GROUNDWATER DIVISION

WATER INVESTIGATIONS BRANCH

WATER RESOURCES SERVICE

DEPARTMENT OF LANDS, FORESTS AND WATER RESOURCES

OKANAGAN VALLEY WATER QUALITY DATA COLLECTION PROGRAM

1969 FIELD MANUAL FOR WATER QUALITY DATA COLLECTION IN OKANAGAN VALLEY

by

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February 1970

File 0249723

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF MAPS

Other maps available in the Special Projects map drawer.

OKANAGAN VALLEY WATER QUALITY DATA COLLECTION PROGRAM

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A. THEORY OF FIELD TESTS

1) Dissolved Oxygen:

Normal sewage contains no dissolved oxygen unless the sewage is very weak or very fresh; natural, pure surface water, on the other hand, contains all of the oxygen that it is capable of dissolving. The amount of dissolved oxygen may be expressed in mg/l, or as the percentage of saturation. With any method, the temperature should be stated since the solubility of oxygen in water is dependent on it. (See table #1). Potable ground water may be deficient in dissolved oxygen, while an unpolluted potable surface water should be saturated with oxygen. Super-saturation with oxygen may be caused by oxygen-producing algae in polluted surface water.

The dissolved oxygen test for slightly polluted water is one of the most significant sanitary tests, particularly when combined with the BOD test. If dissolved oxygen is found in sufficient concentration in a polluted water or in the effluent from a treatment plant, it means that putrefactive odors will not be given off by the liquid, also adequate dissolved oxyten is necessary for the life of fish and other aquatic organisms.

TABLE #1

SOLUBILITY OF OXYGEN IN FRESH WATER

Temp.		Dissolved Oxygen	Temp.		Dissolved Oxygen
$^{o}C.$	$^{o}F.$	(mg/1)	$^{o}C.$	$^{o}F.$	(mg/1)
0	32.0	14.6	15	59.0	10.2
1	33.8	14.2	16	60.8	10.0
2	35.6	13.8	17	62.6	9.8
3	37.4	13.5	18	64.4	9.6
4	39.2	13.1	19	66.2	9.4
5	41.0	12.8	20.	68.0	9.2
6	42.8	12.5	21	69.8	9.0
7	44.6	12.2	22	71.6	8.8
8	46.4	11.9	23	73.4	8.7
9	48.2	11.6	24	75.2	8.5
10	50.0	11.3	25	77.0	8.4
11	51.8	11.1	26	78.8	8.2
12	53.6	10.8	27	80.6	8.1
13	55.4	10.6	28	82.4	7.9
14	57.2	10.4	29	84.2	7.8

2) Biochemical Oxygen Demand (BOD):

This demand is the amount of oxygen required to maintain aerobic conditions during decomposition. The BOD test is the most important in sanitary analyses to determine the polluting strength of sewage or polluted water because it serves as a measure of the amount of clean diluting water required for the successful disposal of the substance by dilution.

There are two factors in the BOD test to be resolved to have a firm figure; i.e. time and temperature.

As complete stabilization time of sewage is generally considered to be over 100 days (hence our 120 retention figure for sewage lagoons), it would be difficult to measure a complete BOD in time to have any significant value. The generally adopted time limit standard has been five days so that in our tests or conversation the term BOD is used with the implication that the figure referred to is the five-day BOD unless otherwise specified.

Now, considering temperature - all activity including biological and chemical is governed by temperature. Van't Hoff's rule - "the speed of chemical or biochemical reaction is roughly doubled by a rise in temperature of 10°C., however it is only valid for the very close vicinity of 20°C. For biochemical reactions the reaction rate constant at 5°C. is 51% of that at 20°C. while that of 30°C. is 160%.

In light of this and other considerations, the temperature 20°C. or 68°F. has been adopted as the standard temperature for BOD determinations.

With these two considerations, we might elaborate on our working definition so that it could read - the quantity of dissolved oxygen in mg/l required during the stabilization of the decomposable organic matter by aerobic biochemical action in five days at 20°C.

3) Alkalinity

Alkalinity is usually imparted by the bicarbonate, carbonate, and hydroxide components of a natural or treated water supply. It is determined by titration with a standard solution of a strong mineral acid to the successive bicarbonate and carbonic acid equvalency points, indicated electrometrically or by means of color. Phenolphthalein indicator enables the measurement of that alkalinity fraction contributed by the hydroxide and half of the carbonate. Indicators responding in the pH range 4-5 are used to measure the alkalinity contributed by hydroxide, carbonate, and bicarbonate. The following are the alkalinity relationships:

(a) Carbonate alkalinity is present when the phenolphthalein alkalinity is not zero but is less than the total alkalinity.
(b) Hydroxide alkalinity is present if the pehnolphthalein alkalinity is more than half the total alkalinity.
(c) Bicarbonate alkalinity is present if the phenolphthalein alkalinity is less than half the total alkalinity.

The mathematical conversion of the results is shown in Table #2.

TABLE #2

ALKALINITY RELATIONSHIPS

Result of Titration	Hydroxide Alkalinity as $CaCO_3$	Carbonate Alkalinity as $CaCO_3$	Bicarbonate Alkalinity as $CaCO_3$
P = 0	0	0	T
P ½T	0	2P	T-2P
P =½T	0	2P	0
P ½T	2P-T	2 (T-P)	0
P = T	T	0	0

For best results, samples should be collected in polyethylene or pyrex bottles. Because of the instability of samples containing considerable causticity of carbon dioxide, the alkalinity determinations should be performed as soon as practicable, and preferably within one day.

4) pH

The hydrogen exponent pH is equal to the logarithm (base 10) of the reciprocal of the hydrogen ion concentration. The hydrogen ion in a solution determines the acidity of the solution.

Excess of hydrogen ions is indicated by a pH below 7. These solutions are ACID. Excess of hydroxyl ions is indicated by a pH above 7. These solutions are alkaline. Decreasing pH means increasing the hydrogen ion concentration. As pH extends further from 7 the acidity or alkalinity increases but not in direct proportion.

pH 5 is 10 times as acid as pH 6
pH 4 is 100 times as acid as pH 6

B. CHEMICAL TECHNIQUES

1) Titrating

The addition of titrant should be done slowly so as not to "overshoot" the indicator. Burette volumes are to be read at the bottom of the meniscus and recorded immediately after the titration has been completed. The sample should be stirred continuously while titrating. It is a good policy to grease the stopcock often, in order to prevent leakage and ensure smooth operation.

