Standard Operating Procedure (SOP) for Water-Level measurements on Non-Flowing and Artesian wells

Prepared By:
John I. LaFave
1994

Updated By:
Camela Carstarphen
2010

Updated By:
Camela Carstarphen
2015

Updated By:
Dan Blythe
2016

Prepared For:
Montana Bureau of Mines and Geology
Ground Water Assessment Program

Document File Location:
\\mbmgs1a\gwap\SOPS

1.0 Title
Standard Operating Procedure for Collecting Water-Level Measurements on Non-Flowing and Artesian Wells

2.0 Location
Groundwater level measurements are made in the field at the well head.

3.0 Purpose
The purpose of these guidelines is to provide technical guidance and to outline a standard procedure to ensure that accurate and consistent water-level measurements are made in the field for the Ground Water Assessment Program. This report describes the more common methods of water-level measurement. Water-levels are commonly measured using a graduated steel tape, electrical measuring lines, or pressure gauge.

4.0 Scope
The scope of this report is to provide citable documentation for the technical field procedures used by MBMG technicians and hydrogeologists in collection of water-level data for the Ground Water Assessment Program. These procedures are used for general field-based guidance, standardization of measurements and are restricted to common field-based procedures. Procedures used in the collection of water-level data to meet special objectives may vary. This report does not provide documentation for all procedures used by the MBMG in the collection of water-level data.

5.0 References
Garber, M. S., and Koopman, F. C., 1968, Methods of Measuring Water Levels in Deep Wells, Techniques of Water-Resource Investigations of the U. S. Geological Survey, Book 8, Chapter A1, 23 p.

U. S. Geological Survey, 2013, National Ground Water Monitoring Framework Report, htp://acwi.gov/sogw/ngwmn_framework_report_july2013.pdf

U. S. Geological Survey, 1980, National Handbook of Recommended Methods For Water-Data Acquisition - Chapter 2, Ground Water, 149 p.

6.0 Sample Handling and Preservation
See Standard Operating Procedure for Field Visit and Water-Quality Sampling.

7.0 Apparatus and Materials
-Steel surveyors tape, of appropriate length, graduated in 0.01 foot increments. Carpenters chalk.
-Graduated electrical line or tape (sounder), e.g. Solinst, Sinco, or equivalent.
-Some method of cleaning the tape (clorox diluted with water in a spray bottle, a container of disinfecting wipes, paper towel or cloth rag).
-Extra batteries for the electric sounder.
-Pressure gauge and series of graduated metal attachments
-Sonic Sounder
-Mirror and/or flashlight

-Site-Inventory Sheet
-Land-owner Water Level Cards/Route Sheet
- Tool kit (plumbers tape, crescent wrenches, allen wrench set, hammer, needle-nosed pliers, pipe wrenches, engin driver, socket wrench and socket set, permanent markers)

8.0 Establishing a site and measuring point

A clearly established measuring point (typically the top of the well casing), should be established where water levels are to be measured. Clearly describe the measuring point and document on MBMG *Site-Inventory Sheet* (appendix I). Document the distance between the land surface and the measuring point. The measuring point for a flowing well should be placed as close to the outlet as possible.

9.0 Procedures

All water level measurements should be conducted before purging the well.

9.1 Steel Tape Measurements

1. Apply chalk to the first few feet of the tape by pulling the tape across a piece of carpenters chalk. A smooth coating of chalk on the tape should result.
2. Lower the tape into the well from the measuring point until a short length of the tape is submerged.
3. When the tape is submerged, hold the tape at the measuring point and read the value and record the "hold" value in the field notes.
4. Retrieve the tape from the well and note the water mark, or "cut" mark, on the chalked part of the tape. Record the "cut" mark in the field notes.
5. Subtract the "cut" reading from the "hold" reading to determine the distance to water below the measuring point. Record the resulting distance to water value in the field notes.
6. Repeat the measurement by lowering the tape into the well a second time and "holding" at a point on the tape 1 foot greater than the initial "hold" point. Subtract the new "cut" mark and determine a second distance-to-water value for the well. If two measurements made within a few minutes do not agree within 0.02 foot (in wells having a depth-to-water less than 300 feet), repeat measurements until a reason for the lack of agreement is determined, the results are shown to be reliable, or until it is determined that an accurate measurement is not possible. For depths greater than 300 feet, measurements should agree to within ± 0.1 ft. Record both measurements on the inventory or route sheet (appendix II).
7. After completing the water-level measurement, disinfect, rinse, and dry the portion of the tape that was submerged should be thoroughly rinsed with distilled water and dried.

