



Natural Resources Conservation Service  
655 Parfet Street, Room E200C  
Lakewood, Colorado 80215

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NATIONAL ENGINEERING MANUAL  
210-V  
AMENDMENT CO 18 – (Part 501)

**SUBJECT:** ENG – ENGINEERING REVIEW AND APPROVAL POLICY

Purpose. To amend National Engineering Manual (NEM), Part 501, as described below.

Effective Date. This Amendment is effective upon receipt.

Explanation. This Amendment modifies current Colorado policy for engineering practice review and approval. The principle changes resulting from this amendment are:

- The threshold job classification where preparation of a Preliminary Design Report is mandatory was increased from Class V to Class VI projects;
- A provision is added for delegation of job approval authority to Conservation District employees;
- Practice spot check criteria is changed by reference to the State Quality Assurance Plan;
- Job classification limits were changed or added for the following practices: excavated ponds, livestock pipelines, turbine pumps, terrace, concrete waste storage structures, animal mortality facility, anaerobic digesters, and waste treatment.

Filing Instructions. Replace the current Colorado Directive Tabulation Sheet with the one dated March, 2006.

- Discard pages: CO 501-12(1) through CO 501-12(16), (Amendment No. CO17, dated January, 2004).
- Insert pages: CO 501-12(1) through CO 501-12(17), (Amendment No. CO18, dated March 2006), immediately after NEM page 501-12.

/s/ Edward M. Biggers, Jr acting for

ALLEN GREEN  
State Conservationist

Attachments: New Tabulation Sheet  
NEM Amendment CO18

DIST: All Area and Field Offices  
All Engineers



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**§CO501.00 General**

(e) Preliminary Design Reports are required for all class VI jobs and higher. However, preparation of a Preliminary Design Report is encouraged for all complex or costly projects and group projects, regardless of the project's engineering job classification. The preliminary design report should be prepared prior to the "practice implementation" step in the conservation planning process, and prior to spending any significant amount of technical or financial resources on the design of the selected alternative(s). The purpose of the preliminary design report is to verify job classification, to obtain technical concurrence for the selected alternative and the proposed site investigation and design methods, to identify any special planning, design or construction considerations, and to obligate an adequate amount of NRCS staff time to complete the project. The preliminary design report shall be signed by the Area Conservationist authorizing use of Field and Area Office staff resources on the project, by the State Conservationist authorizing use of state or higher-level staff resources on the project, and by the State Conservation Engineer for concurrence with the technical content of the report. Exhibit CO-1, *Preliminary Design Report Template*, shall be used as a guide in preparing the preliminary design report.

**§CO501.01 Scope**

(b)(3) In compliance with *Laws of the State of Colorado Regulating The Practice of Professional Engineering*, NRCS Engineering Job Approval Authority shall not be assigned to a non-NRCS employee, unless: (1) The individual is a conservation district employee; or (2) The individual is licensed as a Professional Engineer in Colorado.

**§CO501.03 Compliance of engineering work with laws and regulations.**

(c)(2) Engineering reports, construction drawings and specifications, and other related information that must be submitted to a State or Local regulatory authority as supporting data for a permit, shall be signed and sealed by a Professional Engineer licensed in Colorado who also has adequate job approval authority for the applicable practice component(s).

**§CO501.04 Colorado engineering job approval authority.**

(b)(3) Job approval authority shall be assigned according to the classification limits established on form CO-ENG-9, *Colorado Job Approval Authority Classification*, as shown in §CO501.09. Where a job contains multiple practices or components, the entire job shall be classified according to the practice or component requiring the highest level of approval authority. Individuals shall be given a level of approval authority commensurate with their training, experience, and demonstrated competence to design or install conservation practice component(s). Form CO-ENG-11 (exhibit CO3) may be used to assess an individual's engineering skills in relation to the skills required for a given level of job approval authority. Individuals shall only be assigned job approval authority for design or construction of those practices or components that are a part of their normal work. On an individual basis, additional or more restrictive controlling factors can be added to those shown on CO-ENG-9 as appropriate. The process for delegation of engineering practice planning approval authority is described in Colorado Amendments to General Manual 180-409.

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(b)(5) The State Conservation Engineer shall assign job approval authority to all NRCS engineers at the GS-11 grade level or above, and all non-NRCS engineers requesting delegated authority. Area Engineers shall assign job approval authority to other NRCS and conservation district employees within their Area. Area Engineers may not delegate authority for a practice that exceeds the level delegated to them for that practice. Form CO-ENG-9 shall be used to document the level of job approval authority assigned to each individual.

Job approval authority shall be reviewed annually for employees in their present position for less than three years and at least once every three years for all others. The level of job approval authority may be reduced when the review indicates the employee lacks competence with design or installation of a practice or a practice is no longer part of the employee's normal work.

Individuals are encouraged to work on phases of projects that exceed their approval authority under the technical guidance of an experienced employee that has approval authority for that work.

