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Regulation
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Engineering and Design
GEOTECHNICAL DATA QUALITY MANAGEMENT FOR HAZARDOUS WASTE REMEDIAL ACTIVITIES

1. Purpose. This regulation prescribes Geotechnical Data Quality Management (GDQM) responsibilities and requirements, from initial investigation through closeout at sites contaminated with hazardous, toxic, and radioactive waste. The intent is to assure that a site is sufficiently characterized, and that geotechnical data of acceptable quality are obtained and used properly within the project.

2. Applicability. This regulation applies to Headquarters U.S. Army Corps of Engineers (HQUSACE) elements, major subordinate commands (MSC), districts, laboratories, and separate field operating activities (FOA) responsible for site characterization, design, remediation, and geotechnical and materials testing work related to hazardous, toxic, and radioactive waste sites.

3. Distribution. Approved for public release, distribution is unlimited.

4. References. References are provided in Appendix A.

5. Definitions.

a. *Geotechnical Professional*. A geotechnical engineer, geological engineer, geologist, hydrogeologist, geochemist, or geophysicist.

b. *Geotechnical Data*. Data that characterize the physical properties of earth materials (soil, rock, water, vapor) occurring at or below ground surface, and the interactions among these materials and contaminants. In hazardous, toxic, and radioactive waste (HTRW) work these data, in addition to chemical data, are used for determining the nature and extent of chemical and radioactive waste contamination, and contaminant fate and transport. The data are also used for identifying, evaluating, and designing appropriate remedial actions.

c. *Geospatial Data*. Non-tactical data referenced either directly or indirectly to a location on the earth. Geospatial data identify the geographic location and characteristics of natural or constructed features and boundaries on the Earth.

d. Project Delivery Team (PDT). The group of technical specialists (e.g., geologist, chemist, risk assessor, regulatory specialist, etc.) needed to achieve the customer's goals for an HTRW project.

6. Background. Incomplete or faulty geotechnical data can be very costly to identify and correct. Collecting insufficient geotechnical data during the site characterization phase can lead to an incorrect or incomplete analysis of the risk posed by a site or of remedial alternatives during the feasibility study phase. A thorough understanding of site geology, hydrogeology, and geochemistry is required for identifying contaminant fate and transport potential and to aid in identifying, evaluating, and properly designing remedial measures, while avoiding costly overdesign. Poor understanding of contaminant distribution and the physical properties of site soils, bedrock, and groundwater, if discovered during construction of remedial measures, can result in time delays and costly contract modifications. If physical and geochemical properties remain unknown, misunderstanding or misinterpretation of the site can lead to failure of a remediation project.

7. Policy. The appropriate U.S. Army Corps of Engineers (USACE) functional element will:

a. Determine the geotechnical data needed to produce a quality, cost-efficient HTRW project meeting the customer's needs.

b. Collect data at the appropriate level of quality through cost-effective means to meet project objectives.

c. Manage those data so their level of quality is documented.

USACE will use appropriate principles of technical project planning to develop sound data quality objectives so that only necessary data and data at appropriate levels of quality are collected. USACE will make the best use of state-of-the-art investigation, sampling, and testing methods to attain these objectives. All USACE projects will consider natural attenuation, alone or in combination with other technologies, as a remediation option (reference Appendix B). All work will be done in accordance with Appendix B of ER 385-1-92 and in conjunction with ER 1110-1-263. The following principles and guidelines are provided to help assure that this policy is successfully followed.

8. Geotechnical Requirements.

a. Geotechnical Input and Review. Multidisciplinary teams will be used to develop and document site-specific data quality objectives (DQOs), as described in EM 200-1-2. Geotechnical input, review, or confirmation of no geotechnical involvement will be certified in the project-specific *Project Management Plan* (PMP, as described in ER 5-1-11) on all projects managed by USACE. The signature of the Geotechnical Branch chief or other branch chief with primary HTRW geotechnical design responsibility, or their designee, will constitute certification in the PMP.

(1) Written documentation of site-specific geotechnical DQOs will be prepared for data gathering activities and be placed in the project file. Assumptions and risks considered in developing data collection strategies for site-specific DQOs shall be clearly documented. If necessary, MSC shall ensure that requirements are included in the organizational *Quality Management Plan* for documenting discrepancies between planned and implemented site characterization programs, if those discrepancies significantly affect customer needs.

