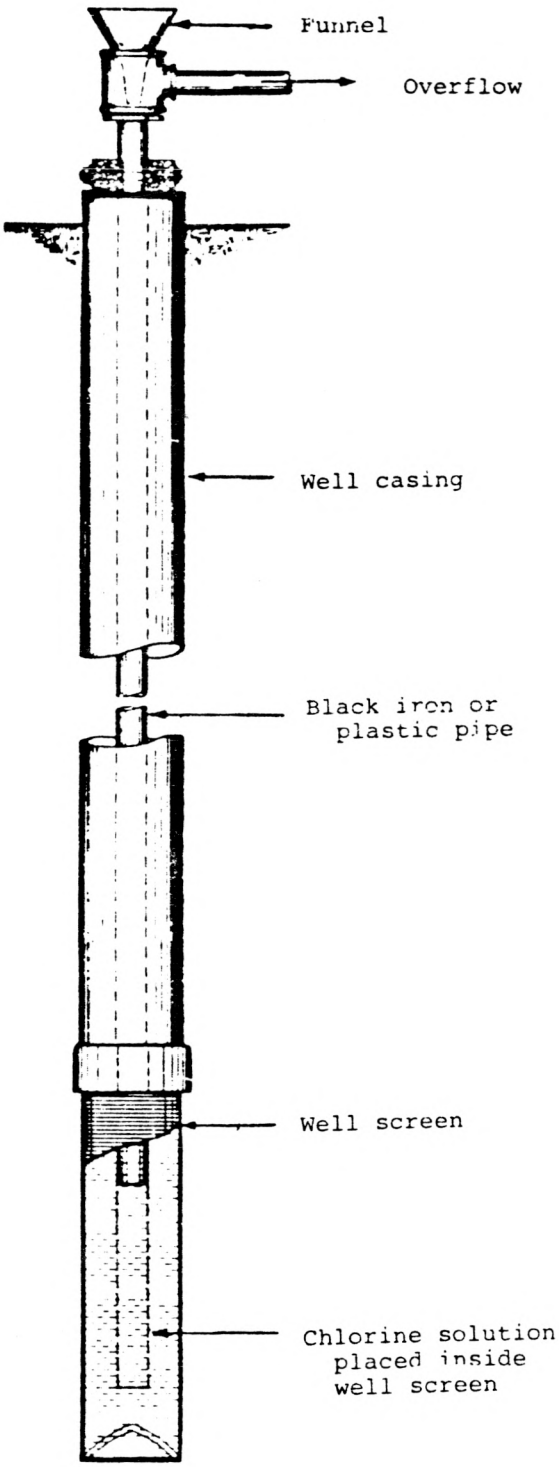
severely affected, hydrochloric acid can be used to remove the encrustation. Due to the danger in handling a strong acid solution, acid treatment should only be done by a person having previous experience.

If encrustation is caused by iron bacteria, the deposits can be reduced through application of a strong chlorine solution (minimum of 200 mg/L) for 12 hours, (See Figure 1).

2.1.2.4 Plugging of a Well

Plugging occurs when a water-bearing formation contains clay, silt, or very fine-grained sand. These materials pass through the screen, partially plugging the screen and slowing the movement of water into the well. The fine-grained particles can move into the intake of a pump and cause excessive wear of the moving parts. The water pipes and pressure tank may also become plugged.

Figure 1




## Addition of Chlorine Solution to Well

### Steps

1. Determine volume of water standing in well.
2. Add a chlorine solution (400 to 500 mg/L) to well. The volume should be from 50 to 100 times the volume of water standing in the well.
3. Vigorously agitate or surge well occasionally during 12 hour treatment period using a pump, bailer or plunger.
4. Two or three successive chlorine treatments should be performed. Alternate chlorine and acid treatments are recommended and highly effective.
5. Following the above, treatment with a polyphosphate is effective in removing oxidized minerals, silts and clay.

The best solution is prevention, by having the well screen and gravel pack properly designed in the first place. If the problem occurs in an existing well, bail it out and install a proper well screen. If this is not possible, the well may have to be reconstructed or replaced.

