FOREST SERVICE

SUPPLEMENTAL SPECIFICATIONS

For

NINEMILE CREEK BRIDGE

ROAD 6500000 – MP 6.674

U.S.D.A. FOREST SERVICE
OKANOGAN-WENATCHEE NATIONAL FOREST

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Preface

Preface_wo_03_22_2022

Delete all but the first paragraph and add the following:

The Forest Service, US Department of Agriculture has adopted FP-14 for construction of National Forest System Roads.

101 - Terms¸ Format¸ and Definitions

101.01_National_3_15_2017

Add the following paragraph to Subsection 101.01:

101.01 Meaning of Terms.

Delete all references to the FAR (Federal Acquisition Regulations) in the specifications when incorporating into 2400-6(T) Timber Sale or 2400-13(T) Stewardship contracts.

101.01_National_11_9_2016

Add the following paragraph to Subsection 101.01:

101.01 Meaning of Terms.

Delete all references to the TAR (Transportation Acquisition Regulations) in the specifications.

101.03_National_11_9_2016

Add the following to Subsection 101.03:

101.03 Abbreviations.

(a) Acronyms.

AGAR — Agriculture Acquisition Regulations

AFPA — American Forest and Paper Association

FSAR — Forest Service Acquisition Regulations

MSHA — Mine Safety and Health Administration

NESC — National Electrical Safety Code

WCLIB — West Coast Lumber Inspection Bureau

(f) Miscellaneous unit abbreviations.

MP	—	milepost	location
ppm	—	parts per million	volume
STA		station	location

101.04_National_1_22_2020

Make the following changes to Subsection 101.04:

101.04 Definitions.

Delete these definitions and replace the following:

Bid Schedule — The Schedule of Items.

Bridge — A structure, including supports, erected over a depression or an obstruction such as water along a road, a trail, or a railway and having a deck for carrying traffic or other loads.

Contractor — The individual or legal entity contracting with the Government for performance of prescribed work. In a timber sale contract, the contractor is the "Purchaser".

Culvert — Any structure with a bottom, regardless of fill depth, depth of invert burial, or presence of horizontal driving surface, or any bottomless (natural channel) structure with footings that will not have wheel loads in direct contact with the top of the structure.

Drawings — (Public Works Contracts) Design sheets or fabrication, erection, or construction details submitted to the CO by the Contractor according to FAR Clause 52.236-21 Specifications and Drawings for Construction. Also refers to submissions and submittals.

Notice to Proceed — (Public Works Contracts) Written notice to the Contractor to begin the contract work.

Right-of-Way — A general term denoting (1) the privilege to pass over land in some particular line (including easement, lease, permit, or license to occupy, use, or traverse public or private lands), or (2) Real property necessary for the project, including roadway, buffer areas, access, and drainage areas.

Solicitation — (Public Works Contracts) The complete assembly of documents (whether attached or incorporated by reference) furnished to prospective bidders.

Add the following definitions:

Adjustment in Contract Price — "Equitable adjustment," as used in the Federal Acquisition Regulations, or "construction cost adjustment," as used in the Timber Sale Contract, as applicable.

Change — "Change" means "change order" as used in the Federal Acquisition Regulations, or "design change" as used in the Timber Sale Contract.

Forest Service — The United States of America, acting through the Forest Service, U.S. Department of Agriculture.

Neat Line — A line defining the proposed or specified limits of an excavation or structure.

Pioneer Road — Temporary construction access built along the route of the project.

Purchaser — The individual, partnership, joint venture, or corporation contracting with the Government under the terms of a Timber Sale Contract and acting independently or through agents, employees, or subcontractors.

Protected Stream course — A drainage shown on the plans or timber sale area map that requires designated mitigation measures.

Road Order — An order affecting and controlling traffic on roads under Forest Service jurisdiction. Road Orders are issued by a designated Forest Officer under the authorities of 36 CFR, part 260.

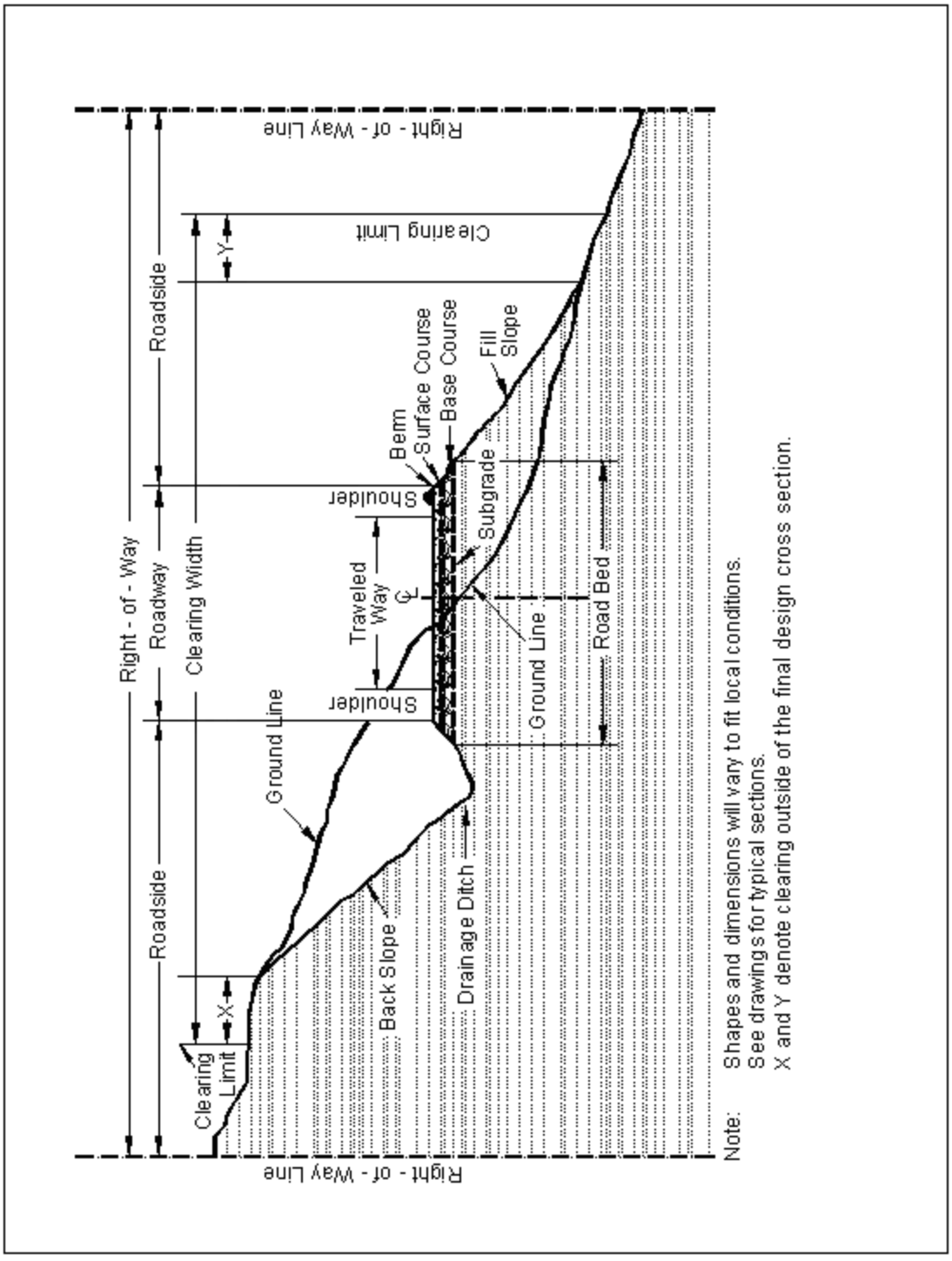
Shop Drawings — (Timber and Stewardship Contracts) Referred to as "Drawings" in FP-14, include drawings, diagrams, layouts, schematics, descriptive literature, illustrations, lists or tables, performance and test data, and similar materials furnished by Purchaser to explain in detail specific portions of the work required by the contract.

Utilization Standards —

The minimum size and percent soundness of trees described in Public Works contract specifications or Timber Sale and IRTC contract provisions to determine merchantable timber.

Add Figure 101-1—Illustration of road structure terms:

Figure 101-1—Illustration of road structure terms.



102 - Bid¸ Award¸ and Execution of Contract

Delete Section 102 in its entirety.

103 - Scope of Work

Delete all of Section 103 except Subsection 103.01 Intent of Contract.

104 - Control of Work

104.00_National_11_9_2016

Delete Subsections 104.01, 104.02, and 104.04.

104.03_National_3_3_2021

Delete Subsection 104.03 and replace with the following:

104.03 Specifications and Drawings.

Refer to B(T) 5.211 in the 2400-6(T)) or the 2400-13(T) contracts for requirements under this subsection.

104.06_National_11_9_2016

Add the following to Subsection 104.06:

104.06 Use of Roads by Contractor.

The Contractor is authorized to use roads under the jurisdiction of the Forest Service for all activities necessary to complete this contract, subject to the limitations and authorizations designated in the Road Order(s) or described in the contract, when such use will not damage the roads or national forest resources, and when traffic can be accommodated safely.

105 - Control of Material

105.02_National_11_1_2016

Add the following to Subsection 105.02(a):

105.02(a) Government-provided sources.

Government-provided sources for this project are identified as follows:

(1) Government-provided mandatory sources.

Pay Item	Description	Material source number or name
62504	Seed	Commercial Source
64801	Streambed simulation Material, Bed Class 2, Method A	Commercial Source or on-site salvage or at upper Ninemile Crossing
64803	Channel Rock for Bank Margins and Rock Structures, Class CR-0, Method A	Commercial Source or on-site salvage or at upper Ninemile Crossing
	Waste Site	Material to be hauled off USFS land.

105.02_National_7_10_2017

Complete any pit or quarry development specified for a designated source, even when material is not obtained from the source.

105.05_National_6_29_2020

Delete 105.05 (a) and (b) and the last sentence of the second paragraph and substitute the following:

105.05 (a)(b) Use of Material Found in the Work.

Materials produced or processed from Government lands in excess of the quantities required for performance of this contract are the property of the Government. Place excess material safely at government-approved location, at no additional cost to government.

105.02_National_11_1_2016

Add the following to Subsection 105.02c:

105.02(c) Contractor-located sources.

All material (e.g., soil, gravel, sand, borrow, aggregate, etc.) transported onto National Forest System land or incorporated into the work shall be weed-free. The Contracting Officer may request written documentation of methods used to determine the weed-free status of any and all materials furnished by the contractor. Contractor-provided expertise and methods to establish weed-free status must be appropriate for the weeds of concern in the local area.

A Forest Service weed specialist will inspect proposed sources to determine weed-free status. Provide the Contracting Officer written notification of proposed material sources **14** days prior to use. Written approval of

the specific source will be provided to the contractor by the CO. If weed species are present in the proposed source, appropriate mitigation measures may allow conditional use of the source as required by the Contracting Officer.

106 - Acceptance of Work

106.01_National_7_18_2017

Delete Subsection 106.01 and replace with the following:

106.01 Conformity with Contract Requirements.

Follow the requirements of FAR Clause 52.246-12 Inspection of Construction.

References to standard test methods of AASHTO, ASTM, GSA, and other recognized standard authorities refer to the methods in effect on the date of solicitation for bids.

Perform all work to the lines, grades, cross-sections, dimensions, and processes or material requirements shown on the plans or specified in the contract.

Incorporate manufactured materials into the work according to the manufacturer's recommendations or to these specifications, whichever is more strict.

Plan dimensions and contract specification values are the values to be strived for and complied with as the design values from which any deviations are allowed. Perform work and provide material that is uniform in character and reasonably close to the prescribed value or within the specified tolerance range. The purpose of a tolerance range is to accommodate occasional minor variations from the median zone that are unavoidable for practical reasons.

When standard manufactured items are specified (such as fence, wire, plates, rolled shapes, pipe conduits, etc., that are identified by gauge, unit mass, section dimensions, etc.), the identification will be considered to be nominal masses or dimensions. Unless specific contract tolerances are noted, established manufacturing tolerances will be accepted.

The Government may inspect, sample, or test all work at any time before final acceptance of the project. When the Government tests work, copies of test reports are furnished to the Contractor upon request. Government tests may or may not be performed at the work site. If Contractor testing and inspection is verified by the Government, the Contractor's results may be used by the Government to evaluate work for acceptance. Do not rely on the availability of Government test results for process control.

Acceptable work conforming to the contract will be paid for at the contract unit bid price. Four methods of determining conformity and accepting work are described in Subsections 106.02 to 106.05 inclusive. The primary method of acceptance is specified in each Section of work. However, work may be rejected at any time it is found by any of the methods not to comply with the contract.

Remove, repair, or replace work that does not conform to the contract, or to prevailing industry standards where no specific contract requirements are noted. Removing, repairing, or replacing work; providing temporary traffic control; and any other related work to accomplish conformity will be at no cost to the Government.

(a) Disputing Government test results. If the accuracy of Government test results is disputed, promptly inform the CO. If the dispute is unresolved after reasonable steps are taken to resolve the dispute, further evaluation may be obtained by written request. Include a narrative describing the dispute and a proposed resolution protocol that addresses the following:

1. Sampling method;
2. Number of samples;
3. Sample transport;

4. Test procedures;
5. Testing laboratories;
6. Reporting;
7. Estimated time and costs; and
8. Validation process.

If the evaluation requires additional sampling or testing be performed, mutually agree with the Government on witnessing procedures and on sampling and testing by a third party laboratory. Use a third party laboratory accredited by the AASHTO accreditation program. Provide proof of the laboratory's accreditation for the test procedures to be used. Do not use the same laboratory that produced the disputed Government test results or that produced the test results used as a basis for the dispute.

The CO will review the proposed resolution protocol and may modify it before final approval and execution.

The Government will use the approved resolution protocol test results to determine the validity of the disputed testing. If the Government test results are validated, the Contractor will be responsible for all costs associated with developing and performing the resolution protocol. If the Government test results are not validated, the Government will be responsible for all costs associated with developing and performing the resolution protocol. If the validity of the Government test results cannot be determined, the Contractor and Government will equally share all costs associated with developing and carrying out the resolution protocol.

(b) Alternatives to removing and replacing non-conforming work. As an alternative to removal and replacement, the Contractor may submit a written request to:

1. Have the work accepted at a reduced price; or
2. Be given permission to perform corrective measures to bring the work into conformity.

The request must contain supporting rationale and documentation. Include references or data justifying the proposal based on an evaluation of test results, effect on service life, value of material or work, quality, aesthetics, and other tangible engineering basis. The CO will determine disposition of the nonconforming work.

106.02_National_11_9_2016

Delete Subsection 106.02 and replace with the following:

106.02 Visual Inspection.

Acceptance is based on visual inspection of the work for compliance with the specific contract requirements. Use prevailing industry standards in the absence of specific contract requirements or tolerances.

106.07_National_11_1_2016

Delete Subsection 106.07.

106.07 Partial and Final Acceptance.

107 - Legal Relations and Responsibility to the Public

107.02_National_11_1_2016

Add the following to Subsection 107.02:

107.02 Protection and Restoration of Property and Landscape.

Work within the wetted perimeter of streams will be allowed only as specified in the approved project permits.

107.05_National_7_18_2017

Delete Subsection 107.05.

107.08_National_3_3_2021

Delete Subsection 107.08 and replace with the following:

107.08 Sanitation, Health, and Safety.

Refer to specific provisions under B(T) 6.0 in the 2400-6(T) or the 2400-13(T) contracts for requirements under this subsection.

108 - Prosecution and Progress

108.00_National_11_9_2016

Delete Section 108 in its entirety.

109 - Measurement and Payment

109.00_National_11_9_2016

Delete Subsections 109.06, 109.07, 109.08, and 109.09:

Delete Subsections 109.06, 109.07, 109.08, 109.09.

109.01_National_2_22_2019

Delete the third paragraph and Table 109-1 of Subsection 109.01 and replace with the following:

109.01 Measurement of Work.

Take measurements as described in Subsection 109.02 unless otherwise modified by the Measurement Subsection of the section controlling the work being performed. Table 109-1 indicates the accuracy required for quantities of the various pay units used in the Schedule of Items. Use this guide to determine the decimal placement in the final payment.

Table 109-1
Decimal Accuracy of Quantities for Final Payment

Pay Item	Level of Precision
Linear Foot	1
Exception--Timber, Steel, and concrete Piles	0.1
Station	0.1
Mile	0.01
Square Foot	0.1
Square Yard	0.1
Each	1
Acre	0.01
Gallon	1
M-Gals.	0.1
Cubic Yard	1
Exception--Structure Excavation; Sheathing Materials; Bedding, Bed Course, and Backfill Materials; Gabions;	0.1
Exception--Concrete; Masonry	0.01
Pound	1
Ton	0.1
Exception--Calcium Chloride; Sodium Chloride; Hydrated Lime; Bituminous Materials; Pavements; Bed Course Materials	0.01
Hour	0.1
MFBM	0.01
Station Yard	1
Cubic Yard Mile	1
Ton Mile	1

Add the following sentence to Subsection 109.02(b):

109.02 Measurement Terms and Definitions.

(b) Contract quantity.

