

National Engineering Manual

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Part 500 – Introduction

500.0 Purpose

This manual establishes national policy governing delivery of engineering services in NRCS. The policy provides a framework for technical excellence in engineering through consistent application of engineering principles, science, and professional judgment. A core cadre of skilled NRCS engineers, geologists, landscape architects, and technicians, along with other NRCS conservationists, partners, technical service providers, architects and engineers, and others, work to develop multidisciplinary solutions to natural resource concerns under this policy.

500.1 Abbreviations

- A. CED.—Conservation Engineering Division
- B. NEH.—National Engineering Handbook
- C. NEM.—National Engineering Manual
- D. NHCP.—National Handbook of Conservation Practices

500.2 Policy

All engineering work performed by NRCS or for NRCS, including work by NRCS for others, must conform to the requirements of this manual.

Part 501 – Authorizations

Subpart A – Review and Approval

501.0 General

A. Engineering practices have the potential, upon failure, to affect public health and safety and cause loss of life and significant property damage, depending on the size, location, and complexity of the work. For this reason, the practice of engineering is regulated by State law governing professional engineering, requiring professional registration as described in Title 210, General Manual (GM), Part 402, “Professional Engineering.”

B. The development of engineering plans or engineering aspects of conservation practices requires that the approving engineer obtain and integrate the needed assistance from an interdisciplinary team.

C. Engineering job approval authority is the quality assurance process that ensures adequate consideration by competent NRCS employees in the planning, design, and installation of conservation engineering practices that, with proper operation and maintenance, will perform the intended functions for the planned practice service life. Engineering job approval authority additionally serves to maintain the credibility and trust of NRCS engineering with State engineering boards of licensure and with the public.

D. NRCS requires approval of all conservation engineering practice designs by a qualified person who has appropriate engineering job approval authority. Others may perform this work under the direction of the qualified person. For the purpose of this policy, a conservation engineering practice is a conservation practice included in Title 450, National Handbook of Conservation Practices (NHCP), with an engineering discipline lead or co-lead.

501.1 Scope

A. Each NRCS employee providing engineering technical assistance must be assigned an appropriate engineering job approval authority based upon training, experience, and demonstrated competence. NRCS requires no more than one level of review.

B. For non-NRCS employees operating under the technical supervision of an NRCS employee and providing engineering services, NRCS requires the evaluation and assignment of an appropriate engineering job approval as provided in section 501.1A with the following additional criteria:

- (1) Non-NRCS employees who are Federal employees may be assigned engineering job approval authority on the same basis as NRCS employees.
- (2) States may assign engineering job approval authority to non-NRCS employees offering engineering services who are licensed to practice engineering in the State on the same basis as NRCS employees.
- (3) NRCS may assign engineering job approval authority to non-NRCS employees offering engineering service who are not Federal employees and who are not licensed to practice engineering in the State when such authority does not conflict with State law. These employees include volunteers, employees of cooperative organizations or units of government, and other partners performing public services similar to NRCS employees and who, therefore, appear to the public as NRCS employees.

501.2 Technical Quality

Engineering technical assistance for the planning, design, and installation of conservation practices is to provide for practices that—

- (1) Function as planned.
- (2) Exhibit sound engineering principles.
- (3) Perform safely.
- (4) Are cost-effective with consideration of initial operation, maintenance, and removal or replacement costs.
- (5) Meet the requirements of site-specific conditions, are sustainable, and address the identified resource concerns.
- (6) Comply with NRCS and industry-established practice standards, technical criteria, and policies.

501.3 Compliance of Engineering Work With Laws and Regulations

A. Engineering work must meet applicable requirements of Federal, Tribal, State, and local laws, regulations, and codes. This applies to all work that involves engineering activities during planning, design, construction, operation, maintenance, modification, rehabilitation, and removal or replacement.

B. NRCS permits registered professional engineers to seal designs, construction plans, reports, and other engineering documents.

C. The State conservation engineer (SCE) develops policy and procedures for approving and sealing engineering plans—

- (1) For works designed by NRCS and by non-NRCS employees working as partners with NRCS.
- (2) For works sent by requirement to regulatory agencies for review, approval, or the granting of permits.
- (3) In States that have laws requiring the cooperating local organization to have plans for public works prepared under the direct supervision of a registered professional engineer.

501.4 Engineering Job Approval Authority

A. The SCE has delegated engineering job approval authority for all engineering work in the State. NRCS classifies engineering jobs with respect to hazard potential, complexity, and size, as described in sections 501.7 and 501.8 of this subpart. Part 503 of this manual defines hazard potential. The SCE must comply with review requirements in section 501.5 of this subpart.

B. State Engineering Job Approval Authority (Classes I Through V).

- (1) Conservation engineering practices in classes I through V must be of low hazard potential as defined in part 503 of this manual. Examples include low hazard potential dams and class-III dikes. For practices with the potential for higher risk, limitations on selected controlling factors and hazard potential must be used to further define the engineering jobs by higher classes.
- (2) Each SCE must develop policy and procedures for approval of engineering work carried out in the State. These apply to every individual providing engineering services, both NRCS employees and non-NRCS employees operating under NRCS technical supervision.
- (3) Assign engineering job approval authority within a State according to the job classes established in the State engineering job approval authority chart. Assign individual engineering job approval authority considering the employee's training, experience, and

demonstrated competence. Individuals assigning engineering job approval authority need only assign authority for practices applicable in the geographic area the employee serves.

- (4) Section 501.9 of this subpart provides a guide for developing and presenting engineering job approval authority delegations. The practices listed in section 501.9 of this subpart are for example only. The SCE is to select the job type, controlling factors, units, and engineering job approval authority breakdowns appropriate for the conditions in the State. The SCE must use the controlling factors for the practices noted in section 501.8 of this subpart. The SCE may select additional factors as needed. Use of available database tools to manage the job approval authority process is recommended.
- (5) SCEs may routinely delegate class-IV engineering job approval authority to professional engineers registered in the State and working under NRCS technical supervision.
- (6) The engineer technically responsible for engineering work (e.g., field or area engineer) delegates engineering job approval authority to those working under their technical supervision. The individual's supervisor must concur in the delegation of the engineering job approval authority. The engineering job approval authority delegation must not be greater than that held by the delegating engineer.
- (7) SCEs must ensure the job approval authority of individuals in their present position for less than 3 years is reviewed and updated annually. For all others, SCEs must ensure job approval authority is reviewed and updated every 3 years.
- (8) The Director, Conservation Engineering Division (CED), must review and concur with the State engineering job approval authority chart.

C. Approval of Class VI through Class VIII Jobs

- (1) SCEs may delegate class-VI engineering job approval authority to NRCS professional engineers registered in the State who have demonstrated competence for the particular practice.
- (2) Class-VII jobs require independent review, described under section 501.5 of this subpart, prior to approval by the SCE.
- (3) Class-VIII jobs require all reviews described under section 501.5 of this subpart and concurrence of the Director, CED, prior to approval by the SCE.

D. Engineering Job Approval Authority for Additional Work

Classify the engineering job approval authority for work performed on an existing practice or structure in accordance with procedures as listed in section 501.7 of this subpart. This applies to any additional work, such as repair, modification, rehabilitation, or removal. The highest category of any single most-limiting factor for the job determines the classification.

E. Documentation of Design Review and Engineering Job Approval

Document the review and approval of an engineering job, comprising the design, drawings, and specifications in one of the following ways:

- (i) Place signatures on the design documentation or report and the cover or first sheet of the construction drawings.
- (ii) Place signatures on an accompanying memorandum that describes the specific job and scope (including design documentation or report and plans).

F. Associated Plans and Specifications

Interdisciplinary design may produce associated drawings and specifications for erosion control, vegetative planting, final grading, and other components. All associated plans and specifications that may affect the performance of an engineering job are subject to the engineering job approval process.

501.5 Engineering Job Review

A. Design Reviews

- (1) Classes I–V.—The SCE may require one level of design review of jobs in engineering job classes I through V.
- (2) Classes VI–VIII.—One level of design review of jobs in engineering job classes VI through VIII is required.
- (3) Perform design reviews as follows:
 - (i) Classes I–V.—As determined by the SCE.
 - (ii) Class VI.—State staff review if review capability exists within the State as determined by the SCE; otherwise, independent staff review is required.
 - (iii) Class VII.—Independent staff review is required.
 - (iv) Class VIII.—Director, CED, review and concurrence is required.
- (4) An independent staff review is conducted by staff not supervised by the SCE and that did not participate in the design. The Director, CED, will concur in the selection of an independent reviewer if outside NRCS.
- (5) The policy on checking and reviewing engineering work is contained in section 511.5 of this manual.

B. Post Reviews

Post reviews are independent reviews made after the installation of the practice or structure. Spot checks, as required by 450-GM, Part 407, “Documentation, Certification, and Spot Checking” are examples of post reviews. Post reviews are valuable for quality assurance, determination of technical competence and experience, determination of the need for additional training, and determination of the need for revision of engineering procedures and criteria. The post review must examine supporting data, drawings, and specifications for conformance to national policy, standards, criteria, and sound engineering practice. Onsite reviews may be necessary, depending on the job’s complexity, safety and health risks, or environmental risks. After review of each job, the post reviewer must prepare a written report to the SCE. The SCE will send the report to the Director, CED, for all class-VII and class-VIII jobs, and for class I through VI jobs if the findings indicate changes in national policy, procedures, or standards may be needed.

- (i) Classes I–VI.—The SCE will develop the procedure for post review of representative engineering jobs.
- (ii) Classes VII–VIII.—The Director, CED, will determine the need for post reviews.

501.6 Engineering Work Reviewed for Other Agencies

A. Engineering Work Reviewed for Regulatory Agencies

- (1) Approval procedures must also contain provisions for reviewing the engineering design components of plans for cooperating regulatory agencies and determining if the plans comply with NRCS technical standards. The approval authority for this type of review is to be the same as assigned for engineering job approval authority.
- (2) NRCS employees are not to review designs that are outside NRCS’s area of technical expertise. For example, NRCS is not to review the structural strength of a building with rooftop storage used for runoff management. For this design, the review should be for the functional aspects of the plan, including storage and release rates. NRCS employees should call any apparent deficiencies in specific designs noted during the review to the attention of the responsible agency, even though they are outside the scope of the review.

- (3) Express review responses in terms of compliance or noncompliance of identified items and not in terms of approval or disapproval. Response comments must indicate the extent or nature of the review, such as: “Review was conducted in accordance with practice standard ____, and the following was determined. Review was limited to the functional layout and size in accordance with the requirements of Regulation ____.”
- (4) In all cases, engineering work must meet applicable requirements of Federal, Tribal, State, and local laws, regulations, and codes.

B. Engineering Work Reviewed for State and Other Federal Agencies

If NRCS reviews engineering work for other Federal or State agencies, NRCS must check the work against NRCS criteria (conservation practice standards) and sound engineering practices appropriate for the size and type of job. The review report provided to the agency must indicate compliance or noncompliance to NRCS standards and criteria. The approval of the review report is at the same level as engineering job approval for similar NRCS designs.

501.7 Classification of Engineering Jobs

A. Section 501.8 of this subpart describes the engineering job classifications that utilize controlling factors. If the value of any one of the controlling factors is exceeded, the job becomes the next higher class.

B. SCEs may delegate approval authority for all of the conservation engineering practices listed as class V as class I through V, and those listed as class VI as class VI. The listed values of the controlling factors are maximums; therefore, SCEs may specify lower values of the controlling factors listed for classes V and VI.

C. SCEs designate the controlling factor values for conservation engineering practices not listed in section 501.8 as class I through V unless the hazard classification is significant, high, or classified differently by the Director, CED. Hazard classification criteria for practices other than dams parallel those for dams (See Part 520, Subpart C, Section 520.21, “Definitions and Classes,” of this manual). In addition, SCEs must designate any practice as significant hazard potential where failure may result in impairment of water quality, environmental damage affecting wildlife or human health, or presents unacceptable economic risk. SCEs must designate any practice where failure would result in loss of life as high hazard potential.

D. The Director, CED, will classify those jobs covered by interim conservation practices standards concurrent with approval of the interim conservation practice standards.

501.8 Engineering Job Classifications That Utilize Controlling Factors

The table entitled “Engineering Job Classifications That Utilize Controlling Factors” contains the maximum values that States can use for engineering job classes V and VI for select practices.

[Click here for a copy of “Engineering Job Classifications That Utilize Controlling Factors”](#)

501.9 Engineering Job Approval Authority

The table entitled “Engineering Job Approval Authority” provides an example for a State to use in developing an engineering job approval authority chart. The practices listed are examples only. section 501.4 of this subpart describes the process by which the SCE is to delegate engineering job approval authority.

[Click here for a copy of “Engineering Job Approval Authority”](#)

Part 501 – Authorizations

Subpart A – Review and Approval

501.8 Engineering Job Classifications That Utilize Controlling Factors

Practice Code	Practice Name	Controlling Factor	Units	Class V	Class VI	Class VII
	Any practice	Hazard potential as defined in 501.7C	class	Low	Significant	High
	Any practice	Alters the visual resources of beaches and shorelines on oceans and the Great Lakes		None	All	All
	Recreation Facilities - Water supply or Sewage Treatment	Onsite daily design capacity	people	200	400	All
		Offsite daily design capacity	people	400	800	All
313	Waste Storage Facility	Storage Capacity	thousand cubic feet	2,000	5,000	All
320	Irrigation Canal or Lateral	Capacity	cubic feet per second	500	1,000	All
348	Dam, Diversion	Streamflow (25-yr)	cubic feet per second	2,000	3,000	All
		Flow diverted	cubic feet per second	200	500	All
		Height of drop	feet	8	15	All
359	Waste Treatment Lagoon	Aerobic surface area	acres	25	50	All
		Anaerobic volume	thousand cubic feet	2,000	5,000	All
350	Sediment Basin	Drainage area	square miles	20	40	50
		Effective height	feet	35	50	75
		Embankment over active fault		None	None	None
402	Dam	Drainage area	square miles	20	40	50
		Effective height	feet	35	50	75
		Embankment over active fault		None	None	None
410	Grade Stabilization Structure	Drainage area	square miles	20	40	50
		Effective height	feet	35	50	75
		Embankment over active fault		None	None	None
430	Irrigation Pipeline	Pipeline capacity < 50 psi maximum pressure	gallons per minute	5,000	All	All
		Pipeline capacity ≥ 50 psi operating pressure	gallons per minute	3,500	All	All

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Practice Code	Practice Name	Controlling Factor	Units	Class V	Class VI	Class VII
436	Irrigation Reservoir	Drainage area	square miles	20	40	50
		Effective height	feet	35	50	75
		Embankment over active fault		None	None	None
453	Land Reclamation, Landslide Treatment	Area	acres	1	5	All
		Depth	feet	10	20	All
		Slope	percent	50	All	All
455	Land Reclamation, Toxic Discharge Control	Flow	cubic feet per second	100	1,000	All
516	Livestock Pipeline	Pressure	psi	300	All	All
533	Pumping Plant	Axial flow pump capacity	gallons per minute	50,000	100,000	All
		Centrifugal & turbine pump capacity	gallons per minute	3,500	5,000	All
		Centrifugal pump static head	feet	350	500	All
		Turbine pump static head	feet	500	1,000	All
580	Streambank and Shoreline Protection	Bankfull capacity	cubic feet per second	5,000	20,000	All
		Bankfull velocity	feet per second	10	12	All
		Water height above shoreline	feet	3	5	All
582	Open Channel	Design capacity	cubic feet per second	1,000	2,000	All
		Design velocity	feet per second	10	12	All
584	Channel Bed Stabilization	Design capacity	cubic feet per second	1,000	2,000	All
		Design velocity	feet per second	10	12	All
587	Structure for Water Control	Drainage area	square miles	20	40	50
		Effective height	feet	35	50	75
		Embankment over active fault		None	None	None
608	Surface Drain, Main or Lateral	Design capacity	cubic feet per second	1,000	2,000	All
		Design velocity	feet per second	10	12	All

Part 501 – Authorizations
Subpart A – Review and Approval

501.9 Engineering Job Approval Authority

Name	<i>Employee Name</i>	Title	<i>Field Office Engineer</i>	Grade	<i>GS-9</i>
		Location	<i>Town, State</i>		
Delegated by	<i>Delegator Name</i>	Title	<i>Area Engineer</i>	Date	<i>4/4/2016</i>
	Responsible engineer				
Concurred by	<i>Supervisor Name</i>	Title	<i>District Conservationist</i>	Date	<i>4/7/2016</i>
	Supervisor				

Practice Code	Practice Name	Controlling Factor	Units	Class I	Class II	Class III	Class IV	Class V	Class VI	Maximum Approval Authority
	Any practice	Hazard potential as defined in 501.7C	class	Low	Low	Low	Low	Low	Significant	<i>Class I</i>
	Any practice	Alters the visual resources of beaches and shorelines on oceans and the Great Lakes		None	None	None	None	None	All	<i>Class I</i>
	Recreation Facilities - Water supply or Sewage Treatment	Onsite daily design capacity	people	10	25	50	100	200	400	<i>Class II</i>
		Offsite daily design capacity	people	25	50	100	200	400	800	<i>Class II</i>
313	Waste Storage Facility	Storage capacity	thousand cubic feet	100	200	500	1,000	2,000	5,000	<i>Class III</i>
317	Composting Facility	Wall height	feet	3	4	6	8	All	All	<i>Class II</i>
		Litter or manure capacity	cubic feet	None	10,000	20,000	50,000	All	All	<i>Class III</i>
320	Irrigation Canal or Lateral	Capacity	cubic feet per second	20	50	100	200	500	1,000	<i>Class III</i>
326	Clearing and Snagging	Length of reach	feet	1,000	2,500	5,000	15,000	All	All	<i>Class I</i>
348	Dam, Diversion	Streamflow (25-yr)	cubic feet per second	100	500	1,000	1,500	2,000	3,000	<i>Class III</i>
		Flow diverted	cubic feet per second	25	50	100	150	200	500	<i>Class III</i>
		Height of drop	feet	3	3	5	7	8	15	<i>Class III</i>
359	Waste Treatment Lagoon	Aerobic surface area	acres	1	2	5	10	25	50	<i>Class II</i>
		Anaerobic volume	thousand cubic feet	100	200	500	1,000	2,000	5,000	<i>Class II</i>
350	Sediment Basin	Drainage area	square miles	0.5	1	2	4	20	40	<i>Class III</i>
		Effective height	feet	10	15	20	25	35	50	<i>Class III</i>
		Conduit diameter	inches	12	24	36	42	48	60	<i>Class III</i>
		Storage x height	acre feet x feet	500	1,000	2,000	3,000	All	All	<i>Class III</i>
		Embankment over active fault		None	None	None	None	None	None	None

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Practice Code	Practice Name	Controlling Factor	Units	Class I	Class II	Class III	Class IV	Class V	Class VI	Maximum Approval Authority
410	Grade Stabilization Structure	Drainage area	square miles	0.5	1	2	4	20	40	Class III
		Effective height	feet	10	15	20	25	35	50	Class III
		Conduit diameter	inches	12	24	36	42	48	60	Class III
		Storage x height	acre feet x feet	500	1,000	2,000	3,000	All	All	Class III
		Embankment over active fault		None	None	None	None	None	None	Class I
430	Irrigation Pipeline	Pipeline capacity < 50 psi maximum pressure	gallons per minute	200	500	1,000	2,000	5,000	All	Class III
		Pipeline capacity ≥ 50 psi operating pressure	gallons per minute	200	500	1,000	2,000	3,500	All	Class III
436	Irrigation Reservoir	Drainage area	square miles	0.5	1	2	4	20	40	Class III
		Effective height	feet	10	15	20	25	35	50	Class III
		Conduit diameter	inches	12	24	36	42	48	60	Class III
		Storage x height	acre feet x feet	500	1,000	2,000	3,000	All	All	Class III
		Embankment over active fault		None	None	None	None	None	None	Class I
516	Livestock Pipeline	Pressure	pounds per square inch	50	100	150	200	300	All	Class III
		Pipe Diameter	inches	1 1/4	2	4	6	All	All	Class III
533	Pumping Plant	Axial flow pump capacity	gallons per minute	1,000	5,000	10,000	20,000	50,000	100,000	Class II
		Centrifugal & turbine pump capacity	gallons per minute	250	500	1,000	2,000	3,500	5,000	Class III
		Centrifugal pump static head	feet	50	100	150	200	350	500	Class IV
		Turbine pump static head	feet	100	200	300	400	500	1,000	Class III
560	Access Road	Surface treatment	kind	Soil	Soil and Gravel	Soil, Gravel, and Asphalt	Soil, Gravel, Asphalt, and Concrete	All	All	Class II
		Length	miles	0.5	1	2	4	All	All	Class II
		Maximum grade	percent	8	10	15	20	All	All	Class II
		Culvert pipe diameter	inches	12	24	48	60	All	All	Class II
587	Structure for Water Control	Drainage area	square miles	1	2	5	10	20	40	Class III
		Effective height	feet	10	15	20	25	35	50	Class II
		Embankment over active fault		None	None	None	None	None	None	Class I
608	Surface Drain, Main or Lateral	Design capacity	cubic feet per second	50	100	200	500	1,000	2,000	Class II
		Design velocity	feet per second	3	4	6	8	10	12	Class II

Part 501 – Authorizations

Subpart B – Repair and Rehabilitation

501.20 General

Many engineering practices require repair or rehabilitation because of advancements in technology, changes in criteria, land use changes, or deterioration from age. A rehabilitated structure must be safe and functional for the design life as extended. As with original design, sound engineering principles must be applied in design of repairs or rehabilitation.

501.21 Scope

Repair or rehabilitation of all engineering practices, originally installed with NRCS assistance or not, must be performed in accordance with provisions of this subpart. These instructions do not apply to operation and maintenance activities.

501.22 Applicable Standards

- A. Applicable standards must be determined when assistance is provided for the repair or rehabilitation of a practice originally installed with NRCS assistance. Normally, standards used for the original design are used for the repair or rehabilitation. Current NRCS State and national criteria must be used if the original standards are not acceptable as determined by the approver with appropriate job approval authority (see section 501.4) in light of new engineering knowledge, change in site conditions, or other factors.
- B. A practice not originally installed with NRCS assistance must meet current NRCS standards and criteria when the repair or rehabilitation is complete (see section 501.23). This ensures a durable, functional practice that justifies the use of NRCS resources.
- C. When repairing a component of a practice or a practice that is an interdependent part of a system, the entire system or practice must be carefully evaluated. The system or practice must be sufficiently sound to permit repair or rebuilding to function as designed.

501.23 Dams Installed Without NRCS Assistance

- A. Because of the hazards associated with dams, a careful and deliberate approach is necessary when responding to requests for the repair or rehabilitation of a dam built without NRCS assistance. The condition of the dam must be determined and a comprehensive engineering report prepared before any commitment for assistance is made. The report must describe the current physical condition of the dam, specify the repairs needed to meet NRCS standards, and include an estimate of the costs for repair or rehabilitation. The report is the basis for the decision to commit resources.
- B. If the dam exceeds class V (see section 501.4), the report must be prepared by a non-NRCS registered professional engineer experienced in the design and construction of dams. The report must be reviewed as required in section 501.5 in accordance with the job class. Technical acceptance of the report by the State conservation engineer (SCE) is necessary before resources can be committed for repair or rehabilitation.
- C. If the dam is class V or below, the owner, sponsor, or an NRCS engineer may prepare the report. An NRCS engineer with appropriate engineering job approval authority must approve the report before resources can be committed.

501.24 Special Conditions

A. If urgent action is necessary to safeguard life and property against flood damage, structure failure, etc., NRCS may provide technical assistance for temporary measures to lessen the immediate threat. If NRCS subsequently makes permanent repairs, they must conform to section 501.22.

B. Repairs or rehabilitations under the Emergency Conservation Program are implemented as specified by the Farm Service Agency. The practices not restored to original or current criteria must be functional. Repaired or replaced practices that may create a safety hazard must be restored to meet current NRCS standards.

C. Repairs or rehabilitation under the Emergency Watershed Protection Program (EWPP) or other emergency assistance program are carried out in accordance with EWPP rules, but if a repaired or replaced practice would create a safety hazard, it must be restored to meet current NRCS standards.

Part 501 – Authorizations

Subpart C – Variance and Changes

501.30 General

Standards and criteria are developed, reviewed, and updated to incorporate improvement in construction methods, equipment, and material, as well as findings of research and experience both in response to immediate needs or on a recurring basis, often 5 years. Site-specific designs must accomplish the intended purpose of a practice or system safely and economically for the intended life with normal operation and maintenance. Frequently, site conditions require additional features or precautions beyond the minimum requirements of standards and criteria. Less frequently, requests to vary specific requirements of standards and criteria are requested. Variances may be granted where the practice or component will safely and economically provide the intended function over the practice life using the varied standard or criteria.

501.31 National Handbook of Conservation Practices

Variances from the requirements of the conservation practice standards in Title 450, National Handbook of Conservation Practices, are handled in accordance with Title 450, General Manual, Part 401, Subpart B, Section 401.16, “Variances.”

501.32 Channel Stability Criteria

A. The analysis of channel stability requires sound judgment. The best-known design techniques and criteria are available in Technical Release No. 25, “Design of Open Channels”; Title 210, National Engineering Handbook, Chapter 654, “Stream Restoration Design”; and Conservation Practice Standard Open Channel (Code 582). However, there are situations in which channel and site conditions in association with the methods of construction and maintenance indicate that variations from minimum stability criteria are warranted.

B. If the SCE determines that a variation from stability criteria is warranted, the results of the analysis and the proposed approach are to be submitted to the Director, Conservation Engineering Division (CED). The Director, CED, and the State will jointly study the data and proposal.

Part 501 – Authorizations

Subpart D – Engineering Work on National Forests

501.40 General

- A. The Forest Service has the responsibility for establishing the standards and criteria used for engineering works installed on national forests. NRCS often assists in engineering works on these lands.
- B. Coordination of engineering criteria and procedures is necessary so that the completed practice will meet the requirements of both agencies and will function for its planned economic life with normal operation and maintenance.

Part 501 – Authorizations

Subpart E – Assistance of Shoreline Erosion Control

501.50 General

- A. Because shoreline erosion is complex, erosion control measures for stabilization differ greatly from those used for upland erosion control and can be very costly.
- B. Effective installation of erosion control measures can be achieved by proper coordination with other Federal and State agencies. This coordination eliminates duplication of services and provides for sharing knowledge in a rapidly changing technology.

501.51 Scope

- A. NRCS may provide assistance in controlling shoreline erosion if all the following conditions are met:
 - (1) The problem is not created by wave action on the open and unprotected shores of the oceanfronts or the Great Lakes.
 - (2) The problem can be solved with vegetation, normal upland erosion control practices, or minor structural measures, such as gabions or riprap revetment, masonry or timber bulkheads, or rock or timber barbs or vanes. All revetments, bulkheads, or groins are to be no higher than 3 feet above mean high tide or, in nontidal areas, no higher than 3 feet above mean high water. As used here, bulkheads are designed primarily to resist lateral earth pressures; revetments are not. Bulkheads and revetments are generally placed parallel to the shore; groins, barbs, or vanes are generally perpendicular to the shore.
 - (3) Failure of structural measures because of high-intensity storms will not create an immediate hazard to life or result in serious damage to buildings, residences, roads, or other high-value property.
 - (4) Installation of the recommended measures will have no significant adverse effects on the environment or on adjacent lands, waters, or installations.
 - (5) Sponsors and cooperators understand the level of protection provided and their responsibility for maintenance and repair.
 - (6) Plans and schedules for installing structures and establishing vegetation are acceptable to local, State, and Federal agencies that have jurisdiction.
- B. Although NRCS is not permitted to provide design or construction assistance to solve erosion problems created by wave action on the open and unprotected shores of major oceanfronts or the Great Lakes, advice and counsel may be provided on complementary erosion control practices used in conjunction with complex or expensive installations built by others at these locations. Assistance may be provided for normal erosion control on lands adjacent to these shorelines but only at elevations not affected by wave action.

501.52 Coordination With U.S. Army Corps of Engineers (USACE)

- A. USACE has responsibility for beach erosion control and shore protection on certain public lands and navigable waters. They have authority to provide technical and engineering assistance to non-Federal public interests for shore and streambank erosion. This may include assistance to soil conservation districts. USACE has defined “shore and streambank erosion” to apply to shorelines of oceans, bluffs, bays, estuaries, the Great Lakes, inland lakes and reservoirs, and along banks of

navigable rivers and their tributaries. They also have responsibility for issuing permits for structures and work in or affecting navigable waters.

B. The kinds of work that must be coordinated with the appropriate USACE district engineer are—

- (1) Any work that will have offsite effects, such as entrapment or diversion of littoral drift.
- (2) Any work that affects USACE jurisdictional waters.
- (3) Any work that requires permits.
- (4) Any work that may be a duplication of effort.

501.53 Requirements for Assistance

A. Assistance on shore-erosion problems for individual landowners or groups of landowners is subject to the cooperator assistance priority controls established by the conservation district.

B. Technical assistance must be coordinated with the agencies issuing permits to ensure conformance with their criteria. Sponsors and cooperators must obtain any required permits. Data NRCS has collected in the course of making an investigation may be used by cooperators in preparing their requests for permits.

