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Prepared by Environment Canada on behalf of the
FEDERAL PROVINCIAL GROUNDWATER WORKING GROUP

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GROUNDWATER DATA MANAGEMENT

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December 1991

Environment Canada
Environnement Canada

Canada

GROUNDWATER DATA MANAGEMENT

TO PROMOTE A CONSISTENT APPROACH TO GROUNDWATER DATA MANAGEMENT IN CANADA

TO FACILITATE ACCESS TO GROUNDWATER DATA FROM ALL CANADIAN SOURCES THROUGH THE USE OF COMMON TERMINOLOGY

Federal-Provincial Working Group on Groundwater

DISCLAIMER

The issuing of these guidelines does not constitute a commitment on the part of the working group or of any of the agencies taking part in the development of the guidelines, to implement them, in whole or in part, at present or at any time in the future. Any decision to do so is the sole responsibility of the agency concerned and is critically dependent on, among other factors, the availability of resources.

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Preface

These guidelines for the management of groundwater data were developed by a working group made up of representatives from most of the government agencies in Canada responsible for or concerned with groundwater data banks.

The motivation behind the development of these guidelines was a collective desire to "do something" about the increasingly intractable problems faced by all operators of groundwater data banks, such as rapidly rising costs of operating existing systems, increasing backlogs of well drillers' reports, and complaints about service to clients. The federal government has long been concerned about the variety of systems used in different jurisdictions, which has made it more expensive and time consuming to prepare national or regional evaluations of groundwater.

The Green Plan stated that the federal government would publish guidelines and codes of practice to help provincial and other agencies deal with groundwater problems. These jointly developed, federal-provincial guidelines for groundwater data management are therefore timely and contribute to the fulfilment of this commitment.

All concerned recognize that the primary responsibility for collecting and storing ground-water data rests with the provinces. Because each province manages its groundwater resources in the way best suited to conditions in that province – which is not the same for every province – it is not possible to develop a single databank that is all things to all provinces. There will always be significant differences between individual databanks.

Accordingly, at the suggestion of Alberta Environment, an ad-hoc federal-provincial working group on groundwater databanks was formed under the chairmanship of Environment Canada to consider these and other problems and to develop solutions. The full working group has met three times over the past 18 months; three regional meetings have also been held.

These deliberations have had several useful outcomes. One of the more important was the development of these guidelines for the management of groundwater data. The working group considers that the guidelines will

a. facilitate the exchange of groundwater data between jurisdictions,
b. reduce the costs of software development for applications such as geographic information systems (GIS) and mathematical groundwater models,
c. facilitate the conduct of national and regional groundwater surveys and assessments.

The guidelines were developed taking into account all major existing groundwater databases in Canada and some that were under development. The guidelines constitute a basic set of codes and formats capable of handling the most important kinds of groundwater water data now being collected and stored by governments across the country.

Because the guidelines were developed as a compilation of the features of all existing systems, no single agency will use all the features of the guidelines. However, every agency should be able to convert the most important and universally used components of its databank(s) into the formats described in the guidelines.

If a databank lacks some, or even many, of the data fields described in the guidelines, it does not mean that it is in some way deficient or inade-quate. It is recognized that some fields or param-eters that may be of primary importance to one agency may be irrelevant to another.

To the knowledge of the working group, no actual groundwater databanks are designed according to these guidelines, and there is no intention, on the part of the working group or any member of the working group, to promote the establishment of a "national" database using the guidelines' specifications. However, individual database managers contemplating designing a new system or updating an older one may use the guidelines' format for such a system, if it meets the agency's needs.

The working group recognizes that no data-base is immutable and that technological progress alone will require modifications to the existing guidelines. Consequently, it expects all sections of the guidelines to need review and revision from time to time.

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PART 1 INTRODUCTION

INTRODUCTION

The guidelines for groundwater data management were developed by a working group made up of representatives of most major holders of groundwater data in Canada and of federal agencies with an interest in groundwater data, at workshops that took place between February 1990 and June 1991.* The first full workshop was held in Saskatoon in February 1990, the second in Halifax in November 1990, and the third in Vancouver in June 1991. In addition, three regional workshops were held, the first in St. John's, Newfoundland, in April 1991, the second in Hull, Quebec, in May 1991, and the third in Saskatoon in June 1991.

The guidelines developed at these workshops reflect the collective views of the workshop participants on

a. The purposes of groundwater data banks,

b. The reasons for and objectives in establishing a basic level of compatibility between groundwater data in various data banks,

c. The rationale for developing and maintaining a mutually agreed-on format for data exchange,

d. The types of data which will most likely be exchanged,

e. The formats to be used in exchanging these data,

f. The technical terms, conventions and coding to be used in exchanging these data.

*A list of participants and their affiliations are given in the Appendix.

PURPOSE OF GROUNDWATER DATABANKS

The purpose of groundwater data banks is to store and retrieve various hydrogeologic and other related data to carry out various tasks in managing groundwater effectively.

"Groundwater management" includes both the development and allocation of groundwater supplies and the protection of the groundwater resource from damage, however caused.

The goal of groundwater management should be to assure the sustainability of uses of groundwater.

OBJECTIVES IN ESTABLISHING COMPATIBILITY BETWEEN GROUNDWATER DATABANKS

NO "BEST" SYSTEM

The different agencies holding groundwater data have different purposes and needs, which determine the characteristics and structure of their groundwater data banks.

EXCHANGE OF DATA

Often an agency may wish to access and process the data held by other agencies. For example, in the Prairie Region, the Prairie Provinces Water Board Committee on Groundwater (PPWB/COG) carries out many studies along the interprovincial boundaries between Alberta and Saskatchewan and between Saskatchewan and Manitoba. Similarly, in the Atlantic Region, all four provinces could benefit if data were available in a mutually agreed format. Many agencies of the federal government have an interest in developing national overviews or reviews of groundwater; their tasks would be easier if all data-holding agencies could provide data in the same, nationally agreed upon format.

SOFTWARE DEVELOPMENT

Increasingly, users of groundwater data are turning to sophisticated data processing packages such as geographic information systems (GIS), computerized numerical models of flow and contaminant transport, and expert systems. Agencies' costs for developing such software would be significantly reduced if data were available in a compatible format, thereby permitting the use of the same software package by many different agencies, and promoting a cooperative approach by agencies to software development.

ACCESS BY OTHER USERS

Access to the data holdings of the various agencies by consultants, contractors, and others would also be much easier if data could be obtained in one, mutually agreed upon format. Users would have to become familiar with only one format, instead of twelve.

The objectives in establishing compatibility between data in various groundwater data banks are therefore to

a. facilitate the exchange of data between agencies,
b. permit more efficient and more cost-efficient software development,
c. enhance the overall utility of the data to users.

RATIONALE FOR DEVELOPING GUIDELINES FOR GROUNDWATER DATA MANAGEMENT

Of the various possible approaches to making data from a variety of data banks available in a compatible format, the most feasible, on the basis of both technical and economic factors, is the development of a set of guidelines for groundwater data management.

The possibility of developing some kind of national groundwater data storage system was briefly considered but rejected on the grounds of excessive costs. Even if the new system could be demonstrated to produce overall improvements in efficiency or effectiveness over existing systems, agencies' budgetary constraints would preclude its adoption now or in the near future.

However, any operators who incorporate the capability to produce (and use) data in the agreed-on exchange format will be able to take advantage of any software developed for that format by other agencies, and will be better able to service users with requirements for data from several agencies.

Major users who do not themselves have major holdings of groundwater data (federal agencies are good examples) would have much more incentive to support development of data systems, software, models, etc., if one such system or software package could access all groundwater data in Canada (by using the exchange format) than if 12 separate packages were needed.

The approach adopted is NOT the development of another data bank: it is the development of a protocol by which data in existing databanks can be better utilized by users other than the prime user.

Nevertheless, the guidelines for groundwater data management must provide the capability for supporting all the functions of aquifer management that an actual data storage system would support.

System operators, over time, may choose to develop their systems to more closely conform with the guidelines for groundwater data management. That is a decision that they alone can make, as it depends on factors that are their sole responsibility (or that of their agency), such as available financing and specific requirements to be met by the data bank.

Detailed guidelines have been developed for seven of the most important subsystems ("files"), namely Site Information; Well Construction Details; Formation Logging; Water Levels, Well Performance, Aquifer Yield; Pump Test Information; Water Quality Sampling Information; and Water Quality Measurements. Detailed guidelines for other files will be developed, as priorities dictate. It is also envisaged that the files now developed will be modified and revised, as the need arises.

For some of the files not yet developed, the working group has identified general considerations to be taken into account when detailed guidelines are developed.

TYPES OF DATA LIKELY TO BE EXCHANGED

AQUIFER INVENTORIES

Recognizing that an inventory of aquifers in a province/region is a fundamental requirement for any groundwater management plan and the basis on which all groundwater data management systems (and therefore, also, these guidelines) must be designed and operated, it is essential to define the minimum requirements for such inventories.

Conceptually, at least, the minimum requirement for an aquifer inventory is fairly straightforward to define: such an inventory should include all aquifers that

a. provide or have the potential to provide significant water supplies,
b. are or are in danger of becoming contaminated,
c. are or have the potential to be sources of or pathways for the movement of contamination towards significant surface water bodies,
d. are of particular importance for some other reason, e.g., special ecological significance.

In practice, these general principles must be translated into guidelines that can be applied objectively, although subjective judgement cannot be eliminated entirely.

Also, for the purposes of these guidelines, the objective is to define the basic requirements, i.e. the requirements that everyone agrees are essential in nearly every situation across the country. This recognizes that there will be special considerations applying to particular provinces or regions that may dictate a more comprehensive approach to aquifer inventories.

The working group considered the following factors in defining the basic requirements for aquifer inventories.