9.2 Electric Line (Sounder) Measurements

1. Test the probe by dipping it in water and observing the indicator or by activating the "test" switch.
2. Lower the probe slowly into the well until contact with the water surface is indicated.
3. Read the electric line at the measuring point while the probe is just touching the water surface, and record the distance to water.
4. Repeat the measurement. If two measurements of static water level made within one minute do

not agree within 0.01 foot, repeat the measurements until a reason for the lack of agreement is determined, the results are shown to be reliable, or until it is determined that an accurate measurement is not possible. In cases of a recovering water level, remain for a reasonable time until consecutive water level measurements agree. Otherwise record both measurements on the inventory or route sheet and note that they are "non-static".

9.3 Pressure Gauge Measurements

1. Turn off the valve controlling flow from the well; note its position when open.
2. Carefully wire brush the threads on the pipe extending from the well. Put Teflon tape around the threads. If the pipe is cross-threaded or if there is any uncertainty about the integrity of the well casing and piping on a discharging well, do not attempt to measure pressure.
3. Carefully attach the necessary fittings to reduce to the diameter of the fitting on the pressure gauge. Attach the pressure gauge.
4. Completely open the valve controlling flow from the well.
5. Give the pressure gauge time to respond a recommended 15 minutes. Read the pressure gauge reading twice several minutes apart. If two measurements of pressure level made within a few minutes do not agree within 0.05 PSI, repeat the measurements until a reason for the lack of agreement is determined or until the results are shown to be reliable or until it is determined that an accurate measurement is not possible.
6. Record both measurements on the inventory or route sheet.

10.0 Quality Control

Quality control will be maintained by collecting two consecutive water level measurements within acceptable agreement for the procedure used. If agreement is not achieved, record the lack of agreement on the inventory or route sheet.

11.0 Documentation

The location and water level measuring point is documented on the *Site-Inventory Sheet* (appendix I) including a map of the site, directions, and notes about any special circumstances or locations of additional wells (see Standard Operating Procedure for Field Visit and Water-Quality Sampling (\\mbmgs1a\gwap\SOPS). Record the well casing diameter, and collect latitude and longitude from a hand-held GPS unit. If this is a state-wide monitoring network well, then record water-level measurements on the field route sheet. Monitoring site will be tagged and photographed.

Site Inventory Sheet

☐ **QAQC** ☐ **entered** ☐ **scanned** ☐ **juno** **SAMPLE**_____ ☐

Date _____ **SITE INVENTORY SHEET** **Project Code**_____

GWIC Id: _____ **Aquifer Code**_____

Owner
Name_____
Address _____
_____
Phone _____

User/Resident (if different)
Name _____
Address_____
_____
Phone _____

LOCATION: T _____$^{N}_{S}$ R _____$^{E}_{W}$ S _____ Tract ___/___/___/___ Irreg. Sect? Y__N__

Latitude_____Longitude_____Datum_____ Geomethod_____

County_____ USGSMap7$^{1}/_{2}$'_____ Altitude _____

WELL DETAILS

Water Use _____ Casing I.D. _____(in) Total Depth From Ground _____

Measuring Point (M.P.) _____ft(+ above, - below land surface) M.P. Elev._____

Water-Level Measuring Point Description:_____

Sampling-Point Description: _____

Can sample be collected?Y__ N__Before pressure tank?Y__ N__Unk__Before Treatment?Y__N__Unk___

