Modified August, 2008 by MDKozar

GROUND-WATER QUALITY ASSURANCE PLAN FOR THE U.S. GEOLOGICAL SURVEY, WEST VIRGINIA WATER SCIENCE CENTER

INTRODUCTION

The Water Resources Division (WRD) of the U.S. Geological Survey (USGS) performs a wide variety of ground-water data-collection programs and investigations to assess the status of the Nation's ground-water resources. Results of these activities are used to aid the Nation in developing, managing, and maintaining its ground-water resources. As the Nation's principal earth-science information agency, the USGS is depended upon to collect accurate data and produce factual and impartial interpretive reports. Methods for data collection and analysis that were developed by the USGS have become standard techniques used by numerous Federal, State, and local agencies and by private enterprises. Data collected by scientific organizations such as the USGS are being used increasingly by the public to define and examine a variety of natural-resource and environmental problems. As a result, scientific organizations are being challenged to demonstrate the credibility of their data on the basis of objective evidence rather than on the organization's history and reputation.

To address these demands and expectations, the WRD has implemented a program designed to ensure that all scientific work done by or for the WRD is conducted in accordance with a quality-assurance (QA) program. The Office of Ground Water (OGW), in coordination with the Branch of Technical Development and Quality Systems, has the responsibility to develop, coordinate, and implement the quality-assurance program for Water Science Center ground-water activities. As part of that program, the OGW has directed the preparation of a Ground-Water Quality-Assurance Plan (GWQAP) which covers all ground-water activities by Center offices of the USGS. USGS Open-File Reports (OFR) 92-136 (Schroder and Shampine, 1992) and 92-162 (Shampine and others, 1992) outline the guidelines for preparing Center quality-assurance plans and integrating the quality assurance into project work plans. Guidelines presented here are intended to supplement these two reports and provide more specific details related to ground-water activities.

A quality-assurance plan can be defined as a formal document that describes the management policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of a responsible organizational unit or group for ensuring quality in its products. The implementation of a ground-water quality assurance plan (GWQAP) will enhance ground-water data collected by the USGS personnel within the West Virginia Water Science Center by providing for the following:

1. Consistency (across projects, subdistricts, WRD, and so forth);
2. Accountability (to client, scientific community, and regulatory agencies);
3. Comparability (yields results of known quality);
4. Traceability (written record of how, who, and when work was performed, training, equipment, etc.);
5. Repeatability (documentation of technique that leads to the similar results time after time with the same accuracy).

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This report is a quality-assurance plan for ground-water activities conducted by the USGS within the West Virginia Water Science Center and is meant to complement similar quality-assurance plans for surface-water and water-quality activities within the Center. The duties and responsibilities for meeting the objectives outlined in this document within the West Virginia Water Science Center are outlined within this report

The purpose of this GWQAP is to establish a minimum set of guidelines and practices to be used by Water Science Center personnel to assure quality in ground-water activities. Included within these practices are the assignment of responsibilities for implementing quality-assurance activities in the Center and establishment of review procedures needed to ensure the technical quality and reliability of ground-water products.

This report presents quality-assurance policies pertaining to the collection, processing, analysis, storage, review, and publication of ground-water data. In addition, policies related to organizational responsibilities, training, and project planning are presented. These policies and practices pertain to all ground-water activities conducted by or for the West Virginia Water Science Center. Ground-water activities include all tasks pertaining to data-collection programs, interpretive and research projects, and data management.

ORGANIZATION AND RESPONSIBILITIES

Though quality assurance is a personal responsibility of all employees of the USGS, ultimate quality-assurance responsibility within each Center lies with the Center Director. Clear statements of specific responsibilities promote an understanding of each person's role in the overall process of assuring quality and can help to prevent errors and deficiencies that may otherwise occur. Implementation and follow-up responsibilities lie with data-collection staff, project chiefs, section chiefs, discipline specialists, Center Directors, regional specialists, and others. Even if quality-assurance responsibilities are ancillary duties for some employees, these functions are documented in this report.