(e) Technical review and approval of all engineering reports, drawings, specifications and other related information shall be documented by the placing the original signature, title and date of the person approving the work on the cover sheet or title page. Electronic signatures are not acceptable. Approval of any subsequent changes must be documented in the same manner.

**§CO501.05 Engineering job review.**

(a) All engineering reports, designs, drawings, specifications, and related information shall be reviewed and checked for accuracy as illustrated in Exhibit CO-2, Colorado Engineering Quality Assurance Process, and as described below.

(a)(1) NEM §511.05(a) describes the requirements for checking engineering work. Whenever possible, work should be checked for accuracy by someone other than the individual who performed the work. Individuals may check their own work on Class I, II and III jobs when another person with the appropriate skills is not available to perform this task in a reasonable timeframe. All Class IV and higher jobs must be checked by someone other than the individual who performed the work.

(a)(3) NEM §511.05(b) describes the required components of an engineering design review. Individuals with adequate job approval authority may review their own work for Class I, II and III jobs only. Design Reviews for Class IV and V jobs will be performed by someone other than the individual who did the work who has adequate design approval authority for the work being reviewed. Class VI and higher jobs will be reviewed in accordance with NEM §501.05 (a)(3).

(b) Post Reviews. Post Reviews of projects planned, designed or constructed with NRCS engineering assistance will be performed in accordance with the Colorado NRCS Quality Assurance Plan and General Manual Part 450. The State Conservation Engineer will perform a post review inspection of selected Class I-V jobs, and all Class VI and higher jobs completed in each area each year.

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§CO501.09 Colorado Engineering Job Approval Authority Classification

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COLORADO ENGINEERING JOB APPROVAL AUTHORITY

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OF AGRICULTURE

NAME: Practice Code	Practice Name or Component	TITLE: Controlling Factor	Units	GRADE: CS -				LOCATION:			Maximum Approval Limits Design Construction
				Class I	Class II	Class III	Class IV	Class V	Class VI		
	Assistance to Units of Government, Community Service Groups,(CSG), Private Companies or Corporations and Similar Organizations on problems not closely associated with normal rural resource conservation activities	Organizational Level	Type			Single City or County	Multiple City or County	Federal State	All		
	Urban Development, Stormwater Management, Erosion Control, & other similar plan reviews	Plan Area	acres	40	160	640	All				
	Any Practice	Hazard potential as defined in NEM §503	class	Low	Low	Low	Low	Low	Significant		
560	Access Road Culvert Bridge Slope	Diameter Total Span Slope Gradient	inches feet percent	18 none <5	24 none 8	36 none 10	48 none 20	60 16 all	All All All		
<b>DAMS AND OTHER WATER IMPOUNDMENTS</b> Applies to structures with relatively impervious cutoffs, uniform foundations and no known geologic hazards											
349	Dam, Multi-purpose	Drainage Area	acres	100	500	1,000	2,000	12,800	25,600		
350	Sediment Basin		feet	10	10	15	15	35	50		
378	Pond	Storage x Effective Height	acre-ft <sup>2</sup>	500	1,000	1,500	2,000	3,000	All		
379	Commercial Fishpond										
402	Dam, Floodwater Retarding	Excavated Pond Volume	acre-feet	0.5	2	4	10	20	All		
410	Grade Stabilization Structure	<i>All practices requiring technical review and approval by the Colorado State Engineer's Office must also have the approval of the State Conservation Engineer</i>									
436	Irrigation Storage Reservoir										
552	Irrigation Regulating Reservoir										
<b>SPILLWAYS AND OTHER HYDRAULIC STRUCTURES</b>											
	Concrete (single pipe spillways)	Diameter	inches	12	18	24	36	48	All		
	Box Culvert (Standard Designs)	Area of Opening	square feet					16	All		
	Straight Drop Spillway	Net Drop (F)	feet	4	2	3	4	All			
		Weir Depth (h)	feet	100	300	400	500				
		Weir Capacity	cfs								
Supplement to all Practices Construction											