2) Procedure of Pipetting

(a) Place tip below surface of liquid.

(b) Suck liquid to about one inch above the mark

(c) Holding liquid in pipette, raise it out of container and wipe off tip with a downward motion using cheesecloth.

(d) Hold tip against inside of container, pipette vertical, and mark at eye level, and lower liquid to mark.

Note: i) The bottom of the meniscus must be brought to the mark.

ii) The tip must not be allowed to re-enter the liquid in the container.

(e) Transfer pipette to receiving vessel, release liquid and allow it to drain freely. Keep the tip above liquid level.

(f) When liquid in pipette stops draining free begin to count five seconds.

(g) At the end of the five-second drain period, lift the pipette from the vessel being sure that it has touched the inside. (note that there must be some liquid remaining in the pipette tip).

3) Collecting Samples

Care should be taken to obtain a sample that is truly representative of the existing conditions. Prior to filling, the sample bottle should be rinsed out two or three times with the water to be collected. If the water is to be transferred to another container before going in the sample bottles, this too should be rinsed several times.

C. FIELD TESTING PROCEDURES

1) Conductivity (Model RA-2A Portable Conductivity Meter)

(a) Connect the blue conductivity cell to the two binding posts on the RA-2A meter. It does not matter which wire is connected to which post.

(b) Depress the button labelled "PRESS TO CALIBRATE".

(c) Rotate the "CALIBRATE" knob until the meter needle is at the zero calibrate line on the right hand side of the scale. This is the zero point of the instrument and it must always be brought to this point before taking a reading.

(d) Dip the cell in the water to be tested, moving it up and down several times under the surface to ensure removal of air bubbles. Immerse the cell to a point at least one-half inch above the air vents and hold there while the measurement is made.

(e) Press "READ" button while holding down "CAL" button and read the meter when the needle comes to rest.

(f) If the needle is below a specific conductance of 200, the white conductivity cell can be used to obtain the reading.

(g) The conductivity meter is automatically turned off when the "CAL" button is released.

(h) Ideally, the blue conductivity cell gives specific conductance reading directly in micro-mhos/cm on the upper scale. This corresponds to a cell constant of unity (K=1.00). The white conductivity cell ideally gives readings in micro-mhos/cm by dividing the upper scale reading by 10. This corresponds to a cell constant of 0.1 (K = 0.10).

(i) To obtain the actual cell constants of the cells, they are tested against a solution of known specific conductance. The actual "K" values should be on the electrodes when they leave the lab.

These "K" values should be checked every few months to ensure they have not changed.

(j) If the reading is greater than 2,000, the water will have to be diluted with de-ionized water. If the water is diluted, the actual specific conductance is given by

$$SC\ (corrected) = (SC)(N)+1)(K)$$

where

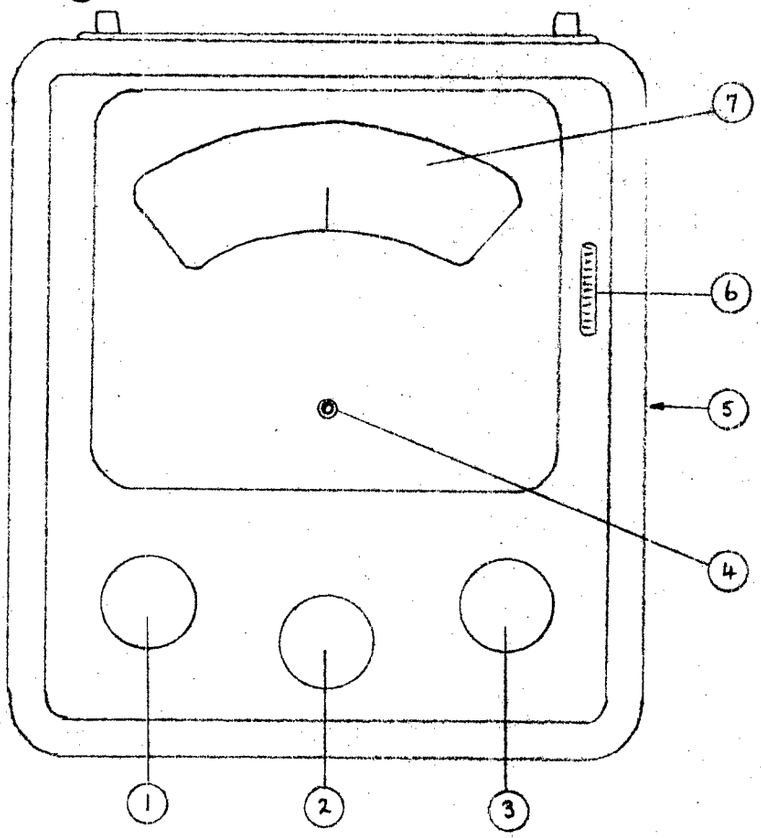
SC - specific conductance reading
N - number of parts of distilled water added per part of the water being tested.
K - cell constant.

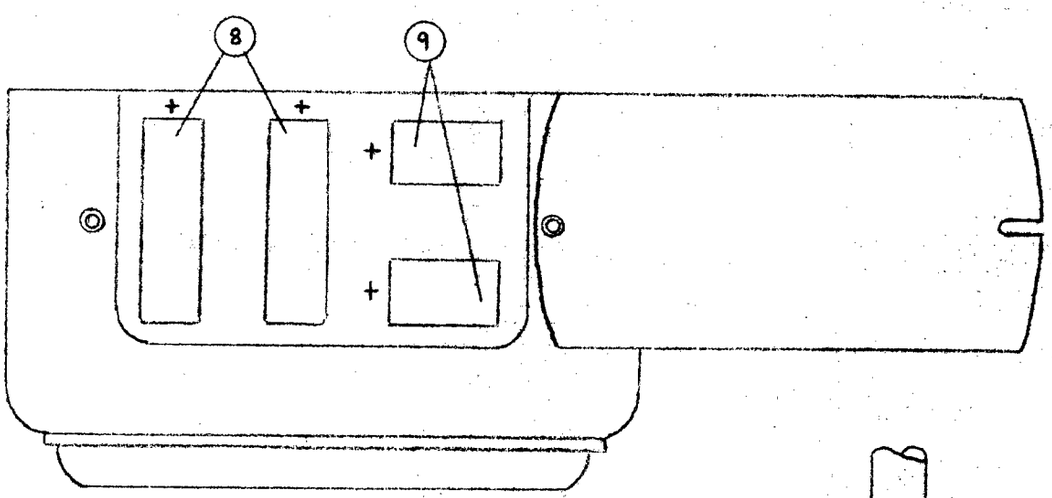
(k) For the laboratory to determine the approximate total dissolved solids, the temperature should be measured at the same time and place as the conductivity.