Contract quantities will be adjusted only when there are errors in the original design of 15% or more.

Add the following to Subsection 109.03(c):

109.03 Weighing Procedures and Devices.

(c) Project weighing system.

For aggregates weighed for payment, adjust scale weights of material to deduct the daily average moisture content in excess of 2 percentage points over optimum moisture as determined by AASHTO T 99 or the designated compaction method. If moisture determination is necessary, determine the daily average moisture content in accordance with AASHTO T 255, from not less than three representative samples of aggregate taken at random intervals each day that aggregate is being weighed.

Manual scales may be used if approved in writing by the CO and if the method of weighing meets all other contract requirements.

152 - Construction Survey and Staking

Add the following to Subsection 152.04(c):

152.04 General.

(c) Material.

Use required stake dimensions and materials. Pre-paint the top 2 inches of all stakes and lath, or mark them with plastic flagging. Use designated colors for paint or flagging. Mark all stakes with a stake pencil that leaves a legible imprint, or with waterproof ink.

Do not use aerosol spray paints.

Use moisture-resistant paper for survey notes. Keep notes in books with covers that will protect the contents and retain the pages in numerical sequence.

Make the following changes to Subsection 152.05:

152.05 Survey and Staking Requirements.

Delete Subsection 152.05(d)(2) and replace with the following:

(d) Slope and reference stakes.

(2) Conventional survey methods. When required, locate slope stakes on designated portions of the road. Locate the slope stake catch points and use them to establish clearing limits and slope stake references.

Mark slope stakes with the station, the amount of cut or fill, the horizontal distance to centerline, and the slope ratios.

Place slope reference stakes at least 10 feet outside the clearing limit and mark with the offset distance to the slope stake. Place sight stakes when required.

Prior to clearing and grubbing operations, move the slope stake outside the clearing limit to the slope reference stake. After clearing and grubbing and before excavation, reset the slope stakes in their original position.

Use the designated method to establish the slope stake catchpoint.

Method I—Computed Method. Use the template information shown in the plans or other Government-provided data to calculate the actual location of the catchpoint. The slope stake "catchpoint distance" provided may be used as a trial location to initiate slope staking. Recatch slope stakes on any section that does not match the staking report within the tolerances established in Table 152-2.

Method II—Catchpoint Measurement Method. Determine the location of slope stake catchpoints by measuring the catchpoint distances shown in the plans or other Government-provided data.

Add the following to Subsection 152.05(e):

(e) Clearing and grubbing limits.

Mark the clearing limits with flagging or tags on trees to be left standing, or on lath. Make markings intervisible, and no more than 90 feet apart.

After establishing clearing limits, move the location line stake outside the clearing limits for station identification purposes, and mark it with horizontal distance to location line.

Replace Table 152-1 with the following:

Table 152-1 Construction Survey and Staking Tolerances

Table 152-1

Construction Survey and Staking Tolerances (1)

Staking Phase	Horizontal	Vertical
Control points set from existing Government control points- Tolerance Class A	±0.03 feet (±10 millimeters)	±0.01 feet × $\sqrt{N}$ (±3 millimeters × $\sqrt{N}$)(2)
Mapping, topography, and cross-section Points- Tolerance Class A	±0.16 feet (±50 millimeters)	±0.16 feet (±50 millimeters)
Centerline points (3) including (PC), (PT), (POT),(POC), and references- Tolerance Class A	±0.06 feet (±20 millimeters)	±0.06 feet (±20 millimeters)
Slope-stake and slope-stake references- Tolerance Class A (4)	±0.16 feet (±50 millimeters)	±0.16 feet ±50 millimeters)
Culverts, ditches, and minor drainage structures stakes- Tolerance Class A	±0.16 feet (±50 millimeters)	±0.06 feet (±20 millimeters)
Retaining walls stakes	±0.06 feet (±20 millimeters)	±0.03 feet (±10 millimeters)
Curb and gutter stakes	±0.06 feet (±20 millimeters)	±0.03 feet (±10 millimeters)
Bridge substructures stakes	±0.03 feet (±10 millimeters)(5)	±0.03 feet (±10 millimeters)
Bridge superstructures stakes	±0.03 feet (±10 millimeters)(5)	±0.03 feet (±10 millimeters)
Clearing and grubbing limit stakes- Tolerance Class A	±1.00 feet (±300 millimeters)	–
Roadway subgrade finish stakes- Tolerance Class A (6)	±0.16 feet (±50 millimeters)	±0.03 feet (±10 millimeters)
Roadway finish grade stakes (6)	±0.16 feet (±50 millimeters)	±0.03 feet (±10 millimeters)

Table 152-1

Construction Survey and Staking Tolerances (continued) (1)

Staking Phase	Horizontal	Vertical
Control points set from existing Government control points –Tolerance Class B (7)	±0.16 feet (±20 millimeters)	±0.16 feet $\times\sqrt{N}$ (±20 millimeters $\times\sqrt{N}$)(2)
Mapping, topography, and cross-section points–Tolerance Class B (7)	±1.00 feet (±300 millimeters)	±0.50 feet (±150 millimeters)
Centerline points including (PC), (PT), (POT),(POC), and references–Tolerance Class B (7)	±0.16 feet (±20 millimeters)	±0.16 feet (±20 millimeters)
Slope-stake and slope-stake references–Tolerance Class B (7)	±0.50 feet (±50 millimeters)	±0.16 feet ±50 millimeters)
Culverts, ditches, and minor drainage structures stakes–Tolerance Class B (7)	±0.50 feet (±150 millimeters)	±0.16 feet (±20 millimeters)
Clearing and grubbing limit stakes–Tolerance Class B (7)	±2.00 feet (±600 millimeters)	—
Roadway subgrade finish stakes–Tolerance Class B (7)	±0.50 feet (±50 millimeters)	±0.16 feet (±10 millimeters)
Roadway finish grade stakes–Tolerance Class B (7)	±0.50 feet (±50 millimeters)	±0.16 feet (±10 millimeters)

(1) At statistical 95 percent confidence level. Tolerances are relative to existing Government control points.

(2) N is the number of instrument setups.

(3) Centerline points: PC - point of curve, PT - point of tangent, POT - point on tangent, POC - point on curve.

(4) Take the cross-sections normal to the centerline ±1 degree.

(5) Bridge control is established as a local network and the tolerances are relative to that network.

(6) Includes paved ditches.

(7) Tolerance Class B for Very Low Volume Roads with an aggregate or native finished surface.

153 - Contractor Quality Control

153.02_National_11_1_2016

Delete Subsection 153.02 and replace with the following:

153.02 Qualifications.

Submit the following for approval with the quality control plan:

(a) Quality control manager (QCM). Furnish a QCM who has at least 2 years' experience in construction, inspector, quality control and material testing on construction projects of similar type and scope.

(b) Testers. Provide testers with at least one year experience in the type of sampling and testing required, and with one of the following for the type of sampling and testing performed:

(1) NICET Level II certification in highway material or equivalent state or industry certification;

(2) Certification by a regional certification program (such as Western Alliance for Quality Transportation Construction (WAQTC), Northeast Transportation Technician Certification Program (NETTCP), Southeast Task Force for Technician Training and Qualification (STFTTQ), or Multi Regional Training and Certification (M-TRAC)); or

(3) At least one year employment by an AASHTO accredited laboratory performing equivalent sampling and testing.

153.03_National_11_1_2016

Add the following paragraph to the end of Subsection 153.03(b):

153.03 Quality Control Plan.

(b) Quality Control Procedures.

Submit written proposals for approval of alternate AASHTO or State approved test methods. Alternate methods may be allowed based on documented equivalence to the specified method.

153.03_National_11_1_2016

Add the following to the end of Subsection 153.04(a)(2):

153.04 Quality Control Plan.

At a minimum the contractor shall provide project submittals as shown on the below Submittal Log. Submittal requirements are listed in the Standard Specifications, Supplemental Specifications, and Plans.

153.07_National_11_1_2016

Delete Subsection 153.07 and replace with the following:

Submittal Log					
Log No.	**Incidental to Pay Item(s)**	**Description of Submittal**	**Type of Submittal**	**Requirement found in Specification No. /Drawings**	**Additional Specification References**
1	151	Weed Free Material Source Certification	Material Certification	FSSS 105.02(c)	
2	151	Spill Prevention, Control, and Countermeasure (SPCC) Plan	Plan	107.10	
3	151	Contractor Quality Control Plan	Plan	153.02	
4	151	Traffic Control Plan	Plan	FSSS 156.03	635
5	151	Safety Plan, including Blasting Plan where applicable	Plan	Accident Prevention clause [FAR 52.236-13]	
6	151	Fire Plan R6-FS-6300-55	Plan	R6-FS-6300-52 part 2 in Section J	
7	151	Proposed Progress Schedule R6-FS-6300-7	Construction Schedule	Schedules for Construction Contracts [FAR 52.236-15]	
8	151	Designation of Representative R6-FS-6300-6	Completed Form	Superintendence by the Contractor [FAR 52.236-6]	
9	151	Drug Free Workplace Policy	Establish a program, take actions, notifications and reporting as required by policy	Drug-Free Workplace [FAR 52.223-6]	
10	151	SF1413 - Statement and Acknowledgement for each Subcontractor including Owner/Operators and other Sole Proprietorship Subcontractors [not required for material suppliers]	Completed Form	Subcontracts (Labor Standards) [FAR 52.236-11]	
11	151	Payroll Record WH347 Certified Payrolls submitted weekly	Copy of Certification	Payrolls and Basic Records [FAR 52.222-8]	
12	154	Material Moisture/Density Testing	Test Results	Table 208-1	106
13	154	Culvert Backfill Compaction Testing	Test Results	209.11, 209.12	106
14	157	Dewatering and Soil Erosion and Pollution Control Plan	Plan	FSSS 157.04	
15	157	Fish Salvage Plan	Plan	FSSS Appendix A / Sheet 3 of Plans	157, 648
16	157	Fish Salvage Personnel Qualifications	Names & Resumes	FSSS Appendix A	
17	207	Geosynthetics: Certification	Material Certification	FSSS 207.08	106, 714
18	272	Geocell Abutment Stabilization	Material Certification	272.06, 736.02	106, Supplemental

Submittal Log					
Log No.	**Incidental to Pay Item(s)**	**Description of Submittal**	**Type of Submittal**	**Requirement found in Specification No. /Drawings**	**Additional Specification References**
					Specifications 736, Drawings
19	272	Geocell: Geotextile – Class 1, Type II-A	Material Certification	272.06	106, 714, Drawings
20	272	Geocell: Granular Backfill	Material Certification	Supplemental Specifications 736.03a	106, 714, Drawings
21	302	Subbase & Base	Material Certification	703.05(b), Table 703.03	302
22	403	Asphalt Concrete	Mix Design	403.02	
23	552	Structural Concrete: Mix Design	Mix Design	552.03	Drawings
24	552	Structural Concrete: Testing	Test Results	552.20	106, Drawings
25	552	Reinforcing Steel	Material Certification	709.01	Drawings
26	552	Miscellaneous Material: Grout	Material Certification	FSSS 725.19	Drawings
27	552	Miscellaneous Material: Grout	Product Approval	FSSS 725.19	Drawings
28	552	Welder Certification	Copy of Certification	Sheet 2 of Plans	
29	552	Precast Concrete Structures	Shop Drawing	FSSS 552.11(b)(6)	104, 554
30	552	Precast Concrete Structures: Industry Certification	Fabrication Certification	FSSS 552.11(b)(6)	
31	552	Precast Concrete Structures: Testing	Test Results	FSSS 552.11(b)(6)	106, 554, 562
32	552	Reinforcing Steel	Order List	554.03	554, 709, Drawings
33	553	Prestressed Concrete	Shop Drawing	104.03	553, Drawings
34	553	Prestressed Concrete: PCI Certification	Fabrication Certification	FSSS 553.03	
35	553	Prestressed Concrete: Prestressing	Method Approval	553.04	Drawings
36	553	Prestressed Concrete: Materials	Material Certification	553	106, 552, 554, 709, Drawings
37	553	Prestressed Concrete: Testing	Test Results	553.06	106, 552, Drawings
38	553	Reinforcing and Prestressing Steel	Material Certification	709.01, 709.02	553, Drawings
39	554	Reinforcing Steel	Material Certification	554.10	554, Drawings

Submittal Log					
Log No.	**Incidental to Pay Item(s)**	**Description of Submittal**	**Type of Submittal**	**Requirement found in Specification No. /Drawings**	**Additional Specification References**
40	648	Streambed Simulation Material	5-day notice prior to construction	705.08	

153.07 Records and control charts.

Maintain complete testing and inspection records by pay item number and make them accessible to the CO.

155 - Schedules for Construction Contracts

155.00_National_11_9_2016

Delete Section 155 in its entirety.

156 - Public Traffic

156.00_National_2_5_2019

Delete Section 156 in its entirety and replace with the following:

156.01 Description

This work consists of controlling and protecting public traffic adjacent to and within the project.

156.02 Material

Conform to the MUTCD and the following Sections and Subsections:

Permanent Traffic Control	633
Traffic Signing and Marking Material	718
Concrete Barriers and Precast Guardwalls	618
Temporary plastic fence	710.11

156.03 Construction Requirements

Accommodate traffic according to MUTCD, approved traffic control plan and this section. Perform work in a manner that ensures safety and convenience of the public. Unless otherwise provided for in Table 156-1, keep existing roads open to all traffic during road improvement work, and maintain them in a condition that will adequately accommodate traffic. Delays may not exceed **30** minutes at any one time followed by an open period of no less than **15** minutes. Accommodate public traffic on roads adjacent to and within the project until the project is accepted according to Subsection 106.07(b).

Submit traffic control plan at least thirty (30) days prior to intended use. Perform no work that interferes or conflicts with traffic or existing access to the roadway surface until a traffic control plan has been approved.

Post construction signs and traffic control devices in conformance with MUTCD and Forest Service EM 7100-15. All required signs will be in place and approved prior to beginning work on project.

If the Contractor agrees in writing to allow public traffic to use a new road being constructed prior to completion, it will be considered an existing road for traffic control purposes.

156.04 Temporary Traffic Control.

Install and maintain temporary traffic control devices adjacent to and within the project as required by the approved traffic control plan and the MUTCD. Install and maintain traffic control devices as follows:

(a) Furnish and install traffic control devices before the start of construction operations.

(b) All detours outside of clearing limits will be approved in writing by the Contracting Officer as part of the traffic control plan.

(c) Install only those traffic control devices needed for each stage or phase.

(d) Relocate temporary traffic control devices as necessary.

(e) Remove devices that no longer apply to the existing conditions.

(f) Immediately replace any device that is lost, stolen, destroyed, or inoperative.

(g) Keep temporary traffic control devices clean.

(h) Remove all temporary traffic control devices upon contract completion or when approved.

(i) When required, use flaggers certified by the American Traffic Safety Services Association, the National Safety Council, the International Municipal Signal Association, a state agency, or other acceptable organization. Perform the work described under MUTCD Part 6. Use type III, VII, VIII, or IX retroreflective sheeting on flagger paddles. Do not use flags. Flaggers must wear high visibility safety apparel as required by MUTCD 6E.02.

156.05 Temporary Closures.

Road segments may be closed as shown in Table 156-1. The maximum consecutive days of closure shall be followed by a minimum number of consecutive days open to traffic as shown. Maintain traffic control devices during closure period(s). Appropriate barricades and signs will be erected and maintained as shown in the traffic control plan or as otherwise designated.

Prior to closing roads during construction, give written notice to the Contracting Officer at least 10 days in advance.

Table 156-1
Temporary Road Closures

Road Number	From Terminus	To Terminus	Maximum Consecutive Days of Closure	Minimum Consecutive Days Open
RD 6500000	**MP 6.31 (Soda Creek)**	**MP 13.8**	**30**	**0**

156.06 Acceptance.

Public traffic work will be evaluated under Subsection 106.02.

156.07 Measurement and Payment.

Do not measure Public Traffic for payment. Payment for contract work is provided indirectly. See Subsection 109.05.

157 - Soil Erosion and Sediment Control

157.01_0618_us_02_03_2009

Delete Subsection 157.04 and replace with the following:

157.04 General.

Thirty (30) days prior to the start of construction, submit a written plan according to subsection 104.03 with all necessary permits that provides permanent and temporary erosion control measures to minimize erosion and sedimentation during and after construction. Do not begin work until the necessary controls for that particular phase of work have been implemented. Do not modify the type, size, or location of any control without approval.

When erosion control measures are not functioning as intended, take corrective action to eliminate or minimize pollutants in storm water discharges from the project.

171 - Weed and Disease Prevention

171.00_nat_us_03_30_2005

171.01 Description.

This work consists of washing and treating construction equipment to remove seeds, plants, and plant fragments from the equipment before the equipment is used on National Forest System lands.

171.02 Material

Conform to the following Subsection:

Water	725.01

Construction Requirements

171.03 General Construction Requirements.

Notify the CO in writing at least fifteen (15) days before moving any construction equipment onto National Forest System lands. Construction equipment does not include cars, pickup trucks, and other vehicles that regularly travel between the construction site and areas outside of National Forest System lands.

