Delaware Water Gap National Recreation Area
New Jersey & Pennsylvania

SAFETY AND PAVEMENT IMPROVEMENTS TO ROUTE 209
DEWA
PMIS Number 310424, 325752, 324741

PROJECT SPECIFICATIONS

NATIONAL PARK SERVICE (NPS)
DENVER SERVICE CENTER (DSC)

TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

01 11 00 Summary of Work
01 26 01 Contract Modification Procedures
01 27 00 Definition of Contract Line Items
01 31 00 Project Management & Coordination
01 32 16 Construction Schedule
01 32 33 Photo Documentation
01 33 23 Submittal Procedures
01 35 13.22 Archeological Protection
01 35 23 Safety Requirements
01 40 00 Quality Requirements
01 42 00 Reference Standards
01 57 19.12 Noise & Acoustics Management
01 57 23 Temporary Storm Water Pollution Prevention
01 67 00 Product Requirements
01 73 40 Execution
01 74 19 Construction Waste Management and Disposal
01 77 00 Closeout Procedures
01 90 00 Acceptance of Work

DIVISION 02 – EXISTING CONDITIONS

02 41 13 Selective Site Demolition
02 41 19 Removal of Structures and Obstructions
02 41 20 Structure Excavation and Backfill

DIVISION 03 – CONCRETE

03 30 53 Miscellaneous Cast-In-Place Concrete
03 41 40 Elevated Precast Concrete Boardwalk

DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

06 90 01 Boardwalk and Trail Rail

DIVISION 10 – SPECIALTIES

10 14 53 Traffic Signage

DIVISION 31 – EARTHWORK

31 00 00 Earthwork
31 11 00 Clearing and Grubbing

31 22 19 Finish Grading
31 23 17 Roadway Reconditioning
31 23 19 Dewatering
31 23 23.33 Flowable Fill
31 25 00 Erosion and Sedimentation Control
31 32 19.23 Geotextile Layer Separation
31 37 00 Rip Rap
31 51 15 Permanent Slope Stabilization – Percussion Driven Earth Anchors
31 62 16.16 Steel H-Piles
31 63 29 Drilled Shafts
31 66 15 Helical Piles

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 01 16.71 Cold Milling Asphalt Paving
32 01 17.61 Sealing Cracks in Asphalt Paving
32 01 17.62 Stress Absorbing Membrane Interlayer
32 01 17.71 Partial Depth Patching of Flexible Paving
32 01 17.72 Full Depth Patching of Flexible Paving
32 11 23 Aggregate Base Course
32 12 13.13 Asphalt Tack Coat
32 12 16 Standard Asphalt Pavement
32 16 23 Gravel Trails
32 17 22 Temporary Pavement Markings and Markers
32 17 23 Pavement Markings
32 17 23.43 Snowplowable Raised Pavement Markers
32 32 15 Precast Modular Block Gravity Retaining Wall
32 91 19.12 Salvaged Topsoil
32 91 19.13 Topsoil Placement and Grading
32 91 19.14 Aggregate Topsoil Course
32 92 20 Seeding and sodding

DIVISION 33 – UTILITIES

33 41 00 Storm Drainage Piping - HDPE
33 41 16.19 Pipe Underdrains
33 42 11 Stormwater Pipe – Welded Steel
33 42 23 Headwalls and Endwalls for Stormwater Piping
33 42 31 Stormwater Area Drains and Inlets
33 42 41 Gratings and Frames for Stormwater Drainage Inlets
33 47 26.09 Regenerative Stormwater Conveyance

DIVISION 34 – TRANSPORTATION

34 01 00 Maintenance of Traffic
34 71 13.26 Guardrail

DIVISION 44 – POLLUTION AND WASTE CONTROL EQUIPMENT

44 11 13 Fugitive Dust Control

SECTION 01 11 00 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Work Covered by Contract Documents
2. Construction Contractor Use of Site
3. Public Use of Site
4. Conduct of Operations
5. Work Restrictions
6. Special Construction Requirements
7. Soils Investigation Report
8. Additional Reports

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Location: Delaware Water Gap National Recreation Area: Slope Failure Repair and Multi-Use Trail Relocation at Highway 209 (Route 014) and the McDade Trail in Pennsylvania. Extending along or adjacent to Route 209 at MP 14.0, 15.0 and MP 16.1 to 17.8 with the relocation of the McDade Trail. The Work consists of:

1. The Work consists of roadway reconstruction, pavement milling, full depth patching, asphalt overlay, paved trail construction, slope stabilization, drainage improvements, boardwalk construction, retaining wall construction, unpaved trail construction, guide rail removal and installation, signage, and pavement markings.

B. Project will be constructed under a single prime contract.

1.3 CONSTRUCTION CONTRACTOR USE OF SITE

A. General: Construction Contractor shall have limited use of site for construction operations. Limit use of premises to areas within the Construction limits indicated on drawings. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Limits: Confine constructions operations to the locations shown in the plans.
2. Limit site disturbance, including earthwork and clearing of vegetation as depicted in the construction drawings. Any deviation from defined LOD shall be approved by the CO.

B. Storage of Materials: Confine storage of materials to existing parking lots at project locations approved by the CO. Staging areas shall be on hard surfaces only. Locations will be discussed

during the project kickoff meeting. Staging areas shall be returned to their original conditions immediately upon vacating the staging area and prior to final completion. Storage of all materials shall be done in a manner than does not restrict use or access to buildings, sheds, machinery, and other features**]**>.

C. Parking: Confine parking to the parking lot closest to the area of construction. In addition, parking is allowed in the work zone or lane closure provided adequate traffic control measures are in place as approved by the CO.

D. Stockpiling: Stockpiling of materials are based on project location within the park. Locations will be discussed during the project kickoff meeting.

E. Preservation of Natural Features:

1. Prevent damage to natural surroundings. Restore damaged areas, repairing or replacing damaged trees and plants, at no additional expense to the Government.
2. Provide temporary barriers to protect existing trees and plants and root zones.
3. Do not remove, injure, or destroy trees or other plants without prior approval. Consult with Contracting Officer (CO) and remove agreed-on roots and branches that interfere with construction.
4. Do not fasten ropes, cables, or guys to existing trees.
5. Carefully supervise excavating, grading, filling, and other construction operations near trees to prevent damage.

F. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Government employees, and emergency vehicles at all times. Do not use for parking or storage of materials.

1. Schedule deliveries to minimize use of driveways and entrances.
2. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

G. Construction Camp: Establishment of a camp within park will not be permitted.

H. Hauling Restrictions: Comply with legal load restrictions in hauling of materials. Load restrictions on park roads are identical to state load restrictions with such additional regulations as may be imposed by the Park Superintendent. Information regarding rules and regulations for vehicular traffic on park roads may be obtained from the Office of the Park Superintendent. A special permit will not relieve Construction Contractor of liability for damage which may result from moving of equipment.

I. Bridge Restrictions: Identify jurisdictions, load restrictions, permit requirements, time and calendar restrictions as outlined.

1.4 PUBLIC USE OF SITE

A. Construction Contractor shall conduct his operations to ensure the least inconvenience to public. Road closures and detours have been authorized as shown on Sheets C3,C3.01, and C3.02 of the plans. Detour operations shall be limited to a maximum of 5 consecutive months and shall be limited to construction of culverts, slope stabilization, and McDade Trail. Durations of closures shall be approved by the CO. Additional time or short durations may be granted with prior

approval by the CO. The detour will be permitted for work at approximately Station 55+00 and between the stations 172+00 to 249+00. All other work shall be accomplished utilizing single lane closures.

1.5 CONDUCT OF OPERATIONS

A. Construction Contractor shall conduct his operations in conformance with rules and regulations promulgated by the Secretary of the Interior for the National Park Service, and applicable park rules and regulations prescribed by Park Superintendent.

B. Work on Saturdays, Sundays, Federal holidays or at night may not be performed unless stated in the Work Restrictions below or without prior consent from the Contracting Officer. Submit requests 2 business days in advance of the work to the Contracting Officer for approval.

C. No signs or advertisements (except those specified herein) shall be displayed on the construction site or within the park unless approved by the Contracting Officer.

1.6 WORK RESTRICTIONS

A. On-Site Work Hours: Work shall be generally performed during normal business working hours of 7:00 a.m. to 6:00 p.m., Monday through Friday, except when otherwise indicated.

1. Weekend and Federal Holiday Hours: No work shall be performed on the weekends and federal holidays without prior approval by the CO.

B. Extended work hours and workdays may be requested with a written request to the CO at least two (2) working days prior to the extended work periods.

1.7 EXISTING UTILITIES

1. Existing Utilities: Notify Contracting Officer and utility companies of proposed locations and times for excavation.
2. Construction Contractor shall be responsible for locating and preventing damage to known utilities. If damage occurs, repair utility at no additional expense to the Government.
3. If damage occurs to an unknown utility, repair utility. An equitable adjustment will be made in accordance with the Changes clause of the contract.

1.8 SPECIAL CONSTRUCTION REQUIREMENTS

A. Project Management and Communication Software: Software administered by NPS shall be used to manage communication and document sharing during construction.

1. See Section 01 31 00 "Project Management and Coordination" for requirements on using NPS project management and communication software.

1.9 SOILS INVESTIGATION REPORT

A. The report Geotechnical Engineering Report DEWA 310424 Route 109 Potential Slope Failure Delaware and Dingman Twps, Pennsylvania, prepared by Terracon is provided with this package.

B. In case of conflict between report and drawings or specifications, the drawings and specifications govern.

1.10 ADDITIONAL REPORTS

A. The report Delaware Water Gap National Recreation Area Wetlands/Waters Delineation Report dated September 2024 prepared by Environmental Systems Analysis, Inc. is provided with this package.

B. In case of conflict between report and drawings or specifications, drawings and specifications govern.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 11 00

SECTION 01 26 01 – CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section consists of administrative and procedural requirements for contract modifications.

1.2 DEFINITIONS AND ALLOWANCES

A. Home Office Overhead: Costs incurred in support of all of a contractor's projects and not attributable to a specific job. The cost for home office overhead is only allowed as a percentage of all direct work excluding profit. The following items represent allowable home office overhead costs identified in Part 31 of the Federal Acquisition Regulation (FAR):

1. Rent
2. Utilities
3. Furnishings
4. Office equipment
5. Executive and management staff not exclusively assigned to the project
6. Support, accounting, and administrative staff
7. Preparation of cost proposals, estimating, and schedule analyses connected with Modifications
8. Estimating and preconstruction services
9. Mortgage costs
10. Real estate and corporate taxes
11. Automobile maintenance and travel costs for home office personnel
12. Home office insurances i.e. structure, automotive, umbrella, flood, etc.
13. Depreciation of equipment and other assets
14. Home office supplies (paper, staples, etc.)
15. Legal services
16. Accounting and data processing
17. Professional fees/registration

B. General Conditions (Field Office Overhead): Management and administrative costs incurred on site for the designated project. Costs associated with preparation of modifications will not be allowed. Costs for these items are to be included only in the general conditions of the modification estimate. Only in the case of a contract time extension are additional general conditions included in modifications. The following items, if applicable, are considered allowable costs for calculating General Conditions:

1. Project Manager (PM), Assistant Project Manager
2. Superintendent, Assistant Superintendent
3. Quality Control, Safety Officer, Environmental Manager, etc.
4. Engineers

5. Travel, lodging, and per diem (as established by Federal Travel Regulations)
6. Scheduling
7. Field Office Trailers and associated temporary utilities
8. Field office supplies

    a. Mailing and couriers
    b. Reproduction costs
    c. Storage
    d. Phones
    e. Computers
    f. Copiers

9. Personal vehicles i.e. Superintendent Pickup trucks

C. General Requirements: Costs directly associated with the project and are necessary to perform the actual work of the modification. These costs shall be shown as direct costs in the estimate. The following items, if applicable, are considered allowable costs for calculating General Requirements:

1. Hoisting
2. Material handling
3. Temporary fencing
4. Port-a-lets
5. Trash removal, dumpsters
6. Barricades
7. Small tools
8. Safety supplies
9. Scaffolding
10. Daily cleaning
11. Traffic control
12. Temporary signage
13. Temporary heating and power

D. Personnel Costs: Costs included in the modification must only be for General Conditions staff and workers actually present and working on project site. Modification costs for salaried workers are only allowed within the structure of a 40-hour week and no overtime or holiday pay will be allowed.

1. Worker Hourly Rates are costs directly associated with the individual worker and consist of the following:

    a. Base Rate: The hourly rate paid directly to the worker
    b. Labor Burden: Employer payments of all applicable burdens; includes insurance and taxes the business must pay on behalf of the worker to government entities and educational forums, such as:

        1) Social Security
        2) Medicare
        3) Workers Compensation – Policy and company calculation to be made available.
        4) Federal Unemployment Tax Act (FUTA) - Cap Rate and percentage to be proportionally allocated over one year.

5) State Unemployment Tax Act (SUTA) - Cap Rate and percentage to be proportionally allocated over one year.
6) Union agreement costs - Other costs required under an enforceable collective bargaining agreement.

c. Fringe Benefits: Various non-wage compensations provided to employees such as:

1) Health Care Insurance Premiums
2) Cell Phone
3) Clothing
4) 401K and Pensions
5) Vehicle allowances
6) Gas allowance
7) Life insurance premiums
8) Disability insurance
9) Other Fringe Benefits required under an enforceable collective bargaining agreement

E. Bonuses or Deferred Compensation: No Bonus or Deferred Compensation will be allowed within any components of pricing including Home Office Overhead, General Conditions, General Requirements, Hourly Worker Rates, or the direct costs of work.

F. General Liability Insurance: An insurance policy that protects Contractor from claims resulting from bodily injury or property damage to a third party. Include as a separate line item within all modification proposals and provide a current insurance quote upon request.

G. Performance and Payment Bonds: A performance bond is a surety bond issued by an insurance company or bank to guarantee satisfactory completion of a project. The Payment Bond guarantees the Contractor will pay the labor and material costs incurred. Banks and Insurance companies charge a premium for individual project based on a sliding scale related to the size of the project. Include as a separate line item in modification proposals and provide current company bonding rates upon request.

H. Builder's Risk Insurance: Covers the contractor's loss due to fire, high winds, or other natural forces. Not reimbursed by the National Park Service (NPS) and shall not be included in modification proposals.

