

Part 531 – Geology

Subpart A – Geologic Investigations

531.0 Purpose

The purpose of Part 531, “Geology,” is to ensure that technically sound consideration of regional, local, and onsite geologic conditions germane to conservation planning and sound engineering design is addressed in all NRCS programs.

531.1 Responsibilities

A. The State conservation engineer (SCE) is responsible for ensuring that geologic conditions at NRCS project sites are sufficiently characterized to support proper conservation planning and sound engineering design, construction, and operation.

B. The NRCS geologist has primary responsibility for geologic investigations and interpretations for NRCS projects. A qualified geologist as defined in section 531.2 is required to conduct investigations in areas where—

- (1) Experience or information is limited.
- (2) Geologic conditions are complex or unstable.
- (3) The kinds of construction materials to be used are complex in their distribution, composition, engineering behavior, or otherwise questionable; or the potential for loss of life or significant economic or environmental damages is high in the event the practice fails as designed.

C. Where State staffs lack a geologist, the SCE determines the need for and secures the services of a qualified geologist. Depending on needed intensity of investigation and site complexity it is appropriate for the SCE to delegate responsibility to a nongeologist to conduct certain investigations. Nongeologists must hold the appropriate job-approval authority as outlined in section 501.4 for the class of structure to be investigated. Allowable investigations include reconnaissance and preliminary geologic investigations of low-hazard structures and practices with the exception of Group-A dams, which must be conducted by a qualified geologist. The delegated nongeologist must be trained and experienced in recognizing pertinent engineering geologic conditions and geologic hazards that can affect the design, construction, and function of the practice.

D. The NRCS geologist must review geological analyses and reports completed by non-NRCS geologists as part of NRCS-assisted projects. The geologist must assist with preparation of the geology sections of soil survey reports if the need is determined by the State soil scientist, and the revision of conservation practice standards and specifications if the need is determined by the SCE. The geologist must ensure that all geology-related resource concerns in such documents are addressed to the satisfaction of the requesting official and the final version completed within the time frame requested.

E. NRCS geologists must not conduct mineral remoteness determinations for tax, regulatory, or legal purposes. However, NRCS geologists may provide mineral assessment reports when requested in support of conservation programs requiring easements.

531.2 Definition of Qualified Geologist

A qualified geologist is defined as an individual who meets the minimum requirements for the practice of geology as defined by the State board of registration of the State in which the individual

resides. In the absence of State registration or licensing requirements or a State definition of geologist for the practice of geology, the geologist must meet qualifications for the title of “Certified Professional Geologist,” as defined by the American Institute of Professional Geologists (AIPG). Do not construe this definition to mean that the geologist must actually be certified by AIPG.

531.3 Classification of Structures for Geologic Investigation and Sampling

A. To establish criteria for geologic investigation and sampling, NRCS structures are categorized into two groups, Group A and Group B, according to the fill height of the structure, construction materials, purpose of structure, and hazard class. Hazard classes H (High), S (Significant), and L (Low) are defined in Technical Release 60, Earth Dams and Reservoirs. These groups are explained further in Title 210, National Engineering Handbook (NEH), Part 631, Chapter 2, Section 631.0202.

B. Minimum requirements for investigations of both Group-A and -B structures are provided in 210-NEH, Part 631, Chapter 2, Section 631.0205.

531.4 Intensity Levels of Geologic Investigations

A. There are several levels of intensity of geologic investigation. The intensity is a function of the appropriate degree of detail required for the stage the project or practice is in. Types of investigations include reconnaissance, preliminary, detailed, construction (as-built), repair, rehabilitation, and decommissioning. The reconnaissance, preliminary, and detailed investigations, respectively, must address all geologic concerns to the level of detail as explained in 210-NEM, Part 511, Subpart A, Section 511.2, “Design Stages.”

B. The scope and intensity of the geologic investigation must be consistent with geologic and geomorphic complexity and stability of the site; size and purpose of the structure, practice, or project; kinds of construction materials to be used; and pertinent social, economic, and safety considerations—in particular, the potential for damage or loss of life in the event of failure to perform as designed.

531.5 Requirements for Geologic Reconnaissance

A. Geologic reconnaissance includes the collection and review of existing data; a site visit to assess engineering and geomorphic feasibility of the site; and consideration of how operation of the proposed project, structure, or practice might adversely impact local resources, particularly soil, surface waters (including the sediment-water balance), and groundwater.

B. Requirements for geologic reconnaissance are provided in 210-NEH, Part 631, Chapter 2, Section 631.0203.

531.6 Requirements for Preliminary Geologic Investigation

A. The purpose of a preliminary geologic investigation is to assess the feasibility of the site in terms of the intended purpose of the project or structure and to make recommendations for further investigation needs. The level of detail must be sufficient to provide preliminary cost estimates in the project planning stage. All NRCS dams must be investigated in the preliminary design stages under the supervision of a qualified geologist as defined in 210-NEM, Part 531.