Perform all work at a location designated on the plans or other locations approved in writing. Provide the CO with an opportunity to monitor the washing and inspection.

171.04 Equipment.

Use a high-pressure washing system.

For work on National Forest System lands, use a washing system that traps all wash water and either stores it for removal from National Forest System lands or recycles the water for continued use. If the equipment recycles the water, provide adequate filters for seed removal. Dispose of the filter material and removed seeds in an approved manner. Do not mix soaps, detergents, or other chemicals with the wash water.

For work at a commercial washing facility, use an approved facility.

171.05 Washing.

Wash the sides, tops, and undercarriages of all construction equipment. Remove all seeds, plants, plant fragments, dirt, and debris from the construction equipment.

171.06 Inspection.

Inspect the washed construction equipment, including the undercarriage, to ensure that the washing removed the dirt, debris, and seeds from the construction equipment. Rewash the construction equipment as necessary or as directed.

171.07 Acceptance.

Weed prevention will be evaluated under Subsection 106.02.

171.08 Measurement.

Do not measure weed prevention for payment.

171.09 Payment.

Include all costs associated with the Section 171-Weed Prevention in the unit price for Section 151-Mobilization.

201 - Clearing and Grubbing

201.04_National_11_8_2016

Delete and replace Subsection 201.04(d) with the following:

201.04(d) Clearing.

(d) Trim tree branches that extend over the road surface and shoulders to attain a clear height of **15** feet. Trim tree limbs as near flush with the trunk as practicable.

201.04_National_11_2_2016

Add the following to Subsection 201.04(e):

201.04(e) Clearing.

(e) Do not cut vegetation less than 3 feet in height and less than 3 inches in diameter that is within the clearing limits but beyond the roadway and not in a decking area and that does not interfere with sight distance along the road unless otherwise designated.

201.06_National_11_2_2016

Delete and replace Subsection 201.06 with the following:

201.06 Disposal.

Merchantable timber is the Government's property. Limb and deck merchantable timber on site as directed by the CO.

Delete this subsection 201.08 and replace with the following:

201.08 Measurement.

Do not measure clearing and grubbing for payment.

203 - Removal of Structures and Obstructions

Add the following to Subsection 203.05:

203.05 Disposing of Material.

(e) Windrowing Construction Slash. Place construction slash outside the roadway in neat, compacted windrows approximately parallel to and along the toe line of embankment slopes. Do not permit the top of the windrows to extend above subgrade. Use construction equipment to matt down all material in a windrow to form a compact and uniform pile. Construct breaks of at least 15 feet at least every 200 feet in a windrow. Do not place windrows against trees.

(f) Scattering. Scatter construction slash in designated areas without damaging trees. Place logs and stumps away from trees, positioned so they will not roll, and are not on top of one another. Downstream of culvert, utilize larger un-limbed trees cleared for construction by scattering on streambanks and placing in the stream channel. Upstream of culvert, scatter limbs and small trees (<7" DBH) on re-constructed streambanks and bare soil areas. Limb and scatter other construction slash to reduce slash concentrations. When scattering for erosion control, place construction slash as flat as practicable on the completed slope.

(g) Chipping. Use an approved chipping machine to chip slash longer than 3 feet. Deposit chips on embankment slopes or outside the roadway to a loose depth less than 6 inches. Minor amounts of chips or ground woody material may be permitted within the roadway if they are thoroughly mixed with soil and do not form a layer.

(h) Debris Mat. Use tree limbs, tops, cull logs, split stumps, wood chunks, and other debris to form a mat upon which construction equipment is operated. Place stumps upside down and blend stumps into the mat.

(i) Decking. Remove brush from designated log deck areas. Limb and top logs.

Logs not meeting the Utilization Standards described in Subsection 201.04(c) shall be cut to lengths less than **30** feet and decked in designated log deck location.

Merchantable timber not associated with an existing timber sale shall be cut to length meeting the Utilization Standards described in Subsection 201.04(c).

Deck logs so that logs are piled parallel to one another; can be removed by standard log loading equipment; will not damage standing trees; will not interfere with drainage and will not roll. Keep logs in log decks free of brush and soil.

(j) Removal to designated locations. Remove construction slash to designated locations.

(k) Piling. Pile construction slash in designated areas. Place and construct piles so that if the piles are burned, the burning will not damage remaining trees. Keep piles free of dirt from stumps.

204 - Excavation and Embankment

Delete Section 204 in its entirety and replace with the following.

204.01 Description

This work consists of excavating material and constructing embankments. This work also includes furnishing, hauling, stockpiling, placing, disposing, sloping, shaping, compacting, and finishing earthen and rocky material.

204.02 Definitions

(a) Excavation. Excavation consists of the following:

(1) Roadway excavation. Material excavated from within the right-of-way or easement areas, except subexcavation covered in Subsection 204.02(a)(2) and structure excavation covered in Sections 208 and 209. Roadway excavation includes all material encountered regardless of its nature or characteristics.

(2) Subexcavation. Material excavated from below subgrade elevation in cut sections or from below the original ground-line in embankment sections. Subexcavation excludes the work required by Subsection 204.05 or 204.06.

(3) Borrow excavation. Material used for embankment construction that is obtained from outside the roadway prism. Borrow excavation includes unclassified borrow, and topping.

(b) Embankment construction. Embankment construction consists of placing and compacting roadway or borrow excavation. This work includes:

(1) Preparing foundation for embankment;

(2) Constructing roadway embankments;

(3) Benching for side-hill embankments;

(4) Constructing dikes, ramps, mounds, and berms; and

(5) Backfilling subexcavated areas, holes, pits, and other depressions.

(c) Conserved topsoil. Excavated material conserved from the roadway excavation and embankment foundation areas that is suitable for growth of grass, cover crops, or native vegetation.

(d) Waste. Excess and unsuitable roadway excavation and subexcavation that cannot be used.

204.03 Material

Conform to the following Subsections:

Topping	704.05
Unclassified borrow	704.06
Water	725.01(c)

Construction Requirements

204.04 Preparation for Roadway Excavation and Embankment Construction.

Clear the area of vegetation and obstructions according to Sections 201 and 203.

Road pioneering, slash disposal, and grubbing of stumps may proceed concurrently with excavation and embankment. Maintain drainage during pioneering operations.

204.05 Conserved Topsoil.

When designated, conserve topsoil from roadway excavation and embankment foundation areas. Stockpile conserved topsoil in low windrows immediately beyond the rounding limits of cut and embankment slopes or in other approved locations. Separate conserved topsoil from other excavated material. When designated, place conserved topsoil on completed slopes according to Section 624.

204.06 Roadway Excavation.

Excavate as follows:

(a) Rock cuts. Blast rock according to Section 205. Excavate rock cuts to 6 inches (150 millimeters) below subgrade within the roadbed limits. Backfill to subgrade with topping or other suitable material. Compact the material according to Subsection 204.11.

(b) Earth cuts. Scarify earth cuts to 6 inches (150 millimeters) below subgrade within the roadbed limits. Compact the scarified material according to Subsection 204.11.

(c) Pioneer Roads. Conduct excavation and placement operations so material to be treated under Section 201 will not be incorporated into the roadway unless specified in the slash treatment method. Maintain drainage during pioneering operations.

Remove snow and ice in advance of the work and deposit beyond the roadway limits in a manner that will not waste material or generate sediment. Do not incorporate snow and ice into embankments. Place snow or ice in a manner to prevent resource damage.

(d) Drainage Feature. Drainage feature includes construction of all ditches, minor channel changes, drainage dips, catch basins, surface water deflectors, and other minor drainage structures. Compact the material according to Subsection 204.11. Excavate on a uniform grade between control points.

Do not disturb material and vegetation outside the construction limits. Retrieve material deposited outside the construction limits. Dispose of unsuitable or excess excavation material according to Subsection 204.14. Replace shortage of suitable material caused by premature disposal of roadway excavation.

Shape to drain and compact the work area to a uniform cross-section at the end of each day's operations.

204.07 Subexcavation.

Excavate material to the required limits. Dispose of unsuitable material according to Subsection 204.14. Take cross-sections according to Section 152. Backfill subexcavated area with suitable material in horizontal layers not exceeding 12 inches (300 millimeters) in compacted thickness and compact according to Subsection 204.11. Prevent unsuitable material from mixing with suitable backfill material.

204.08 Borrow Excavation.

Use suitable roadway excavation in embankment construction. Do not use borrow excavation when it results in excess roadway excavation. Deduct excess borrow excavation from the total borrow excavation quantity.

Obtain borrow source approval according to Subsection 105.02. Develop and restore borrow sources according to Subsections 105.03 and 105.06. Do not excavate beyond the established limits. When applicable, shape the borrow source to permit accurate measurements when excavation is complete.

204.09 Preparing Foundation for Embankment Construction.

Prepare foundation for embankment construction as follows:

(a) Embankment over natural ground. Remove topsoil and break up the ground surface to a minimum depth of 6 inches (150 millimeters) by plowing or scarifying. Compact the ground surface according to Subsection 204.11.

(b) Embankments over an existing asphalt, concrete, or gravel road surface. Scarify gravel roads to a minimum depth of 6 inches (150 millimeters). Scarify or pulverize asphalt and concrete roads to 6 inches (150 millimeters) below the pavement. Reduce particles to a maximum size of 6 inches (150 millimeters) and produce a uniform material. Compact the surface according to Subsection 204.11.

(c) Embankment across ground not capable of supporting equipment. Dump successive loads of embankment material in a uniformly distributed layer to construct the lower portion of the embankment. Limit the layer thickness to the minimum depth necessary to support the equipment.

(d) Embankment on an existing slope steeper than 1V:3H. Cut horizontal steps in the existing slope to a sufficient width to accommodate placement and compaction operations and equipment. Step the slope as the embankment is placed and compacted in layers. Begin each step at the intersection of the original ground and the vertical cut of the previous step.

204.10 Embankment Construction.

Incorporate only suitable roadway excavation material into the embankment. When the supply of suitable roadway excavation is exhausted, furnish unclassified borrow to complete the embankment. Obtain written approval before beginning construction of embankments over 6 feet (2 meters) high at subgrade centerline. Construct embankments as follows:

(a) General. At the end of each day's operations, shape to drain and compact the embankment surface to a uniform cross-section. Eliminate ruts and low spots that could hold water.

During all stages of construction, route and distribute hauling and leveling equipment over the width and length of each layer of material.

Compact embankment side slopes with a tamping foot roller, by walking with a dozer, or by over-building the fill and then removing excess material to the final slope line. For slopes 1V:1¾H or steeper, compact the slopes as embankment construction progresses.

(b) Embankment within the roadway prism. Place embankment material in horizontal layers not exceeding 12 inches (300 millimeters) in compacted thickness. Incorporate oversize boulders or rock fragments into the 12-inch (300-millimeter) layers by reducing them in size or placing them individually as required below. Compact each layer according to Subsection 204.11 before placing the next layer.

Material composed predominately of boulders or rock fragments too large for 12-inch (300-millimeter) layers may be placed in layers up to 24 inches (600 millimeters) thick. Incorporate oversize boulders or rock fragments into the 24-inch (600-millimeter) layer by reducing them in size or placing individual rock fragments and boulders greater than 24 inches (600 millimeters) in diameter as follows:

(1) Reduce rock to less than 48 inches (1200 millimeters) in the largest dimension;

(2) Distribute rock within the embankment to prevent nesting;

(3) Place layers of embankment material around each rock to a depth not greater than that permitted above. Fill voids between rocks; and

(4) Compact each layer according to Subsection 204.11(a) before placing the next layer.

(c) Embankment outside of roadway prism. When placing embankment outside the staked roadway prism, place material in horizontal layers not exceeding 24 inches (600 millimeters) in compacted thickness. Compact each layer according to Subsection 204.11.

204.11 Compaction.

Compact the embankment using one of the following methods as specified.

(a) Placement Method 1. Use AASHTO T 27 to determine the quantity of material retained on a No. 4 (4.75-millimeter) sieve. Compact as follows:

(1) More than 80 percent retained on a No. 4 (4.75-millimeter) sieve. Adjust the moisture content to a level suitable for compaction. Fill the interstices around rock with earth or other fine material as practical. Use compression-type rollers at speeds less than 6 feet (1.8 meters) per second and vibratory rollers at speeds less than 3 feet (1 meter) per second. Compact each layer of material full width with one of the following and until there is no visible evidence of further consolidation:

(a) Four roller passes of a vibratory roller having a minimum dynamic force of 40,000 pounds (180 kilonewtons) impact per vibration and a minimum frequency of 1000 vibrations per minute;

(b) Eight roller passes of a 20-ton (20-metric ton) compression-type roller; or

(c) Eight roller passes of a vibratory roller having a minimum dynamic force of 30,000 pounds (130 kilonewtons) impact per vibration and a minimum frequency of 1000 vibrations per minute.

Increase the compactive effort for layers deeper than 12 inches (300 millimeters) as follows:

- For each additional 6 inches (150 millimeters) or fraction thereof, increase the number of roller passes in Subsection 204.11(a)(1)(a), by four passes; or
- For each additional 6 inches (150 millimeters) or fraction thereof, increase the number of roller passes in Subsection 204.11(a)(1)(b) and (c), by eight passes.

(2) 50 to 80 percent retained on a No. 4 (4.75-millimeter) sieve. Classify the material according to AASHTO M 145. Adjust the moisture content of material classified A-1 through A-5 to a moisture content suitable for compaction. Adjust the moisture content of material classified A-6 and A-7 to within 2 percent of the optimum moisture content. Use AASHTO T 99 to determine the optimum moisture content of the portion of the material passing a No. 4 (4.75-millimeter) sieve. Multiply this number by the percentage of material passing a No. 4 (4.75-millimeter) sieve, and add 2 percent to determine the optimum moisture content of the material.

Use nonvibratory rollers at speeds less than 6 feet (1.8 meters) per second and vibratory rollers at speeds less than 3 feet(1 meter) per second. Compact each layer of material full width according to Subsection 204.11(a)(1).

(3) Less than 50 percent retained on a No. 4 (4.75-millimeter) sieve. Classify the material according to AASHTO M 145. For material classified A-1 or A-2-4, determine the maximum density according to AASHTO T 99, Method C.

Adjust the moisture content of material classified A-1 through A-5 to a moisture content suitable for compaction. Adjust the moisture content of material classified A-6 and A-7 to within 2 percent of the optimum moisture content.

Use compression-type or vibratory rollers. Compact each layer of material full width to at least 95 percent of the maximum density. Determine the in-place density and moisture content according to AASHTO T 310 or other approved test procedures. When required, use AASHTO T 224 to correct for coarse particles.

(b) Placement Method 2. Adjust the moisture content of the material to a moisture content suitable for compaction. Fill the interstices around rock with earth or other fine material as practical. Operate roller compaction equipment over the full width of each layer until there is no visible evidence of further consolidation or, if when a sheepsfoot roller is used, the roller "walks out" of the layer. Make at least three complete passes. Use compression-type rollers at speeds less than 6 feet (1.8 meters) per second and vibratory rollers at speeds less than 3 feet (1 meter) per second. Ensure rollers meet the following requirements:

(1) Steel wheeled rollers, other than vibratory, capable of exerting a force of not less than 250 pounds per inch (4.5 kilogram/millimeter) of width of the compression roll or rolls.

(2) Vibratory steel wheeled rollers equipped with amplitude and frequency controls with a minimum dynamic force of 30,000 pounds (130 kilonewtons) impact per vibration, specifically designed to compact the material on which it is used.

(3) Pneumatic-tired rollers with smooth tread tires of equal size that will provide a uniform compacting pressure for the full width of the roller and capable of exerting a ground pressure of at least 80 psi (550 Kilopascals).

(4) Sheepsfoot, tamping, or grid rollers capable of exerting a force of 250 pounds per inch (4.5 kilogram/millimeter) of width of roller drum.

(c) Placement Method 3. Adjust the moisture content of the material to a moisture content suitable for compaction. Fill the interstices around rock with earth or other fine material as practical. Operate hauling and spreading equipment uniformly over the full width of each layer until there is no visible evidence of further consolidation. Make at least three complete passes.

(d) Placement Method 4. Adjust the moisture content of the material to a moisture content suitable for compaction. Fill the interstices around rock with earth or other fine material as practical. Operate hauling and spreading equipment uniformly over the full width of each layer.

(e) Placement Method 5. Adjust the moisture content of the material to a moisture content suitable for compaction. Compact the complete surface with a bucket of an excavator larger than 39,000 pounds (18 metric ton) Gross Vehicle Weight using a minimum of three blows. Overlap compaction by ½ width of bucket.

(f) Placement Method 6. Adjust the moisture content of the material to a moisture content suitable for compaction. Compact using an approved mechanical tamper for a minimum of three complete passes.

When compacting with rollers or hauling and spreading equipment is not practical, use approved mechanical tampers for a minimum of three complete passes.

204.12 Drainage Features.

Slope, grade, and shape all drainage features. Remove projecting roots, stumps, rock, or similar matter. Maintain all drainage features in an open condition and without sticks, and other debris.