1.3 MODIFICATION PROPOSAL PRICING REQUIREMENTS

A. General:

1. Proposal be received in the format and within the time frame specified in the Request for Proposal (RFP) letter. Costs or delays resulting from failure of contractor to submit within the time frame specified will not be compensable.
2. Proposal shall be detailed with itemized lists of equipment, materials, labor, production rates, overhead, profit, and bond markup for each item. Labor costs must be itemized by craft and hourly rate, including Fringe Benefits and Labor Burden. If the costs of Fringe Benefits and Labor Burden are not itemized, it is assumed they are included in the hourly rate shown, or contractor is not requesting reimbursement. Contractor may

utilize the government provided Contractor Estimate Form, or their own form, provided that it contains the same information and level of detail as the Government's form.

3. Requests for extensions of contract time as a result of change must be justified with a Time Impact Analysis (TIA). Refer to Section 01 32 16 "Construction Schedule", for time impact analysis requirements. TIA and associated costs shall be received with the proposal by the date shown within the Request for Proposal letter. Contractor's failure to submit within the specified time frame will be construed as the Contractor waiving right for additional time and no time extension will be allowed.
4. All supporting documentation used to justify the proposed modification will be made available to the Contracting Officer (CO) upon request.
5. Contractor shall review and approve all subcontractor/supplier pricing in detail for proper format, scope, production rates, and pricing prior to submission to NPS. All delay costs associated with not reviewing and approving subcontractor/supplier pricing will be borne by the Contractor.
6. All pricing and production rates within the estimate must be based on fair and reasonable pricing and cannot include built-in contingency.

B. Labor:

1. Contractor shall estimate cost of labor by itemizing each craft involved, indicating worker hourly rate (base rate + labor burden + fringe benefits) for each and itemizing hours required for each craft directly engaged in modification work. Any work proposed requiring overtime work or premium pay shall be itemized separately. Rates shall be in accordance with the Davis-Bacon Act as incorporated herein. Labor Burden may include payroll taxes, Social Security, unemployment insurances, workers compensation insurance, Federal Insurance Contributions Act (FICA), FUTA, and other direct costs resulting from Federal, State or local laws.
2. Itemize labor costs for equipment operators separate from equipment costs.
3. Labor cost for foremen shall only be costs for related work required for the modification.

C. Materials:

1. Estimated cost for materials shall include quotes from multiple sources. Material prices shall include applicable fees and credits, including but not limited to, sales tax, freight and delivery charges, and tax rebates.
2. No markup shall be applied to any material provided by NPS.

D. Equipment:

1. Equipment used for the project must be appropriately sized for work being performed.
2. Do not include costs for "miscellaneous tools and equipment", in your proposal for a replacement value of $500 or less. Costs shown in excess of $500 shall be broken out separately.
3. Regardless of ownership, rates to be used in determining equipment rental costs shall be the lowest cost from one of the following sources:

   a. United States (U.S.) Army Corps of Engineers, Ownership and Operating Expense Schedule (use latest edition and applicable region)
   b. Construction Blue Book

c. Local equipment rental rates, documented by actual invoice charges, or itemized vendor quotes.

4. Estimated equipment rates shall include operating costs of all fuel, oil, lubrication, supplies, small tools, necessary attachments, ground engaging components, tires and tracks, routine repairs and maintenance (cost of major repair and overhaul is not allowed per Federal Acquisition Regulation (FAR) 31.105(d)(2)), depreciation, storage, insurance, and all incidentals. Mobilization, if applicable, may be included for equipment solely used on the modification work but must be listed separately.
5. Estimate full rate for equipment only for duration that equipment will be utilized to accomplish work of the modification.
6. Standby unit rates used in accordance with paragraph 1.3, D, 2, above. If the U.S. Army Corp of Engineers is utilized then their standby rates prevail. If Bluebook or local equipment pricing is accepted, then 1/2 of equipment costs minus any operating costs, major repair and overhaul will be accepted.
7. If equipment is in standby mode due solely to a documented NPS delay, established standby rate shall apply from the first day of the delay.
8. Equipment not used and on job site for up to five consecutive days may be classified at standby rates, provided the equipment is or has been used solely to perform work on the modification and will be necessary to complete additional modification work. Equipment still on the jobsite but not in use after five consecutive days will not be considered in the modification pricing.
9. Requests for compensation for equipment stand by time must be justified, documented and itemized separately.
10. The estimated timeframe (daily, weekly, monthly) for use of the equipment must reflect the lowest cost to the Government.

E. Establishment and Application of Overhead and Profit Percentages:

1. Home Office Overhead and Profit (OH&P) shall be applied to direct costs only. Profit shall not be applied to overhead amounts; and overhead shall not be applied to profit. Home office overhead shall contain only allowable, allocable, and reasonable costs per the contract documents and FAR Part 31. Profit percentages are based on risk factors found in FAR Part 31which have been applied to the specific type of work included in this project. Negotiated rates shall not exceed the following percentages for OH&P for contractor self-performed work:

   Overhead 10%
   Profit 5.7%

2. Total aggregate limit of markup (OH&P) for Contractor and Subcontractors on modification work shall not exceed 25%. The NPS will not be responsible for allocation of percentages between contractor and subcontractors at any tier.
3. If Contractors form a partnership, partnership may only receive home office overhead and profit in same amount as an individual Contractor (refer to paragraph 1.3,E,1 above). It is the responsibility of the partners to decide on division of revenue.
4. Combined Increases and Decreases: On proposals involving both increases and decreases in the Contract Price, overhead and profit mark-ups are required on net increases and deducted on net decreases.
5. At no time can profit be calculated on Overhead or itself, it must be calculated on direct costs of work only.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 012601

SECTION 01 27 00 – DEFINITION OF CONTRACT LINE ITEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section explains in general, what is and is not included in a contract line item, and limits or cut-off points where one item ends and another begins.

B. If no contract line item exists for a portion of work, include costs in a related item.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF CONTRACT LINE ITEMS

A. Contract Line Item Number [**0001**] Route 209 (Route 0014) Pavement Improvements Mile Marker 13.7 to 18.3 PMIS 310424.

This item consists of milling, full depth patching, crack seal and fill, Stress Absorbing Membrane Interlayer (SAMI), overlay, pavement markings, shoulder restoration shoulder removal and restoration, asphalt and gravel aprons, guardrail replacement inlet repair and replacement and MUTCD signing from approximate Mileposts 13.7 to 18.3.

1. Measurement for payment will be determined based on percent of construction complete.
2. Payment will be made at the contract **lump sum price**.

B. Contract Line Item Number [**0002**] Slope Failures and culverts PMIS 310424

1. This item consists of culver repair/replacement, headwall/endwall, and stone protection outlet as indicated in the following locations:
   - STA 100+85 Head Cut Outfall Repair,
   - STA 109+67 Culvert Endwall & Outfall,
   - STA. 183+10 Culvert, Endwall & Outfall
   - STA. 187+90 Endwall & Outfall
   - STA. 200+00 Culvert, Endwall, & Outfall
   - STA. 206+76 Inlets, Culvert, Headwall & Outfall with Slope Repair,
   - STA. 212+76 Inlets, Culvert, Headwall & Outfall,
   - STA 228+80 Endwall & Outfall
   - STA 232+05 Culverts, Headwall and Outfall
   - STA. 240+35 Culvert, Inlets, Endwall & Outfall,
   - STA 234+35 Abandon Culvert, Jack & Bore, Access & Repair,
2. Measurement for payment will be determined based on percent of construction complete.
3. Payment will be made at the contract lump sum price.

C. Contract Line Item Number [**0003**] Slope Failures, Culverts McDade Trail – ERFO PMIS 325752

1. This item consists of culvert repair/replacment, headwall/endwall, and stone protection outlet, McDade Trail Construction, and Guardrail as noted in the following locations:
   - STA. 55+00 Remove Culvert, Inlets, Culvert, End Wall, Slope Repair, Bridge, McDade Trail
   - STA. 214+50 to 224+50 McDade Trail & Guard Rail
   - STA. 217+35 to 222+72 Culvert & Underdrain
   - STA. 219+50 Abandon Culvert, & Slope Repair
   - STA. 222+83 Inlets, Culvert, Headwall, Outfall Slope Repair
2. Measurement for payment will be determined based on percent of construction complete.
3. Payment will be made at the contract lump sum price.

D. Contract Line Item Number [**0004**] Slope Failures, Culverts McDade Trail – Disaster PMIS 324741

1. This item consists trail clearing, excavation, gravel trail construction, paved trail construction, pile driving, wall excavation, wall construction, precast concrete trail construction, and metal guard rail in the following locations:
   - STA. 183+10 Culvert, Endwall & Outfall
   - STA. 200+00 Culvert, Endwall & Outfall
   - STA. 172+80 to 214+50 & 224+50 to 248+80 McDade Trail and Guard Rail
   - McDade Trail Offroad STA. 700+00 to 710+00 Including Bridge
2. Measurement for payment will be determined based on percent of construction complete.
3. Payment will be made at the contract **lump sum price**.

E. Contract Line Item Number [0005] Bid Option 1 – Route 209 MM 0-7 Crack Seal Cyclic funding
1. This item is for crack seal and fill for Rt 209 from Mile Marker 0 to 7 of the existing pavement. including providing moving maintenance of traffic per MUTCD
2. Measurement for payment will be determined based on percent of construction complete.
3. Payment will be made at the contract lump sum price.

F. Contract Line Item Number [0006] Bid Option 2 – Route 209 Pavement Preservation PMIS 310424
1. This item consists of milling, full depth patching, crack seal and fill, SAMI, overlay, pavement markings, shoulder restoration shoulder removal and restoration, asphalt and gravel aprons, guardrail replacement inlet repair and replacement and MUTCD signing from approximate Mileposts 18.3 to 19.3.
2. Measurement for payment will be determined based on percent of construction complete.
3. Payment will be made at the contract lump sum price.

G. Contract Line Item Number [0007] Bid Option 3 – Route 209 Pavement Preservation PMIS 310424
1. This item consist of milling, full depth patching, crack seal and fill, SAMI, overlay, pavement markings, shoulder restoration shoulder removal and restoration, asphalt and gravel aprons, guardrail replacement inlet repair and replacement and MUTCD signing from approximate Mileposts 19.3 to 20.3.
2. Measurement for payment will be determined based on percent of construction complete.
3. Payment will be made at the contract lump sum price.

H. Contract Line Item Number [0008] Bid Option 4 – McDade Trail – Disaster PMIS 324741

1. This item consists of removing the McDade Trail Wall and trail at grade from Base Bid and Replace with McDade Trail Boardwalk per the Boardwalk Trail Details on C8.01 to C8.92 and per the specifications at the following locations:
   - STA. 192+38 to STA. 196+63
   - STA. 202+15 to STA. 203+63
   - STA. 210+88 to STA. 212+99

- STA. 217+20 to STA. 232+63
- STA. 234+13 to STA. 236+16
- STA. 236+56 to STA. 237+38
- STA. 244+36 to STA. 245+67
- STA. 246+23 to STA. 248+25

2. Measurement for payment will be determined based on percent of construction complete.
3. Payment will be made at the contract **lump sum price**.

I. Contract Line Item Number [0009] Bid Option 3 – Route 209 Wayfinding Signage PMIS 310424
1. This item consists of providing Wayfinding signage from approximate Mileposts 13.7 to 20.3.
2. Measurement for payment will be determined based on percent of construction complete.
3. Payment will be made at the contract lump sum price.

J. Contract Line Item Number [0010] Bid Option 4 – Route 209 Wayfinding Signage PMIS 310424
1. This item consists of providing Wayfinding signage from approximate Mileposts 0.0 to 7.0.
2. Measurement for payment will be determined based on percent of construction complete.
3. Payment will be made at the contract lump sum price.

K. Contract Line Item Number [0011] Bid Option 5 – McDade Trail Guide Rail PMIS 324741
1. This item consists of providing Natina Coated guard rail from approximate Sta 172+80 to Sta 248+80.
2. Measurement for payment will be determined based on percent of construction complete.
3. Payment will be made at the contract lump sum price.

END OF SECTION 01 27 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Definitions
2. Construction Coordination
3. Submittals
4. Coordination Drawings
5. Requests for Information (RFIs)
6. NPS Project Management and Communication Software
7. Project Meetings
8. Environmental Coordination
9. Permits

B. Related Requirements:

1. Section 01 32 16 "Construction Schedule" for preparing and submitting Construction Contractor's construction schedule.
2. Section 01 73 40 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.

1.2 DEFINITIONS

A. Agency with Jurisdiction
B. Construction Permits – Contractor Provided
C. Government Furnished Permits

1.3 CONSTRUCTION COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, which depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other Construction Contractors to ensure maximum accessibility for required maintenance, service, and repair.

3. Make provisions to accommodate items scheduled for later installation.
4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of components, including mechanical and electrical.
5. Properly plan construction operations to include permit requirements. Allow enough time to execute permit provisions to maintain work schedule, site visits, inspections, and reporting deadlines.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other Construction Contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to:

1. Preparation of Construction Contractor Construction Schedule
2. Preparation of the Schedule of Values
3. Installation and removal of temporary facilities and controls
4. Delivery and processing of submittals
5. Progress meetings
6. Permit requirements
7. Pre-installation conferences
8. Project closeout activities
9. Commissioning activities

1.4 SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of Contract Documents or standard printed data. Include following information, as applicable:

a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
b. Indicate dimensions shown on Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Contracting Officer (CO) for resolution of such conflicts.
c. Indicate space requirements for routine maintenance and anticipated replacement of components during the life of the installation.
d. Show location and size of access doors required for access to concealed dampers, valves, and controls.
e. Indicate required installation sequences.

2. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

3. Follow **NPS DSC Electronic Drawing Standards.** See CAD/BIM (Computer Aided Design/Building Information Modeling) & Drafting Standards page > **DSC Requirements** section.

B. Coordination Digital Data Files: Prepare coordination digital data files according to:

1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
2. File Submittal Format: Submit or post coordination drawing files using Portable Document Format (PDF) file format.
3. Contracting Officer will furnish Construction Contractor one set of digital data files (AutoCad.dwg) of Drawings for use in preparing coordination digital data files.

    a. Contracting Officer makes no representations as to accuracy or completeness of digital data files as they relate to Drawings.
    b. Digital Data Software Program: Drawings are available in AutoCad.dwg.