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Practice Code	Practice Name or Component	Controlling Factor	Units	GRADE: G.S.					LOCATION:			
				Class I	Class II	Class III	Class IV	Class V	Class VI	Design	Construction	
<b>SPELLWAYS AND OTHER HYDRAULIC STRUCTURES (continued)</b>												
Supplement to all Conservation Practices	Box Inlet Drop Spillway (open or to conduit)	Net Drop (F) Weir Capacity	feet cfs							6 500		
	Toe Walls (using standard plans)	Net Drop (F)	feet							4		
		Weir Capacity	cfs							300		
	Chutes	Net Drop (F)	feet							12		
		Weir Depth (h) Weir Capacity	feet cfs							3 300		
	Slide Gates	Gate Capacity	cfs	100	150			250	500	All		
		Size, Greatest Dimension	feet	18	24			36	48	All		
	Siphon (use 430 - Pipeline for inverted siphon)	Working Head	feet	≥ 10	8			6	4	2	All	
		Capacity	gpm	500	1,500			2,500	3,000	5,000	All	
	Long Span Supported Steel Pipe	Nominal Diameter	inches		12	18		24	36	48	All	
Capacity		cfs		2	4		6	10	10	All		
587	Structure for Water Control In Piped System In Open Channel System	Use controlling factors & criteria for dams and										
		Capacity	gpm	500	1,500	2,500	3,000	5,000	All			
<b>IRRIGATION SYSTEMS &amp; COMPONENTS</b>												
320	Irrigation Canal or Lateral	Capacity	cfs	10	25	100	200	500	1,000			
		Length	feet	5,000	10,000	15,000	25,000	All				
348	Dam, Diversion	Streamflow (25 yr) Flow Diverted	cfs cfs		500	1,000	1,500	2,000	3,000			
		Net Drop (F)	feet	2	2	4	6	8	15			
388	Irrigation Field Ditch	Design Capacity	cfs	4	6	10	25	All				
		Design Capacity	cfs	10	25	50	100	200	All			
428	Canal Lining	Design Velocity	fps	4	6	9	1.5	All				
		Bottom Width	feet	2	3	4	6	All				
		Pipe Diameter	inches	18	36	48	60	All				

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Practice Code	Practice Name or Component	Controlling Factor	Units	GRADE:						LOCATION:	
				Class I	Class II	Class III	Class IV	Class V	Class VI	Maximum Approval Limits Design	Maximum Approval Limits Construction
<b>IRRIGATION SYSTEMS &amp; COMPONENTS</b> <i>continued</i>											
430	Irrigation Pipeline	Maximum Pressure	psi	12	80	100	150	All			
	Working Pressure < 50 psi	Nominal Diameter	inches		18	24	36	48	All		
	Working Pressure < 50 psi	Pumped Capacity	gpm		1,500	2,500	3,000	5,000	All		
	Working Pressure > 50 psi	Gravity Capacity	gpm		1,500	2,500	3,000	5,000	All		
	Working Pressure > 50 psi	Pumped Capacity	gpm		1,000	2,000	3,000	3,500	All		
	Working Pressure > 50 psi	Gravity Capacity	gpm		1,000	2,000	3,000	3,500	All		
430-HH	Rigid Gated Pipeline	Maximum Head	feet		15	23	All				
		Minimum Head	feet		5	1	All				
441	Irrigation System, Drip	Area Benefited	acres	2	5	40	160	All			
442	Irrigation System, Sprinkler	Area Served	acres	40	80	160	640	All			
443	Irrigation System, Surface and Subsurface	Area Served	acres	40	80	160	640	All			
447	Irrigation System, Tailwater Recovery	Pumped Capacity	gpm			1,000	2,000	3,500	All		
464	Irrigation Land Leveling	Ave. Cut Volume per Acre	cy.yd./acre	400	600	1,000	1,750	All			
466	Land Smoothing	Area Treated	acres	40	80	160	640	All			
	Irrigation Erosion Control, Polyacrylamide	Area Treated	acres	20	40	80	160	All			
<b>WATER SUPPLY SYSTEM &amp; COMPONENTS</b>											
432	Dry Hydrant	Capacity	gpm	250	500	700	1,500	All			
		Lift (static head)	feet	5	10	15	15	All			
516	Pipeline	Pressure	psi	50	100	150	200	300	All		
		Length	miles	1	2	5	20	All			
		Diameter	inches	2	2	2.5	4	All			
521	Pond Sealing (for all practices except waste impoundments)	Area Treated	acres	1	2	5	10	All			
533	Pumping Plant for Water Control	Design Capacity	gpm		5,000	10,000	20,000	50,000	100,000		
	Actual Flow Pump	Static Head	feet		15	15	15	15	All		
	propeller mixed flow	Static Head	feet		50	50	50	50	All		