STATIC WATER LEVEL (E-Line___/Steel Tape___/Pressure Gauge___sonic sounder___&temp___)

Time	Depth Below M.P.	PSI	Head	Water level altitude	Remarks

PURGING PARAMETERS ORP Probe: discharge

Time	Temp C°	S.C .(µS/cm)	pH	Redox (mv)	DO mg/L		notes
FINAL							

PUMPING WATER LEVEL (E-Line___/Steel Tape___/Pressure Gauge___sonic sounder___&temp___)

Time	Depth Below M.P.	Water level altitude	Remarks: pump cycling? ☐ yes ☐ unk

SITE NOTES:

_____

_____

_____

_____

_____

SITE SKETCH MAP
Show location of well and sampling point. If necessary show site location in relation to roads.
^ North

INVENTORY NOTES:_____

_____

_____

_____

General condition of well and surface seal (Good ___ Fair ___ Poor __)
Condition of water: Clear ___ Turbid ___ Other_____

SAMPLE: Standard (250ml **FU**, 500ml **FA**{HNO_3},500ml **RU,** 10ml **FU** 2H&O18) ☐

Other (nitrate only, tritium, etc.) _____

ALKALINITY TITRATION **Bottle Number**_____

Vol. Of Sample	Total Vol. Titrated	Acid Conc.	Original pH	Digits to Reach 8.3 pH	Actual Endpoint	Digits to Reach 4.5 pH	Actual Endpoint	Total Digits

Alkalinity Concentration ☐ (mg/L as CaCO3)_____

FEET OF WATER	gal/ft by casing diameter	total gal	/DISCHARGE RATE	MINUTES PER WELL VOLUME
	(2"x.163),(4"x.65),(6"x1.47),(8"x2.61),(10"x4.08),(24"x23.5)			

Name_____ **Agency** _____

Example of monthly or state-wide monitoring network route sheet

Site Id (Last Date/Meas) Site Name Location	Date	Time	Steel Tape Only			DTW Sounder	Remarks
			Hold	Cut	DTW/MP		
175011 (W) (9/3/2015 - 122.71) LEPROWSE, WALT AND TERRI 03S09W1AABA							
SITE COMMENT:							
221292 (W) (9/3/2015 - 8.63) GARRISON, LETISHA & TODD 04S08W30CBBA							
SITE COMMENT: THIS WELL IS CLOSER TO HOUSE OF 2 WELLS							
108962 (W) (9/16/2015 - 30.42) STODDARD, SPENCE 06S07W34BADA							
SITE COMMENT:							
108949 (W) (9/16/2015 - 22.17) CHRISTIANSEN, TED 06S07W10DACC							
SITE COMMENT:							
108531 (W) (9/3/2015 - 12.24) COLE, GOODMAN 05S07W22CDCD							
SITE COMMENT: BEAVERHEAD ROCK							
131577 (W) (6/10/2015 - 23.3) EAST BENCH...OBS * 312A 05S07W14DDDD							
SITE COMMENT:							
130177 (W) (9/3/2015 - 137.84) EAST BENCH... * 10-5-6A 05S06W10BBCC							
SITE COMMENT:							
130176 (W) (9/3/2015 - -23.86) EAST BENCH...4-6 (DEEP) 04S06W35BBBB							
SITE COMMENT:							
260970 (W) (9/3/2015 - 34.3) EAST BENCH...OBS * 352A 04S06W16AAAA							
SITE COMMENT: WEST SIDE OF NYE RD 1.9 MILES NORTH OF INTERSECTION							

Montana Bureau of Mines and Geology

Standard Operating Procedure SOP
For
Collection of Ground-Water Samples For Inorganic Analyses
From Wells and Springs