PHYSICAL SIZE OF THE AQUIFER

The physical size of the aquifer might be based on the areal extent, i.e., hectares or square kilometres, or on volume, i.e., cubic metres or kilometres, of the aquifer itself. A variant on this would be to use the quantity of water in the aquifer rather than the aquifer volume, but this would involve much increased and unwarranted complexity.

Given the present state of knowledge of aquifers in Canada, the most useful and efficient measure is areal extent.

One drawback to using this parameter is the fact that much of the groundwater used in Canada is drawn from small aquifers by individual, generally rural users, and used for domestic or small farm uses (Hess, 1986). Such aquifers, although individually not very important, add up to a very significant resource in certain areas of the country, and to leave these aquifers out of an aquifer inventory would be a major omission. Some way must be found to ensure that these, as well as other small but essential aquifers, are not excluded from provincial/regional inventories.

LITHOLOGICAL LOGS

The lithological log is probably the most important and widely used component of any groundwater data storage system. The data describing the geological formations encountered in a borehole are essential to the correct interpretation and use of all the other kinds of data that might be contained in a groundwater data storage system.

The quality of lithologic logs varies enormously, depending on who and what kind of organization sponsored the drilling (which determines which depths and kinds of formation are of interest) and on the professional/technical capability of the person who actually performed the logging.

*Hess, P.J. 1986. Ground-water use in Canada, 1981. NHRI Paper No. 28/IWD Technical Bulletin No. 140. National Hydrology Research Institute, Inland Waters Directorate, Ottawa, Canada.

In order that such logs can be used by organizations other than the one maintaining the system, there needs to be provision for

a. common (or at least convertible) codes for describing lithologies (so that one person's "sand" is the same as everyone else's);
b. an indicator of reliability or quality. Such indicators not only are useful to the individual hydrogeologist or well driller consulting the file, but also can be used to weight data and information points when used in machine-processing routines such as contouring packages.

The standard set of codes for lithologies specified in these guidelines is both a blend of and a compromise between the coding systems in use by existing databases in Canada.

AQUIFER CHARACTERISTICS

Aquifer characteristics include measurements of hydraulic conductivity and/or other measures of the aquifer's permeability characteristics, measures of storage capacity and maximum pumping rates. Ideally, minimum requirements for testing techniques (e.g., pumping tests, slug tests, permeameter tests) should be specified, as well as some criteria for assessing the adequacy of coverage of such measurements (e.g., *n* permeability tests per square kilometre). However, at present such data are so sparsely available that any on aquifer characteristics are valuable.

The parameters included in the guidelines include those in at least one existing data bank.

OBSERVATION WELLS AND GROUNDWATER HYDROGRAPHS

Observation wells and groundwater hydrographs are similar to any other time series data in that they consist of a set of two numbers, one describing the water level (or hydraulic head) and the other recording the time at which the level measurement was made. The time reading may be explicitly recorded, or implicit in the data format (e.g., for digital recorders). A wide variety of hydrograph data collected for various purposes exists; both frequency of measurement and precision of water level reading vary considerably.

A peculiarity of groundwater hydrograph data is the potential for realizing very significant savings in storage costs through data compression and compaction techniques. This is because, for an annual hydrograph, most of the changes in level that occur happen during the spring thaw and runoff period. For the rest of the year most observation well hydrographs change only very slowly. Reductions in data volume of up to 3 or 4 times are possible.

Questions to be considered include

a. minimum number of observation wells, if any, both absolute number and number per square kilometre;
b. frequency of observation;
c. standards for design, construction, instrumentation, if any;
d. any other relevant factors.

The following considerations should be kept in mind:

a. To some extent, the degree of coverage for groundwater observation wells in an aquifer is self-regulating in that, as development of an aquifer proceeds, the amount of instrumentation installed should automatically increase to meet management needs. In an undeveloped aquifer, not much more information is required other than the fact that it is there. The first user, say a municipality, will, or should, install one or more observation wells to ensure that groundwater levels are behaving as predicted. Therefore, there already exists some water level information for the next users, who in turn will (should) install observation wells for their own purposes. Thus, as the aquifer develops and more information is required to make the necessary management decisions on licencing, allocations, etc., much of that information already exists (or should exist).

b. However, although it is in the users' best interest to keep good records of water levels, they may not always do so, perhaps for short-term and short-sighted economic reasons. Therefore, groundwater management agencies will have to give some consideration to the need for regulations, legislation, etc., to ensure that the appropriate data are collected and the appropriate records kept. This does not appear to present any major problems: for example, it should be easy enough to attach a monitoring requirement to the terms of a licence.

Detailed specifications of the format in which hydrographic data will be exchanged remain to be developed.

WELL CONSTRUCTION DATA

Many of the same considerations apply for well construction data as for lithological logs. The guidelines specify what are considered to be the most important well construction data and provide a common coding scheme based on existing data systems.

GEOPHYSICAL LOGS

In the groundwater business in Canada, the routine running of geophysical logs in boreholes is still very much the exception rather than the rule. The most commonly run logs are spontaneous potential (SP)/resistivity logs, but a wide variety of techniques have been used, up to and including down-hole TV cameras.

The purposes of many of the logs other than SP/resistivity ones are often highly specialized, and sufficient data may not exist to warrant thinking about data exchange between agencies. If, nevertheless, such data are to be exchanged, agreement will be needed on standards, for example, kinds of log to be included, methods of storage, and formats for exchange.

The working group did not attempt to develop guidelines for exchanging geophysical data.

GROUNDWATER CHEMISTRY AND CONTAMINANT DATA FILES

To a considerable extent, the storage of groundwater chemistry parameters, whether traditional or toxic chemical, has been the domain of the chemical analytical specialist organizations, that is, those that actually carry out the chemical analyses. Generally, these analytical results are stored in general-purpose water quality systems such as NAQUADAT along with water quality analyses from other sources such as surface water.

There is nothing wrong with this approach and there is no particular difficulty in cross-referencing systems so that the water chemistry data relating to a particular well or piezometer can be readily accessed and vice-versa.

For the purposes of these guidelines, some minimum criteria for the determination of groundwater chemical properties are required (e.g., parameters to be included, such as major ions, contaminants; areal coverage, the number of sampling points per square kilometre). Further discussion is required to establish these criteria.

However, some serious concerns emerged during the workshop discussions.

One such concern is the potential for misuse, either deliberate or accidental, of data concerning groundwater chemistry, including any associated contaminants. The increasingly powerful capability of modern equipment and software to process raw data, using techniques such as selective sorting by parameter or the use of interpretive tools such as geographic information systems (GIS) or expert systems, only heightens this concern.

One of the manifestations of this concern is the insistence by data holders that the purpose of the investigation during which the sample was collected must be specified as part of the sample characterization.

The importance of including this information is illustrated by noting that a high value for the concentration of a contaminant (say contaminant X), in a sample of groundwater taken from a contaminated site during the course of an investigation to develop a cleanup procedure would not be unexpected. Indeed, if some kind of sample screening procedure were being used, to avoid a lot of "nil" results, it would in fact, be expected. In any event, such an occurrence would not be cause for alarm.

However, if the same high value for contaminant X were found in a sample intended to establish natural, "background," levels, it would be a matter of considerable importance and would cause serious concern, if its presence had not been suspected beforehand.

If users were to manipulate groundwater chemistry data without knowing the purpose for which each suite of samples was collected, they might seriously misinterpret the data. For example, if samples with measured values of concentration for contaminant X were selectively retrieved and then plotted to show geographic variations in the occurrence of X, a very inaccurate and misleading picture of what the real-world situation actually was would result, if most of the samples containing contaminant X had, in fact come from contaminated site investigations. Such a misleading interpretation could cause much unwarranted public concern and might well result in totally unnecessary expenditures of large amounts of funds to further investigate and remediate a totally imaginary problem.

Data release policies can ensure, to some extent, that responsibility for such misleading interpretations lies with the person/organization making the interpretation, not with the data holder.

It is impossible to prevent completely the misuse of sensitive environmental data, such as groundwater chemistry data. With increasing application of Freedom of Information legislation it will become even more difficult for data holders to withhold data on the grounds that it may be used incompetently or irresponsibly. By and large, data holders will welcome this increased access to data, if only because their data will be used by more people. However, there will always be those with access to the data who do not have the technical capability to assess their true significance. And, unfortunately, there will always be those (on each side of the environmental debate) who will deliberately manipulate data to suit their own particular purposes.

Specifying the purpose for the collection of the sample seems to be the minimum requirement that data holders will want to impose as a condition for release of their data, and,as such, it should be considered to be a basic criterion for the exchange of groundwater chemistry data.

Many data holders may want to impose other requirements as a condition for data exchange in order to provide some additional assurance against being held responsible for misuse of data from their data files. For instance, an organization might insist that the data on a particular investigation, say a contaminated site characterization, would only be released in its entirety; in other words, pre-sorting of a suite of data to screen for a particular criterion before the data were exchanged would be prohibited. The onus would be on the data recipients to select what was and what was not significant to their requirements. In such a situation, groundwater chemistry data might be stored (and exchanged) as "suites" of data, grouped according to the specific purpose for which that data set was collected.

If such a policy were in effect for the exchange of data, provision would need to be made to indicate to which suite the particular sample analysis belonged. However, this provision should be considered optional, as there may be other reasons why a data holder might want to release only partial data sets, for example if proprietary or other confidential data were included in the data suite.

The Guidelines for Groundwater Quality Data are based on the NAQUADAT system with some additional data fields relating to the concerns noted above.

PRESENCE OF CONTAMINATION OR CONTAMINATION HAZARDS

To be useful, any aquifer inventory should contain some indication of present or potential contamination situations. The aquifer inventory could contain detailed information on any actual occurrences of such contamination. However, it may be preferable to deal with the detailed contamination data separately and, in the aquifer inventory, to merely note its presence with a cross-reference to the appropriate file(s).