Form furrow ditches by plowing or using other acceptable methods to produce a continuous furrow. Place excavated material on the downhill side so the bottom of the ditch is approximately 18 inches (450 millimeters) below the crest of the loose material. Clean the ditch using a hand shovel or other suitable method. Shape to provide drainage without overflow.

204.13 Sloping, Shaping, and Finishing.

Complete subgrade, slopes, drainage features, culverts, riprap, and other underground minor structures before placing aggregate courses. Slope, shape, and finish to the designated tolerance class as defined in Table 204-2 as follows:

(a) Sloping. Leave earth slopes with uniform roughened surfaces, except as described in Subsection 204.13(b), with no noticeable break as viewed from the road. Except in solid rock, round tops and bottoms of slopes including the slopes of drainage ditches. Round material overlaying solid rock to the extent practical. Scale rock slopes. Slope rounding is not required on tolerance class D through M roads.

If a slide or slipout occurs on a cut or embankment slope, remove or replace the material and repair or restore damage to the work. Bench or key the slope to stabilize the slide. Reshape the cut or embankment slope to an acceptable condition.

(b) Stepped slopes. Where required, construct steps on slopes of 1⅓V:1H to 1V:2H. Construct the steps approximately 18 inches (450 millimeters) high. Blend the steps into natural ground at the end of the cut. If the slope contains non-rippable rock outcrops, blend steps into the rock. Remove loose material found in transitional area. Except for removing large rocks that may fall, scaling stepped slopes is not required.

(c) Shaping. Shape the subgrade to a smooth surface and to the cross-section required. Shape slopes to gradually transition into slope adjustments without noticeable breaks. At the ends of cuts and at intersections of cuts and embankments, adjust slopes in the horizontal and vertical planes to blend into each other or into the natural ground.

(d) Finishing. Ensure that the subgrade is visibly moist during shaping and dressing; smooth and uniform, and shaped to conform to the typical sections. Remove material larger than 6 inches (150 millimeters) from the top 6 inches (150 millimeters) of the roadbed. Remove unsuitable material from the roadbed, and replace it with suitable material. Scarify to 6 inches (150 millimeters) below the bottom of low sections, holes, cracks, or depressions and bring back to grade with suitable material.

Maintain proper ditch drainage.

204.14 Disposal of Unsuitable or Excess Material.

Dispose of unsuitable or excess material at designated sites or according to Subsection 203.05(a)

When there is a pay item for waste, shape and compact the waste material in its final location. Do not mix clearing or other material not subject to payment with the waste material.

204.15 Acceptance.

See Table 204-1 for sampling, testing, and acceptance requirements.

Material for embankment and conserved topsoil will be evaluated under Subsections 106.02 and 106.04.

Excavation and embankment construction will be evaluated under Subsections 106.02 and 106.04.

Subexcavation will be evaluated under Subsections 106.02 and 106.04.

204.16 Measurement.

Measure the Section 204 pay items listed in the bid schedule according to Subsection 109.02 and the following as applicable:

(a) Roadway excavation. Measure roadway excavation in its original position as follows:

(1) Include the following volumes in roadway excavation:

(a) Roadway prism excavation;

(b) Rock material excavated and removed from below subgrade in cut sections;

(c) Unsuitable material below subgrade and unsuitable material beneath embankment areas when a pay item for subexcavation is not listed in the bid schedule;

(d) Ditches, except furrow ditches measured under a separate pay item;

(e) Conserved topsoil;

(f) Borrow material used in the work when a pay item for borrow is not listed in the bid schedule;

(g) Loose scattered rocks removed and placed as required within the roadway;

(h) Conserved material taken from pre-existing stockpiles and used in Section 204 work, except topsoil measured under 624; and

(i) Slide and slipout material not attributable to the Contractor's method of operation.

(2) Do not include the following in roadway excavation:

(a) Overburden and other spoil material from borrow sources;

(b) Overbreakage from the backslope in rock excavation;

(c) Water or other liquid material;

(d) Material used for purposes other than required;

(e) Roadbed material scarified in place and not removed;

(f) Material excavated when stepping cut slopes;

(g) Material excavated when rounding cut slopes;

(h) Preparing foundations for embankment construction;

(i) Material excavated when benching for embankments;

(j) Slide or slipout material attributable to the Contractor's method of operation;

(k) Conserved material taken from stockpiles constructed at the option of the Contractor;

(l) Material excavated outside the established slope limits; and

(m) Road pioneering for the convenience of the Contractor.

(3) When both roadway excavation and embankment construction pay items are listed in the bid schedule, measure roadway excavation only for the following:

(a) Unsuitable material below subgrade in cuts and unsuitable material beneath embankment areas when a pay item for subexcavation is not listed in the bid schedule;

(b) Slide and slipout material not attributable to the Contractor's method of operations; and

(c) Drainage ditches, channel changes, and diversion ditches.

(b) Unclassified borrow, and topping. When measuring by the cubic yard (cubic meter) measure in its original position. If borrow excavation is measured by the cubic yard (cubic meter) in-place, take initial cross-sections of the ground surface after stripping overburden. Upon completion of excavation and after the borrow source waste material is returned to the source, retake cross-sections before replacing the overburden. Do not measure borrow excavation until suitable roadway excavation is depleted.

(c) Embankment construction. Measure embankment construction in its final position. Do not make deductions from the embankment construction quantity for the volume of minor structures.

(1) Include the following volumes in embankment construction:

(a) Roadway embankments;

(b) Material used to backfill subexcavated areas, holes, pits, and other depressions;

(c) Material used to restore obliterated roadbeds to original contours; and

(d) Material used for dikes, ramps, mounds, and berms.

(2) Do not include the following in embankment construction:

(a) Preparing foundations for embankment construction;

(b) Adjustments for subsidence or settlement of the embankment or of the foundation on which the embankment is placed; and

(c) Material used to round fill slopes.

(d) Rounding cut slopes. If a pay item for slope rounding is included in the bid schedule measure rounding cut slopes horizontally along the centerline of the roadway. If a pay item is not included for slope rounding is not included in the bid schedule payment will be considered indirect to roadway excavation.

(e) Waste. Measure waste by the cubic yard (cubic meter) in its final position. Take initial cross-sections of the ground surface after stripping over-burden. Upon completion of the waste placement, retake cross-sections before replacing overburden.

(f) Slope scaling. Measure slope scaling by the cubic yard (cubic meter) in the hauling vehicle.

(g) Subexcavation. Measure subexcavation by the cubic yard (cubic meter) in its original position.

(h) Drainage features. Measurement includes all excavation, embankment, shaping, and grading necessary for a completed drainage feature.

204.17 Payment

The accepted quantities will be paid at the contract price per unit of measurement for the Section 204 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 204-1
Sampling, Testing, and Acceptance Requirements

Material or Product (Subsection)	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Source								
Topping (704.05)	Measured and tested for conformance (106.04 & 105)	Classification[1]	–	AASHTO M 145	1 per soil type and source of material	Processed material	Yes	Before using in work
Unclassified borrow (704.06)	"	"	–	"	"	"	"	"
Production								
Topping (704.05) and (204.11(a))	Measured and tested for conformance (106.04)	Moisture-density	–	T 99, Method C[2]	1 per soil type, but not less than 1 per each 13,000 yd^3 (10,000 m^3)	Processed material	Yes	Before using in work
		Density	–	AASHTO T 310 or other approved procedures	1 per 3500 yd^2 (3000 m^2), but not less than 3 per layer	In-place	No	Before placement of next layer
Unclassified borrow (704.06) and (204.11(a))	"	Moisture-density	–	T 99, Method C[2]	1 per soil type, but not less than 1 per each 13,000 yd^3 (10,000 m^3)	Processed material	Yes	Before using in work

Table 204-1
Sampling, Testing, and Acceptance Requirements

Material or Product (Subsection)	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
		Density	–	AASHTO T 310 or other approved procedures	1 per 3500 yd^2 (3000 m^2), but not less than 3 per layer	In-place	No	Before placement of next layer
Production (continued)								
Earth embankment (204.11(a))	Measured and tested for conformance (106.04)	Classification	–	AASHTO M 145	1 per soil type	Source of material	Yes	Before using in work
		Moisture-density	–	T 99, Method C(2)	1 per soil type, but not less than 1 per each 13,000 yd^3 (10,000 m^3)	"	"	"
		Density	–	AASHTO T 310 or other approved procedures	1 per 3500 yd^2 (3000 m^2), but not less than 3 per layer	In-place	No	Before placement of next layer
Top of subgrade (204.11(a))	"	Density	–	AASHTO T 310 or other approved procedures	1 per 2500 yd^2 (2000 m^2), but not less than 3 per layer	In-place	No	Before placement of next layer
Finished Product								

Table 204-1
Sampling, Testing, and Acceptance Requirements

Material or Product (Subsection)	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Roadbed (204.13)	Measured and tested for conformance (106.04)	Final line & grade	–	Field measured	Determined by the CO	Determined by the CO	No	Before placement of next layer

(1) Not required when using Government-provided source.
(2) Minimum 5 points per proctor.

Table 204-2
Construction Tolerances

Location Description	Tolerance Class (a)												
	A	B	C	D	E	F	G	H	I	J	K	L	M
Roadbed width (ft)	+0.5	+0.5	+1.0	+1.0	+1.0	+1.0	+1.5	+1.0	+2.0	+2.0	+2.0	+2.0	+2.0
Subgrade elevation (ft)	±0.1	±0.2	±0.2	±0.5	±0.5	±1.0	±1.0	±1.5	±2.0	±3.0	±2.0	±3.0	(c)
Centerline alignment (ft)	±0.2	±0.2	±0.5	±0.5	±1.0	±1.0	±1.5	±1.5	±2.0	±3.0	±3.0	±5.0	(c)
Slopes, excavation, and embankment (% slope[(b)])	±3	±5	±5	±5	±5	±5	±10	±10	±10	±10	±20	±20	±20

(a) Maximum allowable deviation from construction stakes and drawings.
(b) Maximum allowable deviation from staked slope measured from slope stakes or hinge points.
(c) Unless otherwise shown the centerline alignment and subgrade elevation, as built, have no horizontal curves with a radius of less than 80 feet, and no vertical curves with a curve length of less than 80 feet when the algebraic difference in the grade change is less than 10 percent, or a curve length of less than 100 feet when the algebraic difference of the grade change is greater than or equal to 10 percent. The centerline grade is not to exceed 20 percent in 100 feet of length.

207 - Earthwork Geotextiles

Delete third sentence of Subsection 207.04 and replace with the following:

207.04(c)(1) First layer placement and compaction.

Spread the end-dump pile of cover material maintaining 6-inch(es) lift over the geosynthetic.

208 - Structure Excavation and Backfill for Selected Major Structures

208.07_National_11_8_2016

Add the following to Subsection 208.07:

208.07 Dewatering.

Construct diversions according to Subsection 157.10 Diversions. Submit dewatering plans according to Subsection 104.03.

208.12 Measurement.

Delete Subsection 208.12(a) and the last paragraph in Subsection 208.12

209 - Structure Excavation and Backfill

209.03 General.

Add the following to Subsection 209.03:

Submit an Excavation Plan for approval prior to beginning the work. As a minimum, the Excavation Plan must include: drawings and a written outline illustrating and describing the proposed excavation limits, methods, equipment to be used, location of stockpiles, and estimated quantities. The Excavation Plan must comply with all applicable OSHA requirements and list the soil type assumed.

209.09_National_7_18_2017

209.09 Backfill.

Add the following to Subsection 209.09(a):

(a) General.

Backfill without damaging or displacing the culvert or structural plate structure. Replace any pipe that is distorted by more than 5 percent of nominal dimensions, or that is ruptured or broken.

Add the following to Subsection 209.09(b)

(b) Pipe culverts.

Do not place or backfill pipe that meets any of the following conditions until the excavation and foundation have been approved in writing by the CO:

- Embankment height greater than 6 feet at subgrade centerline.
- Installation in a protected stream course.
- Round pipe with a diameter of 48 inches or greater.
- Pipe arches with a span of 50 inches or greater.
- Any box culvert or structure other than pipe culverts.

209.10_National_7_17_2017

Delete Subsection 209.10 and replace with the following:

209.10 Compacting.

Compact the embankment using one of the following methods as specified.

(a) Compaction Method 1. Use AASHTO T 27 to determine the quantity of material retained on a No. 4 (4.75-millimeter) sieve. Compact as follows:

(1) More than 80 percent retained on a No. 4 (4.75-millimeter) sieve. Adjust the moisture content to a level suitable for compaction. Fill the interstices around rock with earth or other fine material as practical. Use compression-type rollers at speeds less than 6 feet (1.8 meters) per second and vibratory rollers at speeds less than 3 feet (1 meter) per second. Compact each layer of material full width with one of the following and until there is no visible evidence of further consolidation:

(a) Four roller passes of a vibratory roller having a minimum dynamic force of 40,000 pounds (180 kilonewtons) impact per vibration and a minimum frequency of 1000 vibrations per minute;

(b) Eight roller passes of a 20-ton (20-metric ton) compression-type roller; or

(c) Eight roller passes of a vibratory roller having a minimum dynamic force of 30,000 pounds (130 kilonewtons) impact per vibration and a minimum frequency of 1000 vibrations per minute.

Increase the compactive effort for layers deeper than 12 inches (300 millimeters) as follows:

- For each additional 6 inches (150 millimeters) or fraction thereof, increase the number of roller passes in Subsection 209.10(a)(1)(a), by four passes; or
- For each additional 6 inches (150 millimeters) or fraction thereof, increase the number of roller passes in Subsection 209.10(a)(1)(b) and (c), by eight passes.

(2) 50 to 80 percent retained on a No. 4 (4.75-millimeter) sieve. Classify the material according to AASHTO M 145. Adjust the moisture content of material classified A-1 through A-5 to a moisture content suitable for compaction. Adjust the moisture content of material classified A-6 and A-7 to within 2 percent of the optimum moisture content. Use AASHTO T 99 to determine the optimum moisture content of the portion of the material passing a No. 4 (4.75-millimeter) sieve. Multiply this number by the percentage of material passing a No. 4 (4.75-millimeter) sieve, and add 2 percent to determine the optimum moisture content of the material.

Use nonvibratory rollers at speeds less than 6 feet (1.8 meters) per second and vibratory rollers at speeds less than 3 feet(1 meter) per second. Compact each layer of material full width according to Subsection 209.10(a)(1).

(3) Less than 50 percent retained on a No. 4 (4.75-millimeter) sieve. Classify the material according to AASHTO M 145. For material classified A-1 or A-2-4, determine the maximum density according to AASHTO T 99, Method C..

Adjust the moisture content of material classified A-1 through A-5 to a moisture content suitable for compaction. Adjust the moisture content of material classified A-6 and A-7 to within 2 percent of the optimum moisture content.

Use compression-type or vibratory rollers. Compact each layer of material full width to at least 95 percent of the maximum density. Determine the in-place density and moisture content according to AASHTO T 310 or other approved test procedures. When required, use AASHTO T 224 to correct for coarse particles.

(b) Compaction Method 2. Adjust the moisture content of the material to a moisture content suitable for compaction. Fill the interstices around rock with earth or other fine material as practical. Operate roller compaction equipment over the full width of each layer until there is no visible evidence of further consolidation or, if when a sheepsfoot roller is used, the roller "walks out" of the layer. Make at least three complete passes. Use compression-type rollers at speeds less than 6 feet (1.8 meters) per second and vibratory rollers at speeds less than 3 feet (1 meter) per second. Ensure rollers meet the following requirements:

(1) Steel wheeled rollers, other than vibratory, capable of exerting a force of not less than 250 pounds per inch (4.5 kilogram/millimeter) of width of the compression roll or rolls.

(2) Vibratory steel wheeled rollers equipped with amplitude and frequency controls with a minimum dynamic force of 30,000 pounds (130 kilonewtons) impact per vibration, specifically designed to compact the material on which it is used.

(3) Pneumatic-tired rollers with smooth tread tires of equal size that will provide a uniform compacting pressure for the full width of the roller and capable of exerting a ground pressure of at least 80 psi (550 Kilopascals).

(4) Sheepsfoot, tamping, or grid rollers capable of exerting a force of 250 pounds per inch (4.5 kilogram/millimeter) of width of roller drum.

(c) Compaction Method 3. Adjust the moisture content of the material to a moisture content suitable for compaction. Fill the interstices around rock with earth or other fine material as practical. Operate hauling and spreading equipment uniformly over the full width of each layer until there is no visible evidence of further consolidation. Make at least three complete passes.

(d) Compaction Method 4. Adjust the moisture content of the material to a moisture content suitable for compaction. Fill the interstices around rock with earth or other fine material as practical. Operate hauling and spreading equipment uniformly over the full width of each layer.

(e) Compaction Method 5. Adjust the moisture content of the material to a moisture content suitable for compaction. Compact the complete surface with a bucket of an excavator larger than 39,000 pounds (18 metric ton) Gross Vehicle Weight using a minimum of three blows. Overlap compaction by ½ width of bucket.

(f) Compaction Method 6. Adjust the moisture content of the material to a moisture content suitable for compaction. Compact using an approved mechanical tamper for a minimum of three complete passes.