The following West Virginia Water Science Center personnel are responsible for carrying out the provisions of the GWQAP:

1. Center Director - Hugh E. Bevans
2. Hydrologic Investigations and Surveillance Section Chief - Ronald D. Evaldi
3. Center Ground-Water Specialist - Mark D. Kozar
4. Center Ground-Water Hydrologists/Project Technicians - Melvin V. Mathes, James D. Scott, Lary K. Rogers, and Jeremy S. White
5. Center Ground-Water Hydrologic Technicians - Scott T. Flynn, Carl Faulkenburg, Fred Brogan, Gary Crosby.
6. Other Center scientists and technicians as needed for selected ground-water activties, especially synoptic well sampling surveys.

The Center Director is responsible for:

1. Managing and directing the Center program, including all ground-water activities.
2. Ensuring that ground-water activities in the Center meet the needs of cooperating agencies, including state and local agencies; the general public; and the Federal Government.
3. Ensuring that all aspects of this GWQAP are understood and followed by Center personnel.
4. Providing final resolution of any conflicts or disputes related to ground-water activities within the Center.
5. Keeping Center staff briefed on procedural and technical communications from Region and Headquarters.
6. Ensuring that technical reviews of all ground-water activities are conducted.
7. Ensuring that all publications and other technical communications released by the Center are accurate and are in accord with USGS policy.
8. Ensuring that ground-water training is incorporated into each employee's training plan, where appropriate.

The Hydrologic Investigations and Surveillance Section Chief is responsible for:

1. Managing and directing ground-water activities assigned to their section and ensuring that the stated objectives are met in a timely manner.
2. Reviewing work plans for ground-water programs and projects.
3. Providing the project chief with technical and administrative support as needed.
4. Creating, with ground-water personnel in the section, a training plan for each employee, where appropriate.
5. Reviewing ground-water reports under their direction.
6. Monitoring progress of ground-water project chiefs in implementing the GWQAP for their respective projects.

The ground-water project chief is responsible for:

1. Directing and conducting the technical work of the project, including all phases of data collection, data review, data storage, data analysis, and report preparation according to appropriate procedures.
2. Communicating project plans, progress, and problems to supervisors by providing written progress reports at periodic reviews.

3. Preparing written work plans, documenting project activities, and ensuring that data are placed in the USGS National Water Information System (NWIS) data base, as appropriate, prior to project termination.
4. Maintaining a project file containing memoranda, personal communications, technical-procedure documents used, original data, and other documentation.
5. Ensuring that project activities are carried out in a timely manner.
6. Creating, with the supervisor, a personal training plan.
7. Archiving of project files, at the completion of the project.

The Center ground-water specialist duties shall include but not be limited to:

1. Maintaining current ground-water technical expertise for the Center.
2. Maintaining the ground-water technical-procedure documents file.
3. Consulting with the Center staff on ground-water technical matters.
4. Advising on training needs for employees engaged in ground-water activities.
5. Participating in technical reviews of ground-water activities.
6. Reviewing ground-water related project proposals.
7. Reviewing ground-water related project reports.

TRAINING

Employee training is an investment that has short-term and long-term benefits to Center ground-water activities. The immediate benefits permit confidence that the work is being performed correctly and accurately. The long-term benefits provide for technically competent employees that are of great value to the organization. Because all work in the scientific arena is receiving increased scrutiny, the qualifications of ground-water personnel relative to the technical demands of the work to be performed must be well-documented. Training already received as well as current and planned training need to be incorporated into a documented training plan for each employee. Periodic reviews of these plans by Center management will help determine additional training needs.

The following quality-assurance activities shall be performed by the Center:

1. A training plan shall be prepared for each employee (including observers and volunteers, as appropriate) performing technical tasks relating to ground water.

   a. Each training plan shall include an individual's short-term training needs, such as the knowledge and skills needed to perform currently assigned tasks as well as long-term training needs, such as skills needed to perform future tasks and for career development.

b. Training plans should be reviewed and updated annually.

2. Individuals shall receive appropriate training before assigned tasks are performed. Appropriate training includes new employee training, USGS National Training 2. Center courses, mentoring, on-the-job training (OJT), vendor-provided training, and academic courses.

3. Each training activity shall be documented according to existing policy. The Center shall establish a training file to facilitate cross referencing by critical task and individual training. Qualifications of contractors performing tasks shall be documented. Qualifications of cooperators (Federal, State, and local agencies) performing tasks shall be to the satisfaction of the Center Director.