The susceptibility of aquifers to potential contamination incidents is another area that requires discussion. Clearly it is very important to know whether or not an aquifer is vulnerable to some particular kind of contamination, so that appropriate precautions can be taken to minimize the risks of the contamination actually happening. However, whether the aquifer inventory is the place where the detailed data should be kept requires further consideration.

FUNDAMENTAL LOCATIONAL PARAMETERS

General Considerations

All groundwater data, to be useful, must relate to a specific point in space and a specific instant in time. Therefore, a fundamental requirement of all groundwater data systems is the capability to store data relative to a point defined in space and time. Such points are defined, relative to the earth's surface, by

a. latitude and longitude,
b. elevation above a standard reference point (e.g., mean sea level),
c. date and time of observation relative to a standard meridian (e.g., Greenwich).

All systems should therefore include these parameters (or equivalents) as fundamental reference parameters for each data point.

The use of latitude and longitude for horizontal locations can be cumbersome and inconvenient, and equivalent systems that can be readily converted to latitude and longitude are often preferable. One such system in wide use is the Universal Transverse Mercator (UTM) system, for which automatic conversion routines are readily available.

The use of legal land descriptors (such as the section/township/range system prevalent in Western Canada) must not be used for the purposes of establishing geographic locations. Such systems are often invaluable for the purposes of particular groundwater agencies and, where they exist, may be essential to the day-to-day work of the agency concerned, but they are not a substitute for proper geographic locational coordinates. Computer codes exist to convert section/township/range locations to UTM or latitude/longitude values, but

a. they are not widely available;
b. they are not universally applicable to all areas, even in the West (e.g., in cities and towns; in the northern, unorganized areas of the Prairie provinces; along some rivers where the river lot system of subdivision has been used);
c. they are not always accurate (in areas where errors occurred in the original land surveys).

Precision/Accuracy of Locational Parameters

Groundwater data are used for many different purposes. For example:

- A lithological log may be used by a well driller to locate the best spot for drilling a water supply well, by a hydrogeologist cleaning up a waste site, or by an engineer in charge of a grouting project.

- A groundwater hydrograph may be used to assess the reliability of a municipal water supply, to determine the hydrogeologic characteristics of an aquifer, to monitor the possible impacts of climatic change, or to forecast or record the effects of earthquakes.

- Chemical analyses of groundwater may be used to determine the suitability of well water for irrigation, to assess the effects of acid rain on the hydrologic regime, or to detect the existence and monitor the development of a contaminant plume from an industrial waste site.

These various applications require different precisions and accuracies in the fundamental locational parameters used to locate the measuring point in space or time.

A well driller attempting to construct a well for a client requires knowledge of the areal location of a permeable horizon to within perhaps a few tens or hundreds of metres and can use information located to a precision/accuracy of up to a kilometre or more in some situations. In terms of elevation, the requirements are somewhat more stringent: the cost of a 100-m well is significantly greater than that of a well of only 10 m and the cost of a well a kilometre deep would be prohibitive. Therefore, the precision/accuracy of the vertical coordinate should be greater than for the horizontal location, perhaps of the order of 1–10 m. The precision/accuracy of the time dimension, i.e., <u>when</u> the lithological log was made, is essentially immaterial to the well driller. Generally it does not much matter to the driller whether the log was made yesterday or 20 years ago. The most accurate time precision required here would be a year. However, often less accuracy will suffice.

For a contamination problem and the grouting problem, the precision/accuracy requirements are much more restrictive. A contamination investigation will generally require a horizontal accuracy of 1 m or less. Vertically, an accuracy of 1 cm or even less is needed in some critical situations. A grouting engineer would need about the same order of accuracy. In addition, if fracture permeability is a significant consideration, very accurate measurements of fracture aperture may be required, to better than a millimetre in many cases. These requirements reach the limits of what can be expected from a standard, visual lithologic log, and the smaller aperture openings must be measured in the laboratory. Nevertheless, it would normally be expected that fractures as big as 1 cm would be recorded on a lithologic log. The time dimension for contamination investigations also calls for much better accuracy than for the well driller's situation. If the contamination situation could have generated lithologic changes such as changes in colour or in fracture development in clays, the time at which the log was made is obviously important. Similarly, a grouting engineer wants to know whether the log was made before or after the injection of cement. The time accuracy required in these two cases is therefore of the order of a day to a week.

Applying similar kinds of reasoning to the other examples, the range of accuracies required for the various kinds of hydrogeological data lie roughly in the ranges listed below.

PRECISION/ACCURACY REQUIREMENTS FOR LOCATION

Type of Data	Horizontal	Vertical	Time
Lithological log	1 metre to several hundred metres	1 cm to 5 m	1 day to several years
Hydrograph	1 metre to several hundred metres	1 mm to .5 m	15 sec to 3 months
Chemical analysis	As for lithological log		1 day to 1 year
Well construction	As for lithological log		
Geophysical logs	As for lithological log		1 day to 1 year

NOTE: The 15-second time precision for hydrographs is required to resolve long-period earthquake waves.

Any groundwater data storage system capable of responding to the variety of demands likely to be placed on it today should have the capability of recording the primary location parameters to the precision indicated below:

Horizontal coordinates (Lat/long, UTM)	1 m
Vertical coordinate (elevation)	1 cm
Time (relative to GMT)	15 sec

A distinction should be made between the precision of a measurement and its accuracy. For example, at a particular site, it is much more important to know the horizontal location accurately relative to a nearby local datum than to be sure that the position of the site is accurately located on the earth's surface. In other words, it is important to know, say, the position of an observation well relative to a pumping well to an accuracy no worse than a metre, whereas the geographic coordinates of the two wells on the earth's surface may be in error by a matter of miles without causing any significant practical problems. The important thing is for the data system to be able to record the data to sufficient <u>precision</u> (i.e. ± .5m).

Because of the importance of the precision of locational data, some qualifier should be appended to each set of recorded data to indicate its degree of precision. The form and format of this qualifier should therefore be standardized across all compatible systems, as well as the form of the locational data itself.

GUIDELINES

PART 2 SUMMARY OF DATA FIELDS

FILE #1 SITE INFORMATION

DESCRIPTION

Information to identify and accurately locate the well.
General information on well type, why it was drilled, and flow allowances.
Protected information on the contractor, and technician.

FIELDS

100 Well identification
101 Location UTM
102 Location lat/long
103 Legal land description
104 Location accuracy
105 Drainage basin
106 Map series
107 Map number
108 Aquifer
109 Hydrostragraphic unit
110 Physiographical division
111 Elevation
112 Elevation accuracy
113 Well site description
114 Well status
115 Comments re status
116 Purpose of well
117 Water use
118 Data provided by/fields
119 Contractor
120 Comments

FILE #2 WELL CONSTRUCTION DETAILS

DESCRIPTION

Overall well dimensions.
Construction method.
Type and composition of all materials used.
Dimensions, design features, and location of each significant component (including the well pump).
Well abandonment method and materials.

FIELDS

200 Well identification
201 Date well completed
202 Uncased hole diameter
203 - From (metres)
204 - To (metres)
205 Depth completed well

206 Well head completion
207 Drilling method
208 Type of drilling fluid
209 Drill bit diameter
210 Apron width
Casing dimensions
211 - Nominal pipe diameter
212 - Wall thickness
213 - From
214 - To
Casing design
215 - Material
216 - Coatings
217 - Form
Open hole
218 - Diameter
219 - From
220 - To
Screen dimensions
221 - Nominal screen diameter
222 - From
223 - To
224 Screen make
225 Screen model/number
Screen design
226 - Material
227 - Coatings
228 - Form
229 Screen slot/hole size
230 Slot/perforation method
231 Screen attachment method
232 Screen fitting [bottom]
233 Screen placement method
234 Filtration medium
Filter pack/formation stabilizer
235 - Material
236 - From
237 - To
238 - Grain size
239 Filter placement method
240 Development duration
241 Development method
Annular sealing
242 - Material
243 - From
244 - To
245 Grouting placement method
Seal components
246 - Component
247 - Depth
Plugging
248 - Material
249 - From
250 - To

Casing left after plugging
251 - From
252 - To
Casing slit
253 - From
254 - To
255 Comments

FILE #3 FORMATION LOGGING

DESCRIPTION

Geologic and hydrogeologic data obtained from the borehole and supplied by contractors (driller's log).
Interpreted information provided by other experts (lithologic log).
Information on geophysical logging activities (for logging results see appropriate file).

FIELDS

300 Well identification
301 Grain-size curve
302 Effective diameter
303 Coefficient of uniformity
Borehole log
304 - Type
305 - From
306 - To
307 Material
308 - From
309 - To
310 Natural gas detected
311 Comments

FILE #4 WATER LEVELS, WELL PERFORMANCE, AQUIFER YIELD

DESCRIPTION

Information on the behaviour of water when first encountered, under static conditions and under pump test conditions.
Information on aquifer potential.
Production recommendations.

FIELDS

400 Well identification
401 Artesian head
402 Water found (depth)
403 Water bearing fractures (depth)
404 Static level (pre)
405 Drawdown
406 Static level (post)

407 Method of measurement
408 Pump test
409 Test date
410 Start time
411 Test method
412 Type of test
413 Test duration
414 Pump intake during test
415 Method of measuring discharge
416 Accuracy of discharge measurement
Derived parameters
417 - Hydraulic conductivity
418 - Transmissivity
419 - Storativity
420 - Specific capacity
421 Observation well ID
Operating recommendations
422 - Pumping rate
423 - Pump intake depth
424 Well-owner requirements
425 Annual allocation
426 Annual use
427 Peak withdrawal rate (approved)
Flowing conditions
428 - Flowing
429 - Flow
430 Spring flow
431 Boundary conditions
432 Pump type installed
433 Pump capacity
434 Pump intake depth
435 Pump location
436 Date installed
437 Make
437 Model
439 Pump riser pipe diameter
440 Comments

FILE #5 PUMP TEST INFORMATION (PUMPED WELL)

DESCRIPTION

Flow and drawdown information from pumped well. (For drawdown information from observation wells see appropriate file under observation well identification number).