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Practice Code	Practice Name or Component	Controlling Factor	Units	GRADE: GS -						LOCATION:	
				Class I	Class II	Class III	Class IV	Class V	Class VI	Maximum Approval Limits Design	Maximum Approval Limits Construction
<b>WATER SUPPLY SYSTEM &amp; COMPONENTS</b> <i>continued</i>											
533	Pumping Plant for Water Control Centrifugal Pump Turbine Pump Photovoltaic Powered Pump	Design Capacity Static Head Design Capacity Static Head Design Capacity Static Head	gpm feet gpm feet gpm feet	All 500 50 20	1,000 50 1,000 100 5 20	2,000 100 2,000 200 5 50	3,150 200 3,150 300 10 100	3,500 350 3,500 500 20 200	5,000 500 5,000 1,000 All All		
574	Spring Development	Installations	number	All							
614	Watering Facility (trough or tank)	Prefab. & Std. Designs Special Designs	gal. gal.	1,000 500	2,600 750	6,000 1,000	All 2,500	All All			
642	Well	Depth Required Yield	feet gpm		100 5	300 10	1,000 20	All All			
351	Well Decommissioning	Depth Diameter	feet inches	50 4	100 6	300 12	1,000 24	All All			
<b>STREAM &amp; CHANNEL SYSTEMS</b>											
326	Cleaning & Snagging	Bankfull Capacity	cfs	500	1,000	2,000	5,000	All			
356	Dike	Risk Design Height	Class feet	III 3	III 6	III 8	III 8	III All	All		
400	Floodwater Diversion	Design Capacity	cfs	100	200	300	400	500	All		
404	Floodway	Design Capacity	cfs		100	200	500	1,000	2,000		
580	Streambank & Shoreline Protection Shoreline Protection Vegetative Streambank Protection Mechanical Streambank Protection	Wave Height Bankfull Capacity Bankfull Velocity Bankfull Capacity Bankfull Velocity	ft cfs fps cfs fps		500 <5 500 <5	1,000 6 1,000 6	2,000 8 2,000 8	3 5,000 10 5,000 10	5 20,000 12 20,000 12		
582	Open Channel	Design Capacity Design Velocity	cfs fps	25 2	100 5	200 6	500 8	1,000 10	2,000 12		
584	Stream Channel Stabilization	Design Capacity Design Velocity	cfs fps	25 2	100 5	200 6	500 8	1,000 10	2,000 12		

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Practice Code	Practice Name or Component	Controlling Factor	Units	GRADE:					LOCATION:					
				Class I	Class II	Class III	Class IV	Class V	Class VI	Maximum Design	Maximum Approval Limits Construction			
<b>EROSION CONTROL &amp; WATER MANAGEMENT SYSTEMS</b>														
362	Division	Design Capacity	cfs	15	25	100	500	All						
412	Grassed Waterway	Design Capacity Velocity	cfs	25	100	200	500	All						
468	Lined Waterway or Outlet	Design Capacity	fps	2 to 4	2 to 5	2 to 5	2 to 5	All						
532	Pumped Well Drain	Design Capacity	cfs	25	100	200	500	All						
554	Regulating Water in Drainage Systems	Pump Capacity	gpm			2,500	5,000	All						
600	Terrace	Area Benefited	acres	10	20	40	80	160	All					
606	All Gradient Terraces Level Terrace Flat Channel Terrace Flat Channel Terrace	Area Treated	acres	40	80	160	640	All						
		Maximum Land Slope	percent	4	8	12	16	All						
		Maximum Land Slope	percent	4	8	10	12	All						
		Maximum Land Slope	percent	2	3	4	5	All						
606	Subsurface Drain Pattern Drain Interceptor Drain	Channel Width	feet	20	50	80	100	All						
		Area Benefited	acres	10	20	40	80	160	All					
607	Surface Drain - Field Ditch	Length	feet	200	500	800	1,200	All						
608	Surface Drain - Main or Lateral	Design Capacity	cfs			5	10	All						
		Design Capacity	cfs	10	25	100	500	1,000	2,000					
		Design Velocity	fps	2 to 3	4	5	<2 or 5-7	10	12					
620	Underground Outlet	Design Capacity	cfs	2	5	10	15	All						
630	Vertical Drain	Design Flow	cfs	10	50	100	All							
638	Water and Sediment Control Basin	Design Height	feet	3	5	10	10	All						
		Drainage Area	acres	5	20	40	80	All						
<b>LAND RECLAMATION</b>														
453	Landslide Treatment	Area Treated	Depth	acres		0.25	0.5	1	5					
			Slope	feet	2	5	8	10	20	All				
460	Lead Cleaning	Area	Area	percent	10	15	20	30	50					
			Area	acres	20	40	80	160	All					
500	Obstruction Removal	Area	Area	acres	20	40	80	160	All					
			Acres without complex	acres	10	40	160	640	All					
543, 544	Land Reclamation - Currently owned & Abandoned Liquid Load	Area	acres	5	10	20	40	All						
566	Recreation Land Grading & Shaping	Area	acres	5	10	20	40	All						
568	Recreation Trail & Walkway	Length	feet	2,000	5,000	All								