B. Requirements for preliminary investigations are provided in 210-NEH, Part 631, Chapter 2, Section 631.0204, and also may be applicable as needed in other types of investigations.

531.7 Requirements for Detailed Geologic Investigation

- A. A detailed geologic investigation must be sufficiently thorough to verify and supplement findings encountered in reconnaissance and preliminary investigations.
- B. Requirements for detailed geologic investigations are provided in 210-NEH Part 631, Chapter 2, Section 631.0205.
- C. Detailed engineering geologic investigations for all NRCS Group-B structures must be investigated by a qualified geologist (as defined in section 531.2) and in accordance with current industry standards and practices as required by State or local law.
- D. The geologist and design engineer must jointly develop a detailed geologic investigation plan that describes what data to collect and how the data will be used to support sound engineering design. The plan of investigation must be based on their assessment of the adequacy of all previous field and laboratory testing. Items that must be jointly addressed include agreeing on the intensity of investigation; determining requirements for preparation for subsurface exploration; identifying investigative considerations for structures with permanent storage and those that have potential for subsidence; and identifying the need for hydraulic pressure tests and other special testing and sampling. They must jointly develop detailed plans of investigation for structures underlain by economic mineral deposits including oil and gas and for structures that will have permanent storage.
- E. The investigating geologist, the engineer designated for soil mechanics leadership, and the design engineer must periodically review findings during the investigation process to determine the adequacy of results of subsurface investigation, including in-situ field testing and sampling for soil mechanics testing. They must agree to the need for additional field tests and sampling to be carried out by the investigating geologist.
- F. In addition to meeting all above requirements, Group-A structures must meet minimum requirements provided in 210-NEH Part 631, Chapter 2, Section 631.0205. These must include the geologist's correlation and interpretation of the site geologic conditions.
- G. If the structure included an auxiliary spillway, the geologist must calculate the erodibility index for each material mapped in the spillway according to procedures in 210-NEH, Part 628, Chapter 52. Refer also to policy in 210-NEM, Part 531, Subpart C, Section 531.23, "Earth Auxiliary Spillways."

531.8 Requirements for Geologic Investigation of Group-A Structures During Construction (As-Built)

- A. An as-built geologic investigation must be conducted or supervised by a qualified geologist during construction of all Group-A structures as defined in section 531.03. The investigation must verify all assumptions and interpretations made in previous investigations and to identify and document differing conditions that might impact the long-term performance of the structure.
- B. Throughout construction, the project engineer must notify the geologist as geologic materials become exposed during excavation of pipeline trenches, structure foundations, core trenches, auxiliary spillway cuts, and borrow areas. The geologist may need to visit the site several times to conduct this investigation.
- C. The geologist must prepare an as-built geologic report. All findings and interpretations that differ from those reported in previous geologic investigations must be explained.
- D. The qualified geologist must write the report with all supporting documentation and file it as part of the as-built engineering folder as explained in 210-NEM, Part 512, Subpart F, Section 512.50.

531.9 Requirements for Geologic Investigations for Repair and Rehabilitation of Structures

- A. Requirements for geologic investigations and documentation related to repair and rehabilitation of structures are provided in 210-NEH, Part 631, Chapter 2, Section 631.0209.
- B. Engineering structures and practices requiring repair or rehabilitation may need additional geologic information. This supports design changes that may result from a change to a higher structure class, changes in criteria or standards, or a lack of specific information in the area of interest.
- C. The determination of the adequacy of available geologic information is conducted as part of the design review process, explained in 210-NEM, Part 501, Subpart A, Section 501.5. The design engineer and geologist jointly determine the need for a geologic plan of investigation based on the results of the review.

531.10 Requirements for Decommissioning of Structures

- A. Engineering structures and practices selected for decommissioning may involve complete or partial removal of a structure or a change in its original design function. The determination of the adequacy of available geologic information is conducted as part of the design review process, explained in 210-NEM, Part 501, Subpart A, Section 501.5. The design engineer and geologist jointly determine the need for a geologic plan of investigation based on the results of the review.
- B. Policies provided in Subpart B, “Dam site Investigations,” and Subpart D, “Erosion and Sedimentation Investigations,” apply for geologic investigations for decommissioning of engineering structures and practices.
- C. The geologist must gather geologic information to address the needs for sound engineering design, and the potential impacts on applicable local physical resources, including soil quality, sediment quality, groundwater and surface water quality, and stream channel stability.
- D. Investigations of impoundment structures and practices selected for decommissioning must address the sediment pool in terms of—
 - (1) The location, type, and quality of sediment that will be—
 - (i) Affected by decommissioning measures
 - (ii) Exposed to erosion and downstream transport
 - (iii) Dredged or excavated.
 - (2) The effects of changes in the sediment-water balance on the geomorphic stability of the stream channel downstream of the site.
- E. The geologic report must be filed with engineering records for the decommissioned structure or practice.