C. Special authorization will be considered for providing assistance during emergencies or for meeting the requirements of special legislation.

Part 503 – Safety

Subpart A – Engineering Activities Affecting Utilities

503.0 General

- A. Private and public utilities may be jeopardized and equipment operators and others may be injured during site investigations and construction of engineering conservation practices and project structures if proper safety precautions and procedures are not followed.
- B. Established procedures for locating utilities and notifying owners are the first step in eliminating many potential accidents. These procedures, if followed, will reduce personal injuries, property damage, and interruption of utility service.

503.1 Scope

- A. This subpart provides the minimum requirements for developing a plan to prevent damage to public or private utilities and injury to people from contact with utilities during engineering and construction activities.
- B. Public and private utilities include all transmission lines, cables, fiber optic lines, and pipelines.
- C. Other buried infrastructure, such as landowner-installed drainage tile or private waterlines, are the responsibility of the landowner to locate.

503.2 General Considerations

- A. NRCS personnel must take adequate precautions to minimize hazards from or damages to utilities, both overhead and underground, during location, investigation, design, and construction of any works carried out under NRCS programs, technical assistance, or both.
- B. Landowners or operators, sponsoring organizations, and contractors must be informed that they are liable for any damage resulting from disruption of service caused by construction activities. They must also be informed that NRCS makes no representation on the existence or nonexistence of any utilities. A letter may be used for this purpose. Absence of utilities on construction drawings is not assurance that no utilities are present at the site.
- C. NRCS may be held responsible for damage done by its employees during site investigations.
- D. Clearly show location of known utilities on construction drawings with appropriate symbols and identification. Indicate on the construction drawings or specifications that the contractor or landowner is responsible for contacting the utility companies prior to construction or contact the One Call system for the State.
- E. Each State office must develop a procedure for carrying out its responsibilities within these guidelines.

503.3 Investigations

If subsurface investigation or construction is proposed, the responsible NRCS employee must check with the landowner-operator or with the sponsoring organizations to determine if there are underground utilities in the work area. During field inspection, particular attention should be given to utility markers set in fence lines or elsewhere.

503.4 Buried Utilities

A. If buried utilities are known to be in the vicinity of the proposed work, the responsible NRCS employee must notify the landowner-operator or the sponsoring organizations of this fact and of the landowner-operator or the sponsoring organization's responsibility to take the following actions:

- (1) Notify the utility notification center (i.e., One Call Center, Dig Safe, or equivalent) or the affected utility company of time, place, and type of work to be performed.
- (2) Request that the utility owner locate and stake the buried utility on the ground, both horizontally and vertically.
- (3) Request that a representative of the utility company be present during any excavation operations.
- (4) Notify the contractor of the location of the utility in relation to the job work area.
- (5) Supply to NRCS in writing either the ticket number from the utility notification center or a certification that the affected utility company has been notified. States may set up their own procedures, with the aforementioned being the minimum requirement. Failure to notify NRCS that utilities have been contacted will result in termination of NRCS assistance.

B. The responsible NRCS employee must ensure that the preceding steps have been carried out by the landowner-operator or the sponsoring organizations before beginning work in the vicinity of the buried utility.

503.5 Documentation

The responsible NRCS employee must document action taken pertaining to work in the vicinity of buried utilities. The documentation must be maintained in the NRCS job file. In lieu of a separate checklist, the same documentation could be kept in the conservation assistance notes.

503.6 State Laws

If State laws and regulations have different requirements, NRCS must comply with State laws and regulations. Procedures may vary from section 503.4 of this subpart, if equivalent in effectiveness. If State requirements are more stringent, the State conservation engineer may supplement section 503.4 of this subpart, as needed.

Part 503 – Safety

Subpart B – Public Safety at Structure Sites

503.10 General

Many NRCS-assisted structures, by nature, may be hazardous to the public. Features designed for recreation or fish and wildlife enhancement invite the public. Children especially are attracted to structures that provide an opportunity to play in water. Reservoirs and structures such as open-top spillway risers, high- or steep-walled channels and chutes, plunge pools, and stilling basins are especially hazardous and require special attention to ensure public safety.

503.11 Scope

All NRCS-assisted designs and structures must include necessary safety measures, regardless of who is responsible for installation and maintenance of safety measures.

503.12 Recommended Safety Measures

All structures must be designed to avoid hazardous conditions where possible; safeguards must be provided to protect the public where hazards are unavoidable. Following are examples of specific safety measures that should be used where appropriate:

- (1) Post warning signs where they are clearly visible, visually appealing, and appropriately sized.
- (2) Paint “DANGER—STAY OFF” on risers and highwalls. Use only if no other method is appropriate.
- (3) Locate riser in the reservoir rather than in the embankment if climatic conditions permit.
- (4) Use a covered-top drop inlet.
- (5) Use a low-level inlet to keep the normal water level below the main inlet.
- (6) Do not install permanent ladders.
- (7) Use a trash rack that cannot be easily entered.
- (8) Use catwalks only where absolutely necessary and use guard rails or protective fences with a locked gate where catwalks are necessary.
- (9) Prevent access to deep stilling basins, drop structures, plunge pools, chutes, steep- or vertical-walled channels, etc., with a protective chain-link fence, provide escape routes, or both.
- (10) Flatten side slopes of pools on at least one side.
- (11) Install guardrails on the top of highwalls and steep cuts that cannot be protected with fences.

503.13 Maintenance of Steep Slopes

- A. Advise farmers, maintenance personnel, and others against operating equipment on steep slopes.
- B. Recommend use of proper safety devices on equipment (protective frames, crush-resistant cabs, and seat belts).
- C. Call attention to hazards in maintenance plans and agreements.
- D. Specify safe procedures in maintenance plans and agreements that clearly exclude operation of equipment on steep slopes.

Part 503 – Safety

Subpart C – Safety During Geologic Investigations

503.20 General

Geologic investigations can be hazardous to the personnel involved because of the nature of site terrain and equipment used. These conditions require a careful analysis of the investigation process to anticipate and fully evaluate the potential safety hazard that may exist.

503.21 Scope

All NRCS detailed geologic investigation plans must include an assessment of anticipated safety hazards and a schedule of planned precautionary measures, known as the “safety plan.” This plan must include a schedule of safety meetings.

503.22 Hazard Potential

The following potential hazards related to geologic investigations are cited for illustration. This list is not intended to be all inclusive, and site-specific safety evaluations must be made.

- (1) Rock falls and avalanches
- (2) Landslides
- (3) Flash floods
- (4) Overhead utilities
- (5) Underground utilities
- (6) Dead trees and snags
- (7) Pit and trench walls
- (8) Lightning
- (9) Hazards associated with equipment use
- (10) Snakebite and insect bites
- (11) Open test pits or bore holes
- (12) Sinkholes
- (13) Subsidence
- (14) Weak bridges
- (15) Hazardous waste
- (16) Poisonous plants
- (17) Hot and cold weather
- (18) Sunburn

Part 503 – Safety

Subpart D – Dam Safety

503.50 Involvement With Dams

- A. NRCS involvement with dams and dam safety includes activities in planning, design, construction, operation, and maintenance. NRCS is concerned about the safety of dams and addresses safety aspects at the appropriate stages of involvement.
- B. NRCS has provided technical assistance on more dams than any other Government agency or consulting firm. NRCS does not own these dams; most of them are non-Federal. For some dams, financial assistance is available through NRCS programs. NRCS is involved in operation and maintenance (O&M) activities through the preparation of O&M plans for all inventory dams (Title 180, National Operation and Maintenance Manual (NOMM), Part 500, Subpart D, Section 500.30, “Overview”). In addition, NRCS receives formal inspection reports for dams installed under project activities (180-NOMM, Part 500, Subpart E, Section 500.44, “Formal Inspections”). NRCS may provide additional technical assistance for O&M as determined by the State Conservationist.
- C. A Presidential memorandum of October 4, 1979, established the Federal Guidelines for Dam Safety. The memorandum stated, “... I ask that the head of each Federal Agency responsible for or involved with planning, site selection, design, construction, certification or regulation, inspection, maintenance and operation, repair, financial or technical assistance, or ultimate disposition of dams adopt and implement the Federal guidelines, as applicable.”

503.51 USDA Involvement

- A. USDA Departmental Regulation 1043-018 establishes a USDA Dam Safety Committee and requires the Rural Housing Service, Forest Service, Rural Utilities Service, Agricultural Research Service, and NRCS each to designate a dam safety officer to serve on the committee.
- B. The Under Secretary for Natural Resources and Environment chairs the committee. The NRCS dam safety officer is the executive secretary of the committee.
- C. For technical matters, the executive secretary of the committee is the USDA contact with the Chief, Dams Section, Department of Homeland Security (DHS).

503.52 NRCS Dam Safety Officer

- A. The Director, Conservation Engineering Division (CED), is the NRCS dam safety officer.
- B. The dam safety officer reports directly to the Chief on issues that affect dam safety. The dam safety officer implements directives and needed actions.
- C. The dam safety officer has the responsibility to—
 - (1) Ensure adequacy of policy and procedures related to dam safety.
 - (2) Make reasonable and prudent efforts to ensure the safety of dams installed with NRCS assistance.
 - (3) See that all levels of NRCS are aware of the need for actions to ensure that dams installed with NRCS assistance are safe.
 - (4) Evaluate safety-related administrative and technical practices concerning the design, construction, operation, maintenance, periodic inspections, and rehabilitation of dams.

- (5) Maintain an inventory of NRCS assisted dams meeting the inclusion criteria described in part 520, subpart C, section 520.21F of this manual.
- (6) Provide leadership by representing NRCS in Federal and other activities leading to the establishment of policy, procedure, and criteria for dam safety.

503.53 Interagency Involvement

- A. NRCS is involved with other Federal agencies in dam safety activities. As executive secretary of the USDA Dam Safety Committee, the Director, CED, is the USDA member on the Interagency Committee on Dam Safety (ICODS).
- B. State Conservationists are encouraged to work with other Federal and State agencies in dam safety activities.

503.54 Other (Nongovernmental) Involvement

NRCS encourages its employees to become involved at all levels with various technical and professional groups in dam safety activities.

503.55 NRCS-State Relationships

NRCS supports State dam safety programs. A State dam safety program is imperative to protect public health and safety. NRCS lacks O&M authority on dams installed with Federal assistance and does not have continuing responsibility for the non-Federal dams installed under NRCS programs. It is NRCS policy to complement and not compete with State dam safety programs.

503.56 Responsibility for Dams

The owner of a dam is responsible for potential hazards created by the dam. States are responsible for safeguarding the lives and property of their citizens. NRCS is responsible for ensuring that the assistance it provides for dams is technically sound and meets applicable State regulations and criteria.

503.57 NRCS Assistance

- A. Each State Conservationist must help the State to develop and implement a strong dam safety program, as needed. The State Conservationist must work with the State, as appropriate, at the policy level and by technology transfer. NRCS involvement in formal inspections could be limited to some percentage of the NRCS-assisted dams. This involvement, however, permits NRCS and the State to derive the benefits of mutual technology exchange. NRCS participation in at least some of the initial inspections may also be particularly desirable to provide feedback to the design process.
- B. Each State Conservationist must establish needed working arrangements with the State for NRCS assistance in maintaining a strong State dam safety program.

503.58 Key Factors

NRCS must remain aware of several key factors of the State dam safety program, including—

- (1) Consistency with the Federal guidelines for dam safety.
- (2) Consistency with the model State law prepared by the Association of State Dam Safety Officials.

- (3) Recognition that some classification system is desirable.
- (4) Assurance of proper engineering criteria through a State approval or certification system covering both design and construction.
- (5) Requirements for adequate maintenance of dams.
- (6) Procedures for adequate inspection, including appropriate participation by qualified personnel.
- (7) Provisions for periodic reviews of hazard class and educational programs and regulations to discourage development downstream of low and significant hazard potential dams that would change the classification.
- (8) Provisions for emergency action plans for all high hazard potential dams.
- (9) Authority to take action to alleviate unsafe conditions, such as by modifying or removal of the dam or removing the hazard.
- (10) Adequacy of staffing and funding on a continuing basis.
- (11) Inclusion of all inventory-type dams (see part 520, subpart C, section 520.21F of this manual) in the State-regulated program.

503.59 Assistance to State Dam Safety Programs

With the exception of Alabama, all States have State dam safety programs that provide for inspection of existing dams and newly constructed dams under their jurisdiction. To assist a State dam safety program, the State Conservationist may wish to assist by making inspection assistance available. The State Conservationist should encourage the State to take on full responsibility for non-NRCS-assisted dams. NRCS assistance may be desirable for the initial formal inspections of new significant and high hazard potential dams. To establish a structure and mechanism that promotes cooperation, NRCS encourages each State Conservationist to maintain a memorandum of understanding between NRCS and the appropriate State dam safety agency or agencies.

503.60 Department of Homeland Security

- A. The chairman of the USDA Dam Safety Committee is the primary contact with DHS for dam safety.
- B. The executive secretary participates in DHS activities and represents the Department in the chairman's absence. The executive secretary is the point of contact with DHS in technical matters.

503.61 DamWatch

- A. NRCS provides access to the Web-based application DamWatch to assist dam owners, project sponsors, NRCS personnel, and State dam safety officials to monitor conditions for nearly 12,000 NRCS-assisted dams. DamWatch provides real-time monitoring of potential threats to dams such as rainfall events and seismic activity. DamWatch also provides access to important information about dams, including as-built plans, operation and maintenance agreements, emergency action plans, inspection reports, photos, videos, and assessment reports. User Guide (UG) 210-15-5, "DamWatch," contains instructions for accessing DamWatch.
- B. The Director, CED, provides State conservation engineers (SCEs) permission to serve as DamWatch State administrators. Each SCE may provide up to four additional employees in their State permission to serve as DamWatch State administrators. DamWatch State administrators may provide other NRCS employees permission to access DamWatch as users or local users.
- C. SCEs provide non-NRCS personnel permission to access DamWatch as follows:
 - (1) State Dam Safety Officials.—User or local user permission statewide.

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- (2) State Dam Safety Employees.—User or local user permission statewide or for select dams in State.
- (3) Dam Owners and Project Sponsors.—User or local user permission statewide or for dams in project area.
- (4) Emergency Response Officials.—User or local user permission for dams in emergency action official area of responsibility.

D. SCEs provide other non-NRCS personnel, such as Federal, State, or local government employees and engineering consultants working for project sponsors, permission to access DamWatch. Because DamWatch contains sensitive information, NRCS encourages each SCE to use discretion when providing non-NRCS personnel permission to access DamWatch. NRCS encourages each SCE to coordinate with dam owners and project sponsors when granting permission to access DamWatch.

E. SCEs must monitor access to DamWatch by dam owners and project sponsors. NRCS encourages all State Conservationists to contact all dam owners and sponsors of dams in DamWatch on a regular basis to inform them of the availability of the application and to obtain user feedback.

F. During emergencies, SCEs should assist project sponsors, State dam safety officials, emergency response officials and others with the use of DamWatch.

G. DamWatch provides an interactive forum where all users contribute to the information in the DamWatch database. SCEs have the primary responsibility for managing and providing access to the information on DamWatch. Each SCE should work with dam owners and project sponsors to develop a system for managing data and responding to alerts in DamWatch for their State. SCEs should encourage dam owners and project sponsors to take the lead managing data and system alerts in DamWatch.

H. SCEs must ensure that DamWatch contains all available as-built drawings, emergency action plans, project work plans, operations and maintenance agreements, inspection reports, and design reports for dams in DamWatch. SCEs should encourage users to load additional material such as photographs, videos, inundation maps, floodplain management studies, design computations, and news articles for each dam in DamWatch.

Part 503 – Safety

Subpart E – Prohibited Technical Assistance

503.70 General

NRCS is often asked to provide technical assistance in many areas. However, this assistance must not be provided for activities that are outside the normal area of expertise if these activities expose NRCS field employees to hazardous conditions or expose the agency to uncontrolled liability.

503.71 Prohibited Activities

The following activities are prohibited:

- (1) Assistance with removal of underground storage tanks
- (2) Assistance with removal of hazardous waste
- (3) Assistance with removal of unidentifiable waste

Part 504 – Special Investigations, Studies, and Reports

Subpart A – Problems and Deficiencies

504.0 General

A. Engineering activities must be carried out with a high level of technical competence if the results are to be of proper quality. The appropriate level of quality can be maintained only by engineers who use high-quality specifications, criteria, standards, and procedures. These tools must be constantly updated because of advancements in technology and experience. Problems, deficiencies, and failures often reflect a breakdown in the quality control of engineering activities.

B. Special investigations, studies, and reports of engineering problems and deficiencies must clearly define the conditions that led to the problem or deficiency. These studies should—

- (1) Describe the situation that existed at the time of the study, in detail, including induced damages.
- (2) Define additional survey or investigation needs.
- (3) Determine the cause of the problem.
- (4) Provide recommendations for resolving the problem or deficiency.
- (5) Provide recommendations or changes needed to avoid a recurrence.
- (6) Fully document findings in an engineering report, providing the information needed to improve future engineering work and resolve possible claims or litigation.

504.1 Scope

A. An investigation is required and a report is prepared whenever an engineering practice, system, structure, structural element, or material does not function as planned. Deficiencies or failures that become evident during construction must also be investigated and reported.

B. An investigation must be initiated as soon as signs of instability or serious distress are detected in engineering practices. Deterioration of concrete, severe erosion in channels, movement or cracking of an embankment, malfunction of pipelines, and excessive seepage are some examples of serious distress.

504.2 Reporting Problems, Deficiencies, and Failures

A. The State Conservationist and Regional Conservationist must be notified immediately of a problem or deficiency that might create a serious emergency or a failure that has led or might lead to loss of life, serious offsite damages, disruption of public utilities, or major economic losses for owners, sponsors, contractors, or NRCS. The State Conservationist must telephone and email the Chief promptly. The telephoned report must include such critical information as identification of the structure, project, and location and a description of the situation at the time of the call. When a major dam, class V or larger (see section 501.4 of this manual) is affected, the State Conservationist must see that the State conservation engineer (SCE) provides the report required in paragraph D of this section.

B. Normal lines of communication are used when reporting problems, deficiencies, or failures other than those described in paragraph A of this section. Political and social effects must be considered in determining the urgency of the notification to line officers and the need for informing others. Jobs in classes I through IV (see section 501.4 of this manual) do not usually merit special reporting because they rarely have the potential to create significant damages.

- C. If there is a significant danger to life or property, the State Conservationist must ensure that appropriate authorities, owners, and sponsors are notified.
- D. If there is failure or potential failure of a class-V or larger dam or other structure that may cause major economic losses, the SCE must telephone and email the Director, Conservation Engineering Division (CED), and report the situation. The Director, CED, must provide engineering guidance on emergency or remedial measures and, if appropriate, arrange for special engineering assistance. The SCE must keep the Director, CED, informed of changes in the situation.

504.3 Committee Assignments

- A. An investigating committee must be named as soon as possible after a problem, deficiency, or failure has been identified. An investigating engineer may be named in lieu of a committee if the cause of the problem is obvious and the practice or structure is minor. Jobs in classes I through IV are usually considered minor. A committee may be named for these minor structures if the problem is unusually complex.
- B. Committee members or investigating engineers should not have had any significant prior participation in the design, construction, or approval of the practice or structure. SCEs may not be members of committees in their States. Non-NRCS personnel will be named to the committee only if specifically approved by the Director, CED. The committee may also include sponsors, State agencies, or others as observers.
- C. The committee must include specialists in appropriate disciplines, such as design, hydraulics, soil mechanics, construction engineering, geology, or others.
- D. For a minor practice or structure (class I through IV) the State Conservationist, if so instructed, appoints the investigating committee or the investigating engineer. The SCE provides recommendations on membership for the committee.
- E. For class V or VI jobs, the State Conservationist must appoint the committee based upon the recommendations from the Director, CED, and the SCE. Depending on the nature of the issue, it may be necessary to arrange for engineers or other specialists from the National Design Construction and Soil Mechanics Center, other centers, or from outside the State to serve on the committee.
- F. For class VII or VIII jobs, the State Conservationist and the Director, CED, will determine the committee membership and the disciplines to be included. The State Conservationist must arrange for the participation of the members and issue the letter of appointment.
- G. If the problem is unusual, national in scope, or especially significant, the Chief may appoint a separate board to study the problem. The Director, CED, will make the recommendation for the board and its membership. The State Conservationist must be notified when a board will be established. If an investigating committee has been established, its members will submit their findings to the board and, as appropriate, serve as staff for the board.
- H. The SCE provides general guidance and technical support and arranges for any assistance required by the committee or board.
- I. The appointment letter provides general guidance on the scope of the investigation and tentative schedule. If there are problems or questions about the assignment, the chairperson or the investigating engineer must resolve these issues as soon as possible.

504.4 Procedures

- A. General guidance in conducting and reporting the investigation of a problem or deficiency is contained in Technical Release No. 24, Investigating Structure Failures.
- B. Because evidence may be obscured by subsequent flow of water, continued deterioration of the structure, or emergency repairs, the investigation must begin as soon as possible. The district conservationist (or anyone visiting the site) should photograph the site as soon as possible.
- C. The investigating committee must—
 - (1) Inspect the structure.
 - (2) Obtain photographs of the structure and affected areas.
 - (3) Determine the high-water level that prevailed.
 - (4) Interview eyewitnesses and record their statements, giving particular attention to the sequence and timing of events.
 - (5) Determine when the deficiency was discovered and when the structure was last inspected.
 - (6) Assemble and review construction records, such as diaries, reports, test data, as-built plans and as-built reports on construction geology.
 - (7) Review the design file.
 - (8) Gather any other information regarding the event, such as precipitation and streamflow records.
 - (9) Define field surveys required to record topography and physical changes.
 - (10) Specify any geologic investigations and soil mechanics testing needed.
 - (11) Review all communications and staffing assignments during the design and installation of the structure.
- D. After compiling the necessary data, the committee or investigating engineer must—
 - (1) Determine the causes of the problem, deficiency, or failure. Support for each cause must be presented carefully so as to define completely the conditions that led to the problem.
 - (2) Define and support conclusions.
 - (3) List, as appropriate, suggestions on how procedures, criteria, designs, staffing, etc., should be changed to avoid a recurrence.
 - (4) When directed by the appointing official, make suggestions for alternative treatments in descriptive concepts and not treatment design details. This is a secondary purpose of the report.

504.5 Engineering Report

- A. An engineering report must be prepared for each investigation. The detail and composition of the report must be consistent with the size, complexity, and significance of the problem, deficiency, or failure.
- B. The engineering report must include—
 - (1) A brief description of the committee activities.
 - (2) A description of the structure, with pertinent data on name, location, size, age, etc.
 - (3) Appropriate geologic and engineering information.
 - (4) A detailed description and explanation of the situation. Include photographs to enhance the explanation.
 - (5) Sufficient narrative and data to fully document facts and support findings and conclusions. The report must discuss where standards, criteria, procedures, or practices failed or were

- improperly followed. The questions “What went wrong to permit the incident to occur and what would have prevented it?” must be answered to the best of the committee’s ability.
- (6) Pertinent drawings, specifications, reports, etc.
- C. An abstract must be prepared for all engineering reports of measures that are class V to VIII. The abstract is used to inform other engineers so they can gain from the experience. The abstract should not be more than two pages and must include—
- (1) Data on location, size, etc.
 - (2) Description of the problem, deficiency, or failure.
 - (3) Statement of the cause and effect.
 - (4) Discussion of the findings and conclusions, including any identified procedure or practice that, if followed, would have prevented or alleviated the situation.
 - (5) Sketches, as appropriate.

504.6 Report Review and Acceptance

- A. The committee or the investigating engineer must submit the report to the State Conservationist through the SCE. The SCE will coordinate the reviews required and upon technical acceptance, forward the report with his recommendations to the State Conservationist for distribution.
- B. The SCE must solicit review comments by employees who were responsible for preparing the design and inspecting the construction. The SCE and the employees’ comments must be attached to all copies of the report. Before the reports are released, they must be reviewed and accepted, as follows:
- (1) Classes I to IV.—The SCE determines when the report is technically acceptable. The SCE will work with the committee to resolve all issues raised. If the report identifies problems resulting from inadequate national specifications, practice standards, or procedures or otherwise merits special attention, the SCE will request review comments from the Director, CED. After all issues are resolved and the SCE has determined that the report is acceptable, the SCE must submit the report to the State Conservationist and indicate its technical acceptance.
 - (2) Classes V to VIII.—The report must be submitted to the Director, CED. The Director, CED will review the report and indicate that the report is acceptable or request additional details, study, or other action needed for acceptance. After all issues are resolved and the report is accepted, the SCE must submit the report to the State Conservationist and indicate its technical acceptance.

504.7 Release and Distribution of Reports

- A. After technical acceptance and receipt by the State Conservationist, the report may be released to others and may be used as supporting documentation for requesting funds to correct problems or deficiencies. Owners, sponsors, State agencies, and others may be given copies after the report is accepted.
- B. As a minimum, a copy of the accepted report must be forwarded to the Director, CED.

Part 504 – Special Investigations, Studies, and Reports

Subpart B – Emergency Spillway Performance

504.10 General

- A. Thousands of auxiliary spillways have been installed since 1954, when NRCS began using the present procedure for design. More are installed each year. Major spillway flows can be expected at several structures each year.
- B. Current auxiliary spillway criteria is outlined in Title 210, National Engineering Handbook (NEH), Part 628, “Dams,” and is based on judgment and experience gained over the years. However, most research and field evaluations to date have been on structures with drainage areas of less than 10 square miles. Further research is needed, but laboratory model studies are not always directly applicable and large field models or prototype studies are only now being undertaken. An alternative is to make field studies of the operation of existing structures.
- C. The purpose of auxiliary spillway performance and overtopping analyses studies is to carry out a continuing program to provide information that will be helpful in confirming or improving existing design criteria, give an indication of the upper limits of applicability of various types of spillways and earthen embankments, and show the extent and cost of spillway and embankment maintenance required after flood flows.

504.11 Scope

A study must be made of any earth, rock (except massive, unweathered rock), or vegetated spillway built since 1954 if it is determined that the information from an auxiliary spillway, overtopping flow, or both would help with continued Agricultural Research Service research and development of the models used by NRCS. The need for a study will be made on a case-by-case basis by contacting the Director, Conservation Engineering Division (CED), if any of the following conditions occurred:

- (1) The water surface in the reservoir has reached an elevation above the crest of the auxiliary spillway of 3 feet or more.
- (2) The auxiliary spillway has suffered severe damage, has approached breaching, or has breached to any degree.
- (3) The auxiliary spillway has sustained continuous discharge for 7 days or more.
- (4) Flow resulted in overtopping of the embankment.

504.12 Reporting Major Flows

If conditions require a study (see section 504.11 of this subpart), the Director, CED, must be notified. This notification may be sent by email and must include the watershed names; site names, site numbers, or both; and preliminary flow data. Notification must be made as soon as possible in order to aid in data collection efforts if further investigation is required.

504.13 Assignments

The Director, CED, determines the need to develop performance studies on a case-by-case basis. If it is determined that a study is needed, it is to be made by qualified engineers. The Director, CED, will coordinate with the State conservation engineer (SCE) to formulate members of the evaluation team. Hydrologists, hydraulic engineers, and geologists are needed in various parts of the evaluation.

504.14 Procedures

If an auxiliary spillway study, overtopping study, or both are needed, the performance study should be made as soon after the occurrence as practical. The study and the report must consider and document the—

- (1) Name of the watershed.
- (2) Name or number of the structure and inventory number
- (3) Location (State and latitude and longitude to nearest degree and minute).
- (4) Date built.
- (5) Drainage area in square miles.
- (6) Height of dam.
- (7) Plan and profile along the auxiliary spillway centerline from entrance to streambed.
- (8) Cross sections at control section and at selected points in the exit channel showing the depth and width of the constructed spillway.
- (9) Profiles along the embankment top, starting from the upstream side of the top and across the embankment back slope at intervals that show the erosion that occurred, and embankment cross sections at selected locations that show the length of back slope at different intersection points along the profile.
- (10) Geologic map and profiles of the embankment, the auxiliary spillway control section and the exit channel, or both.
- (11) Statement regarding the condition of the embankment, the auxiliary spillway, or both before the flood event, including the density and type of vegetation.
- (12) A copy of the last maintenance and inspection report before the storm.
- (13) Photographs, if available, of prestorm conditions.
- (14) Date of flood.
- (15) Rainfall depths for various durations according to either official rain gages or a “bucket survey,” and the related frequency for each duration.
- (16) Runoff; if a stream gage is available, U.S. Geological Survey provisional data should be included.
- (17) Observed or reconstructed inflow and outflow hydrographs at the structure, including maximum reservoir stage and duration of overtopping, auxiliary spillway flow, or both.
- (18) Physical factors of drainage area related to a weighted “curve number,” including antecedent moisture and vegetative cover conditions immediately preceding the storm.
- (19) Description of the damage on the embankment, in the auxiliary spillway, or both, including location, depth, and severity of erosion.
- (20) Photographs of poststorm conditions in the spillway and downstream.
- (21) Estimate of volume of soil and rock eroded from various sections of the spillway.
- (22) An estimate of the cost to repair the spillway.
- (23) Any other pertinent information.