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Practice Code	Practice Name or Component	Controlling Factor	Units	GRADE: GS -						LOCATION:		
				Class I	Class II	Class III	Class IV	Class V	Class VI	Design	Construction	Maximum Approval Limits
<b>AGRICULTURAL WASTE MANAGEMENT</b>												
CNMP	Manure and Waste Handling and Storage Plan Approval	Animal Units (AU) (1000 lbs. Animal Weight)	# AU	50	150	300	1,000	3,000	All			
313	Waste Storage Structure Earthen Impoundments Cast in Place Concrete Prefabricated Tanks Timber Structures	Design Volume Embankment Height Design Volume Wall Height Vendor Design Wall Height	cubic feet feet cubic feet feet	50,000 3 50 4	100,000 3 250 4	500,000 3 1,000 4	1,000,000 10 2,500 5	2,000,000 10 5,000 8	5,000,000 All All All All			
316	Animal Mortality Facility	AU Handled / Year	cubic feet	none	5	10	100	200	All			
317	Composting Facility	Raw Waste Volume / Year	cubic feet	20,000	40,000	200,000	400,000	800,000	All			
359	Waste Treatment Lagoon Passive Aerobic Anaerobic Mechanically Airstered	Embankment Height Treatment Surface Area Design Volume Design Volume	feet acres cubic feet cubic feet	3 1 50,000 none	3 2 100,000 none	3 5 500,000 none	10 10 1,000,000 none	10 25 2,000,000 1,000,000	All 50 5,000,000 All			
360	Closure of Waste Impoundments	Volume	cubic feet	50,000	100,000	500,000	1,000,000	2,000,000	5,000,000			
367	Waste Facility Cover	Surface Area	square feet	none	none	none	none	none	All			
365,366	Anaerobic Digester (all types)	Daily Treatment Volume	cubic feet	none	none	none	none	none	All			
521	Pond Sealing or Lining Compacted Clay Treatment Geosynthetic Liner Bentonite or Dispersant Treatment	(waste impoundments only) area area area	acres acres acres	none none none	0.5 0.5	1 1	2 2	All All				
591, 629	Waste Treatment	Daily Treatment Volume	cubic feet	none	none	none	none	none	All			
558	Roof Runoff Management	Roof Area	sq. ft.	1,000	5,000	10,000	All					
632	Waste Separation Facility	Treatment Volume	gal/day	none	500	1,000	2,000	5,000	All			
634	Manure Transfer	Size of Operation	AU	50	150	300	1,000	3,000	All			
635	Wastewater Treatment Strip for Feedlot Runoff for Milking Center Wastewater	Drainage Area Treatment Volume	acres gal/day	none none	1 500	2 1,000	5 2,000	10 5,000	All All			
656	Constructed Wetland	Wetland Area	acres	none	none	none	none	All				
702	Agri-Chemical Handling Facility	Containment Volume	cubic feet	none	1,250	2,500	5,000	10,000	All			



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**EXHIBIT CO-1          Preliminary Design Report Template**

PRELIMINARY DESIGN REPORT

Project Name: {job name}  
Engineering Job Class:

Owner/Sponsor: {individual(s) or group name}

Field Office:  
Conservation District:

Prepared By: {name, title, location}  
Date of Report: {date}

I. PROJECT DESCRIPTION

A. Client/Sponsor Information

1. Name of Client(s) & type (individual, group, unit of government, etc.)
2. Client objective(s) & expectations for the project.
3. Evaluate client's commitment to follow NRCS plans & specifications.
4. Evaluate client's capability to fund the project.
5. Proposed construction dates.

B. Project Components.

1. Practice name(s) & code(s)
2. Extent of practice(s) to be installed (size, length, volume, etc.)
3. Hazard Classification (see NEM Part CO-503).
4. Basis for engineering job classification.

C. Location

1. Legal description & name(s) of applicable U.S.G.S. Quad Sheet(s).
2. Location of nearest town.
3. Accessibility

D. Background Information

1. Description of the problem the project will address.
2. Describe any previous investigations by NRCS or others.
3. Status of required water rights, fillings, dam permits, 404 permits, etc., necessary to complete the project or otherwise pertinent to the job.
4. Describe the history of existing structures, applicability of NEM, Part 501 on repair jobs.

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II. PROJECT FORMULATION

- A. Authorizations for assistance
- B. Alternatives
  - 1. Describe alternative solutions to the problem.
  - 2. Describe reason(s) the preferred alternative was selected.
- C. Feasibility
  - 1. Provide a cost estimate for the selected alternative.
  - 2. Describe source(s) & availability of cost share funds.
  - 3. Describe type & value of expected tangible benefits.
  - 4. Describe type & nature of intangible benefits (e.g. water quality, aesthetics, etc.)
  - 5. Describe any environmental compliance requirements such as 404 permit requirements, wetland mitigation, cultural resource avoidance, outcome of environmental evaluation or an environmental assessment, etc.

III. DESIGN REQUIREMENTS

- A. Site Investigation
  - 1. Survey data needs.
  - 2. Geology/soils investigation requirements.
  - 3. Identify presence of utilities, property boundaries, or other site constraints associated with the project.
- B. Design & Construction Elements
  - 1. Hydrologic analysis method.
  - 2. Hydraulic design requirements.
  - 3. Geotechnical analysis/design requirements.
  - 4. Structural design requirements.
  - 5. Environmental considerations.
  - 6. Extent of construction drawings needed.
  - 7. Type & extent of construction specifications needed.
  - 8. Construction inspection requirements.
  - 9. Special considerations.