For maintenance of the Model RA-2A, conductivity meter, see Appendix III.

2) pH Measurement (Metrohm E280 A Portable pH Meter)

a) Controls (see Figure 1)





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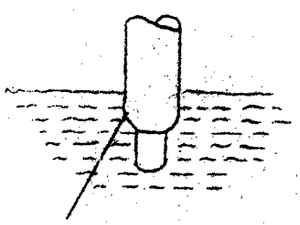


DIAPHRAGMA

ELEKTRODEN - DETAIL

BATTERY - pH - METER	
METROHN AG HERISAU	GB4 - 280 A

Legend:

1. counter - EMF
2. selector switch
3. temperature compensation
4. zero-point screw
5. electrode socket
6. fix-point adjuster
7. indicator
A. battery compartment
8. LT batteries 135V: type Q-RM-502
9. HT batteries 15V: type Q- B-121

b) Putting into operation.

Switching on:

i) turn the selector switch (2) to "battery check" (Bat. Conts.) The pointer must deflect beyond the line marked "battery good" (Bat.gut.). If it does not, see Appendix III.

ii) turn the selector switch to 'warm up" (the centre position) and wait a few seconds.

iii) turn the selector switch to "zero point" ( ). After half a minute, the apparatus is ready for use.

Switching off:

i) When the selector switch (2) is in the "zero-point" position, the electrode assembly is switched off and the amplified input is shorted across. Always return the switch to this position between measurements or when moving the electrode from the storage vessel to the measuring vessel.

ii) To avoid running down the batteries, the selector switch (2) should be turned to "off" (0). In this position, the indicator is shorted across. This is an effective protection in transportation.

c) Calibration

With pH electrode assemblies, only relative and not absolute measurements may be made. In addition, electrode potential is subject to certain variations with time. For this reason, calibration with buffer solutions is necessary. This calibration should be performed once a day before sampling begins.

i) Turn the selector switch to "zero point"

ii) Wash the measuring vessel with the pH 7 buffer several times.

iii) Fill the measuring vessel about one-quarter full with the buffer.

iv) Transfer the electrode assembly to the right side of the meter and remove the rubber stopper from the KCl filler opening of the reference electrode.

v) Take the reference electrode from its storage vessel and wipe it with soft tissue.

vi) Transfer it to the measuring vessel.

vii) Set knob (3) to the temperature of the buffer solution.

viii) Turn the selector switch (2) to "measure".

ix) Set pointer (7) to the pH valve of the buffer solution with the counter - EMF(1).

x) Return selector switch (2) to "zero-point".

xi) Set the pointer to the centre of the scale with the fixed-point adjustor (6).

xii) Repeat steps viii to xi until the pointer does not move.

Note 1: After calibration, the fixed-point adjuster (6) should not be touched until the next calibration.

Note 2: If there is some doubt that the instrument is working properly, a test measurement with the pH4 buffer solution should be done.

d) Measurement

i) Turn the selector switch (2) to "zero-point".

ii) Check the fix-point setting. If the pointer is no longer in the centre of the scale, correct any deviations with the counter - EMF (1).

iii) Wash the measuring vessel several times with the water to be tested.

iv) Fill the measuring vessel about one-quarter full with the water to be tested.

v) Transfer the electrode assembly to the right side of the meter and remove the rubber stopper from the KCl filler opening of the reference electrode.

vi) Take the reference electrode from its storage vessel and wipe it with soft tissue.

vii) Transfer it to the measuring vessel.

viii) Set knob (3) to the temperature of the water.

ix) Turn the Selector switch (2) to "Measure".

x) Allow about 30 seconds and then make a mental note of the reading.

xi) Return the selector switch to "zero point", readjust the fix-point setting and return the selector switch to "measure".

xii) This process should be repeated until two identical or nearly identical consecutive readings have been attained.

For maintenance instructions, see Appendix III.

3) Dissolved Oxygen

a) Fixing the sample in the field.

i) Rinse the bottle with the water to be tested.

ii) Fill the bottle slowly, being careful not to cause excess bubbling.

iii) Let the bottle set for a few minutes.

iv) Tap lightly on the side of the bottle with the lid to remove any bubbles adhering to the inside of the bottle.

v) Stopper the bottle, being careful not to introduce any air.

vi) Remove the lid (Steps v and vi are intended to create enough room for re-agents).

vii) To the sample, add 2 ml. of manganous sulphate solution (pink) followed by 2 ml. of alkali-iodide-ozide reagent (colourless). The top of the burette should be below the surface of the sample to avoid bubbling.

viii) Stopper carefully and shake the sample for about 30 seconds.

b) Preparation and Titration in the Laboratory

i) Sample should be shaken again and the precipitate allowed to settle halfway.

ii) Add 2 ml. of concentrated sulphuric acid. The tip of the burette should not be put into the sample.

iii) Stopper, mix and allow to stand at least five minutes and not more than five hours.

iv) Titrate 203 ml. with 0.025 N thiosulphate to a pale straw colour.

v) Add 1-2 ml. of starch indicator and slowly continue the titration to the first disappearance of the blue colour.

Dissolved Oxygen $mg/_l$ - ml. of titrant.

4. Biochemical Oxygen Demand

a) In the Field:

i) Put about 800 ml. of sample in a one-litre plastic bottle.

ii) Stopper and shake vigourously.

b) In the Laboratory:

i) Shake vigourously again.

ii) Fill two D.O. bottles with the water from the one-litre bottle.

iii) Perform a D.O. test on one of the samples immediately.

Note 1: When the sample is "fixed"in the laboratory, the sample should be shaken and allowed to settle at least twice before the acid is added.

iv) Stopper the other bottle, being careful to leave water on the lid. This "water seal" prevents air from entering the bottle.

v) Place the bottle in an incubator for five days at 20°C.