504.15 Report

A. A separate spillway flow report is required for every flood event meeting the conditions in section 504.11 of this subpart. If a storm event affects many structures over a wide area, a reconnaissance may be made to determine the need for making a field study on every structure. If this situation occurs, the SCE must advise the Director, CED, and reach agreement on the studies needed. An auxiliary spillway performance study does not alter circumstances under which a problem or deficiency study may be required.

B. A report must be prepared for each site, except as provided in the preceding paragraph. A copy of each report must be submitted to the Director, CED. After the report has been approved and

accepted, a copy is submitted to the State Conservationist, the State agency responsible for dam safety, and to the owner or sponsor of the structure.

504.16 Review and Approval

- A. The SCE must approve the report before it is sent to the Director, CED.
- B. The Director, CED, notifies the State Conservationist of acceptance of the report or of additional data required.

Part 504 – Special Investigations, Studies, and Reports

Subpart C – Reservoir Sedimentation Surveys

504.20 General

A. Sediment has a major impact on water quality, water and land use, environmental value, and structure performance. Sedimentation surveys provide States with more reliable and defensible procedures for quantifying the off-farm impacts of sediment, assessing the effects of conservation practices on these off-farm impacts, and predicting sedimentation rates in ponds and reservoirs. Measurements of the sediment accumulating in reservoirs and determining the physical conditions influencing the sediment yield from the contributing watersheds provide some of the best data that can be obtained on erosion and deposition.

B. Selection of sites and interpretation and analysis of data must be made by the State for local applications.

504.21 Procedures

The detailed procedures for making these surveys are described in Title 210, National Engineering Handbook (NEH), Section 3, Chapter 7, and in the American Society for Testing and Materials (ASTM) D4581 “Standard Guide for Measurement of Morphologic Characteristics of Surface Water Bodies.”

504.22 Reports

A. Reservoir sedimentation reports must be prepared by the State for each survey as described in section “Survey Reports” (pages 7-27–7-31) in 210-NEH, Section 3, Chapter 7. The reservoir sediment accumulation data collected must be sufficient to complete Form NRCS-ENG-34, “Reservoir Sediment Data Summary” and provide the data on related watershed conditions (e.g., soils, surface geology, topography and land forms, land use and treatment, and all types of significant erosion).

B. The Director, Conservation Engineering Division, provides data from the completed NRCS-ENG-34 to the Subcommittee on Sedimentation and the Interagency Advisory Committee on Water Data to add to the database.

Part 504 – Special Investigations, Studies, and Reports

Subpart D – Field Trials and Evaluations

504.30 General

- A. New products, procedures, and techniques are essential in maintaining a technically strong and current engineering program. These new items become available over time. There are requests from industry and others to put these items into immediate use. Many of these items have great potential for use in engineering. Others, while appearing to have merit, may in fact be inferior and unacceptable. Before NRCS adopts a product or procedure, it must be determined that it will function as designed and last for the design life. This may require detailed study and testing.
- B. Field trials and evaluations, in conjunction with test data, can provide the necessary information to support the approval of a material or procedure for NRCS use. Before a new product or procedure is included in standards or specifications, it must be documented that it will meet the design criteria. Field trials and evaluations are frequently the only methods for developing acceptable data.
- C. Trials and evaluations must conform to policy stated in Title 450, General Manual, Part 403, “Conservation Field Trials.”

504.31 Scope

Field trials and evaluations must be considered if there is a need for determining if a product, procedure, or technique can be used to alter, replace, or supplement existing standards, criteria, or procedures.

504.32 Approval Procedures

- A. Proposed field trials or evaluations that may change procedures, policy, standards, or criteria must be submitted to the Director, Conservation Engineering Division (CED). Proposals must be specific as to the scope of the trial and the materials or procedures to be tested.
- B. The Director, CED, makes a recommendation on each proposal. This may include guidance on the scope and intensity of the study to ensure national application of results. This technical recommendation for the study does not constitute approval for expenditure of resources. If necessary, a request for funds and personnel should be made to the appropriate source by the State asking for the request.
- C. Proposed field trials or evaluations that do not require a variance from standards, criteria, specifications, policies, or procedures may be approved by the State Conservationist.

504.33 Study Plan

- A. Generally, the brief statement describing the trial or test that accompanies the request for approval is not sufficiently detailed to define the scope, intensity, purpose, and plan for the study.
- B. The study plan must fully describe the need, benefits, approach to be taken, anticipated schedule, and resources required. These must be sufficiently detailed to permit a valid assessment of the potential for obtaining the needed data and of the potential demands for resources (personnel, equipment, and costs).

504.34 Reports

- A. Each State must maintain an index and a schedule for all field trials and evaluations.
- B. At the time the study is approved, a schedule must be established for progress reports. These reports must be appropriate to the trials and evaluations.
- C. When the trial or evaluation is completed, a final report must be prepared.
- D. Copies of all reports are submitted to the Director, CED.

Part 505 – Non-NRCS Engineering Services

Subpart A – Introduction

505.0 General

A. Non-NRCS engineering and other technical services are important to meeting the NRCS engineering workload and specific technical and program needs. NRCS must maintain a quality, well-trained engineering staff to support the delivery of NRCS programs and to engage others in the work. In using non-NRCS services, NRCS will strive to ensure—

- (1) Professionalism and respect for others.
- (2) Quality work.
- (3) Excellence in customer service.
- (4) Teamwork with others.
- (5) Clearly defined responsibilities.
- (6) Partnerships with State boards of registration.
- (7) Sustainable solutions.

B. For the purpose of this policy, “non-NRCS engineering services” means services provided by any engineer, landscape architect, geologist, or others employed by a consulting firm, sponsoring local organization, other unit of government, private individual land users, technical service providers, manufacturers of structural elements or components, and construction contractors.

Part 505 – Non-NRCS Engineering Services

Subpart B – Procedures

505.10 Technical Service Providers (TSPs)

Landowners may engage the services of certified TSPs directly for technical assistance in implementation of engineering practices in accordance with Title 440, Conservation Programs Manual (CPM), Part 504, “Technical Service Provider Assistance.”

- (1) NRCS will provide the applicable NRCS standards and provide appropriate predesign support at the request of the landowner.
- (2) The certification of practices or activities accomplished by the TSP is the responsibility of the TSP. The TSP must furnish documentation as outlined in the statement of work for the conservation practice or activity.
- (3) The TSP must include the following certification on drawings for engineering practices: “To the best of my professional knowledge, judgment, and belief, these plans meet applicable NRCS standards.”
- (4) NRCS is responsible for quality assurance and spot-checking of work performed by TSPs in accordance with Title 450, General Manual (GM), Part 407, “Documentation, Certification, and Spot Checking.”
- (5) Services performed by certified TSPs may be accepted under these provisions independent of the source of compensation for the services.

505.11 Non-TSP Providers

Consultants and others may complete designs, drawings, and specifications and may inspect construction for NRCS, sponsors, or landowners.

- (1) The provider must submit documentation as required in the statement of work for the practice.
- (2) The provider must include the following certification on the drawings: “To the best of my professional knowledge, judgment, and belief, these plans meet applicable NRCS standards.”
- (3) The State conservation engineer (SCE) will establish State policy for reviewing the submittal to ensure, at a minimum, that the work achieves the objectives and criteria in the applicable conservation practice standards.
- (4) When the provider assists with construction inspection the landowner or sponsor must submit final as-built drawings with the following certification by the responsible individual: “To the best of my professional knowledge, judgment, and belief, this practice is installed in accordance with the plans and specifications and meets NRCS standards.”

505.12 Conservation Contractors

Conservation contractors may provide technical services to landowners and land users in conjunction with the installation of terraces, diversions, grassed waterways, stabilization structures, on-farm drainage and irrigation systems, low-hazard agricultural waste management systems, land grading and leveling, and other conservation practices.

- (1) NRCS is responsible for technical standards, conservation planning and application, and the certification and reporting for conservation practices assisted by conservation contractors.

- Field office staff will review the checkout and layout and other construction documentation provided by the contractor. Practice documentation must comply with 450-GM, Part 407.
- (2) NRCS must ensure that services provided by the contractor during the design phase meets NRCS program needs and technical standards.
 - (3) Upon request from a contractor, the field office staff will furnish information related to acceptance of his or her work by NRCS in writing describing the specific practices and elements of work performed. A sample letter is included in subpart C, section 505.20. This information is protected by the Privacy Act from unwarranted disclosure and may not be divulged by NRCS to any individual or organization other than the contractor to whom it pertains. Exceptions to this require approval of the Freedom of Information Act officer.

505.13 Engineering Services Contracts and Agreements

Contracts and agreements must comply with the following:

- (1) Coordinate acquisition of engineering services with the NRCS Acquisitions, Grants, and Agreements Division.
- (2) If NRCS provides funds for engineering performed by a sponsoring local organization or by a private source engaged by a sponsoring local organization, an agreement for services is required. The SCE and the NRCS acquisition specialist must assist in selection and negotiation.
- (3) Guidance and assistance in establishing engineering services contracts and agreements are available through the Acquisitions, Grants, and Agreements Division SharePoint site.

505.14 Exchange of Technical Services Between Government Agencies

NRCS participates in the exchange of engineering services between Government agencies to expedite and improve technical work of the agencies by sharing expertise and enhancing on-the-job training. An agreement for exchange of services may be formal or informal depending on the nature of the work. Generally, simple routine exchanges are arranged by correspondence between the agencies. More complex jobs require formal agreements. Contact the Acquisitions, Grants, and Agreements Division for assistance and guidance in establishing agreements.

505.15 Standard Designs and Drawings

A. NRCS is often requested to approve standard drawings for such measures as manure tanks or prefabricated structures by a vendor.

B. The SCE may perform the review using available NRCS resources and approve the standard design and drawing.

- (1) The SCE may request that the vendor supply a peer review conducted by an independent engineering firm.
- (2) The SCE must require the vendor to supply NRCS with a certification by a licensed professional engineer registered in the State that the measure meets all NRCS standards for the States where the measure is to be applied.
- (3) The submittal must include all necessary substantiating data, including calculations, design constraints, and limitations.
- (4) The SCE will notify the Director, Conservation Engineering Division, of all approved standard designs and drawings prepared by others.

505.16 Engineering Services Not Provided by NRCS

NRCS engineers do not provide certain engineering services that are outside the scope of NRCS authority or engineering capacity. NRCS also avoids competition with private-sector providers better suited for specialized services. NRCS does not provide the following engineering services:

- (1) Boundary or location surveys for legal purposes, unless the State Conservationist has determined that providing such service in a State meets the requirements of the State Professional Engineers and Land Surveyors Board.
- (2) Representation of drainage or irrigation districts or similar enterprises in legal proceedings required by State laws, unless non-NRCS sources are not available and the State Conservationist presents justification acceptable to the Chief.
- (3) Obtaining water rights or filing applications with regulating agencies for pollution abatement facilities, except as provided in 130-GM, Part 400, “Mission Statement.”
- (4) Single-Purpose Municipal and Industrial Water Supply.—NRCS does not provide or contract for engineering services for the planning, design, or installation of single-purpose structures for municipal and industrial water supply.
- (5) Multiple-Purpose Municipal and Industrial Water Supply.—Multiple-purpose structures for municipal and industrial water supply may have provisions for flood control, irrigation water management, recreation, fish and wildlife, water quality management, or any combination of these or other purposes. The division of engineering work among NRCS and others depends on which purposes are included. The Chief may consider exceptions to this rule at the request of sponsoring local organizations and on submission of justification if the storage volume for municipal and industrial water is less than 20 percent of the total water storage volume.

Part 505 – Non-NRCS Engineering Services

Subpart C – Exhibits

505.20 Conservation Contractor Sample Letter

Place the following on NRCS letterhead.

[Date]

[Name]

[Address]

[City, State, and ZIP Code]

Dear [XXXX]:

As you requested on [Date], I am furnishing you this office's acceptance of your construction and documentation of conservation practices installed by farmers and ranchers in this county. Our acceptance is based on a review of the documentation you submitted and our field review of your work. The practices are as follows:

Ponds—construction only

Terraces—construction and checkout documentation

Grassed Waterways—construction and checkout documentation

Diversions—construction, layout, and checkout documentation

Land Leveling—construction, design, layout, and checkout documentation

We commend you and appreciate your efforts and cooperation in promoting and installing high-quality conservation practices in this county.

Thank you for your support in protecting our soil and water resources.

Sincerely,

[NAME]

District Conservationist

Part 506 – Technical Materials

506.0 General

NRCS develops and maintains national conservation engineering technical materials, including documents, drawings, and computer programs to reflect NRCS technical expertise, experience, and procedures in engineering, geology, and landscape architecture. Most of these engineering materials serve as permanent references for providing technical assistance across the range of agency programs. Other engineering materials provide information to the public on agency projects and practices.

506.1 Definitions

- A. Conservation Practice.—A specific treatment, such as a structural measure, vegetative measure, or management technique, commonly used to meet specific needs in planning and conservation for which NRCS developed standards and specifications.
- B. Conservation Practice Specification.—A general or site-specific document that establishes the technical details and workmanship required to install a practice in accordance with the practice standard.
- C. Conservation Practice Standard.—A set of statements (criteria) that establish the minimum acceptable level of quality for planning, designing, constructing, operating, and maintaining conservation practices.
- D. Criteria.—Policy statements of specific quantitative technical requirements. Criteria may contain reference to procedures. As policy statements, criteria are, by definition, a subset of policy.
- E. Guide.—A compendium of information or series of options that does not recommend a specific course of action.
- F. Policy.—A statement of an adopted and definitive course of action.
- G. Procedure.—A method of analysis that can be either a technical or an administrative process methodology. Procedures contain a series of steps taken to determine a result for a desired objective.
- H. Specification.—An explicit set of requirements to be satisfied by a material, product, system, or service, such as construction. Specifications also identify the methods for determining whether each of the requirements is satisfied.
- I. Standard.—A statement of acceptable quality or technical excellence in terms of both form and function (performance), usually expressed in terms of limits (i.e., minimum or maximum).

506.2 Organization of Permanent Materials

- A. NRCS utilizes an agencywide-coordinated system to organize, issue, and manage its permanent documents. Title 120, General Manual (GM), Part 403, “Directives, Forms, and Reports,” and Title 120, National Directives Management Manual, Part 503, detail this system. NRCS incorporates legacy engineering policy and guidance documents into the agencywide directives system upon revision.
- B. Within the directives system, NRCS organizes all permanent national engineering materials under title 210 using a wide variety of directive types and formats, including National Engineering Handbook (NEH) sections, technical releases, design notes, and others. The following represents those most commonly used:

Title 210 – National Engineering Manual

- (1) General Manual (GM).—The GM contains policy that applies to all offices. 450-GM, “Technology,” contains additional policies applicable to engineering.
- (2) National Engineering Manual (NEM).—The NEM contains national policy for engineering work.
- (3) National Engineering Handbook (NEH).—The NEH contains detailed how-to instructions (i.e., procedures, guides, and specifications). NEH provides a uniform framework for locating technical references, eliminating duplication of distributed materials, and managing the development of new materials.
- (4) National Handbook of Conservation Practices (NHCP).—The NHCP contains national conservation practice standards and specifications. The material within the NHCP is agency policy and criteria by cross-reference in the GM. The NHCP falls within title 450.
- (5) National Instructions (NI).—NHQ uses national instructions to issue detailed instructions and procedures on a specific subject to State offices.
- (6) Circulars.—Circulars are used to transmit critical changes and revisions to permanent directives (manuals, handbooks, and national instructions) when there is insufficient time or information available for complete revisions. NRCS does not post circulars to eDirectives, but distributes them directly.
- (7) Engineering Technical Notes (TN).—Engineering technical notes transmit technical and procedural information not suitable for supplementation to or creation of a manual or handbook. Typically, this information is narrow in scope and transmits experimental or developmental materials, such as research and field trials.
- (8) Engineering Technical Releases (TR).—NRCS issues technical releases only within Title 210, “Engineering.” TRs primarily contain procedures and technical information.
- (9) User Guides.—User guides provide specific instructions on the use and operation of NRCS-created and supported software applications and databases. NRCS also issues user guides for software developed outside of NRCS, but made available for NRCS users through the common computer environment (CCE) certification process.

506.3 Reserved

506.4 Developing NEH Materials

Based upon input from the State conservation engineers, the Engineering Business Area Advisory Group (EBAAG), engineering discipline leads, and others, the Director, Conservation Engineering Division (CED), approves development of national technical materials focused on agency priority needs. The director engages appropriate discipline leads and staff to coordinate development of materials, to scope the final product, and to ensure organized integration into NEH.

506.5 Distribution of Engineering Technical Materials within NRCS

NRCS distributes engineering technical publications in electronic form through the NRCS eDirectives System at <https://directives.sc.egov.usda.gov>. NRCS provides notification of the posting of new and updated technical materials on the NRCS eDirectives site.

506.6 Distribution of Engineering Technical Materials Outside of NRCS

NRCS offices at all levels respond to requests for engineering technical materials from non-NRCS individuals or organizations. Some documents, such as the NEH, are quite large; and it is unreasonable to fill a request for printed NEH materials due to the time and expense involved in printing individual copies when the entire document is available through eDirectives.

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- (1) Refer requestors to the materials available on the NRCS eDirectives site.
- (2) At the discretion of the State conservation engineer, fill requests for printed copies from Federal, State, and local agencies, individuals working with NRCS in a professional capacity, contractors working with NRCS, and others involved with NRCS programs and contracts.

Part 510 – Planning

510.0 General

Planning for the conservation and sustained use of natural resources often requires engineering input, which should be provided early in the planning process. Planning should be in sufficient detail to ensure that decisions by individuals, groups, units of government, and sponsors can be implemented without extensive changes in scope, purpose, or cost. All plans must be formulated so as to be complete, effective, efficient, acceptable, and in conformance with local, State, and Federal laws, rules, and regulations. Additional guidance on specific NRCS planning procedures can be found in Title 180, National Planning Procedures Handbook (NPPH), Part 600, Subpart A, “Framework for Planning.”

510.1 Scope

A. The approach taken during a planning study will vary according to the scope, size, and complexity of the issues involved.

- (1) A simple conservation practice involving just one individual might proceed rapidly through planning, design, construction, and operation. However, even simple measures must be planned with due consideration for their impact on the larger system or the plan for the area.
- (2) More complex practices, involving several individuals, ecological components, or both, require more intense planning and input from a number of disciplines and organizations. For these complex practices, several approaches and multiple alternatives within those approaches may need to be developed and evaluated.
- (3) A combination of practices comprising a plan may (or may not) be on a single parcel and address one or more resource concerns. It may require a suite of practices used together to resolve the resource problems.

B. The planning guidance in the NPPH is applicable to planning for all NRCS programs. Plan content and criteria may vary for each individual program or funding source.

C. Preliminary engineering work may be needed during phases I and II of the planning process outlined in the NPPH. The land user or sponsor must understand the scope, size, economics, and operational obligations for each alternative being considered before significant engineering resources are expended in more detailed studies.

D. Site investigations conducted during planning for engineering measures are often less intense than those required for final design. Final design investigations may reveal some adverse conditions not identified during the planning process. Land users or sponsors should be informed by NRCS staff that it is possible that agreements reached on the details of planned measures, needed land rights, and estimated costs in the planning phase may require revision during final design and construction. Upstream and downstream development that takes place after planning can also greatly affect the design.

E. The data collected and the resulting analyses must be sufficiently detailed to aid in selecting alternatives. Engineering job classes should be identified early to establish proper engineering job approval authorities and an appropriate review process. An individual having appropriate engineering job approval authority for the practices being considered must be consulted during the planning process and review and sign the approved engineering plan.

F. Expertise from all appropriate disciplines associated with natural resource management should be involved as early as possible in the planning process.

510.2 Documentation

Document engineering investigations and analyses. Computations, other data, and documentation supporting engineering decisions must be checked for accuracy and reasonableness by personnel with appropriate job approval authority. Documentation provides for expediting reviews, allows the work to progress smoothly into final design and construction, and aids in post reviews. The degree of supporting data must be commensurate with the specific situation and the type of project planned. The data are to be documented and filed so that later investigations for detailed design can build on, rather than repeat, investigations and analyses accomplished during the planning phase. Supporting documentation must include the project name and location, who performed the work, who checked the work, and the date of the work. The checker must initial the materials checked.

510.3 Engineering Data to Support Plans

A. Perform engineering analysis to the extent necessary to ensure that all engineering measures will function properly and achieve the planned results. Surveys, investigations, and preliminary designs must be performed in sufficient detail to prepare necessary cost estimates, land rights requirements, etc.

B. The size and complexity of planned actions dictate the level of detail required for the engineering report. Design the format and content of the report to meet the needs of the client. The report must clearly describe the problems, investigations, alternatives, and conclusions. Use graphics as necessary to provide a clear understanding. The final planning report must be tailored to meet program requirements, as appropriate. In all cases, the report must be sufficient to document decisions in a professional manner.

C. Review and approval is required for planning reports containing engineering data and analysis. This review and approval includes technical approval of the overall system of engineering measures to ensure that they perform their planned functions.

510.4 Criteria

A. Current engineering standards and procedures are to be used for planning all measures.

B. If revisions or modifications are made to the plans, the current criteria must be used for at least the following situations:

- (1) New structural measures not included in the original plan.
- (2) Structural measures modified enough to require a supplement to the plan.
- (3) Structural measures included in the approved plan that, if built according to original criteria, would endanger new structural measures, existing structures, or ones that are to be modified.

510.5 Cost Estimates

Determine all costs, including installation costs and expected periodic costs. Costs must be current in accordance with the most recent available information. The costs of engineering measures generally include the following:

- (1) Engineering.—The direct cost of engineers and other personnel for surveys, investigations, design, preparation of plans and specifications, preparation of the operation and maintenance plan, and the cost of inspection during construction.
- (2) Land Rights.—The actual cost or value of land required for construction and operation of the measures, including changes to fixed improvements.

- (3) Water Rights.—The actual cost or value of water rights required by local interests for carrying out the measure.
- (4) Contract Administration.—The expected cost of administering the contracts, cost of permits, and any legal costs.
- (5) Construction.—The expected cost of constructing the measure. Construction estimates during planning should include specific estimates for all the identifiable components. Contingencies should be included to allow for unforeseen conditions and costs that are likely to be identified during the final design and construction phases. Contingencies are established according to the detail of planning. Higher contingencies should be allowed for less detailed planning.
- (6) Operation, Maintenance, and Replacement.—The cost required to operate and maintain the measure, including necessary inspections and repairs for the planned life of the project. Any items to be replaced during the evaluation period must be included.

510.6 Postdesign Life Considerations

At the end of their design life, some practices may create safety, health, and environmental concerns. Those issues should be considered when alternatives are formulated and discussed with the land user, sponsor, or both. Costs for replacement, rehabilitation, or decommissioning of these practices should be anticipated, estimated to the extent possible, documented in the plan report, and communicated to the landowner or sponsor.

Part 511 – Design

Subpart A – Procedures

511.0 General

A. Engineering design is an organized and rational process that applies the natural laws of science for the enhancement of human welfare. Engineering design should be sensitive to the needs of people, their activities, and the landscape.

B. Engineering design is performed at many organizational and geographic locations. The designs prepared are of varying complexity and are often performed at locations some distance from the construction site. The design is performed by personnel having various levels of knowledge and skill. The designs often require review and approval by someone at a location other than the construction site or design office. Designs must be reviewed to ensure adequate performance and safety (see part 501 of this manual). Because of the diverse nature of the design activities in NRCS, some standardization of basic nomenclature and procedures is needed.

511.1 Scope

A. The principles defined in this part apply to all sizes and complexities of designs. The detail to which the procedures are to be followed varies according to the need. The simplest conservation practice may require only a few notes, computations, and drawings. Larger and more complex works may require numerous notes, computations, and drawings to complete all stages of the design. Likewise, the complexity of site conditions and engineering along with the number of alternatives and organizational units affects the intensity and duration of work at each design stage.

B. Engineering design must provide for the quality and durability required for the economic life of the practice or component at the least-total cost consistent with functional requirements. Engineering designs must be determined by comparative design studies and cost estimates prepared with full consideration of the landscape, environment, topography, foundation, and other site conditions and the economy and feasibility of construction, operation, and maintenance. Economic comparisons of alternative designs are determined by the amortized average annual cost of installation (including costs of land rights), operation, and maintenance. Environmental comparisons must consider ecological, cultural, and aesthetic values.

511.2 Design Stages

A. To provide standard terminology for orderly scheduling and coordination of work, three stages of design activity are defined. This terminology is to be used in all NRCS correspondence, publications, and documents relating to design. The design activities included in these stages may be further subdivided into phases or subphases as necessary to control NRCS work or to administer engineering services contracts and agreements.

B. On small and simple structural measures, all three stages of design can be accomplished in one brief period of time and in such a manner that they are nearly inseparable. On larger works, such as projects, much of the work in stages one and two may be completed during planning (see section 510.1 of this manual.). Items for which the final design data are known during planning, such as topographic, hydrologic, and hydraulic features, should be completed for final design purpose at that time. The planning data need only be reviewed before design commences to verify accuracy and adequacy. In this manner, data gathered during planning can be used to avoid duplication of effort

and ensure that there is little or no modification needed in the general layout during final design. Similarly, data should be gathered on the geology and foundation if assurance against significant cost changes is desired.

C. Stage one includes data collection and evaluation for all information on—

- (1) Physical data, including topographic, hydrologic, visual, biologic, geologic, seismic, and archeological data.
- (2) System and structure functional requirements and purpose, including capacity, controlled water level, and location.
- (3) Site constraints, including information on ownership boundaries, easements, utilities, and water rights.

D. Stage two is the preliminary design, which consists of developing the general features of the works of improvement. It includes selecting the most suitable types of structures, the optimum layout and arrangement of the elements of the structural system in the landscape, the types and locations of appurtenant mechanical equipment, and, if applicable, the most feasible power source. Also, cost studies and an economic feasibility examination must be made. The conceptual phase of preliminary design is the point at which design alternatives and configurations for key elements have been developed but not selected.

- (1) Hydraulic design must be sufficient to select alignment, grade, size, and critical elevations for each evaluated alternative.
- (2) Foundation conditions must be analyzed and the embankments designed in sufficient detail to provide seepage control and stability requirements.
- (3) Structural details of alternate designs are developed sufficiently to prepare reasonable quantity and cost estimates.
- (4) Landscape resource objectives, preliminary landscape resource designs, and preliminary plans are sufficiently developed to determine feasibility and prepare preliminary cost estimates.
- (5) Specifications of material and work requirements are outlined, and a schedule of work and payment items is to be included.
- (6) Cost estimates are determined by estimating construction costs. Alternate designs must be compared according to the average annual cost of installation, operation, and maintenance, including costs of land, easements, rights-of-way, and relocation of roads, utilities, or both.
- (7) A design report is to be compiled to include all information, either directly or in appendices, necessary for a technical review by others. Such review may be internal or by outside organizations.

E. Stage three is the final design, which consists of—

- (1) Checking the adequacy of the surveys and investigations and the accuracy of the layout chosen in the preliminary design.
- (2) Refining and revising the preliminary design information.
- (3) Detailing the layout and hydraulic design.
- (4) Completing the structural design.
- (5) Refining the landscape resources design.
- (6) Preparing the construction drawings, contract specifications, bid schedule, engineer's estimate, and construction schedule.
- (7) Preparing the design report.
- (8) Preparing the operation and maintenance plan.
- (9) Preparing the quality assurance plan.

511.3 Operating Procedures

A. The operating procedures to be followed depend on the organizational level at which the design is done. If the design is done by many offices or by offices that are remote from one another, the need for an established documented procedure is greater. Designs made at field and area offices are usually processed by simple informal procedures.

B. The more complex designs often require technical assistance, peer review, and concurrence by the Director, Conservation Engineering Division (CED). The design may be prepared by—

- (1) The NRCS State engineering staff (field, area, or State office).
- (2) A multistate design team or the National Design, Construction, and Soil Mechanics Center (NDCSMC) using data collected by State staffs.
- (3) The engineering staff of a sponsoring local agency under an agreement for engineering services.
- (4) A private engineer under a contract for engineering services negotiated either by NRCS or the sponsoring local agency.

C. If it is anticipated that the design will require assistance, independent review by the NDCSMC or others, or concurrence by the Director, CED, the State conservation engineer (SCE) must prepare a realistic design and construction schedule. In addition, the SCE develops operating procedures for preparing designs, construction drawings, and specifications and for accomplishing their orderly and timely review and approval (see section 501.4 of this manual). Operating procedures must comply with the following:

- (1) The State engineering staff is responsible for all surveys and investigations.
- (2) The office providing the design assistance, independent review, or concurrence will be consulted at the conceptual phase to provide review and concurrence as needed, before key project elements and configurations have been selected or significant detailed design work has begun. Any significant changes in elements and configurations at later stages of the design must be made in consultation with those providing independent review and concurrence.
- (3) The work must be completed by the State engineering staff if qualified design engineers are available.
- (4) NDCSMC assistance may be requested at any stage in the preparation of the design.
- (5) If designs prepared by local sponsoring agencies or by architect-engineer (A&E) contractors require independent review, the review must include task orders including independent Government estimates (IGE), specifications for engineering services, or agreements covering the work. Performance time must be adequate to permit the necessary review. The State will perform necessary quality assurance of deliverables before submitting for independent review.
- (6) Construction drawings and specifications are prepared concurrently so that they can be properly coordinated.
- (7) Contract specifications must be compiled by the office responsible for the design of the work.