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IV. STAFF REQUIREMENTS

Task	Duration (days)	Start Date	End Date	Lead Person
Finish Planning:				
Design Hydrology:				
Design Survey:				
Geotechnical Investigation:				
Soil Mechanics:				
Preliminary Design:				
Drawings & Specs:				
Design Review:				
Final Drawings and Specs:				
Design Approval:				
Permits and Easements:				
Land Rights Acquisition:				
Project Agreement:				
Award Contract:				
Construction Inspection:				
Final Inspection:				
As Built Drawings:				
Total Time:	xxx	d	Est. Completion date: xx-xx	
		a		
		y		
		s		

V. TECHNICAL CONCURRENCE & ADMINISTRATIVE APPROVAL

A. Technical Concurrence

The information in this report is accurate, the proposed project will accomplish the client's objectives, the proposed design requirements are adequate for the level of complexity associated with this job, and staffing requirements represent the amount of NRCS staff time needed to plan, design, and construct this project.

*Prepared by:*

*Concurred:*

\_\_\_\_\_  
Signature  
\_\_\_\_\_  
Title

\_\_\_\_\_  
State Conservation Engineer

B. Administrative Approval

I have reviewed this report and approved the use of the NRCS staff resources under my direction in order to provide technical assistance for this project, as described in this report.

\_\_\_\_\_  
Area Conservationist

\_\_\_\_\_  
State Conservationist

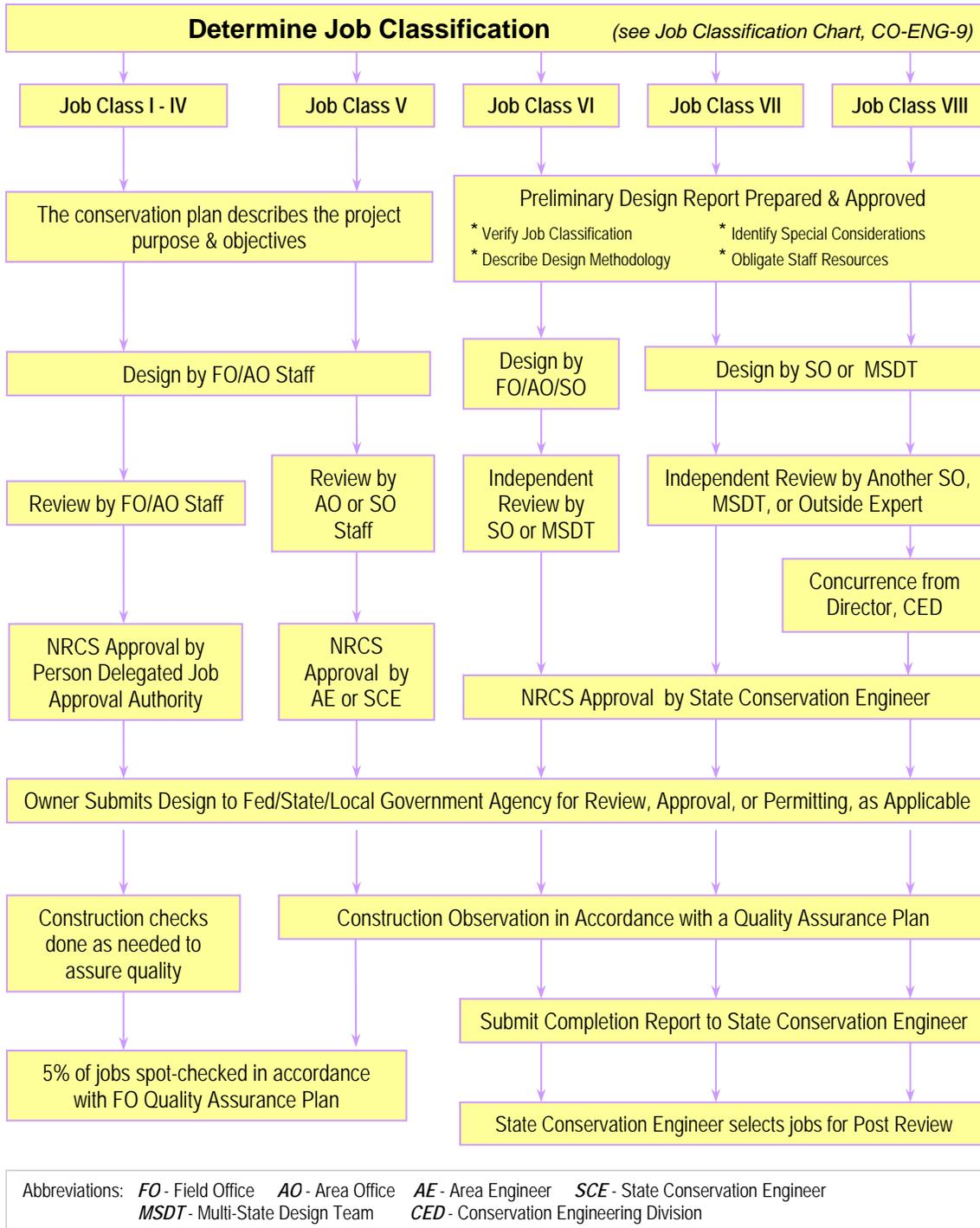
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*(where use of state or higher level staff is required)*