PLANNING

Centers routinely conduct technical ground-water projects and data-collection programs. The success of these activities is dependent on a careful, deliberate, and systematic planning process. Quality-assurance requirements should be integrated into the project proposal, if one is required for the ground-water activity. Whether a ground-water program or project requires a separate quality-assurance plan should be evaluated on the basis of the complexity of the work, the needs of the Center or cooperator, or other criteria as described by Shampine and others (1992).

A workplan shall be developed for every ground-water program or project. The workplan can be a part of the proposal or a stand-alone document. The complexity of the program or project will determine the detail of the workplan. The project proposal may satisfy the requirement of a workplan where ground-water activities are routine or highly standardized. The workplan shall include, as appropriate, data-collection and storage plans, equipment and instrumentation needs, data-analysis techniques, report plans, cost estimates, time schedules, availability of personnel, training needs, and other elements, as necessary. Without appropriate project planning (Green, 1991) and the documentation of individual project tasks, quality objectives and project deadlines may not be reasonably known. Initial project/program planning can be guided by a detailed workplan, continued planning can be guided by periodic reviews.

WORKPLANS

To quality assure workplans, the following steps shall be performed by the Center:

1. Workplans for programs with ground-water activities should clearly state that the GWQAP will be implemented.

2. To the extent practicable, workplans should state data-quality objectives and describe the strategies to collect data to meet the intended use. When developing

data-quality objectives, broader network needs should be considered as well as immediate objectives.

Data-Quality Objectives are those qualitative and quantitative statements developed by data users to specify the quality of data needed from a particular data-collection activity. For example, in order to describe land subsidence in an area, ground-water levels need to be measured using a particular method, at a particular frequency, and to a particular accuracy.

3. The workplan shall specify the means for cataloging and archiving all ground-water activities and files according to WRD policy (Hubbard, 1992).

Development of workplans might also include the following:

1. A bibliographic search of available reports, data, and other pertinent information.

2. Retrieval of relevant data from existing data bases in order to determine the availability of and the need for additional data. Errors or inconsistencies in the data base should be identified and corrected at this time.

3. Review of other USGS file (paper) data, such as field canvass sheets, water-level records, geophysical logs, lithologic logs, water-quality laboratory analytical sheets, or other original data.

PROJECT REVIEWS

Project reviews are conducted periodically by Center management, technical advisors, and discipline specialists to ensure that project objectives are being met and to evaluate implementation of the GWQAP. Project reviews are used to maintain consistency in data collection, data analysis, and reporting. The following quality-assurance functions related to project reviews shall be performed by the Center:

1. The Center shall establish and implement a ground-water program and project review schedule that considers the technical development and progress of the endeavor. The Center shall schedule regular periodic reviews. Regularly planned reviews shall ensure that the ground-water program or project is implemented and performed in a manner that results in a quality product done efficiently. The purpose of the review is to ensure that all the data required to meet the objectives have been obtained, that data-analysis is on schedule and is yielding expected or reasonable results, and that the report is on schedule.

2. The Center shall develop a procedure for documenting project reviews. At a minimum the following information should be included in project review documentation:

Date of review.

Type of review (quarterly reviews are held in the West Virginia Center).

Names of reviewers and/or attendees.

Response to recommended action items from the last review.

Status, plans, and problems with data collection, data analysis, and report writing.

Major findings.

Cooperator/customer contacts.

Training needs.

Recommended follow-up or action items.

Date for next review.

DATA COLLECTION

Documentation of Technical Procedures

Written records of exactly how data are collected are critical to establishing the consistency, comparability, repeatability, and traceability of scientific data. The methods used to collect a specific data set shall be documented and the documentation shall be maintained with the data. For routine field activities, technical-procedure documents are a means of ensuring that detailed documentation is generated prior to data collection and shall be identified or prepared during the formal planning phase of the project, as applicable.

> *A technical-procedure document is a detailed description of a sequence of actions to be used to collect data to ensure repeatability of the work and comparability of results.*

If it is necessary to deviate from the technical-procedure documents when collecting data, then these deviations must be clearly described in the project records. When data-collection methods are new or experimental, a record of the conduct, progress, and results of these methods shall be maintained in a procedures notebook.