C. Division 1 documents:

1. Letter designating Project Superintendent
2. Construction Schedule
3. A Comprehensive Schedule of Values
4. Accident Prevention Plan
5. A List of Subcontractors for this project
6. Written statements from Subcontractors certifying compliance with applicable labor standard clauses.
7. Certificates of Insurance and Standard Form SF1413 for Contactor and all Subcontractors
8. Waste Management Plan
9. Quality Control Plan
10. Construction Contractor Commissioning Plan
11. List of Required Construction Permits. Include the following information for each permit:
    a. Name of Permit
    b. Agency(ies) with Jurisdiction issuing the permit
    c. Information required from Government to complete permit application

D. Provide items listed to Contracting Officer at least one week prior to Pre-Construction Conference, or as directed by Contracting Officer.
1. Failure to submit items may result in:
    a. Construction conference may be cancelled, Notice to Proceed may not be issued, and Contracting Officer will consider other contractual remedies.
    b. Work shall not commence until written Notice to Proceed has been issued and Certificates of Insurance and SF1413 documents are received for Construction Contractor and all Subcontractors.

1.5 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of Contract Documents, Construction Contractor shall prepare and submit an RFI utilizing form created on NPS project management and communication software.

1. Contracting Officer will not respond to RFIs submitted by other entities controlled by Construction Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in the work.

B. Content of RFI: Include detailed, legible description of item needing information or interpretation and the following:

1. RFI number, numbered sequentially
2. Date
3. RFI subject
4. Specification Section number and title and related paragraphs, as appropriate.
5. Drawing number and detail references, as appropriate.
6. Field dimensions and conditions, as appropriate.
7. Construction Contractor's suggested resolution: If suggested resolution impacts Contract Time or Contract Sum, Construction Contractor shall state impact in RFI.
8. Construction Contractor's signature
9. Requested date for response
10. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Form: Complete and submit on NPS project management and communication software.

D. Contracting Officer’s Action: Contracting Officer will review each RFI, determine action required, and respond. Contracting Officer will determine critical nature of each RFI and issue response accordingly.

1. The following are not considered to be RFIs and will receive no action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Construction Contractor's means and methods.
    d. Requests for coordination information already indicated in Contract Documents.
    e. Requests for adjustments in Contract Time or Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Contracting Officer's action may include a request for additional information; time for response will date from time of receipt of additional information.
3. Contracting Officer's action on RFIs may result in need for a change to Contract Time or Contract Sum. All contract changes will be processed following terms and conditions of contract.

1.6 PROJECT MANAGEMENT AND COMMUNICATION SOFTWARE

A. Use to manage project communication and document sharing during contract period on:

1. Project directory
2. Project correspondence
3. Meeting agendas and minutes
4. Contract modifications forms and logs
5. RFI form and processing
6. Task and issue management
7. Photo documentation
8. Baseline schedule, schedule updates and calendar management
9. Submittal form and processing
10. Payment coordination documentation
11. Reminder and tracking functions
12. Archiving functions
13. Notification of submittal and RFI statuses and current responsible party
14. Permits and addendums

B. Some documents are not suitable to be shared using NPS project management and communication software. Documents containing Personal Identifying Information (PII) (i.e. certified payrolls) shall not be shared and shall be coordinated with project team as appropriate.

1.7 PROJECT MEETINGS

A. Preconstruction Conference: Before start of construction, Contracting Officer will arrange an on-site meeting with Construction Contractor. Meeting agenda will include the following as a minimum:

1. Roles & Responsibilities / Lines of Authority
2. Park rules and regulations
3. Jobsite Safety
4. Resolution of comments on required Division 1 documents
5. Coordination of Subcontractors
6. Labor law application
7. Modifications
8. Payments to Construction Contractor
9. Payroll reports
10. Contract time
11. Liquidated damages
12. Construction Contractor Performance Evaluation
13. Display of Hotline posters
14. Notice to proceed
15. Correspondence procedures
16. NPS project management and communication software
17. Acceptance/rejection of work
18. Progress meetings
19. Submittal procedures
20. NPS Final Accessibility Inspection
21. Environmental requirements
22. Permit requirements
23. As-constructed drawings/operation and maintenance (O&M) manuals.
24. Saturday, Sunday, holiday and night work.
25. Reference materials

26. Value engineering
27. Schedule of Values

B. Progress Meetings: Contracting Officer will schedule weekly meetings with Construction Contractor.

1. Attendees: In addition to Government Representatives, each Construction Contractor, Subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented. Participants at meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Meeting agenda will include:

    a. Approval of minutes of previous meetings
    b. Submittal status
    c. Review of off-site fabrication and delivery schedules.
    d. Requests for information (RFI) and other issues.
    e. Modifications
    f. Work in progress and projected.
        1) Status of required inspections (Special Inspections, Accessibility, etc.)
    g. Inspections of work in progress and projected (Special inspections, Accessibility, etc.)
    h. Construction Schedule update (provide updated Critical Path Method (CPM)).
    i. Status of Project Record Drawings and O&M manuals.
    j. Other business relating to work.
    k. Permit requirements

C. Preinstallation Conferences: Conduct at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend meeting. Advise Contracting Officer of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for particular activity under consideration, including requirements for:

    a. Contract Documents
    b. Options
    c. Related RFIs
    d. Related Change Orders
    e. Purchases
    f. Deliveries
    g. Submittals
    h. Review of mockups
    i. Possible conflicts
    j. Compatibility requirements
    k. Time schedules
    l. Weather limitations

m. Manufacturer's written instructions
n. Warranty requirements
o. Compatibility of materials
p. Acceptability of substrates
q. Temporary facilities and controls
r. Space and access limitations
s. Regulations of agency(ies) with jurisdiction
t. Testing and inspecting requirements
u. Installation procedures
v. Coordination with other work
w. Required performance results
x. Protection of adjacent work
y. Protection of construction and personnel

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene conference at earliest feasible date.

1.8 ENVIRONMENTAL COORDINATION

A. Construction Contractor's Environmental Manager: Designate on-site party responsible for overseeing Construction Contractor's conformance to environmental goals for project and implementing procedures for environmental protection.

1. Qualifications: Minimum 3 years Construction experience on projects of similar size and scope; with environmental procedures similar to this project;; familiar with environmental regulations applicable to construction operations.
2. Responsibilities: Responsibilities shall include:

a. Compliance with applicable Federal, State, and local environmental regulations, including maintaining required documentation.
b. Implementation of Waste Management Plan (WMP).
c. Present overview of environmental issues and summarize site specific procedures relating to management plans at Preconstruction conference.
d. Training for Construction Contractor personnel in accordance with position requirements.
e. Monitoring and documentation of environmental procedures.

B. Perform project quality control in accordance with requirements specified in Related Sections, including:

1. Quality Requirements
2. Regulatory Requirements

3. Noise and Acoustics Management
4. Temporary Storm Water Pollution Prevention Environmental Management
5. Construction Waste Management

C. Construction Contractor's Environmental Training Program: Construction Contractor shall provide environmental training for workers performing work on project site. Training shall include:
1. Overview of environmental issues related to Project.
2. Review of site-specific procedures and management plans:

a. Construction Waste Management
b. Noise and Acoustics Management
c. Temporary Storm Water Pollution Prevention

3. Pollution Prevention (P2) practices: Submit evidence of **participation in P2 programs**.
4. Compliance with environmental regulations: As specified in Regulatory Requirements. Submit Construction Contractor 40 CFR (Code of Federal Regulations) employee training records upon request of Contracting Officer.

D. Provide documentation for environmental procedures as specified herein and in accordance with approved Waste Management Plan, IAQ Management Plan, and Storm Water Pollution Prevention Plan.

1.9 PERMITS

A. General:

1. Permits and Responsibilities: Construction Contractor shall, without additional expense to the Government, be responsible for obtaining necessary licenses and permits, and for complying with Federal, State and municipal laws, codes, and regulations applicable to the performance of the work. Construction Contractor shall also be responsible for damages to persons or property that occur as a result of Construction Contractor's fault or negligence; and for materials delivered and work performed until completion and acceptance of the work.
2. For the purpose of this contract, Construction Contractor will not be considered an agent of the Government. Construction Contractor shall comply with appropriate Federal, State and local laws.

B. Coordination with Agency(ies) with Jurisdiction Issuing Permits

1. Coordination: Contact the Agency(ies) with Jurisdiction as needed and sufficiently in advance to avoid delaying work: Coordinate meetings, reporting requirements, inspections, and other requirements.

C. Administrative Procedures:

1. Coordinate scheduling and timing of required administrative provisions of project permits with Agency(ies) with Jurisdiction, Construction Manager, and Park to avoid conflicts.
2. Supply needed information to Agency(ies) with Jurisdiction issuing permits, pay fees required and provide material needed to comply with permit's conditions and provisions.
3. Upload permits to NPS project management and communication software when permits are obtained.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 32 16 – CONSTRUCTION SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

A. Section consists of Construction Schedule requirements including:

1. Schedule of Values
2. Construction Schedule Requirements.
3. Construction Schedule Updates.
4. Time Impact Analysis.

B. Purpose: The Construction Schedule ensures adequate planning, coordination, scheduling, and reporting during execution of the work by the Construction Contractor. It shall assist the Construction Contractor and Contracting Officer (CO) in monitoring the progress of the work, evaluating proposed changes, and processing Construction Contractor's monthly progress payments. It shall include the dates in the contract, phases, milestones, occupancies, holidays, weather consideration, a critical path, and the requirements of this section.

1.2 DEFINITIONS

A. Activity: A discrete part of a project identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path. They start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: Allocation of the Schedule of Values for completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by the Contracting Officer.

C. Critical Path Method (CPM): Method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: Longest connected chain of interdependent activities through the network schedule that establishes minimum overall Project duration and contains no float.

E. Float: Measure of leeway in starting and completing an activity.

1. Float: Not for the exclusive use or benefit of the Government or Construction Contractor but is jointly owned.
2. Free Float: Amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total Float: Measure of leeway in starting or completing an activity without adversely affecting planned Project completion date.

F. Resource Loading: Allocation of manpower and equipment necessary for completion of an activity as scheduled.

G. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

1.3 SUBMITTALS

A. Electronic Copies: Schedules and reports submitted shall be posted on the NPS project management and communication software as PDF (portable document format) files. The intent of the Government is to limit the number of printed reports to those determined by the project team as essential.

B. Schedule of Values: After contract award and before Pre-Construction conference, submit schedule of dollar values based on Contract Price Schedule.

C. Construction Baseline Schedule: After contract award and before Pre-Construction conference, submit **two** paper copies of baseline schedule, large enough to show entire schedule for entire construction period. Utilize Schedule of Values in preparation of Construction Baseline Schedule.

D. Critical Path Method (CPM) Reports: Concurrent with CPM schedule, submit **three** paper copies of the following computer-generated reports. For each activity, include activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of predecessor and successor tasks for activities sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of activities sorted in ascending order of total float.

E. Construction Schedule Updates: On or before 7th day preceding progress payment request date, submit estimates of percent completion of each schedule activity and necessary supporting data. Provide two paper copies.

F. Construction Schedule Revisions and Time Impact Analysis: For each Construction Schedule revision, submit **two** paper copies of a Time Impact Analysis. Incorporate a Fragmentary Network (Fragnet) into currently accepted Construction Schedule demonstrating proposal to incorporate a modification, change, delay, or Construction Contractor request.

1.4 QUALITY ASSURANCE

A. Construction Contractor shall meet with Contracting Officer on day of the preconstruction conference to go over:

1. Review software limitations, content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including closures and calendar limitations..
4. Review delivery dates for Government-furnished products.
5. Review schedule for work of separate Government contracts.
6. Review time required for review of submittals and re-submittals.
7. Review requirements for tests and inspections by independent testing and inspecting agencies.
8. Review time required for completion and startup procedures.
9. Review time required for obtaining and activating permits.
10. Review and finalize list of construction activities to be included in schedule.
11. Review baseline schedule comments, resolve issues and progress on incorporating them
12. Review procedures for updating schedule.
13. Discuss reporting requirements and establish protocol for naming and transmitting electronic schedules.

B. Construction Contractor's Schedule Representative: Before the preconstruction conference, designate an authorized representative to be responsible for preparing and maintaining the Construction Schedule. Submit resume outlining qualifications of Scheduler to Contracting Officer for acceptance. Scheduler shall have prepared and maintained at least 5 previous schedules of similar size and complexity similar to this Contract, demonstrating proficiency of using scheduling software. Authorized representative will be responsible for preparing the Baseline Schedule, required updates, revisions, Time Impact Analyses, and reports.

1.5 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate Construction Contractors.

B. Coordinate Construction Baseline Schedule with Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. In developing Construction Baseline Schedule, ensure Subcontractor’s work at all tiers, and prime Construction Contractor’s work, is included and coordinated.
2. Secure time commitments for performing critical elements of work from parties involved.
3. Coordinate each construction activity in network with other activities and schedule in proper sequence.

PART 2 - PRODUCTS

2.1 SCHEDULE OF VALUES

A. Breakdown each lump-sum item into component work activities used in the schedule for which progress payments may be requested. Work activities broken out within schedule of values shall be integrated into and made a logical part of the construction baseline schedule. Total costs for the component work activities shall equal contract price for that lump-sum item. Contracting Officer may request data to verify accuracy of dollar values. Include mobilization, general condition costs, overhead and profit in the total dollar value of unit price items and in the component work activities for each lump-sum item. Do not include mobilization, general condition costs, overhead or profit as a separate item.

B. Do not break down unit price items. Use only the contract price for unit price items.

C. Total cost of all items shall equal the contract price. The Schedule of Values will form the basis for progress payments and the Construction Schedule.

2.2 CONSTRUCTION SCHEDULE REQUIREMENTS

A. Construction Baseline Schedule: Prepare Construction Baseline Schedule using a computerized, cost and resource-based**,** time-scaled Critical Path Method network analysis diagram for the Work.

1. Develop and finalize Construction Baseline Schedule so it can be accepted for use no later than **30** days after date established for the Notice of Award.

    a. Failure to include any work item required for performance of this Contract shall not excuse Construction Contractor from completing work within applicable completion dates, regardless of Governments acceptance of schedule.

2. Establish procedures for monitoring and updating Construction Baseline Schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.

B. Construction Baseline Schedule Preparation: Prepare a list of all activities required to complete the Work. Using preliminary Critical Path Method network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate estimated duration, sequence requirements, and relationship of each activity in relation to other activities.
2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the Critical Path Method schedule within the limitations of the Contract Time.