(2) All projects will include a review of existing site data and technical literature; the usability of those data will also be evaluated, as described in EM 200-1-2. Recommended sources of information include: previous site-specific studies; regional and site-specific studies by the US Geological Survey, state, or local agencies; aerial photos and remote sensing imagery; and technical journals.

(3) EM 200-1-2 will be used in planning all project activities. Input must be obtained from the appropriate geotechnical discipline during development of DQOs on all project activities (including preparation of project scope, work plans, and data analysis activities). Lead technical staff on the PDT should be present at all meetings with the customer where project criteria are discussed to ensure that the customer understands the minimum essential professional standards, laws, and codes applicable to the project. Products generated from project activities shall be reviewed and approved by project geotechnical personnel for compliance with DQOs.

(4) Geotechnical input must also be obtained for design services, such as feasibility studies, RCRA/CERCLA decision documents, design analyses, and plans and specifications, where the project involves any earthwork or work related to the subsurface. Examples of such activities include (but are not limited to) landfill design (e.g., cap and liner, subaqueous bottom cap); treatability studies (e.g., for contaminant solidification or stabilization); natural attenuation studies; groundwater and non-aqueous phase liquid remediation; and in situ remedies for groundwater or soils (e.g., soil vapor extraction, permeable reaction wall). Products generated from such activities will be reviewed and approved by project geotechnical personnel for compliance with project DQOs.

b. Conceptual Site Model. A conceptual site model should first be developed on the basis of available data. ASTM D 5979 (*Standard Guide for Conceptualization and Characterization of Ground-Water Systems*) and ASTM E 1689 (*Standard Guide for Developing Conceptual Site Models for Contaminated Sites*) may be used to guide creation of the conceptual model. The conceptual model should be modified as necessary as additional site-related information is collected.

c. Representative Sample Collection. Collection of representative samples at a site is critical for properly characterizing chemical and physical features. The PDT shall determine the need to collect representative samples from different lithologies and from materials of different depositional environments to improve the completeness of site characterization activities. This is particularly applicable to studies of background chemical concentrations (EPA 540/S-96/500;

Naval Facilities Engineering Command 1998, 1999). Once contamination has been discovered at a site, initial efforts will include characterizing site geology and hydrogeology. If groundwater is contaminated, characterizing the groundwater flow system and geochemical reactions within the aquifer shall be equally as important as characterizing the extent of chemical or radioactive contamination in the groundwater. Field screening or field analytical technologies and processes that are outlined in EM 200-1-2 and EM 200-1-3, Appendix H, shall be used as appropriate to develop site characterization strategies. Such characterization shall include vertical as well as horizontal delineation of contamination, as appropriate.

d. Sampling Unconsolidated Material. Requirements for collecting geotechnical samples will be determined by project geotechnical personnel to support the intended data uses and data needs of the project developed under paragraph 8*a* above. Use of direct push technologies is encouraged in unconsolidated material to determine site stratigraphy and obtain samples of site materials (soil and water). Data density is increased and investigation-derived waste is decreased, which reduces both project time and cost. Soil-type classifications generated by electric cone penetrometer testing (CPT) should be confirmed by comparison to site-specific soil samples collected from at least one boring on site. On large or geologically-complex sites, the number of confirmation borings and samples should be increased accordingly.

e. Sampling Consolidated (Bedrock) Material. For sites where intrusive work into bedrock is required, project geotechnical personnel will determine the location and depth of coring requirements in accordance with the geotechnical data uses and needs developed for the project under paragraph 8*a* above. Cores will be descriptively logged in accordance with EM 1110-1-1804, Appendix B. Other methods, such as (but not limited to) downhole geophysics and hydrophysics, fracture trace analyses, aquifer tests, tracer tests, and borehole flowmeters will be used as necessary to characterize fractured media and the potential for contaminant transport.

f. Alternative Sampling/Testing Methods.

(1) In unconsolidated materials, “cuttings” samples generated by auger, air, or mud rotary drilling are not recommended because of the difficulty of accurately relating such samples to discrete depths. In addition, such samples may not be representative because coarse and fine materials may segregate before samples are collected during rotary drilling operations. Cuttings should be used for geotechnical sampling only as a last resort, where other sampling methods are impractical or ineffective. If cuttings samples are collected, the *Sampling and Analysis Plan* should specifically address the methods that will be used to help isolate samples to discrete depths. Cuttings samples are unacceptable for most chemical analyses.