FIELDS

500 Well identification
501 Elapsed time
502 Pumping rate during test
503 Water level while pumping
504 Water level while recovering
505 Comments

FILE #6 WATER QUALITY SAMPLING INFORMATION

DESCRIPTION

Information about samples collected for water quality purposes; including when sample was collected, by whom, and why.

FIELDS

600 Well identification
601 Agency code
602 Sample purpose
603 Sample number
604 Sample date
605 Sample time
606 Time zone
607 Comments

FILE #7 WATER QUALITY MEASUREMENTS

DESCRIPTION

Values for measurements of chemical, physical, and biological parameters.

FIELDS

700 Well identification
701 Sample number
702 Sample date
703 Sample time
704 Lab identifier
705 Variable code
706 Method code
707 Detection limit
708 Pretreatment code
709 Value type code
710 Flag
711 Value
712 Unit code

GUIDELINES

GUIDELINES

GUIDELINES

GUIDELINES

GUIDELINES

GUIDELINES

GUIDELINES

GUIDELINES

PART 3 STANDARDIZATION OF DATA FIELDS, DATA FILES, TERMINOLOGY

INFORMATION SOURCE

Unless otherwise noted, all information in Files #1 to 5 is provided by the drilling contractor.

PRECISION

Unless otherwise noted, allowances should be made to collect and store data to a precision of 2 decimal places.

ACCURACY/RELIABILITY

The data user must, in all instances, be able to determine the accuracy/reliability of the data.

MEASUREMENTS

While it is recognized that the use of imperial measurements is still widespread in the well-drilling industry, the adoption of the metric system should be encouraged. It is expected that data will be provided to users in metric units.

FILE # 1

SITE INFORMATION

1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
100	Well identification	AN				
101	Location UTM	N				UTM Zone: 2 digits Easting: 6 digits Northing: 7 digits
102	Location lat/long	N				Lat/Long DEG: 2 digits MIN: 2 digit SEC: 4 digits (to 2 decimal places)
103	Legal land description					
	COMMENT UTM or lat/long should be used as the main site locator. The rationale for the use of proper geographic locational co-ordinates, such as lat/long or UTM, is stated in Part 1, p. 10. If the use of legal land descriptors (section/township/range) is necessary for reasons of practicality, they should be assigned a separate field and not used as locational data.					
104	Location accuracy	C				
	COMMENT See Table 1 for a description of locational accuracy codes based on Ontario MOE practice. See Part 1, Precision/Accuracy of Locational Parameters.					
105	Drainage Basin	AN				
	COMMENT Identification of drainage basins should follow the surface water procedure now in use by the Water Survey of Canada but should allow for one additional level of basin delineation.					
106	Map series	N				
107	Map number	AN				
108	Aquifer	C				
109	Hydrostragraphic unit	C				
110	Physiographical division	N				
111	Elevation (ground level)	N				

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1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
	COMMENT This ground level at the well site is normally stated as an elevation above a standard reference point (e.g., mean sea level). This is usually obtained by altimeter reading, by surveying, or from a topographic map.					
112	**Elevation accuracy**	C				
	COMMENT See Part 1, Precision/Accuracy of Locational Parameters, p. 11. The method used to obtain the site elevation should be included in the accuracy coding description. See table 2 for a description of codes based on Ontario MOE practice.					
113	**Well site description**	C	Plain Valley Terrace Piedmont Flank Summit	Plain Valley Terrace Piedmont Flank Summit	01 02 03 04 05 06	
114	**Well status**	C	New Unfinished Reconditioned Well reconstruction Deepened Standby Unknown	New Unfinished Reconditioned Deepened Not in use Standby Unknown	01 02 03 04 05 06 07	
			ABANDONED/NOT IN USE			
			Abandoned well Abandoned because of insufficient supply Abandoned, dry	Abandoned - Dry Abandoned - Insufficient Abandoned - Quality	08 09 10	
			Abandoned because of poor quality Abandoned, salt water Abandoned, poor quality			
			New well abandoned Old well abandoned Test hole abandoned			
115	**Comments re status**	F				
	COMMENT Reason for abandonment should not be limited to "dry," "low," or "quality" but should also include details of the quality concern. Date of abandonment can also be inserted here.					

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1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
116	Purpose of well Allow for 2 entries	C	WATER SUPPLY			
			Water supply well Withdrawal Production	Water supply	01	
			TEST HOLE			
			Test hole	Water exploratory	02	
			Exploratory	Oil exploratory	03	
			Oil	Oil	04	
			Core hole	Core	05	
			Mineral test hole	Mineral	06	
			Coal E log	Coal E log	07	
			Seismic test	Seismic	08	
			Flowing shot	Flowing shot	09	
			Cathodic protection	Cathodic protection	10	
			Oil exploratory Drill stem test			
			GEOTECHNICAL			
			Geotechnical borehole Structure test Soil test Engineering testing	Geotechnical	11	
			MONITORING			
			Observation Piezometer/observati on Piezometer	Level/head	12	
			Quality monitoring Chemistry Water test Old well test	Quality	13	
			DEDICATED USE			
			Recharge Injection	Recharge	14	
			Waste disposal	Disposal	15	
			Dewatering	Dewatering	16	
			Dewatering & relief	Decontamination	17	
			OTHER			
			Spring Not a well	Spring	18	

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1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
117	Water use Allow for 3 entries	C	Private individual Domestic	Domestic	01	See Table 3 for description of water uses
			Research	Research	02	
			Stock Livestock Domestic & stock Agricultural (not irrigation)	Agricultural (not irrigation)	03	
			Irrigation	Irrigation	04	
			Industrial Industrial & stock Mineral recovery	Industrial	05	
			Commercial Mineral water	Commercial	06	
			Multipurpose	-		
			Public supply Recreation Institutional (Schools/hospitals) Public (not municipal)	Public/recreation	07	
			Cooling or A/C Heat pump (source or disposal) Air conditioning	Heat transfer	08	
			Other Unknown Not used	Other Unknown -	09 [F] 10	
118	Data provided by/fields Allow for 4 entries	C/N				
119	Contractor	C				
120	Comments	F				

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TABLE 1

ACCURACY CODES FOR HORIZONTAL COORDINATES* (UTM)

1	<3 m margin of error location measured in field from mapped features (e.g., road intersections, buildings, railways, lot lines)
2	3–10 m margin of error location measured in field from mapped features
3	10–30 m margin of error locations measured in field from mapped features points plotted by inspector in field on topographic maps of 1:10 000 scale or larger
4	30–100 m margin of error points plotted by inspector in field on topographic maps of 1:25 000 scale
5	100–300 m margin of error points plotted by inspector in field on topographic maps of 1:50 000 scale
6	300–1 000 m margin of error points plotted on topographic maps of 1:125 000 scale or 1 inch = 2 miles
7	1 000–3 000 m margin of error points plotted on topographic maps of 1:250 000 scale
8	3 000–10 000 m margin of error code "elevation RC" as "9" assign UTM coordinates to nearest 10 000 m grid lines
9	well location is unknown Code "elevation RC" as "9"

TABLE 2

ACCURACY CODES FOR ELEVATION*

1	instrument level, accurate to 0.3 m
2	instrument level, accurate to 1.52 m
3	instrument level, accurate to 3.05 m
4	elevation read from topographic map, contour interval - 3.05 m
5	elevation read from topographic map, contour interval - 7.62 m
6	elevation read from topographic map, contour interval - 15.25 m
7	elevation read from topographic map, contour interval - 30.5 m
8	elevation read from topographic map, contours crowded, i.e., location point of well touches on 2 or more contour lines
9	elevation accuracy unknown or unreliable - leave elevation blank

* Based on Ontario MOE practice

TABLE 3

WATER USES

DOMESTIC

Water used to supply household needs. Most domestic wells are constructed for suburban or farm homes.

AGRICULTURE

Water used to supply drinking water and wash water for the maintenance of livestock.

IRRIGATION

Water used in the irrigation of farm crops.

INDUSTRIAL

Water used in the production of goods or materials.

COMMERCIAL

Water used in business establishments that do not fabricate or manufacture a product.

MUNICIPAL

Water owned and distributed by a municipality to residences, factories, and other grouped structures within the municipality.

PUBLIC/RECREATION

Water used to supply remote areas within a municipality, e.g., parks, summer camps, trailer camps.

HEAT TRANSFER

Water used for cooling or heating in any of the other categories.

FILE # 2

WELL CONSTRUCTION DETAILS

1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
200	Well identification	AN				
201	Date well completed (incl. development)	N	Date well completed Date drilling completion			YY/MM/DD
202 203 204	Uncased hole diameter (cm) [FROM] (metres) [TO] (metres) Allow for 3 records	N N N				Precision: 0.1 cm Precision: 0.1 m
	COMMENT Diameter of hole should be entered for full depth to which hole was drilled - even although it may have been backfilled in completing the well.					
205	Depth completed well	N				Precision: 0.1 m
206	Well head completion	C		Well pit Pitless unit Buried Other	01 02 03 04 [F]	
207	Drilling method	C	DRILLED			
			Rotary conventional Rotary air Rotary hydraulic Rotary reverse Rotary	Rotary Rotary air Rotary reverse	01 02 03	
			Drilled Diamond Diamond drill	Diamond	04	
			PERCUSSION			
			Downhole hammer Percussion Cable tool Air percussion Jet Jetted Jetting	Downhole hammer Cable tool Jetted Hydraulic percussion	05 06 07 08	
			AUGERED			
			Augered Auger Hand auger Power auger Hollow stem auger Bored Boring	Hollow stem auger Solid stem auger Bored (large dia.)	09 10 11	