The following quality-assurance activities shall be performed by the Center.

1. Technical-procedure documents shall be maintained for routine field data collection that is performed in support of ground-water activities. The water-

quality aspects of ground-water activities that are addressed in the quality-assurance plan for water quality need not be duplicated. Technical-procedure documents shall be in place prior to data collection and shall contain the following:

a. Identification of materials and instruments used to collect data.

b. Quantitative statement of the accuracy of data collected using the procedure (for example, "to the nearest 0.01 foot") and limitations on the use of these data.

c. Step-by-step instructions to collect data that would enable an independent, qualified person to repeat the work and produce comparable results.

d. A description of how data collected by using the procedure are recorded and preserved.

e. A description of samples to be collected or used, if applicable.

f. Attachments (field forms, operator's manual, diagrams, and other pertinent supporting information).

2. The Center shall establish and maintain a file of technical-procedure documents.

a. Technical-procedure documents shall be identified and filed.

b. The file shall be maintained by the Center ground-water specialist or designee.

c. The file shall contain all current and superseded versions of technical-procedure documents.

3. Deviations from approved technical procedures shall be documented by the project chief and reviewed by the Center ground-water specialist to determine if a formal revision of the technical-procedure document is warranted.

4. New or revised technical-procedure documents shall be reviewed and approved by the Center ground-water specialist. The reviews shall address the following:

Applicability and appropriateness of the selected methods for the intended purpose.

Correctness of facts, figures, tables, and equations.

Completeness and clarity of step-by-step instructions and technical content.

Evaluation of the stated accuracy of the procedure.

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Documentation of non-routine activities

When data-collection methods are new, non-routine, or research oriented and involve a high degree of professional judgement or trial-and-error, an active record of the conduct, progress, and results of the data collection shall be maintained in a procedures notebook. These records shall be prepared and maintained in accordance with the following:

1. Prior to use of a non-routine method, the project chief shall consult with the Center ground-water specialist concerning the appropriateness of the method for planned data collection.

2. The results of the technique developed shall be reviewed by the Center ground-water specialist to ensure that work is proceeding in a technically appropriate and relevant manner.
3. If the technique which has been documented becomes a routine procedure for the Center, then a technical-procedure document shall be developed.

Instrumentation

All instruments, devices, and equipment (including steel tapes) used to collect ground-water data are categorized as instruments. Because of the complexity of some instruments, their effect on the quality of the data may be unknown or unquantifiable. To ensure the consistency, comparability, and repeatability of collected data, instruments must be identified, calibrated, maintained, and operated in an appropriate manner.

> *Calibration is the comparison of the output from an instrument to a standard or to the output from another instrument or procedure of known accuracy in order to detect, correlate, report, or eliminate by adjustment variations in the accuracy of the instrument being evaluated.*

The following quality-assurance activities shall be performed by the Center.

1. Instruments used to collect data shall be identified with a unique identifier on the field form.

2. Calibration procedures and schedules shall be established for each instrument based on the stability characteristics of the instrument, required accuracy, intended use, manufacturer's recommendation, and other conditions that may affect the quality of the data. The calibration procedure and schedule shall be documented in the technical-procedure document that requires use of the instrument, or in a stand-alone technical-procedure document if not satisfactorily documented in the user's manual for the instrument. Instruments shall be identified by type, manufacturer, and model. Calibration shall be performed whenever the accuracy of the instrument is suspect, regardless of the calibration

schedule. Instruments consistently found to be out-of-calibration shall be repaired or replaced.

3. A log shall be maintained for each instrument requiring calibration. The log shall contain all information pertinent to calibration, whether performed by Center staff or by an outside organization or vendor. Calibration documentation recorded in the log shall include:

   a. Name of organization and individual performing the calibration.

   b. Identification of the instrument by type, manufacturer, model, serial number, or other unique and permanent identifier.

   c. Identification of calibration standard, including the range and accuracy.

   d. Date of current calibration and date or milestone for next scheduled calibration.

   e. Records of instrument readings before and after any calibration.

4. Data collected with instruments found to be out-of-calibration shall be evaluated to determine the effect on the intended use of the data. Affected data shall be discarded or their limitations documented in the data base and in any application of the data.