Note 2: The water above the lid evaporates quite rapidly in the incubator so the BOD bottles should be "watered" every day.

vi) After the incubation period, do a D.O. test on the sample.

vii) The BOD in mg/l = Initial D.O. - 5 day D.O.

5. Alkalinity

i) Measure out 100 ml. of sample in a porcelain dish or a 250 ml. beaker. Putting a piece of white filter paper under the beaker will help identify the end-point.

ii) Add four drops of Phenolphthalein solution to the sample.

Note 1: If the solution becomes coloured (light pink), titration is required. If no colour develops, the phenolphthalein alkalinity is zero. If the water has a pH of less than 8.3 the phenolphthalein alkalinity will be zero.

iii) Add the 0.02N sulphuric acid titrant slowly with continuous stirring until coloration disappears.

iv) Record the ml. of titrant used and calculate the phenolphthalein alkalinity.

Phenolphthalein alkalinity as mg/l $CaCO_3$

$$= \frac{\text{ml of titrant} \times 1000}{\text{ml. of sample}}$$

v) Using the same sample, add 10 drops of mixed methyl orange and phenolphthalein indicator.

vi) If the solution turns green, add titrant slowly with continuous stirring until the colour changes from a faint purple to a pink.

Note 2: The end-point is very difficult to see and requires a little practice to get consistent results. It is important to add the same number of drops of indicator for every test. It is a good idea to do a trial

run on a tap water sample, adding an excess of titrant. When the end-point has been reached, the colour will not change. This colour can be used as a guide to the end-point on all the tests to be performed.

vii) Record the total ml. of titrant used and calculate the total alkalinity.

Total alkalinity as mg/l $CaCO_3$

$$= \frac{\text{ml. of titrant} \times 1000}{\text{ml. of sample}}$$

This procedure should be repeated until there is agreement to within 0.05 ml.

6. Flow Measurement

a) 90^{o} Triangular V-notch Weir

The day before the sampling is to take place, the weirs in the irrigation ditch should be checked to see if any repairs are needed. Quite often, water will work its way around or under the weir face resulting in an incorrect reading. The weir reading should be made with the weir gauge set on the bottom of the V with the graduations on the gauge set upstream as much as possible to record the actual level of the water behind the weir plate. A drop in level occurs just in front of the weir plate where the water flows through the notch. The reading should be taken to the nearest 1/100 of a foot.

b) Flow-meter Cross Section

The flows in the Trout Creek study area will be measured by Mr. Walter Lutsiak of the Water Survey of Canada every month at a time to be arranged between Mr. Lutsiak and the Groundwater Division. In case extra samples are to be taken, the outline of the procedure used in measuring these flows will be given. The necessary equipment can be obtained from Mr. Paul Fee (see Appendix II for the telephone number).

The site should be in a location where the cross-sectional depth is as even as possible. Also, there should not be any large rocks or white water at or just above the site. For a large enough stream, 20 positions, equally spaced across the stream, should be chosen as sites for the flow-meter readings. If the stream is very small, a more appropriate smaller number of sites can be chosen. The flow-meter readings should be taken downstream of the tape and the technician should stand as far away from the meter as possible to avoid interference with the natural flow patterns of the stream.

A chart such as the one shown below can be prepared for recording the measurements.

Date: 5/8/69

Tape Measure	Depth	Revolutions	Time (sec.)
Left Bank 1 ft. 6.in.	0 ft. @	4:10 PM	P.S.T.
2 ft.	0.4 ft.	10	43.5
3 ft.	0.6 ft.	10	45.0
4 ft.	0.8 ft.	15	58.3
:	:	:	:
:	:	:	:
Right Bank 30 ft.	0 ft. @	5:30 PM	P.S.T.

Each flow-meter is calibrated annually and a rating table prepared. This table contains experimental data of the velocity of the water when the meter turns various numbers of revolutions in various time intervals. Using the velocity and the depth of the stream at each site, graphical integration can be used to calculate the total volumetric flow rate.

Flow-meter Readings

i) Drive a stake into the bank on both sides of the stream at the site.

ii) Stretch a tape out between the stakes and tie at either end.

iii) Place the automatic weighting rod on the bottom of the stream at the first site.

iv) Record the tape measure reading here.

v) Record the depth of the stream as determined from the graduations on the bottom of the rod.

vi) Set the meter to the correct depth. For example, if the depth of the stream is 1.6 feet, the 0.6 on the handle should be lined up with the one on the bar. This automatically sets the meter 6/10 of the depth from the surface. To be accurate, the velocity should be measured at 2/10 and 8/10 but if the depth is less than 2.5 feet, one reading at 6/10 is usually measured.

vii) With a stopwatch, determine the time it takes the meter to turn a specific number of revolutions mentioned on the rating table.

Note 1: In order to make the calculations easier, it is beneficial to record the time it takes the flow-meter to turn one of the numbers of revolutions (5, 10, 15, 20, 30, 40, 60, 80, 100, 150, etc.) recorded on the rating table. The time also must be within the time interval found on the table.

Note 2: The use and care of the meter should be discussed with either Mr. Paul Fee or Mr. Walter Lutsiak before any readings are attempted. The meter is very delicate and any rough or incorrect treatment could result in throwing it out of calibration.

Equipment Needed

i) Automatic weighting rod
ii) Standard flow-meter
iii) Steel tape (50 ft.)
iv) Stopwatch
v) Wooden stakes (2)
vi) Rating table.

c) Staff Gauge

Establishment of a staff gauge at a site is beneficial if the flow is to be measured often. It eliminates the necessity of performing a flow-meter cross-section every time the flow rate is required. Firstly, however, the gauge must be calibrated. A flow-meter cross-section is performed and the equivalent gauge height recorded for three or four widely different flows in the creek. A curve is prepared of discharge rate versus gauge height. From this curve, the flow of the creek can be determined directly from the gauge height, provided high flow rates do not disturb the bed too much. If this happens, the staff gauge will have to be re-calibrated.

D. WELL SAMPLING NETWORK

1) Representative Samples

a) Directly from the well

If possible, the well should be sampled directly by use of the three-litre sampler. Remove the well cover being careful not to introduce any debris into the well. With the well line, determine the static water level and the depth of water in the well. Because the sampler must not disturb the bottom sediments or protrude above the water's surface, the depth of the water should be at least three feet. In an effort to be as consistent as possible, the well should be sampled from the same depth in every survey.