Prepared by:
John I. LaFave and Dennis P. McKenna

Updated by Dan Blythe
2016

Prepared For:
Montana Bureau of Mines and Geology

Document File Location:
\\mbmgs1a\gwap\SOPS

1.0 Title
Standard Operating Procedure for Collection of Groundwater Samples for Inorganic Analysis.

2.0 Location
Groundwater samples are collected upstream from any water treatment, or as close as possible, the well head

3.0 Purpose
The purpose of this document is to provide a description of the requirements, recommendations and guidelines used by the MBMG to collect water-quality samples from wells and springs. These water-quality data are used for the Ground Water Assessment Program. The methods described in this SOP are fundamental to the collection of water-quality samples that are representative of the ambient environment.

4.0 Scope
The scope of this report is to provide citable documentation for the technical field procedures used by MBMG technicians and hydrogeologists in collection of groundwater samples for inorganic analysis. These procedures are used for general field-based guidance, standardization of measurements and are restricted to common field-based procedures. Procedures used in the collection of groundwater samples to meet special objectives may vary. This report does not provide documentation for all procedures used by the MBMG in the collection of groundwater samples.

5.0 References
U.S. Geological Survey, 2006, Collection of water samples (ver. 2.0): U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A4, September 2006, accessed [date viewed], at http://pubs.water.usgs.gov/twri9A4/.

6.0 Apparatus and Materials
Submersible pump & generator or bailer (if well does not have a pump)
Conductivity, pH, temperature, redox, and DO probes with meters
Alkalinity titration equipment and supplies
Flow-through chamber
Filters (0.45 um), regular or high density
Sample bottles (250-mL and 500-mL)
Acid preservatives
Site Inventory Sheets (Appendix I)
1-gallon Ziplock bags
Waterproof pens (Sharpies)
Ice chest and ice
Plastic bucket
Garden hose/y-valves/small diameter tubing that fits filter
Decontamination solution – water and Clorox or disinfectant wipes
Extra batteries for all equipment
Nitrate strips

Water-Level indicator, steel tape, pressure gage (needed bushings)

7.0 Procedures

7.1 Wells

At each well site, the following activities will be conducted.

1) Confirm landowner permission to sample the well.
2) Measure static water level in well and calculate volume of water in well.
3) Set up flow-through chamber and field meters.
4) Pump well until purging parameters stabilize.
5) Collect ground-water samples and QA/QC samples as necessary.
6) Conduct titration to determine total alkalinity of sample.
7) Confirm that all bottles are properly labeled and that the Site Inventory sheet is completely and accurately filled out.

7.2 Equipment Setup

The following are general steps for equipment setup:

1) Rinse the faucet threads and Y-adapter coupling with DI water.
2) Attach the Y-adapter to the sampling faucet.
3) Attach the garden hose to one end of the Y-adapter and place the other end of the garden hose at an appropriate drainage area.
4) Rinse the threaded coupling on the end of the tubing on the flow-through cell with DI water and attach the tubing to the faucet Y-adapter.
5) Use the long length of tubing to route the discharge water from the flow-through cell to an appropriate drainage area.

7.3 Stabilization of Purging Parameters

At least one well volume should be pumped from the well and the purging parameters temperature, pH, and specific conductance should stabilize before collecting the sample. Redox and dissolved oxygen are also monitored. The purging parameters should be recorded at regular intervals on the *Site Inventory Sheet*. If the field parameters do not exhibit stability after three well volumes have been removed, the well may be sampled. Temperature is considered stable when three consecutive readings are within 0.5 degrees, pH when three consecutive readings are within 0.1 units, and specific conductance is considered stable if three consecutive readings are within +/- 5 percent.

7.4 Springs

Attach the y-valve to the spring outlet and connect flow-through cell. Return to 7.1. and follow sampling steps.

7.5 Sample Collection

In general, at each sample location a total of four sample bottles will be filled:

1) a 250-mL sample that has been filtered but not preserved (for inorganic anions and fluoride),
2) a 500-mL sample that has been filtered and preserved with nitric acid (for dissolved metals and trace metals),
3) a 250-mL filtered sample that has been preserved with sulfuric acid (for nitrate-nitrite), and
4) a 500-mL unfiltered, unpreserved sample (for laboratory alkalinity and specific conductance).

