

Part 531 – Geology

531.0 Purpose

Geologic investigations and analyses are essential for conservation planning and the implementation of sound engineering practice for the protection of public health, safety, welfare, and the environment. The purpose of this part is to ensure that geologic, hydrogeologic, and geomorphic processes, conditions, and hazards, and the engineering physical properties of earth materials, are properly and sufficiently characterized in support of NRCS conservation efforts. References to geologic work herein applies to all geology-related fields.

531.1 Definitions

NRCS Structure and Practice Classifications for Engineering Geologic Investigations

- (1) Group A
 - (i) Any high-hazard-potential dams, significant-hazard-potential dams, and low-hazard-potential dams over 35 feet in effective height.
 - (ii) Any concrete or masonry arch or gravity dams, drop spillways, box-inlet drop spillways, or chutes, if the structure is over 20 feet in effective height.
 - (iii) Any dam 20 feet or more in effective height constructed where the product of the storage (in acre-feet) times the dam height (in feet) is 3,000 or more.
 - (iv) All structures, embankments, and practices with an Engineering Job Class VI and above as defined in section 501.8 of this manual.

- (2) Group B

Structures, embankments, and engineering practices that do not classify as Group A, including low-hazard-potential dams with an effective fill height of 35 feet or less, streambank and shoreline stabilization, and conservation practices (for example: Pond (Code 378), Waste Storage Facility (Code 313), Dike (Code 356), Diversion (Code 362), Grade Stabilization Structure (Code 410)).

531.2 Responsibilities

A. NRCS State conservation engineers (SCEs) delegated authority to approve all engineering work under Title 210, General Manual (GM), Part 402, “Professional Engineering Practice” (210-GM-402) ensure the purpose of this part has been met when planning and implementing engineering practices.

B. NRCS geologists work under the purview of 210-GM-402 and have primary responsibility for conducting or providing guidance on geologic investigations in support of planning and implementing conservation efforts.

C. All geologic work, including that delegated by authority or by contract in accordance with 210-GM-402, must be conducted—

- (1) By persons adequately trained in recognizing and understanding geologic processes, conditions, hazards, and the physical and engineering properties of earth materials, and the potential impacts on—
 - (i) The location, design, construction, operation and maintenance of the structure or practice
 - (ii) Public health, safety, welfare, and the environment.
- (2) In accordance with—
 - (i) This part, and other applicable parts of this manual.

- (ii) Title 210, National Engineering Handbook (NEH), including—
 - Part 631, “Geology.”
 - Part 628, “Dams.”
 - Part 651, “Agricultural Waste Management Field Handbook.”
 - (ii) Technical releases (TRs), such as TR-60, “Earth Dams and Reservoir.”
 - (iii) Nationally acknowledged entities, such as ASTM International (ASTM) and American Geological Institute (AGI).
 - (iv) Other Federal, State, and local agencies with planning responsibilities for geology-related projects, operational responsibilities, or both.
- D. NRCS geologists must—
- (1) For Group A structures and practices conduct all geologic investigations from inception to completion in support of planning, design, construction, modification, repair, rehabilitation, or removal or decommissioning, and as-built documentation.
 - (i) Collaborate with design engineers on structure and practice design investigations, including the development of parameters and profiles cited in section 531.6 below.
 - (ii) Determine the level of geologic work required at the project’s inception and provide technical assistance and reviews of all work conducted by non-NRCS engineering services.
 - (2) For all Group B structures and practices conduct or provide direct guidance for geologic investigations and technical reviews of geologic work conducted by other NRCS employees or non-NRCS engineering services where—
 - (i) Published geologic information and construction and practice history in the area is limited or not available.
 - (ii) Geologic conditions cited in section 531.3C of this part are present.
 - (iii) Construction materials to be used are complex in their distribution, composition, or engineering behavior, or are otherwise questionable.
 - (3) Conduct or provide direct guidance for geologic investigations and technical reviews of geologic work conducted by other NRCS employees or non-NRCS engineering services when—
 - (i) Groundwater resource development, groundwater quality protection, and groundwater control are key elements of the design.
 - (ii) Erosion and sediment can or has impacted the operation and maintenance of the structure or practice.
 - (4) Conduct all geological investigations when unanticipated geologic conditions arise during construction requiring an evaluation prior to proceeding.
 - (5) Provide training to other NRCS employees, partners, and stakeholders upon request.
 - (6) Assist with the development and revision of NEM State supplements and relevant guidance documents for this part; conservation practice standards and specifications where the engineering geologist is the discipline lead per the Title 450, National Handbook of Conservation Practices; other practice standards and specifications; soil surveys; or other directives upon request.
- E. NRCS geologists must **not** conduct mineral remoteness determinations for tax, regulatory, or legal purposes. Mineral assessment reports are **only** to be provided in support of conservation programs requiring easements or as part of an environmental evaluation.

531.3 Levels of Geologic Investigations

A. Levels of geologic investigations include reconnaissance, preliminary, and detailed as defined in 210-NEH-631. The scope and level of investigation must be consistent with—

- (1) Size and purpose of the structure, practice, or project.
- (2) Geologic complexity and stability of the site.
- (3) Kinds of construction materials to be used.
- (4) Pertinent social, economic, environmental, and safety considerations—in particular, the potential for damage or loss of life in the event of failure to perform as designed.