5. All instruments used to collect data shall be operated in accordance with the manufacturer's manual, unless otherwise documented. Modifications to the manufacturer's operating procedure shall be appended to the manufacturer's manual, which shall be kept with the equipment at all times. Duplicate manuals for all instruments shall also be kept on file. Operating procedures may be included in technical-procedure documents.

6. Instrument maintenance shall be performed in accordance with the manufacturer's recommendations. A record of maintenance performed will be noted in the instrument calibration log.

Identification and Control of Samples

During the course of many ground-water investigations, samples of various types of earth materials are collected to supplement field observations or to allow laboratory tests, analyses, and measurements that are not possible to perform in the field. Types of samples include rock core, drill cuttings, soil, and outcrop. Because these samples can be critical scientific evidence to support interpretations, samples must be easily identifiable, handled and stored in a controlled manner, and be traceable. The relation between samples and the data set they represent must be maintained.

The following quality-assurance activities shall be performed by the Center.

1. Develop a unique identifier which shall be placed on each individual sample or sample container using materials and methods that are clearly visible, legible, and durable.

   a. The unique identifier, as well as other information that is critical for the intended use of a sample (such as orientation), shall be recorded on field forms and laboratory log books.

   b. If a sample is subdivided for analysis, the sample identifier shall be transferred to each part of the sample, or its container.

2. Establish a sample-control system to record information pertinent to each set of samples. This may be achieved by maintaining a log book, a set of forms, or other appropriate documentation. The sample-control system shall contain the following information for each sample:

   a. Unique identifier

   b. Type of sample and general description

   c. Source location specifications (x, y, z)

   d. Date and time of collection

   e. Reference to technical-procedure document or procedures notebook describing sample collection, handling, preservation, transportation, and storage.

   f. Storage location

3. Sample-control system documentation shall be placed in the project file.

DATA PROCESSING, REVIEW, AND STORAGE

A data-management plan describes the procedures used for data processing, review, and storage, and may also include archiving. After ground-water data are collected, they often are processed using one or more procedures, such as the application of time or datum corrections, and then are stored in computerized or physical files. Descriptive information on data-collection sites, such as well construction data and location, also should be stored. In general, data are most accessible and useful to the project chief and other Center employees, as well as to those outside the Center office, if they are stored in a computerized data base. Storage in a single data base also enables interpretations to be more easily verified and repeated. All water data collected as part of the routine data collection of the WRD, which are all ground-water data collected by basic data programs and Center projects (OGW Technical Memorandum 93.03) (see appendix), must be stored in computer files of the USGS National Water Information System (NWIS). In addition, "all data collected by others -- such as cooperators, universities, or consultants -

-that are used to support published USGS documents and not published or archived elsewhere, shall be placed in NWIS" (Hubbard, 1992). Exceptions to these requirements are spatial data coverages and other data for which appropriate data-base capabilities do not exist in NWIS.

A quality data base is maintained by:

1. Checking data-base files against original data files to ensure accuracy,
2. performing internal cross-checks of the data in the data base to identify anomalous data, and
3. maintaining the original data in paper or electronic archives to ensure integrity.

   Original data are those data -- from automated data-collection sites, laboratories, outside sources, and non-automated field observations -- unmodified as collected or received, once put into conventional units (engineering units, generally with a decimal) (Hubbard, 1992).

The following quality-assurance activities shall be performed by the Center.

1. All original data in paper form shall be placed in project or data-collection program files. Original data in electronic form shall be stored in NWIS. All original data shall be preserved unmodified as collected or received.

2. All data collected as part of the routine data collection of the WRD, and all existing data collected by WRD and others that are used to support published USGS documents and not published or archived elsewhere, shall be placed in NWIS unless excluded under current WRD policy (Hubbard, 1992). Excluded data are spatial data coverages and other data that cannot be stored in NWIS

3. The Center shall prepare and implement a Center Data-Management Plan, which documents established policies, conventions, and responsibilities for data processing, data review, handling project and data-collection program files, and computerized data bases. OFR 94-61 (Martin and Cohen, 1994), offers an example of such a document. The Center Data-Management Plans shall:

   Describe the processing of each type of data through such steps as entry on a field form, data review, data entry, and filing of the original data. Data processing that is described in a technical-procedure document may be referenced.