8.0 Sample Handling and Preservation

Following sample collection the samples should be transferred to coolers packed with ice and cooled to 4^{o} C. Storing the samples in a cooler also helps protect the sample bottles from damage during transport. Samples should not be frozen.

9.0 Documentation

In general, the information documented on the *Site Inventory Sheet* should include what type of sample was collected, who collected sample, when the sample was collected, the location of the sampling point, why or for what program the sample was collected, condition of the sample, stabilization criteria and the purging method. In addition, the total number of bottles, the filter and preservation status, and the desired analyses should be documented. It is impossible to over document your work; if you are not sure if a bit of information is necessary, record it.

Site Inventory Sheet

☐ QAQC ☐ entered ☐ scanned ☐ juno **SAMPLE**_____ ☐

Date _____ **SITE INVENTORY SHEET** **Project Code**_____

GWIC Id: _____ **Aquifer Code**_____

Owner
Name_____
Address _____
_____
Phone _____

User/Resident (if different)
Name _____
Address_____
_____
Phone _____

LOCATION: T _____$^{N}_{S}$ R _____$^{E}_{W}$ S _____ Tract ___/___/___/___ Irreg. Sect? Y__N__

Latitude_____Longitude_____Datum_____ Geomethod_____

County_____ USGSMap7$^{1}/_{2}$'_____ Altitude _____

WELL DETAILS

Water Use _____ Casing I.D. _____(in) Total Depth From Ground _____

Measuring Point (M.P.) _____ft(+ above, - below land surface) M.P. Elev._____

Water-Level Measuring Point Description:_____

Sampling-Point Description:_____

Can sample be collected?Y__ N__Before pressure tank?Y__ N__Unk__Before Treatment?Y__N__Unk___

STATIC WATER LEVEL (E-Line___/Steel Tape___/Pressure Gauge___sonic sounder___&temp___)

Time	Depth Below M.P.	PSI	Head	Water level altitude	Remarks

PURGING PARAMETERS ORP Probe: discharge

Time	Temp C°	S.C .(µS/cm)	pH	Redox (mv)	DO mg/L		notes
FINAL							

PUMPING WATER LEVEL (E-Line___/Steel Tape___/Pressure Gauge___sonic sounder___&temp___)

Time	Depth Below M.P.	Water level altitude	Remarks: pump cycling? ☐ yes ☐ unk

SITE NOTES:

_____

_____

_____

_____

_____

SITE SKETCH MAP
Show location of well and sampling point. If necessary show site location in relation to roads.
^ North

INVENTORY NOTES:_____

_____

_____

_____

General condition of well and surface seal (Good ___ Fair ___ Poor __)

Condition of water: Clear ___ Turbid ___ Other_____

SAMPLE: Standard (250ml **FU**, 500ml **FA**{HNO_3},500ml **RU,** 10ml **FU** 2H&O18) ☐

Other (nitrate only, tritium, etc.) _____

ALKALINITY TITRATION **Bottle Number**_____

Vol. Of Sample	Total Vol. Titrated	Acid Conc.	Original pH	Digits to Reach 8.3 pH	Actual Endpoint	Digits to Reach 4.5 pH	Actual Endpoint	Total Digits

Alkalinity Concentration ☐ (mg/L as CaCO3)_____

FEET OF WATER	gal/ft by casing diameter	total gal	/DISCHARGE RATE	MINUTES PER WELL VOLUME
	(2"x.163),(4"x.65),(6"x1.47),(8"x2.61),(10"x4.08),(24"x23.5)			