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1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
			DRIVEN			
			Driving	Driven	12	
			DUG			
			Dug Hand dug Backhoe	Hand Power	13 14	
			Combination Other Unknown Not known Not applicable	Other Unknown	15 [F] 16	
208	Type of drilling fluid	C		<u>Water Based</u> Clean water Water and clay Water and polymers Water clay and polymers Other <u>Air Based</u> Dry air Mist Foam Stiff foam (polymer and bentonite additives) Other	 01 02 03 04 05 [F] 06 07 08 09 10 [F]	
209	Drill bit diameter	N	Drill bit diameter			cms
210	Concrete pad	N	Apron width	Concrete pad		

CASING DETAILS

211 212 213 214	Casing dimensions Nominal pipe diameter Wall thickness [FROM] [TO] Allow for 3 records	N N N N				Precision: Diameter - 0.1 cm Length - 1 cm

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1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
	Casing design	C	MATERIALS			
215 216 217	[MATERIAL] [COATINGS] [FORM]		Corrugated metal Metal culvert Brass/metal culvert	Metal	01	
	Allow for 5 records (211 to 218 linked) ?		Stainless steel Galvanized steel Steel Copper-bearing steel Steel curbing	Steel	02	
			Iron Galvanized iron Black iron	Iron	03	
			Concrete Porous concrete	Concrete	04	
			Wood Wood cribbing	Wood	05	
			Brick cribbing	Brick	06	
			Plastic Plastic hose PVC ABS	Plastic Teflon PVC ABS	07 08 09 10	
			Fibreglass Asbestos	Fibreglass Asbestos cement	11 12	
			Unknown Other	Unknown Other	13 14 [F]	
			MATERIAL COATINGS OR PROPERTIES			
			Galvanized	Galvanized Stainless Mild Low carbon Copper bearing Black Porous	01 02 03 04 05 06 07	
			FORM OF MATERIAL			
			Culvert	Curbing Cribbing Corrugated Culvert Hose Pipe/casing/tubing	01 02 03 04 05 06	
218 219 220	Open hole Diameter [FROM] [TO]	N N N				

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1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS

WATER INTAKE DETAILS

221 222 223	Screen dimensions Nominal screen diameter [FROM] [TO] Allow for 3 records	N N N				Precision: Length - 1 cm Diameter - 0.1 cm
224	Screen make	AB	Screen make			
225	Screen model/number	N AN	Screen model Screen number			Screen No. corresponds to hole size and is given in .001 inch
226 227 228	Screen design [MATERIAL] [COATINGS] [FORM] Allow for 5 records (221 to 228 linked)	C	MATERIAL			
			Porous metal	Metal	01	
			Steel Stainless steel Steel casing Galvanized steel Copper-bearing steel Milled pipe	Steel	02	
			Iron Galvanized iron Black iron	Iron	03	
			Copper Brass Bronze Everdur Armco metal	Copper Brass Bronze Everdur Armco metal	04 05 06 07 08	
			Veriperm	Veriperm	09	
			Porous stone tube	Stone	10	
			Plastic Slotted PVC PVC ABS	Plastic PVC ABS	11 12 13	
			Fibreglass	Fibreglass	14	

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1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
			MATERIAL COATINGS AND PROPERTIES			
				Galvanized	01	
				Stainless	02	
				Copper bearing	03	
				Low carbon	04	
				Black	05	
				Porous	06	
			FORM OF MATERIAL			
			Slotted casing	Slotted casing	01	
			Casing	Perforated casing	02	
			Wire wrapped	Bridge slot casing	03	
			Wire mesh	Wire wrapped or continuous slot	04	
			Shutter screen			
			Well point	Wire mesh	05	
			Screen type	Shutter or louvered	06	
				Well point	07	
				Tube	08	
			Unknown	Unknown	09	
			Other	Other	10 [F]	
			None			
229	Screen slot/hole size	N	Size of slots/ perforations	Slot/hole size		
230	Slot/perforation method	C	Hand drill	Drill	01	
			Grinder	Grinder	02	
			Axe/chisel	Axe/chisel	03	
			Machine	Machine	04	
			Saw Sawed	Saw	05	
			Torch	Torch	06	
			Other	Other	07 [F]	
			Unknown	Unknown	08	
231	Screen attachment method Allow for 2 records		Method of coupling - Threaded - Telescoped			
			Telescoped			
			Attached to casing	Telescoped	01	
			Attached to riser	On casing	02	
			Screen fitting (top)	On riser pipe	03	
			- Coupler	Neoprene (K) packer	04	
			- Neoprene	Lead packer	05	
			- Packer	Other	06 [F]	
			- Riser			
			Other	Unknown	07	
			Unknown			

1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
232	Screen fitting [bottom]	C	Screen fitting (bottom)	Screen bottom fitting		
			- Bail	Bail	01	
			- Open	Open	02	
			- Plug	Plug	03	
			- Tail pipe	Tail pipe	04	
			- Washdown	Washdown	05	
			- Unknown	Unknown	06	
233	Screen placement method	C	Jetted	Bail down	01	
			Washed down	Pull back	02	
				Jetted	03	
				Washed down	04	
				Unknown	05	

FILTRATION

234	Filtration medium	C		Natural	01	
				Filter pack	02	
				Formation stabilizer	03	
	Filter pack/formation stabilizer		Gravel pack (From/To)			Accuracy:
235	[MATERIAL]	C	Gravel pack -			Depth 0.1 m
236	[FROM]	N	Material			Grain size 0.1 cm
237	[TO]	N	Filter pack - details			
238	[GRAIN SIZE]	N	Gravel placed			
			Well screen & gravel			
	Allow for 3 records		Pack type			
			- Artificial			
			- Crush	Gravel	01	
			- Gravel	Pit run	02	
			- Natural	Silica sand	03	
			- Pit run	Washed sand	04	
			- Silica sand	Crushed rock	05	
			- Washed sand	Artificial (unspecified)	06	
			- Unknown			
			Giant size	Unknown	07	
			Amount	Other	08 [F]	
239	Filter placement method			Tremie	01	
				Pour down	02	

WELL DEVELOPMENT

240	Development duration	N				

1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
232	Screen fitting [bottom]	C	Screen fitting (bottom) - Bail - Open - Plug - Tail pipe - Washdown - Unknown	Screen bottom fitting Bail Open Plug Tail pipe Washdown Unknown	 01 02 03 04 05 06	
233	Screen placement method	C	Jetted Washed down	Bail down Pull back Jetted Washed down Unknown	01 02 03 04 05	

FILTRATION

234	Filtration medium	C		Natural Filter pack Formation stabilizer	01 02 03	
  235 236 237 238	Filter pack/formation stabilizer [MATERIAL] [FROM] [TO] [GRAIN SIZE] Allow for 3 records	 C N N N	Gravel pack (From/To) Gravel pack - Material Filter pack - details Gravel placed Well screen & gravel Pack type - Artificial - Crush - Gravel - Natural - Pit run - Silica sand - Washed sand - Unknown Giant size Amount	Gravel Pit run Silica sand Washed sand Crushed rock Artificial (unspecified) Unknown Other	01 02 03 04 05 06 07 08 [F]	Accuracy: Depth 0.1 m Grain size 0.1 cm
239	Filter placement method			Tremie Pour down	01 02	

WELL DEVELOPMENT

240	Development duration	N				

1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
241	Development method Allow for 2 records	C		Overpumping Surge block Isolation surge block Bailer Air surging Back washing High velocity jetting Hydrofracturing Dry ice Explosives Polyphosphates Acid	01 02 03 04 05 06 07 08 09 10 11 12	

SEALING AND PLUGGING

242 243 244	Annular sealing [MATERIAL] [FROM] [TO] Allow for 3 records	C N N	Casing cemented from Material & type (From/To) Casing grout Grouting method - Positive displacement - Grout pump Dry bentonite Bentonite pellet Grout Bentonite Cement/grout Cuttings Drive shoe Driven Driven & bentonite Formation packer Peltonite Puddled clay Sand & gravel Shale trap Shale & bentonite Shale & cuttings Shale & welded ring Volclay Welded ring Welded & bentonite Welded & cement Other Unknown	Portland cement Bentonite or Volclay dry Bentonite or Peltonite pellet Bentonite grout Cuttings Puddled clay Other None Unknown	01 02 03 04 05 06 07(F) 08 09	Accuracy: Depth 0.1 m
245	Grouting placement method	C		Positive displacement Pump	01 02	

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1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
246 247	Seal components [COMPONENT] [DEPTH] Allow for 3 records	C N		Formation packer Welded ring Shale trap Drive shoe Driven casing Other	01 02 03 04 05 06 [F]	Accuracy: Depth 0.1 m
248 249 250	Plugging [MATERIAL] [FROM] [TO] Allow for 3 records	C N N	Bassani plug Bentonite product Cement Cuttings Formation packer Not applicable	Bassani plug Bentonite Cement Cuttings Formation packer Sand Gravel Other Unknown	01 02 03 04 05 06 07 08 [F] 09	Inside casing (or filling in of uncased well or backfilling) Accuracy: Depth 0.1 m
251 252	Casing left after plugging [FROM] [TO] Allow for 3 records	N N		Casing still in place after plugging		Accuracy: Depth 1 m
253 254	Casing slit [FROM] [TO] Allow for 3 records	N N		Casing slit opposite water bearing zones before plugging		
255	Comments	F				

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FILE # 3

FORMATION LOGGING

1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
300	Well identification	AN				
301	Grain size analysis	C			1 or 0	Yes/No
302	Effective diameter	N				
303	Coefficient of uniformity	N				

BOREHOLE LOGGING

	Borehole log		Formation log description			
304	[TYPE]	C	Driller's log	Driller's log	01	See comment below
305	[FROM]	N	Geological profile			
306	[TO]	N	Bedrock depth			
			Well log			
	Allow for 3 records		Stratigraphic log			
			Lithology description			
			Lithologic log	Lithologic log	02	See comment below
			Log of overburden and bedrock material			
			Lithology			
			Geophysical			
			- Electric			
			- Gamma	Gamma ray log	03	
			Resistivity	Apparent resistivity log	04	
			Spontaneous potential			
			Radioactivity	Spontaneous potential log	05	
			Geothermal			
			Geochemical	Geothermal log	06	
				Geochemical log	07	
				Caliper log	08	
				Drilling time log	09	
				Other	10	
307	[MATERIAL]	C				
308	[FROM]	N				
309	[TO]	N				
	Allow for 30 records					
310	Natural gas detected	C			1 or 0	Yes/No
	COMMENT The "lithologic log" is prepared by an expert using information obtained from the driller's log. Standard geologic terminology as listed in the following pages will be used. The "driller's log," as completed by the well contractor, can continue to use local and familiar expressions; however regional officials will be expected to have a thorough understanding of their intended use.					
311	Comments	F				

Definitions for Lithological Terms

For the purposes of these guidelines, reference was made to Chapter 4 of Groundwater, Freeze, R.A., and Cherry, J.A., 1979, Prentice-Hall, Inc., Englewood Hills, NJ 07632.