4. Show sequence and interdependence of activities required for completion of work. Ensure work sequences are logical and Construction Baseline Schedule shows a coordinated plan of the work.
5. Resource loading of each activity shall include personnel by labor category and equipment type and capacity proposed to complete the activity in duration shown.
6. Consider seasonal weather conditions in planning and scheduling work influenced by high and low ambient temperatures, wind, or precipitation to ensure completion of work within contract time.
7. Time Frame: Proposed duration assigned to each activity shall be Construction Contractor's best estimate of time required to complete activity considering the scope and resources planned for activity.

    a. An early finish date may be shown but the late finish date shall be same date as last day of contract period. An early completion schedule shall contain:

        1) Insert an activity titled "Project Float" as a successor to last activity in early project completion schedule network.
        2) Add a milestone titled "Contract End Date" as a successor to the activity "Project Float".
        3) Add duration to the activity "Project Float" as required so the milestone "Contract End Date" equals the last day of Contract Period.

    b. Contract completion date shall not be changed by submission of a schedule that shows an early completion date.
    c. Construction Contractor shall limit use of lead or lag duration's between schedule activities.
    d. Project Calendars: Develop and incorporate the following calendars:

        1) Administrative Calendar: Include calendar based on a 7-day week to be used on activities based on calendar days. Apply this calendar to administrative tasks or other tasks not affected by non-working days (Federal Holidays, weather, etc.).
        2) Project Calendar: Include calendar based on planned work week for the project. Include Federal Holidays, weekends, and non-workdays indicated in contract documents. Apply this calendar to activities not anticipated to be affected by weather. Be clear when identifying number of work days in work week.
        3) Weather Calendar: Utilize Project Calendar and show anticipated normal downtime related to weather as non-working time. Weather days shall be based on data for local area from a reliable source like the National Oceanic and Atmospheric Administration (NOAA), National Park Service records, or source acceptable to Contracting Officer. Apply this calendar to activities anticipated to be affected by weather.

    e. Activity Duration: Define so no activity is longer than **14** days, except for non-construction activities including mobilization, shop drawings and submittals, fabrication and delivery of materials and equipment.
    f. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 calendar days, as separate activities in the schedule. Procurement cycle activities can include submittals, approvals, purchasing, fabrication, and delivery.

1) Contractor to provide list of items with long lead times at construction kick-off meeting.

g. Submittal Review Time: Include review and re-submittal times indicated. Coordinate submittal review times in Construction Baseline Schedule.
h. Substantial Completion: Allow time for Government administrative procedures necessary for certification of Substantial Completion. (For more information, refer to Specification 01 77 00 "Closeout Procedures.")

8. Constraints: Include constraints and work restrictions indicated in Contract Documents and as follows in schedule and show how the sequence of Work is affected.

a. Phasing: Arrange list of activities on schedule by phase.
b. Work under More Than One Contract: Include a separate activity for each contract.
c. Work Restrictions: Show effect of the following on the schedule:

1) Coordination with existing construction
2) Limitations of continued occupancies
3) Uninterruptible services
4) Partial occupancy before Substantial Completion
5) Use of premises restrictions
6) Provisions for future construction
7) Seasonal variations
8) Environmental control
9) Permit provisions

d. Other Constraints: Calendar constrictions, not limited to, breeding seasons for protected wildlife.
e. Work Stages: Indicate important stages of construction for each major portion of the Work.

1) Subcontract awards
2) Submittals
3) Purchases
4) Mockups
5) Fabrication
6) Sample testing
7) Deliveries
8) Installation
9) Tests and inspections
10) Adjusting
11) Curing
12) Building flush-out.
13) Building commissioning activities.

9. Milestones: Include milestones indicated in Contract Documents in schedule, including, but not limited to, Notice to Proceed, Substantial Completion

C. Joint Review, Revision, and Acceptance:

1. Within seven calendar days of receiving Construction Contractor's proposed Construction Baseline Schedule, Contracting Officer shall review initial Construction Baseline Schedule.
2. Within seven calendar days after review, Construction Contractor shall revise and resubmit Construction Baseline Schedule in accordance with comments presented from review.
3. In the event the Construction Contractor fails to define any element of work, activity, or logic and the Contracting Officer review does not detect this omission or error, such omission or error, when discovered by Construction Contractor or Contracting Officer, shall be corrected by Construction Contractor within seven calendar days and shall not affect contract period.
4. Upon acceptance of the Construction Baseline Schedule, Contracting Officer saves schedule as a baseline and updates on a monthly basis. Construction schedule update will be used to evaluate Construction Contractor's monthly applications for payment based upon information developed at monthly Construction Schedule update meeting.

D. Cost Correlation: In the heading of the schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of Work performed as of dates used to prepare payment requests.

1. Construction Contractor shall assign cost to construction activities on Construction Baseline Schedule. Costs shall not be assigned to submittal activities unless specified otherwise but may, with Contracting Officer’s approval, be assigned to fabrication and delivery activities. Costs shall be included for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project Record Documents, and demonstration and training (if applicable).
2. Each activity cost shall reflect an accurate value based on the Contract Price Schedule.
3. Total cost assigned to activities shall equal total Contract Price.

E. Recovery Schedule: When periodic schedule update indicates Work is **14** or more calendar days behind current accepted schedule, a separate recovery schedule indicating means by which Construction Contractor intends to regain compliance with the schedule shall also be submitted. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery shall be accomplished.

F. Computer Software: Prepare schedules using a program developed specifically to manage construction schedules.

1. Use Microsoft Project or Primavera, for Windows 10 or newer.

PART 3 - EXECUTION

3.1 CONSTRUCTION SCHEDULE UPDATES

A. Progress Meeting Updates: Provide a **2** week look-ahead schedule, derived from the currently accepted schedule, before each weekly progress meeting. Utilize look-ahead schedule to facilitate and take notes on discussions held during progress meeting.

B. Monthly Schedule Updates:

1. General: Update Construction Schedule on monthly basis to reflect construction progress and activities throughout entire contract period and until project substantial completion. The status date of each schedule update shall be the 7th day preceding the progress payment request date.
2. Procedure: Construction Contractor shall meet with Contracting Officer each month at Construction Schedule update meeting to review progress made through the status date of the Construction Schedule update, including dates activities were started or completed and percentage of work completed on each activity started or completed.
3. Reports: Concurrent schedule revisions, prepare tabulated reports showing:

    a. Identification of activities that have changed
    b. Changes in early and late start dates
    c. Changes in early and late finish dates
    d. Changes in activity durations in workdays
    e. Changes in the critical path
    f. Changes in total float or slack time
    g. Changes in the Contract Time

4. Narrative: Report shall include a brief description of actual progress made during update period; actual and potential delaying activities; impediments to progress; issues related to inclement weather; progress toward established milestones and project float. Report shall include a brief description of work anticipated to be performed in the next month. Minor revisions to the schedule should be identified for evaluation and acceptance or rejection.
5. As Work progresses, indicate Actual Completion percentage for each activity.
6. If schedule update shows a late finish date after contract completion date, include:

    a. Known delays
    b. Actions to get back on schedule
    c. Pending modifications
    d. Impediments or constraints affecting progress

7. Progress Payments: Monthly updating of the currently accepted Construction Schedule shall be an integral part of the process upon which progress payments will be made. If Construction Contractor fails to provide schedule updates or revisions, a portion of the monthly payment may be retained until corrections have been made.

C. Distribution: Distribute copies of accepted schedule to Contracting Officer, Contracting Officers Representative, Construction Management Representative, Subcontractors, testing and inspecting agencies, and other parties identified by Construction Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to same parties and post in same locations. Delete parties from distribution when they have completed their assigned portion of the Work.

D. Construction Schedule Revisions:

1. Required Revisions: If, as a result of the monthly schedule update, it appears the currently accepted Construction Schedule no longer represents actual prosecution and progress of the work, Contracting Officer will request, and Construction Contractor shall submit, a

revision to the Construction Schedule. Construction Contractor may also request reasonable revisions to currently accepted Construction Schedule in event the Construction Contractor's planning for the work is revised. If Construction Contractor desires to make changes, Construction Contractor shall notify Contracting Officer in writing, stating reason for proposed revision. Accepted revisions shall be incorporated into currently accepted Construction Schedule for next monthly schedule update.

2. Procedure: If revision to currently accepted Construction Schedule is contemplated, Construction Contractor or Contracting Officer shall advise the other in writing at least seven calendar days prior to next monthly schedule update meeting, describing revision and reasons for the revision. Government-requested revisions will be presented in writing to the Construction Contractor, who shall respond in writing within seven calendar days.
3. Reports: Concurrent with making revisions to schedule, prepare tabulated reports showing:

    a. Identification of activities changed
    b. Changes in early and late start dates
    c. Changes in early and late finish dates
    d. Changes in activity durations in workdays
    e. Changes in critical path
    f. Changes in total float or slack time

3.2 TIME IMPACT ANALYSIS FOR CONTRACT MODIFICATIONS CHANGES DELAYS AND CONSTRUCTION CONTRACTOR REQUESTS:

1. Requirements: When contract modifications or changes are initiated, delays experienced, or Construction Contractor desires to revise currently accepted Construction Schedule, Construction Contractor shall submit to Contracting Officer a written time impact analysis illustrating the influence of modification, change, delay, or Construction Contractor request on contract time.
2. Time Extensions: Activity delays, resulting in a late completion date projection, shall not automatically mean an extension of contract time is warranted or due to Construction Contractor. It is possible a modification, change, or delay will not affect existing critical path activities or cause non-critical activities to become critical. A modification, change, or delay may result in absorbing a part of available total float that may exist within an activity chain of the Schedule, not causing any effect on contract time. Time extensions will be granted in accordance with terms of contract.
3. Extension of contract time will be granted only to the extent the equitable time adjustments to activity or activities affected by modification, change, or delay exceeds total (positive or zero) float available on a particular activity.
4. Procedure: Each time impact analysis shall be submitted within time period stated in a request for proposal, or time period designated under the clauses entitled Changes or Default. In cases where Construction Contractor does not submit a written request for extension of time and a time impact analysis within the designated time, it is mutually agreed that the particular modification, change, delay, or Construction Contractor request does not require an extension of the contract time. Upon acceptance, time impact analysis shall be incorporated into currently accepted Construction Schedule at next monthly schedule update.
5. Contract Modifications: Prepare time-impact analysis using fragnets to demonstrate effect of proposed change on overall Construction Schedule for each proposed contract modification concurrent with submission.

END OF SECTION 01 32 16

SECTION 01 32 33 – PHOTO DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for:

1. Existing condition images
2. Periodic construction images

B. See Section 01 77 00 "Closeout Procedures" for a complete listing of closeout documents.

C. See Section 01 79 00 "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of National Park Service (NPS) personnel.

1.2 SUBMITTALS

A. Construction Images: Submit images electronically within **seven** days of taking the image. Include:

1. Date, time and number (sequentially number all images) in filename.
2. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
3. Submit digital images exactly as originally recorded in digital camera, without alteration, or modifications using image-editing software.

B. Closeout: Submit complete set of digital image electronic files as a Project Record Document**.** Submit on Digital Video Disc (DVD).

1. Provide index as separate file on Disc. List each image as a file name with number, date, and time. Include description and or vantage point image was taken.
2. Submit images that have the same aspect ratio as the sensor, un-cropped.

PART 2 - PRODUCTS

2.1 FORMAT REQUIREMENTS

A. Media Submission or Digital Transfer

B. Format should be compatible with all digital cameras.Media: DVD-R Archival Gold or USB Flash Drive.

C. Media Labels: Archival DVD labeling markers, archival labels, or direct print.

D. Images: Provide sRGB (standard Red Green Blue) color images in JPEG (Joint Photographic Experts Group) format. Minimum sensor size of **8** megapixels, and at image resolution of not less than **3200 by 2400**, and 300 dpi (dots per inch).

PART 3 - EXECUTION

3.1 CONSTRUCTION IMAGES

A. General: Take digital images using the maximum range of depth of field, in-focus, to clearly show the Work. No blurry or out-of-focus areas accepted.

1. Maintain index with each set of Construction images and identify the number, date, time, and description for each.
2. Maintain one set of images accessible in field office at Project site available for reference.

B. Existing Condition Images: Before **starting construction**, take color digital images of Project site and surrounding properties, including existing items to remain during construction, from different vantage points.

1. Flag **construction limits** before recording construction images.
2. Take **eight** separate images to show existing conditions adjacent to property before starting Work.
3. Take **eight** separate images of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.

C. Periodic Construction Images: Take **12** color, digital images **monthly, coinciding** with cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last images were taken.

D. Additional Images: Contracting Officer may issue requests for additional images.

1. Three days advance, where feasible.
2. In emergency situations, take additional images within 24 hours of request.
3. Additional images include, but are not limited to:

a. Immediate follow-up when on-site events result in construction damage or losses.
b. Fabrication locations away from Project site.
c. Substantial Completion of a major phase or component of Work.
d. Extra record images at time of final acceptance.

END OF SECTION 01 32 33

SECTION 01 33 23 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.2 DEFINITIONS

A. Action Submittals: Written, graphic information, and physical samples that require Government's responsive action.

B. Informational Submittals: Written information that does not require Government's responsive action. Submittals may be rejected for not complying with requirements.

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.3 GENERAL SUBMITTAL PROCEDURES

A. General: Prepare and submit submittals required by individual Specification Sections and in some cases as requested in drawings. Types of submittals are indicated in individual specific sections.

1. Contracting Officer (CO) reserves right to require submittals in addition to those called for in individual sections.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Review for legibility, accuracy, completeness, and compliance with Contract Documents.

1. Coordinate submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of Work so processing will not be delayed because of need for concurrent review coordination.

a. Contracting Officer reserves right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Submittal List: Submittal list is attached to the end of this Specification Section. The intent is to provide an overall summary of submittal requirements. The requirements of individual Specification Sections and terms and conditions of the Contract still apply regardless of what is shown on submittal list.

D. Processing Time: Allow enough time for submittal review and re-submittals. Contract time extensions will not be authorized if submittals are not transmitted with enough time to permit processing, including re-submittals.

1. Action Submittals

a. Initial Review: Allow 30 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required.
b. Re-submittal Review: Allow 30 days for review of each re-submittal.

2. Informational submittals

a. Review: Allow 10 days for review of each submittal.

E. Approved Equal Submittal Requirements:

1. For each item proposed, submit supporting data, including:

a. Drawings and samples as appropriate.
b. Comparison of the salient characteristics of the proposed item with that specified.
c. Changes required in other elements of the work because of the substitution.
d. Name, address, and telephone number of vendor.
e. Manufacturer's literature regarding installation, operation, and maintenance, including schematics for electrical and hydraulic systems, lubrication requirements, and parts lists. Describe availability of maintenance service, and state source of replacement materials.

2. A request for approval constitutes a representation that Construction Contractor:

a. Has investigated the proposed item and determined that it is equal or superior in all respects to that specified.
b. Will provide the same warranties for the proposed item as for the item specified.
c. Has determined that the proposed item is compatible with interfacing items.
d. Will coordinate installation of an approved item and make changes required in other elements of the work because of the substitution.
e. Waives claims for additional expenses that may be incurred as a result of the substitution.