Another source of this problem is inadequate well development. This can be rectified by having a contractor properly develop the well. Although this is ideally done as part of the installation package, it is also possible to have an existing well rehabilitated through some development method (i.e. surging with plunger).

2.1.2.5 Corrosion of Well Casing and Screen

Well water is often corrosive and can chemically attack the casing and screen. Four common corrosion processes are:

a) direct chemical,
b) dezincification,
c) electrolytic, and
d) bacterial.

If the casing or screen is destroyed by any of these processes the well will fail.

Install casings and screens that are unlikely to be corroded, as little can be done about corrosion once it has occurred. The corroded casing and well screen will have to be replaced.

2.1.2.6 Design Life Exceeded

Although wells generally last for many years, they do not last forever. Either the well casing or the screen will corrode, causing well failure, or the demand for water will exceed the capacity of the well. When this happens, a new well must be constructed.

## 2.2 Contamination of Well Water

Contamination of a well might be chemical, bacteriological or both. The contamination can be a natural condition in the groundwater or caused by a source of contamination (septic field, leaking underground fuel tank) or by vandalism.

The normal solution to the problem is to remove the source of contamination and purify the well. If the source of contamination cannot be removed, consider treating the water before distribution. If the contamination is too difficult or expensive to remove or treat, abandon the well, using the proper method, and develop a new one.

# 3.0 RECORDS AND MAINTENANCE

## 3.1 Records

The main function of records is to alert the operator of changes, determine equipment performance, anticipate maintenance or repair and provide future design data. The system should be simple and permanent and records should be filed where they can be located rapidly. A band office is a good location. Permanent records should be kept of the following:

a. materials and equipment supplies;
b. instruction and operating manuals;
c. a description of automatic controls;
d. plans and specifications (as built); and
e. names, addresses and phone numbers of operators, band personnel, health officers and DIAND district staff.

Maintain records of test data that are not normally obtained on a routine basis such as water quality, well logs, pump test results etc.

Daily operation records should include pumpage, well water levels, drawdown, power use, hours of pumping and remarks. Appendix 2 has a sample daily pumping record along with an example and explanation of the form.

A maintenance record is very important. See Appendix 3 for a sample and an example of an equipment card.

## 3.2 Maintenance

### 3.2.1 Maintenance Program

Any maintenance program should start with good housekeeping and observe the following rules:

a. Keep a clean, neat and orderly pumphouse.

b. Establish a daily schedule for the operation.

c. Establish a routine inspection and lubrication schedule.

d. Keep data and records for each piece of equipment with an emphasis on unusual incidents and faulty operating conditions.

e. Observe safety measures.

All manufacturers of equipment provide instructions for installation, lubrication and operation; procedures for dismantling and re-assembling; a parts list and repair order instructions. Any maintenance program for a piece of equipment should be in accordance with the manufacturer's recommendations. In order to work effectively, operators must:

- be familiar with the equipment,
- use proper tools,
- use adequate repair parts, and
- plan ahead.

### 3.2.2 Well Maintenance

Commonly, maintenance of wells is neglected until the well yield has decreased considerably or the pump breaks suction. It is essential to keep daily pumping records so that slight changes in well performance can be detected (see Appendix 2). Visit the well daily and check that the well seal is tight and intact and that the air vent is screened and unobstructed.

### 3.2.3 Equipment Maintenance

Every 6 months, have a qualified electrician check the motor, electrical control equipment, fuses and automatic tripping elements to make sure they are in working order.

For pumps, follow the manufacturer's instructions and schedule for greasing bearings, packing glands and selecting lubricants. Lubricate packing well, but avoid over lubrication and do not tighten a packing follower too much. During the daily visit, give special attention to:

a. bearings - heat and noise;

b. motors - operating speed;

c. controls - cleanliness;

d. pump operation - vibration and noise; and

e. packing glands - excessive leakage;

### 3.2.4 Pump House and Grounds

Within the pump house, good housekeeping is required. Pipes and airlines should be kept open and free from obstruction. Metal (pipes) and concrete surfaces should be clean and painted at least once every two years. DO NOT USE LEAD BASED PAINTS.