B. Geologic investigations must address all geologic concerns to the level of detail as explained in 210-NEM-511-A.

C. Where site conditions include, but are not limited to, one or more of the following geologic processes, conditions, and hazards, a more detailed investigation may be required to determine the complexity and potential for instability, and the level to which these can impact the location, design, construction, operation, and maintenance of the structure or practice:

- (1) Seismic hazards
- (2) Volcanism
- (3) Karst
- (4) Seeps
- (5) Unstable slopes, slope failure, and mass movements (landslides)
- (6) Rock quality deficiencies
- (7) Dispersive soils and/or soil deposits susceptible to piping
- (8) Expansive clays
- (9) Soft cohesive, loose coarse-grained, and/or collapsible soil conditions susceptible to settlement and differential settlement (nonkarst subsidence)
- (10) High soluble salt content soils, caliche soils, or gypsum deposits
- (11) Aquifers susceptible to surface contamination
- (12) Sole-source aquifers

531.4 Requirements for All Geologic Investigations

The following requirements, including those prescribed in 210-NEH-631, apply to all investigations:

- (1) Conduct all field work in accordance with Occupational Safety and Health Administration (OSHA) requirements, and the safety concerns outlined in 210-NEM-503.
- (2) Complete all drilling and well installation activities in accordance with applicable Federal, Tribal, State, and local laws, regulations, and codes. For safety purposes, all bore holes and test pits must be covered if they need to remain open overnight or longer.
- (3) Record horizontal and vertical control (i.e., coordinates, elevations, station and offset where applicable) for each drill hole, test pit, or other pertinent information as part of the investigation.
- (4) If NRCS soil mechanics laboratories are to perform engineering analyses, samples submitted must be accompanied by supporting geologic reports or sufficient data to support analyses and design recommendations.
- (5) Resources that may have historical, archeological, cultural, paleontological, or other scientific significance or value discovered during any type of investigation or construction must be immediately reported in accordance with NRCS policy.

531.5 Classification and Logging of Soil and Rock

A. Soil and rock must be logged, sampled, preserved, transported, and tested in accordance with 210-NEH-631 and applicable ASTM standards. For engineering and geology purposes, soil includes all unconsolidated material above bedrock.

- B. Classify all soil, in-situ or sampled, in accordance with ASTM D2487, “Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System),” and ASTM D2488, “Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).”
- C. Material considered transitional, between rock and soil, must be classified in accordance with the Unified Soil Classification System (USCS).
- D. Identify rock using locally common rock-type names. See 210-NEH-628, Table 52-1, for reference.
- E. Classify rock used for specific engineering purposes in accordance with the rock classification system prescribed in 210-NEH-631.
- F. Determine soil and rock colors in accordance with the Munsell color charts for each.
- G. Label and photograph all rock core samples in accordance with 210-NEH-631 and Technical Note (TN) 210 – Geology Note (GN) – 4, “Photography of Rock Core Samples.” Labeling must include the date collected, the length of the core run, the recovery in percentage, and the assigned rock quality designation, at a minimum. See ASTM D6032, “Determining Rock Quality Designation (RQD) of Rock Core.”
- H. Retain all rock core samples that support the interpreted foundation conditions considered during design through the initial operation of the structure or practice as determined by the SCE.
- I. 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.

531.6 Requirements for Group A Structures Designed With Vegetated and Earth Auxiliary Spillways

- A. A detailed geologic investigation of the foundation must be conducted and full characterization of each soil and rock horizon made from the spillway inlet through the exit channel, and from the control section elevation to the elevation of the floodplain (valley floor).
- B. A profile representing the weakest materials by horizon within the extent of the spillway must be developed, and the headcut erodibility index (K_h) values calculated for each horizon in support of the required stability and integrity analysis detailed in 210-NEH-628, Chapters 50 through 52.

531.7 Geologic Reports

- A. Document all geologic investigations in a geologic report. Geologic reports provide—
 - (1) A detailed record of the investigations performed.
 - (2) Factors considered in selection of planning and design alternatives.
 - (3) A foundation for future investigations and studies.
- B. Complete geologic reports in accordance with 210-NEH-631. Minimum requirements for all geologic reports are as follows:
 - (1) Geologic investigation reports must be prepared, signed, and dated by the investigating NRCS geologist, those delegated the authority, or contracted.
 - (2) The report must address all geology-related concerns that can influence planning and design considerations.
- C. Factual findings in the report must be separated from interpretations, conclusions, and recommendations.

- D. Substantiate recommendations by the findings of the investigations conducted.
- E. Any disclaimers for use of the geologic report must be included in the interpretations, conclusions, and recommendations section of the report.
- F. References in the report must include complete citations for all published materials including data, photographs, and illustrations of any type. Inclusion of any illustrations from outside sources must conform with 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 AGI Glossary of Geology; AGI data sheets; or the Digital Cartographic Standard for Geologic Map Symbolization by the Federal Geographic Data Committee.
- H. Photos of all rock cores, test pits, rock outcrops evaluated, select sampling where conditions are potentially complex and/or unstable, and key elements of the field work conducted, which substantiate the findings of the report, must be incorporated and properly referenced.
- I. Geologic Maps, Sketches, Profiles, and Cross Sections
 - (1) A geologic evaluation map or sketch must be developed that locates all geologic attributes pertinent to the geologic investigation conducted.
 - (2) An engineering geologic map must be developed that identifies and spatially represents zones of geologic material that meet similar engineering performance criteria.
 - (3) Present correlations between drill holes, test pits, outcrop, existing data, or other on profiles and cross sections where possible to substantiate foundation interpretations.
 - (4) For high-hazard-potential structures, profiles and cross sections must be provided characterizing foundation conditions for all features of the design being evaluated.

531.8 Geologic Information Provided to Potential Construction Contractors.

Provide only factual findings to potential construction contractors. Do not include interpretive correlations where geologic and soils information is displayed on cross section and profile views or other drawing documentation. See 210-NEM-541 for drawing requirements.