F. Submittals: Identify and incorporate information in each submittal file as follows:

1. Transmittal Form (CM-16): Utilize NPS Transmittal Form for all submittals. No action will be taken on a submittal item unless accompanied by this Transmittal Form.
2. Physical samples: Complete Transmittal Form and deliver physical sample to the Contracting Officer (or designee) on site for processing. All comments and actions will be documented on the Transmittal Form.

G. Identification: Submittal number or other unique identifier, including revision identifier.

1. Submittal number shall use a sequential number (e.g. .001). Re-submittals shall include alphabetic suffix after another decimal point (e.g. .001.A).

H. Re-submittals: Make re-submittals using same process used with initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in the title block on the Transmittal Form (CM-16) and clearly indicate extent of revision.
3. Re-submit submittals until they are marked "Approved" or "Approved with notations".

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, and others as necessary for performance of construction activities.

J. Use for Construction: Use only final submittals with mark indicating "Approved" or "Approved with notations". Ensure notations have been incorporated and, at a minimum, keep one copy of final approved submittal on site for use during construction.

1.4 CONSTRUCTION CONTRACTOR'S USE OF CAD/BIM FILES

A. General: At Construction Contractor's written request, copies of CAD/BIM (Computer Aided Design/Building Information Modeling) files will be provided to Construction Contractor for use in connection with Project, subject to:

1. Files provided as is; no format or other changes to files or changes to objects in the drawing will be done by the Government

2. The contractor acknowledges that the CAD files are representational of the design intent for the project and are not presented or warranted to be accurate.

3. Use of the CAD files is not a defense for failure to conform with the requirements of the contract documents.

4. Reliance on dimensional or other information contained or inherent in the CAD files is at the contractor's sole risk.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each submittal to show which products and options are applicable.
3. As applicable, include:

a. Manufacturer's product specifications.
b. Manufacturer's installation instructions: When Contract Documents require compliance with manufacturer's printed instructions, provide one complete set of instructions to Contracting Officer and keep another complete set of instructions at the project site until substantial completion.
c. Manufacturer's catalog cuts: Submit only pertinent pages; mark each page of standard printed data to identify specific products proposed for use.
d. Wiring diagrams showing factory-installed wiring.
e. Printed performance curves.
f. Operational range diagrams.
g. Compliance with specified referenced standards.
h. Testing by recognized testing agency.

4. Submit product data in PDF (portable document format) file format before or concurrent with samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in Contract Documents. As applicable, include:

a. Dimensions
b. Identification of products
c. Fabrication and installation drawings
d. Roughing-in and setting diagrams
e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring
f. Shopwork manufacturing instructions
g. Templates and patterns
h. Schedules
i. Notation of coordination requirements
j. Notation of dimensions established by field measurement
k. Relationship to adjoining construction clearly indicated
l. Seal and signature of professional engineer if specified
m. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring

2. Submit shop drawings as PDF electronic file

C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Complete and post the Transmittal Form (CM-16) on the NPS project management and communication software website for processing and documentation of action on submitted samples.
3. Identification: Attach label on unexposed side of Samples that includes:

a. Generic description of Sample
b. Product name and name of manufacturer

c. Sample source
d. Submittal Number and title of appropriate Specification Section

4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing full range of colors, textures, and patterns available.

   a. Number of Samples: Submit **two** full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Contracting Officer will return with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

   a. Number of Samples: Submit four sets of Samples. Contracting Officer will retain three Sample sets; remainder will be returned.

D. Construction Materials: Construction Contractor is encouraged to submit products made out of recycled or environmentally responsible material. Every effort will be made by NPS to approve these materials.

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by individual Specification Sections.

1. Post informational submittals as PDF electronic files directly to the NPS project management and communication software.
2. Certificates and Certifications: Provide a notarized statement with signature of entity responsible for preparing certification. Certificates and certifications shall be signed by officer or other individual authorized to sign documents on behalf of that entity.
3. Informational submittals that do not comply with requirements specified in Contract Documents will be rejected and one copy will be returned.

B. Coordination Drawings: Comply with requirements specified in Section 01 31 00 "Project Management and Coordination."

C. Construction Contractors Construction Schedule: Comply with requirements specified in Section 01 32 16 "Construction Schedule."

D. Accident Prevention Plan: Comply with requirements specified in Section 01 35 23 "Safety Requirements."

E. Schedule of Values: Comply with requirements specified in Section 01 32 16 "Construction Schedule."

F. Waste Recycling Plan: Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."

G. Quality Control Plan: Comply with requirements specified in Section 01 40 00 "Quality Requirements."

H. Storm Water Pollution Prevention Plan: Comply with requirements specified in Section 01 57 23 "Temporary Storm Water Pollution Prevention" and storm water permit requirements identified in Section 01 31 00 "Project Management and Coordination."

I. Qualification Data: Prepare written information demonstrating capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

J. Welding Certificates: Prepare written certification that welding procedures and personnel comply with Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on American Welding Society (AWS) forms. Include names of firms and personnel certified.

K. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying Installer complies with Contract Documents and, where required, is authorized by manufacturer for this specific Project.

L. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying manufacturer complies with Contract Documents. Include evidence of manufacturing experience where required.

M. Product Certificates: Prepare written statements on manufacturer's letterhead certifying product complies with Contract Documents.

N. Material Certificates: Prepare written statements on manufacturer's letterhead certifying material complies with Contract Documents.

O. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in Contract Documents.

P. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

Q. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.

R. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in Contract Documents.

S. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

T. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in Contract Documents.

U. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Section 01 78 23 "Operation and Maintenance Data."

V. Design Data: Prepare written and graphic information, including: performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

W. Manufacturer's Instructions: Prepare written or published information documenting manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer.

X. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. As applicable, include:

1. Statement on condition of substrates and their acceptability for installation of product.
2. Summary of installation procedures being followed, compliance with requirements and, if not, what corrective action was taken.
3. Results of operational and other tests and a statement of whether observed performance complies with the requirements.

Y. Permit Compliance Products: Prepare required information for compliance with permit provisions. Products include written notification of project startup, suspension, and completion of work; photo documentation of site conditions; reports; and drawings.

PART 3 - EXECUTION

3.1 CONSTRUCTION CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of Contract and for compliance with Contract Documents. Note corrections and field dimensions.

3.2 CONTRACTING OFFICER'S ACTION

A. General: Submittals will be disapproved without technical review if identification information is missing, not filled in, or if placed on back of submittal; an incorrect format of submittals is provided; transmittal form is incorrectly filled out; submittals are not coordinated; or submittals do not show evidence of Construction Contractor's approval.

   1. Any work done or orders for materials or services placed before approval shall be at Construction Contractor's own risk.

B. Action Submittals: Contracting Officer will review each submittal, generate comments on corrections or modifications required, and indicate appropriate action on the Transmittal Form (CM-16). Submittal will be marked as defined below:

   1. APPROVED: Acceptable with no corrections.
   2. APPROVED WITH NOTATIONS: Minor corrections or clarifications required. Comments are clear and no further review is required. Construction Contractor shall address review comments when proceeding with the work.
   3. DISAPPROVED - RESUBMIT: Rejected as not in accordance with the contract or as requiring major corrections or clarifications. Contracting Officer will identify reasons for disapproval. Construction Contractor shall revise and resubmit with changes clearly identified.

C. Informational Submittals: Contracting Officer will review each submittal and will either accept or reject it.

D. Partial submittals are not acceptable, will be considered non-responsive, and will be returned without review.

END OF SECTION 01 33 23

SUBMITTAL LIST

Note: Attach to end of Specification Section 01 33 23 when complete.

DEWA 310424 Safety and Pavement Improvements to Route 209

SUBMITTAL			REQUIREMENTS (indicate with an "X")							
			INFORMATIONAL				ACTION			
Spec. Sec.	Par. No.	Description	CERT./LAB TEST	REPORT/CALC. OR PLAN	Mfg. DATA & INSTRUCTIONS		SHOP DRAWING	SAMPLE	Mfg. DATA & INSTRUCTIONS	
013216	1.3	Schedules/Reports		x						
013216	1.3	Schedule of Values		x						
013216	1.3	Construction Basline Schedule		x						
013216	1.3	Construction Schedule Updates		x						
013216	1.3	Construction Schedule Rev. & Time Impact Analysis		x						
013233	1.2	Construction Images	x							
013233	1.2	Closeout	x							
013513	1.3	Daily Work Schedule		x						
013523	1.2	Accident Prevention Plan		x						
014000	1.4	Quality Control Plan		x						
014000	1.4	Qualification Data	x							
014000	1.4	Contractor's Quality Control Daily Reports	x							
014000	1.4	Test Reports	x							
014000	1.4	Accesibility Inspection Report	x							
014000	1.4	Offsite Inspection Report	x							
014000	1.4	Permits, Licenses, & Certficates	x	x						
015723	1.3	Under-An-Acre Pollution Prevention Plan (UPPP)		x						
015723	1.3	UPPP Inspection Schedule		x						
015273	1.3	Erosion Control Products		x			x			
016700	1.3	Affirmative Procurement Reporting Form	x							
016700	1.3	Paints & Coatings Environmental Data (ASTM E2129)							x	
016700	1.3	Material Safety Data Sheets							x	
017340	1.2	Location/Elevation Certification	x							
017340	1.2	Landfill receipts for hazardous materials	x							
017419	1.4	Waste Management Plan		x						
017419	1.4	Waste Reduction Calculations		x						
017419	1.4	Record of Donation, Sales, Recycling/Processing Facility, and/or Landfill and Incinerator Disposal		x						
017419	1.4	Qualification Data for Waste Management Director	x							
017700	1.4	Punch List		x						
024119	1.3	Permits, Licenses, & Certficates, Procedures & Sequence	x	x						
024120	1.3	Permits, Licenses, & Certficates, Procedures & Sequence	x	x						

SUBMITTAL LIST

Note: Attach to end of Specification Section 01 33 23 when complete.

DEWA 310424 Safety and Pavement Improvements to Route 209

SUBMITTAL			REQUIREMENTS (indicate with an "X")							
			INFORMATIONAL				ACTION			
Spec. Sec.	Par. No.	Description	CERT./LAB TEST	REPORT/CALC. OR PLAN	Mfg. DATA & INSTRUCTIONS		SHOP DRAWING	SAMPLE	Mfg. DATA & INSTRUCTIONS	
033053	1.3	Concrete mixture designs, trial batches, and test reports	x	x						
034140	1.7	Design package, detailed plans, computations, certification, specifications, quality acceptance/rejection criteria, plans, product data, shop drawings	x	x	x		x		x	
040120	1.5	Quality-Control Program		x						
040120	1.5	Restoration Program		x						
040120	1.5	Cleaning Program		x						
040120	1.5	Laboratory Test Results	x							
040120	1.4	Product Data						x		
040120	1.4	Samples for Intial Selection						x		
040120	1.4	Samples for Verification						x		
069001	1.3	Product data, material certificate, test reports, product instructions, Quality Control Plan, Quality Control Qualifications	x	x	x		x		x	
101453	1.3	Traffic Signage shop drawings and manufacturing warranties	x				x			
310000	1.3	Material certificate	x							
312500	1.3	Material certificate	x							
313700	1.3	Material certificate	x							
315115	1.3	Material certificate	x							
315115	1.3	Shop Drawings, design calculations, material certicates	x	x	x		x		x	
316216.16	1.7	Shop Drawings, design documents, material certicates, personnel qualifications, test reports, location plan	x	x	x		x		x	
316329.00	1.6	Shop Drawings, calculations, design documents, plans and procedures, calibration documentation	x	x	x		x		x	
316615.00	1.3	Shop Drawings, design documents, material certicates, personnel qualifications, test reports, location plan	x	x	x		x	x	x	
320117.61	1.3	Material Data	x	x	x					
320117.62	1.2	JMF, samples, spread rates, test results	x	x				x		

SUBMITTAL LIST

Note: Attach to end of Specification Section 01 33 23 when complete.

DEWA 310424 Safety and Pavement Improvements to Route 209

SUBMITTAL			REQUIREMENTS (indicate with an "X")							
			INFORMATIONAL				ACTION			
Spec. Sec.	Par. No.	Description	CERT./LAB TEST	REPORT/CALC. OR PLAN	Mfg. DATA & INSTRUCTIONS		SHOP DRAWING	SAMPLE	Mfg. DATA & INSTRUCTIONS	
320117.71	1.3	Full depth patching JMF, testing laboratory certification of compliance, QC technician certifications, production plant certification, manufacturer's certificate for emulsified asphalt	x	x				x		
320117.72	1.3	Full depth patching JMF, testing laboratory certification of compliance, QC technician certifications, production plant certification, manufacturer's certificate for emulsified asphalt	x	x				x		
320119	1.3	Concrete mixture designs, trial batches, material certifcate, and test reports	x	x						
321123	1.3	Aggregate base course certified test report and 100lb sample	x					x		
321213.13	1.3	Asphalt tack coat material certification	x							
321216.03	1.3	Asphalt pavement JMF design parameters, laboratory facility accreditations/certification, qualifications for inspection and testing personnel, and sample copies of all forms for reporting data	x	x			x	x		
321623.00	1.3	Certified test reports, sample	x		x			x		
321722	1.3	Material certificates	x	x						
321723	1.3	Pavement markings material certificates	x							
323215	1.5	Material Certificate, Installer Qualification Data, Shop drawing, Soil Compaction data	x	x			x		x	
329119.13	1.3	Test reports	x	x						
329119.14	1.3	Soil Test reports, certified seed mix, and 50 lb sample of aggregate topsoil	x	x				x		
334116.19	1.3	Shop Drawings					x			
334116.19	3.3	Granular Backfill	x	x				x		
329220	2.1	Certified seed mix	x							
334100	1.3	Shop Drawings					x			
334116.19	1.3	Shop Drawings					x			
334116.19	3.3	Granular Backfill	x	x				x		
334211	1.3	Shop Drawings					x			
334213	1.3	Shop Drawings					x			

SUBMITTAL LIST

Note: Attach to end of Specification Section 01 33 23 when complete.