When compacting with rollers or hauling and spreading equipment is not practical, use approved mechanical tampers for a minimum of three complete passes.

Delete this subsection 209.12 and replace with the following:

209.13 Measurement.

Measure the Section 209 items listed in the bid schedule according to Subsection 109.02.

Add the following to Subsection 209.14:

209.14 Payment.

The accepted quantities measured as provided in Subsection 109.02 will be paid at the contract price per unit of measurement for the Section 209 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this section. See Subsection 109.05

Add the following note to Table 209-1:

Table 209-1 Sampling and Testing Requirements

(3) Compaction methods 1 and 2 do not require AASHTO T-99 or T-310 test methods for foundation fill.

272 - Geocell Abutment Stabilization

Description

272.01 This work consists of constructing geocell abutment stabilization at each abutment using a cellular confinement system such as Presto Geoweb Cellular Confinement System or Webtec TerraCell in accordance with the plans and manufacturers recommendations.

Materials

272.02 Requirements. Ensure that material conforms to specifications in the following subsections:

Granular Backfill Type (c)	703.03
Geotextile, Class 1, Type II-A	714.01
Geocell	736

Construction Requirements

272.03 General. Perform the work specified in Section 208 or 209. Use ditches, grading or similar methods to prevent surface runoff that may occur during inclement weather from ponding in the foundation excavation.

272.04 Storage and Handling of Material. During shipment and storage, wrap geotextile materials in heavy-duty protective covering. Protect the material from mud, soil, dust, debris and sunlight prior to installation.

272.05 Geotextile Installation. Place the geotextile according to Section 207. Have the surface approved by the CO prior to placing geotextile.

Sew or overlap adjacent strips a minimum of 12" at joints. Insert securing pins through both strips of overlapped geotextile at minimum intervals of 3 feet, but no closer than 2 inches to each edge, to prevent the geotextile from being displaced.

Have the installed geotextile approved by the CO prior to setting the geocells.

272.06 Geocell Installation. Furnish the CO with product literature and certification as required in Section 106.03 for review and approval 7 days prior to installation. When requested by the CO, furnish a sample of the geocell from each lot for verification testing.

Place the geocell sections directly on the prepared subgrade. Expand the geocell sections into position at the grades and lines as shown on the plans. Hold the expanded geocell sections with suitable "stretcher frames", steel stakes driven inside selected outer cell walls, or other similar methods as allowed by the manufacturer prior to filling. Ensure that the individual cells have expanded to the minimum dimensions required by the manufacturer. If necessary field cut sections as per the manufacturer's recommendations to the lines shown on the plans.

Connect geocell panels in accordance with the manufacturer's recommendations.

272.07 Infill Placement. Furnish the CO with the manufacturer's specific recommendations for backfilling 7 days prior to placement of the geocells.

Place coarse granular backfill meeting Subsection 703.03 into the expanded cells with equipment appropriate for the site conditions such as a backhoe or a front-end loader. Do not drop infill material more than 3 feet to avoid damage or displacement of the cell walls.

Overfill the geocell cells and level to a minimum of 2 inches above the top of the cell walls. A front-end loader may be used to place the infill provided that it only traffics above geocell sections that have been filled and covered with the minimum 2 inches of additional material. Compact the infill material with a vibratory plate compacter. Operate compaction equipment over the full width of the geocell. Make at least three complete passes or until visible deformation of the infill ceases. Grade the surface to be ½ inch above the top of the cells. Ensure that the cell walls are not exposed after fine grading is completed.

Use the geocell manufacturer's specific recommendations for backfilling if they are more stringent than stated above.

272.08 Acceptance. Geotextile will be evaluated under Subsections 106.02 and 714.01.

Material for geocell will be evaluated under Subsections 106.02 and 106.03.

Granular backfill material will be evaluated under Section 106.02 and 106.04.

Measurement

272.09 Method. Measure the items listed in the bid schedule according to Subsection 109.02 and the following.

Measure geocell by the square yard in place, exclusive of wastage.

Payment

272.10 Basis. The accepted quantities will be paid for at the contract price per unit of measurement for the Section 272 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

The cost for furnishing and placing the granular backfill required in Sections 207, 208, and 209 for geocell infill is incidental to this pay item and no separate payment will be made.

The cost for furnishing and placing geotextile for the geocell installation is incidental to this pay item and no separate payment will be made.

302 - Minor Crushed Aggregate

302.04_National_7_18_2017

Add the following to Subsection 302.04 and 302.04(a)

302.04 Placing Crushed Aggregate.

Written approval of the surface is required before placing aggregate.

(a) Roadway aggregate.
For pit run or grid-rolled material, furnish material smaller than the maximum size, no gradation will be required otherwise. After processing on the road, remove all oversize material from the road and dispose as directed by the CO.

302.04_National_7_10_2017

Delete Subsection 302.05(a) and replace with the following:

302.05 Compacting and Finishing Crushed Aggregate

(a) Roadway aggregate. Compact using the methods below, specified in the Schedule of Items.

(1) Method 1. Compact the aggregate by operating compaction equipment over the total width until visible deformation ceases. A minimum of three complete roller passes shall be made at a moisture content suitable for compaction.

(2) Method 2. Operate equipment over the full width of spread aggregate.

552 - Structural Concrete

Delete the first paragraph of Subsection 552.01 and replace with the following:

552.01 Description.

This work consists of furnishing, placing, finishing, and curing concrete to be cast-in-place in bridges, culverts, and other structures; furnishing precast concrete elements by forming, placing reinforcing steel, placing and finishing concrete, curing, and transporting members; and materials testing and implementing quality control procedures. When specified, work also includes installation of furnished precast concrete elements, including performing all necessary grouting, welding or other connections; and repairs or finishing associated with transport and the removal of lifting devices.

Add the following references to Subsection 552.02:

552.02 Material.

Dowel bars	709.01(f)
Falsework and forms	562
Hook bolts	709.01(e)
Mortar cement	701.02(b)
Reinforcing steel	554
Structural steel	717.01

552.03 Construction Requirements.

Delete Table 552-1 and its footnotes and replace with the following table and footnotes:

Table 552-1

Composition of Concrete

Class of Concrete	Minimum Compressive Strength @ 28-Days, f'c, psi (MPa)	Maximum Water/ Cementitious Material Ratio	Coarse Aggregate Size Number AASHTO M 43 [1]
A	4500 (31.0)	0.45	5, 56, 57
A(AE) [5]	4500 (31.0)	0.45	5, 56, 57
C	4500 (31.0)	0.45	7, 78
C(AE)	4500 (31.0)	0.45	7, 78
D(AE) [2]	5000 (34.5)	0.40	5, 56, 57
P (Precast, Prestressed) [3] [4] [5]	See plans	–	6,7,67,68,78
P(AE) [3] [4] [5]	See plans	–	6,7,67,68,78
S (Seal)	–	0.54	5, 56, 57

[1] Meet the processing requirements of AASHTO M 43, Table 1 – Standard Sizes of Processed Aggregate.

[2] The maximum water-soluble chloride ion (Cl-) content is 0.15 percent by mass of cement. Determine the water-soluble chloride ion content of concrete made with mix ingredients at an age between 28 and 48 days according to ASTM C1218. Submit test results with the concrete mix design for approval.

[3] The maximum water-soluble chloride ion (Cl-) content is 0.06 percent by mass of cement. Determine the water-soluble chloride ion content of concrete made with mix ingredients at an age between 28 and 48 days according to ASTM C1218. Submit test results with the concrete mix design for approval.

[4] Use Class P (AE) concrete in the entire depth of the top flange of all multi-beam bridge girders. In lieu of this, Class P (AE) concrete may be used for fabrication of the entire girder and throughout the entire depth of prestressed slabs. In all cases, furnish concrete meeting the 28 day specified minimum concrete strength requirements for the prestressed members as shown on the plans, unless otherwise specified.

[5] Use Class A (AE) or Class P (AE) concrete for precast elements to be used as substructure elements, such as footings or foundations. Use Class P (AE) concrete for fabrication of precast elements to be used in a precast (non-prestressed) superstructure element, including slabs, girders, and box culverts where traffic will be in contact with the horizontal top surface. In all cases, furnish concrete meeting the 28 day specified minimum concrete strength requirements for the precast or prestressed member s as shown on the plans, unless otherwise specified.

Delete the second and third paragraph of Subsection 552.03 and replace with the following:

Submit written concrete mix designs on FHWA Form 1608, 552 *Structural Concrete Mix Design Submittal*, or other format that is professional in appearance and provides all of the required information in subsections (a) through (z) of this section, 552.03. Allow at least thirty (30) calendar days for approval before production.

Add the following Subsection 552.03 under the list of items to be included in the mix design submittal:

(z) Evaluation of potential aggregate reactivity

552.08 Delivery.

Delete the last sentence of the first paragraph of Subsection 552.08(a) with the following:

Do not exceed 130 total revolutions at mixing speed, including both initial mixing and remixing. Do not exceed 300 total revolutions, including both mixing and agitating speed.

Delete table 552-4 and its footnotes and replace with the following table and footnotes:

Table 552-4
Concrete Remixing and Discharge Time Limits

Cement Type [1]	**Admixtures**	**Remixing Time Limit (hour)**	**Discharge Time Limit (hour)**
Type I, IA, II, IIA, V, or approved blended hydraulic cement	None	0.75	1.00
Type I, IA, II, IIA, V, or approved blended hydraulic cement	ASTM C494, Type B, D, or G[2]	1.25	1.50
Type I, IA, II, IIA, V, or approved blended hydraulic cement	Hydration stabilizer	3.00	Approved design discharge time limit, 3.50 maximum
Type III	None	0.50	0.75
Type III	ASTM C494, Type B, D, or G[2]	1.00	1.25

[1] AASHTO M 85 or AASHTO M 240 as applicable.

[2] ASTM C494 defines Type B as a retarding admixture, Type D as a Water-reducing and retarding admixture, and Type G as a Water-reducing, high range, and retarding admixture.

Add the following paragraph to Subsection 552.18:

552.18 Loads on New Concrete Structures.

Do not allow public traffic on the bridge until approaches, curbs, and bridge rail are completed and in-place. Erect barricades at each end of bridge spans when road approaches allow vehicles to drive directly onto the structure.

Delete Subsections 552.20, 552.21, and 552.22 and replace with the following:

552.20 Precast Elements.

Precast concrete elements and members considered structural in nature shall meet the following specifications of this section.

(a) Certification and/or Quality Assurance of Precast Manufacturing Plant. Furnish precast concrete members using a plant with one of the following certifications, appropriate to the type of member being fabricated:

(1) Precast/Prestressed Concrete Institute (PCI)
  (a) Bridge 1, Precast Bridge Products (no prestressed reinforcing).
  (b) Commercial 1, Precast Concrete Products (no prestressed reinforcing).
(2) National Precast Concrete Association (NPCA)
(3) American Concrete Pipe Association (ACPA)

When available, submit a copy of the transmittal letter of the latest PCI, NPCA, or ACPA inspection and certification with the shop drawings.

In lieu of the above certification, the Contractor shall retain a professional engineer to provide quality assurance for the work by inspecting and certifying in writing the concrete members are constructed in accordance with the contract specifications and FSSS Section 552 and shall include information including but not limited to the following:

(a) Shop drawings review.
(b) Concrete member dimensions.
(c) Concrete mix design.
(d) Aggregate sources, moisture contents, test results.
(e) Steel reinforcing placement.
(f) Concrete curing and strength test results.
(g) Concrete material certifications.
(h) Placement mixing, delivery and sampling.
(i) Properly calibrated production and test equipment
(j) Proper records keeping including; personnel qualifications and training records, material sources, quality control testing results for the aggregate and concrete, pre-pour and post-pour inspection reports, batching records, disposition of failing products, and shipping.

Material sources shall be on the State's approved supplier list or approved in writing by the CO.

Furnish the certification or supplemental information above to the CO prior to shipment of materials and installation at the job site.

Perform all sampling, testing, and inspection necessary to ensure quality control of the component materials and the concrete. Sample and test for quality control and acceptance testing in accordance with the AASHTO or ASTM test methods prescribed in Section 552.

Maintain adequate records of all inspections and tests. Keep records that indicate the nature and number of observations made, the number and type of deficiencies found, the quantities approved and rejected, and the nature of any corrective action taken.

(b) Precast Manufacturing Plant (i.e. Casting Yard). The precasting of concrete structural members may be done at a casting yard of an industry-certified plant or a casting yard of the Contractor's choice with the appropriate certifications discussed above.

(c) Tolerances. Place and consolidate concrete so that shrinkage cracks are not produced in the member.

Verify that the prefabricated elements will fit-up and align properly before shipping from the precast facility. Assembling each superstructure and substructure composed of prefabricated elements in the yard prior to shipping the elements to the project site is a suitable way to perform such verification. If assembled in the yard, use blocking to simulate the support of the elements and the spacing between the elements. Verify all elements are constructed in compliance with all plan requirements. Dry fit all connections in the fabrication yard prior to installation of the elements at the bridge site.

Fabricate precast concrete foundation units straight and true size and shape with exposed edges and corners precise and true so each finished unit complies with the following dimension tolerances as well as position tolerances for cast in items:

(1) Length shall not vary by more than ¾ inch.
(2) Height/Width shall not vary from that shown in the design by more than ¼ inch.
(3) Local smoothness shall be no more than ¼ inch in 10 feet for any surface, except when finishing or form liners are called out or accepted as part of the submittal
(4) Position of inserts for structural connections shall not vary from that shown in the shop drawings by more than ½ inch.
(5) Placement of non-prestressed reinforcement shall comply with Section 554 Reinforcing Steel.

(d) Submittals. Submit four (4) sets of shop drawings to the CO for approval according to subsection 104.03, a minimum of 21 days before fabrication of the precast member(s). In lieu of hard copy shop drawing submittals, electronic submittals are acceptable. Show all details necessary for fabrication, including the following:

(1) Details and location of all lifting holes, inserts, hardware, devices, and any additional reinforcing required for lifting. Include supporting calculations and lifting procedures.
(2) Describe the method of curing, handling, storing, and transporting the elements.
(3) Concrete mix design for all precast elements.

(e) Quality Assurance.

(1) Permanently mark each element with date of fabrication, supplier identification and module identification. Stamp markings in fresh concrete.
(2) Prevent cracking or damage of precast components during handling and storage.
(3) Replace or repair defective or broken precast concrete deck and concrete deck overhang elements according to section 106. Requests to repair defective or broken elements are subject to the following;
   (a) Obtain approval before performing concrete repairs.
   (b) Concrete repair work must re-establish the module's structural integrity, durability, and aesthetics to the satisfaction of the CO.
   (c) Describe the cause of damage and the corrective action taken to eliminate future damage.
   (d) An updated CPM schedule showing the effects of repair work on project completion must be submitted.
(4) Elements will be rejected if they do not conform to the contract documents, and for the following reasons:
   (a) Full-depth cracking of concrete and concrete breakage that is not repairable.
   (b) Cracks that extend to the nearest reinforcement plane, or fine surface cracks that do not extend to the nearest reinforcement plane but are numerous or extensive.
   (c) Camber that does not meet the requirements of the plans or fabrication drawings.
   (d) Honeycombed texture.
   (e) Dimensions exceeding the allowable tolerances.
   (f) Damage during fabrication, transportation, erection, or construction.
(5) Document all test results for structural concrete. Show in the quality control files at least the following information:
   (a) Element identification.
   (b) Date and time of fabrication concrete pour.
   (c) Concrete cylinder test results.
   (d) Concrete mix design and the batch print out.
   (e) Form-stripping date.
   (f) Location and number of blockouts and lifting inserts.
   (g) Temperature, moisture, and duration of curing period.
   (h) Approved repair procedures.

(f) Handling, storing, and transporting.

(1) *Damage/Cracking.* Prevent cracking or damage of prefabricated elements and modules during handling, storing, and transporting.

(2) *Precast Element Sizes.* Finalize the size of precast elements with consideration for shipping restrictions, equipment availability, and site constraints. Show the final element sizes on the assembly plan.

(3) *Lifting Devices.* The design and detail of the lifting devices is the responsibility of the contractor. Use lifting devices in a manner that does not cause damage, cracking, or torsional forces. Place the lifting devices in locations that are not visible once the prefabricated element is placed, or within recessed pockets that can be patched after installation.

(4) *Safety.* The Contractor is responsible for the safety and stability of prefabricated elements during all stages of handling, transportation, and construction.

(5) *Handling and Storing.* Store the precast units in a horizontal and upright position, supported at their designated bearing points. Follow Chapter 5 of the PCI Design Handbook for handling and erection bracing requirements.

Lift the precast elements so that the angle between the top surface of the precast element and the lifting line is not less than 60 degrees when measured from the top surface of the precast elements to the lifting line. If two cranes are used, then the lifting lines shall be vertical. Lift the modules at the designated points. The Contractor is responsible for handling stresses in the modules. Choose the locations of the lifting points so that the anticipated flexural tensile stress induced in the top of the structural concrete for the assumed support locations is not greater than the allowable stress.