EXHIBIT CO-2 Engineering Quality Assurance Process

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*Colorado NRCS Engineering Quality Assurance Process*



**EXHIBIT CO-3. Engineering Skill Assessment**

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USDA-NRCS  
Colorado

**CO-ENG-11**  
rev: 1-03  
File code: 210

**ENGINEERING SKILLS ASSESSMENT**

Name: _____	Title: _____	Grade: _____
Location: _____	Date: _____	

Task o.	Skill		Subject Description
	Existing	Needed	
<b>SURVEYING &amp; MATH SKILLS</b>			
S.1.			Ability to perform basic profile and cross section surveys including: note keeping and reduction, stationing, and completing a level circuit as described in EFH Chpt. 1 or TR-62.
S.2.			Ability to maintain horizontal and vertical control for open and closed traverse surveys.
S.3.			Ability to perform basic topographic surveys and produce a topographic map.
S.4.			Knowledge of basic math needed to apply common engineering formulae.
S.5.			Ability to perform earthwork quantity and cut/fill balance computations using average and area, prismatic, four point, horizontal plane or summation methods.
S.6.			Ability to perform typical unit conversions for length, area, volume, time, velocity and flow rate.
S.7.			Ability to field classify soils using both the Unified System and USDA textural system.
<b>HYDROLOGY SKILLS</b>			
H.1.			Determination of design rainfall depths for typical erosion and water control structures.
H.3.			Computing a weighted Runoff Curve Number, runoff volume, and peak discharge (EFH Chpt. 2).
H.4.			Estimating peak discharge for small but complex watersheds with sub-areas using TR-55.
H.5.			Developing runoff hydrographs for complex watersheds with multiple sub-areas using TR-20.
H.6.			Making reservoir routing computations associated with the design of a typical pond.
H.7.			Evaluating the scope and effect of surface or subsurface drains on wetland hydrology.
<b>HYDRAULIC DESIGN SKILLS</b>			
D.1.			Application of weir and orifice flow equations to the solution of common hydraulic problems.
D.2.			Using Manning's equation to estimate velocity & capacity for natural and constructed channels.
D.3.			Evaluation of vegetated channel stability and capacity using "Retardance" (EFH Chapters 7).
D.4.			Evaluation of vegetated channel stability & capacity by tractive stress method (Ag. Hndbk 667).
D.5.			Computing water surface profiles for uniform steady flow in natural & constructed channels.
D.6.			Computing actual and allowable tractive stress on natural channel beds and banks.
D.7.			Geomorphic classification of natural streams using both Rosgen's and Schum's systems.
D.8.			Application of fluvial geomorphic concepts to the solution of channel stability problems.
D.9.			Identification and evaluation of traditional structural alternatives for streambank protection.
D.10.			Identification and evaluation of soil bioengineering alternatives for streambank protection.
D.11.			Computing minor losses, friction losses, and hydraulic grade line elevations using both Hazen-Williams and Manning's equations for full pipe flow in gravity and pumped systems.
D.12.			Estimation of headwater depth or flow rate for culverts for all flow regimes (EFH Chapter 3).
D.13.			Selection & design of flow measurement devices (Parshall flumes, weirs, and flow meters).
D.14.			Computing seepage & uplift forces for typical hydraulic structures (weighted creep & flow net).

<sup>†</sup> SKILL LEVEL RATING: 1-AWARE 2-UNDERSTAND 3-PERFORM W/ SUPERVISION 4-APPLY INDEPENDENTLY 5-CAN TRAIN OTHERS

Part 501 - AUTHORIZATIONS  
Colorado Policy and Procedures

CO-ENG-11 cont.