The grounds around the pump house should be neat and walkways and driveways cleared of snow. Avoid steep grades but maintain drainage away from the pump house.

## 4.0 PROTECTION PROGRAMS

### 4.1 Sanitary Protection Program

A sanitary protection program will vary with the well location and the geologic formations. The following are general practice:

a. maintain drainage away from the well;

b. remove all sources of contamination around the well;

c. maintain all seals, vents and openings into the well casing in a proper sanitary manner;

d. abandon all wells that are not in use properly; and

e. check the bacterial quality of the well once a month and the chemical quality once a year.

### 4.2 Security Protection Program

A security protection program starts with the layout of the facility. Proper lighting, fencing and structural hardware should be chosen. Security items should be maintained and security staff should protect the facility during the hours when operating staff are not around.

### 4.3 Safety Program

The dangers in pump houses are infections, physical injuries, noxious gases and oxygen deficiencies. Accidents can be caused by indifference, neglect, poor housekeeping, ignorance, carelessness, poor lighting and poor arrangement of equipment. In setting up a safety program, remove all physical hazards. For assistance in setting up a safety program, contact the DIAND Regional Fire and Safety Officer.

## 5.0 REFERENCES

Bishop, B. February 1982. Water Well Maintenance. Paper presented at Band Training Workshop. Calgary, Alberta. Canada.

Johnson Division, Universal Oil Products Co. 1966. Ground Water and Wells. Saint Paul, Minnesota, USA.

New York State Department of Health. 1978. Manual of Instruction for Water Treatment Plant Operators. Albany, New York, USA.

Ontario. Ministry of the Environment. 1980. Pump Operation Workshop. Toronto, Ontario, Canada.

Ontario. Ministry of the Environment. 1980. Water Wells and Ground Water Supplies in Ontario. Toronto, Ontario, Canada.

# APPENDIX 1

## PROBLEMS AND TROUBLE SHOOTING FOR PUMPS

Problems in pumps are commonly caused by the following:

1. Dirt, dust and grime - plug ventilating spaces and prevent cooling by providing an insulating layer over the metal surfaces which are intended to radiate heat.

2. Moisture - harms insulation on windings so they no longer provide the required insulation for the voltage applied to the motor. In addition, moisture on windings tends to absorb acid and alkali fumes which destroy insulation and metals.

3. Friction - causes wear in all moving parts. Manufacturers' lubricating instructions should be followed very strictly. Excessive oil or grease should not be used as this will cause friction itself. Do not add new oil while a motor is running.

4. Vibration - causes parts to shake loose; may break electrical connections; may crystallize parts of the metallic structures.

The following shows what to do when the pump failure alarm goes off and the pump is out.

STEP 1 Check the lighting panel to see if the lights are on. If so, there is power to the pump house.

STEP 2 Check the main current breaker. If not tripped, there is power to the pump control panel and pumps.

STEP 3 Check the "manual/automatic" switch panel of each pump and, if it is in the automatic mode, try to run the pump manually in the hand position. Do this for each pump separately.

STEP 4 If the pump runs in the hand position, the problem is in the automatic control device.

STEP 5 If the pump fails to run in the hand position, check the individual pump starter with overload protection and the individual pump circuit breaker.

STEP 6 If the pump circuit breaker is open, this indicates a short in the pump windings or in the circuit between the breaker and the motor.

STEP 7 If the motor starter overload is tripped, manually reset and restart the pump. If the pump runs and then the starter overload trips out again, the problem is a motor overload. The problem could be the pump being too small, partial blockage in the pipe, etc.

# APPENDIX 2

## DAILY OPERATION RECORD

Daily operation or pumpage records are important tools for providing proper maintenance for a well and useful information for the future.