D. Operating procedures for continuity between employees performing site investigations, design, and construction are not complicated for small or simple jobs if the work is prepared at one or two offices. However, if there are several offices and employees involved or segments of the work are prepared by specialists, maintaining continuity is much more difficult. In these more complex operations, coordination and communication must be facilitated between engineers, geologists, and others during stages two and three of design and during construction. This is coordinated by the designer, the soil engineer assisting the geologist in planning and evaluating the site investigation, or both. Field reviews during the investigation may be necessary to ensure all information needed for

the design is obtained. Likewise, the designer arranges for transfer of information to the construction inspection staff. For more complex projects, the design and soil engineers, geologist, construction engineer, and inspector may meet to exchange information. This preconstruction meeting should cover critical interpretation and assumptions dealing with design features and those items that need verification during construction.

511.4 Design Analysis

A. The design analysis defines the scope of the design and evaluates the relationships of the principles that determine the design. It consists of a step-by-step description of the procedures used. Each step must be described concisely and completely.

B. The design analysis must include the data used, criteria, and procedures. The design analysis must be technically sound, performed in a logical manner, and documented.

511.5 Design Checking and Review

A. Checking during design is essential. Checking consists of an examination of the narrative, computations, and drawings for accuracy, conformation with procedures, and consistency between the various parts of the design. The checker must be experienced in the type of design, the criteria, and the procedures. The checker initials each sheet completed and verifies that—

- (1) The basic data were correctly applied and assumptions were applied appropriately and used in the computations.
- (2) Mathematic computations are accurate.
- (3) Details are consistent from sheet to sheet.
- (4) Drawings comply with the design.
- (5) Drawings comply with the specifications.
- (6) Computed critical elevations, costs, and quantities are accurate.
- (7) Construction drawings are complete.

B. Reviews must be made during the design to ensure technical quality. All designs, drawings, and specifications must be reviewed (see part 501 of this manual). Reviews must be made progressively by the responsible design office through an examination of narrative, computations, and drawings. The reviewer assumes responsibility with the designer for the functional adequacy and structural soundness of the structure or structural system. The reviewer's capability must be equal to that needed to do the design. The review must determine that the—

- (1) Design provides for the planned purpose.
- (2) Basic data are adequate.
- (3) Design assumptions are valid.
- (4) Methods of analysis are valid.
- (5) Alternatives evaluated are equal in meeting minimum performance requirements.
- (6) Solution is appropriate to the problem or site condition.
- (7) Design complies with policy and criteria.
- (8) Design is consistent with sound engineering practice.

C. The review procedures as outlined in section 501.05A(3) of this manual depend upon the operating procedures used for class I through VIII jobs. The review procedures for class VI and VII jobs are the responsibility of the SCE. Review procedures for class-VIII jobs are the responsibility of the SCE with concurrence by the Director, CED. The SCE must ensure that the design schedule provides enough time for review by the appropriate authorities at the various design stages. Review

schedules must reflect a realistic consideration of the locations of the reviewing offices, time needed to transmit material, and coordination of the work with the rest of the workload of the offices.

511.6 External Reviews

Consideration must be given to the need for an external review of dams and other engineering structures that, when installed, will become a potential hazard to human life in case of failure. See section 520.26 of this manual for the procedure to be used for dams. When necessary, a similar procedure should be used for other structures.

511.7 Design Criteria

A. Design criteria established by policy directives are often of a general nature. The criteria provide guidance in obtaining the quality of acceptable work. Designs must be prepared to satisfy the functional purpose in a safe and stable manner, which may often result in requiring more restrictive limits than the established minimum criteria. In other words, meeting minimum engineering criteria will not, in all cases, ensure adequate designs.

B. Minimum design criteria established by policy are to be met.

C. Criteria used in preparing project plans are normally used in the design and construction of structural measures. At the time of final design, the individual having the appropriate engineering job approval authority (see section 501.4 of this manual) must reaffirm that all aspects of the engineering plans are legally permissible and that the structure will perform its assigned function in a normal manner during its service life. The design criteria are to be changed from that used in planning if—

- (1) The planned design is not acceptable in light of new engineering knowledge as reflected in the revised criteria. In this situation, the measure must be designed to meet new criteria.
- (2) Downstream development requires a change in structure classification before construction. In this situation, the structure must be reclassified and designed in accordance with the latest criteria.

D. The sponsors or landowners must be informed of changes that increase the cost or require alterations in land rights.

511.8 Construction Drawings and Specifications

A. The preparation of construction drawings and specifications is the final step in the design process. The drawings are a graphical description, and the specifications are the narrative description of the works to be constructed. The construction drawings and specifications provide descriptive information on the quantity and quality of the completed work. The work must be clearly described so that the owner and constructor will understand the requirements. This provides a mutual understanding when the requirements are met.

B. Construction drawings must be prepared and assembled in a clear and logical manner. The minimum requirements are contained in part 541 of this manual.

C. Construction specifications must include both materials and construction methods. The minimum requirements are contained in part 542 of this manual. Requirements must be established in terms of a specified end product.

D. Construction drawings and specifications must be completed and approved prior to commencing of the work, unless directed by the SCE.

Part 511 – Design

Subpart B – Documentation

511.10 Scope

Design folders must be prepared for all designs within approval categories VI, VII, and VIII (see part 501 of this manual) and for all dams that have importance for reasons of public safety (see section 520.21F of this manual).

511.11 Design Folders

A. The design folder contains the design analyses, design report, construction drawings, specifications, bid schedule, performance schedule, inspection plan, and operation and maintenance plan. All notes, computations, drawings, sketches, and other data must be recorded neatly and organized in a manner that allows reproduction and incorporation in reports with a minimum of editing. Design drawings, diagrams, graphs, sketches, or other pictorial representations should be incorporated into the computation file if the size and scale permit. Designs drawn on larger sheets that cannot be folded to computation sheet size must be cited at the appropriate place in the computations by a notation that fully identifies the drawing and its file location. The design documents should be kept in a binder to keep them in order.

- (1) Design records must be kept orderly and current to allow for efficient review at any stage. They must be complete and understandable because they may be used for later actions, such as—
 - (i) Design changes required during construction.
 - (ii) Structural modification or addition during operation or maintenance.
 - (iii) Investigation of performance.
- (2) Design records must completely document the—
 - (i) Data gathered to demonstrate the physical, chemical, and biological conditions at the site.
 - (ii) Purpose and function of works designed.
 - (iii) Standards, criteria, and limitations used as design guidance.
 - (iv) Problem conditions to be considered.
 - (v) Qualitative and quantitative design analysis.

B. Design reports summarize in narrative form the design objective, data, criteria, assumptions, procedures, and decisions used in the design. Selected structure dimensions, elevations, and capacities should be used to augment the narrative, but are not to serve as a replacement.

C. Previously developed requirements established during the planning phase must be included by reference. Design reports may vary in length from a brief synopsis to an extensive review. A design report addresses the topics in the following list, as appropriate. The report contents should be commensurate with the design complexity and significance; some items listed may not be relevant, and if not, need not be included.

- (1) Summary.—A concise statement of the history and status of the design, previous reviews for disposition of applicable policy items, justification for departure from standards, receipt of waivers, etc.
- (2) Description of the Job.—A brief description of the major features, hazard classification, drainage area, storm frequencies, landscape resources, capacities, etc., must be included. Include any variance from project plans.

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- (3) Design Objective.—A brief, clear statement that may be a summary from a project plan. Differences identified from plans must be supported by proper approvals.
- (4) Basis for Design.—A listing of reference documents used in the design, such as handbooks, codes, reports, studies, and criteria.
- (5) General Basic Data.—Hazard analyses, seismic assessment, limiting conditions or restraints that may influence the design, construction, or facility operation.
- (6) Location and Layout.—Consideration of site configuration or landscape conditions that had an effect.
- (7) Hydrology.—The data reference, procedures, spillway operation frequency water yield, reservoir operational studies, and summary of precipitation amount and intensity.
- (8) Hydraulic Design.—A summary of the hydraulic shape and proportioning selected. Include channel stability and sediment transport considerations.
- (9) Foundations, Embankment Design, or Both.—A summary of data, site conditions, assumptions, treatments selected, and design analyses used to—
 - (i) Make seepage analyses and design control measures.
 - (ii) Make stability analyses and determine material quality and quantity.
 - (iii) Make foundation design analyses.
 - (iv) Permit planning instrumentation systems.
- (10) Structural Design.—A summary listing the assumptions, loading conditions, and design procedures.
- (11) Environmental Considerations.—Features or practices to provide for conservation of visual, biological, and surface and ground water resources that may be affected by the planned measures, both during and after construction.
- (12) Construction Drawings.—Mention of standard detail drawings or any use of previously prepared special drawings.
- (13) Specifications.—Mention of special specifications and why they were needed. Explain special conditions or the need for special provisions in the construction contract.
- (14) Bid Schedule.—Give the rationale for selection of lump sum or subsidiary items.
- (15) Cost Estimate.—The considerations used that may be affected by the season or changes in size of contract.
- (16) Construction Schedule.—Explanation of any critical starting, delay, or completion dates.
- (17) Operation and Maintenance (O&M).—Explanation of conditions in which design assumptions depend on proper O&M and significant O&M activities are anticipated (for example, grasses in the emergency spillway to protect against erosion during flow). Items identified and evaluated during the design that are planned for replacement during the evaluation period must be noted and described.
- (18) Construction Review.—A summary of those items, conditions, or features encountered during construction that require a field review by the designer, geologist, soil engineer, or other specialist to ensure that conditions anticipated during the design are verified and consistent with the design assumptions. Include the request for timely notification. Note whether a preconstruction conference is needed.
- (19) Authority.—The name (with signature) and title of the designer and approving officer must appear on the report.

Part 511 – Design

Subpart C – Instrumentation

511.20 General

- A. Structures, including foundations, abutments, and the surrounding area of influence, are instrumented to facilitate evaluation of their condition and performance during and after construction.
- B. Instruments are installed to measure water levels or pore pressures, earth or rock loads and pressures, settlements, deflections or other movements, ground motions during earthquakes, leakage rates or volumes, and other important items relating to safety and performance.
- C. Instruments are used if it is determined that information is needed for determining one or more of the following:
 - (1) Safe rates of earth fill placement
 - (2) If structural strength is adequate for backfill placement or for shoring removal
 - (3) Safe rates or limits of excavation
 - (4) Water levels and pressures within soil and rock formations
 - (5) Seepage rates or volumes
 - (6) Safe rates of reservoir filling
 - (7) The instability of natural or constructed slopes

511.21 Scope

The use of instrumentation must be considered for all high-hazard dams more than 30 feet in height and any dam that has more than 600 acre-feet of storage. Earth dams and other structures with unique or complex foundations, abutment problems, or uncertain soil conditions must also be considered for performance monitoring with instruments.

511.22 Need for Reliable Instruments

Many types of instruments are commercially manufactured or can be assembled to perform the measurements needed. Only instruments proven to be reliable and serviceable may be included. If NRCS lacks experience in the use of an instrument, check with other users to determine its reliability.

511.23 Use of Instrumentation

- A. The decision on whether to monitor with instruments depends on—
 - (1) Reliability and completeness of the investigation information.
 - (2) Whether soil and rock conditions or criteria used in analyses are sufficiently conservative.
 - (3) The consequences of misjudging these items.
- B. In the design folder, document the process by which the decision to instrument or not to instrument was made and the rationale for that decision.
- C. Instrumentation must be used in all situations in which the effects of treatment have any degree of uncertainty that would result in unsafe conditions or an inadequate structure. All safety conditions, including safety to the construction force, must be considered. The design must include the details and specifications for the instruments and their installation.

D. For earth structures, the design analyses must determine the magnitude of water pressure, physical movement, soil pressure, or other measurable items where potentially unstable or undesirable conditions exist. This information must be included in the design report and used in the development of a plan for reading the instruments.

511.24 Instrumentation Plans

A. Instrumentation designs must include a plan that describes the purpose, layout and location, type of instruments to be used, and limits of loading, pressures, movement, or volumes for satisfactory structure performance. The plan must include installation details and sequence. Instructions must be included that indicate the timing and frequency of reading and recording both during and after construction. Special attention must be given to the critical periods in the life of the structure, such as during the first filling, any rapid raising or lowering of water, and after an earthquake or other disturbance. The plan is part of the design documentation and must have the same review and approval as the other design items.

B. As the instruments are installed and reading procedures are started, the instrumentation plan must be adjusted to include procedures for data reporting and reduction or plotting. Forms for recording data may be developed. Individuals responsible for interpreting the results are to be specified. Emergency procedures must be developed that indicate those individuals to be notified when critical readings are approached and steps to be taken if necessary.

C. When the project is completed and the structure is in operation, the plan may need to be supplemented for use by new personnel who will read and evaluate the instruments or for the different operating personnel and conditions. The plan should also include the location and method of data storage.

511.25 Instrumentation Monitoring and Reporting

A. The State Conservationist provides assistance to ensure that the needed monitoring is performed, recorded, and reported. This may be included in the operation and maintenance agreement.

B. An annual report of the monitoring is a summary to update the instrumentation plan. The report is to be made to the State conservation engineer (SCE) until monitoring is terminated. The Director, Conservation Engineering Division (CED), must receive a copy of this report if any unusual readings are reported.

C. The monitoring program may be terminated on completion of the intended purpose with mutual consent of the SCE and the Director, CED, on class-VIII jobs. A completion report must be prepared.

D. A summary of the site condition and structure performance exhibited by the instrumentation readings must be made on termination of the monitoring program. This summary must include an appropriate graphical array of the readings and interpretations or conclusions regarding the performance. Additional conclusions and recommendations for improvement may be made regarding the instrument's location, performance, and installation.

Part 512 – Construction

Subpart A – General Information

512.0 Introduction

Engineering conservation practices and project structures must be installed in accordance with approved drawings and specifications if the practice is to serve its intended purpose and expected service life with anticipated normal operation and maintenance. In order to achieve proper installation, NRCS has standardized construction practices and procedures to promote a common understanding between all parties involved with the design and installation of an engineering practice. Quality assurance (QA) activities are an important part of NRCS standard construction practices.

512.1 Scope

This policy applies to all conservation engineering practices, structures, and systems in every NRCS program for engineering job approval classes I through VIII as defined in part 501 of this manual. QA activities may vary in accordance with complexity and hazard class of the structures. In subparts A and B of this manual, sections 512.03, 512.10, 512.11, 512.12, and 512.14 do not apply to nonproject work (as defined in section 512.02 below).

512.2 Definitions

A. Owner.—The party responsible for contracting for construction. The owner pays the contractor and accepts the completed work. The owner may be NRCS (Federal contract), a contracting local organization (CLO), or a private individual or group.

B. Contract.—A mutually binding legal relationship obligating the seller to furnish the supplies or services (including construction) and the buyer to pay for them. For purposes of this part contracts can be considered to fall within three basic categories:

- (1) Federal Contract.—This contract type is governed by the Federal Acquisition Regulation (FAR) and is administered by NRCS.
- (2) CLO Contract.—This contract is governed by the CLO's contracting regulations amended to include requirements set forth in a project agreement between NRCS and the local sponsor. The local sponsor administers the contract.
- (3) Private Contracts.—This contract is between a private individual or group and a contractor.

C. Contractor.—The individual or firm that performs the construction or installs the project or conservation measure. Contractors are responsible for providing a finished product in accordance with plans and specifications, quality control, and safety. Project sponsors may function as a contractor under provisions that may include division of work, performance of work, or force account.

D. Contracting Officer (CO).—A Federal employee with the authority to enter into, administer, and terminate contracts on behalf of the Government and who may bind the Government only to the extent of the authority delegated to them. COs ensure performance of all necessary actions for effective contracting, ensure compliance with the terms of the contract, and safeguard the interests of their governmental unit in its contractual relationships. COs should request and consider the advice of specialists in audit, law, engineering, information security, transportation, and other fields as appropriate. A CO is required only on Federal contracts. A non-Federal contracting official, similar to a Federal CO, is required for a CLO contract. Other non-Federal contracts may not require a CO;

the owner or someone assigned by the owner has the authority to enter into, administer, and terminate the contract.

E. Project Engineer.—The project representative for the owner who is assigned technical and contract administration duties as outlined in the quality assurance plan (QAP) and, for Federal contracts, in the appointment letter issued by the CO. The project engineer may be an NRCS employee, an employee of an architectural and engineering (A&E) firm under contract with NRCS or a CLO, or an employee of the CLO or partnership agency. The main responsibility of the project engineer is to verify that the construction complies with the plans and specifications.

F. Government Representative (GR).—An NRCS employee responsible for protecting the Government’s interest and maintaining close working relations with the CLO for all construction work performed under contracts administered by a CLO. If the project agreement specifies that NRCS has QA responsibility for a construction contract, then the GR must be an engineer.

G. Contracting Officer’s Representative (COR).—If the project is a Federal contract, a COR may be appointed by the CO. If the procurement activity is related to engineering, construction, or both, then the COR must be an engineer whose primary duties are QA responsibilities, such that the Government’s interests are protected. The NRCS CO will appoint, by letter, a COR for design and construction contracts. The COR may be the project engineer or the project QA inspector.

H. Project QA Inspector.—Responsible for QA testing, engineering surveys, daily documentation of project activities, coordination with the contractor’s quality control personnel, maintenance of the project files, and “as-built” documentation. The NRCS CO will appoint, in writing, project QA inspectors with the qualifications outlined in the QA plan on Federal contracts. The State conservation engineer (SCE) appoints the project QA inspectors if the CLO project agreement states that NRCS will provide QA.

I. Project Work.—Activities in support of work installed under Federal or locally awarded contract and project agreement with a local sponsor as authorized by programs such as the Emergency Watershed Protection (EWP) Program.

J. Nonproject Work.—Activities in support of planning, design, and installation of conservation practices and systems by landowner or group engaged contractors, for which a project agreement is not utilized.

K. Value Engineering Change Proposal (VECP).—A proposal submitted by a contractor under the value engineering (VE) provisions of the FAR that would create acquisition savings for the Government through a change in the project’s plans, designs, or specifications as defined in the contract. The contractor and the Government share the savings if a VECP is accepted. Any proposed change to an engineering structure must be approved by the designer and a person with the appropriate job approval authority.

512.3 Value Engineering

A. Authority

- (1) 48 CFR Parts 48 and 52 describe the policy and procedures for using and administering VE techniques in contracts.
- (2) Office of Management and Budget Circular A-131, “Value Engineering,” requires Federal agencies to use VE as a management tool, where appropriate, to reduce program and acquisition costs.

B. Contractors may use VECP to—

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- (1) Voluntarily suggest design alternatives that may be more economical or less costly to install, where both the owner and contractor would benefit.
- (2) Identify and submit to the Government methods for performing work more economically. FAR, Part 48, “Value Engineering,” provides the terms and conditions. Consideration of any VECP must include the comparison of future costs of operation and maintenance and other costs that may be affected as a result of the change.

C. Contractors must submit VECPs in writing, including supporting computations, drawings, rationale, or some combination of these showing how the requested change will result in both cost savings and a product that is technically equivalent or superior.

D. States’ Responsibilities

- (1) Each State will establish internal guidelines for processing VECPs and procedures for funding the contractor’s share of the collateral savings.
- (2) Approval of VECPs must be reported to the SCE.

E. Written requests for changes to conservation engineering practices proposed by the contractor should be handled similar to a VECP. When the change is technically acceptable (meets NRCS standards and specifications), the decision to accept the change remains with the landowner-operator. NRCS will provide adequate review of the proposal and provide the decision maker with the necessary information to support the acceptance or rejection of the proposal. Any proposed change to an engineering structure must be approved by a person with the appropriate engineering job approval authority.

Part 512 – Construction

Subpart B – Preconstruction Activities

512.10 Selection of the Contractor

Design engineers, project engineers, or both may be asked to contribute their technical expertise in determining the ability of a contractor to perform the project for a sealed-bid project. They may also be asked by the contracting officer (CO) to lead or participate on the technical selection panel for contractor selection on negotiated contracts under the Federal Acquisition Regulation (FAR). The CO is responsible for determining if the offeror is responsible, the submitted proposal is responsive, and the determination of either the offeror providing the best value or establishment of the lowest bid.

512.11 Prebid or Proposal Meeting (Site Showing)

- A. The date and time for all prebid or proposal meetings and site showings must be included in the requests-for-proposals (RFPs) from contractors, regardless of the contractual vehicle used.
- B. The requirements of the bid package must be discussed at the prebid or proposal meeting. The CO and engineer, or their authorized representatives, should chair the meeting for a Federal contract. The project engineer should be present regardless of whether the contract type is contracting local organization (CLO) or private.
- C. Potential offerors will be given the opportunity to tour the project site so that they may inspect the area. Stakes, flagging, or both must be in place at the time of the site showing to identify the major items of work and their relationship to other elements of the proposed project.
- D. If the contract is a Federal contract, the CO must make a written record of all questions asked and any answers given at the prebid or proposal meeting. Engineering staff present at the prebid or proposal meeting must not express opinions as to the difficulty or the ease of performing work elements and must not interpret the contract or contract conditions.
- E. When individual landowners-operators hire a contractor, prebid or proposal meetings for engineering conservation practices may be less formal. The landowner-operator may request that an NRCS employee be present to assist with the site showing. A job diary, conservation assistance notes, or other permanent record will be utilized to document questions and answers and other pertinent items discussed at the showing. NRCS participation in site showings for the installation of engineering conservation practices installed under a private contract is encouraged, especially for projects of high complexity or value.
- F. It is critical that all responses to questions that may affect a contractor's evaluation and potential bid or proposal be shared with all solicitation package holders. This may require a written followup or an amendment to the solicitation, as required by Agriculture Acquisition Regulation (AGAR) 452.237-71. The followup or amendment is the responsibility of the CO for Federal, the CLO contracting official for CLO contracts, and the landowner for private contracts.
- G. The prebid or proposal meeting and site showing must be fully documented, regardless of contract type. The CO must prepare the documentation. The CO's technical representative or Government representative must submit copies of all notes taken at the site showing to the CO. Copies of the documentation must be given to the Federal CO, the CLO contracting official, or to the landowner for private contracts. These individuals issue the formal minutes. Copies of the documentation must be maintained in the project file.

512.12 Evaluation of Bidders

A. Prior to Award.—After the bids or proposals are received, the contractor’s responsibility and the responsiveness of their offer must be evaluated prior to award of a construction contract. The responsibility and responsiveness of the contractor must be determined by the NRCS CO for a Federal contract, the local sponsor’s CO for a CLO contract, and by the landowner for a private contract. NRCS may provide technical assistance (TA) to the local sponsor or landowner-operator in evaluating bidders, but should not make recommendations.

B. Determining the Contract Awardee.—Government agencies have the choice of several contracting methods and contract types, depending on the complexity of the work and the anticipated competition. For example, a contract may be awarded using sealed bids, where the award is made to the bidder whose responsible bid is the most advantageous to the Government, considering only price and the price-related factors, or a negotiated contract, where tradeoffs are made between technical qualifications and price and price-related factors to provide the best value to the Government. Technical qualifications on a best-value acquisition are based on evaluation factors published with the solicitation. Project sponsors with contract administration duties have similar contractual opportunities. Individual owners have similar interests to ensure quality and timely installation of their works of improvement at a reasonable cost. The CO (NRCS or CLO) or the owner determines the contract awardee. The criteria for determining responsiveness and responsibility must be included in the invitation for bid or the request for proposal (if a Federal contract) or in the announcement for a local sponsor or private contract.

C. Documentation.—Any information collected on behalf of the CO that deals with bidder evaluation must be given to the CO for inclusion with their files. Copies should not be maintained in the project file.

512.13 Preconstruction Conference

A. This is usually the first meeting between the owner and contractor following the contract award. Individuals representing the contractor and subcontractors, the owner, major suppliers, and others who will be working together in the execution of the contract should be present. The authorities and responsibilities of these individuals must be jointly understood. The conference will be used to develop a positive working relationship and generate a discussion that centers on the procedures the contractor plans to implement to meet the terms and conditions of the contract.

B. For project work, the preconstruction conference minutes must be recorded. Minutes must be reviewed by the Government attendees and CLO if applicable, finalized, and shared with all participants. Any questions and answers and any interpretations of contract documents provided at the preconstruction conference will be included in the minutes. Any questions that could not be answered by the contract documents (where interpretation is provided) will be addressed and included in the minutes. A contract modification may be necessary if a response affects the length of the contract or a change in the extent of the work or final cost of the contract. The preconstruction conference minutes will be included as part of the project’s permanent record.

C. It is important to review the extent of the work required of the contractor for installing engineering conservation practices under private contracts. Documentation is the responsibility of the owner and can be accomplished through the use of a job diary, conservation assistance notes, other permanent record, sharing in writing of agreed-to action items, or any combination of these. NRCS participation in the preconstruction conference for the installation of engineering conservation practices installed under a private contract is encouraged, especially for projects of high complexity or value. The owner must be involved in any decision that could affect the practice installation, final cost, or both.

512.14 Partnering

A. “Partnering” means a relationship of open communication and close cooperation that involves both Government and contractor personnel working together for the purpose of establishing a mutually beneficial, proactive, cooperative environment to achieve contract objectives and resolve issues and implementing actions, as required. Partnering involves an agreement in principle to share the risks involved in completing a project and to establish and promote a partnership environment. Partnering is not a contractual agreement in itself, does not create any legally enforceable rights, and does not change the responsibility for risks established by the contract. Instead, partnering seeks to create a cooperative attitude in completing Government contracts.

B. Benefits to partnering include the following:

- (1) The establishment of a partnering environment usually leads to higher quality products, completed more quickly, at lower overall costs, and with fewer accidents and litigation.
- (2) The use of partnering is encouraged as it has been shown to reduce the average contract cost, schedule growth, and the number of contract claims and litigation.

C. Partnering should be used on a contract when the CO, in coordination with the project engineer, determines that the benefits to be achieved from its use are expected to be greater than the costs. In determining whether the benefits of partnering are greater than the costs, the following factors should be considered:

- (1) The estimated dollar value of the contract
- (2) The complexity of the work to be performed
- (3) The contemplated length of the contract
- (4) The estimated costs to be incurred in conducting the partnership development and team building initial and followup workshops or meetings

D. The partnership for construction contracts may be established through a facilitated process. The costs to conduct a partnering workshop must be agreed to and shared equally by all parties, with no change in contract price. Accordingly, the contractor will not include costs associated with this partnering effort as part of the bid or proposal price, nor will such costs be allowable under the contract. This partnering effort conveys no legally enforceable rights or duties; any changes to the contract must be made by the CO under the terms of the written contract. The participants should represent all levels of each organization involved with the construction contract. A partnering charter or similar agreement should be developed and shared with all participants.

E. When issues that arise during the contract period are not resolved to the satisfaction of those directly involved at one level, the issues are elevated to the next management level for resolution. Partnering has the potential to expedite the resolution process.

Part 512 – Construction

Subpart C – Evaluation of Construction Materials

512.20 General

A. Quality requirements for construction materials are contained in Title 450, National Handbook of Conservation Practices (NHCP), and Title 210, National Engineering Handbook (NEH). Many of these specifications and standards refer to standards and specifications used in the industry, such as the following:

- (1) ASTM International
- (2) American Association of State Highways and Transportation Officials (AASHTO)
- (3) American Water Works Association (AWWA)
- (4) USA Standards Institute
- (5) American Concrete Institute (ACI)
- (6) Federal Supply Service (FSS)
- (7) Product standards published by the National Bureau of Standards (NBS)
- (8) Others

B. These referenced standards and specifications set forth requirements for material performance, material testing, quality control, and quality assurance.

C. To ensure that construction materials meet job requirements as defined by the plans and specifications, an evaluation of material quality in relation to applicable industry standards, specifications, or both must be made. The nature, time, and place of this evaluation depend on the type of material, specifications, the kind of construction, and other factors that could affect the public's health and safety.

512.21 Evaluation Procedures

A. Material quality will be evaluated by a procedure specified by the design engineer. Evaluation procedures may include laboratory testing, manufacturer certifications, examination at the job site, or prequalification.

B. Incorporation of used materials in systems for which NRCS provides technical or financial assistance is subject to concurrence by the State conservation engineer (SCE), based on the guidelines below, and any other criteria established by the SCE. The owner must pay special attention to used items during operation and maintenance activities. Used materials are acceptable if they meet all of the following requirements:

- (1) Are suitable for the proposed work
- (2) Meet testing requirements
- (3) Have an expected service life equal to or greater than the projected design service life for the overall structure or system
- (4) Are structurally adequate and environmentally acceptable
- (5) Do not increase operations or maintenance costs over the use of new materials

C. Most Federal contracts contain Federal Acquisition Regulation Clause 52.236-5, "Material and Workmanship," which requires that all materials be new.

D. New products that have not been used previously for conservation practice application must be evaluated and approved for use by the SCE before being specified. Trial use of new products must be

under the approval of the SCE and must be supported by industry or applicable standards, specifications, evaluation data, reports, or some combination of these. Reports on the material placement, properties, and durability may be required.