If there are any problems with the sampler, Mr. Fred Waterman (see Appendix I for telephone number) will be able to help.

b) From a Domestic Pressure System

If the well cannot be sampled directly, it can be sampled from a tap connected to the domestic pressure system. The tap should be run until the storage tank has been emptied and the water is being pumped directly from the aquifer that feeds the well. With maximum flow, the average pressure tank should be emptied in ten minutes.

c) Artesian Systems

The water that flows out of the ground will be representative of the ground water and can be sampled directly.

2) Samples Required

There are 75 wells in the well-sampling network in 43 areas scattered from Armstrong to Osoyoos. The wells are listed on the well location master sheet which gives each well's area and number, its owner's name and address, and any information that will be useful in finding the wells and compiling records of them later.

3) Field Tests Required

a) conductivity
b) temperature
c) pH
d) static water level

One one-litre sample collected from each well is enough for the laboratory analysis. The sample should be put in a cooler containing ice pacs as soon as it has been collected and transferred to a freezer two or three hours after it has been collected to stop bacterial action on the nitrates and phosphates. The bottle should only contain about 900 ml. of water to allow for expansion when the samples are frozen.

4) Laboratory Analysis

a) ortho-phosphate
b) total phosphate
c) nitrate
d) total carbon.

5) Shipping

The well and surface samples should be shipped by Greyhoud to the Federal Water Quality Laboratory in Calgary for analysis. To ensure these samples are frozen solid before being shipped, they should be left in a freezer overnight. No special insulation is required when packaging the samples. If they are shipped on the evening bus, they will arrive in Calgary in time for analysis the next morning. If it is convenient, two days' sampling may be sent at once. The lab has requested, however, that no more than 20 samples be sent at one time and that the samples not be left frozen more than three days. The time from the collecting of a sample to its arrival at the lab is the better part of three days. For example, if the samples are collected on Wednesday, they will be frozen overnight, shipped on Thursday evening to arrive in Calgary on Friday morning. Because of this time lag, no sampling can be done on Thursday or Friday. A copy of the field sample sheet with the results of the field tests should be sent to Calgary with the bottles. The shipping expenses are to be paid by Calgary.

E. SUMP SAMPLING NETWORK

1) Representative Samples

If the water is deep enough, the samples can be collected with the three-litre sampler. During the summer, the Osoyoos North sumps were in this category.

If the water is very shallow, as in the Glenmore Valley study area, a different technique is required. A ladder should be lowered into the sump and a small beaker used to fill a bucket. Care should be taken not to disturb the sediments in the bottom of the sump. In the Glenmore Valley study area, these sediments are very fine and require considerable time to settle out. The sampling should be started at Sump 8. Then, if the bottom is disturbed, the turbid water will be carried downstream to the sumps that have already been sampled.

2) Samples Required

a) Glenmore Valley - sample every sump
b) Osoyoos North - sample sumps 3, 4, 5, 6, 8 and 10 as well as the seepage area.

3) Field Tests Required

a) conductivity
b) temperature
c) pH
d) static water level (Osoyoos North)
e) D.D.

The sample size collected and its treatment before shipping to Calgary is the same as for the well samples. Because the conductivity of the water in the sumps at the Glenmore Valley study area is greater than 2,000, the water used for the conductivity test has to be diluted 1:1 with de-ionized water.

4) Laboratory Analysis (Calgary)

a) ortho-phosphate
b) total phosphate
c) nitrate
d) total carbon.

5) Shipping

The shipping procedure is the same as was outlined for the well samples.

F. SURFACE SAMPLING NETWORK

1) Representative Samples

The surface water samples in Trout Creek are best taken at midstream and mid-depth. The kettles in Osoyoos South should be sampled below the surface and as far away from the shore as possible. Surface algae should be kept out of the samples collected.

2) Samples Required

a) Glenmore Valley Irrigation Ditch
   i) north of the Weisbeck property
   ii) south of the Weisbeck property
   iii) intersection of Glenmore Drive and Valley Road.

b) Trout Creek

i) above the irrigation diversion dam
ii) in the domestic water supply waste
iii) in the irrigation flume just below the dam
iv) in the irrigation flume at the lake.
v) at the mouth of Trout Creek

c) Osoyoos South

i) large kettle
ii) small kettle

3) Field Tests Required

a) conductivity
b) temperature
c) pH
d) dissolved oxygen (D.O.)
e) biochemical oxygen demand (BOD)
f) alkalinity
g) flow measurement
i) weir readings (Glenmore Valley)
ii) flow-meter cross-sections (on all locations at Trout Creek except at the mouth).
iii) staff gauge (Trout Creek mouth)

Since the lab has to be ready to do part of the analysis immediately, they should be telephoned at least two days ahead of time and informed as to when the samples will be arriving. Two samples from each site are required for the lab analysis.

- One one-litre bottle for the chemical oxygen demand test (COD)
- One one-gallon bottle for the rest of the analysis.

The COD samples should be kept in a cooler after being collected and kept close to 32° F. until the analysis is to be performed. The large sample bottles should be kept in a cool place but they need not be refrigerated in the field. The alkalinities, dissolved oxygens and biochemical oxygen demands can be performed in the portable Energy, Mines and Resources laboratory at the Kelowna Pollution Control Centre. A few hundred ml. from each of the large samples can be used to do the alkalinities.

4) Laboratory Analysis

a) Turbidity
b) Total phosphate
c) Total nitrogen
d) Nitrite nitrogen
e) Nitrate nitrogen
f) Chemical oxygen demand
g) Major ions.

5) Shipping

The surface samples should be shipped by Greyhound the same day as they are sampled. The COD samples are shipped in a cooler containing one or two ice pacs but the one-gallon samples can be simply packed in a suitable cardboard box. A water chemistry requisition form should be filled out and sent in with each sample (see Appendix IV). The Groundwater Division is responsible for the freight costs.

G. BACTERIOLOGICAL SAMPLING

1) Representative Samples

The sample bottle should not be opened until it is required for sampling. The lid and foil should be removed as a unit with care not to touch the inside of the lid or the neck of the bottle. The bottle should be filled without rinsing

to within one inch of the top and the lid replaced immediately.

If the samples are taken from a top on a domestic well pressure system, the end of the top should be heated with a match to kill any local contamination. Then the tap should be run wide open for 10 minutes to get fresh water. When collecting the sample, the flow from the tap should be restricted to avoid splashing.