(2) To improve cost effectiveness, samples for geotechnical analysis will be collected from the same borings used to collect chemical samples whenever possible.

(3) Downhole geophysics may be used, provided the geophysical logs have been correlated with at least one hole that has been continuously sampled or cored and descriptively logged. Geophysical methods should, at a minimum, allow determination of subsurface materials that

may affect how contaminants migrate (e.g., low permeability horizons, high porosity material, etc.). EM 1110-1-1802 provides guidance on applicable downhole geophysical methods and procedures.

g. Laboratory Testing of Samples. Based on site conditions, project geotechnical personnel will determine the appropriate number of field samples for geotechnical laboratory analysis. Such analyses will, at a minimum, include grain size distribution, Atterberg limits, and moisture content. Total organic carbon data will be collected on soils to support natural attenuation evaluation and vadose zone modeling. In addition, on projects where subaqueous caps or dredging are necessary, analysis of sediment (subaqueous) samples will include specific gravity and density (Dredging Research Program Report 93-3). These tests and the data they provide are inexpensive and useful for confirming visual soil classifications, helping determine soil properties, and helping identify additional testing that may be necessary on site materials. The above-described laboratory testing data will generally be presented as part of the optimum data collection option in the Technical Project Planning process, as described in EM 200-1-2.

(1) On sites where multiple aquifers will be delineated or where groundwater will potentially be remediated, data will be collected on groundwater geochemistry. Water samples will be collected and analyzed for total cations/anions, alkalinity, pH, dissolved oxygen, oxidation-reduction potential, total dissolved solids, temperature, and turbidity. This information is inexpensive and is helpful for designing remediation systems and for operation and maintenance (O&M) considerations.

(2) Additional testing will be specified as required to meet project-specific data needs. For example, laboratory hydraulic conductivity may be specified for fine-grained samples where data are required to: determine transport potential of contaminants; determine baseline soil conductivity for borrow source, cap, or liner feasibility; or determine suitability of soils for slurry wall key-in. Strength testing, such as unconfined compression testing, may also be required as part of treatability studies for solidification/stabilization.

h. Selection of Testing Laboratory. The appropriate Corps laboratory assigned responsibility for HTRW soils testing (as listed in ER 1110-1-8100) will perform the testing requirements outlined in paragraph 8*g*. Alternatively, a district office may contract directly with a non-Government commercial laboratory, provided the laboratory has been inspected and approved in accordance with ER 1110-1-261, or meets the requirements outlined in ASTM D 3740. Regardless of the laboratory used, adequate QA/QC procedures should be specified in the QAPP to generate data of known quality.

i. Field Oversight. Most questions regarding field activities, sampling methodology, procedural changes, etc., are asked early in the field work phase. For contracted site characterization work, the project delivery team will determine the need for field oversight. If oversight of site characterization work is deemed necessary, a trip report will be completed and placed in the project's permanent record after each site visit. Trip reports should note whether or not site activities are in compliance with the project work plans and the contract. Reports should also

note if study objectives are being fulfilled in the event field modifications have been made to work plans. Oversight and quality assurance testing of geotechnical work for construction projects will be performed in accordance with ER 1180-1-6.

(1) The frequency and length of site characterization oversight visits (field audits) and the need for unannounced visits will be determined by the project delivery team to ensure quality work and that project DQOs are met. Team members should consider the complexity and length of the field effort, the intended use of data being collected, and past contractor performance in determining oversight requirements. Guidance for conducting field audits, including recommended field audit checklists, may be found in Chapter 6 of EM 200-1-6.

(2) Project geotechnical or other qualified personnel will conduct field oversight of site characterization activities. If practicable, local geographic district personnel should be involved in oversight to increase their knowledge of the site, particularly if it is known during site characterization that the project will be remediated. Use of local geographic district personnel can also improve manpower utilization and contribute to oversight logistics. Inspectors for site characterization work will coordinate with the local or on-site Corps office (e.g., resident or project office) if one exists.

(3) If field oversight is done by anyone other than project geotechnical personnel, the project delivery team will prepare *Engineering Considerations and Instructions* (ECI). ECI will be prepared for field oversight personnel in accordance with Appendix C. For site characterization projects, the ECI will describe critical project elements that need to be monitored or verified by oversight personnel. For construction projects the ECI will:

(a) Include a description of critical or unique project features and the requirements necessary to provide adequate Government acceptance testing (if applicable).