DEWA 310424 Safety and Pavement Improvements to Route 209

SUBMITTAL			REQUIREMENTS (indicate with an "X")							
			INFORMATIONAL				ACTION			
Spec. Sec.	Par. No.	Description	CERT./LAB TEST	REPORT/CALC. OR PLAN	Mfg. DATA & INSTRUCTIONS		SHOP DRAWING	SAMPLE	Mfg. DATA & INSTRUCTIONS	
334223	1.3	Shop Drawings	x				x			
340100	3.1	Traffic Control Plan	x	x						
347113.26	1.3	Manufacturer Drawings	x				x		x	

SECTION 01 35 13.22 – ARCHEOLOGICAL PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section consists of protecting archeological resources contained in soil deposits.

1.2 DEFINITIONS

A. Archeological Resources: Archeological resources are physical evidences of past human activity, including evidences of effects of that activity on the environment. Archeological resources represent both prehistoric and historic time periods, found above and below ground and under water.

B. Archeologically Sensitive Areas: Areas having potential to contain significant (National Register eligible) archeological resources. If National Register eligible or listed archeological resources could not be avoided, an appropriate mitigation strategy would be developed in consultation with state historic preservation officer and, if necessary, associated American Indian tribes.

C. Non-sensitive Areas: Areas with little potential of containing significant (National Register eligible) archeological resources.

D. Archeological Monitor: Representative of Government designated to oversee construction activities that could disturb archeological resources.

E. Tribal Monitor: Representative of Tribes designated to oversee construction activities that could disturb Tribal resources.

F. Archeological Resources Protection Act (ARPA) of 1979 (Public Law (P.L.) 96-95; 93 United States Statues at Large (Stat.) 712): defines archeological resources as any material remains of past human life or activities that are of archeological interest and at least 100 years old; Section 4 of the statute describes the requirements that must be met before Federal authorities can issue a permit to excavate or remove any archeological resource on Federal or Indian lands; the curatorial requirements of artifacts, and other materials excavated or removed.

1.3 SUBMITTALS

A. Daily Work Schedule: Detail construction work in archeologically sensitive areas. Submit to Contracting Officer (CO) 30 days before start of ground disturbing site work.

1.4 QUALITY ASSURANCE

A. At least one week before on-site work begins, Contractor shall meet with Contracting Officer and Archeological Monitor to discuss Daily Work Schedule, equipment, and special methods used in archeologically sensitive areas. Contractor shall ensure approved Daily Work Schedule is

followed throughout construction.

PART 2 - PRODUCTS

2.1 DAILY WORK SCHEDULE

A. Daily Work Schedule is required for work occurring within archeologically sensitive areas. Include all work that is to occur within the area and key the schedule to the drawings to include:

1. Starting and ending dates of ground-disturbing construction.
2. Locations of temporary facilities, such as barriers, field offices, staging areas, sanitary facilities, borrow pits, and haul and access roads.
3. Types of construction, such as clearing, topsoil stripping, structure or trench excavation, landscaping, and post construction clean-up.
4. Methods and equipment used for each type of construction.
5. Plan for relocating work in the event of temporary work stoppages at each archeologically sensitive area

PART 3 - EXECUTION

3.1 OBSERVATION

A. Government Archeological and/or Tribal Monitor will observe ground-disturbing site work, including construction of temporary facilities, at archeologically sensitive areas, from a safe location mutually agreed on by Contractor and Monitor. As new ground is broken, Monitor will examine excavated materials, using construction layout centerline and perimeter staking as a reference point to record locations of findings.

3.2 DISCOVERY OF RESOURCES

A. If Archeological Monitor discovers resources, immediate relocation of work to a non-sensitive area may be required for Monitor to identify and document resources and, if necessary, develop appropriate mitigation plan. While Archeological Monitor is documenting resources in sensitive areas, Contractor shall relocate work to non-sensitive areas where monitoring is not normally required.

B. If resources are discovered while Archeological Monitor is absent, stop work immediately and report the discovery to the Contracting Officer.

3.3 WORK STOPPAGE

A. Contractor shall plan, schedule, and execute work to prevent stoppages at one area from stopping all work at construction site.

END OF SECTION 01 35 13.22

SECTION 01 35 23 - SAFETY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes establishing an effective accident prevention program and providing a safe working environment for personnel and visitors.

1.2 CONDITIONS PRESENT FOR PROJECT

A. **Weather**

B. **Vehicular Traffic**

C. **Bicycle Traffic**

D. **Pedestrians**

E. **Confined Spaces**

F. **Water**

G. **Electrocution**

H. **Trenching**

I. **Trip and Fall Hazards**

1.3 SUBMITTALS

A. Accident Prevention Plan (APP): Submit APP after contract award and before Pre-Construction conference. Contracting Officer (CO) will review proposed APP. If APP requires any revisions or corrections, Contractor shall resubmit Plan within 10 days. No progress payments will be made until the APP is accepted.

1.4 QUALITY ASSURANCE

A. Comply with contract clauses "Accident Prevention" and "Permits and Responsibilities." In case of conflicts between Federal, State, and local safety and health requirements, the most stringent shall apply. Onsite equipment shall meet 29 CFR 1926 (Code of Federal Regulations) (Occupational Safety and Health Administration (OSHA)) requirements. Failure to comply with requirements of this section and related sections may result in suspension of work.

B. Site Safety Supervisor:

1. Designate authorized onsite representative for preparation and maintenance of the APP.
2. Shall be responsible for:

    a. Implementation and enforcement of the APP
    b. Daily safety inspections
    c. Conducting and documenting weekly and monthly safety meetings
    d. Review of safety requirements at progress meetings
    e. Compilation and maintenance of Safety Data Sheets (SDS) and safety reference materials
    f. Tracking and resolution of safety violations
    g. Site personnel and visitor compliance with site safety and health requirements and APP
    h. Investigation and reporting of accidents and injuries

C. Qualifications of Employees:

1. Physically and able to perform their assigned duties in a safe manner.
2. Do not allow employees whose ability or alertness is impaired because of prescription or illegal drug use, fatigue, illness, intoxication, or other conditions that may expose themselves or others to injury to perform work.
3. Provide operating instructions for equipment. Operators of vehicles, hoisting equipment, and hazardous plant equipment shall be able to understand signs, signals, operating instructions, and be fully capable of operating such equipment. Retain copies of operator licenses and certifications onsite.

1.5 ACCIDENT REPORTING

A. Reportable Accidents: Defined as: death, occupational disease, and/or traumatic injury to employees or the public; fires; and/or property damage by accident in excess of $100.

1. Notify Contracting Officer immediately in the event of a reportable accident.
2. Fill out and forward an Accident/Property Damage Report Form (CM-22) to Contracting Officer within 7 days of a reportable accident. Obtain form from Contracting Officer.

1.6 RESOURCES

PART 2 - PRODUCTS

2.1 ACCIDENT PREVENTION PLAN (APP)

A. APP shall be written to comply with OSHA and project requirements (generic plan is not acceptable) including but not limited to:

1. Name and qualifications of supervisor responsible to carry out program.
2. Weekly and monthly safety meetings shall be documented with topics and attendees.
3. First aid and rescue procedures.
4. Job Hazard Analysis (JHA) for each major phase. List of hazards associated and methods proposed to provide for property protection and safety of the public, National Park Service personnel, and Contractor's employees. Include initial and continuing training.
5. Planning for possible emergency situations, as detailed in Article 1.2. Such planning shall take nature of construction, site conditions, and degree of exposure of persons and property into consideration.
6. Infectious Disease Preparedness:

a. Contractors are responsible for their employees' safety and the safety of job site visitors during the performance of this contract. We encourage Contractors to follow guidance from the Department of Labor (DOL), Occupational Safety and Health Administration (OSHA), the Centers for Disease Control and Prevention (CDC), and all other applicable local, city, and state mandates. We encourage Contractors to develop policies for infection prevention and an Infectious Disease Preparedness and Response Plan.
b. To the extent appropriate, Contractors should include the protective health and safety measures they intend to implement in any accident prevention or safety submittals required under this contract. These plans should contain preventive measures the Contractor intends to follow while performing work on government property as well as responsive and corrective actions to be taken if an employee exhibits symptoms or tests positive for contagion.
c. Upon contract award, Contractors should communicate with Contracting Officer regarding Contractor decisions and actions to protect the health and safety of workers for the duration of contract performance under which pandemic conditions exist.

2.2 FIRST AID FACILITIES

A. Provide adequate facilities for number of employees and appropriate to construction hazards.

2.3 PERSONNEL PROTECTIVE EQUIPMENT (PPE)

A. Selection shall conform to OSHA Subpart E.

PART 3 - EXECUTION

3.1 DAILY SAFETY INSPECTIONS

A. Conduct daily safety inspections and maintain daily safety reports which include:
   1. Area/operation inspected
   2. Date of inspection
   3. Identified hazards
   4. Corrective actions taken

3.2 EMERGENCY INSTRUCTIONS

A. Post telephone numbers and reporting instructions for ambulance, physician, hospital, fire department, and police in conspicuous locations at work site.

3.3 FIRE AND LIFE SAFETY

A. Comply with requirements of 2024 International Fire Code **Chapter 33 Fire Safety During Construction and Demolition**.

3.4 HAZARDOUS MATERIALS

A. Hazardous materials: Explosive, flammable, poisonous, corrosive, oxidizing, irritating, or otherwise harmful substances that could cause death or injury.

B. Store hazardous materials in accordance with manufacturer's and OSHA Subpart D requirements. Maintain Safety Data Sheets (SDS) for each chemical readily available on site.

   1. Immediately report spills of hazardous materials to the Park.
   2. Maintain a spill emergency response kit.
   3. Train employees how to respond to a spill and use emergency response kit.

3.5 PROTECTIVE EQUIPMENT

A. Inspect personal protective equipment daily and maintain in a serviceable condition. Clean, sanitize, and repair personal items as appropriate before issuing to another individual.

3.6 SAFETY MEETINGS

A. As a minimum, conduct one weekly 15-minute "toolbox" safety meeting conducted by a foreman or supervisor and attended by construction personnel at worksite. Topics shall coincide with work scheduled for following week. Document and submit meeting minutes to Contracting Officer within one day after meeting.

B. Conduct monthly safety meetings for personnel, contractors, and subcontractors performing work on the site. Notify Contracting Officer of meeting dates and times. Meetings shall be used to:

review effectiveness of Contractor's safety effort; resolve current health and safety problems; provide a forum for planning safe construction activities, and for updating Accident Prevention Plan. Contracting Officers Representative will attend meetings and enter results of meetings into the daily log.

3.7 HARD HATS AND PROTECTIVE EQUIPMENT AREAS

A. A hard hat use area shall be designated by Contractor. Hard hat area shall be posted by Contractor in a manner satisfactory to Contracting Officer.

B. It is Contractor's responsibility to require persons working on or visiting site to wear hard hats and PPE in good repair at all times. As a minimum, maintain **six** hard hats and other APP required equipment.

3.8 TRAINING

A. First Aid: Provide training to personnel to ensure prompt and efficient first aid.

B. Hazardous Material: Train and instruct each employee exposed to hazardous material in safe and approved methods of handling and storage.

END OF SECTION 01 35 23

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements. Quality of work shall be responsibility of the Contractor.

1. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and control procedures that facilitate compliance with Contract Document requirements.

C. See Divisions 2 through 49 Sections for specific test and inspection requirements.

D. Contractor shall hire third party independent testing agency for all construction testing.

1.2 DEFINITIONS

A. Quality Assurance Services: Activities, actions, and procedures performed before and during execution of the work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality Control Services: Tests, inspections, procedures, and related actions during and after execution of the work to evaluate actual products incorporated into the work and completed construction comply with requirements.

C. Mockups: Full-size physical assemblies constructed on-site. Mockups are constructed from selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Approved mockups establish the standard by which the Work will be judged, unless otherwise indicated.

1. Laboratory Mockups: Full-size physical assemblies constructed at a testing facility to verify performance characteristics.
2. Integrated Exterior Mockups: Mockups of exterior envelope erected separately from building but on Project site, consisting of multiple products, assemblies, and subassemblies.
3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.

D. Preconstruction Testing: Tests and inspections performed specifically for project before products and materials are incorporated into work to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections performed by a Nationally Recognized Testing Laboratory (NRTL), a National Voluntary Laboratory Accreditation Program (NVLAP), or a testing agency qualified to conduct product testing, to establish product performance and compliance with industry standards.

F. Source Quality Control Testing: Tests and inspections performed at the source, i.e., plant, mill, factory, or shop.

G. Field Quality Control Testing: Tests and inspections performed on-site for installation of work and for completed work.

H. Testing Agency or Laboratory: Entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Using a term such as "carpentry" does not imply certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of corresponding generic name.

1.3 CONFLICTING REQUIREMENTS

A. Reference Standards: If compliance with two or more standards is specified and standards establish different or conflicting requirements for minimum quality levels, comply with most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Contracting Officer before proceeding.

B. Minimum Quality Levels: Quality level shown or specified shall be minimum provided or performed. Actual installation may comply exactly with minimum quality specified, or it may exceed minimum within reasonable limits. To comply with requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Contracting Officer before proceeding.

1.4 SUBMITTALS

A. Quality Control Plan:

1. After contract award and before Pre-Construction conference, submit a written Contractor Quality Control (CQC) plan.
2. If plan requires revisions or corrections, Contractor shall resubmit plan within 10 days.
3. Government reserves the right to require changes in plan during contract period as necessary to obtain the quality specified.

4. No change in the approved plan may be made without written concurrence by Contracting Officer.

B. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in form of a recent report on inspection of testing agency by a recognized authority.

C. Contractor Quality Control (CQC) Daily Reports: Submit showing inspections and tests on first workday following date covered by report. Quality Control Supervisor shall utilize DSC Forms.

1. Review Construction Management Representative (CMR) Daily report if applicable and reconcile any differences prior to posting.

D. Test Reports

1. Test reports shall be completed by person performing test.
2. Submit Daily Test Information Sheets with Quality Control Daily Reports.
3. Submit failing test results and proposed remedial actions within four hours of noted deficiency.
4. Submit three copies of complete test results no later than one calendar day after test was performed.

E. Accessibility Inspection Report:

1. Fill out applicable sections of the Accessibility Inspection Report and attach to Contractor Quality Control Daily Report.
2. Utilize attached Accessibility Inspection form to document compliance with Architectural Barriers Act Accessibility Standards (ABAAS).
3. Inspect at various stages of construction as needed to ensure finished product meets standards.
4. Submit report no later than one calendar day after inspection was performed.

F. Off-Site Inspection Reports: Submit prior to shipment.

G. If Contractor Quality Control plan and Quality Control Daily Reports are not submitted as specified, Contracting Officer may retain payments until such time plan(s) is/are accepted and implemented, or may retain payments for work completed on days with no Quality Control Daily Reports.