   Include descriptions of filing systems for site data and maps, local well-numbering systems, requirements for field-checking sites, and Center-specific data-base management policies and practices.

   Indicate how the Center ensures that data are reviewed promptly after data collection. Data reviews shall verify that as data are collected, they are entered in the data base and that the data in the data base have been checked against the

original data, including the processing of electronic data to original data, application of shifts and datums, correction of transducer drift, and so forth. Data reviews shall be documented during project reviews.

Document any data bases external to NWIS. Documentation should include a description of data elements (data dictionary), information about the data base table or file structure, copies of customized program code, and information about any algorithms used by the data base to calculate results for storage or output. If the data base is described in a separate report, the documentation may be referenced by the Center Data-Management Plan and a copy of the documentation kept with the plan.

Include a plan for performing periodic internal checks of ground-water data in NWIS and any other ground-water data bases to identify and correct anomalous data.

4. Data shall be reviewed promptly after any data-processing procedure is completed to ensure that the procedure was correctly applied and that the results are consistent both internally to the data set and with other data for the same site. This review shall be performed prior to publication or other dissemination to the general public and prior to the technical review of publications that contain the data or that use the data in interpretations. The Center shall establish a review schedule for data in addition to or in conjunction with other reviews. Reviews should be scheduled and implemented for data-collection programs as well as interpretive projects and may be combined with regular project or discipline reviews.

DATA ANALYSIS

Analysis of ground-water data includes activities ranging from simple statistical applications to the development and application of complex, numerical models. Quality assurance of data analysis begins with a well thought out and detailed workplan that describes methods and approaches of data analyses. Analysis procedures shall be reviewed as part of the proposal and workplan development, and during project reviews as appropriate. The methods by which data, or the results of data analyses, are "interpreted," such as the insight involved in the interpolation of water-level data to produce a potentiometric-surface map or the interpretation of the results of model simulations, cannot be completely documented. However such interpretations must be appropriately qualified, including descriptions of model limitations and data uncertainty.

Reviews of data-analysis procedures ensure that selected analysis techniques are appropriate for meeting project objectives. Data-analysis techniques are identified, at least preliminarily, during development of the project workplan. During project reviews, after a better understanding of the project is developed, data-analysis procedures should be reviewed for suitability in meeting the project's objectives. At about 40 percent of project completion, data-analysis techniques should be reviewed to ensure that

preliminary analyses produce valid results. If modifications to procedures are warranted, these modifications are documented in review comments. At a point when data analysis is complete, all data that were collected for a project, and the results of intermediate and final data analyses, are assembled and reviewed. Original data, data analyses, and data that were collected but not used in analysis, along with reasons for the exclusion, are documented as a part of the project review.

The following quality assurance activities shall be performed by the Center.

1. Data-analysis procedures shall be referenced and new data-analysis procedures, including those implemented by software, shall be documented in a report released prior to, or as part of, the report giving the results of that technique. Documentation might include:

   a description of the theoretical basis and computational procedure in sufficient detail to perform the analysis, all data requirements or options for the data-analysis procedure, and comparisons of the technique with known or accepted solutions.

Office of Ground Water Technical Memorandums 79.04, 91.04, and 96.04 (see appendix) have outlined documentation requirements for data-analysis procedures implemented by software.

1. The results of data analysis shall not be presented at a finer spatial or temporal resolution than supported by the input data. The results shall not be displayed with an accuracy that exceeds the capability of the analysis or the accuracy of the data-collection methods. Interpretations of data analysis, shall be appropriately qualified, including descriptions of limitations and data uncertainty.

2. Centers shall establish a written policy for reviewing data-analysis procedures and documenting the review. The results of any data analysis shall be reviewed, prior to release, to ensure that the analysis is valid. The reviewer shall be provided with any necessary background information to adequately perform the review. The Center shall establish a procedure for resolving the reviewers' concerns that ensures that the review comments are carefully considered and revisions made, if appropriate, and that direct interaction occurs between the project chief and the reviewer. The Center also shall establish and implement an archiving process for the review documents.

PUBLICATIONS

Disseminating information to Congress and the general public has been required of the USGS, since its creation in the Organic Act of 1875. The report review process ensures the quality of the written report, which is the culmination and final result of the training, planning, data collection, and data analysis. To satisfy national responsibilities and to produce accurate and timely reports, the Center shall perform the following quality-

assurance activities.