(b) Be submitted to the Construction Division before the 90% design submittal to allow sufficient time for them to review the ECI and to improve the biddability, constructability, operability, and environmental review.

(4) The memo (ECI) discussed in paragraph 8*i*(3) above shall include or highlight any special customer-dictated requirements or concerns, and shall be discussed during a pre-mobilization (for site characterization) or pre-construction (for remediation) meeting. Alternatively, on construction projects, the memo can be discussed at the Contractor Quality Control/Quality Assurance (CQC/QA) coordination meeting. Suggested attendees at these meetings are designers, oversight personnel, the contractor, customer, and regulators (as discussed in EP 415-1-266). The intent is to improve partnering among all parties involved in the project.

j. Documentation Requirements.

(1) DQOs will be documented as described in EM 200-1-2. Plans for intrusive field activities and other sampling will be included in the *Field Sampling Plan* portion of the *Sampling and Analysis Plan* outlined in EM 200-1-3. Descriptive logging for intrusive field activities will be

done in accordance with EM 1110-1-4000 (for general logging requirements) and EM 1110-1-1804, Appendix B (for bedrock logging requirements). ASTM D 5434 (*Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock*) may also be used for borehole logging requirements.

(2) *Daily Quality Control Reports* will be completed for field sampling work. At a minimum, it is necessary to record the following information concerning collection of geotechnical and chemical samples: weather, description of samples collected, equipment used, field instrument calibrations and readings, unexpected conditions or changes/variations from the work plans, and perceived effects of changed conditions on sample quality.

(3) All field documentation will become part of the project files. Additional documentation requirements are described elsewhere in this regulation (e.g., preparation of written DQOs, field oversight trip reports, etc.).

k. Data Management. Large amounts of geotechnical and chemical data are generated at hazardous waste sites. The project delivery team shall review data stored in digital (electronic) form to ensure its accuracy. In order to comply with Executive Order (EO) 12906, all geotechnical data generated on HTRW projects *owned by USACE* (including Formerly Used Defense Sites) will be documented using FGDC-STD-001-1998, the Federal Geographic Data Committee *Content Standard for Digital Geospatial Metadata*. This requirement exists for data generated both in-house and by contractors. USACE customers for reimbursable work, such as Department of Defense installations, EPA, and other government agencies, are responsible for their compliance with EO 12906. These customers may request that USACE prepare metadata for their projects so as to comply with the EO. Appropriate funding shall be secured from the customer to prepare the metadata.

9. Responsibilities.

a. The HQUASCE Environmental Division, Military Programs Directorate (CEMP-R), is responsible for program management and USACE HTRW policy and guidance development and dissemination. The HQUSACE Engineering and Construction Division, Civil Works Directorate (CECW-E) is responsible for USACE HTRW technical policy and technical guidance. HQUSACE is also responsible for distributing lessons learned from noncompliance with the quality control measures described in this regulation.

b. MSCs, in their quality assurance role, are responsible for monitoring and oversight of quality control activities of their districts and ensuring that the policies and procedures of this regulation are implemented. MSCs will document and forward to HQUSACE, for distribution as lessons learned, any issues arising from noncompliance with the quality control measures described in this regulation. MSCs shall develop a policy outlining requirements for documenting discrepancies between planned and implemented site characterization programs if the discrepancies significantly affect customer needs.

c. Districts and FOAs are responsible for implementing the guidance outlined in this regulation. Districts will document corrective actions resulting from noncompliance with the quality control measures described in this regulation. Project funds will be used to conduct the required planning, testing, data management, and field oversight outlined in this regulation. Project management personnel will ensure that sufficient funds are programmed for these activities and ensure that project schedules allow sufficient time for these activities to be adequately completed.

d. The Hazardous, Toxic, and Radioactive Waste Center of Expertise (HTRW CX) will:

(1) Perform technical reviews of selected documents and geotechnical data to verify compliance with this regulation, in accordance with Appendix D.

(2) Provide technical assistance to District, MSC, or HQUSACE offices upon request.

(3) Provide support to special programs, and provide assistance with resolution of issues identified by HQUSACE.

(4) Provide support to MSCs in their oversight of district quality control processes.

FOR THE COMMANDER:

JOSEPH SCHROEDEL
Colonel, Corps of Engineers
Chief of Staff

4 Appendices
Appendix A - References
Appendix B - Policy on Natural Attenuation
Appendix C - Engineering Considerations
and Instructions
Appendix D - CEMP-RT memo
dated 23 Sep 1997