531.11 Requirements for Resource Planning Investigation

In support of the conservation, development, and management of physical natural resources in NRCS programs, the NRCS geologist is responsible for—

- (1) Providing information pertinent to resource issues of concern such as topography, soils, erosion, sedimentation, drainage, groundwater quality, groundwater quantity, geomorphology, geologic hazards, and mineral resources. Geologic evaluation maps are prepared as part of the documentation process.

- (2) Determining location, quantity, suitability, and excavation characteristics of potential sand, gravel, and quarry rock resources within a project area. For guidance on field examination of rock for erosion control, refer to ASTM D4992, Standard Practice for Evaluation of Rock to Be Used for Erosion Control.
- (3) Cooperating with other technical specialists and planners in locating, mapping, and documenting undeveloped geologic resources within the project area to avoid their damage, contamination, or destruction by project activities.
- (4) Supporting soil survey activities as explained in 210-NEM, Part 533, Subpart C, Section 533.22, by assisting in the preparation of the geology sections of soil survey reports and providing training, as needed, by soil survey parties.
- (5) Identifying geologic resources that are integral components or concerns of a structure or conservation practice area, including groundwater, building stone, sand and gravel deposits, quarry stone, and related geologic materials.
- (6) Identifying geologic attractions that may have scenic, educational, scientific, or similar intangible value.

531.12 Requirements for All Geologic Investigations

A. The geologist must identify and evaluate the potential impacts of geologic processes, conditions, and attributes that can affect the design, cost, construction, performance, and safety of the proposed structure or practice. The geologist must conduct additional geologic investigation in sufficient detail to enable engineering mitigation of deleterious conditions.

B. Geologic investigations must be conducted in accordance with Occupational Safety and Health Administration (OSHA) requirements for pit and trench safety and for working around heavy machinery, such as drill rigs, backhoes, tractors, earth-moving equipment, and explosives. Safety concerns during all geologic investigations must comply with 210-NEM, Part 503, Subpart C, “Safety During Geologic Investigations.”

C. All exploratory bore holes must be covered if they need to be left open overnight or longer during investigation. All exploratory test holes, test pits, and trenches must be backfilled and sealed in accordance with local or State requirements at the completion of the geologic investigation.

D. Resources discovered during any type of investigation or construction activity that may have historical, archeological, cultural, paleontological, or other scientific significance or value must be immediately reported in accordance with policy contained in Title 420, General Manual, Part 401, “Cultural Resources, Archeological and Historical Properties.”

E. Requirements provided in 210-NEM, Part 520, Subpart A, Section 520.1, for erosion, sediment, and pollution control during site investigations must be followed during geologic site investigations.

F. If an unanticipated geologic condition that requires design modification is encountered during construction of any NRCS project, structure, practice, or component, the responsible field person must notify and apprise the SCE as soon as possible. The SCE determines the need for and secures the services of a qualified geologist to conduct a site visit to assess the unanticipated geologic condition and provide interpretations and technical support for design or installation changes.

531.13 Classification and Logging of Earth (Geologic) Material

A. For NRCS purposes, the terms “earth material” and “geologic material” are considered synonymous. They cover all natural and processed soil and rock materials. Earth material ranges on a broad continuum from loose, granular soil or soft cohesive soil through extremely hard, intact rock. To remove potential ambiguity in communication among the various geotechnical disciplines, earth

materials must be differentiated and referred to by subjective terms for hardness rather than by their genetic category alone. The hardness terms are logarithmically scaled to eliminate uncertain classification. Each hardness category is determined by simple means field tests that enable reasonable estimation of unconfined (uniaxial) compressive strength of any type of earth material.

B. Soil material must be classified in the field according to the Unified Soil Classification System, ASTM D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Refer to 210-NEH, Part 631, Chapter 3, “Engineering Classification of Earth Materials,” for related information.

C. Laboratory soil samples must be classified according to the Unified Soil Classification System, ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes. Refer to 210-NEH, Part 631, Chapter 3, “Engineering Classification of Earth Materials,” for related information.

D. Earth material that is transitional between soil and rock must be classified by its genetic category as well as by criteria in ASTM D2488. The simple means tests are provided in 210-NEH, Part 628, Chapter 52, Tables 52-2, 52-3, and 52-4. Transitional material that can be characterized by criteria in ASTM D2488 must be considered soil for classification purposes.