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LITHOLOGICAL LOGGING - UNCONSOLIDATED SEDIMENTS

STANDARD TERM	CODE	OTHER TERMS PRESENTLY USED								
		ALBERTA	BRITISH COLUMBIA	QUEBEC	ONTARIO	NOVA SCOTIA	NEWFOUNDLAND	SASKATCHEWAN	GOWN	USGS
Unspecified Overburden	01			Dépôt non consolidé	Overburden	Overburden	Overburden		Overburden	Overburden Outwash
Organic matter	02	Organic matter	Peat	Terre végétale	Peat (muskeg, bog) Wood fragments		Peat Wood fragments	Organic matter	Peat Plant detritus Humus Wood	Peat Residium
Soil	03	Topsoil	Loam Topsoil		Topsoil (loam, earth, soil)	Loam Topsoil	Topsoil	Topsoil	Soil	Soil (saprolite, loam)
Fill	04	Fill		Remblai	Fill (rubble)	Fill	Fill	Fill Drift	Fill	Rubble Drift
Rock	05	Rocks	Rock				Rock	Rock		Rock
Till	06	Till	Till		Till	Glacial till	Till	Till	Till	Till
Boulders	07	Boulders	Boulder		Boulders	Boulders	Boulders	Boulders	Boulder Boulders	Boulders and sand Boulders
Cobbles	08	Stones	Stones	Blocaux	Pea gravel Stones (pebbles, rocks)		Pea gravel Stones	Cobblestones Stones	Pebble Pebbles	Cobbles Cobbles, silt & clay Cobbles and sand

LITHOLOGICAL LOGGING - UNCONSOLIDATED SEDIMENTS

STANDARD TERM	CODE	OTHER TERMS PRESENTLY USED								
		ALBERTA	BRITISH COLUMBIA	QUEBEC	ONTARIO	NOVA SCOTIA	NEWFOUNDLAND	SASKATCHEWAN	GOWN	USGS
Gravel	09	Gravel	Gravel	Graviers Graviers au grain fin Graviers au grain moyen Graviers au grain grossier Graviers homogènes - homogènes au grain fin - homogènes au grain moyen - homogènes au grain grossier Graviers hétérogènes argileux Graviers hétérogènes silteux Graviers hétérogènes sablonneux Graviers hétérogènes à blocaux	Gravel Fine gravel Medium gravel Coarse gravel	Gravel	Gravel Fine gravel Medium gravel Coarse gravel	Gravel Gravel & rocks	Gravel	Gravel Gravel and clay Gravel, sand & clay
Sand	10	Sand Sand & coal Sand & clay stringers Sand & gravel Sand & rocks Quickstand	Sand	Sables - au grain fin - au grain moyen - au grain grossier Sables homogènes - homogènes au grain fin - homogènes au grain moyen - homogènes au grain grossier Sables hétérogènes - hétérogènes argileux - hétérogènes silteux - hétérogènes graveleux - hétérogènes à blocaux	Sand Fine sand Medium sand Coarse sand Quicksand	Sand Quicksand	Sand Fine sand Medium sand Coarse sand	Sand Sand & gravel Quicksand	Sand	Sand Sand and clay Sand and silt Sand and gravel (and clay)

LITHOLOGICAL LOGGING - UNCONSOLIDATED SEDIMENTS

STANDARD TERM	CODE	OTHER TERMS PRESENTLY USED								
		ALBERTA	BRITISH COLUMBIA	QUEBEC	ONTARIO	NOVA SCOTIA	NEWFOUNDLAND	SASKATCHEWAN	GOWN	USGS
Silt	11	Silt	Silt	Silt Silt homogène Silt hétérogène - hétérogène argileux - hétérogène sablonneux - hétérogène graveleux - hétérogène à blocaux	Silt	Silt	Silt	Silt	Silt	Silt Silt and clay Loess
Muck	12	Mud			Muck (mud)	Mud	Muck			Muck (mud)
Clay	13	Clay Clay & silt Clay & shale Clay & gravel Clay & rocks Clay & sandstone Clay & coal	Clay	Argile Argile homogène Argile hétérogène - hétérogène silteuse - hétérogène sablonneuse - hétérogène graveleuse - hétérogène à blocaux	Clay	Clay	Clay	Clay Silty clay Sandy clay Gravelly clay	Clay	Clay Clay, some sand
Hardpan	14	Hardpan	Hardpan		Hardpan		Hardpan	Hardpan		Hardpan

LITHOLOGICAL LOGGING - CONSOLIDATED SEDIMENTS

STANDARD TERM	CODE	OTHER TERMS PRESENTLY USED								
		ALBERTA	BRITISH COLUMBIA	QUEBEC	ONTARIO	NOVA SCOTIA	NEWFOUNDLAND	SASKATCHEWAN	GOWN	USGS
Sedimentary rock (unspecified)	15			Sédimentaire - fissurée - peu fissurée - triturée - triturée sale - triturée propre					Sedimentary Rock	Sedimentary (undifferen.)
Breccia	16								Breccia	Breccia
Conglomerate	17	Conglomerate	Conglomerate	Conglomerat - fissuré - poreux - trituré - trituré sale - trituré propre	Conglomerate		Conglomerate		Conglomerate	Conglomerate Gravel, cemented
Sandstone	18	Sandstone Sandstone stringers Sandstone & gravel Sandstone & coal	Sandstone	Grès Grès fissuré Grès poreux (semi-consolidé) Grès trituré Grès trituré sale Grès trituré propre	Sandstone (arkose, freestone, grit)	Sandstone	Sandstone	Sandstone	Sandstone	Sandstone (arkose)
Greywacke	19	Sst & shale ledges			Greywacke		Greywacke		Wacke	Sandstone and shale Greywacke
Chert	20	Chert			Chert Flint		Chert Flint			Chert
Quartzite	21			Quartzite - fissurée - peu fissurée - triturée - triturée sale - triturée propre	Quartzite	Quartzite	Quartzite		Quartzite	Quartzite

LITHOLOGICAL LOGGING - CONSOLIDATED SEDIMENTS

STANDARD TERM	CODE	OTHER TERMS PRESENTLY USED								
		ALBERTA	BRITISH COLUMBIA	QUEBEC	ONTARIO	NOVA SCOTIA	NEWFOUNDLAND	SASKATCHEWAN	GOWN	USGS
Siltstone	22	Mudstone							Mudstone Claystone	
Siltstone	23						Siltstone		Siltstone	
Shale	24	Shale Shale & coal Shale & sandstone Shale & Sst ledges Shale & siltstone Shale stringers Hard ledges	Shale		Shale	Shale	Shale	Shale	Shale	Shale
Carbonate rocks (unspecified)	25		Shell			Plaster	Dolostone		Carbonate rocks Shells Shell	Coquina Chalk Calcite
Marble	26				Marble		Marble		Marble	Marble
Marl	27				Marl		Marl		Marl	Marl (Marlstone)
Limestone	28	Limestone	Limestone	Calcaire - fissuré - dissous - trituré - trituré sale - trituré propre	Limestone (lime)	Limestone	Limestone	Limestone	Limestone	Limestone
Dolomite	29			Calcaire - fissuré - dissous - trituré - trituré sale - trituré propre	Dolomite		Dolomite	Dolomite	Dolomite	Dolomite
Evaporites	30								Evaporitic Salts	Evaporite
Gypsum	31				Gypsum (anhydrite)	Gypsum	Gypsum		Gypsum	Gypsum (anhydrite)

LITHOLOGICAL LOGGING - CONSOLIDATED SEDIMENTS

STANDARD TERM	CODE	OTHER TERMS PRESENTLY USED								
		ALBERTA	BRITISH COLUMBIA	QUEBEC	ONTARIO	NOVA SCOTIA	NEWFOUNDLAND	SASKATCHEWAN	GOWN	USGS
Iron formation	32	Ironstone			Iron formation (hematite)		Iron formation			
Coal	33	Coal				Coal		Coal	Coal	Coal Lignite
Bentonite	34	Bentonite						Bentonite	Bentonite	Bentonite

LITHOLOGICAL LOGGING - CRYSTALLINE ROCKS

STANDARD TERM	CODE	OTHER TERMS PRESENTLY USED								
		ALBERTA	BRITISH COLUMBIA	QUEBEC	ONTARIO	NOVA SCOTIA	NEWFOUNDLAND	SASKATCHEWAN	GOWN	USGS
Basalt	35		Basalt Volcanic		Basalt (andesite, diorite, diabase, gabbro) Feldspar	Basalt	Basalt Feldspar		Lava Tuff	Basalt Volcanic (undiffer.) Anorthosite Tuff Rhyolite (syenite SYNT) Diorite
Greenstone Soapstone	36 37	Soapstone		Ignée et métamorphique -fissurée -peu fissurée -triturée -triturée sale -triturée propre	Soapstone Greenstone		Soapstone Greenstone		Meta-volcanic rock Greenstone Igneous rock Metamorphic rock	Serpentine Greenstone Igneous (undifferen.) Metamorphic (undifferen.)
Schist	38			Schiste métamorphique -fissuré -peu fissuré -trituré -trituré sale -trituré propre	Schist		Schist		Schist	Schist
Granite Gneiss	39 40		Granite Quartz	Granite et gneiss métamorphique -fissuré -peu fissuré -trituré -trituré sale -trituré propre	Granite (biotite, mica, pegmatite, porphyry, rhyolite, syenite, tuff) Gneiss Quartz	Granite	Granite Gneiss	Granite	Granite Gneiss Pegmatite	Granite Diabase Gabbro Granite, gneiss Gneiss
Slate	41				Slate	Slate	Slate		Meta-sediment Slate	Slate