Select smooth and well compacted storage areas to prevent damage due to differential settlement. Support precast elements during storage to prevent cracking or creep induced deformation (sagging). Check precast elements at least once per month to ensure that creep-induced deformation does not occur.

Protect the elements from freezing temperatures for 5 days after casting or until precast concrete attains design compressive strength. Do not remove thermal protection for any length of time before the units attain the specified compressive strength when the surrounding air temperature is below 20 °F (-6 °C).
Before transporting precast concrete members, provide written certification that the members were fabricated and visually inspected in conformance with 552 and meet minimum quality requirements.

(6) *Additional Reinforcement.* Provide additional reinforcement, as needed, to meet the requirements of handling, transporting, and erecting precast members.

(7) *Requirements Prior to Shipping.* Do not ship precast concrete members until concrete cylinder tests, manufactured from the same concrete and cured under the same conditions as the members, indicate that the concrete in each member has attained the minimum required design strength and is at least 7 days old.

(g) Installation.

(1) Install members without damage to structural capacity, shape, or finish. Replace or repair damaged members.

(2) Install members level and plumb without exceeding the following allowable tolerances:

(a) Plan Location from Design Datum: Plus or Minus ½ in. (±13mm).

(b) Top Elevation from Nominal Top Elevation: Plus or Minus 3/8 in. (±6mm).

(c) Maximum Plumb Variation over the Lesser of Height of Structure or 100 ft (30m): 1 in. (25 mm).

(d) Plumb in Any 10 ft (3 m) of Element Height: ¼ in. (6mm).

(e) Maximum Jog in Alignment of Matching Edges: ¼ in. (6mm).

552.21 Acceptance.

See Table 552-9 for sampling, testing, and acceptance requirements and the quality characteristic category.

Reinforcing steel, anchor devices, elastomeric bearings, and material for concrete and grout will be evaluated under Subsection 106.03. Furnish production certifications for hydraulic cement, reinforcing steel, and any other cementitious materials.

Cast in place concrete mixture's slump, air content, density, and temperature will be evaluated under Subsections 106.02 and 106.04.

Concrete compressive strength will be evaluated under Subsection 106.05. The lower specification limit is the minimum required compressive strength at 28 days (f'_c) specified in the contract. Remove and replace concrete represented by cylinders having a compressive strength less than 90 percent of the minimum 28-day strength (f'_c).

Concrete for precast concrete members will be evaluated under Subsections 106.02, 106.03, and 106.04.

Construction of all precast concrete members and concrete structures (including batching, placing, finishing, and curing concrete) will be evaluated under Subsections 106.02 and 106.04.

Reinforcing steel will be evaluated under Section 554.

Falsework and forms will be evaluated under Section 562.

552.22 Measurement.

Measure the Section 552 pay items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

When measuring structural concrete by the cubic yard (cubic meter), measure in the structure.

Do not measure reinforcing steel, concrete, anchorages, plates, nuts, and other material contained within or attached to the unit for precast concrete structural members.

552.23 Payment.

The accepted quantities will be paid at the contract price per unit of measurement for the Section 552 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05

553 - Prestressed Concrete

553.03_Forest_12_11_2018

Delete Subsection 553.03 and replace with the following:

553.03 Qualifications

Submit either of the following for approval at least 30 days before prestressed concrete operations begin.

a. **Plant & Personnel Certification**. Precast/Prestressed Concrete Institute (PCI) plant certification. Name of engineer who is certified by PCI for Plant Quality Personnel, Level I or higher.

Or

b. **Professional engineer** retained by Contractor to provide quality assurance for the work by inspecting and certifying in writing that the concrete members are constructed in accordance with the contract specifications and Sections 552 & 553. Quality assurance certification shall include but not be limited to the following information:

1. Shop drawings review.
2. Prestressed concrete member design calculations
3. Prestressed concrete member dimensions.
4. Prestressed concrete mix design.
5. Aggregate sources, moisture contents, test results.
6. Steel reinforcing certification and placement.
7. Prestressing steel certification and placement.
8. Concrete material certifications.
9. Verification of calibration of production and test equipment
10. Proper records keeping including; personnel qualifications and training records, material sources and quality control testing results for the aggregate and concrete

Material sources shall be on the State's approved supplier list or approved in writing by the CO.

553.04 Method Approval.

Add the following to the list of items to be submitted with the report:

l. Calculations to validate supporting prestressed members while in storage or transit at locations different from those indicated on the contract drawings;

m. Documentation and details for all desired changes or deviations from the contract.

Add the following paragraph after item (m):

To meet requirements of subsection 153.03 all phases, furnish a Quality Control (QC) Report prepared by the fabricating plant upon delivery of the prestressed members to the job. Include certification that the quality and quantity of the furnished prestress members conforms to the

contract. Affix the seal and signature of the professional engineer most directly responsible for the plant's quality control organization, whether a member of the QC organization or not, on the report.

553.06 Concrete.

Add the following after the first paragraph:

As a minimum use air-entrained Class P(AE) concrete according to Section 552 for the top 2 inches of prestressed concrete members.

Ensure that threaded inserts required by the contract develop the full tensile strength of the bars or bolts they secure. Provide lifting devices of adequate strength to safely lift the girders at locations shown in the contract or on the girder shop drawings, if different from the contract.

Add the following to the third paragraph:

Finish surfaces that will be paved with an asphalt concrete wearing surface with a uniformly applied rough texture by course brooming or other approved methods, or that will not receive any wearing surface with a transverse stiff broom finish.

Add the following at the end of this subsection:

Submit all concrete cylinder test results and temperature curing records as part of the fabricating plant's QC report, except 28 day concrete strength test results may be submitted later when prestressed girders are authorized to be shipped before that date.

553.07 Tensioning.

Delete the last sentence in the eighth paragraph and replace with the following:

Stress and anchor prestressing steel at the initial stress called for by the approved stressing calculations.

553.09 Storing, Transporting and Erecting.

Add the following at the end of the subsection:

Use high-pressure water blasting to remove all debris and paste in the keyways immediately prior to placing mortar. Remove all free-standing water and allow keyways to completely surface dry. Use mortar in keyways between multibeam members and to patch defects, blockouts, or other areas on the concrete roadway portion of the structure 1 inch or more in depth and over 1 inch in width. Patch smaller areas on the concrete roadway and set anchor bolts and dowels with high-strength, non-shrink grout.

Strike off exposed grout or mortared surfaces flush and apply the same surface texture finish as the surrounding concrete as soon as the grout or mortar has sufficiently set. Cure the grout or mortar in accordance with manufacturer’s recommendations.

Meet the requirements of AWS D1.1-Structural Welding Code when field welding.

554 - Reinforcing Steel

554.03_nat_us_06_20_2007

Delete the first paragraph in Subsection 554.03 and replace with the following:

554.03 Order Lists.

Do not submit order lists or bending diagrams for approval.

Add the following to the end of the second paragraph of 554.11:

554.11 Measurement.

Do not measure or include reinforcing steel fabricated into the prestressed member.

602 - Culverts and Drains

602.05_National_6_11_2020

Replace the first paragraph of Subsection 602.05 with the following:

602.05 Laying Metal Pipe.

Position the pipe with a longitudinal joint so the joint is opposite the invert. Unless otherwise specified fully join pipe sections to control the infiltration of soil according to AASHTO M 36 or AASHTO M 196. Use one of the following:

Add the following to Subsection 602.05:

(c) Standard Connecting bands. Band corrugation shall match that of the pipe sections being joined or the annular rerolled ends of those pipe sections.

625 - Turf Establishment

625.00_National_7_18_2017

Delete Section 625 in its entirety and replace with the following:

625.01 Description.

This work consists of soil preparation, watering, fertilizing, seeding, and mulching. Seeding and mulching methods are designated as dry or hydraulic.

625.02 Material

Conform to the following Subsections:

Agricultural limestone	713.02
Fertilizer	713.03
Mulch	713.05
Seed	713.04
Tackifiers	713.11
Water	725.01(b)

Construction Requirements

625.03 General Construction Requirements.

Apply turf establishment to prepared ground or any disturbed area between **August 1** and **October 31.** Apply turf establishment to the areas shown on the plans or worklists within **7** days after completion of ground disturbing activities.

Seeded areas damaged by construction activities shall be reseeded within 10 days of the damage. Do not seed during windy weather or when the ground is excessively wet, frozen, or snow covered.

Assure that all seed and mulch used in the work conforms to the weed free requirements of Section 713.

625.04 Preparing Seedbed.

Ensure that the surface soil is in a roughened condition favorable for germination and growth.

625.05 Watering.

Ensure that the surface soil is in a roughened condition favorable for germination and growth.

625.07 Seeding.

Apply **Contractor-furnished** seed by the following methods:

(a) Dry Method. Apply the seed with approved power driven seeders, drills, or other mechanical equipment. Hand-operated seeding methods are satisfactory on areas inaccessible to mechanical equipment; or

(b) Hydraulic Method. Use hydraulic-type equipment capable of providing a uniform application using water as the carrying agent. Add a tracer material consisting of either wood or grass cellulose fiber mulch to the water. Apply the tracer material at a rate of 400 pounds per acre (450 kilograms per hectare) to provide visible evidence of uniform application. Add the seed to the water slurry no more than 30 minutes before application. Seed by hand areas inaccessible to seeding equipment.

(c) Hydromulch. Hydromulch must be Mat-Fiber Plus, manufactured by Mat Inc.,12402 Hwy 2, Floodwood, MN 55736, 1 -888-477-3028; Spray Mulch X-80 manufactured by Pacific Wood Fibers, PO Box 2109, Redmond WA 98052; or equal, having the following essential characteristics:

1. Wood cellulose fiber.
2. No germination or growth inhibiting factors.
3. Dyed appropriate color to allow visual metering of application.
4. Evenly dispersed and suspended when agitated in water.
5. Forms blotter like ground cover that readily absorbs water and allows infiltration to underlying soil.

The contractor will be responsible for purchasing native seed recommended by the USFS botanist. Native seeds should be purchased through:

Benson Farms, Inc.
1145 S. Jefferson Ave.
Moses Lake, WA 98837
509-765-6348

Due to USFS requirements to use locally adapted genetically appropriate plant propagules, it must be purchased from this grower. If specific biotypes are not available, contact the local USFS botanist for recommendations.

Furnish and apply the following kinds and amounts of pure live seed:

Species	Percent of Seed Mix (%)	Quantity of Pure Live Seed (Lbs/Half-Acre)
Locally adapted native biotype		
Upper Yakima- Slender hairgrass (Deschampsia elongata)	**30%**	**3.75**
Upper Yakima- Spike bentgrass (Agrostis exigua)	**30%**	**3.75**
Upper Yakima- Broadleaf lupine (Lupinus latifolius)	**10%**	**1.25**
Adams- Idaho fescue (Fescue idahoensis)	**30%**	**3.75**
TOTAL	**100%**	**12.5**

Determine the pounds of seed to be furnished per acre by dividing the pounds of pure live seed required per acre by the product of the percent purity and percent germination. Ideally seeds should be sown in the fall -before 2 inches of snow cover the ground. Other alternative dates may be discussed with the Naches District Botanist on a situational basis as long as there is good soil and seed contact occurring simultaneously.

Installation of Plants.

Vertical planting depth, site selection, species appropriateness, handling, mechanical damage during planting, i.e. excessive broken branches, tops, and roots, excessive damage to bark which exposes cambium shall be inspected. Due to the perishable nature of trees and shrubs, care and protection is considered critical and shall be carefully monitored throughout the planting schedule to ensure proper care. The CO shall frequently observe planting in progress, dig trees and/or shrubs to check underground planting quality and observe planting methods. Planting intervals/spacing shall be provided by the CO on site. Planting into frozen ground or during periods of excessive rainfall are not permissible, planting times shall be dependent on weather conditions.

Mulch & Gravel:

Mulch and gravel must be from sources which are state certified weed free or approved by the district botanist. Excess local wood debris can also be chipped to use for mulch. Wood mulch should be used when large areas of ground are exposed and erosion is a concern. Mulching ensures, moisture is retained for successful seed germination.

625.08 Mulching.

Apply mulch within **36** hours after seeding by the following methods. Locally chipped on site material, certified Weed Free Straw Mulch or Woodstraw. They should be placed over the seed at depths of 1 - 2 inches or 1.5-2 tons/acre.

625.09 Protecting and Caring for Seeded Areas.

Protect and care for seeded areas including watering according to 625.05. Repair or apply supplemental applications of seed, mulch, fertilizer, and water according to 625.05 as many times as needed until turf is established or final acceptance.

625.10 Acceptance.

Material for turf establishment will be evaluated under Subsections 106.02 and 106.03.

Placing of turf establishment will be evaluated under Subsections 106.02 and 106.04.

625.11 Measurement

Measure the Section 625 pay items listed in the bid schedule according to Subsection 109.02 and the following as applicable:

When measuring turf establishment and supplemental applications by the acre (hectare), measure on the ground surface.

When measuring water by volume or mass, measure in the hauling vehicle or by metering.

625.12 Payment

The accepted quantities will be paid at the contract price per unit of measurement for the Section 625 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

648 - Stream Simulation

Add Section 648:

648.01 Description.

This work consists of furnishing and installing alluvium, rock, logs, trees, rootwads and specified fill to simulate natural stream profile, grade control structures, and streambed through culverts, bridge structures, and existing stream channels. Work includes developing materials; hauling materials; dewatering; sediment control; placing bedding and backfill to construct stream simulation channels inside and outside of the structures (culverts, bridges, existing channels); placing, keying, sealing, and compacting designed streambed fill; constructing instream structures (steps, pools, riffles, ribs, banks); reconstructing existing channels; and all other streambed work to complete the project.

648.02 Material.

Conform to the following Subsections:

Backfill Material	704.03
Stream Bed Simulation Material	705.08
Channel Rock	705.08

Furnish instream structures materials (boulders, boulder clusters, ribs, steps, riffles, etc.) and stream simulation streambed mix with the sizes and gradations as required in the contract.

Provide native log materials that are green, sound, and free of cracks or defects that would affect structural integrity or accelerate decay.

Sort material for streambed simulation rock by screening (power screen or grizzly/stationary screen) as shown on the plans. Large particles may be machine sorted by heavy equipment or hand labor.

Mix streambed simulation rock in proportions based on Table 705-4. All streambed material will be similar in shape / angularity as those found in the natural stream channel or as designated in the specifications. Tolerance for material gradation is + or – 5% for each screen size listed in the gradation.

Provide streambed simulation rock and channel rock that is durable and at least as angular as those found in the natural stream channel or as SHOWN ON THE PLANS.

Request approval of rock to be used for steps, banks and all grade control structures prior to scheduled placement.

648.03 General Construction Requirements.

Place streambed simulation material on a prepared surface to form a well-graded, low permeability mass, similar in appearance and texture to the natural streambed. Do not drive metal track or rubber-tired equipment directly on metal or concrete structure surfaces.

648.04 Equipment Operations.

An oil spill containment kit is required on each job site when working in and around the stream. Composition of the kit is dependent on the job; determine contents of the kit as needed for each job. At a minimum, include tarps and oil-absorbent pads.

648.05 Equipment Limitations.

Do not drive metal track or rubber tired equipment directly on metal or concrete structure surfaces. Place a layer of streambed mix material on the structure bottom before operating metal track or rubber tired equipment directly on metal or concrete structure surfaces.

648.06 Excavation.

Control excavated material to minimize disturbance to the adjacent channel and banks. Incorporate suitable streambed materials into the project if required gradations are accordance with contract specifications.

Specific culvert installation time restrictions and installation plan requirements are indicated in the contract.

648.07 Dewatering.

Dewatering or diversions are required for construction and adjacent instream work in addition to complete reconstruction of the channel. Dewatering is not required when constructing isolated or infrequent structures such as single rock or log step and other instream structures in channel reconstruction areas. Customize dewatering to the site depending on flow, ground water depths at the time of installation, terrain configuration, and culvert embedment depths. Submit a dewatering plan at least thirty (30) days in advance of construction. Include in the plan the method (bypass or pumping), number of pumps and capacity required, pump and bypass culvert calculations, location/layout of dewatering operations and equipment, and erosion control measures for dealing with the return flow back to the existing stream channel.

Dewatering operations will be capable of passing the dewatering flow SHOWN ON THE PLANS.

Maintain the dewatering pumping operations to ensure return flow does not exceed State water quality standards. Water pumped from the construction site may require additional filtration by filter fabrics or other methods (settling basins, hay bales, etc.) to prevent turbid water from directly entering the stream.

Place additional measures or cease operations until the discharge reaches allowable levels when turbidity exceeds State water quality standards.

Relocate fish contained within the cofferdams before the site is completely dewatered. Place relocated fish in the closest pool upstream of the construction zone.

If trash pumps are used during construction, the intake must be operated and maintained to prevent fish entrapment, entrainment, or injury with the use of perforated or slotted plate and woven wire with a mesh size not greater than 3/32 inch or a profile bar and wedgewire with openings not greater than 1/16 inch. Approach velocities shall not exceed a passive velocity of 0.2 feet per second (fps) or an active velocity 0.4 fps.