E. Rock material must be identified by common rock-type names. A simplified geologic scheme is provided in 210-NEH, Part 631, Chapter 4, “Engineering Classification of Rock Materials.”

F. Rock used for specific engineering purposes in NRCS work must be classified by 210-NEH, Part 631, Chapter 4, Section 631.0406, “Rock Material Field Classification System.”

G. Field logs and documentation of geologic investigations must conform to guidance in ASTM D5434, Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock; and ASTM D2113, Standard Practice for Diamond Core Drilling for Site Investigation. It is also acceptable to use the logging scheme provided in 210-NEH, Part 651, Chapter 7, Appendix 7B.

H. Test hole and test pit locations and their minimum depths must conform to requirements in 210-NEH, Part 631, Chapter 2, Section 631.0205. The numbering of test holes and test pits must conform to the numbering system provided in table 2-2 in section 631.0205.

I. Sample size and labeling requirements for samples collected for laboratory analysis must conform to requirements provided in 210-NEH, Part 631, Chapter 5, Section 631.0504, “Samples.”

J. All rock cores must be labeled and photographed according to ASTM D5079. Photographs must be annotated and filed with the project design folder. Refer to 210-NEH, Part 631, Chapter 5, Section 631.0503(f), “Disposition of Rock Cores,” for additional information.

K. Requirements for preserving and transporting soil samples must conform to ASTM D4220, Standard Practices for Preserving and Transporting Soil Samples. Refer to 210-NEH, Part 631, Chapter 5, Sections 631.05 03(d), “Disturbed Samples,” and (e), “Undisturbed Samples,” for additional information.

531.14 Transport, Shipping, and Quarantine Requirements of Earth Material Samples and Sampling Equipment

A. The shipping and transport of all soil samples and soil-moving equipment under any NRCS activity or program must conform to regulations of the USDA Animal and Plant Health Inspection Service (APHIS) to stop the human-assisted spread of agricultural pests.

B. Regulated soil samples must be shipped only to USDA-approved facilities for processing, testing, or analysis. Soil samples from regulated areas must not be sent or transported to any facility without

first determining whether the receiving facility is approved by APHIS. The following NRCS facilities are approved by APHIS to receive soil samples:

- (1) National Design, Construction, and Soil Mechanics Center (NDCSMC), Fort Worth, TX
- (2) National Soil Survey Center, Lincoln, NE
- (3) Soil Mechanics Center, Lincoln, NE; this is the only NRCS facility that accepts soil from the Pacific Islands and foreign sources.

C. Preservation and transporting of rock core samples must conform to ASTM D5079, Standard Practices for Preserving and Transporting Rock Core Samples. Additional information is provided in 210-NEH, Part 631, Chapter 5.

D. Contractors must be advised of quarantine requirements through the applicable clause in bid notifications and contracts as covered under general or special provisions.

531.15 Geologic Maps

A. A geologic evaluation map or sketch must be developed to locate all geologic attributes pertinent to the geologic investigation. It must be completed and submitted as part of any geologic report.

B. An engineering geologic map must be drawn to identify and spatially represent zones of geologic material that meet similar engineering performance criteria. All geologic maps and sketches must conform to requirements in 210-NEH, Part 631, Chapter 2, Section 631.0204(e), "Mapping."

531.16 Geologic Reports

A. All geologic investigation reports must be prepared, signed, and dated by the investigating geologist or by the investigating person with delegated approval authority.

B. Detailed geologic investigation reports must conform to the outline requirements in 210-NEH, Part 631, Chapter 2, Section 631.0205(e), "Report of Detailed Geologic Investigation."

C. Factual findings in the report must be clearly separated from interpretations and recommendations. Geologic cross-sections and profiles developed by correlation between drill hole and test pit logs are considered interpretations. Photographs upon which engineering geologic mapping units are delineated, and any illustrations developed by geophysical techniques shall be considered interpretations.

D. Only factual findings may be provided to potential contractors.

E. Recommendations and disclaimers for the use of the report must be given in the section of the report on recommendations. Recommendations for design parameters are subject to restrictions imposed by State licensing law. They must be made only by professional engineers and geologists specializing in the field of geotechnical engineering and engineering geology and who are familiar with the purpose, conditions, and requirements of the investigation.

F. References in the report must be complete citations for all published materials including data, photographs, and illustrations of any type. Inclusion of any illustrations from outside sources must conform to copyright law.

G. Geologic terms and symbols not specifically defined in NRCS technical references must conform to authoritative sources, such as ASTM D653, Standard Terminology Relating to Soil, Rock, and Contained Fluids; the American Geological Institute (AGI) Glossary of Geology; AGI Data Sheets; or the Digital Cartographic Standard for Geologic Map Symbolization by the FGDC.