When the sample is taken from a well fitted with a hand pump, the water should be pumped to waste for five minutes before taking a sample. If there is no pumping machinery, the sample was collected with the three-litre sampler. The sampler should be "sterilized" before it is put into the well. This can be done by washing it inside and out with a fairly strong bleach solution, followed by a thorough rinse with clean water.

2) Samples Required

All of the wells on the well location master sheet have been sampled once. If the results indicated some contamination, the well was sampled again. If the well had a positive result for coliform on the first round and a negative result on the second round, it was sampled another time. Any wells that have had one test done and it indicated contamination, have had one positive and one negative test, and are new on the network, will have to be sampled again.

3) Shipping

A Requisition/Report form (see Appendix IV) should be filled out and included with each bacteriological sample. The label on the bottle should also be filled out giving the sample location and to whom the laboratory results are to be sent. The samples should be sent to Vancouver the same day as they are collected and collected as early in the week as possible. The bottles can be shipped in an ordinary cardboard box. As with the surface samples, the Groundwater Division is responsible for the freight costs.

H. PROBLEMS AND RECOMMENDATIONS

The well and sump samples had to be in a freezer two to three hours after being collected. This subtracted from the time spent sampling and added many miles of driving to the job. Once the samples were in the freezer, they could not be removed until frozen. This meant either staying at the freezer location for three to six hours (depending on the freezer) and then driving back to Kelowna or returning the next day to pick them up. In sampling the southern area for example, this resulted in a waste of five hours or an extra 140-mile drive. If dry ice were used in future years, considerable economies in time and mileage would result. Unfortunately, there are no suppliers in the Okanagan so the dry ice would have to come from Vancouver. This Vancouver supplier is:

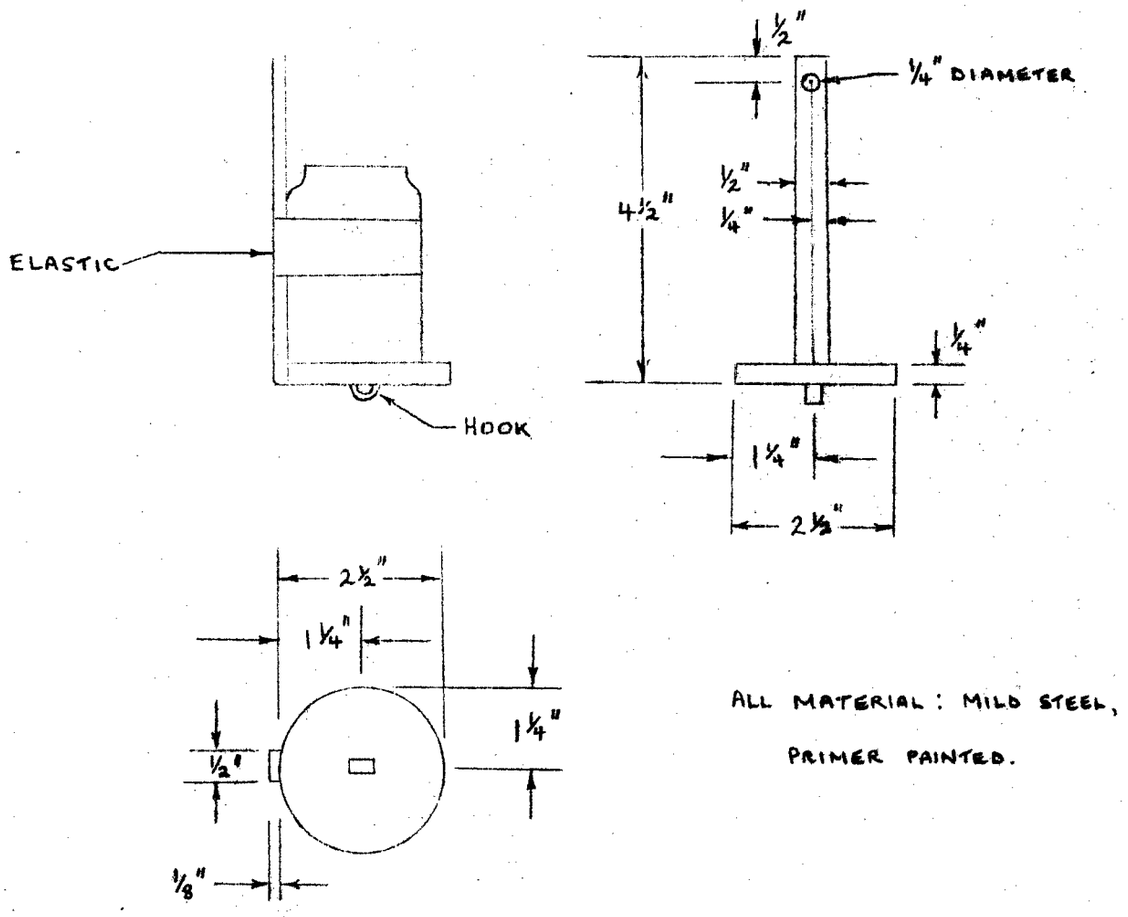
Liquid Carbonic Canadian Corporation
8797 Burrard Street, Vancouver, B.C.
Telephone 266-5311

The minimum shipment is 30 lbs. which would cost $3.66, plus $0.60 for a carton, plus $7.00 for shipping expenses. The ice would be shipped by CP Transport. According to a Liquid Carbonic representative, the dry ice should last three to five days in a styrofoam cooler, depending upon how often it was open and how well it was insulated. From an economic point of view, the extra cost of the ice would be more than offset by the savings in car expenses and time. If the work load is increased in future years by increasing the frequency of the surveys or by increasing the number of samples on the networks, the extra time saved would be extremely valuable. Also, the samples would be frozen almost immediately so the samples could be shipped the same day. This means samples could be collected on Thursday.

I would also recommend obtaining a larger and better insulated cooler for the vehicle. The cooler currently in use could only hold a maximum of six to eight

sample bottles with the increased bulk of the dry ice. This would restrict the amount of sampling done in one day. The dry ice would last longer also.

There was no apparatus available to obtain a proper bacteriological sample from a well that had no pumping machinery. The three-litre sampler was used by transferring a bacteriological sample from one vessel to another is not good technique. A device such as the one proposed below could be used to introduce the sample bottle directly into the well.