E. SCEs must designate new or used materials that require certification, testing, or both based on the quantity of the items used, the life of the item in relation to the life of structures in which it is used, the cost of the types of structures in which it is used, the difficulty of replacement, and the consequences of failure of the structures in which it is used. Acceptance of a material on the basis of certification is permissible only if the material meets all of the specification requirements.

512.22 Waivers of Material Certifications

NRCS contracts require certification for all materials incorporated in the works of improvement unless specifically waived. Certification may be waived under certain conditions, as determined by the design or project engineer with the concurrence of the SCE or approving authority.

512.23 Prequalification of Materials

A. Prequalification is the evaluation and determination of materials that may be used without further certifications. Prequalification eliminates the need for requesting and furnishing individual certifications and test results for each project or contract. Acceptable materials to consider for prequalification are those items that are manufactured under close quality control and consistently meet the applicable specifications. For small projects, the use of prequalified materials is a viable alternative to ensure material quality.

B. Prequalified materials may be used in NRCS construction by referring to the certification, test data file, or both. When a prequalified item or product is used, its use must be recorded on the as-built drawings, recorded in the job diary, or documented by other suitable methods as determined by the SCE.

C. States have the authority to prepare and maintain a list of materials approved for prequalification when the quantity of materials being used economically justifies its preparation.

D. Many factors affect the quality and acceptability of manufactured products. Prequalified products, materials, or both may require occasional review to ensure minimum quality requirements are current. The SCE determines the review frequency at the time the material is initially placed on the prequalification list.

Part 512 – Construction

Subpart D – Quality Assurance Activities

512.30 General

A. The requirements for construction quality assurance on Federal and non-Federal contracts are outlined in the general and special provisions of the contract and the quality assurance plan (QAP). The construction specifications and contract clauses outline the duties and responsibilities of the contractor's quality control (CQC) program.

B. QA activities may vary in accordance with the complexity and hazard class of the engineering measures being constructed. QAPs will be prepared and included in the design folder during the design phase with input from construction engineers and the State conservation engineer (SCE).

512.31 Definitions

A. Quality Control.—Activities performed by the contractor to document that the work installed meets the minimum requirements of the contract. CQC required by “Construction Specification (CS) 94, Contractor Quality Control” in Title 210, National Engineering Handbook (NEH), Part 642, Chapter 2, may be a bid item if using sealed bids and must be included in any negotiated construction contract.

B. Quality Assurance (QA).—Activities performed by or for the owner, including observing construction methods and procedures, reviewing the CQC testing activities and test results, conducting periodic material testing to evaluate the CQC system, and other measures to ensure compliance with the contract provisions. The duties and responsibilities for this activity are outlined in the QAP for the specific project being installed. NRCS should only perform active QA duties on a CLO contract if NRCS QA is included in the project agreement. Monitoring and surveillance of CQC and QA on a CLO contract must be performed regardless of whether NRCS QA is included in the project agreement.

C. Quality Assurance Plan (QAP).—This plan defines NRCS QA duties. A QAP will outline the technical and administrative expertise required, identify the individuals with that expertise, outline the frequency and timing of technical assistance (TA), estimate the contract completion date, and be approved by all responsible supervisors and the appropriate line officer. QAPs are required on all Federal and CLO contracts.

512.32 QA Procedures

A. States may develop QAP templates for engineering conservation practices with engineering job approval classes I to V. These QAP templates must provide the minimum QA needed for proper installation. The responsible line officer and the responsible technical staff person must review the QAP template to determine the adequacy and availability of the technical resources required. This determination will be evaluated and established prior to practice layout. The line officer must assign this responsibility to the appropriate personnel and provide adequate time to ensure quality installation.

B. QAPs for engineering job classes VI to VIII will be developed per project and will be signed by the SCE and State Conservationist. QAPs will be prepared by the design engineer and supplemented by the SCE who has knowledge of individuals with QA technical skills and are available for appointment for the project. Under no circumstances will certification stating that work has been

accomplished in compliance with the drawings, specifications, and other contract provisions occur without a physical review and documentation of the work performed.

- (1) Continuous QA is required for construction activities where the quality of work cannot be verified by intermittent observations. Continuous inspection is also required for work that cannot be readily removed and replaced if it fails to meet the requirements of the contract.
- (2) Intermittent or periodic QA may be adequate for certain phases of project activities depending on the complexity of the installation and the potential impacts upon the health and welfare of the public.

512.33 Inspection of Materials

A. Construction materials, including prequalified materials, must be inspected as part of the CQC program prior to installation. Documentation of verification of the material certification must be recorded in the project job diary, conservation assistance notes, contract records or on the as-built drawings.

B. NRCS will only perform QA functions at factories, locations of fabrication, or other sources of supply if the SCE determines this to be necessary.

C. QA of materials compliant with specifications or standards may include—

- (1) Field verification of the CQC certification of materials, such as the size, dimensions, standards (ASTM International, American Concrete Institute (ACI), American Water Works Association (AWWA)), other standards and specifications, or some combination of these.
- (2) Verification of material sampling and testing and specification compliance submitted by the contractor.

Part 512 – Construction

Subpart E – Equipment, Records, and Coordination

512.40 Engineering Equipment

A. Each State conservation engineer (SCE) must develop a list of engineering equipment that will be permanently assigned to each field or technical service office. Procedures must be established to ensure that all engineering equipment is periodically inspected for accuracy and serviceability (see Part 544, “Equipment” of this manual).

B. Specialty equipment may only be assigned to qualified individuals with the necessary skills and approvals to operate and maintain the equipment. This requirement includes, but is not limited to, survey-grade geospatial positioning system (GPS) survey equipment and portable nuclear gauges. Under the Nuclear Regulatory Commission license to USDA, nuclear gauge users are required to be qualified and have permits. The USDA entity responsible for nuclear safety is the Radiation Safety Division. Qualifications and permit requirements and other information can be found on their Web site at <https://www.dm.usda.gov/ohsec/rsd/index.htm>.

512.41 Records

A. Job Diary.—A job diary must be maintained to document the daily activities of contracts utilized to install conservation engineering practices or project elements and for all engineering job classes VI to VIII practices and projects. On engineering job approval classes I to V, details must be recorded in either the job diary or conservation assistance notes, hereafter referred to as a job diary.

- (1) The level of detail recorded directly corresponds to the complexity of the work and potential impacts upon public health and safety, and must be thorough enough to show that all aspects of the completed project meet the specifications or standards.
- (2) The SCE, contracting officer (CO), Government representative, or CO’s technical representative, individually or jointly, will determine which quality assurance (QA) personnel will maintain a job diary to record the progress and other elements of the project.
- (3) It may be beneficial on projects where construction activity is occurring at more than one location to have more than one diary to ensure important information is recorded. The job diary serves as a source of factual data related to the contractor’s performance in both quantity and quality.

B. Photographs.—The job diary must be supplemented with photographs to detail site conditions, quality of work, etc. Photographs may be digital or film, and should be clearly labeled with the date, project, and item being viewed.

C. Construction contracts that include Construction Specification (CS) 94, “Contractor Quality Control” (CQC), found in Title 210, National Engineering Handbook (NEH), Part 642, Chapter 2, will include specific testing and documentation and other requirements for the contractor.

512.42 Coordination Between Disciplines

A. The engineer or the technician responsible for onsite QA, or both, must ensure that items in the design report are addressed, and all recommended testing and examinations are properly completed as outlined in the QA plan. QA personnel must understand the design report and recognize potential variations during the construction phase. When variations from the design are detected on a Federal contract, the CO must be notified of the potential for a change. After notifying the CO, any design-

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related changes in the work must be reviewed and concurred with by the designer and an individual with appropriate job approval authority. The appropriate disciplines necessary to review potential variations must be contacted as early as possible to minimize delays in the performance of the work.

B. On contracting local organization (CLO) and private contracts where variations from design requirements or standards is noted, the NRCS personnel must inform the CLO or landowner and the appropriate line officer, as well as document the variations in the job diary or conservation assistance notes. The design engineer must also be notified.

C. On smaller projects (classes I–V), the QA process may be less rigorous. However, changes must meet the following requirements:

- (1) All parties involved must be aware of and concur with any changes prior to formalization as a modification.
- (2) Contract and program requirements continue to be satisfied.
- (3) The function of the project or practice being installed must not be impaired.

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Subpart F – As-Builts

512.50 General

- A. “As-builts” are a set of drawings and specifications that depict the actual as-built conditions of the completed construction and provide the owner with a permanent record of each project feature. As-built drawings and specifications are also known as “redlined” or “record” drawings and specifications. These drawings and specifications are important in providing critical information for those physical features of the structure that are not visible following completion of the project installation. Note that the term “as-built drawings” refers to all plans and specifications that have been altered during construction.
- B. As-builts may be prepared by the project engineer or by an architect-engineer (A&E) firm, if applicable. If the A&E firm is responsible for preparing as-builts, the A&E’s working set of as-builts must be reviewed at least monthly by the project engineer, until completion of the final as-builts.
- C. All changes (no matter how minor) and clarifications are entered on the as-built documents. Changes and clarifications refer to shop drawings, field engineering change proposals, change orders, modifications, and requests for information that have been reviewed and approved by the Government.

512.51 Scope

- A. As-built drawings must be prepared for all major (classes VI to VIII) structural works of improvement and for all inventory size dams. As-built drawings must also be prepared for any engineering job approval class structures when any of the following apply:
- (1) Another government entity or agency requires as-built plans (for example, statewide utility notification system for buried pipes).
 - (2) The final installed plans are required to properly locate structural features and perform operation and maintenance (for example, pipeline system where the as-built shows the final location of valves, drains, and pipe sizes).
 - (3) Future plans could include additions to the present structure, adaptations, or both (for example, plans include the extension of the pipeline system).
- B. As-built drawings for structures in the engineering job classes I to V will be prepared as determined by the State conservation engineer (SCE).

512.52 Documentation

- A. Recording Changes.—All changes during construction must be recorded on the drawings or in the specifications to indicate as-built conditions. The SCE must outline procedures for supplementing the design report to include analysis and supporting data. If a structure is altered at any time following initial completion, the as-built plans must be retrieved and revised to indicate the alterations. After the drawings have been revised to include the additions and modifications, updated as-built plans will be redistributed to the same offices or entities as the original as-built plans.
- B. Labeling.—Each sheet of the completed as-built drawings must be clearly identified as “AS-BUILT.” The title sheet of the drawings must list the contractor, contract number, construction completion date, names of the Government quality assurance (QA) inspectors, and final amount of

the contract. The title sheet must also contain the name of the Government representative (GR) or contracting officer's representative (COR) and his or her signature to certify that all work under the contract was installed in accordance with the as-built drawings and specifications and that the as-built documents are a true and correct record. Similarly, if construction oversight and QA is provided by an A&E firm, the title sheet must include all of the information listed above, the name and address of the firm, and the name and contact information for the firm's president.

C. Checking.—Following construction, the as-built plans must be certified complete by the COR, project engineer, GR, or A&E engineer of record. The certifying individual must initial each sheet of the drawings and sign the title sheet. The as-built drawings must be submitted to the NRCS office that has the technical responsibility for the project work and be available for future reference.

D. Reproduction.—After NRCS review and approval, these marked-up drawings may be digitized in a noneditable format. Paper copies, electronic copies, or both will be transferred to each sponsor or owner of the project, the local NRCS office that had responsibility for the project, the State office, and other outside governmental agencies requiring documentation. Follow Title 120, General Manual (GM), Part 408, Subpart D, Section 408.63, for transferal of copies of the as-built plans and specifications.

E. Operation and maintenance information, including shop drawings for equipment that was installed for the project, practice, or both must be included with the as-built drawings for the sponsors, owner, or operator. It is recommended that operation and maintenance information also be available in electronic format, if possible.

F. As-builts prepared for conservation engineering practices, when required under section 512.51 of this subpart, must be maintained at the local NRCS office and may be provided to the landowner-operator following completion and acceptance of the work.

512.53 Disposition

For the disposition of as-built files, see 120-GM, Part 408, Subpart D, Section 408.63, under file code 210-12-11.

Part 512 – Construction

Subpart G – Safety

512.60 General

Safety is a major concern for all parties on a construction site, including contractor, subcontractor, NRCS personnel. NRCS is required to furnish a place of employment free from recognized hazards that cause or are likely to cause death or serious physical harm.

512.61 Personal Protective Equipment (PPE)

All NRCS personnel on a construction site must be issued a hard hat and high-visibility vest. Each State determines policy concerning the provision of other PPE, such as steel-toed shoes and hearing and eye protection, in accordance with Occupational Safety and Health Administration (OSHA) rules and the anticipated safety hazards. It is the employee's responsibility to comply with safety and occupational health requirements, wear prescribed safety and health equipment, report unsafe conditions or activities, prevent avoidable accidents, and work in a safe manner. Employees must not place themselves into a work environment that requires PPE without the necessary safety equipment. Visitors to a construction site must be temporarily issued a hard hat and high-visibility vest at a minimum.

512.62 Training

A minimum of 4 hours of safety training must be completed every 2 years for all NRCS personnel working on a construction site for engineering job classes VI to VIII. The State conservation engineer (SCE) may increase this requirement at their discretion. Options for safety training may include OSHA safety training courses (10-hour or 30-hour), instructor-led safety training (in-house or commercial), online, or webinar safety training courses. A self-study plan approved by the SCE may also count toward this requirement. The OSHA safety training courses are generally available as distance learning (online) and may also be applied to the maintenance training requirements for contracting officer's representatives' certification renewal. NRCS has produced several webinars directed toward construction safety. They can be found online by searching for "OSHA" on the Science and Technology Training Library at <http://conservationwebinars.net/>.

Part 520 – Soil and Water Resource Development

Subpart A – Erosion and Sediment Control

520.0 General

A. Effective erosion and sediment control requires a comprehensive system of engineering and cultural practices applied to the land for the specific purpose of controlling erosion and preventing excessive sediment accumulation. Federal, Tribal and State laws, rules, regulations, and Executive orders emphasize the need to conserve natural resources and to improve the quality of the environment. Erosion and sediment control systems address this need. Landowners, project sponsors, and other partners often request technical assistance from NRCS for planning, design, and construction of erosion and sediment control systems.

520.1 Minimizing Erosion and Sediment during Construction

A. NRCS uses practices and techniques to minimize erosion and sediment for construction operations carried out under all programs. Determine the need for sediment abatement for each site by evaluating the sediment hazard and its relation to the sediment tolerance or standard for the area in question. Conduct a review of State and local standards, established in response to the Federal Water Pollution Control Act (the Clean Water Act, as amended), when determining the control necessary for special sites.

B. Include sediment control measures as a part of all engineering plans prepared by NRCS and all construction operations administered by NRCS.

C. Include sediment control measures as a part of all construction operations administered by local organizations for which NRCS provides the engineering design, installation services, or financial assistance.

D. Clearly outline requirements for erosion and sediment control measures in construction contracts. NRCS designs typically include these requirements in the items of work and construction details section.

E. To reduce risks associated with erosion and sediment during construction, prepare plans and specifications to minimize the area of disturbance and duration of exposure of erodible soils. Additional measures include temporary vegetation of disturbed soil, completing work as rapidly as construction schedules allow, installing measures to mechanically retard the rate of runoff, installing sediment traps, minimizing dust on site and on haul roads, installing temporary bridges or culverts, and scheduling construction to avoid periods of inclement weather.

Part 520 – Soil and Water Resource Development

Subpart B – Floodplain Management

520.10 General

Floodplain management is essential in the development of plans to reduce flood damages and requires the application of sound engineering principles.

520.11 Scope

Floodplain management includes structural and nonstructural measures to reduce flood damages and is subject to the rules and regulations in 7 CFR Section 650.25.

520.12 Description

- A. Floodplain management is a tool for reducing flood damage, protecting human safety, health, and welfare; preserving and restoring important environmental values; and ensuring the risk of floodplain use is compatible with the degree of flooding expected. A floodplain management system avoids direct or indirect development in the floodplain if there is a feasible alternative.
- B. There are two methods for meeting floodplain management goals: those for “people control” that reduce the effect of and susceptibility to flooding and those for “flood control” that reduce the amount of flooding.

520.13 Types of Measures

- A. This subpart does not include well-understood structural measures, such as dams, channels, and diversions, used to control and modify floodwater flows.
- B. Nonstructural measures include—
 - (1) Acquisition, including purchase in fee title or suitable easements, to preclude future uses incompatible with the expected degree of flooding or setting time limits for use of inhabitable buildings.
 - (2) Relocation of residential, commercial, industrial, and other buildings to flood-free areas to reduce or prevent flood damages.
 - (3) Regulation, including actions by local government entities through zoning, building codes, etc., to ensure land use compatibility with the expected degree of flooding. Regulation often applies to a floodway, which is the part of the floodplain that can contain a flood without causing an excessive increase in the elevation of the water surface. This increase is usually 1 foot, but some communities set a lower limit. The flood fringe is the area of the floodplain below the increased elevation (as defined above) and outside the floodway. The floodway is to remain unobstructed. Development may be allowed in the flood fringe if structures are elevated above the area of flooding. In these areas, consider the need for ingress and egress as well as the possibility of larger floods.
 - (4) Floodproofing consists of modifications of existing structures, their sites, and building contents to reduce the probability and adverse effects of water entry.
 - (5) Flood warning systems and emergency action plans provide information on the time of occurrence and magnitude of flooding to be expected. Features include, but are not limited to, visual observations, stage recorders in streams, precipitation gages in the uplands,

- continuous or periodic rainfall and/or streamflow data collection, manual or automatic relay systems, flood warning markers, etc. The degree of sophistication varies with the needs of the local community and the hydrologic characteristics of the area. Integrate flood warning with the emergency action plan compatible with local situations. It is desirable to provide a warning time of several hours—perhaps 10 to 12 hours. However, if only a 1- or 2-hour warning is possible, give due consideration to short warning times in implementing the emergency plan.
- (6) Information and education are essential to any floodplain management system. The development of needed technical information and its dissemination to the public, especially local government officials, planners, and affected landowners, are essential. Included are flood-warning markers designating flood-prone areas to increase recognition of hazards. Where possible, reference these to historic floods, frequency of historic floods, and/or the floodway location.
 - (7) Flood insurance is a method of spreading economic loss over time and among a relatively large number of people. It does not directly reduce damage. The Department of Homeland Security's Federal Emergency Management Administration administers the National Flood Insurance Program.
 - (8) Flood emergency measures include contingency and emergency floodproofing completed in anticipation of flooding. One of the functions of overall flood plain management is to reduce the need for emergency action.

520.14 Risk to Life and Property

Consider the risk to human life and property in evaluating various floodplain management alternatives. Although risk is difficult to measure, there are certain physical parameters useful for assessing the potential risk for individual structures.

- (1) Frequency of flooding defines the probability of occurrence. The 100-year frequency flood (1 percent chance in any 1 year) is the minimum acceptable if there is risk to human life. For certain critical facilities, such as hospitals, schools, nursing homes, utilities, and facilities for producing or storing volatile, toxic, or water-reactive materials, regulations require considering the effects of the 500-year frequency flood.
- (2) Depth of flooding is a crucial factor. In some areas, depths of from 1 to 3 feet are not considered hazardous to life.
- (3) Estimated warning time for evacuation may be significant.
- (4) Consider velocities either along with or in combination with depth and other parameters.
- (5) In general, combinations of depth (in feet) and velocity (in feet per second) are indicators of risk. Products of 4 or greater are often used as a limit for "people safety" and values of 15 or 20 for "structural safety."
- (6) Duration of flooding is a significant factor for some agricultural crops.
- (7) Other factors are also available to evaluate risk.

Part 520 – Soil and Water Resource Development

Subpart C – Dams

520.20 General

- A. Dams are essential to soil and water resource development. To ensure safety, dams need controls to protect life and property.
- B. NRCS requires uniform, high-quality standards in the planning, design, and construction of dams to ensure consistently safe and efficient performance.

520.21 Definition and Classes

- A. As used in this manual, a dam is an artificial barrier, together with any associated spillways and appurtenant works, that impounds, may impound, or diverts water.
- B. Storage is the capacity of the reservoir, in acre-feet, below the elevation of the crest of the lowest auxiliary spillway or below the elevation of the top of the dam if there is no open channel auxiliary spillway.
- C. Overall height is the difference in elevation in feet between the top of the dam and the lowest elevation at the downstream toe.
- D. Effective height is the difference in elevation, in feet, between the lowest open channel auxiliary spillway crest and the lowest point in the original cross section on the centerline of the dam. If there is no open channel auxiliary spillway, the top of the dam becomes the upper limit.
- E. NRCS classifies dams according to the potential hazard to life and property if the dam should suddenly breach or fail. Dam classification requires consideration of existing and future downstream development, including controls for future development. The potential hazard from failure determines the classification of a dam as follows.
 - (1) Low Hazard Potential.—Dams in rural or agricultural areas where failure may damage farm buildings, agricultural land, or township and country roads.
 - (2) Significant Hazard Potential.—Dams in predominantly rural or agricultural areas where failure may damage isolated homes, main highways, or minor railroads, or interrupt service of relatively important public utilities.
 - (3) High Hazard Potential.—Dams where failure may cause loss of life or serious damage to homes, industrial or commercial buildings, important public utilities, main highways, or railroads.
- F. Some dams have greater significance than others because of their potential to affect public safety. Although the public's concern for safety of dams often corresponds with the size of the dam and reservoir, small dams may also present a hazard. In addition, while some dams initially may present no hazard in terms of loss of human life, their degree of hazard can change because of downstream development. Because of this and the need to manage an overall NRCS program for dam safety, the Director, Conservation Engineering Division (CED), must maintain a national inventory of NRCS-assisted dams. Each State conservation engineer (SCE) must maintain the State inventory. NRCS considers dams meeting any of the following criteria as NRCS inventory dams:
 - (1) All significant and high hazard potential dams.
 - (2) Low hazard potential dams more than 6 feet in National Inventory of Dams (NID) height and with an NID storage of 50 acre-feet or more.

- (3) Low hazard potential dams with an NID height of 25 feet or more and an NID storage of more than 15 acre-feet.

G. For the purposes of the NRCS inventory, U.S. Army Corps of Engineers (USACE) definitions apply as follows:

- (1) Dam Height.—The vertical distance between the lowest point on the crest of the dam and the lowest point in the original streambed. Height of the dam is expressed in feet and rounded to the nearest foot.
- (2) Structural Height.—The vertical distance from the lowest point of the excavated foundation to the top of the dam. Top of dam refers to the parapet wall and not the crest. Structural height is expressed in feet and rounded to the nearest foot.
- (3) Hydraulic Height.—The vertical difference between the maximum design water level and the lowest point in the original streambed. Hydraulic height is expressed in feet and rounded to the nearest foot.
- (4) NID Height.—Maximum value of dam height, structural height, and hydraulic height.
- (5) Maximum Storage.—The total storage space in a reservoir below the maximum attainable water surface elevation, including any surcharge storage. Maximum storage is expressed in acre-feet.
- (6) Normal Storage.—The total storage space in a reservoir below the normal retention level, including dead and inactive storage and excluding any flood control or surcharge storage. Normal storage is expressed in acre-feet.
- (7) NID Storage.—Maximum value of normal storage and maximum storage.

H. NRCS must keep the NRCS inventory of dams current and accurate. SCEs are responsible for maintaining all inventory fields and updating the hazard classification of each project dam as required in Title 180, National Operations and Maintenance Manual (NOMM).

I. States must use the Web-based application GeoObserver for Dams to maintain the NRCS inventory of dams. User Guide 210-14-6, “GeoObserver for Dams,” contains instructions for accessing GeoObserver for Dams.

J. The Director, CED, provides each SCE, and may provide other employees selected by the SCE, permission to access GeoObserver for Dams to edit the inventory in their State. The Director, CED may provide other NRCS employees the necessary permission to access GeoObserver for Dams to view all or portions of the NRCS inventory of dams.

K. Because the NRCS inventory of dams contains sensitive data, and data intended for agency use only, NRCS limits access. The Director, CED, submits portions of the data as required by law, to USACE for inclusion in the NID. USACE provides public access to portions of the NID. As needed, the Director, CED will provide USACE the names of NRCS employees requesting access to nonpublic portions of the NID.

520.22 Design Criteria

A. Low hazard potential earth dams with a product of storage times the effective height of the dam of less than 3,000 acre ft² and with an effective height of the dam of 35 feet or less must meet or exceed the requirements of Conservation Practice Standard (CPS) Pond (Code 378).

B. Low hazard potential earth dams whose product of storage times the effective height of the dam is 3,000 acre ft² or more, those more than 35 feet in effective height, and all significant hazard potential and high hazard potential dams must meet or exceed the requirements of Technical Release (TR) 210-60, “Earth Dams and Reservoirs.”

C. Dams of materials other than earth must comply with the applicable portions of CPS Pond (Code 378) and TR 60. Other features must meet or exceed the requirements as stated in other applicable NRCS standards.

520.23 Classification

A. Classification of dams is determined at the time of inventory and evaluation and verified immediately prior to construction. The person having the appropriate engineering job approval authority (section 501.4 of this manual) is responsible for the classification.

B. Documentation of the classification of dams is required. Documentation must include but is not limited to location and description of the dam, configuration of the valley, description of existing development (houses, utilities, highways, railroads, farm or commercial buildings, and other pertinent improvements), potential for future development, recommended classification, and signatures of those performing and concurring in the classification. When using breach routings as part of the classification process, documentation must also include results obtained from the breach routings.

C. If there are indications that any existing dam is misclassified, including changes resulting from downstream development, proposals for reclassification must be submitted to the SCE for action. If the SCE approves, NRCS officially reclassifies the dam. When this occurs, the SCE must document the case file, make proper notification, and update the inventory of NRCS assisted dams.

520.24 Special Considerations

A. Criteria in addition to the requirements in CPS Pond (Code 378) and TR 60 apply for some dams.

- (1) Dams in series, dams with drainage areas of more than 10-square miles, and dams located in regions of high earthquake hazard require special considerations.
- (2) Design low hazard potential dams for municipal or industrial water supplies with minimum criteria equivalent to criteria used for significant hazard potential dams.
- (3) Do not construct high hazard potential dams and those with permanent storage over an active fault without the concurrence of the Director, CED.

B. Local experience, State laws and regulations, site conditions, or other special features may require the use of more stringent criteria to ensure a satisfactory dam.

520.25 Clearing Reservoirs

A. Clear reservoir areas to facilitate the movement of water, to provide for the proper functioning of outlets and spillways, to provide convenient access to dams and related structures for operation and maintenance, and to comply with State and local laws and regulations.

B. Use the following minimum standards to determine the clearing required for reservoir areas:

- (1) Dry Dams.—Minimum requirements include—
 - (i) Clear reservoir areas for a distance of 200 feet upstream from the principal spillway inlet, except that no clearing is necessary above the elevation of the top of the inlet.
 - (ii) Clear areas immediately upstream from auxiliary spillways to the extent required to permit spillways to function properly.
- (2) Dams That Retain Water in a Reservoir.—This includes dams with space allocated for sediment storage and dams that provide water storage for beneficial use. Minimum requirements include—
 - (i) Clear reservoir areas at least up to the elevation of the crest of the lowest ungated principal spillway inlet.

- (ii) Consider allowing less clearing for a specific site if the structure incorporates fish and wildlife features and the sponsor or owner requests that the area not be cleared, or if the cost of clearing is disproportionate to the other costs of the structure and lack of clearing will not interfere with the functioning of the reservoir. The minimum area cleared must extend the full length of the dam for a distance of 400 feet upstream from the principal spillway and include the area upstream from the auxiliary spillway to the extent required for it to function properly. The operation and maintenance plan must include specific procedures addressing the potential for debris on the upstream slope of the dam and around the principal spillway.

520.26 External Reviews for Dam Safety

A. Definition of an External Review.—An external review is an examination and evaluation of procedures used and decisions made during the design and construction of a dam by peers from outside NRCS or from an organizational unit other than the one responsible for the design and construction. Section 511.2 of this manual provides the meaning of “design” used here.

B. Purpose of an External Review.—External reviews ensure that design and construction procedures and decisions reflect safety considerations and economy. The reviewer must determine whether the methods of analyses are appropriate and the assumptions are justified by the site conditions and whether the results are reasonable. An external review is not a substitute for expertise needed during design and construction.

C. Design Review.—Perform design reviews as established in section 511.5 of this manual. Perform independent reviews for quality assurance as established in section 501.5 of this manual. An independent review may only be considered an external review if the office performing the independent review had little or no role in the design.

D. Determination of Need for an External Review.—The SCE must evaluate all dams proposed for construction, modification, or repair to determine the need for an external review. The SCE must determine the need for an external review during preliminary design (see section 511.2C of this manual). For project structures, the SCE must determine the need for an external review during planning.

- (1) For high hazard potential dams, factors to consider include the level of risk, size of the dam, reservoir volume, complexity of site geology, complexity and margin of safety reflected by the design layout and construction methods, and other unique condition or complexity noted during planning, design, or construction.
- (2) To determine the need for an external review for all other dams, consider site complexity, unique design features, or other special conditions requiring special expertise.