1. All ground-water data collected in USGS data-collection programs and interpretive and research projects shall be published in a timely manner. Data in NWIS that have been reviewed and approved are available to the general public, and can be considered published.

2. The Center Director in consultation with the Office of Ground Water shall approve, in writing, any exceptions to the requirement to publish all data, including data collected under an agreement of confidentiality.

3. Data furnished by sources other than WRD may be used for analysis and published if the source of the information approves and if (1) the data have been appropriately quality assured, or (2) the data have not been thoroughly quality-assured but are described in terms of appropriate qualifications and limitations. In either case, the source of the data must be acknowledged. Care should be taken to assure that data are published with the correct number of significant figures.

4. Reports shall be reviewed and approved according to current Center and WRD policy.

ARCHIVING

Archiving is the final step in the processes of data collection, analysis, and interpretation. Although the report represents the summary of the current work, the data and its interpretation should be available for further analysis.

> ***Archiving is the systematic process of storing data and information to protect it from change or loss, by providing the necessary security.***
>
> ***Electronic archiving is the systematic process of removing data from active, on-line computer storage and preserving it with the capability to recover the data.***

To quality assure the archiving process, the following steps shall be performed by the Center:

1. All data shall be archived as specified by current WRD policy.
2. All model related computer files and appropriate simulation results shall be archived as outlined in OGW Technical Memorandum 93.01 (see appendix).
3. All aquifer-test data and results shall be archived as outlined in OGW Technical Memorandum 94.02 (see appendix).
4. All borehole geophysical data will be archived in accordance with OGW Technical Memoranda.

An Archiving Plan for the Center which documents the disposition of all project information upon completion of Center projects shall be established. The Archiving Plan shall document the archiving process and the responsibilities of personnel assigned to archiving tasks. The disposition of technical-procedure documents and procedures notebooks developed for an individual project should be described in the Archiving Plan.

Internal California Water Science Center policy (Instruction 1641.1A, July 9, 1991, Ron Fogelman, California WSC, written communication) and Indiana Water Science Center data management and archival policies (Martin and Cohen, 1994) are examples of archiving plans. Parts of the project files may be incorporated into the Center-wide file system, as appropriate.

AUDIT

Audits are designed to ensure that all tasks described in the GWQAP are being performed. Audits will be performed during the Technical Center Reviews.

> *Audits are documented quality-assurance activities performed to determine compliance with the GWQAP and associated documents and the effectiveness of their implementation. Audits include observing field data-collection activities and reviewing office documentation. Audits are usually peer reviews.*

The following quality-assurance activities shall be performed by the Office of Ground Water.

1. Develop an Audit Plan to monitor compliance with the requirements of the GWQAP. Audits apply to all ground-water field and office activities. The Audit Plan identifies the activities to be audited, scope of the audit, requirements governing the audit, organizations to be notified (if any), applicable documents, and tentative audit schedule. The audit shall, at a minimum, address the following questions:

   Do training plans, workplans, technical-procedure documents, calibration records, and maintenance logs exist, are they complete, and are the plans and technical-procedure documents being implemented?

   Do data-management and archiving plans exist, are they complete and up-to-date, and are they being implemented?

   Are project reviews being performed and documented according to the GWQAP?

2. Conduct the audit during the technical review of the Center program.

3. Document all comments and recommendations in the technical review report.

4. Send all comments and recommendations to the Regional Hydrologist and the Center.

The Region is responsible to see that all recommendations are addressed. The Office of Ground Water will receive copies of all correspondence between the Center and the Regional Hydrologist relating to audits and audit plans.

SUMMARY

This report provides a plan to direct the quality assurance of ground-water activities in the USGS West Virginia Water Science Center office, and presents policies pertaining to training; planning; data collection, processing, review, analysis, and storage; publications; archiving; and audits as they relate to these activities. The implementation of a GWQAP will enhance the consistency, accountability, comparability, traceability, and repeatability of ground-water activities of the USGS.

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APPENDIX

Copies of the following policy memorandums are appended.
Office of Ground Water Technical Memorandums 79.04, 91.04, 93.01, 93.03, 94.02, 96.04