BIBLIOGRAPHY

1. Instructions for Use
   Portable pH Meters E280A and E444
   Metrohm Ltd.
   Herisan, Switzerland.

2. Instructions for Use
   Portable Conductivity Meter RA-2A
   Industrial Instruments, inc.
   89 Commerce Road
   Cedar Grove, New Jersey

3. Field Manual
   Okanagan Lake Survey
   British Columbia Division of Laboratories
   Health Branch

4. Standard Methods for the Examination of Water and Wastewater
   American Public Health Association
   New York
   1967

See rear of report for copies of 1, 2 and 3
See Groundwater Division Library for 4.

APPENDIX "I"

EQUIPMENT INVENTORY

Item	Quantity	Owner
400 ml. beaker	1	Dept. of Energy, Mines & Resources
polyethylene test tube	1	" " " " " "
Pyrex graduated cylinder (100 ml.)	1	Water Quality- Division
1000 ml. beaker	1	" " "
polyethylene cylinder	1	" " "
Model RA-2A portable conductivity meter	1	" " "
Metrohm E280 A portable pH meter	1	" " "
biochemical oxygen demand bottles	22	" " "
disposable pipettes	2	" " "
conductivity meter case	1	" " "
thermometer	1	" " "
steel thermometer case	2	" " "
sample bottle holder	1	" " "
weir gauge	1	Dept. of Energy, Mines & Resources Water Survey of Canada
small sampler	1	Dept. of Energy, Mines & Resources
small sampler case	1	" " " " " "
rod and reel	1	Hydrological Sciences Division
3-litre sampler	1	B.C. Dept. of Agriculture
well line	1	Water Resources Service
crowbar	1	Groundwater Division
hose	25 ft.	" "
artificial ice pacs	3	" "
styrofoam cooler	1	" "
small Hach kit	1	" "
stepladder	1	" "
bucket	1	" "
waders	1	" "

Re-agent List

manganous sulphate solution
alkali-iodide-ozide reagent
concentrated sulphuric acid
0.02 N sulphuric acid
0.025 N sodium thiosulphate
starch indicator
phenolphthalein indicator
methyl purple indicator (or mixed phenolphthalein and methyl orange indicator)
saturated potassium chloride solution
pH 7 buffer solution
pH 4 buffer solution
de-ionized water

APPENDIX "II"

USEFUL TELEPHONE NUMBERS AND ADDRESSES

British Columbia Government			
Dept. of Agriculture Soil Survey Branch	Mr. C.H. Brownlee Mr. Fred Waterman	1420 Water St. Kelowna, B.C.	762-2229
Water Resources Service Water Rights Branch	Mr. B.F. Alcock	1420 Water St. Kelowna, B.C.	762-2404
Water Investigations Branch	Mr. S.B. Mould	Oliver	498-2200
Groundwater Division	Dr. J.C. Foweraker Mr. J.T. Gulliver	Parliament Buildings Victoria, B.C.	763-4322* Loc. 3434
	Mr. R.D.B. Lyttle	"	763-4322* Loc.3429
South Okan. Health Unit	Mr. F. Alcock	390 Queensway Ave. Kelowna, B.C.	762-2704
	Mr. J. Shannon	300 Eckhardt Ave.E. Penticton, B.C.	492-6116
Health Branch, Division of Laboratories	Mr. A. Lynch-Head	828 West 10th Aven.	874-2331 Loc.242
	Mrs. H. Kalnins-Chem.		Loc.259
	Miss J. Campbell-Bac.		Loc.249
* Telpac			
Government of Canada			
Dept.Energy, Mines and Resources Water Survey of Canada	Mr. P. Brock Mr. W. Lutsiak	301 Main Street Penticton, B.C.	493-0135
DEMR, Water Quality Div.	Mr. S.W. Reeder	724 - 11th Ave.S.W. Calgary, Alberta	
	Mr. Paul Fee	Kelowna Kelowna Pollution Control Centre, cor.Ethel St. and Raymer Rd.	763-5318 Lab. 763-2372 Res.
Summerland			
Trout Creek I.D.	Mr. P. Monroe	Municipality of Summerland, Main St., Summerland	494-6451
Municipal Works Yard	Mr. K. Blagborne	Jubilee Rd.	494-3456
Miscellaneous			
Greyhound Bus Depot		235 Queensway Ave. Kelowna, B.C.	762-2052
Interior Electronic Supplies Ltd.	(for conductivity and pH meter batteries)	3005 - 28th Ave. Vernon, B.C.	542-7637
Regatta City Motel		1780 Glenmore Ave. Kelowna, B.C.	762-3221
Warehouse		cor.Clement Ave. and Glenmore	

Freezer Locations

Pi[illegible]er Meat Market, Osoyoos, B.C.
Provincial Building, Oliver, B.C.
Bob's Market, Beach Avenue, Peachland, B.C.
Domestic Frozen Foods Ltd., 224 Leon Avenue, Kelowna, B.C.
Inn Towner Motel, 1627 Abbott Street, Kelowna, B.C.
Inland Ice and Cold Storage, 3001 - 37th Avenue, Vernon, B.C.
Armstrong IGA, Okanagan Street, Armstrong, B.C.

APPENDIX "III"

A. MAINTENANCE OF THE METROHM E280A PORTABLE pH METER

The instrument should be protected from contamination by corrosive atmosphere and also from the weather (damp, frost, etc.).

1. Batteries

A new set of batteries will give about 100 hours' continuous operation, while the effective working life can be increased by intermittent operation with sufficient resting time in between for the batteries to recover. If the selector switch (2) is put on "battery check", the pointer should reach the "battery good mark". If not, the batteries are so far run down that the accuracy and stability of the pointer can no longer by guaranteed. The whole set of batteries (four in all) must be replaced.

The batteries are located in a compartment in the top of the instrument (see figure 1). Make absolutely sure that the new batteries are connected with the right polarity and make good contact with the springs. In no case are 1.5V batteries to be used for LT.

B. MAINTENANCE OF THE RA-2A PORTABLE CONDUCTIVITY METER

1. Batteries

The only attention required in the normal service of the RA-2A Stream Conductivity Meter is the replacement of the batteries about once very year. Replacement is necessary only when it is no longer possible to bring the needle to "zero adjust" by rotating the "cal." knob. Two penlight size batteries or two longer-life mercury cells are required and a complete set should be installed. Remove the screw type plug on top of the meter case, remove the old batteries and replace with fresh ones. If the instrument is not in use for a while, the penlight battery terminals may require cleaning.