LITHOLOGICAL LOGGING - UNSPECIFIED

STANDARD TERM	CODE	OTHER TERMS PRESENTLY USED								
		ALBERTA	BRITISH COLUMBIA	QUEBEC	ONTARIO	NOVA SCOTIA	NEWFOUNDLAND	SASKATCHEWAN	GOWN	USGS
Unspecified	42	See Comments Unknown			Unknown		Unknown	Unknown	Unspecified	Other
Bedrock (unspecified)	43	Bedrock	Bedrock	Roche en place -fissurée -peu fissurée -triturée -triturée sale -triturée propre	Rock (bedrock)	Bedrock		Bedrock	Bedrock	
Nodule	44	Concretions				Manganese		Concretion		

LITHOLOGICAL MODIFIERS

Enter the adjective modifiers needed to describe the rock type.

SUBORDINATE OR COMPOSITIONAL DESCRIPTOR TERMS

01..acidic
02..argillaceous (see also clayey)
03..basic
04..bentonitic
05..bituminous (also carbonaceous)
06..bouldery
07..calcareous
08..carbonaceous
09..chalcedonic (see cherty)
10..cherty (also opaline)
11..clay streaks
12..clayey
13..coal streaks
14..conglomeritic
15..dolomitic
16..feldspathic
17..ferruginous
18..gravel streaks
19..gravelly
20..gypsiferous
21..limy
22..marly
23..micaceous
24..muddy
25..non-calcareous
59..unconsolidated
26..opaline (see cherty)
27..organic
28..pebbly
29..phosphatic
30..pyritic
31..quartzose
32..sand streaks
33..sandy
34..sand-gravel streaks
35..shale streaks
36..shaley
37..sideritic
38..siliceous
39..silt streaks
40..silty
41..slaty streaks
42..slaty
43..stony
44..till streaks

COLOUR ABBREVIATIONS

01..black
02..blue
03..brown
04..grey
05..green
06..red
07..white
08..yellow
09..light
10..dark
11..purple
12..rust-coloured
13..speckled
14..vari-coloured
15..salt & pepper

Allow for 2 codes

ADVERBS

01..slightly
02..very

STRUCTURAL OR PHYSICAL PROPERTY DESCRIPTIVE TERMS

01..amorphous
02..aquitard
03..abundant
04..angular
05..bedded
06..broken
07..cemented
08..chunky
09..clean
10..coarse
11..compact
12..consolidated
13..cross-bedded
14..crumbly
15..crypto-crystalline (crystals not seen with unaided eye)
16..crystalline
17..dense
18..dirty
19..dry
20..fine
21..fissile
22..firm
23..fractured (broken)
24..fresh
25..friable

26..glassy
27..graded
28..granular
29..greasy
30..gritty
31..hard
32..interbedded
33..jointed
34..laminated
35..layered
36..loose

37..lost circulation
38..medium
39..moist
40..odd
41..open
42..packed
43..plastic
44..platey
45..porous
46..round(ed)
47..rubbly
48..seepage
49..sharp

50..soft
51..sticky
52..stiff
53..stratified
54..sub-angular
55..sub-rounded
56..subsidiary
57..thick
58..thin

60..uniform
61..vesicular
62..waxy
63..water-bearing
64..well sorted
65..wet

Allow for 2 codes

GRAIN SIZE (Sand)

01..very fine-grained	02 - 0.063 mm
02..fine-grained	0.02 - 0.2 mm
03..fine-medium-grained	0.063 - 0.2 mm
04..medium-grained	0.063 - 0.63 mm
05..coarse-medium-grained ..	0.2 - 0.63 mm
06..coarse-grained	0.2 - 2.0 mm
07..gravely sand	0.63 - 2.0 mm

GENETIC or PARAGENETIC DESCRIPTIVE TERMS

01..alluvial--(detrital deposits of rivers)
02..beach
03..bioclastic
04..eolian--(detrital deposits arranged by winds)
05..flowing zone
06..fluvio-glacial--(produced by river action)
07..fossiliferous (shelly)
08..gassy
09..glacial
10..lacustrine--(pertaining to, or produced by a lake)
11..littoral--(pertaining to, or production along a shoreline)
12..marine
13..oolitic--(usually of calcareous ellipsoidal bodies)
14..outwash
15..oxidized
16..pisolitic (see oolitic)
17..shelly
18..stylolitic--(clayey columnar developments in limestone)
19..unoxidized
20..weathered

FILE # 4

WATER LEVELS, WELL PERFORMANCE, AQUIFER YIELD

1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
			WATER LEVELS			
400	Well identification	AN				
401	Artesian head (height above ground)	N	If flow artesian, head above ground Artesian head	Head above ground		Precision: 0.1 m
402	Water found (DEPTH) Allow for 3 records	N	Water found at Water occurrences at Depth water struck Water struck Depth to water	Water found		Precision: 1 cm
403	Water bearing fractures (DEPTH) Allow for 3 records	N	Water bearing fractures	Water bearing fractures		Precision: 1 cm
404	Static level (pre)	N	Non pumping (static) WL Static level Static water depth WL before pumping Static water level	Static level (pre)		Precision: 1 cm
405	Drawdown	N	Final drawdown Total drawdown Drawdown	Drawdown		Precision: 1 cm
406	Static level (post)	N	Water level after pumping Final level WL at end of test Recovery	Static level (post)		Precision: 1 cm
407	Method of measurement	C	Hand held chalk tape Hand held electric tape Automatic recorder	Tape Sensor Recorder	01 02 03	Precision: 1 cm
			AQUIFER TESTING			
408	Pump test	C	Production test Pump test data Yield test	Pump test	1 or 0	Yes/No (If yes see File #5)
409 410	Test date Start time	N N				1 day 1 minute
411	Test method Allow for 2 codes	C	Pump Pump test Timed pump test Pumping test Pump and air	Pump	01	

F = Freeform N = Numeric AB = Alphabetic AN = Alphanumeric C = Code

1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
			Bailer Bailed Bailer test Bailer and air	Bailer	02	
			Air Air blown	Air lifted	03	
			Field permeameter	Field permeameter	04	
			Lab permeameter	Lab permeameter	05	
			Slug test	Slug test (water in)	06	
			Other	Other	07[F]	
			Unknown	Unknown	08	
412	Type of test	C		Step drawdown Constant rate	01 02	
413	Test duration	N	Duration of test Pump duration Duration of pumping	Test duration		1 minute
414	Pump intake during test	N	Depth of intake Pump intake set at Pump intake at Depth of pump/drill stem	Pump intake during test		0.1 m
415	Method of measuring discharge	C		Container Meter Orifice weir Weir or flume	01 02 03 04	
416	Accuracy of discharge measurement	C	Measured Reported estimated		01 02	
 417 418 419 420	Derived parameters Hydraulic conductivity Transmissivity Storativity Specific capacity	 N N N N				
421	Observation well ID Allow for 4 records	AN				

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1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
  422 423	Operating Recommendations [PUMPING RATE] [PUMP INTAKE DEPTH]	 N N	Estimated well yield (yield value) Safe yield Recommended pumping rate Recommended pump rate Rate of diversion	Recommended pumping rate		Litres/min
			Recommended pump intake at Recommended pump intake set at Recommended pump rate Recommended pump setting	Recommended pump intake depth		0.1 m
424	Well-owner requirements	N	Well-owner - anticipated Water requirement	Well-owner water requirement		Litres/min
425	Annual allocation	N				
426	Annual use	N				
427	Peak withdrawal rate (Approved)	N				
 428 429	Flowing conditions [FLOWING] [FLOW]	 N	Flowing Artesian flow If flowing give rate	 Flowing Flow	 0 or 1	 No/Yes Litres/min
430	Spring flow	N	Spring yield	Spring flow		Litres/min
431	Boundary conditions	C	Level influenced by neighbouring pumping	Boundary conditions	0 or 1	No/Yes (If Yes see Field 440)

INSTALLED PUMP DETAILS

432	Pump type installed	C	Type - Turbine - Centrifugal - Airline - Jet - Piston - Rotary Rec. pump type - Shallow - Deep	Positive displacement pump - Piston - Rotary Variable displacement pump - Centrifugal - Jet - Airlift	 01 02 03 04 05	
433	Pump capacity	N				
434	Pump intake depth	N				
435	Pump location	F				

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1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
436	Date installed	N	Pump installed (Y/N) Install date	Date installed		YY/MM/DD
437	Make	AB	Manufacturer	Make		
438	Model	AN	Model	Model		
439	Pump riser pipe diameter	N	Riser pipe diameter	Pump riser pipe diameter		0.1 cm
440	Comments	F				

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FILE # 5

PUMP TEST INFORMATION (PUMPED WELL)

1	2 FIELD	3	4 PROV. OR FED. TERMS PRESENTLY USED	5 STANDARD TERM	6 CODE	7 • COMMENTS • MEASUREMENT UNITS
500	Well identification	AN				
501	Elapsed time	N	Elapsed time	Elapsed time		10 sec
502	Pumping rate during test	N	Pump settings during test Flow rate Pumping rate Rate of pumping during test Well yield Rate of yield of well Aquifer pumping rate	Pumping rate during test		0.1 L/sec
503	Water level while pumping	N	Depth to water level during pumping	Water level while pumping		1 cm
504	Water level while recovering Allow for 100 records (501 to 504 linked)	N	Depth to water level during recovery Water level measurements taken during pumping/recovery	Water level while recovering		1 cm
505	Comments	F				