E. Procedure for Establishing an External Review

- (1) The SCE and the Director, CED, on class-VIII jobs will make a joint recommendation to the State Conservationist on the need for an external review. The recommendation must be supported by a justification statement and include a brief description of the site, the proposed structure layout, composition of technical specialists making up the review team, and other essential data. This becomes part of the design folder. The initiation of an external review may occur at any stage of the design or construction process.
- (2) The State Conservationist is responsible for implementing the external review and advising the Director, CED, of the plan to conduct the external review.
- (3) When recommending an external review, the State Conservationist must request a list of employees and others qualified to make the review from the Director, CED.

- (4) The State Conservationist makes the necessary arrangements for appointing the review board and assigning their responsibilities. If the board is composed of more than one member, the State Conservationist must designate a chairperson.
- (5) The State Conservationist must permit the review board to make reviews at the times they determine necessary. The review assignment must require evaluation until construction is completed.

520.27 Emergency Action Plans – High Hazard Potential Dams

A. Applicability.—An emergency action plan must be prepared for each high hazard potential dam for which NRCS provides technical or financial assistance. The State Conservationist must ensure that an emergency action plan is prepared prior to the initiation of construction.

B. Inundation Maps.—SCEs provide appropriate inundation maps needed for emergency action plans. These maps define areas that would be affected in an emergency and provide other appropriate information. The inundation areas to be delineated on the maps must show the following:

- (1) Outflow from routing the auxiliary spillway hydrograph (or larger hydrograph) through the spillways and downstream.
- (2) Discharge due to a sudden breach of the dam. Unless otherwise determined by the SCE, the conditions at the time of breach may be water level in the reservoir at or above the crest elevation of the lowest open channel auxiliary spillway and “nonstorm” conditions downstream of the dam.
 - (i) For dams in series, make an evaluation to determine whether the breach of an upstream dam would endanger a downstream dam. If the upstream breach endangers a downstream dam, base the breach inundation map on multiple failures.
 - (ii) For dams not in series affecting a common downstream area, it is usually adequate to consider the failure of each dam individually unless circumstances would warrant analysis of multiple failures.

520.28 Potential Impact Area – Low Hazard Potential Dams of Inventory Size and All Significant Hazard Potential Dams

A. Applicability.—For each low hazard potential dam of inventory size and each significant hazard potential dam, determine the potential inundation area in event of a breach. Complete this as part of the hazard classification (section 520.21E) and its documentation (section 520.23B of this subpart).

B. Requirements

- (1) The potential impact area may be determined by performing breach routings or by other methods.
- (2) Clearly describe the potential impact area by the use of maps, narrative description, or both. In addition to the description of the area, precautions outlining the desire to exclude future development within the impact area must be included. These precautions may be specific (e.g., if based on breach inundation studies) or may point out the need for breach routings in the future if development is ever considered. The landowner or sponsor should be made aware of the potential impact area as early as practicable and before expending significant resources in design.

C. Distribution

- (1) As early as practicable prior to the initiation of construction, the State Conservationist must officially transmit the description of the potential impact area and precautions on

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- development to the owner or sponsor. It is the responsibility of the owner or sponsor to transmit the description of the potential impact area and precautions on development to—
- (i) The local land-use control agency or county.
 - (ii) The State agency responsible for dam safety.
 - (iii) The conservation districts and others, as appropriate.
- (2) If requested by the owner or sponsor, or if the owner or sponsor fails to act, the State Conservationist must make the specified notification.

Part 522 – Snow Survey and Water Supply Forecasting

522.0 Reservoir Operations Guides

A. Selecting appropriate storage levels and average release rates for reservoirs in snowmelt runoff environments is a prerequisite to sound water management. A number of impoundments, operated for single- or multiple-purpose use in the United States, lack adequate management tools to guide this process each year. Seasonal volume forecasts improve water management at these reservoirs.

B. Reservoir operations guides are decision support tools to help reservoir operators manage their facilities by using streamflow forecasts. Reservoir operations guides provide a means to optimize water use while minimizing flood damages. This policy has been developed to ensure that operation guides are technically sound and meet the operator's needs.

522.1 Authority and Request for Assistance

A reservoir operations guide may be prepared for any reservoir upon receipt of a written request from the reservoir operator or owner. Requests must be reviewed by the soil and water conservation district before forwarding to the State Conservationist for approval.

522.2 Responsibility

A. Upon receipt of a request, a determination of feasibility and desirability of preparing a reservoir operations guide will be made jointly by the State conservation engineer (SCE) and the water supply specialist or the data collection office supervisor. Their concurrence is required before proceeding with the development of the reservoir operations guide.

B. For federally owned, operated, or funded structures, it is essential that full agreement on the feasibility and desirability of developing a reservoir operations guide be reached between the Federal agency (non-NRCS), the sponsor or land user, and NRCS.

522.3 NRCS Technical Review

The SCE and the National Water and Climate Center will be actively involved in the development and review of the reservoir operations guide. A copy of the reservoir operations guide must be sent to the State agency responsible for administering dam regulations during the NRCS review process.

522.4 Reservoir Operations Guide Review

For the first 3 years after the reservoir operations guide is implemented, there will be an annual review by the SCE to determine its effectiveness as a management tool. After the first 3 years, the frequency of review must be reevaluated to determine an appropriate review frequency.

Part 523 – Irrigation

523.0 General

- A. Agricultural irrigation is the application of water to land for purposes of sustained crop production.
- (1) In arid regions, irrigation provides the majority of crop water requirements.
 - (2) In humid areas, it is used to supplement natural rainfall for periods of drought or to ensure crop productivity.
- B. As part of an agricultural water management system, irrigation requires careful planning, design, construction, and operation. Properly designed system components will facilitate the effective management of irrigation water supplies, to maximize production while minimizing degradation of water quality, water consumption, and energy use.

523.1 Scope

- A. Each State Conservationist must prepare a State irrigation guide, setting forth the basic design and management criteria for all irrigation methods applicable to local combinations of crops, soils, topography, water supply, water quality, and climatic conditions. As a minimum, a State may use Title 210, National Engineering Handbook, Part 652, “Irrigation Guide” with State supplements, as appropriate.
- B. State Conservationists may assign leadership responsibility to a staff member for irrigation guide development and updates. Although NRCS has the technical responsibility for preparing the irrigation guide, cooperation from partners, such as representatives from State agencies, State universities, State experiment stations, the Cooperative Extension Service, and the Agricultural Research Service, is desirable.

Part 524 – Drainage

524.0 General

A. Agricultural drainage is the collection and removal of excess surface or subsurface water from agricultural land.

- (1) In humid areas, its dominant purpose is to remove excess soil water, allow the timely movement of field equipment, warm soils early in the season, provide adequate aeration for root activity and plant growth, reduce diseases in crops and livestock, and reduce surface runoff. Benefits include reduced risk in farming, higher yields, and better quality crops.
- (2) In arid regions where land is irrigated, the dominant purpose of drainage is to remove salts from the root zone.

B. As part of an agricultural water management system, drainage requires careful planning, design, construction, and operation. Properly designed system components will facilitate the effective management of soil moisture to maximize benefits to the land while minimizing negative impacts to the environment.

524.1 Scope

A. Each State Conservationist must prepare a State drainage guide to set forth the basic design and management criteria for all drainage methods applicable to local combinations of crops, soils, topography, water quality, and climatic conditions. As a minimum, a State may use one or a combination of NRCS drainage handbooks, namely—

- (1) Title 210, National Engineering Handbook (NEH), Section 16, “Drainage of Agricultural Land.”
- (2) 210-NEH, Part 624, Chapter 10, “Water Table Control.”
- (3) 210-NEH, Part 650, “Water Management-Drainage,” with State supplements as appropriate.

B. State Conservationists may assign leadership responsibility to a staff member for drainage guide development and updates. Although NRCS has the technical responsibility for preparing the drainage guide, cooperation from partners, such as representatives from State agencies, State universities, State experiment stations, the Cooperative Extension Service, and the Agricultural Research Service, is desirable.

Part 530 – Hydrology

Subpart A – Hydrologic Investigations

530.0 General

Hydrologic investigations and analyses are essential for determining the location, quantity, timing, and availability of water resources in the planning and design of water-related structures and projects and for project monitoring and evaluation. Hydrologic investigations and analyses rely on available hydrologic data, such as volumes and rates of stream flow; meteorological data, such as precipitation rates and amounts; and watershed characteristics. Collectively, these are referred to as hydrometeorological data. If existing hydrometeorological data are inadequate, the installation of instruments for the collection of data may be necessary.

530.1 Available Hydrometeorological Information

A. Use the most current existing hydrometeorological data for planning, design, and operation of water-related structures and systems. Hydrometeorological data sources include—

- (1) NRCS National Water and Climate Center (NWCC).
- (2) U.S. Geological Survey (USGS).
- (3) National Oceanic and Atmospheric Administration (NOAA).
 - (i) National Weather Service (NWS)
 - (ii) National Centers for Environmental Information (NCEI), formerly the National Climatic Data Center (NCDC)
- (4) Regional climate centers (RCCs).
- (5) State climatologists.
- (6) USDA sister agencies.
 - (i) Agricultural Research Service (ARS)
 - (ii) Forest Service (FS)
- (7) Other Federal, State, and local agencies with planning responsibilities for water-related projects, operational responsibilities, or both.

B. Various watershed and floodplain reports found in the libraries of Federal agencies involved in study and report preparation sometimes also contain hydrometeorological data.

530.2 Hydrometeorological Instrumentation

A. Need for Hydrometeorological Instrumentation.—Hydrometeorological instrumentation is occasionally required for project planning, monitoring, and evaluation.

- (1) Project Planning.—Consider hydrometeorological instrumentation in cases where existing data are inadequate for making reliable hydrologic estimates, particularly for projects that include storage for irrigation or other beneficial use and for which accurate estimates of available water supply are essential to project performance and justification.
- (2) Monitoring and Evaluation.—Monitoring and evaluation are actions and activities used to measure the effectiveness of conservation practices and systems. The data are useful for model development, verification, or validation, and particularly modeling unmonitored areas.

B. Types of Hydrometeorological Instruments.—Hydrometeorological instruments include but are not limited to water stage recorders; devices for measuring snow depth and snow-water content; and

instruments for collecting precipitation, soil moisture, maximum and minimum temperatures, wind direction and speed, relative humidity, evaporation, and solar radiation data.

C. Planning and Installation of Hydrometeorological Instrumentation

- (1) When instrumentation is necessary, develop a plan for collecting needed hydrometeorological data at the earliest possible time. Ensure the plan is consistent with project planning or project operation objectives. Include in the plan a statement of justification for the instrumentation; documentation of the type, quantities, and proposed location of required instruments; a schedule for installation; and anticipated operation and maintenance costs.
- (2) Install instruments as soon as practical after planning begins and concurrently with other planning activities to ensure the longest possible record.
- (3) Install temporary or permanent instruments, depending on their probable future usefulness. For planning purposes, instruments are usually as inexpensive as possible to keep planning costs to a minimum. However, if the intent is to use the sites for both planning and operation, select more sophisticated and durable equipment.
- (4) When selecting sites, consider the potential for future installation of additional or more sophisticated instrumentation, or both.
- (5) If needed, supplement project plans authorized for construction to include hydrometeorological instrumentation.
- (6) In developing proposals that include hydrometeorological instrumentation, follow appropriate Federal guidelines to avoid duplication of effort and to ensure efficiency of the data collection system.

D. Operation and Maintenance of Hydrometeorological Instruments

- (1) Projects that include hydrometeorological instrumentation for monitoring purposes require an appropriate operation and maintenance plan that includes appropriate considerations for NRCS and partner responsibilities, including the costs associated with the operation and maintenance of the instrumentation. Include funding for the operation and maintenance costs as part of the engineering services cost of the structure.
- (2) Inspection and Followup.—Inspection and followup includes documenting, as necessary—
 - (i) Proper maintenance of hydrometeorological instruments to ensure collection of reliable data.
 - (ii) Collection and use of data in a timely manner according to the operating needs of the reservoir.
 - (iii) Updates to forecast procedures as additional data are collected to document improved forecast accuracy.
 - (iv) Operation of project features, including reservoir gates and other features regulating the storage or release of water for project purposes, in accordance with the operation and maintenance agreement.

530.3 Hydrologic Reports

A. Need for Hydrologic Reports.—Hydrologic reports provide—

- (1) A record of investigations performed.
- (2) Factors considered in selection of project alternatives.
- (3) Information for future studies.
- (4) A record of how a structure or system of structures operates under design conditions.

B. Types of Hydrologic Reports.—Reports include, but are not limited to—

- (1) Site investigations for water supply storage.

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- (2) Effects of alternative systems of floodwater retarding structures on downstream discharges.
- (3) Reports on unusual storm or flood discharges.
- (4) Reports on field study of emergency spillway performance.
- (5) Reservoir operation plans.
- (6) Floodplain management and flood insurance reports.
- (7) Dam breach and inundation studies for emergency action plans.
- (8) Water budget analysis for wetland restoration, enhancement, and construction.

C. Review and Approval of Reports.—Ensure that the preparation, review, and approval of these reports and investigations are consistent with job approval authority.

Part 530 – Hydrology

Subpart B – Hydrologic Procedures and Criteria

530.10 General

NRCS developed hydrologic procedures to assist in the planning and design of on-farm conservation practices, including water control structures; and to assess hydrology as part of plan development and design for project activities. Because structure or project costs range from several hundred to several million dollars, it is important to select the most suitable hydrologic procedure for a particular situation. Select the procedure to provide the desired level of accuracy and to complement other design procedures to ensure that the structure or project meets its functional objectives. NRCS developed hydrologic criteria for designing conservation practices and water control structures largely based on field experience. These criteria represent minimum acceptable standards consistent with the objectives of the practice or structure.

530.11 Hydrologic Procedures

Numerous NRCS-developed hydrologic procedures and computer models are available for making hydrologic analyses. Train all engineers and technicians in the proper use of NRCS hydrologic procedures and computer programs needed for the planning, design, and installation of conservation measures.

- (1) For on-farm conservation practices, the NRCS preference is to use procedures in Title 210, National Engineering Handbook (NEH), Part 650, “Engineering Field Handbook” (EFH), Chapter 2, Section 650.2, “Estimating Runoff and Peak Discharge,” and the associated computer program, EFH2, unless specifically excepted by the State conservation engineer (SCE).
- (2) To the maximum extent practicable, carry out hydrologic analyses of soil and water conservation practices using procedures in 210-NEH, Part 630, “Hydrology,” and other designated references, including the WinTR-55, “Small Watershed Hydrology,” and WinTR-20, “Computer Program for Project Formulation – Hydrology,” computer programs.
- (3) Since NRCS-developed procedures are not practical for use in all NRCS engineering work, use other designated references and procedures outside the scope of the 210-NEH with prior approval of the SCE.

530.12 Hydrologic Criteria

Use hydrologic criteria established in standards and directives for designing conservation practices and water control structures. If necessary, obtain exceptions to the use of national criteria from the Director, Conservation Engineering Division (CED). Include SCE recommendations for such exceptions in the request to the Director, CED.

Part 531 – Geology

Subpart A – General

531.0 Purpose

The purpose of this policy is to ensure that technically sound consideration of onsite geologic conditions pertinent to conservation planning and engineering design is addressed in all NRCS programs. The planning, design, and construction of all conservation practices are influenced by geologic conditions and an understanding of the geology, geologic hazards, and physical properties of earth materials is critical for the successful performance of conservation practices.

531.1 Definitions

A. Geologically Complex or Unstable Sites.—Sites where site conditions include one or more of the following geologic processes, conditions, or attributes:

- (1) Seismicity and fault rupture
- (2) Karst terrain
- (3) Dispersive clays
- (4) Expansive clays
- (5) Soft cohesive soils deposits
- (6) Low piping resistance soil deposits
- (7) High soluble salt content soils or gypsum deposits
- (8) Loose coarse-grained deposits
- (9) Caliche soils
- (10) Rock quality
- (11) Collapsible soil
- (12) Unstable slopes, slope failure, and mass movements
- (13) Subsidence

B. NRCS Structure Classifications for Engineering Geological Investigations

- (1) Group A
 - (i) Any high-hazard dams, significant-hazard dams, and low-hazard dams over 35 feet in 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 height.
 - (iii) Any dam 20 feet or more in height constructed for the purpose of forming storage reservoirs for recreation, municipal water supply, or irrigation where the product of the storage (in acre-feet) times the dam height (in feet) is 3,000 or more.
- (2) Group B.—Structures and embankments that do not classify as group A, including low-hazard dams with a fill height of 35 feet or less, and conservation practices such as Pond (Code 378), Waste Storage Facility (Code 313), Dike (Code 356), Diversion (Code 362), and Grade Stabilization Structure (Code 410).

C. Qualified Geologist.—An individual who meets the minimum requirements for the practice of geology as defined by the State board of registration of the States in which the individual is assigned. 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.

531.2 Organization

- A. Conservation Engineering Division (CED).—National geologist position is located on the staff of CED under the supervision of the director. The national geologist also serves as the Geological Services Unit (GSU) coordinator for the geologists located in the States.
- B. Technical Centers.—Technical center geologist positions are located on the staff of the National Design, Construction, and Soil Mechanics Center (NDCSMC) under the supervision of the center director. Technical center geologist positions may also be included on other technical center staffs at the discretion of the technical center directors.
- C. Geological Services Unit (GSU).—GSU geologist positions are located on State-level engineering staffs under the supervision of the residing State conservation engineer (SCE), with salaries, travel, and training expenses directly funded through National Headquarters. The GSU provides geologic assistance to every State plus the Caribbean and Pacific Areas.
- D. Other geologist positions outside the GSU may be created at the discretion of State Conservationists.

531.3 Responsibilities

- A. The national geologist maintains engineering policy pertaining to the practice of geology including that contained in the Title 210-National Engineering Manual (NEM) and Title 450-National Handbook of Conservation Practices (NHCP). In addition, the national geologist assists the CED director with managing the GSU budget.
- B. Technical center geologists provide independent reviews of engineering projects as required under 210-NEM, Part 501, Subpart A, Section 501.5 “Engineering Job Review”; develop, maintain, and update procedural handbooks, such as the NEH; and develop and present training materials in support of sound engineering practice.
- C. The SCE is responsible for ensuring that geologic conditions at NRCS project sites are sufficiently characterized to support conservation planning efforts and sound engineering design, construction, and operation.
- D. NRCS geologists—
 - (1) Have primary responsibility for geologic studies and investigations in support of NRCS projects, although depending on needed intensity of investigation and site complexity, the SCE may delegate responsibility to a nongeologist to conduct certain investigations.
 - (2) NRCS geologists must—
 - (i) Review geological analyses and reports completed by non-NRCS geologists as part of NRCS-assisted projects.
 - (ii) Assist with preparation of geology sections of soil survey reports as requested by the State soil scientist.
 - (iii) Assist with the development and revision of conservation practice standards and specifications as requested by the SCE.

- (iv) Ensure that all geology-related resource concerns in such documents are addressed to the satisfaction of the requesting official and that the final version is completed within the appropriate timeframe.
- (3) NRCS geologists must not conduct mineral remoteness determinations for tax, regulatory, or legal purposes. However, NRCS geologists may provide mineral assessment reports to support conservation programs requiring easements or as part of an environmental evaluation required for project planning.

E. Qualified geologists are—

- (1) Required to conduct—
 - (i) Geologic investigations where published geologic information or construction experience is limited.
 - (ii) Geologic investigations where geologic conditions are complex or unstable.
 - (iii) Geologic investigations where the kinds of construction materials to be used are complex in their distribution, composition, or engineering behavior or are otherwise questionable.
 - (iv) Geologic investigations where the potential for loss of life or significant economic or environmental damages is high in the event the practice fails as designed.
 - (v) Reconnaissance, preliminary, and detailed investigations for all group-A structures. See section 531.21 of this part.
 - (vi) All detailed geologic investigations.
- (2) Required to conduct all hydrogeologic investigation evaluations for groundwater resource development, groundwater quality protection, and groundwater control, such as dewatering operations during construction.
- (3) Responsible for writing and filing the as-built report for group-A structures in accordance with 210-NEH, Part 631, Chapter 2, Section 631.0208, “Geologic investigation during project implementation and construction (as-built),” and part 512, subpart F, section 512.50, of this manual.
- (4) Required to conduct or provide direct supervision for—
 - (i) As-built geologic investigations during construction of all group-A structures. See 210-NEH, Part 631, Chapter 2, 631.0208, for guidance.
 - (ii) Sedimentation surveys for group-A structures, group-B structures, and conservation practice Dams (Code 402).

F. NRCS nongeologists must hold the appropriate job approval authority as outlined in 210-NEM, Part 501, Subpart A, 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 structures, 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 design, construction, and function of the practice.

531.4 Geologic Reports

A. All geologic investigations must be documented in a geologic report. Geologic reports provide—

- (1) A record of investigations performed.
- (2) Factors considered in selection of project alternatives.
- (3) Information for future studies.

B. Minimum requirements for all geologic reports are as follows:

- (1) Geologic studies and investigation reports must be prepared, signed and dated by the investigating geologist or by the investigating person with delegated job approval authority, and concurred by the SCE.
- (2) 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 are considered interpretations.
- (3) Only factual findings may be provided to potential contractors.
- (4) Any disclaimers for use of the geologic report must be included in the recommendations section of the report.
- (5) Recommendations for design parameters are subject to restrictions imposed by State licensing law. They must be made only by professional geologists and engineers specializing in the field of engineering geology and geotechnical engineering who are familiar with the purpose, conditions, and requirements of the investigation.
- (6) 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 shall conform to copyright law.
- (7) Geologic terms and symbols not specifically defined in NRCS technical references must conform to authoritative sources, such as American Society for Testing and Materials (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 Federal Geographic Data Committee.
- (8) Geologic Maps
 - (i) 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.
 - (ii) 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.”

Part 531 – Geology

Subpart B – Engineering Geology

531.20 Purpose

Engineering geology studies and investigations support the planning and design of conservation practices that address resource concerns through engineering works of improvement. Engineering geology activities characterize the physical properties of earth materials for use in construction and identify potential geologic hazards for consideration in the planning and design of engineering projects.

531.21 Intensity Levels of Geologic Investigations

A. Intensity levels of geologic investigations include reconnaissance, preliminary, and detailed investigations. The intensity is a function of the appropriate degree of detail required for the current stage of the project or practice. The geologic investigations must address all geologic concerns to the level of detail as explained in part 511, subpart A, section 511.2, of this manual. Refer to Title 210, National Engineering Handbook (NEH), Part 631, Chapter 2, for minimum requirements for each type of investigation.

B. The scope and intensity of the geologic investigation must be consistent with—

- (1) Geologic and geomorphic complexity and stability of the site.
- (2) Size and purpose of the structure, practice, or project.
- (3) Kinds of construction materials to be used.
- (4) 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.

531.22 Requirements for All Geologic Investigations

A. Geologic Investigations

- (1) 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 (GM), Part 401, “Cultural Resources (Archeological and Historic Properties),” and 210-NEH, Part 631, Chapter 3, Section 631.0303(c), “Fossils and Artifacts.”
- (2) 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 part 503, subpart C, of this manual. Refer to 210-NEH, Part 631, Chapter 5, Section 631.0501, “Safety,” for guidance.
- (3) All exploratory bore holes must be covered if they need to remain open overnight or longer. All exploratory test holes, test pits and trenches must be backfilled and sealed in accordance with Federal, State, and local laws, regulations, and codes at the completion of the geologic investigation as per section 501.3A of this manual.
- (4) Classification and Logging of Earth (Geologic) Material

- (i) 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.
 - (ii) Soil material must be classified in the field according to the Unified Soil Classification System, American Society for Testing and Materials (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.
 - (iii) 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, for related information.
 - (iv) 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, “Field Procedures Guide for the Headcut Erodibility Index.”
 - (v) 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.”
 - (vi) 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.”
 - (vii) Earth material must be logged, sampled, and tested in accordance with 210-NEH, Part 631, Chapter 5, “Engineering Geology Logging, Sampling, and Testing.”
- (5) In accordance with part 533, subpart F, section 533.22F of this manual, if NDCSMC-SM laboratories are to perform engineering analyses, samples submitted must be accompanied by geologic reports commensurate with the complexity of the structure.
- (6) If the structure includes an auxiliary spillway, the geologist and design engineer must jointly calculate the erodibility index for each material mapped in the spillway according to procedures in 210-NEH, Part 628, Chapter 52.
- B. All geologic investigations must be documented in a geologic report. Refer to part 531, subpart A, section 531.3 of this manual.

Part 533 – Geotechnical Engineering

Subpart A – General

533.0 General

A. Soils are used as construction materials and foundations for engineering structures. A wide range of soil properties and conditions affect their performance and use.

B. For engineering purposes, soils are grouped according to their predicted engineering behavioral characteristics. This classification is used by engineers and geologists to accurately define soil properties based on a soil's particle-size and plasticity characteristics. These soil groups, as well as the various index properties of a soil provides a preliminary understanding of the behavior of soils under various engineering conditions. It is the role of a geotechnical engineer or other qualified personnel to develop and implement a soil testing program that can provide the information for design criteria for construction activities and other guidelines related to the engineering performance of soils. Typically, the geologist or other technical personnel performs the geotechnical site investigations in an effort to gather information on soil properties and conditions that are relevant to the design.

533.1 Responsibilities

A. Director, Conservation Engineering Division (CED), is responsible for—

- (1) Establishing soil mechanics testing standards.
- (2) Inspection of NRCS soil mechanics testing facilities that are national, regional, or multistate in scope.
- (3) Jointly developing annual and long-range plans of the kinds of activities that can be accomplished and priorities of national benefit.
- (4) Working jointly to develop guidelines for soil survey criteria that requires engineering interpretations.

B. The co-director of the National Design, Construction, and Soil Mechanics Center-Soil Mechanics Laboratory (NDCSMC-SML) directs the inspection of State soil mechanics testing facilities and other soil mechanics testing facilities under contract or agreement with NRCS and jointly develops annual and long-range plans of the kinds of activities that can be accomplished and priorities of national benefit.

C. The State conservation engineer (SCE) is responsible for—

- (1) All geotechnical site investigations and the collection of samples.
- (2) Evaluating workload and staff capabilities regarding geotechnical engineering expertise and develops an operational plan that defines the scope of assistance or staffing needed and the training required.
- (3) Assisting in engineering interpretation for soil survey activities in the State and works closely with the responsible soil scientist. This authority may be delegated to a staff engineer who has been assigned leadership in geotechnical engineering or to a geologist or field engineer with sufficient training and experience.

D. NRCS engineers and geologists—

- (1) Participate in making soil potential ratings that indicate the relative quality of a soil for a particular use as compared with other soils in a given area. Soil scientist, engineers, and others provide guidance in interpreting soil survey data and in establishing procedures for

- preparing potential ratings. For nonagricultural uses, experts from other agencies or institutions are invited to participate in determining corrective measures, costs, and continuing limitations to determine the types of corrective measures that are appropriate, with final acceptance by NRCS.
- (2) Act as advisors in providing leadership in making soil potential ratings. In this advisory capacity, they assist in the work, make recommendations, and assist in correcting deficiencies and procedures.
 - (3) Keep informed on the development and use of engineering interpretations for soil surveys. All engineering interpretation for soil survey activity must be prepared in accordance with established guidelines and criteria. Engineering training programs must include appropriate instruction.
 - (4) Assist in soil survey engineering interpretations and participate in the following decisions:
 - (i) Decide whether engineering interpretations are adequately defined for a given use.
 - (ii) Establish criteria and guidelines for making geotechnical engineering interpretations.
 - (iii) Verify the quality of geotechnical engineering interpretations for published soil surveys, special reports, or special planning efforts.
 - (iv) Examine the method of presentation of soil interpretations and reports on engineering uses of soil.
 - (v) Provide training of soil scientists and engineers to make engineering interpretations.
- E. Soil scientists are responsible for engineering interpretations in soil survey reports and other forms and documents as outlined in the National Cooperative Soil Survey. These interpretations, reports, and narrative sections are written to describe soil properties. Ranges within soil mapping units are established based on correlated data, as well as field and laboratory observations.
- F. The NDCSMC-SMLs provide assistance to CED for a variety of activities of national benefit, including—
- (1) Training engineers, geologists, and other technical personnel in soil mechanics. This includes short-term staff position assignments.
 - (2) Renovating or modernizing specialized testing techniques and equipment.
 - (3) Developing and updating technical references in soil mechanics.
 - (4) Maintaining a testing database and preparing correlations for design reference.
 - (5) Laboratory testing for correlation of test results.
 - (6) Investigating behavior and performance of soil as related to engineering use.

Part 533 – Geotechnical Engineering

Subpart B – Engineering Classification of Soils

533.10 Scope

The soil classification systems identified in this policy will be used in NRCS engineering activities, including the engineering sections of soil survey reports.

533.11 Soil Classification Systems

A. The Unified Soil Classification System (USCS) is to be used in classification of soils for NRCS engineering activities. The USCS is the standard accepted by the American Society for Testing and Materials (ASTM) International D2487: Classification of Soils for Engineering Purposes, and ASTM D2488: Description and Identification of Soils (Visual-Manual Procedure). Soil classification for engineering purposes are best interpreted by the USCS.