H. Permits, Licenses, and Certificates: For National Park Service (NPS) records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of work.

1.5 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Contractors Quality Control Staff:

1. Contractor's Quality Control Supervisor may also perform other duties.
2. Contractor's Quality Control Supervisor shall be assigned no other duties.
3. Contractor's designated Quality Control Supervisor shall be on the project site whenever contract work is in progress.
4. Contractor's job supervisory staff may be used to assist Quality Control Supervisor supplemented, as necessary, by additional certified testing technicians.

C. Installer Qualifications: Firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent indicated for Project, whose work has resulted in construction with a record of successful in-service performance.

D. Manufacturer Qualifications: Firm experienced in manufacturing products or systems similar to those indicated for Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Fabricator Qualifications: Firm experienced in producing products similar to those indicated for Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

F. Professional Engineer Qualifications: Professional engineer legally qualified to practice in jurisdiction where Project is located and is experienced in providing engineering services of kind indicated (including Structural Tests and Special Inspections (STSI)). Engineering services are defined as those performed for installations of system, assembly, or products similar to those indicated for Project in material, design, and extent.

G. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for activities indicated.

1. Requirement for specialists shall not supersede building codes and regulations governing Work.

H. Testing Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL), a National Voluntary Laboratory Accreditation Program (NVLAP), or an independent agency with experience and capability to conduct testing and inspecting indicated, according to ASTM E 329; and with additional qualifications specified in individual Sections; and where required by Contract, is acceptable to Contracting Officer.

1. Nationally Recognized Testing Laboratory (NRTL): Nationally recognized testing laboratory according to 29 CFR 1910.7 (Code of Federal Regulations).
2. National Voluntary Laboratory Accreditation Program (NVLAP): Testing agency accredited according to National Institute of Standards and Technology's (NIST) National Voluntary Laboratory Accreditation Program.
3. Measuring devices, laboratory equipment, and instruments shall be calibrated at established intervals against certified standards in accordance with NIST requirements. Measuring and testing devices shall be made available for use by Government for verification tests.

I. Factory-Authorized Service Representative Qualifications: Authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products similar in material, design, and extent to those indicated for Project.

J. Mockups: Before installing portions of work requiring mockups, build mockups for each form of construction and finish required to comply with following requirements, using materials indicated for completed work:

1. Build mockups in location and of size indicated; if not indicated, as directed by Contracting Officer.
2. Notify Contracting Officer **seven** days in advance of dates and times when mockups will be constructed.
3. Demonstrate proposed range of aesthetic effects and workmanship.
4. Obtain Contracting Officer's approval of mockups before starting work, fabrication, or construction.
5. Maintain mockups in an undisturbed condition as a standard for judging the completed work.
6. Demolish and remove mockups when directed, unless otherwise indicated.

K. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 2 through 49.

1.6 QUALITY CONTROL

A. Contractor is responsible for testing and inspections, including Structural Tests and Special Inspections (STSI), as identified in attached STSI. Inspect and test work as needed to ensure quality of materials, workmanship, construction, finish, and functional performance are in compliance with applicable specifications, drawings, and those required by the Building Code.

1. Engage qualified testing agency to perform quality-control services.
2. Submit appropriate report for each quality-control service.
3. Testing and inspecting requested by Contractor and not required by Contract Documents are Contractor's responsibility.
4. Contracting Officer may designate test locations.

B. Manufacturer's Field Services: Where indicated, engage factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

C. Re-testing/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction of replaced work that failed to comply with Contract Documents.

D. Testing Agency Responsibilities: Cooperate with NPS and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Contracting Officer and Contractor promptly of irregularities or deficiencies observed in work during performance of services.
2. Determine location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections, State in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit 3 copies of certified written report of each test, inspection, and similar quality-control service through Contractor.

5. Do not release, revoke, alter, or increase Contract Document requirements or approve or accept any portion of Work.

E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide:

1. Access to Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for material mixes that require control by testing agency.
7. Security and protection for samples and testing and inspecting equipment at Project site.

F. Coordination: Coordinate sequence of activities to accommodate required quality assurance and control services with minimum delay and to avoid removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS

2.1 QUALITY CONTROL PLAN

A. Quality Control Plan shall include:

1. List of personnel responsible for quality control and assigned duties. Include each person's qualifications. Include alternate(s) and qualifications.
2. Copy of letter of direction to Contractor's Quality Control Supervisor(s) outlining assigned duties and authorities designated by principal or owner.
3. Names, qualifications / accreditations, and descriptions of laboratories to perform sampling and testing, and samples of proposed report forms from laboratories.
4. Methods of performing, documenting, and enforcing quality control of work including Contractor report forms and acknowledgment of NPS forms.
5. Methods of monitoring and controlling environmental pollution and contamination as required by regulations and laws.
6. Specific discussion regarding mockups, off-site visits, receiving inspections, manufacturers representation, startup requirements, and other aspects of performance specific to Project.
7. Provisions for substantial completion(s) and final inspection(s) per Contract.

PART 3 - EXECUTION

3.1 OFF-SITE CONTROL

A. Items fabricated or assembled off-site shall be inspected for quality control at place of fabrication.

3.2 ON-SITE CONTROL

A. Notification:

1. Notify Contracting Officer at least 48 hours in advance of preparatory phase meeting.
2. Notify Contracting Officer at least 24 hours in advance of initial and follow-up phases.

B. Preparatory Phase: Perform before beginning each feature of work.

1. Review control submittal requirements with personnel directly responsible for quality assurance and quantity control of the work. As a minimum, Contractor's Quality Control Supervisor and foreman responsible for feature of work shall be in attendance.
2. Review applicable specifications sections and drawings related to feature of work.
3. Ensure copies of referenced standards related to sampling, testing, and execution for feature of work are available on site.
4. Ensure provisions have been made for field control testing.
5. Examine work area to ensure preliminary work has been completed.
6. Verify field dimensions and advise Contracting Officer of discrepancies with contract documents.
7. Ensure necessary equipment and materials are at project site and they comply with approved shop drawings and submittals.
8. Document preparatory phase activities and discussions on Contractor's Quality Control Daily Report.

C. Initial Phase:

1. As soon as work begins, inspect and test representative portion of particular feature of work for quality of workmanship.
2. Review control testing procedures to ensure compliance with contract requirements.
3. Document initial phase activities and discussions on Contractor's Quality Control Daily Report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

D. Follow-Up Phase: Inspect and test as work progresses to ensure compliance with contract requirements until completion of work.

E. Additional Preparatory and Initial Phases: Additional preparatory and initial phases may be required on same feature of work for following reasons:

1. Quality of on-going work is unacceptable.
2. Changes in quality control staff, on-site production supervision, or work crew.
3. Work on particular feature of work is resumed after substantial period of inactivity.

3.3 DOCUMENTATION

A. Maintain Quality Control Daily Reports, Daily Test Report Information Sheets, and Accessibility Inspection Reports of quality control activities and tests. (Download from DSC Workflows website > Forms/Templates/Samples/Guidelines page > Construction Forms section.)

B. Quality Control Daily Reports shall not be substituted for other written reports required under clauses of contract, such as Disputes, Differing Site Conditions, or Changes.

C. Quality Control Daily Reports shall accurately portray all work and materials. The materials shall match the materials as approved from the Construction Documents (CD) requirements. Combustible/flammable materials shall be documented as well.

3.4 ENFORCEMENT

A. Contractor shall stop work on any item or feature pending satisfactory correction of deficiency noted by quality control staff or Contracting Officer.

3.5 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams as invisible as possible.
2. Comply with Contract Document requirements for Section 01 73 29 "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 42 00 – REFERENCE STANDARDS

PART 1 - GENERAL

1.1 ENVIRONMENTAL DEFINITIONS

A. Definitions pertaining to sustainable development: As defined in ASTM E2114 and as specified herein.

B. Biobased Materials: As defined in the Farm Security and Rural Investment Act, for purposes of Federal procurement of biobased products, "biobased" means a "commercial or industrial product (other than food or feed) that is composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials." Biobased materials also include fuels, chemicals, building materials, or electric power or heat produced from biomass as defined by The Biomass Research and Development Act of 2000.

1. Biobased content: Amount of biobased carbon in the material or product as a percentage of weight (mass) of total organic carbon in the material or product.

C. Chain-of-Custody: Process whereby a product or material is maintained under physical possession or control during its entire life cycle.

D. Deconstruction: Disassembly of buildings for purpose of recovering materials.

E. DFE (Design for the Environment): A technique that includes elements of resource conservation and pollution prevention as applied in various product sectors. A technique that incorporates approaches which are part of product (or assembly) concept, need and design. Considerations involve material selection, material and energy efficiency, reuse, maintainability and design for disassembly and recyclability. Refer to International Organization for Standardization (ISO) Guide 64 for additional clarification.

F. Environmentally preferable products: Products and services that have a lesser or reduced effect on the environment in comparison to conventional products and services. Refer to EPA's Final Guidance on Environmentally Preferable Purchasing Program.

G. Non-Renewable Resource: A resource that exists in a fixed amount that cannot be replenished on a human time scale. Non-renewable resources have potential for renewal only by geological, physical, and chemical processes taking place over of millions of years. Examples include iron ore, coal, and oil.

H. Perpetual Resource: A resource that is virtually inexhaustible on a human time scale. Examples include solar energy, tidal energy, and wind energy.

I. Recycled Content Materials: Products that contain pre-consumer or post-consumer materials as all or part of their feedstock. Recycled content claim shall be consistent Federal Trade Commission (FTC) Guide for Use of Environmental Marketing Claims.

J. Renewable Resource: A resource that is grown, naturally replenished, or cleansed, at a rate which exceeds depletion of the usable supply of that resource. A renewable resource can be exhausted if improperly managed. However, a renewable resource can last indefinitely with proper stewardship. Examples include trees in forests, grasses in grasslands, and fertile soil.

1.2 QUALITY ASSURANCE

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into Contract Documents to the extent referenced. Such standards are made a part of Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of Contract Documents, unless otherwise indicated.

C. Conflicting Requirements: Where compliance with two or more standards is specified, and standards may establish different or conflicting requirements for minimum quantities or quality levels, comply with most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Contracting Officer (CO) for decision before proceeding.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless Contract Documents include more stringent requirements, applicable construction industry standards have same force and effect as if bound or copied directly into Contract Documents to the extent referenced. Such standards are made a part of Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities found in Section 01 42 00 Sources for Reference Publications, Unified Facilities Guide Specifications (UFGS) (accessible via Masters website > Downloads section > click on UFGS Master (WBDG Website).

Names, telephone numbers, and websites are subject to change and are believed to be accurate and up-to-date as of date of Contract Documents.

XX	EXAMPLE Association (The) www.EXAMPLE.org	

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in following list. Names, telephone numbers, and websites are subject to change and are believed to be accurate and up-to-date as of date of Contract Documents.

DIN	Deutsches Institut fur Normung e.V. www.din.de	49 30 2601-3003
IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICC	International Code Council www.iccsafe.org	(888) 422-7233
ICC-ES	ICC Evaluation Service, Inc. icc-es.org	(800) 423-6587 (562) 699-0543

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in following list. Names, and websites are subject to change and are believed to be accurate and up-to-date as of date of Contract Documents.

ABA & ABAAS United States Access Board	Architectural Barriers Act (ABA) Architectural Barriers Act Accessibility Standards (ABAAS) www.access-board.gov
CoE	Army Corps of Engineers www.usace.army.mil
CPSC	Consumer Product Safety Commission www.cpsc.gov
DOC	Department of Commerce www.commerce.gov
DOD	Department of Defense www.defense.gov
DOJ	Department of Justice www.justice.gov

DOE	Department of Energy www.energy.gov
EPA	Environmental Protection Agency www.epa.gov
FAA	Federal Aviation Administration www.faa.gov
FCC	Federal Communications Commission www.fcc.gov
FDA	Food and Drug Administration www.fda.gov
GSA	General Services Administration www.gsa.gov
HUD	Department of Housing and Urban Development www.hud.gov
LBL	Lawrence Berkeley National Laboratory www.lbl.gov
NCHRP	National Cooperative Highway Research Program (See TRB (Transportation Resource Board))
NIST	National Institute of Standards and Technology www.nist.gov
OSHA	Occupational Safety & Health Administration www.osha.gov
PHS	U.S. Department of Health and Human Services www.hhs.gov
RUS	Rural Utilities Service (See USDA (Department of Agriculture))
SD	State Department www.state.gov
TRB	Transportation Research Board www.nationalacademies.org/trb/transportation-research-board
USDA	Department of Agriculture www.usda.gov
USP	U.S. Pharmacopeia www.usp.org

USPS	Postal Service www.usps.com

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in following list. Names, telephone numbers, and websites are subject to change and are believed to be accurate and up-to-date as of date of Contract Documents.