The operator should visit the pump house once a day at approximately the same time. The following essential and desirable information should be recorded every day unless noted otherwise (see example of a pumpage record).

Title Block - Note the well number or name, and month.

Column 1 - (essential) "Day" -- the date of the visit.

Column 2 - (essential) "Pumpage-Meter" -- record the water meter reading for the well.

Column 3 - (esential) "Pumpage-Daily Pump" -- by subtracting the previous days meter reading from the current reading, the daily pumpage can be determined and recorded.

Column 4 - (desirable) Water Level-Pumping" -- for this value, permanent water level measuring equipment must be installed in the well. Record the well water level while the pump is pumping, and when the maximum depth is reached.

Column 5 - (desirable) "Water Level-Static" -- once a week or so, record the static water level. This water level should not be measured for several hours after the well has been pumped. The level should not change.

Column 6 - (desirable) "Draw Down" -- subtract the static well water level from the pumping level to obtain the draw down. Record draw down value each day.

Column 7 - (desirable) "Power Use-Meter" -- for this value, a electric meter must be connected only to the pump. Record the daily meter reading.

Column 8 - (desirable) "Power Use-Daily Power" -- by subtracting the previous day's reading from the current reading, the power used for pumping the water can be determined and recorded.

Column 9 - (desirable) "Hours in Use" -- for this, a clock can be wired with the pump to operate only when the pump operates. The number of hours that the pump operated should be recorded.

Column 10 - (essential) "Remarks" -- note any problems (motor running hot, vibration) or samples taken (bacterial, chemical).

The example form given is for one well of a two well groundwater system serving a community of 600. The wells are rated at 7.5L/s (100 gpm) and are alternated once every month as the primary well or the standby well. The well is used as the primary well for the example except for the two day shutdown in late September. Please note the example given is in imperial units, however, metric units can also be used.