648.08. Rewatering.

Conduct rewatering activities to minimize sediment movement downstream of the site upon completion of instream work. Prior to rerouting stream flow into the new channel, rinse the surface of the streambed to settle fine grained sediments into the newly constructed channel substate, then slowly breach the coffer/diversion dams to avoid a large pulse of water being sent through the newly constructed channel.

648.09 Blasting and Rock Removal.

Remove bedrock encountered during excavation to the lines and grades required in the contract. Remove rock by either mechanical means with hydraulic impact hammers / rock breakers, by ripping, or blasting. When explosives are used, do not cause mortality to juvenile fish by transmitting excessive blasting overpressures through the ground to the fish habitat. Limit blasting overpressures to a maximum of 2 psi in fish habitat.

648.10 Placed Streambed Simulation Material.

Begin construction from the downstream end working upstream. Changes to this sequence will be allowed on a case by case basis due to poor stream to culvert alignment, traffic requirements, limited access, and preservation of existing trees reinforcing the banks.

Place streambed simulation rock in one or more layers with a maximum layer depth less than 1 ½ times the average dimension of the B-axis of the streambed simulation rock, but no greater than 2ft. Place streambed simulation rock by methods that do not cause segregation or damage to the prepared surface. Place or rearrange individual rocks to obtain a uniformly dense, compact, low permeability mass, matching streambed simulation details. Fill voids by machine or hand tamping before placing the next lift. Compact streambed materials by mechanical means such as hand or excavator operated vibratory plate compactors or jumping jack type compactor.

Fill all voids left during placement of streambed simulation rock, boulders, steps, ribs, banks and streambed materials adjacent to footings, concrete structures or corrugated pipes with fine material. Use water pressure, metal tamping rods, and similar hand operated equipment to force material into all surfaces and subsurface voids between the structure and rocks, and between individual rocks. Ensure the streambed is sealed to limit permeability.

Notify the CO at least five (5) business days in advance of the streambed material installation.

648.11 Rock Bedforms (Steps, Ribs, Riffles), Forcing Features Boulders, Boulder Clusters), and Bank Construction.

Construct bedforms and banks as specified in the contract. Construction will proceed from downstream to upstream. Machine or hand place banks, steps, and ribs and key in place with select key pieces of the required size class, along with smaller materials of varying sizes to fill voids. Construct low flow channel through the center of the channel AS SHOWN ON THE DRAWINGS. Place steps and ribs so the tops are uneven, containing several high and low points to concentrate water during low flows. Place step and rib surfaces so they are higher at the outside edge of the culvert (culvert wall) and slope down to the outside edge of the constructed low flow channel AS SHOWN ON THE PLANS.

Construct steps with footer rocks placed before the top step rocks are installed. Use footer rocks which are the same size class as the top step rocks. Fill all voids with smaller materials as construction progresses to minimize permeability.

Construct banks out of large blocky key pieces of the required size class AS SHOWN ON THE DRAWINGS. Key and lock smaller materials of varying sizes to fill voids. Bank materials will be hand keyed in place and compacted depending on the size of materials used as designated in the field by the CO. Construct bank faces to be uneven, protrude into the channel, and be rough in appearance. Construct the top of the bank to be fairly uniform. Tie back constructed banks and margins at the edge of the structure walls into the existing stream banks at dimensions similar to those found in the reference reach or AS SHOWN ON THE DRAWINGS.

When single rocks are used as roughness elements and habitat diversity, bury to 50% of the diameter or as SHOWN ON THE PLANS. Fill and compact voids around these structures. When constructed as clusters of particles, key pieces within the cluster will be buried 50% of the diameter or as SHOWN ON THE PLANS.

Notify the CO at least five (5) business days in advance of the installation of any streambed, bedform, roughness feature, log structure, or bank construction.

648.12 Log and Root Wad Structures.

Locate and place log structures as required in the contract, and/or designated in the field by the CO.

Construct log weirs with cross slope gradients not less than 5(H):1(V), unless SHOWN ON THE DRAWINGS or staked in the field by the CO, and maximum tolerance of 6(H):1(V), unless approved in writing by the CO.

Embed log weirs to a minimum depth of 10 feet beyond bank full widths or half bankfull width on each side, whichever is greater or AS SHOWN ON THE DRAWINGS. When placing habitat logs (overhanging a portion of the stream) that lay on the banks, ensure 2/3 of the log remain behind bankfull width on top of the bank.

Embed rootwad revetment trunks a minimum of 10 feet behind bankfull width limits or as SHOWN ON THE DRAWINGS. Bury the root to a point where the base of the bowl is resting in the bottom of the bank or as required in the contract, and/or designated in the field by the CO.

648.13 Acceptance.

Placing streambed simulation material will be evaluated under Subsections 106.02 and 106.04.

648.14 Measurement.

Measure the items listed in the bid schedule according to Subsection 109.02.

Channel construction per linear unit includes furnishing and installing all rock and work associated with simulation streambed construction and includes the installation of rock steps, ribs, pools, banks, riffles, boulders/boulder clusters and miscellaneous rock structures.

All log structures and rootwad revetment will be measured separately for payment if designated on the schedule of items.

Instream structures composed of rock and wood will be measured separately for payment if designated on the schedule of items.

Do not measure dewatering and diversions, they are considered incidental to construction of the structures unless measured separately for payment if designated on the schedule of items.

Work and materials required for stream simulation are considered incidental to installation of the structure unless designated on the schedule of items.

648.15 Payment.

The accepted quantities, measured as provided in Subsection 109.02, will be paid at the contract unit price per unit of measurement for Section 648 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05

Payment of foundation fill that is described in Subsection 648.13 shall not be paid for separately but shall be included in the Section 648 pay item for Channel Rock.

703 - Aggregate

703.05_National_7_18_2017

703.03 Granular Backfill.

Add the following:

(c) **Coarse Granular Backfill.** Furnish backfill material that consists of clean, hard durable particles or fragments of crushed stone, crushed slag or crushed gravel meeting the gradation shown below.

Sieve Size	Percent Passing
1 inch	100
¾ inch	75 to 100
No. 4	0 to 60
No. 40	0 to 50
No. 200	0 to 5

703.05_National_3_17_2021

Delete 703.05 and replace with the following:

703.05 Subbase, Base, Surface Course, and Screened Aggregate.

(a) Subbase or base aggregate. Furnish hard, durable particles or fragments of crushed stone, crushed slag, or crushed gravel conforming the following:

(1) Gradation	Table 703-2
(2) Liquid limit, AASHTO T 89	25 max.
(3) Plastic limit, AASHTO T 90	Nonplastic
(4) Los Angeles abrasion, AASHTO T 96	40% max.
(5) Sodium sulfate soundness loss (5 cycles), AASHTO T 104	12% max.
(6) Durability index (coarse), AASHTO T 210	35 min.
(7) Durability index (fine), AASHTO T 210	35 min.
(8) Fractured faces, ASTM D 5821	50% min.
(9) Free from organic matter and lumps or balls of clay	

Do not use material that breaks up when alternately frozen and thawed or wetted and dried.

Obtain the aggregate gradation by crushing, screening, and blending processes as necessary. Fine aggregate, material passing the No. 4 sieve, shall consist of natural or crushed sand and fine mineral particles.

(b) Surface course aggregate. Furnish hard, durable particles or fragments of crushed stone, crushed slag, or crushed gravel conforming the following:

(1) Gradation	Table 703-3
(2) Liquid limit, AASHTO T 89	35 max.
(3) Plastic Index, AASHTO T 90	
a) If the percent passing the No. 200 sieve is less than 12%	2 to 9
b) If the percent passing the No. 200 sieve is greater than 12%	Less than 2
(4) Los Angeles abrasion, AASHTO T 96	40% max.
(5) Sodium sulfate soundness loss (5 cycles), AASHTO T 104	12% max.
(6) Durability index (coarse), AASHTO T 210	35 min.
(7) Durability index (fine), AASHTO T 210	35 min.
(8) Fractured faces, ASTM D 5821	75% min.
(9) Free from organic matter and lumps or balls of clay	

Do not use material that breaks up when alternately frozen and thawed or wetted and dried.

Do not furnish material that contains asbestos fibers.

Obtain the aggregate gradation by crushing, screening, and blending processes as necessary. Fine aggregate, material passing the No. 4 sieve, shall consist of natural or crushed sand and fine mineral particles.

(c) Screened aggregate – Furnish hard, durable particles or fragments of stone, slag, or gravel conforming the following:

(1) Gradation	Table 703-13
(2) Plastic Index, AASHTO T 90	Less than 9
(3) Los Angeles abrasion, AASHTO T 96	55% max.
(4) Free from organic matter and lumps or balls of clay.	

Do not use material that breaks up when alternately frozen and thawed or wetted and dried.

Obtain the aggregate gradation by crushing, screening, and blending processes as necessary.

Delete Subsection 703.05(c)(3) and Replace with the following:

703.05 (c) Surface course aggregate. (3) Plastic Index

(3) Plastic Index, AASHTO T 90	
If the percent passing the No. 200 sieve is less than 12%	2 to 9
If the percent passing the No. 200 sieve is greater than 12%	Less than 2

Delete Table 703-2 and replace with the following:

Table 703-2
Target Value Ranges for Subbase and Base Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 and T 11)				
	Grading Designation				
	A (Subbase)	B (Subbase)	C (Base)	D (Base)	E (Base)
2½ inch	100				
2 inch	97 – 100	100	100		
1½ inch		97 – 100			
1 inch	65 – 79 (6)		80 – 100 (6)	100	
3/4 inch			64 – 94 (6)	86 – 100 (6)	100
1/2 inch	45 – 59 (7)				
3/8 inch			40 – 69 (6)	51 – 82 (6)	62 – 90 (6)
No. 4	28 – 42 (6)	40 – 60 (8)	31 – 54 (6)	36 – 64 (6)	36 – 74 (6)
No. 40	9 – 17 (4)			12 – 26 (4)	12 – 26 (4)
No. 200	4.0 – 8.0 (3)	4.0 – 12.0 (4)	4.0 –7.0 (3)	4.0 – 7.0 (3)	4.0 – 7.0 (3)

( ) The value in the parentheses is the allowable deviation (±) from the target values..

Delete Table 703-3 and replace with the following:

Table 703-3
Target Value Ranges for Surface Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 and T 11)					
	Grading Designation					
	F	G	H	S	T	U
1 1/2 inch	100			100		
1 inch	97-100	100		72 – 92 (6)	100	
3/4 inch	76-89 (6)	97 - 100	97 - 100			100
1/2 inch					71 – 91 (6)	
3/8 inch	56-68 (6)	70 – 80 (6)	80 – 92 (6)	51 – 71 (6)		71 – 90 (6)
No. 4	43-53 (7)	51 – 63 (7)	58 – 70 (7)	36 – 53 (7)	43 – 60 (7)	50 – 68 (7)
No. 8				26 – 40 (6)	30 – 46 (6)	34 – 51 (6)
No. 16	23-32 (6)	28 – 39 (6)	28 – 40 (6)			
No. 40	15-23 (5)	19 – 27 (5)	16 – 26 (5)	14 – 25 (5)	16 – 28 (5)	19 – 30 (5)
No. 200	10.0-16.0 (4)	10.0 – 16.0 (4)	9.0 – 14.0 (4)	8.0 – 15.0 (4)	8.0 – 15.0 (4)	8.0 – 15.0 (4)

( ) The value in the parentheses is the allowable deviation (±) from the target values.
If the plasticity index (PI) is greater than 0, the TV range for the No. 200 sieve size is 8-12 (4).

Add Table 703-13:

Table 703-13
Gradation Requirements for Screened Aggregate

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 and T 11)						
	Grading Designation						
	L	M	N	O	P	Q	R
6 inch	100	100					
4 inch			100	100			
3 inch					100	100	
2 inch							100
No. 4		15-45		15-45		15-45	

704 - Soil

Delete 704.01 and replace with the following:

704.01 Foundation Fill.

Furnish crushed Surface Course Aggregate

Delete Subsection 704.02(a) and replace with the following:

704.02 Bedding Material.

(a)	Maximum particle size	3 in (75 millimeters) or half the corrugation depth, whichever is smaller

Delete 704.04 and replace with the following:

704.04 Structural Backfill.

Furnish crushed Surface Course Aggregate

Delete 704.06(a) and replace with the following.

704.06(a) Unclassified Borrow.

(a)	Maximum particle size	12 in (300 mm)

705 - Rock

Add Subsection 705.08:

705.08 Streambed Simulation Rock.

(a) Simulation Material. Furnish a mixture of soil, gravel, cobble, and boulders to simulate a natural streambed. The cobbles and boulders should be hard, durable rock that conforms to test values in 705.02.

Table 705-4
Gradation requirements for Streambed Simulation Material (inches or sieve size)

Bed Class	100% passing	84% passing	50% passing	16% passing	10% passing
2	5	2	3/4	1/4	No. 10
4	10	4	1 3/4	1/2	No. 10
6	14	6	2 1/2	3/4	No. 10
8	22	8	3	1	No. 10
10	24	10	4	1	No. 10
12	30	12	5	1 1/2	No. 10
14	36	14	6	1 3/4	No. 10
16	42	16	7	2	No. 10
20	48	20	8	3	No. 10
24	60	24	10	3	No. 10
36	72	36	14	4	No. 10
48	96	48	18	6	No. 10

(b) Streambed Channel Rock. Furnish hard durable rock that is resistant to weathering and water action, free of organic or other unsuitable material, similar in color to those in the area, and at least as angular as that found in the natural stream channel. Do not use shale, rock with shale seams, or other fissile or fissured rock that may break into smaller pieces in the process of handling and placing. Conform to test values in 705.02.

Table 705-5
Gradation Requirement for Channel Rock (CR)

Class	Mass (Pounds)	Approximate Cubic Dimension (inches)
CR - 0	12 - 90	6 - 12
CR - 1	90 - 300	12 - 18
CR - 2	300 - 700	18 - 24
CR - 3	700 - 1350	24 - 30
CR - 4	1350 - 2400	30 - 36
CR - 5	2400 - 3700	36 - 42
CR - 6	3700 - 5500	42 - 48
CR - 7	5500 - 7900	48 - 54
CR - 8	7900 - 10800	54 - 60
Note: Mass / Pounds of channel is based on a sphere of the approximate cubic dimensions composed of granite. Mass will vary with rock type. Inspection should be performed by using the cube root of the A axis * B axis * C axis of each piece.		

717 - Structural Metal

Delete Subsection 717.01 (e) and replace it with the following:

717.01 Structural Steel.

(e) High-strength bolts, nuts, and washers. Conform to ASTM F3125, Grade A325 or A490 as specified. Use Type 1 bolts with steels other than weathering steel. Use Type 3 bolts with weathering steel.

Grade A325, Type 1 bolts may be either hot-dip galvanized according to AASHTO M 232, Class C or mechanically galvanized according to ASTM B695, Class 50. Retest galvanized bolts after galvanizing according to ASTM F3125. Do not galvanize Grade A490 bolts.

Galvanize washers, nuts, and bolts of any assembly by the same process. Overtap the nuts to the minimum required for the fastener assembly and lubricate with a lubricant containing a visible dye.

Except as noted below, for Grade A325, Type 1 bolts, use nuts conforming to ASTM A563, Grades DH, DH3, D, C, or C3. For Grade A490, Type 1 bolts, use nuts conforming to ASTM A563, Grade DH. Heat treat nuts to be galvanized to Grade DH. Lubricate galvanized nuts with a lubricant containing a visible dye.

Provide plain nuts with a minimum hardness of 89 HRB. Use only Grade C3 or Grade DH3 nuts with Grade A325, Type 3 bolts. Use only Grade DH3 nuts with Grade A490, Type 3 bolts.

Use washers conforming to ASTM F436.

725 - Miscellaneous Material

725.04_National_10_13_2016

Delete paragraph (a) of Subsection 725.04 and replace with the following:

725.04 Pozzolans.

(a) Fly ash. Conform to AASHTO M 295, Class C or Class F, except the loss on ignition must not exceed 3.0%.	1.5 max

736 - Geocell

736.01 Geocell.

Furnish geocell material consisting of sheet strips fabricated from high-density polyethylene (H.D.P.E.), connected in series at off-set, full-depth ultrasonic seams aligned perpendicular to the longitudinal axis of the strips. When expanded, the interconnected strips form the walls of a flexible, three-dimensional cellular confinement structure into which the specified infill material is placed.

736.02 Requirements.

Furnish geocells consisting of polyethylene material treated to resist ultraviolet degradation and conforming to the requirements shown in table 736-1.