Name_____ **Agency** _____

Example of Completed Site Inventory Sheet

☒ QAQC ☒ entered ☒ scanned ☒ juno SAMPLE Tuck ☒

SITE INVENTORY SHEET

Date 6/4/2014 Project Code GWCP09

GWIC Id: 153624 Aquifer Code 210 UNFD JLRX - Eagle

Owner
Name David Duncan & Ellen Winter
Address 607 Swingley Rd
Livingston, MT 59047
Phone (406) 224-1573

User/Resident (if different)
Name
Address
Phone email davidtduncan@icloud.com

LOCATION: T 02 N (S) R 11 E (W) S 19 Tract C ID 1B1A Irreg. Sect? Y__ N X

Latitude 45.64105500 Longitude -110.41916500 Datum NAD83 Geomethod NAVGPS 1 unit

County Park USGSMap7½' MISSION Altitude 5360

WELL DETAILS

Water Use DOM Casing I.D. 6 (in) Total Depth From Ground 100 ← on cap (Hillman!)

Measuring Point (M.P.) 2.1 ft (+ above, - below land surface) M.P. Elev. 5362.1

Water-Level Measuring Point Description: top of casing

Sampling-Point Description: hydrant in yard close to tank & fence

Can sample be collected? Y ✓ N___, Before pressure tank? Y ✓ N___ Unknown ___

Before treatment? Y ✓ N___ Unknown ___, Comments

STATIC WATER LEVEL (E-Line X /Steel Tape___/Pressure Gauge___sonic sounder___&temp___)

Time	Depth Below M.P.	PSI	Head	Water level altitude	Remarks
1233	46.15			5315.95	B
1234	46.15				

5362.10
46.15
5315.95

PURGING PARAMETERS ORP Probe: WTW discharge

Time	Temp C°	S.C .(µS/cm)	pH	Redox (mv)	DO mg/L	gal/min	notes
1240	10.2	420	7.73	58.4	8.00		
1245	8.7	413	7.4	41.6	7.60	20/39gal	@ 58 pump cycling
1250	8.6	409	7.27	34.5	4.53		
1255	8.9	406	7.31	27.3	4.38		holding steady
1300	8.6	405	7.31	21.3	2.64	If not m, just dr	
FINAL	8.6	405	7.3	21.3	2.64	9gpm	

PUMPING WATER LEVEL (E-Line___/Steel Tape___/Pressure Gauge___sonic sounder___&temp___)

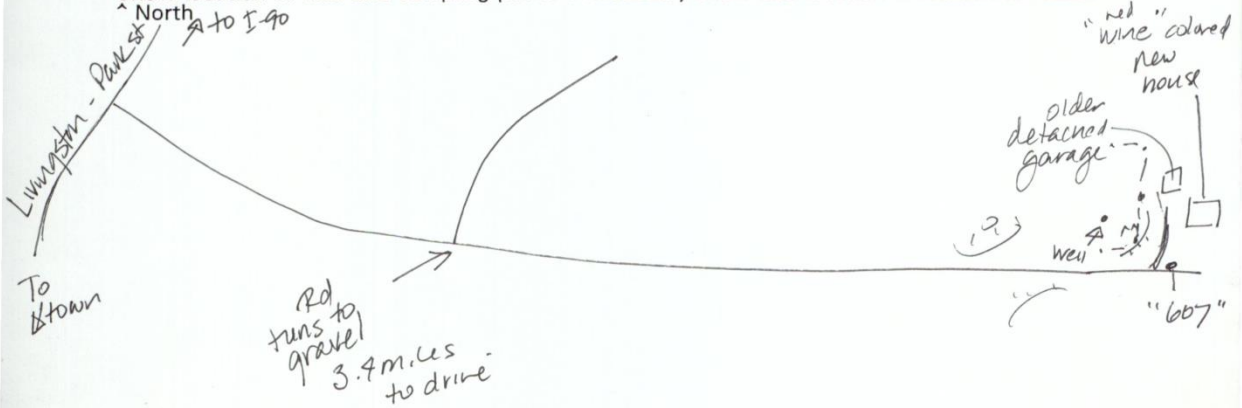
Time	Depth Below M.P.	Water level altitude	Remarks: pump cycling? ☐ yes ☐ unk
	Pump Cycling		