B. The USDA National System of Soil Classification (Soil Taxonomy) is the pedological classification used in the National Cooperative Soil Survey. Additional information can be obtained from Title 430, National Soil Survey Handbook.

C. Soil classes determined by the USCS and the USDA textural classes in the pedological system provide information on the nature and size of soil particles. If the full combination of characteristics denoted by pedological soil names are used, additional information such as natural drainage condition can be deduced. Soil surveys show the location and extent of different soils; however, site-specific identification or classification determined by soil testing is needed for designing engineering structures.

D. The engineering sections of soil survey reports include both the USDA and the USCS soil classification systems. Data contained in soil survey reports can be used and should be supplemented as necessary to classify soils at specific sites. For some small farm-type structures, soil survey information properly interpreted may provide much of the soil information needed for planning and installation.

E. All engineers and geologists must be trained to use both the USCS and the USDA textural systems with competence. Construction inspectors, engineering and physical science technicians, and conservation technicians must also be trained in these soil classification systems to assist in the planning, design, and installation of conservation practices.

Part 533 – Geotechnical Engineering

Subpart C – Operations

533.20 General

A. Soil mechanics is a branch of soil physics and engineering mechanics that describes the behavior of soils and provides the theoretical basis for analysis in geotechnical engineering. Soil mechanics is the application of the laws and principles of mechanics and hydraulics to engineering problems dealing with soil as an engineering material. The testing of soil's properties are typically done at a testing laboratory with specialized equipment or can be measured or correlated in the field. Soil mechanics is a subdivision of civil engineering and engineering geology that evaluates the action of forces within a soil mass for natural or artificial structures that are supported on or made of soil.

B. Collection and analysis of geotechnical engineering data are essential in the investigation and design of engineering structures. The examination and verification of soil properties during construction are critical. Specialized training and experience in geotechnical engineering are needed due to the many factors which depend on interpretation and judgment of soil related issues. Close coordination is needed between the investigation, soil testing, design, and construction functions.

C. Soil mechanics testing provides data for evaluating soil and rock as engineering materials for planning, design, and construction. Test results identify the index, chemical, and engineering properties used in the analysis and design of foundations and earth or earth-supported structures such as dams, buildings, bridge foundations, retaining walls, as well as the support structure of buried pipeline systems.

533.21 Data Collection

A. The engineering staff or team that prepares the final design will assist in planning of the geotechnical site investigation, sample selection, and final soil testing program.

B. All data needed for analyzing soil conditions pertinent to planning, designing, and constructing engineering structures must be obtained for each phase. Field tests and interpretation procedures in Part 531, Subpart A, "Geologic Investigations," of this manual must be used to determine as many in-situ soil properties as practical. If further testing is needed or verification of field conditions is in order, appropriate representative samples must be obtained for laboratory testing.

C. Before completion of the geologic investigation, the geologist, the engineer designated for geotechnical engineering leadership, the project engineer, or some combination of these individuals must jointly review the results of the investigation and the adequacy of sampling for testing. The data must be examined to determine that it is adequate for use in all stages of design and construction.

533.22 Testing

A. Soil mechanics testing must conform to established NRCS and American Society for Testing and Materials (ASTM) standards and procedures. The testing must be completed at appropriate times during the investigation, design, and construction phases. To facilitate field investigations and construction operations, index and chemical tests may be performed at either state NRCS facilities or commercial facilities. Laboratory tests for engineering properties (shear, consolidation, permeability, etc.) must be performed at accredited geotechnical laboratories supervised by engineers with geotechnical engineering expertise.

B. For designs prepared through engineering services contracts, the testing may be performed as a phase of the total design contract (see part 505 of this manual). Soil mechanics testing facilities may also use engineering services contracts with commercial geotechnical facilities to supplement their own forces, redistribute peak workloads, and provide more efficient operation. Testing by non-NRCS facilities must be reviewed and checked for accuracy and proper procedures by NRCS engineers with geotechnical engineering expertise.

C. NRCS soil mechanics testing services are provided through the National Design, Construction and Soil Mechanics Center Soil Mechanics Labs (NDCSMC-SML) in Lincoln, NE. The center has two testing laboratories available to perform testing services: the national laboratory located in Lincoln, NE, serves the States in the West Region, Northeast Region, northern States in the Central and Southeast Region; a satellite laboratory in Fort Worth, TX, serves the southern States in the Central and Southeast Regions. Figure 533-C1 shows which State each laboratory serves.

Figure 533-C1: Laboratory Facility Service Location

State	Laboratory Location	State	Laboratory Location
Alabama	Fort Worth, TX	Nevada	Lincoln, NE
Alaska	Lincoln, NE	New Hampshire	Lincoln, NE
Arizona	Lincoln, NE	New Jersey	Lincoln, NE
Arkansas	Fort Worth, TX	New Mexico	Lincoln, NE
California	Lincoln, NE	New York	Lincoln, NE
Colorado	Lincoln, NE	North Carolina	Fort Worth, TX
Connecticut	Lincoln, NE	North Dakota	Lincoln, NE
Delaware	Lincoln, NE	Ohio	Lincoln, NE
Florida	Fort Worth, TX	Oklahoma	Fort Worth, TX
Georgia	Fort Worth, TX	Oregon	Lincoln, NE
Hawaii	Lincoln, NE	Pennsylvania	Lincoln, NE
Idaho	Lincoln, NE	Rhode Island	Lincoln, NE
Illinois	Lincoln, NE	South Carolina	Fort Worth, TX
Indiana	Lincoln, NE	South Dakota	Lincoln, NE
Iowa	Lincoln, NE	Tennessee	Fort Worth, TX
Kansas	Lincoln, NE	Texas	Fort Worth, TX
Kentucky	Lincoln, NE	Utah	Lincoln, NE
Louisiana	Fort Worth, TX	Vermont	Lincoln, NE
Maine	Lincoln, NE	Virginia	Lincoln, NE
Maryland	Lincoln, NE	Washington	Lincoln, NE
Massachusetts	Lincoln, NE	West Virginia	Lincoln, NE
Michigan	Lincoln, NE	Wisconsin	Lincoln, NE
Minnesota	Lincoln, NE	Wyoming	Lincoln, NE
Mississippi	Fort Worth, TX	Pacific Basin	Lincoln, NE
Missouri	Lincoln, NE	Puerto Rico	Fort Worth, TX
Montana	Lincoln, NE	U.S. Virgin Islands	Fort Worth, TX
Nebraska	Lincoln, NE		

D. Both facilities have the equipment and NRCS personnel to run all geotechnical tests routinely required for soil mechanics testing. The testing laboratories are managed under one co-director and either laboratory can provide testing services during peak workload periods.

E. NRCS laboratory testing services may be requested by letter or electronic mail. The request must include the name and address of sender, name of site or project, financial project code, name of watershed or location, type of project and brief description, list of samples and type (disturbed or undisturbed), hazard class (for dams), testing requested, and other pertinent information. More detailed directions, including information on sample size, shipping information, sample list form, and the testing request form can be downloaded from the NDCSMC-SML Web site. The center operates on its own budget and States are not charged for testing services or assistance. Testing is accomplished on a first-come, first-served basis.

F. If the NDCSMC-SMLs are to perform geotechnical engineering analyses, samples submitted must be accompanied by geologic and engineering reports that commensurate with the complexity of the structure. The reports must be submitted to the testing laboratory by the SCE or others with delegated authority from the SCE.

G. The engineering report must include the preliminary design and other information required for establishing a soil testing program, testing parameters, and other details for completing soil tests. The report must also explain the purpose for which samples were obtained, the potential use of the soil represented by the samples, and the expected use for the test results.

H. The SCE must maintain close contact with the testing facility when changes occur in the soil testing program. For projects requiring design assistance from other engineering staffs or teams, the SCE will keep that staff informed of any changes in the scope of the project and target dates which affect the completion of the testing.

I. The testing facility will submit a report to the SCE that includes all requested test data and a narrative giving details of the testing workload, soil classifications, descriptions of soils, condition of samples, and observed test performances.

J. NRCS soil mechanics testing facilities will comply with the requirements of the Animal and Plant Health Inspection Service when receiving or disposing of soil samples from areas where quarantine regulations are imposed. Each facility must obtain a permit for receiving these samples. Requirements for taking and shipping soil samples under quarantine regulations are included in part 531, subpart A, sections 531.2 F and G of this manual.

533.23 Geotechnical Engineering Analyses

A. Geotechnical engineering analyses must be made by the engineer closest to the field who has the necessary expertise in geotechnical engineering. If possible, this workload is scheduled concurrently with all stages of design and construction.

- (1) One staff engineer must be designated to provide geotechnical engineering leadership in each State that has a significant expertise in earth dam design or other activities requiring geotechnical engineering expertise. This engineer must be trained in geotechnical engineering principles and have an understanding of the behavior of soils under various conditions. Engineers with specialized training and broad experience are required to make judgments and analyses for structures that require extensive geotechnical engineering expertise, such as large earth dams and foundations with complex conditions.
- (2) States that do not have the necessary expertise may obtain assistance from another State within their region, a multistate design staff, an outside source, or NDCSMC-SML staff.

B. If geotechnical engineering analyses by the NDCSMC-SMLs are requested in conjunction with the soil mechanics testing, the SCE will arrange for the assistance and analyses (see section 533.23A of this subpart). The engineer responsible for the analyses must participate in all the geotechnical

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engineering phases of investigation, soil testing, design, and soil-related problems during construction.

C. The geotechnical engineering analyses report will be provided to the SCE as part of the soil mechanics report including the documenting site conditions, preliminary design assumptions, engineering properties of soils used in the analyses, and other factors pertinent to the design and construction of the project. Appropriate recommendations for design features will also be included in the report.

D. If geotechnical investigations, sampling, testing, or geotechnical engineering analyses are performed by local sponsoring agencies or consultants, the SCE will forward the results to NRCS personnel that have the necessary expertise to ensure that standards and specifications are met. States that regularly request geotechnical engineering assistance from the NDCSMC-SML or another State on designs completed by in-State NRCS personnel must also obtain NDCSMC-SML's or that State's assistance on preparing contracts and reviewing geotechnical engineering criteria completed by local sponsoring agencies or consultants.

Part 535 – Landscape Architecture

535.0 General

NRCS conservation and project work results in noticeable and permanent changes to the landscape across the United States on millions of acres. On a national scale, the public need for conservation of landscape resources becomes more important as development, population, and management pressures increase. Federal legislation recognizes the need for landscape resource conservation.

535.1 Scope

NRCS policy is to maintain or enhance landscape resources. The basic principles of landscape architecture are to be applied as an integral part of all engineering work. They must be considered early in planning and continued through design, construction, operation, and maintenance to ensure safe, appropriate, cost effective, functional, and efficient results.

535.2 Definitions

Landscape Architecture.—The science of planning and designing the landscape for sustainable use and the conservation of landscape resources. It is an integrating discipline that links biophysical sciences, engineering, and sociopolitical sciences into holistic site and landscape-scale designs. Landscape architecture evaluates traits, patterns, and structure of geographic areas, including the biological and physical characteristics and its social and economic relationships.

535.3 NRCS Technical Assistance for Landscape Architecture

- A. Landscape resource planning procedures must be performed in accordance with Technical Release Number 65 (TR-65), “Procedures to Establish Landscape Resource Priorities.”
- B. If additional assessments are necessary, NRCS landscape architects, or the landscape architectural services of private firms or individuals can be used for both planning and design. Sponsors and governmental institutions that have specialized landscape resource planning capabilities may also be used.
- C. Other inventories, investigations, and studies of the landscape resources may be required in special situations, such as when a project is located within the viewshed of a property on the National Register of Historic Places.

Part 536 – Structural Engineering

536.0 General

NRCS provides structural engineering assistance in a variety of applications. Structural engineering requires the use of sound engineering principles.

536.1 – 536.9 Reserved

536.10 Method

A. The method selected for the analysis and design of structures must be based on a systematic and comprehensive evaluation of the structural functions expected during the design life. Consideration must be given to the structural resiliency, redundancy, robustness, durability, and sustainability.

B. The structural design method must include an evaluation of the following: function, operation, loading, stability analysis, structural analysis, and material criteria. In practice, the structural design will typically involve an iterative evaluation of each of these elements.

536.11 Function

All structure functions, whether intended or not, must be considered in the structural design evaluation. Functions typically include all the operational structure conditions for each external condition imposed on the structure. The designer must consider structure conditions imposed during construction, normal operations, extreme events, and maintenance activities.

536.12 Loads

A. Consider all anticipated loads and load combinations in the design of a structure. Loads typically include wind, snow, hydraulic, earth, occupancy, vehicular, equipment, and seismic. Designs must consider loads imposed during construction, normal operations, extreme events, and maintenance activities.

B. Use the applicable provisions of the current American Society of Civil Engineers (ASCE) Minimum Design Loads for Buildings and Other Structures (ASCE 7) to develop design loads and load combinations. In lieu of compliance with ASCE 7, use the applicable provisions of the current International Building Code (IBC) to develop design loads and load combinations.

C. In addition to the requirements in ASCE 7 or the IBC, where required by State regulation, local regulation, or other legal mandate, develop design loads and load combinations using local guidance and requirements.

536.13 – 536.19 Reserved

536.20 Design Criteria for Reinforced Concrete Structures

A. Design reinforced concrete structures, not classified as hydraulic or environmental in section 536.21 of this subpart, in accordance with the applicable provisions of the current American Concrete Institute (ACI) Building Code Requirements for Structural Concrete (ACI 318).

The specified yield strength of reinforcement (f_y), must not exceed 60,000 pounds per square inch (psi) unless approved in advance by the Director, Conservation Engineering Division (CED).

B. In lieu of the applicable provisions of ACI 318, designers may use the applicable provisions of the current ACI Code Requirements for Environmental Engineering Concrete Structures (ACI 350) to design reinforced concrete structures.

536.21 Design Criteria for Reinforced Concrete Hydraulic and Environmental Structures

A. A hydraulic structure is any structure subjected to hydrostatic or hydrodynamic pressures, either externally or internally. An environmental structure is any structure intended for conveying, storing, or treating water, wastewater, or other liquids and nonhazardous materials, such as solid waste, and for secondary containment of hazardous liquids or solid waste and designed to be liquid-tight, with minimal leakage under normal service conditions.

B. Design reinforced concrete hydraulic and environmental structures in accordance with the applicable portions of the current ACI 350.

- (1) The flexural tension reinforcement stress due to unfactored loads must not exceed 20,000 psi.
- (2) The specified yield strength of reinforcement (f_y) must not exceed 60,000 psi unless approved in advance by the Director, CED.
- (3) Construction joints, intended to be watertight, prepared in accordance with ACI Joints in Concrete Construction (ACI 224.3R-95), Section 3.2.1, need not include integral water stops stipulated in ACI 350-06, Section 6.4.7.

C. Designers may use Technical Release No. 30, “Structural Design of Standard Covered Risers” (TR 30), for the design and analysis of drop-inlet spillway riser structures.

D. Designers may use Technical Release No. 68, “Seismic Analysis of Risers,” including appendix D, as amended, 1992 (TR 68) for the seismic design and analysis of drop-inlet spillway riser structures.

- (1) For utilization with the computer program SARisers, combine the values for the zone “Z” and the site classification “S” to produce a base shear approximately equal to the base shear obtained using the methods described in ASCE 7. When interpolation of the combined zone and site class value is required, input the next higher value into the computer program.
- (2) For utilization with the computer program SARisers, determine the values for the zone using figure 4-1 in Technical Release No. 60, “Earth Dams and Reservoirs,” July 2005 (TR 60).
- (3) For drop-inlet spillway riser structures, designers may perform seismic analysis and design using rational methods not in compliance with TR 68, subject to approval of the Director, CED.

E. Reinforced concrete circular tanks designed in accordance with the Portland Cement Association’s Circular Concrete Tanks Without Prestressing (1993) need not comply with conflicting provisions of the current version of ACI 350.

536.22 Design Criteria for Concrete Slabs-on-Ground

A. Design concrete slabs-on-ground subject to distributed stationary loads, light vehicular traffic, or infrequent use by heavy truck or heavy agricultural equipment in accordance with applicable provisions of the current ACI Guide for the Design and Construction of Concrete Parking Lots (ACI 330R).

B. Design concrete slabs-on-ground subject to regular or frequent heavy truck or heavy agricultural equipment traffic in accordance with applicable provisions of the current ACI Design of Slabs-on-Ground (ACI 360R).

C. For liquid-tight slabs-on-ground, with minimal leakage under normal service conditions, design in accordance with the applicable provisions the current ACI Code Requirements for Environmental Engineering Concrete Structures, Appendix H, Slabs-on-Soil (ACI 350 App. H).

536.23 Existing Designs for Reinforced Concrete Structures

States may utilize existing designs, including State and national standard designs, previously developed in accordance with Technical Release No. 67, “Reinforced Concrete Strength Design” (TR 67), or Title 210, National Engineering Handbook (NEH), Section 6, “Structural Design,” provided that no substantial changes are necessary to implement the use of the design.

- (1) For minor changes to an existing design for a reinforced concrete structure, design the changes in accordance with TR 67, 210-NEH, Section 6, or both.
- (2) For substantial changes to an existing design for a reinforced concrete structure, reanalyze and redesign the structure to comply with section 536.30 or section 536.31 as applicable.

536.24 – 536.29 Reserved

536.30 Design Criteria for Steel Structures

- A. Design steel structures in accordance with the applicable provisions of the current American Institute of Steel Construction (AISC) Steel Construction Manual.
- B. Use seismic analysis and design in accordance with applicable provisions of the AISC Seismic Design Manual.

536.31 – 536.39 Reserved

536.40 Design Criteria for Wood Structures

Design wood structures in accordance with the applicable provisions of the current American Wood Council National Design Specification for Wood Construction.

536.41 – 536.49 Reserved

536.50 Design Criteria for Masonry Structures

Design masonry structures in accordance with the applicable provisions of the current ACI Building Code Requirements for Masonry Structures (ACI 530).

536.51 – 536.59 Reserved

536.60 Design Criteria for Bridges

- A. Design vehicle, livestock, and pedestrian bridges in accordance with American Association of State Highway and Transportation Officials Load Resistance Factor Design (LRFD) Bridge Design Specifications, with interim revisions.
- B. Designate the vehicle or live load used for design on the construction drawings and in the specifications.
- C. Design all bridges with railings, guardrails, or barriers to protect the users of the bridge. Railings, guardrails, or barriers, their connections to the bridge superstructure, and the supporting bridge

superstructure must comply with applicable requirements stipulated in the LRFD Bridge Design Specifications, with interim revisions.

Exceptions to the railings, guardrails, or barriers requirement on bridges require authorization from the State conservation engineer (SCE) and must meet both of the following criteria:

- (i) The intended use of the bridge is for vehicles, machinery, or equipment having dimensions or proportions such that they cannot access the bridge with approved railings, guardrails, or barriers installed.
- (ii) Bridges constructed without railings, guardrails, or barriers, or with railings, guardrails, or barriers that do not comply with applicable requirements stipulated in the LRFD Bridge Design Specifications, with interim revisions, must have signs installed at or near each end of the bridge to warn users of the lack of railings. Signage must comply with applicable requirements stipulated in the U.S. Department of Transportation's Federal Highways Administration Manual on Uniform Traffic Control Devices.

536.61 – 536.69 Reserved

536.70 Standard Designs

- A. Developing standard designs for frequently used structures or structural features can be an efficient method of providing technical assistance.
- B. Developing standard designs based upon conservative assumptions may permit the ready adaptation of those designs to a wide variety of locations and applications.

536.71 Use of Standard Designs

- A. Use standard designs when appropriate for the development of construction drawings.
- B. The design engineer must determine the site conditions, structure function, and hydraulic and structural requirements. The design engineer must examine the applicability of a standard design and include in the design notes the verification for the selection of a standard design. If differing site conditions preclude the use of a standard design, the design engineer must include this determination in the design notes.
- C. The approving engineer must determine the appropriate use of standard designs by considering the acceptability of performance, the overall efficiency of adapting the standard design to a specific project, and the risk of incorporating errors if modifications are required.
- D. A State office may not develop standard designs if standard designs are available from CED for the same size and kind of structure, component, or appurtenance.
- E. Keep documentation containing the design notes and computations developed for standard designs for reference as long as the designs are available for use.

536.72 Standard Design Drawings

- A. Develop standard design drawings as detailed construction drawings based upon standardized design assumptions. Select the design assumptions such that the design drawings will provide for the requirements of many sites.
- B. Design structures for standard design drawings to perform satisfactorily within the range of conditions assumed in their development. Indicate the assumed range of conditions in reference drawings, technical releases, or design notes. Include design assumptions and notes on material

quality on the drawings.

C. Prepare essentially complete standard design drawings for use directly in preparing construction drawings for incorporation in contract documents. They are to be complete in construction or fabrication detail.

D. Portions of the drawings may provide for changes in size or length and thus require some additions for completion. Consider these changes during the development of the design and ensure that the changes do not affect the performance or capability of the structure. Incorporate the provisions for these adaptations into the drawings in a manner to facilitate their use.

E. Support each standard design drawing using design notes, computations, drawings, sketches, and other pertinent data. Record and organize documentation in a manner that allows for reproduction, and comply with applicable provisions of section 511 of this manual.

F. Standard design drawings may be prepared as a series to provide for a range of sizes frequently needed.

G. Drafting must comply with applicable requirements of section 541 of this manual.

H. Design Note No. 18, “Unattached Engineering Standard Drawings” (DN 18), includes an index of available standard drawings for hydraulic structures.

536.73 Adaptation of Standard Design Drawings

A. Make additions or minor changes to standard detail drawings by including reference drawing numbers, notes, or details. These additions or changes should not affect the performance of the structure as originally designed.

B. If an adaptation of the standard design drawing affects the performance of the original design, amend and incorporate the original design notes and computations for the design into the design documentation for the project utilizing the adapted standard design. This documentation must include new or differing design assumptions, the effect of the modification on the original design, and the revised analysis and design of the structure.

536.74 Revision of Standard Design Drawings

Periodically review and revise standard design drawings as necessary to comply with current design and construction practice criteria. Furnish revisions to the office responsible for the standard drawing.

536.75 Availability of Standard Design Drawings to the Public

A. Provide copies of drawings when requested, in accordance with the procedures in Title 120, General Manual (GM), Part 408, Subpart C, “Freedom of Information Act and Privacy Act.”

B. Each drawing provided must include—

- (1) A precautionary statement stipulating that the design presented is a standard design that may require adaptation for a specific use or site. The statement must also stipulate that a qualified registered professional engineer perform or review the adaptation.
- (2) Material design strength and quality assumptions.
- (3) Site conditions assumed in the design.
- (4) Name and address of the office retaining the design notes and computations.

536.76 National Standard Detail Drawings

- A. Standard detail drawings are prepared for structures, spillways, and appurtenances. These drawings are prepared according to hydraulic and structural design criteria in 210-NEH, technical releases, or design notes. The drawings are prepared to permit direct use without any significant change.
- B. The drawings may be prepared as a series to provide the range of sizes frequently used. The Director, CED, determines the kind of structures and range of sizes.
- C. The CED keeps original drawings on file. SCEs may request drawings from CED for use in preparing plans for specific structures. Indexes of available standard detail drawings are in DN 18.

536.77 State Standard Detail Drawings

- A. Only prepare standard detail drawings for structures and structural appurtenances that are likely to be constructed on a regular basis. Prepare the design supporting the drawings in accordance with all NRCS design procedures, criteria, and materials specifications. Prepare drawings in accordance with section 541.
- B. Keep the folder containing the design notes and computations made during the preparation of these drawings on file for reference as long as the drawings are available.
- C. States must maintain a current index of standard detail drawings prepared by that State containing:
 - (1) Name or type of structure, structure element, or appurtenance
 - (2) State responsible for the design
 - (3) Date of design
 - (4) Criteria used for design
 - (5) Location of folder containing design notes and computations
 - (6) Types of materials used in the structure or element, size ranges, general application, and significant limiting assumptions
- D. The SCE should review all standard detail drawings as part of the design review before approval is given. This may require the SCE to request the design folder with the design notes and computations that support the standard drawing from the State that developed the standard drawing.
- E. States may use State standard detail drawings in class-VI or class-VII jobs as long as the States follow the proper design review process outlined in section 501.5 of this manual.

536.78 Standard Detail Drawings Prepared by Non-NRCS Engineers

- A. Non-NRCS engineers, other engineering organizations, vendors, and fabricators prepare standard detail drawings for NRCS conservation practices and systems. The design documentation supporting the drawings and the materials used in the structures or appurtenances must meet minimum NRCS criteria and should be of professional quality. Maintain the documentation on file for reference as long as the drawing is available for use.
- B. The SCE must review and concur in any use of standard detail drawings prepared by non-NRCS engineers. In conducting the review, the SCE may request assistance from the National Design Construction and Soil Mechanics Center. Accompany requests by documentation indicating the frequency of use and an estimate of the regional application of the drawing. Accompany all drawings with documentation containing design notes and computations.
- C. Use of standard detail drawings prepared by non-NRCS engineers in class-VI or class-VII jobs is

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allowed as long as the proper design review process is followed as outlined in section 501.4 of this manual.

D. The SCE must maintain an index of standard detail drawings used in the State and prepared by non-NRCS engineers. The index must contain the following information:

- (1) Name and type of structure, structural element, or appurtenance
- (2) Name and address of designer
- (3) Name and address of the vendor, distributor, or fabricator
- (4) Identifying name and number of the drawing
- (5) Date of original design and all revisions
- (6) Criteria used for design
- (7) Location of the folder containing design notes and computations
- (8) Type of materials used in the structure or element, size ranges, general application, and significant limiting assumptions

E. The SCE should review the consolidated index and, as appropriate, request from the State, vendor, or fabricator a copy of the desired standard detail drawing. When using a standard detail drawing so obtained, the SCE must obtain a copy of the folder containing the design notes and computations, including design assumptions that identify the limitations for use of the structure or elements.

Part 540 – Field Surveys

540.0 General

Concise, accurate, and legible engineering notes are necessary to document planning, design, and construction. They provide the basis for expenditure of Federal and other funds for conservation installations. Title 210, National Engineering Handbook (NEH), Part 650, Chapter 1, “Engineering Surveys,” provides the recommended format for engineering notes and related staking.

540.1 Responsibility

- A. All surveys and surveyor qualifications must comply with local and State regulations, as applicable.
- B. The information from basic staking of earthwork normally becomes the basis for measurement of payment quantities. Therefore, basic staking must be performed by NRCS, an architect-engineer (A-E), the local contracting organization, the owner, or the contractor as described within the appropriate construction contracts, grants, or agreements.

540.2 Format

- A. Each State conservation engineer (SCE) is to establish the format and minimum requirements for engineering notekeeping based on 210-NEH. Engineering records are to be uniform to simplify training, improve clarity and overall efficiency, and allow consistency if personnel change through the course of a project. If local contracting organizations elect to use their own engineering staffs or if consulting engineers or other qualified persons, such as licensed surveyors, perform the survey, notekeeping must be of comparable quality and similar content to the sample format in 210-NEH. When using electronic data collection systems to record survey data, the SCE must develop a method to secure electronic copies of the recorded data in at least two separate locations.
- B. For class V-VIII jobs and work performed by Federal or local contract—
 - (1) Bound field notebooks must be used to record engineering surveys and notes when electronic data collection systems are not used.
 - (2) When electronic data collection systems are used to record the engineering surveys, an unaltered electronic copy of the survey data must be downloaded from the data collector and permanently stored in a location along with other important survey information for that project. A backup copy of the electronic survey data must also be kept in a separate location.
- C. Loose-leaf notebooks, special forms, or electronic copies of downloaded electronic data may be used for recording engineering surveys, notes, and design data for onfarm conservation practices (class I-IV jobs) such as ponds, terraces, diversions, waterways, and animal waste management facilities. The documentation for the engineering surveys for conservation practices must provide the minimum information as outlined in 210-NEH.

540.3 Light Detection and Ranging (LiDAR) Data

Ground elevation data obtained through the LiDAR remote sensing method can facilitate the planning and design of engineering practices. LiDAR data must meet fundamental vertical accuracy for the desired quality level considering the planning or design need. Minimum LiDAR quality levels recommended for practice design use and applicable practice types are presented in Surveying Technical Note 210-SRVN-01, “Using LiDAR for Planning and Designing Engineering Practices.”

540.4 Precision and Accuracy

The required precision and accuracy of each survey will vary with its purpose; therefore, each SCE must establish the minimum requirements for precision and accuracy within the framework outlined in the NEH.

540.5 Staking

A. Basic Staking.—“Basic staking” is defined as alignment and grade stakes for structures other than embankments and channels. For channels and embankments, basic staking includes alignment and grade stakes plus slope stakes at the normal interval for the work. Normal interval is 100-foot stations on tangents and may decrease to as little as 25 feet on sharp curves. When construction pay quantities are determined from basic staking, a fair and equitable description of the ground surface is needed for the calculation of performance quantities.

B. Construction Stakes.—Additional stakes necessary for forming the structure, constructing the slopes of embankments above the slope stakes, or constructing the sides of channels below the slope stakes or between stations are “construction” stakes. They are the responsibility of the construction contractor.