Table 736-1 – Requirements for Geocells

Density	ASTM D 1505	0.935 to 0.965 g/cm^3 (58.4 to 60.2 pounds per cubic foot).
Environmental Stress Crack Resistance	ASTM D 1693	3000 hour
Strip Sheet Thickness	ASTM D 5199	1.27 mm (50 mil), minus 5 percent, plus 10 percent. Determine thickness in the flat before any surface texturing or other surface disruption.
Short-term peel strength	U.S. Army Corps of Engineers Technical Report GL-86-19, Appendix A	2000 N (450 pound) minimum for 150 mm (6.0 inch) depth cell
Seam Hang Strength	101.6 mm (4”) weld joint supporting load of 72.5 kg (160 pounds) or 101.6 mm (4”) weld joint supporting load of 72.5 kg (160 pounds) while undergoing temperature change from 23^{O} C to 54^{O} C (74^{O} F to 130^{O} F) on 1 hour cycles.	30 days minimum 7 days minimum

Appendix A

CONTRACT SPECIFICATIONS FOR FISH CAPTURE/SALVAGE FOR INSTREAM WORKSITE ISOLATION OF FOREST SERVICE CONSTRUCTION CONTRACTS (Okanogan-Wenatchee National Forest, Naches Ranger District)

RESPONSIBILITIES AND TRAINING REQUIREMENTS

Implementation of the work area isolation and fish capture and removal protocols will be planned and directed by a qualified biologist (directing biologist), possessing all necessary knowledge, training, and experience. If electrofishing is used for fish capture, the directing biologist will have a minimum of 100 hours electrofishing experience in the field using similar equipment. All individuals participating in fish capture and removal operations will have the training, knowledge, skills, and ability to ensure safe handling of fish, and to ensure the safety of staff conducting the operations.

STAGING AND SEQUENCING OF WORK

The directing biologist will work with the appropriate person (such as the construction and equipment operators for the project) to plan the staging and sequence for work area isolation, fish capture and removal, and dewatering. This plan will consider the size and channel characteristics of the area to be isolated, the method(s) of dewatering (e.g., diversion with bypass flume or culvert; diversion with sandbag, sheet pile or similar cofferdam; etc.), and what sequence of activities will provide the best conditions for safe capture and removal of fish. Where the area to be isolated is small, depths are shallow, hiding cover is limited, and/or conditions are conducive to fish capture, it may be possible to isolate the work area and remove all fish life prior to dewatering or flow diversion. Where the area to be isolated is large, water is deeper, uncut banks and other hiding cover is present, flow volumes or velocities are high, and/or conditions are not conducive to easy fish capture, it may be necessary to commence with dewatering or flow diversion staged in conjunction with fish capture and removal. The directing biologist will use his/her best professional judgment in deciding what sequence of activities is likely to minimize exposure of fish to conditions causing stress or injury (including stranding, exposure to temperature extremes or reduced dissolved oxygen levels, risk of injury resulting from electrofishing, etc.).

Work Area Isolation-Block Nets

The directing biologist will select suitable block nets. Type of material, length, and depth may vary based on site conditions. Typically block nets will be composed of stretched nylon mesh ($\leq$ 9.5 mm; 3/8 inch) and will be installed at an angle to the direction of flow (i.e., not directly perpendicular to flow) so as to reduce the risk of impinging fish. Block nets must be secured along both banks and the channel bottom to prevent erosion and failure due to debris accumulation, high flows, and/or flanking.

The directing biologist will determine appropriate locations for the placement of block nets, based on site characteristics and a consideration of the type and extent of planned in-water work. Sites that exhibit reduced flow volume or velocity, uniformity of depth, and good accessibility are preferred; sites with heavy vegetation, large cobble or boulders, undercut banks, deep pools, etc. should be avoided due

to the difficulty of securing and/or maintaining nets. Sites with a narrow channel cross-section ("constriction") will be avoided if foreseeable flow conditions might overwhelm or dislodge the block nets, posts, or anchors.

Except when planning and intending to seine/herd fish upstream, an upstream block net will be placed first. With a block net secured to prevent movement of fish into the work area from upstream, a second block net will be used as a seine to herd fish in a downstream direction (as feasible) out of the planned worksite isolation area. For example, the second block net could be used to seine fish from a culvert outlet, downstream to the lower block net set location.

In most instances where gradual dewatering or flow diversion is staged in conjunction with fish capture and removal, it is appropriate to delay installation of the downstream block net(s) until after fish have been given sufficient time to move downstream by their own choosing. If flows are reduced gradually over the course of several hours, some fish will make volitional movements downstream beyond the area to be isolated. Gradual dewatering can be an effective means by which to reduce the risk of fish stress or injury. Gradual dewatering and the encouragement of volitional movement are particularly important where the area to be isolated is large and may hold many fish. However, where the area to be isolated includes a culvert(s), deep pools, undercut banks, or other cover attractive to fish, some (perhaps many) fish will not choose to move downstream regardless of how gradually flows are reduced. The directing biologist will use his/her best professional judgment in deciding what sequence of activities is likely to minimize fish stress or injury (including stranding).

Electrofishing Based on National Marine Fisheries Guidelines

After low impact fish removal methods are completed, the directing biologist will commence with electrofishing actions to complete fish removal from the work isolation area. Refer to and follow the *NMFS Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act (2000)* document for specific electrofishing conservations actions to implement.

Local Forest Service Unit Fish Capture Specifications

1. Continue successive electrofishing passes through the fish removal area until no additional fish are detected/captured during a single pass. Typically a minimum of three or four passes is required to accomplish this in small streams (< 10 feet wetted width).
2. Record fish capture data: number of fish captured, by species and total length categories (field form provided by Forest Service local unit).
3. Use of anesthetics during fish handling and processing is not recommended.
4. Release processed fish upstream of worksite isolation area.
5. Record the total length and average width of stream channel electrofished.
6. Contractor shall clean and maintain block nets to keep them free of debris, in place, and effective for preventing fish travel through or around. Perform maintenance a minimum of three times per day (early morning, noon, late afternoon) during the entire period of worksite isolation.

National Marine Fisheries Service

Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act

June 2000

Purpose and Scope

The purpose of this document is to provide guidelines for the safe use of backpack electrofishing in waters containing salmonids listed by the National Marine Fisheries Service (NMFS) under the Endangered Species Act (ESA). It is expected that these guidelines will help improve electrofishing technique in ways which will reduce fish injury and increase electrofishing efficiency. These guidelines and sampling protocol were developed from NMFS research experience and input from specialists in the electrofishing industry and fishery researchers. This document outlines electrofishing procedures and guidelines that NMFS has determined to be necessary and advisable when working in freshwater systems where threatened or endangered salmon and steelhead may be found. As such, the guidelines provide a basis for reviewing proposed electrofishing activities submitted to NMFS in the context of ESA Section 10 permit applications as well as scientific research activities proposed for coverage under an ESA Section 4(d) rule.

These guidelines specifically address the use of backpack electrofishers for sampling juvenile or adult salmon and steelhead that are *not* in spawning condition. Electrofishing in the vicinity of adult salmonids in spawning condition and electrofishing near redds are not discussed as there is no justifiable basis for permitting these activities except in very limited situations (e.g., collecting brood stock, fish rescue, etc.). The guidelines also address sampling and fish handling protocols typically employed in electrofishing studies. While the guidelines contain many specifics, they are not intended to serve as an electrofishing manual and do not eliminate the need for good judgement in the field.

Finally, it is important to note that researchers wishing to use electrofishing in waters containing listed salmon and steelhead are not necessarily precluded from using techniques or equipment not addressed in these guidelines (e.g., boat electrofishers). However, prior to authorizing the take of listed salmonids under the ESA, NMFS will require substantial proof that such techniques/equipment are clearly necessary for a particular study and that adequate safeguards will be in place to protect threatened or endangered salmonids. Additional information regarding these guidelines or other research issues dealing with salmon and steelhead listed under the ESA can be obtained from NMFS' Protected Resources Divisions in:

Washington, Oregon, and Idaho
Leslie Schaeffer
NMFS
525 NE Oregon Street, Suite 500
Portland, Oregon 97232-2737
Phone: (503) 230-5433
FAX: (503) 230-5435
Internet Address: Leslie.Schaeffer@noaa.gov

California
Dan Logan
NMFS
777 Sonoma Ave., Room 325
Santa Rosa, California 95404-6515
Phone: (707) 575-6053
FAX: (707) 578-3435
Internet Address: Dan.Logan@noaa.gov

Appropriateness of Electrofishing

Backpack electrofishing for salmonids has been a principal sampling technique for decades, however, recent ESA listings underscore the need to regulate the technique and assess its risks and benefits to listed species (Nielsen 1998). With over 25 Evolutionarily Significant Units (ESUs) of threatened or endangered salmonids now identified along the U.S. West Coast, researchers can expect to encounter one or more listed species in nearly every river basin in California, Oregon, Washington, and Idaho. There are few if any non-invasive ways to collect distribution, abundance, or morpho-physiological data on salmonids in freshwater. This is reflected in the requirement that all activities that involve intentional take of juvenile salmonids for research or enhancement of an ESA listed species require an ESA Section 10 permit from NMFS. While NMFS has not precluded the use of electrofishing in all cases, researchers must present rigorous study designs and methods for handling fish prior to NMFS authorizing electrofishing to take listed salmonids under the ESA.

NMFS believes there is ample evidence that electrofishing can cause serious harm to fish and the general agency position is to encourage researchers to seek out other less invasive ways to sample listed species. Direct observation by snorkeling is one of the least invasive ways to collect information concerning abundance and distribution, although there can be both practical (e.g., poor viability) and statistical (e.g., large numbers of fish, low observation probability) constraints to direct observation. Preliminary efforts should be directed at study designs that use less invasive methods. If such methods cannot provide the quality of data required or when the benefit exceeds potential mortality risk, then electrofishing can be considered. Electrofishing used on a limited basis to calibrate direct observations (e.g., Hankin and Reeves 1988) is commonly used and methods are currently under development that increase the use of direct observation counts (e.g., bounded counts, "multiple snorkel passes") which, in many cases, will further reduce the need for electrofishing.

Electrofishing Guidelines

Training

Field supervisors and crew members must have appropriate training and experience with electrofishing techniques. Training for field supervisors can be acquired from programs such as those offered from the U. S. Fish and Wildlife Service - National Conservation Training Center (*Principles and Techniques of Electrofishing* course) where participants are presented information concerning such topics as electric circuit and field theory, safety training, and fish injury awareness and minimization. A crew leader having at least 100 hours of electrofishing experience in the field using similar equipment must train the crew. The crew leader's experience must be documented and available for confirmation; such documentation may be in the form of a logbook. The training must occur before an inexperienced crew begins any electrofishing and should be conducted in waters that do not contain ESA-listed fish. Field crew training must include the following elements:

1. A review of these guidelines and the equipment manufacturer's recommendations, including basic gear maintenance.
2. Definitions of basic terminology (e.g. galvanotaxis, narcosis, and tetany) and an explanation of how electrofishing attracts fish.
3. A demonstration of the proper use of electrofishing equipment (including an explanation of how gear can injure fish and how to recognize signs of injury) and of the role each crew member

performs.

4. A demonstration of proper fish handling, anesthetization, and resuscitation techniques.
5. A field session where new individuals actually perform each role on the electrofishing crew.

Research Coordination

Research activities should be coordinated with fishery personnel from other agencies/parties to avoid duplication of effort, oversampling small populations, and unnecessary stress on fish. Researchers should actively seek out ways to share data on threatened and endangered species so that fish samples yield as much information as possible to the research community. NMFS believes that the state fishery agencies should play a major role in coordinating salmonid research and encourages researchers to discuss their study plans with these agencies prior to approaching NMFS for an ESA permit.

Initial Site Surveys and Equipment Settings

1. In order to avoid contact with spawning adults or active redds, researchers must conduct a careful visual survey of the area to be sampled before beginning electrofishing.
2. Prior to the start of sampling at a new location, water temperature and conductivity measurements should be taken to evaluate electroshocker settings and adjustments. **No electrofishing should occur when water temperatures are above 18°C or are expected to rise above this temperature prior to concluding the electrofishing survey. In addition, studies by NMFS scientists indicate that no electrofishing should occur in California coastal basins when conductivity is above 350 µS/cm.**
3. Whenever possible, a block net should be placed below the area being sampled to capture stunned fish that may drift downstream.
4. Equipment must be in good working condition and operators should go through the manufacturer's preseason checks, adhere to all provisions, and record major maintenance work in a logbook.
5. Each electrofishing session must start with all settings (voltage, pulse width, and pulse rate) set to the **minimums** needed to capture fish. These settings should be gradually increased only to the point where fish are immobilized and captured, and generally not allowed to exceed conductivity-based maxima (Table 1). Only direct current (DC) or pulsed direct current (PDC) should be used.

Table 1. Guidelines for initial and maximum settings for backpack electrofishing.

	Initial settings	Maximum settings	Notes
Voltage	100 V	Conductivity (µS/cm) / Max. Voltage < 100 / 1100 V 100 - 300 / 800 V > 300 / 400 V	In California coastal basins, settings should never exceed 400 volts. Also, no electrofishing should occur in these basins if conductivity is greater than 350 µS/cm.
Pulse width	500 µs	5 ms	
Pulse rate	30 Hz	70 Hz	*In general*, exceeding 40 Hz will injure more fish

Electrofishing Technique

1. Sampling should begin using straight DC. Remember that the power needs to remain on until the fish is netted when using straight DC. If fish capture is unsuccessful with initial low voltage, gradually increase voltage settings with straight DC.
2. If fish capture is not successful with the use of straight DC, then set the electrofisher to lower voltages with PDC. If fish capture is unsuccessful with low voltages, increase pulse width, voltage, and pulse frequency (duration, amplitude, and frequency).
4. Electrofishing should be performed in a manner that minimizes harm to the fish. Stream segments should be sampled systematically, moving the anode continuously in a herringbone pattern (where feasible) through the water. Care should be taken when fishing in areas with high fish concentrations, structure (e.g., wood, undercut banks) and in shallow waters where most backpack electrofishing for juvenile salmonids occurs. Voltage gradients may be high when electrodes are in shallow water where boundary layers (water surface and substrate) tend to intensify the electrical field.
5. Do not electrofish in one location for an extended period (e.g., undercut banks) and regularly check block nets for immobilized fish.
6. Fish should not make contact with the anode. Remember that the zone of potential injury for fish is 0.5 m from the anode.
7. Electrofishing crews should be generally observant of the condition of the fish and change or terminate sampling when experiencing problems with fish recovery time, banding, injury, mortality, or other indications of fish stress.
8. Netters should not allow the fish to remain in the electrical field any longer than necessary by removing stunned fish from the water immediately after netting.

Sample Processing and Recordkeeping

1. Fish should be processed as soon as possible after capture to minimize stress. This may require a larger crew size.
2. All sampling procedures must have a protocol for protecting held fish. Samplers must be aware of the conditions in the containers holding fish; air pumps, water transfers, etc., should be used as necessary to maintain safe conditions. Also, large fish should be kept separate from smaller prey-sized fish to avoid predation during containment.
3. Use of an approved anesthetic can reduce fish stress and is recommended, particularly if additional handling of fish is required (e.g., length and weight measurements, scale samples, fin clips, tagging).
4. Fish should be handled properly (e.g., wetting measuring boards, not overcrowding fish in buckets, etc.).
5. Fish should be observed for general condition and injuries (e.g., increased recovery time, dark bands, apparent spinal injuries). Each fish should be completely revived before releasing at the location of capture. A plan for achieving efficient return to appropriate habitat should be developed before each sampling session. Also, every attempt should be made to process and release ESA-listed specimens first.
8. Pertinent water quality (e.g., conductivity and temperature) and sampling notes (e.g., shocker settings, fish condition/injuries/mortalities) should be recorded in a logbook to improve technique and help train new operators. *It is important to note that records of injuries or mortalities pertain to the entire electrofishing survey, including the fish sample work-up.*

Citations and Other References

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Fish Capture Field Data Form

Stream: **Date:** **Project:**

Forest: Okanogan-Wenatchee, Naches RD **Streamflow est (cfs):** **Water Temp/Time:**

Channel Length:_ Chan. Avg Width Chan. Avg Depth Collection Method Pass#

GPS Lat/Lon: Observers:

Species Code	Length (FL) <50 mm	FL 50-99 mm	FL 100-199 mm	FL 200-299 mm	300 mm+ (Actual Measure)	Morts #	Comments

Block nets were set above and below the site prior to fish removal. Channel measurements are fish removal area.
Electroshocker was set to ____ volts, DC, after determining that lower volt settings were ineffective in immobilizing fish for capture.

Species Codes:

RBT=rainbow/steelhead CUT= cutthroat SPC= spring Chinook COH= coho salmon EBT= brook trout
BUL= bull trout MWF= mountain whitefish COT= sculpin DAC= dace RSS= red side shiner **UNK*= unknown salmonid**

***Small rainbow/cutthroat (<80 mm) are very difficult to distinguish, and features may be similar on fish < 100-120 mm long.**

Fish Capture Field Data Form
Stream: **Date:** **Project:**
Forest: Okanogan-Wenatchee, Naches RD **Water Temp/Time:**
Channel Length:_ Chan. Avg Width Chan. Avg Depth Collection Method Pass#
GPS Lat/Lon: Observers:

Species Code	Length (FL) <50 mm	FL 50-99 mm	FL 100-199 mm	FL 200-299 mm	300 mm+ (Actual Measure)	Morts #	Comments

Block nets were set above and below the site prior to fish removal. Channel measurements are fish removal area. Electroshocker was set to ____ volts, DC, after determining that lower volt settings were ineffective in immobilizing fish for capture.							

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***Small rainbow/cutthroat (<80 mm) are very difficult to distinguish, and features may be similar on fish < 100-120 mm long.**