FIELD NITRATE (HACH) 0.0 (mg/L-N) **Comments**

Montana Bureau of Mines and Geology 1300 West Park St. Butte, MT 59701 (406) 496-4306 Version 6.1 08/12

SITE NOTES: Travel S. from Livingston's Main St onto Swingley. ~~Rd~~ Drive is 3.4 miles on left past pavement end. View 2 story house w/ older detached garage. Address on post. Well is to SE. of house across fence – due east of rocky outcrop.

SITE SKETCH MAP
Show location of well and sampling point. If necessary show site location in relation to roads.



INVENTORY NOTES: Bull snake on the prowl!

General condition of well and surface seal (Good ✓ Fair ___ Poor __)
Condition of water: Clear ✓ Turbid ___ Other_____

SAMPLE: Standard (250 ml ~~RA~~ FA {H_2SO_4}, 250 ml **FU**, 500 ml **FA** {HNO_3}, 500 ml **RU**) ☑
Other (nitrate only, tritium, etc.) 2 500 ml for tritium + 10ml OIB+2H

ALKALINITY TITRATION **Bottle Number** 153624

Vol. Of Sample	Total Vol. Titrated	Acid Conc.	Original pH	Digits to Reach 8.3 pH	Actual Endpoint	Digits to Reach 4.5 pH	Actual Endpoint	Total Digits
100ml	100ml	1.6	8.1	—	—		4.31	18
~~50~~								

Alkalinity Concentration 186 (mg/L as CaCO3)_____

FEET OF WATER	gal/ft by casing diameter	total gal	/DISCHARGE RATE	MINUTES PER WELL VOLUME
54	(2"x.163),(4"x.65),(6"x1.47),(8"x2.61),(10"x4.08),(24"x23.5)	81	9	9 minutes

Name Pamela A Castagner **Agency** MBMG

Montana Bureau of Mines and Geology 1300 West Park St. Butte, MT 59701 (406) 496-4306 Version 6.1 08/12

Landowner Information Sheet

Your well was visited on _____by_____
of the Montana Bureau of Mines and Geology Well GWIC ID_____Total Depth_____

The following parameters were measured:

Depth to groundwater	**_____feet below casing**
Groundwater temperature	**_____F**
Specific conductance*	**_____micromhos**
	_____estimated TDS
pH**	**_____**
Nitrate***	**_____mg/l**
Pumping rate and drawdown	**_____gallons/minute _____ (ft)**

***Specific Conductance** is a measure of how easily water conducts electricity and provides an indication of the amount of minerals in the water. When minerals dissolve in water they form ions that can conduct electricity. The more minerals dissolved in water the greater the conductance. The total dissolved solids (TDS), in parts per million, can be estimated by multiplying the Specific Conductance by 0.6.

****pH** is a measure of how acidic or basic the water is. Water with a pH of 7 is neutral; less than 7 is acidic, and greater than 7 is basic. Low values of pH, particularly below pH 4, indicate a highly corrosive water. High values, particularly above pH 8.5, indicate alkaline water. Most groundwater has a pH between 6.5 and 9.0.

*****nitrate mg/l** is a field measurement of the nitrate concentration from your well. This field measurement is made using a colorometric method and is less accurate than a lab test, but is useful as a reference. Source of nitrates in groundwater can range from the geologic deposits that form the aquifer, to infiltration from septic tank seepage, fertilizers, or animal wastes. The national drinking water standard for nitrate is 10 mg/l.

For more information about your well or wells in your area visit the Ground Water Information Center on the web: www.mbmggwic.mtech.edu.

For more information contact:

John I. LaFave
Groundwater Characterization Program
Montana Bureau of Mines and Geology
Montana Tech of the University of Montana
1300 West Park Street
(406) 496 – 4306