F = Freeform N = Numeric AB = Alphabetic AN = Alphanumeric C = Code

FILE # 6

WATER QUALITY SAMPLING INFORMATION

1	2 FIELD	3	4 DESCRIPTION	5 STANDARD TERM	6 CODE
600	Well identification	AN			
601	Agency code	AN	Code to indicate agency or organization that collected water sample	Coding used in NAQUADAT/ENVIRODAT dictionary of codes	
602	Sample purpose	AN		Background water quality Contamination investigation - septic systems - petroleum tanks/pipelines - industrial chemicals at manufacturing facilities - underground injection wells(industrial waste) - municipal landfills - livestock wastes - leaky sewer lines - wood preservation facilities - mining/mill tailings - power plant fly ash - petroleum refinery sludge - spreading of sewage sludge - graveyards - road salt storage areas - liquid waste disposal wells - road runoff of salt and other chemicals - highway/railway spills - coal tar from gasification sites - asphalt production and equipment cleaning sites - agricultural fertilizers - agricultural/silvicultural pesticides - contaminants in precipitation and dry atmospheric fallout - other	00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 [F]
603	Sample number	AN	Unique sample identifier	No standard required; whatever is used by sampling agency	
604	Sample date	AN	Date that a sample is collected	YY/MM/DD	
605	Sample time	AN	Time that a sample is collected	HH:MI (24 hour clock)	
606	Time zone	AB	Time zone for time reported in field 705	NST,NDT,AST,ADT, EST,EDT,CST,CDT, MST,MDT,PST, PDT, YST,YDT,DDT	
607	Comments	F	Textual field for description of other pertinent information or observations related to the sample		

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FILE # 7

WATER QUALITY MEASUREMENTS

1	2 FIELD	3	4 DESCRIPTION	5 STANDARD TERM
700	Well identification	AN		
701	Sample number	AN	Unique sample identifier	No standard required; whatever is used by sampling agency
702	Sample date	AN	Date that a sample is collected	YY/MM/DD
703	Sample time	AN	Time that a sample is collected	HH:MI (24 hour clock)
704	Lab identifier	AN	Identifier for the lab performing analyses	Codes in the NAQUADAT/ENVIRO-DAT Dictionary of Codes
705	Variable code	AN	The variable or parameter measured	Codes in the NAQUADAT/ENVIRO-DAT Dictionary of Codes
706	Method code	AN	The method by which the measurement was made	Codes in the NAQUADAT/ENVIRO-DAT Dictionary of Codes
707	Detection limit	N	The method detection limit for this variable and method combination	
708	Pretreatment code	AN	The type of pretreatment applicable to the measurement, e.g., F - filtered P - preserved	Codes in the NAQUADAT/ENVIRO-DAT Dictionary of Codes
709	Value type code	N	The type of value reported, e.g., M - mean E - estimated	Codes in the NAQUADAT/ENVIRO-DAT Dictionary of Codes
710	Flag	AN	A qualifier for the data value, e.g., L - less than G - greater than	Codes in the NAQUADAT/ENVIRO-DAT Dictionary of Codes
711	Value	N	The numeric or numerically encoded value for the measurement	
712	Unit code	AN	The units of the reported value	Codes in the NAQUADAT/ENVIRO-DAT Dictionary of Codes

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GUIDELINES

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PART 4 GROUNDWATER DATABASES AND SYSTEMS MANAGEMENT

GUIDELINES

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PART 4 GROUNDWATER DATABASES AND SYSTEMS MANAGEMENT

DATABASE MANAGEMENT SYSTEMS

The organizations that are mandated to collect groundwater data are normally responsible for the design, maintenance, and updating of their databases. There are more than 10 groundwater databases at various places across Canada, with at least one in each province. These databases should be readily available to consulting firms, drillers, public special interest groups, and other participating provincial, federal and municipal agencies, who often require near-instantaneous turn around on their requests. This necessitates the storage of the data collections on-line, or at least in a form that can be very quickly copied on-line. These databases should conform to the SQL (structured query language) standard to make their development and maintenance easier. By adopting the SQL standard it will not be necessary to select only one commercial relational database management system (RDBMS) software vendor. Several different commercial relational database management systems may already be in place in provincial offices which conform, in varying degrees, to the SQL standard.

Due to the existence of numerous groundwater databases, it will be necessary to develop a standard user program to interface with the commercial SQL relational database management systems being used by provincial and federal agencies.

The standard user interface will query the user to determine which groundwater data are desired, will get the data from the database, and put them on the user's screen at that time, if so desired, or will send them electronically at that moment to the user as a PC file, or will have them sent on diskette by mail or courier if the volume is extremely large and there is no urgency. Only if the data are to be sent by mail or courier should it be necessary for the end-user to contact provincial staff. The standard user interface should eventually have the capability to provide the data in the form of printed tables, PC files as well as various graphs.

The output files created through this standard user interface will conform to the standardized groundwater data management format.

This standard user interface must appear to the user to be identical in appearance and function, no matter which commercial RDBMS is being used by the province or federal agency. By adopting the SQL standard for the groundwater databases, the level of effort to maintain the standard user interface for a particular commercial RDBMS will be minimized.

The data fields and codes found within the provincial/federal groundwater databases will consist of only those enumerated in the data management format. Presently, seven files or logical groupings of the groundwater data have been covered under the data management format. Additional fields will be identified and defined, such as time series groundwater hydrographs.

STANDARDIZED FORMAT FOR GROUNDWATER DATA MANAGEMENT

For the groundwater community at large, the development of a set of standard machine readable formats is essential so that subsequently software can be developed that takes advantage of the availability of groundwater data being provided in a predetermined form. Agencies will be able to develop their groundwater models or GIS knowing the formats in which they will receive the groundwater data. In the future, a form of the data management format could possibly be developed specifically for GIS.

For the groundwater database agencies, the adoption of standard formats will reduce the computer science effort required to develop and maintain the user interfaces.

TELECOMMUNICATIONS

Direct user access via telecommunications should be strongly encouraged to reduce the time delay and costs involved in filling data requests manually by a groundwater agency. Telecommunications could also play an important role in improving the data capture process.

Telecommunications access should be put in place to ensure that the drillers have convenient access to the provincial database to which they supply data and from which they retrieve them. It is suggested that a combination of 1-800 telephone numbers and the Datapac packet-switching network service of Telecom Canada be used to accommodate low volume data traffic from a variety of users, for example, drillers, consultants, or other provincial or federal agencies. The selection of this combination does not exclude the option of a private internal provincial government network being set up to accommodate only the various departments of a given provincial government. As an incentive to drillers who contribute groundwater data, their data communications costs could be covered by provincial database managers. The drillers and users not contributing groundwater data could be charged for their telecommunications traffic by the respective telephone company within their province when retrieving groundwater data.

At the provincial database site, 4800 or 9600 baud service is suggested with 1200 or 2400 baud service for the drillers and infrequent users. These are speed suggestions based on medium traffic volumes, and they can be increased with no adverse impacts on the groundwater databases. If provincial sub-offices exist, the captured groundwater data could be sent to these sites to reduce the telecommunication charges to a more distant single provincial headquarters site.

REFERENCING OF DATABASES

Initially, the DREF system at CISTI (Canada Institute of Scientific and Technical Information) of NRC will provide the means to determine the availability of groundwater databases, the content of each, and instructions on how to access each database to obtain the requested data. Later, in a subsequent phase of this development work, actual linkages can be put in place to retrieve data from several groundwater databases through a single user interface.

GUIDELINES

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APPENDIX LIST OF PARTICIPANTS

NATIONAL WORKSHOPS

SASKATOON, SASKATCHEWAN FEBRUARY 6-7, 1990

Newfoundland	Department of Environment and Lands
New Brunswick	Department of Municipal Affairs and Environment
Manitoba	Department of Natural Resources
Saskatchewan	Saskatchewan Water Corporation
	Saskatchewan Research Council
Alberta	Department of Environment
British Columbia	Ministry of Environment
Prairie Provinces Water Board	
Federal	Department of the Environment
	Department of Indian Affairs and Northern Development
Private	Integrated Environments Limited
	Piteau Engineering Limited

HALIFAX, NOVA SCOTIA NOVEMBER 20-21, 1990

Newfoundland	Department of Environment and Lands
Prince Edward Island	Ministry of Environment
Nova Scotia	Department of Environment
New Brunswick	Department of Municipal Affairs and Environment
Ontario	Department of Natural Resources
Manitoba	Department of Natural Resources
Alberta	Department of Environment
Federal	Department of the Environment

VANCOUVER, BRITISH COLUMBIA JUNE 13-14, 1991

Newfoundland	Department of Environment and Lands
Ontario	Department of Natural Resources
Manitoba	Department of Natural Resources
Alberta	Department of Environment
British Columbia	Ministry of Environment
Prairie Provinces Water Board	
Federal	Department of the Environment

REGIONAL WORKSHOPS

Atlantic Region

ST. JOHNS, NEWFOUNDLAND APRIL 18–19, 1991

Newfoundland	Department of Environment and Lands
Prince Edward Island	Ministry of Environment
Nova Scotia	Department of Environment
New Brunswick	Department of Municipal Affairs and Environment
Federal	Department of the Environment

Central Region

HULL, QUEBEC MAY 3, 1991

Quebec ×	Ministère de l'Environnement du Québec
Ontario	Department of Natural Resources
Federal	Department of the Environment

Western and Northern Region

SASKATOON, SASKATCHEWAN JUNE 3, 1991

Manitoba	Department of Natural Resources
Saskatchewan	Saskatchewan Water Corporation
Alberta	Department of Environment
Prairie Provinces Water Board	
Federal	Department of the Environment
	Department of Agriculture