2. Inspection and Maintenance of Conductivity Cells

The electrodes of all Industrial Instruments conductivity cells are supplied coated with platinum black. Cells will operate satisfactorily with the RA-2A meter even when this coating has worn off or has been removed. However, the cells will not perform well if the electrodes are dirty or crusted with hard water solids. Any unusual behaviour of the meter not attributable to known variations in the stream measured should be taken as an indication that the cells require inspection and cleaning. An initial inspection interval of one or two weeks is suggested.

Period inspection of the cells should include a check on the following:

a) Are there cracks or chips in the cell or signs of wear?
b) Are the electrodes and inner wall of the cell clean and free of crusted salts?
c) Are the cell cable and neoprene sleeve in good condition?
d) Are the vent holes in the shield clear and free of obstruction?

The cells, being made of polystyrene, should not be cleaned in any organic solvent but rather immersed in 10% hydrochloric acid for a few minutes to dissolve carbonic solids and then rinsed in clean water.

APPENDIX "V"

A. OKANAGAN VALLEY WATER QUALITY DATA COLLECTION PROGRAM

Interim Federal-Provincial Sub-Committee No. 2, Summary Progress Report to October 26th, 1969.

Here is a list of the recommendations made for the 1969 season and a progress report to October 26th, 1969.

1) Water well inventory survey through the Okanagan Valley; preparation of well location maps and well record cards by the Water Investigations Branch, British Columbia Water Resources Service personnel.

Progress Report: the well location maps for the wells on the survey have been prepared. Some new well data was recorded in the process of picking up wells for the sample locations on the well network. During the winter, these records will be transferred to well cards. A full scale well survey should be done next summer in the Okanagan Valley.

2) Collection of groundwater samples, including the recording of pH, conductivity and static water levels from 75 wells, mostly domestic from 43 areas selected throughout the Okanagan Valley.

Progress Report: Two rounds have been completed. The third round has been completed except for areas 1 to 8 in the far southern area of the valley. The fourth round will be done in January or February 1970.

3) Collection of groundwater samples from the above 75 wells for water bacteriology analysis.

Progress Report: One round of bacteriology samples has been collected from all the wells on the network and the results have been received by the Groundwater Division. The wells that showed evidence of contamination on the first round were sampled again to see if the positive result was due to contamination in the water supply or contamination introduced in the sampling technique. These results have also been received. The few bacteriological samples left to do are:

a) wells that had one positive and one negative coliform test;
b) new wells on the survey.

There have been 109 samples collected to date.

4) Collection of groundwater samples by the Water Investigations Branch, the British Columbia Water Resources Service personnel from a representative 20 water wells in the Okanagan Valley for full chemical water quality analysis.

Progress Report: The 20 samples were collected between September 22nd and 24th. The areas were selected in order to obtain an even distribution of samples in the valley. The specific wells that were sampled were chosen because their water seemed to be the most representative of the ground water in that area. No attempt was made to determine the choices based on soil type, etc.

5) Mapping in the study areas to show:

a) sump sites
b) location of drains and direction of flow
c) piezometer sites
d) surface and sump water sample sites
e) water table contours

Progress Report: Quite a lot of this information has been obtained and is available on field maps of the four study areas. These field maps will be finalized this winter.

6) Collection of 15 groundwater samples from the drains in the Glenmore Valley and Osoyoos North study areas. These sumps are to be collected four times a year at similar times to those taken for the domestic well sampling program.

Progress Report: The third round has now been completed and the samples have been sent to Calgary for analysis. The fourth round will be collected in January or February.

7) Collection of surface water samples from the Glenmore Valley, Trout Creek and Osoyoos South study areas by Water Investigations Branch, British Columbia Water Resources Service personnel. The flow-meter readings in the Trout Creek study area by the Water Survey of Canada.

Progress Report: One round of seven surface samples were collected and sent to Division of Laboratories, Health Branch in Vancouver. The results have been received. The second round will be done at the end of October or the beginning of November. The third round will be done in January or February.

B. FUTURE WORK

1) Assist Mr. C.H. Brownlee on collecting information in the study areas on irrigation, fertilizer and pesticide schedules.

2) Sample the 40 peizometers once this year.

3) Look into measuring the drainage flow in the Osoyoos North study area.

4) Look into acquiring some evaporimeters for the study area.

5) Dry Ice test.

6) Information for Mr. Reeder

   a) Well revision list
   b) Details on the study areas (location, sample sites, etc.)

7) Prepare graphs of the fluctuations in the nutrient levels over the period of the sampling program.

8) Maps of the study area.

APPENDIX "VI"

"PROBLEM" WELLS WITHIN EXISTING NETWORK

Area	Well No.	Remarks
1	1	Mr. Matei complains of an oily taste in the water. It may be due to a leak in a service station gas tank up the hill.
4		Most of the water in the area is excessivly high in iron. Mr. Janssen's well is not very high in iron.
5	12	The land is not irrigated - natural bottom land.
6	1	The pump switch is in the house, so Mr. Taylor has to be home before the well can be sampled.
6	14	It is near a barn. There is quite a lot of foreign material in the well.
8	2	The well pump has to be primed. It takes a little practice.
9		The well is very shallow. It is difficult to sample because the large sampler will not fit through the hole in the lid. The small sampler must be used if the pump is off, which it usually is.
13	18	Mr. Fehr discontinued use of the well this fall. It was condemned by the health authorities.
16	18	The water in the well casing has quite a strong organic odor. The water taken from the sandpoint is much better is this respect.
22	8	The well is shut off in the winter.
25	2	The well is very shallow.
28		The wells in this area are quite deep (150 to 250 feet).
31		The wells in this area have a strong organic smell. The deeper wells are better than the shallow wells in this respect.
31	7	Mr. Pickering objects quite strenuously to the well being sampled because of the odor created when the well is pumped. His well is shallow and the hand pump is in the kitchen. The Silver Star Auto Court has a well of similar depth which can be substituted. Casing - 2 inch steel pipe; Method of Drilling - sandpoint; Depth - 30 feet. Artesian flow.
32	1	The well is not used very often.
33		The well is disconnected in the winter.
37	2	The well is extremely shallow and it is not being used anymore.
40		The well is new and a permanent pump will be installed next year.
42	1	The well is abandoned. It has a very high conductivity and should be pumped.