# PUMPAGE RECORD

WELL NO. 1

MONTH Sept. 1982

| DAY | PUMPAGE | | WATER LEVEL | | DRAW DOWN | POWER USE | | HOURS IN USE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | METER | DAILY PUMP. | PUMPING | STATIC | | METER | DAILY POWER | | |
| | Cal.X1000 | GalX1000 | Feet | Feet | Feet | KW/Hour | KW/Hr. | Hours | |
| 1 | 108,020 | 39.0 | 57.5 | 37 | 20.5 | 7807.0 | 26 | 6.50 | Bacterial sample |
| 2 | 108,058 | 38.0 | 57.5 | | 20.5 | 7832.3 | 25.3 | 6.30 | |
| 3 | 108,098.5 | 40.5 | 57.5 | | 20.5 | 7859.3 | 27.0 | 6.75 | |
| 4 | 108,134.8 | 36.3 | 57.5 | | 20.5 | 7883.5 | 24.2 | 6.05 | |
| 5 | 108,167.8 | 33.0 | 57.5 | | 20.5 | 7905.5 | 22.0 | 5.50 | |
| 6 | 108,207.0 | 39.2 | 57.5 | | 20.5 | 7931.7 | 26.2 | 6.55 | |
| 7 | 108,248.0 | 41.0 | 57.5 | | 20.5 | 7959.1 | 27.4 | 6.85 | |
| 8 | 108,288.5 | 40.5 | 57.5 | 37 | 20.5 | 7986.1 | 27.0 | 6.75 | |
| 9 | 108,326.6 | 38.1 | 57.5 | | 20.5 | 8011.5 | 25.4 | 6.35 | |
| 10 | 108,364.4 | 37.8 | 57.5 | | 20.5 | 8036.7 | 25.2 | 6.3 | |
| 11 | 108,399.5 | 35.1 | 57.5 | | 20.5 | 8060.1 | 23.4 | 5.85 | |
| 12 | 108,433.9 | 34.4 | 57.5 | | 20.5 | 8083.1 | 23.0 | 5.75 | |
| 13 | 108,475.2 | 41.3 | 57.5 | | 20.5 | 8110.7 | 27.6 | 6.90 | |
| 14 | 108,514.8 | 39.6 | 57.5 | | 20.5 | 8137.1 | 26.4 | 6.60 | |
| 15 | 108,555.0 | 40.2 | 57.5 | | 20.5 | 8163.9 | 26.8 | 6.70 | Bacterial sample |
| 16 | 108,595.1 | 40.1 | 57.5 | | 20.5 | 8190.7 | 26.8 | 6.70 | |
| 17 | 108,634.7 | 39.6 | 57.5 | | 20.5 | 8217.1 | 26.4 | 6.60 | |
| 18 | 108,672.0 | 37.3 | 57.5 | | 20.5 | 8241.9 | 24.8 | 6.20 | |
| 19 | 108,706.2 | 34.2 | 57.5 | 37 | 20.5 | 8264.7 | 22.8 | 5.70 | |
| 20 | 108,749.2 | 43.0 | 57.5 | | 20.5 | 8293.3 | 28.6 | 7.15 | |
| 21 | 108,792.4 | 43.2 | 57.5 | | 20.5 | 8322.1 | 28.8 | 7.20 | |
| 22 | 108,833.4 | 41.0 | 57.5 | | 20.5 | 8349.5 | 27.4 | 6.85 | |
| 23 | 108,870.5 | 37.1 | 57.5 | | 20.5 | 8375.0 | 25.5 | 6.20 | motor vibrating |
| 24 | 108,908.2 | 37.7 | 57.5 | | 20.5 | 8401.3 | 26.3 | 6.30 | " " |
| 25 | 108,942.5 | 34.3 | 57.5 | | 20.5 | 8425.4 | 24.1 | 5.70 | Motor vib./more power |
| 26 | 108,974.4 | 31.9 | 57.5 | | 20.5 | 8449.2 | 23.8 | 5.30 | " " /called company |
| 27 | - | - | - | | - | - | - | - | Worked on motor |
| 28 | - | - | - | 37 | - | - | - | - | " " " |
| 29 | 109,013.4 | 39.0 | 57.5 | | 20.5 | 8475.2 | 26.0 | 6.50 | |
| 30 | 109,054.7 | 41.3 | 57.5 | | 20.5 | 8502.8 | 27.6 | 6.90 | |
| 31 | | | | | | | | | |
| TOTAL PUMPAGE | | 1073.7 | TOTAL POWER | | | | 721.8 | | |

A blank copy provided for your use.

# PUMPAGE RECORD

WELL NO. _____

MONTH _____

| DAY | PUMPAGE | | WATER LEVEL | | DRAW DOWN | PDWER USE | | HDURS IN USE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | METER | DAILY PUMP. | PUMPING | STATIC | | METER | DAILY POWER | | |
| 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 | | | | | | | | | |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | |
| 30 | | | | | | | | | |
| 31 | | | | | | | | | |
| TOTAL PUMPAGE | | | TOTAL PDWER | | | | | | |

# APPENDIX 3

## MAINTENANCE RECORD

It is almost impossible to place too much emphasis on maintenance record keeping. From a review of such records, an operator can determine the weaknesses of various items of equipment and determine which parts to stock. The records can be kept on cards, one for each piece of equipment. On these cards, record the type of lubrication, regular lubrication, inspection, cleaning, replacement of worn parts, etc. The date of the next regular servicing can also be noted. The schedule for lubrication can be noted in advance on a calendar.

A sample maintenance record card and an example of some notes are presented in the following pages.

**SERVICE RECORD**

Well Pump No. 1

5HP -- 100gpm

| DATE | WORK DONE | INIT. | REMARKS |
|---|---|---|---|
| 82/9/3 | Checked bearings | DG | |
| 82/9/23 | -- | DG | Motor vibrating |
| 82/9/25 | | DG | Vibration continued |
| 82/9/27 | Motor replaced, bearing and alignment adjusted by B.C. Service | DG | |

A blank copy provided for your use.

**SERVICE RECORD** _____

| DATE | WORK DONE | INIT. | REMARKS |
|---|---|---|---|
| | | | |