540.6 Contractor Surveys

Contractor surveys apply to construction contracts and conservation operations that require the contractor to provide basic staking, quantity surveys, measurements, and computations for progress payments. When authorized, contractors will provide original and final surveys for final quantity determinations. 210-NEH, Part 642, “Specifications for Construction Contracts,” must be used to provide contract requirements for contractor surveys. Surveys completed under conservation operations must follow the requirements of 210-NEH, Part 650, Chapter 1, “Engineering Surveys.” Primary controls, which include items such as baselines, control points, and bench marks, must be sufficiently defined to allow the contractor to perform the required surveys.

540.7 Checking

NRCS employees or individuals under contract with NRCS must conduct quality assurance checking. Checking includes a visual review of survey markings, notes, and random surveys to check for accuracy.

Part 541 – Drafting and Drawings

541.0 General

- A. Engineering designs are normally described, displayed, and documented with construction drawings. These drawings provide details of the location, content, and dimensions of the components needed to complete the work.
- B. Drawings need to communicate information clearly and effectively among designers, reviewers, owners, and contractors at different locations. This requires uniformity and consistency in drawing layout and style.
- C. Drawings reflect the professional quality of NRCS engineering services to the owner, contractor, and general public. Drawings must be legible, accurate, complete, and have a consistent appearance throughout the agency.

541.1 Media

- A. Drawings may be developed by manual drafting techniques, computer-aided design (CAD) methods, or both.
- B. Paper is appropriate for most NRCS conservation work. More durable media, such as vellum or mylar, should be considered for standard drawings that will be reused repeatedly, or for drawings that need to be retained for many years.
- C. Save CAD files in accordance with Title 210, General Manual (GM), Part 408, Subpart E, “Managing Electronic Records.”

541.2 Sheet Size

- A. Drawing sheet size should be appropriate for presentation of required information in a neat and uncluttered manner.
- B. Standard sheet sizes for NRCS work are as follows:
 - (1) Full Size.—22 inches by 34 inches (American National Standards Institute (ANSI) D size)
 - (2) Half Size.—11 inches by 17 inches (ANSI B size)
 - (3) Page Size.—8.5 inches by 11 inches (ANSI A size)
- C. Normally, full-size sheets should be used for projects involving large land areas or complex structures. Half-size sheets should be used for smaller, simpler work. Page-size sheets should be limited to simple details.
- D. Other-size paper may be used for NRCS work if necessary due to local paper supply availability or special plotting, copying, or reproduction equipment limitations.

541.3 Title Blocks

- A. Each sheet in a set of construction drawings must have a title block to identify the drawing and provide other information about the drawing. Location data, including State, county, township, section, or similar information, must be included in each title block.
- B. Full- and half-size drawing sheets must have a vertical title block on the right side of the sheet. Page-size sheets must have horizontal title blocks across the bottom of the sheet.

C. The standard title blocks for NRCS work shown in sections 541.7 through 541.10 of this subpart must be used for all new drawings or drawing forms prepared by NRCS.

D. Alternative title blocks may be used or added for work prepared by other agencies, local organizations, or private firms. Such alternate title blocks must contain at least the same drawing identity and other information as contained on the NRCS standard title block.

541.4 Cover Sheet

A. Each set of construction drawings consisting of more than five sheets must have a cover sheet showing the name and location of the project, the names of the sponsoring agencies or owners, an index of the drawings, space for approval signatures, and professional seals, as appropriate.

B. The cover sheet for major, long-lasting NRCS work, such as dams and channels, may also include a location map, general notes, and project data.

541.5 Orientation

A. Maps should be drawn with north toward the top of the sheet. If this orientation is not feasible, the map should be drawn with north toward the left. A north arrow must be shown on all maps.

B. Layout drawings (plan view) should be drawn so that the direction of flow is from left to right or bottom to top of the sheet. A north arrow and flow arrow indicating direction of flow must be shown.

C. Cross section and elevation views of structures representing surfaces essentially parallel to the direction of the stream flow should be drawn so that flow is from left to right.

D. Cross section and elevation views representing surfaces essentially normal to flow should be drawn so that they are viewed looking downstream. If such orientation makes the drawing unclear, it may be changed and the orientation labeled on the drawing; for example, orientation could be labeled as “Looking Upstream.”

E. Stationing on open channels can be upstream or downstream, depending on local practice, design software, or existing drawings.

F. Multiple cross sections on a sheet should be arranged sequentially, according to stationing.

G. Orientation of views and directions of stationing must be consistent throughout the drawing set.

541.6 Style and Content

A. Drawings should present as much related information as reasonable on the same sheet for efficiency and clarity. If possible, details should be drawn on the same sheet as the work to which they apply. If details are shown on a separate sheet, appropriate sheet references must be noted. Dimensions and sizes of components should be shown on the drawings rather than referenced to the specifications.

B. Drawings must follow agency and industry standards for content, appearance, details, and symbols to best communicate requirements to reviewers, contractors, and the building trades. Standards include the following:

- (1) American Concrete Institute (ACI)
 - (i) ACI 315 – Details and Detailing of Concrete Reinforcement
 - (ii) ACI 315R – Manual of Engineering and Placing Drawings for Reinforced Concrete Structures
- (2) American Institute of Steel Construction (AISC)

AISC – Manual of Steel Construction

(3) American Society of Mechanical Engineers (ASME)

ASME Y14.1 to Y14.5 – Drawings, Dimensions, etc.

(4) NRCS

Title 170, National Digital Geospatial Map Symbols Handbook, Part 601

(5) National Institute of Building Sciences

U.S. National CAD Standard, Version 2.0

C. Scales for drawings should be selected carefully to assure clarity of details and accommodate reduced-size reproductions. Bar scales are preferred for maps and plan views and are necessary for any drawings that will be reduced for contracting.

D. The minimum scale for structural drawings should be as follows:

(1) One-fourth inch equals 1 foot for layout sheets.

(2) Three-eighths inch equals 1 foot for reinforcing steel sheets.

(3) One-half inch equals 1 foot for any sheets that will be reduced. Drawings that will be reduced must include bar or graphic scales, or each reduced sheet must bear a prominent warning note stating that the drawing is a reduced size and the indicated scales are not accurate.

E. Notes on the drawings should be limited to those required for complete and accurate description of the drawings and those required to supplement the contract specifications.

F. All lines and letters must be clear, sharp, and dense to ensure clear reproductions and one-half scale reductions. Manually drafted letters must be single-stroke type.

G. Drawings should include geographic location information. Routine work should show at least a simple location map containing readily identifiable landmarks. Major work should include structure reference lines and right-of-way limits referenced to fixed and readily identifiable geographical points.

H. Drawings should include geologic and soils information where available. Boring numbers, station and offset of borings, waterline depth and date of waterline, and soil classification at various depths can be displayed on cross section and profile views.

I. Drawings should include survey information (i.e., benchmark location, data and datum used) where available.

541.7 Standard Title Block for ANSI A (8.5x11) Sheet

[Click here for a copy of the Standard Title Block for ANSI Sheet](#)

541.8 Standard Title Block for ANSI B (11x17) and ANSI D (22x34) Sheets

[Click here for a copy of the Standard Title Block ANSI B and ANSI D Sheets](#)

541.9 Standard ANSI A (8.5x11) Sheet

[Click here for a copy of the Standard ANSI A Sheets](#)

541.10 Standard ANSI D (22x34) and ANSI B (11x17) Sheets

[Click here for a copy of the Standard ANSI D and ANSI B Sheets](#)

Part 541 – Drafting and Drawings

541.7 Standard Title Block for ANSI A (8.5x11) Sheet

Agency
Signature

Drawing and Project
Identification

Management Block

Sheet Identification
Block

 United States Department of Agriculture		Date _____	File Name
			Drawing Name
Natural Resources Conservation Service		Designed _____ Drawn _____ Checked _____ Approved _____	Sheet _____ of _____

Part 541 – Drafting and Drawings

541.8 Standard Title Block for ANSI B (11x17) and ANSI D (22x34) Sheets

	Date
Designed _____	_____
Drawn _____	_____
Checked _____	_____
Approved _____	_____

Management Block


	United States Department of Agriculture
Natural Resources Conservation Service	

Agency Signature/Logo

File Name
Drawing Name
00/00/00 00:00
Sheet _____ of _____

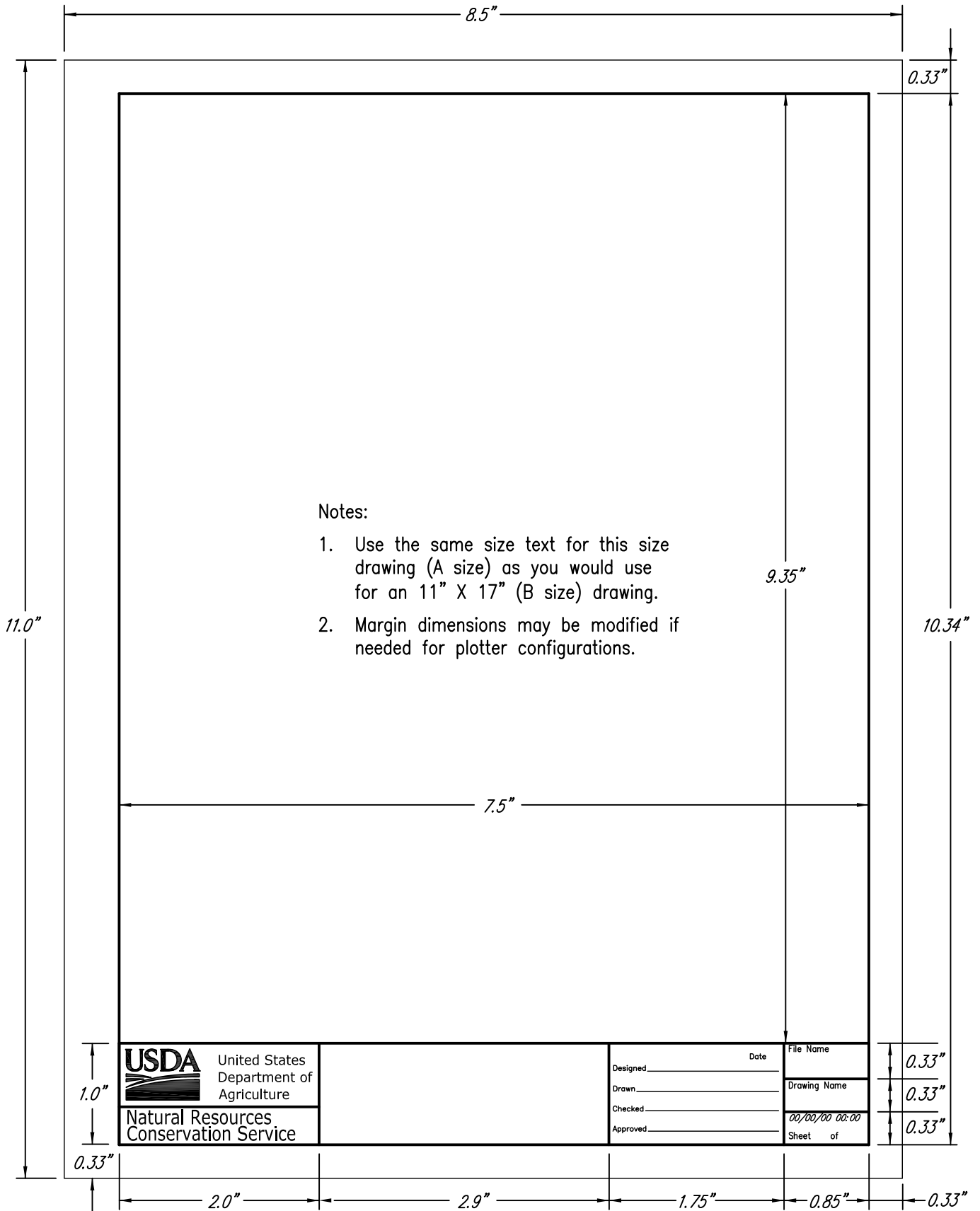
Date-Time Stamp

Sheet Identification Block

Date	_____
_____	_____
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Designed	_____
Drawn	_____
Checked	_____
Approved	_____
(Drawing and Project Identification)	
United States Department of Agriculture	Natural Resources Conservation Service
	
File No.	_____
Drawing No.	_____
00/00/00 00:00	_____
Sheet _____ of _____	

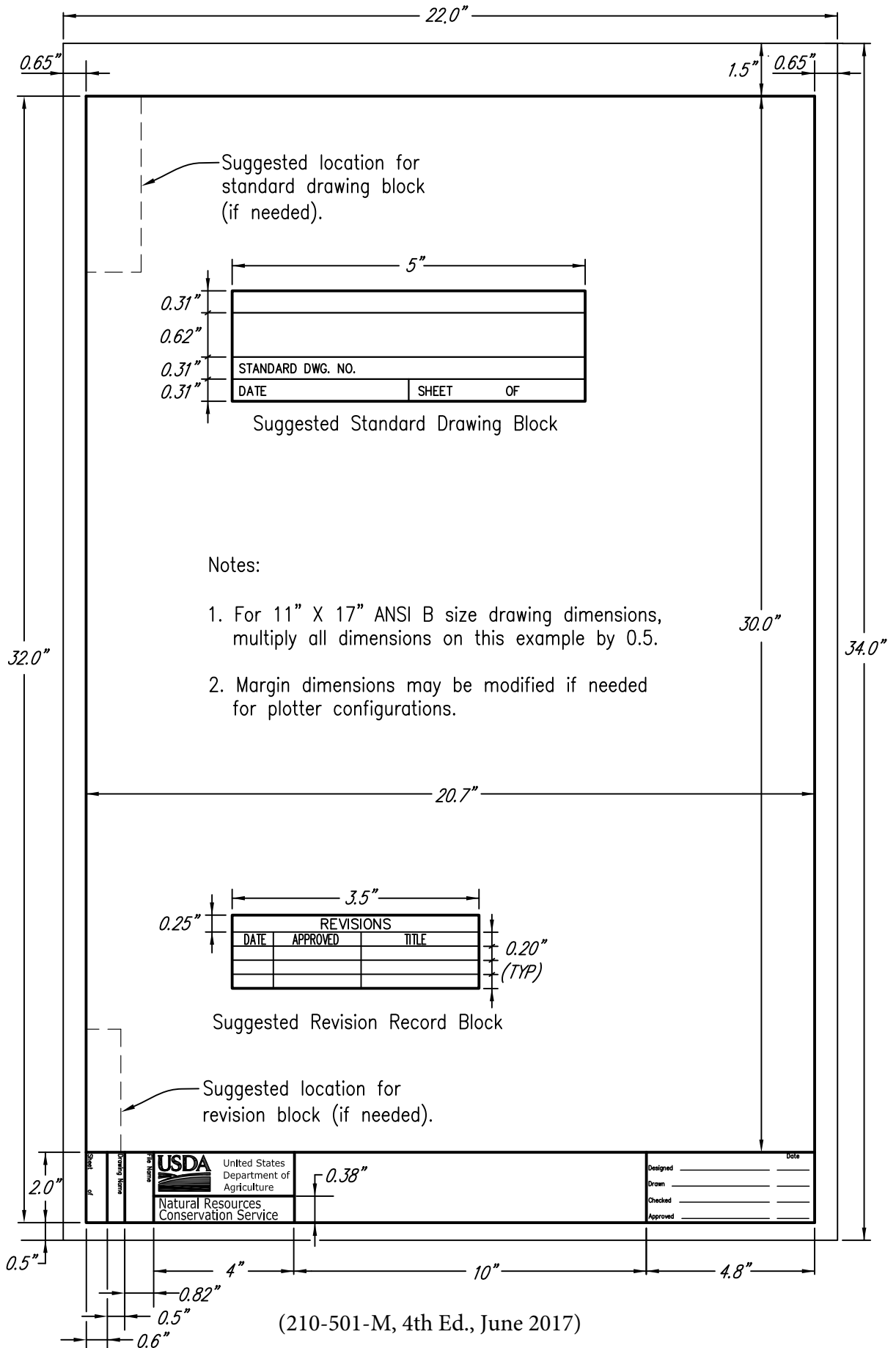
Part 541 – Drafting and Drawings

541.9 Standard ANSI A (8.5x11) Sheet



Part 541 – Drafting and Drawings

541.10 Standard ANSI D (22x34) and ANSI B (11x17) Sheets



Part 542 – Specifications

Subpart A – Construction Specifications

542.0 General

- A. NRCS uses standard construction specifications as a tool to ensure consistency and efficiency with the many contracts administered through various programs.
- B. Specifications are the written portion of the contract documents that convey the requirements for materials, equipment, systems, standards, workmanship for the project, and performance of related services. The national standard specifications must be supplemented for specific projects. The content of the standard specifications will be developed and maintained in a manner that ensures adherence to State laws and NRCS regulations and prevents conflict with other contract provisions. The national specifications can be found in Title 210, National Engineering Handbook (NEH), Part 642, on the eDirectives Web site.
- C. Generally, specifications take precedence over the construction drawings in claims or disputes. Equal attention must be given to both when developing suitable site-unique drawings and project-unique specifications.

542.1 Scope

- A. Specifications must be developed as outlined in 210-NEH, Part 642, “Specifications for Construction Contracts,” and incorporated in all contracts prepared for projects that are designed or installed by NRCS. Exceptions may be granted by the State conservation engineer (SCE) if the type of work is outside the standard NRCS scope of expertise or due to other concerns. Specifications formats must remain consistent throughout a set of contract documents.
- B. Design drawings and specifications must reflect the level of complexity of the project. The responsible engineer or employee determines the adequacy of the drawings and specifications. Responsibility is determined in accordance with the level of engineering approval authority as defined in part 501 of this manual.
- C. Contracts for NRCS-funded projects designed by others and installed under non-Federal contracts may use specifications other than NRCS construction and material specifications. Sponsoring local organizations that either prepare their own designs or hire architect-engineer (A&E) firms for design are not required to use NRCS standard specifications but are encouraged to do so. Non-NRCS specifications must be compatible with all other provisions in the contract documents and must be equivalent to the NRCS standard specifications such that the completed project achieves similar standards of quality to NRCS construction efforts.
- D. Agreements with sponsoring local organizations and contracts with A&E firms for engineering design services must include preparation of construction and material specifications in the appropriate format (see section 542.01 A and C above).

542.2 Preparation of Standard Specifications

- A. Procedures for use of specifications for construction contracts are outlined in 210-NEH, Part 642, Chapter 1. National standard specifications for construction are located 210-NEH, Part 642, Chapter 2, and material specifications are in Chapter 3.
- B. The national standard specifications must be utilized verbatim, with two exceptions:

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- (1) Revisions allowed in paragraph D, below
- (2) Alternative methods that do not apply to the project may be deleted, as described in 210-NEH, Part 642, Chapter 1

C. National standard specifications are revised and issued through the Director, Conservation Engineering Division (CED), and become effective immediately upon posting on the eDirectives Web site.

D. The SCE may adapt the national construction and material specifications to better fit specific State needs.

- (1) The national specifications may be adapted if the amended specification is more stringent than the national specification.
- (2) If the SCE determines that a less-stringent specification is needed for certain practices within the State, then the amended specification and the circumstances for use must be approved by the Director, CED.

E. The SCE is responsible for the development of any new specifications at the State level. A new specification at the State level is issued as an interim specification with a maximum lifespan of 3 years following the issue date. At the end of an interim specification life, the SCE may allow the specification to expire or request action from the national construction engineer. There are two possible outcomes from requesting action:

- (1) If the specification has limited applicability (useful only in one or two States), the specification may be granted permanent status for the State submitting it. Maintenance of the specification will be the responsibility of the SCE.
- (2) If the specification is applicable to three or more States, the Director, CED, will evaluate it for inclusion as a national specification. The lifespan of the original interim specification may be extended until such time as the new national specification is released. State experience and recommendations must be provided if inclusion in the national specifications is requested.

F. Interim specifications may be written to address new technologies or materials. A variance must be requested from the Director, CED, prior to use in any contract documents. For each product or technology, include—

- (1) Technical data.
- (2) Benefits provided.
- (3) References where the product or technology has been used.
- (4) Independent laboratory test results, if applicable.
- (5) Draft specifications for the product or technology.

G. Variances may be approved on an evaluation basis. The manufacturer or supplier must be willing to be present during installation, as applicable, to ensure recommended procedures are followed. Do not use product or technology names in writing specifications.

542.3 Reference Specifications

A. Reference specifications are those specifications developed and issued by other agencies, associations, societies, or institutes, which are cited in 210-NEH, Parts 642, and Title 450, National Handbook of Conservation Practices (NHCP).

B. The SCE must develop a system to maintain all current reference specifications cited in 210-NEH, Part 642, and 450-NHCP, as noted in section 542.20 of this manual, with the exception of American Society for Testing and Materials (ASTM) standards (see section 542.03E below).

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C. Other NRCS engineering staff members designated by the SCE are to maintain or have direct access to copies of reference specifications as noted in section 542.20 of this manual.

D. Reference specifications that are outdated must be removed from the reference file at the time a revised or updated version is received.

E. ASTM standards cited in 210-NEH, Part 642, and 450-NHCP are made available to all NRCS and conservation district employees who are authorized to use an NRCS computer. The electronic standards are available through a portal (ASTM Portal) provided by ASTM International and accessed using an NRCS computer. ASTM standards downloaded from the ASTM Portal may not be transmitted electronically, in accordance with the NRCS agreement with ASTM International.

F. “As-built” documents and files must contain a list of all of the specific construction contract reference specifications used.

Part 542 – Specifications

Subpart B – Engineering Services Specifications

542.10 General

Technical assistance may be obtained from other sources for various reasons, including—

- (1) Resources not being available to meet commitments.
- (2) Specialty area expertise not being available within the agency.

542.11 Technical Services

A. Technical expertise in differing subject areas may be needed to assist NRCS in meeting program commitments. This assistance would generally be considered in one of the following categories:

- (1) Professional services
- (2) Architectural and engineering (A&E) services

B. Procurement for the above-listed services must be in accordance with applicable Federal acquisition regulations, USDA acquisition regulations, and NRCS mandatory procedures (MPs).

C. The contracting officer (CO) is responsible for development and administration of the contract. The State conservation engineer (SCE) is responsible for developing the technical requirements for the procurement. The SCE must outline clear and concise requirements for service contracts.

D. The SCE, under the direction of the CO, must develop quality control and quality assurance (QA/QC) plans and contract administration procedures for A&E contracts.

Subpart C – Exhibits

542.20 List of Reference Specifications

A. An index that includes the designation, current issue date, and title of reference specifications (with the exception of ASTM International standards) must be maintained by each State conservation engineer (SCE). These are the specifications referenced in Title 210, National Engineering Handbook, Part 642, and Title 450, National Handbook of Conservation Practices.

B. Each SCE must post a current index of reference specifications electronically so that it is available to all offices and individuals. Alternatively, hardcopies may be provided.

C. Only the most current copy of each reference specification must be used for contract purposes. The reference specification included in the contract is the applicable standard for that project, regardless of whether the reference specification is changed or updated after contract award. The contract may be modified to include the updated reference specification, if needed. Care must be taken to avoid the potential use of obsolete or out-of-date specifications.

D. Reference specifications that may be listed in this section could include but are not limited to the following:

- (1) American Association of State Highway and Transportation Officials (AASHTO)
- (2) American Concrete Institute (ACI)
- (3) American National Standards Institute (ANSI)
- (4) American Water Works Association (AWWA)
- (5) American Welding Society (AWS)
- (6) American Wood Preservers Association
- (7) Product standards
- (8) Steel Structures Painting Council

Part 543 – Materials

543.0 General

The designer is responsible for the choice of materials used in a design, the coordination of the design, and the material specifications. Materials used in construction must comply with the material specifications.

543.1 Scope

Materials are selected based on a number of factors, including but not limited to quality, project budget, availability, cost, longevity, project economic life, ease of installation and maintenance, life cycle costs, compatibility with site conditions and other materials, and public health and safety. Materials may be those items or products used in either conservation practices or construction specifications. NRCS does not maintain a national approved-products list for construction-related materials, although States may maintain such a list.

543.2 Use of New Materials

A. New materials are those materials that are not specifically identified either in a conservation practice standard or national material specification (Title 210, National Engineering Handbook (NEH), Part 642).

B. New materials and products frequently appear on the market. They may be selected for use with a conservation practice or construction project. The objective in selecting a new material is to meet or exceed the physical, cost-effectiveness, or functional characteristics of the currently specified material, including the longevity or design life of the material. If a new material could impact the cost or design life of a structure or practice, then the rationale for its use must be documented for the files.

C. A new material's physical or functional characteristics should meet or exceed those of the standard specified material. The new material should have reference standards directly applicable to it, so the physical characteristics can be verified and quantified. The decisionmaking process should also include verification of the material or product's past performance and independent laboratory test results. The State conservation engineer (SCE) is responsible for the selection, evaluation, and decision to use a new material within the appropriate level of engineering design approval authority. If a new material is proposed for a conservation practice, a variance from the conservation practice standard may need to be requested, per policy contained in Title 450, General Manual, Part 401, Subpart B, "Conservation Practice Standards."

D. New products should be used on an evaluation basis. The manufacturer or supplier should be willing to provide the product and be present during installation to ensure recommended procedures are followed. Upon completion of the practice installation or construction project, the new material must be evaluated. The evaluation period should generally be 1 year, unless a longer period is deemed necessary. The evaluation should include such factors as material quality control, ease of installation, records from any periodic inspections conducted during the evaluation period, problems encountered, and assessment of future use. A brief evaluation report must be prepared after the completion of the evaluation period.

E. The SCE must forward copies of any completed evaluation reports to the Director, Conservation Engineering Division. The SCE should include a recommendation on each new material used (i.e., discontinue use, research further, or include in specifications or conservation practice standards). The

evaluation reports will be made available to others within NRCS and to agency partners and used to determine if a new material has a potential for future inclusion into a conservation practice standard or national material specification.

543.3 New Material Specification Preparation

A. The designer is responsible for preparing project-specific material specifications if there are no applicable material specifications in 210-NEH, Part 642. The designer must ensure that the material specifications are coordinated with the materials used in the design.

B. Performance specifications are preferred. A performance specification states requirements in terms of the required results and provides criteria for verifying compliance, but it does not state methods for achieving results. It defines the functional requirements for the product, the environment in which it must operate, and the interface and interchangeability requirements. Avoid brand-name descriptions.

Part 544 – Equipment

544.0 General

Much of the equipment utilized to collect data, test materials, and store samples are sensitive to vibration, weather, or other environmental conditions. All equipment must be maintained, transported, and stored properly. Taking extra care to handle equipment properly and in accordance with the manufacturer's recommendations helps ensure accurate data collection and reduces downtime due to inoperable equipment. Nuclear moisture and moisture-density gauges have special requirements for permitting, including training, due to the license requirements of USDA from the Nuclear Regulatory Commission.

544.1 Radiation Use Permits

Permits issued by the USDA Office of Homeland Security and Emergency Coordination's Radiation Safety Division are required to operate, store, and transport nuclear gauges. Refer to the permit conditions for moisture-density gauges posted by the Radiation Safety Division at <https://www.dm.usda.gov/ohsec/rsd/index.htm>. The permit conditions cover requirements for authorized users, field use, transportation, storage, personnel radiation monitoring, equipment testing, training, disposal, and record keeping.

544.2 Transporting Equipment

Sensitive equipment, such as survey equipment, requires special handling and transport. Follow all manufacturers' recommendations concerning the operation, maintenance, transport, and storage of the equipment. Equipment will be transported only in the appropriate containers and braced to minimize shifting. Special requirements must be followed in the handling and transporting of equipment that contain radioactive sources. The manufacturers' requirements and all terms and conditions of the permit for a nuclear moisture-density gauge must be followed.

544.3 Adjustment and Calibration

All equipment utilized to collect data for designs and to provide quality assurance must be checked frequently to ensure accurate information is being obtained. All equipment must be checked, adjusted, and calibrated in accordance with the manufacturers' recommendations, preferably by personnel trained in the care and maintenance of the equipment.

544.4 Maintenance

All equipment must be kept in good working order, following the maintenance instructions provided by the manufacturer. Do not attempt any maintenance that exposes the radioactive source of a nuclear moisture-density gauge.

544.5 Storage

All equipment must be stored in clean, dry conditions as recommended by the manufacturer. Nuclear moisture-density gauges have requirements concerning location, security, and signage. Storage and security requirements for nuclear moisture-density gauges are covered in the permit conditions for moisture-density gauges (see section 544.1 above).

544.6 State Procedures

A. Each State conservation engineer must develop specific procedures for ensuring proper care and maintenance of engineering equipment, including storage and carrying cases. The procedures should outline the minimum skills needed to operate the equipment, specific transport requirements, and specific guidelines to follow during usage.

B. Information about proper cleaning, maintenance, and repairs should be available to all personnel assigned or permitted for equipment. Scanned copies of manufacturers' information and manuals posted on a shared drive or other electronically accessible portal is acceptable, as is posting links in the same locations to manufacturers' Web sites. If hardcopies are the only format available, then copies of the manufacturers' information should be provided to all personnel with responsibilities for that equipment type and model. If the State has individuals with equipment operation and maintenance responsibilities, their names and telephone numbers should be provided to offices within the State with equipment.