Task No.	Skill Level†		Subject Description
	Existing	Needed	
<b>STRUCTURAL DESIGN SKILLS</b>			
D.15.			Ability to interpret practice standard requirements and develop site specific design criteria.
D.16.			Determining loads on flexible or rigid pipes using TR-77, TR-5 or industry guides.
D.17.			Determining loads, including lateral earth pressures, on simple structures.
D.18.			Evaluating stability of simple structures for over-turning, sliding, and flotation.
D.19.			Selecting temperature and shrinkage reinforcement for minor concrete structures.
D.20.			Computing shear and moments for simply supported structural members.
D.21.			Computing shear and moments for complex and indeterminate structural members.
D.22.			Design of reinforced concrete members to resist shear and moments (NEH-6 or TR-67).
D.23.			Design of structural timbers & selection of fasteners for live and dead loads.
D.24.			Design of structural steel members for live and dead loads.
D.25.			Design of chutes and drop spillways using standard procedures (NEH-11 & NEH-14).
D.26.			Ability to adapt standard drawings to site specific conditions.
D.27.			Ability to adapt conservation practice specifications for site specific requirements.
D.28.			Ability to adapt formal construction specifications for site specific requirements (NEH-642).
D.29.			Production of construction drawings in accordance with EFH Chpt. 5, & standard practice.
<b>CONSTRUCTION SKILLS</b>			
C.1.			Ability to read and interpret plans & specifications for typical NRCS designed structures.
C.2.			Ability to read and interpret complex drawings & formal specifications (NEH-642) for major structures built with formal contracts.
C.3.			Completion of construction surveys for structure layout, grade control, and quantity measurement as shown in TR-62 or NEH-19.
C.4.			Inspection of concrete forms and reinforcing steel for conformance with plans and specs.
C.5.			Inspection of concrete mix design, placement methods and curing methods for conformance with plans and specifications.
C.6.			Knowledge of concrete sampling and field testing procedures.
C.7.			Inspection of general excavations and trench construction to assure dimensions, grade and foundation conditions conform with plans and specifications.
C.8.			Inspection of earthfill placement and compaction for conformance with plans and specifications for both Class A and Class C compaction methods.
C.9.			Inspection of structural and pipe trench backfill placement and compaction for conformance with plans and specifications.
C.11.			Knowledge of basic soil moisture & density field testing procedures.
C.12.			Knowledge of applicable NRCS and OSHA construction safety requirements.
C.13.			Ability to utilize effective communication skills in order to maintain a working relationship with contractor and client representatives.
C.14.			Knowledge of NRCS policy regarding client / contractor relationship as applicable to non formal construction projects (typical projects under CO-01, EQIP, etc.)
C.15.			Ability to maintain required construction records for formal contracts.
C.16.			Knowledge of contract administration procedures and COTR duties for formal federal and local construction contracts.

† SKILL LEVEL RATING: 1-AWARE 2-UNDERSTAND 3-PERFORM W SUPERVISION 4-APPLY INDEPENDENTLY 5-CAN TRAIN OTHERS

SUBPART A - REVIEW AND APPROVAL  
Colorado Policy and Procedures

CO-ENG-11 cont.

Task No.	Skill Level <sup>1</sup>		Subject Description
	Existing	Needed	
<b>IRRIGATION PLANNING SKILLS</b>			
I.1.			Computing seasonal or daily crop water requirements using generally accepted models.
I.2.			Estimating the moisture holding capacity of soils based on texture.
I.3.			Determining the gross irrigation water requirements for a field or farm.
I.4.			Using practice criteria, water rights and crop water requirements to determine design flow rates for irrigation system components.
I.5.			Scheduling irrigations using climate data, ET estimates, soil characteristics and a given MAD.
I.6.			Application of FIRI to identify the relative value of irrigation system improvements.
I.7.			Design & evaluation of surface irrigation systems.
I.8.			Design & evaluation of sprinkler irrigation systems.
I.9.			Design & evaluation of micro irrigation systems.
<b>ENVIRONMENTAL ENGINEERING SKILLS</b>			
E.1.			Estimating the volume of liquid and solid wastes generated by various livestock operations.
E.2.			Identifying the natural resource concerns associated with livestock enterprises.
E.3.			Identifying manure & wastewater collection, handling, storage & treatment alternatives.
E.4.			Selection & design of treatment practices for manure solids.
E.5.			Selection & design of collection, storage and treatment practices for contaminated runoff.
E.6.			Selection & design of treatment practices for liquid manure & process wastewater.
E.7.			Selection & design of seepage control measures for earthen waste retention structures.
E.8.			Selection & design of alternatives for handling and disposal of animal mortalities.
E.9.			Selection & design of secondary containment measures for on farm fertilizer or pesticide mixing and storage facilities.
<b>WATER TABLE MANAGEMENT SYSTEMS</b>			
W.1.			Identification of surface & subsurface drainage alternatives for various soils and land uses.
W.2.			Ability to determine the extent and size of components for a surface drainage system.
W.3.			Ability to determine the extent and size of components for a subsurface drainage system.
W.4.			Ability to determine the extent and size of components for an interceptor drain.

Prepared by:	_____	_____	_____
	<i>name</i>	<i>title</i>	<i>date</i>
Concurrence by:	_____	_____	_____
	<i>name</i>	<i>title</i>	<i>date</i>
	_____	_____	_____
	<i>name</i>	<i>title</i>	<i>date</i>

<sup>1</sup> SKILL LEVEL RATING: 1-AWARE 2-UNDERSTAND 3-PERFORM W/ SUPERVISION 4-APPLY INDEPENDENTLY 5- CAN TRAIN OTHERS