ABAAS	Architectural Barriers Act Accessibility Standards www.access-board.gov
CFR	Code of Federal Regulations Available from Government Printing Office www.govinfo.gov/app/collection/cfr
DOD	Department of Defense Military Specifications and Standards Available from Department of Defense Single Stock Point www.dsp.dla.mil/Specs-Standards/
DSCC	Defense Supply Center Columbus (See FS (Federal Specification))
FED-STD	Federal Standard (See FS (Federal Specification))
FS	Federal Specification Available from Department of Defense Single Stock Point www.dsp.dla.mil/Specs-Standards/ Available from General Services Administration www.gsa.gov Available from National Institute of Building Sciences www.nibs.org
FTMS	Federal Test Method Standard (See FS (Federal Specification))
MIL	(See MILSPEC (Military Specification and Standards))
MIL-STD	(See MILSPEC (Military Specification and Standards))
MILSPEC	Military Specification and Standards Available from Department of Defense Single Stock Point www.dsp.dla.mil/Specs-Standards/
UFAS	Uniform Federal Accessibility Standards Available from Access Board www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-aba-standards/ufas *(UFAS is **only** for housing projects per Fair Housing Act. See also the Fair Housing Act Design Manual, www.huduser.gov/portal/publications/destech/fairhousing)*

1.5 ENVIRONMENTAL REFERENCE STANDARDS

A. American Forest and Paper Association:

1. Sustainable Forestry Initiative

B. American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE):
- **ASHRAE 52.2,** *Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size*
- **ASHRAE 55,** *Thermal Environmental Conditions for Human Occupancy*
- **ASHRAE 62.1,** *Ventilation for Acceptable Indoor Air Quality*
- **ASHRAE 62.2,** *Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings*
- **ASHRAE/IESNA 90.1,** *Energy Standard for Buildings, Except Low-Rise Residential Buildings*
- **ASHRAE 90.2,** *Energy Efficient Design of Low-Rise Residential Buildings*

C. American Association of State Highway and Transportation Officials (AASHTO):
- M288 Geotextile Specification for Highway Applications
- **MP009-06 Standard Specification for Compost for Erosion/Sediment Control (Filter Berms and Filter Socks)**
- **MP010-03 Standard Specification for Compost for Erosion/Sediment Control (Compost Blankets)**

D. American Society for Testing and Materials International (ASTM):
- A478 Standard Specification for Chromium-Nickel Stainless Steel Weaving and Knitting Wire
- A580/A580M Standard Specification for Stainless Steel Wire
- A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- B813 Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
- C1240 Standard Specification for Silica Fume Used in Cementitious Mixtures
- C128 Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
- C131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- C1319 Standard Specification for Concrete Grid Paving Units
- C1338 Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings
- C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- C1371 Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers
- C1386 Standard Specification for Precast Autoclaved AERATED Concrete (PAAC) Wall Construction Units
- C1483 Standard Specification for Exterior Solar Radiation Control Coatings on Buildings
- C1549 Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer

- C1601 Standard Test Method for Field Determination of Water Penetration of Masonry Wall Surfaces
- C289 Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)
- C311 Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete
- C33 Standard Specification for Concrete Aggregates
- C593 Standard Specification for Fly Ash and Other Pozzolans for Use With Lime
- C595 Standard Specification for Blended Hydraulic Cements
- C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
- C67 Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
- C739 Standard Specification for Cellulosic Fiber (Wood-Base) Loose-Fill Thermal Insulation
- C936 Standard Specification for Interlocking Concrete Paver Units
- C989 Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
- D1435 Standard Practice for Outdoor Weathering of Plastics
- D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 foot pound force per cubic foot (ft-lbf/ft3) (2,700 kilonewton meter per cubic meter (kN-m/m3))
- D1972 Standard Practice for Generic Marking of Plastic Products
- D198 Standard Test Methods of Static Tests of Lumber in Structural Sizes
- D2103 Standard Specification for Polyethylene Film and Sheeting
- D217 Standard Test Methods for Cone Penetration of Lubricating Grease
- D2369 Standard Test Method for Volatile Content of Coatings
- D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
- D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
- D3792 Standard Test Method for Water Content of Coatings by Direct Injection Into a Gas Chromatograph
- D3864 Standard Guide for Continual On-Line Monitoring Systems for Water Analysis
- D3960 Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
- D4017 Standard Test Method for Water in Paints and Paint Materials by Karl Fischer Method
- D4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
- D4444 Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters
- D4491 Standard Test Methods for Water Permeability of Geotextiles by Permittivity
- D4552 Standard Practice for Classifying Hot-Mix Recycling Agents
- D4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- D4716 Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
- D4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Product
- D4840 Standard Guide for Sampling Chain-of-Custody Procedures

- D4887 Standard Test Method for Preparation of Viscosity Blends for Hot Recycled Bituminous Materials
- D5106 Standard Specification for Steel Slag Aggregates for Bituminous Paving Mixtures
- D5116 Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products
- D5199 Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
- D5261 Standard Test Method for Measuring Mass per Unit Area of Geotextiles
- D5268 Standard Specification for Topsoil Used for Landscaping Purposes
- D5359 Standard Specification for Glass Cullet Recovered from Waste for Use in Manufacture of Glass Fiber
- D5505 Standard Practice for Classifying Emulsified Recycling Agents
- D5509 Standard Practice for Exposing Plastics to a Simulated Compost Environment
- D5512 Standard Practice for Exposing Plastics to a Simulated Compost Environment Using an Externally Heated Reactor
- D5539 Standard Specification for Seed Starter Mix
- D5957 Standard Guide for Flood Testing Horizontal Waterproofing Installations
- D5603 Standard Classification for Rubber Compounding Materials—Recycled Vulcanizate Particulate Rubber
- D5663 Standard Guide for Validating Recycled Content in Packaging Paper and Paperboard
- D5759 Standard Guide for Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
- D5792 Standard Practice for Generation of Environmental Data Related to Waste Management Activities: Development of Data Quality Objectives
- D5834 Standard Guide for Source Reduction Reuse, Recycling, and Disposal of Solid and Corrugated Fiberboard (Cardboard)
- D5851 Standard Guide for Planning and Implementing a Water Monitoring Program
- D5852 Standard Test Method for Erodibility Determination of Soil in the Field or in the Laboratory by the Jet Index Method
- D6002 Standard Guide for Assessing the Compostability of Environmentally Degradable Plastics
- D6006 Standard Guide for Assessing Biodegradability of Hydraulic Fluid
- D6007 Standard Test Method for Determining Formaldehyde Concentration in Air from Wood Products Using a Small Scale Chamber
- D6046 Standard Classification of Hydraulic Fluids for Environmental Impact
- D6081 Standard Practice for Aquatic Toxicity Testing of Lubricants: Sample Preparation and Results Interpretation
- D6108 Standard Test Method for Compressive Properties of Plastic Lumber and Shapes
- D6109 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastic Lumber
- D6112 Standard Test Methods for Compressive and Flexural creep and Creep-Rupture of Plastic Lumber and Shapes
- D6117 Standard Test Methods for Mechanical Fasteners In Plastic Lumber and Shapes
- D6155 Standard Specification for Nontraditional Coarse Aggregates for Bituminous Paving Mixtures
- D6245 Standard Guide for Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation
- D6261 Standard Specification for Extruded and Compression Molded Basic Shapes Made from Thermoplastic Polyester (TPES)

- D6262 Standard Specification for Extruded, Compression Molded, and Injection Molded Basic Shapes of Poly(aryl ether ketone) (PAEK)
- D6270 Standard Practice for Use of Scrap Tires in Civil Engineering Applications
- D6329 Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers
- D6330 Standard Practice for Determination of Volatile Organic Compounds (Excluding Formaldehyde) Emissions from Wood-Based Panels Using Small Environmental Chambers Under Defined Test Conditions
- D6345 Standard Guide for Selection of Methods for Active, Integrative Sampling of Volatile Organic Compounds in Air
- D6400 Standard Specification for Compostable Plastics
- D6435 Standard Test Method for Shear Properties of Plastic Lumber and Plastic Lumber Shapes
- D6629 Standard Guide for Selection of Methods for Estimating Soil Loss by Erosion
- D6662 Standard Specification for Polyolefin-Based Plastic Lumber Decking Boards
- D6712 Standard Specification for Ultra-High-Molecular-Weight Polyethylene (UHMW-PE) Solid Plastic Shapes
- D6886 Standard Test Method for Speciation of the Volatile Organic Compounds (VOCs) in Low VOC Content Waterborne Air-Dry Coatings by Gas Chromatography
- D692 Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures
- D696 Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C With a Vitreous Silica Dilatometer
- D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))
- D7186 Standard Practice for Quality Assurance Observation of Roof Construction and Repair
- E1021 Standard Test Methods for Measuring Spectral Response of Photovoltaic Cells
- E1038 Standard Test Method for Determining Resistance of Photovoltaic Modules to Hail by Impact with Propelled Ice Balls
- E1039 Standard Test Method for Calibration of Silicon Non-Concentrator Photovoltaic Primary Reference Cells Under Global Irradiation
- E1040 Standard Specification for Physical Characteristics of Nonconcentrator Terrestrial Photovoltaic Reference Cells
- E1105 Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference
- E1171 Standard Test Method for Photovoltaic Modules in Cyclic Temperature and Humidity Environments
- E1333 Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Under Defined Test Conditions Using a Large Chamber
- E1362 Standard Test Method for Calibration of Non-Concentrator Photovoltaic Secondary Reference Cells
- E1433 Standard Guide for Selection of Standards on Environmental Acoustics
- E1462 Standard Test Methods for Insulation Integrity and Ground Path Continuity of Photovoltaic Modules
- E1596 Standard Test Methods for Solar Radiation Weathering of Photovoltaic Modules
- E1597 Standard Test Method for Saltwater Pressure Immersion and Temperature Testing of Photovoltaic Modules for Marine Environments

- E1609 Standard Guide for Development and Implementation of a Pollution Prevention Program
- E1686 Standard Guide for Selection of Environmental Noise Measurements and Criteria
- E1690 Standard Test Method for Determination of Ethanol Extractives in Biomass
- E1721 Standard Test Method for Determination of Acid-Insoluble Residue in Biomass
- E1755 Standard Test Method for Ash in Biomass
- E1758 Standard Test Method for Determination of Carbohydrates in Biomass by High Performance Liquid Chromatography
- E1780 Standard Guide for Measuring Outdoor Sound Received from a Nearby Fixed Source
- E1799 Standard Practice for Visual Inspections of Photovoltaic Modules
- E1802 Standard Test Methods for Wet Insulation Integrity Testing of Photovoltaic Modules
- E1821 Standard Test Method for Determination of Carbohydrates in Biomass by Gas Chromatography
- E1827 Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door
- E1830 Standard Test Methods for Determining Mechanical Integrity of Photovoltaic Modules
- E1861 Standard Guide for Use of Coal Combustion By-Products in Structural Fills
- E1918 Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field
- E1971 Standard Guide for Stewardship for the Cleaning of Commercial and Institutional Buildings
- E1980 Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces
- E1991 Standard Guide for Environmental Life Cycle Assessment of Building Materials/Products
- E2047 Standard Test Method for Wet Insulation Integrity Testing of Photovoltaic Arrays
- E2114 Standard Terminology for Sustainability Relative to the Performance of Buildings
- E2128 Standard Guide for Evaluating Water Leakage of Building Walls
- E2129 Standard Practice for Data Collection for Sustainability Assessment of Building Products
- E2397 Standard Practice for Determination of Dead Loads and Live Loads associated with Green Roof Systems
- E2398 Standard Test Method for Water Capture and Media Retention of Geocomposite Drain Layers for Green Roof Systems
- E2399 Standard Test Method for Maximum Media Density for Dead Load Analysis of Green Roof Systems
- E2400 Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems
- E241 Standard Guide for Limiting Water-Induced Damage to Buildings
- E2432 Standard Guide for General Principles of Sustainability Relative to Buildings
- E408 Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques
- E413 Standard Classification for Rating Sound Insulation
- E477 Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers

- E648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
- E683 Standard Practice for Installation and Service of Solar Space Heating Systems for One- and Two-Family Dwellings
- E779 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
- E781 Standard Practice for Evaluating Absorptive Solar Receiver Materials When Exposed to Conditions Simulating Stagnation in Solar Collectors With Cover Plates
- E782 Standard Practice for Exposure of Cover Materials for Solar Collectors to Natural Weathering Under Conditions Simulating Operational Mode
- E823 Standard Practice for Nonoperational Exposure and Inspection of a Solar Collector
- E881 Standard Practice for Exposure of Solar Collector Cover Materials to Natural Weathering Under Conditions Simulating Stagnation Mode
- E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
- E903 Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres
- E948 Standard Test Method for Electrical Performance of Photovoltaic Cells Using Reference Cells Under Simulated Sunlight
- F1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
- F2034 Standard Specification for Sheet Linoleum Floor Covering
- F2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

E. Bat Conservation International:
- Bat Approved Bat Houses

F. Carpet and Rug Institute
- Green Label & Green Label Plus Testing Programs, carpet-rug.org/testing/green-label-plus

G. Center for Resource Solutions
- Green-e program

H. Environmental Protection Agency (EPA):
- **Comprehensive Procurement Guidelines**
- **ENERGY STAR**
- **Environmentally Preferable Purchasing Program Final Guidance**
- **GreenScapes program**
- **Heat Island Initiative**
- **Indoor Air Quality Building Education and Assessment Model (I-BEAM)**
- **National Environmental Performance Track**
- **Pollution Prevention (P2)**
- **Product Stewardship Program**
- **Significant New Alternatives Policy (SNAP) Program**

I. Federal Trade Commission:
- **Guide for the Use of Environmental Marketing Claims**

J. Forest Stewardship Council:
- **Chain-Of-Custody**
- **Forest Management**

K. Green Building Initiative (GBI):
- **Green Globes - US**

L. Green Seal:
- **GC-03 Anti-Corrosive Paints**
- **GC-12 Occupancy Sensors**
- **GC-13 Split-Ductless Air-Source Heat Pumps**
- **GS-05 Compact Fluorescent Lamps**
- **GS-11 Paints**
- **GS-13 Windows**
- **GS-14 Window Films**
- **GS-31 Electric Chillers**
- **GS-32 Photovoltaic Modules**
- **GS-36 Commercial Adhesives**
- **GS-37 Industrial & Institutional Cleaners**

M. International Iron and Steel Institute:
- **CO2 Breakthrough Program**

N. International Organization of Standardization:
- **Guide 64; Guide for Inclusion of Environmental Aspects in Product Standards**
- **9660 Information processing -- Volume and file structure of CD-ROM for information interchange**
- **14001 Environmental management systems – Specification with guidance for use**
- **14004 Environmental Management Systems – General Guidelines on Principles, Systems and Supporting Techniques**
- **14020 Environmental labels and declarations – General principles**
- **14024 Environmental labels and declarations – Type I environmental labelling - Principles and procedures**
- **14040 Environmental management – Life cycle assessment – Principles and framework**

O. National Association of Home Builders:
- **Advanced Framing Techniques: Optimum Value Engineering**

P. National Institute of Building Sciences:
- **MOIST program for transfer of heat and moisture**
- **Whole Building Design Guide**

Q. National Institute of Standards and Technology:
- **BEES (Building for Environmental and Economic Sustainability) Lifecycle Decision Support Tool**

R. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
- **IAQ Guidelines for Occupied Buildings Under Construction**

S. Southcoast Air Quality Management District:
- **1168 Adhesive And Sealant Applications**

T. US Composting Council:
- Seal of Testing Assurance Program

U. US Department of Agriculture:
- **Biobased Products – Definitions and Descriptions**

V. US Green Building Council:
- **LEED™ 2009 Green Building Rating System**
- **LEED™ v4 (version 4) Green Building Rating System**

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

SECTION 01 57 19.12 – NOISE AND ACCOUSTICS MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Special requirements for noise and acoustics management during **construction** operations.

1.2 DEFINITIONS

A. Ambient noise level: The total noise associated with a given environment, being usually a composite of normal or existing sounds from all sources near and far, excluding the noise source at issue.

B. Daytime: The hours from 7 A.M. to 9 P.M. on weekdays and 9 A.M. to 9 P.M. on weekends and holidays.

C. Nighttime: All non-daytime hours.

D. Property line: The real or imaginary line along the ground surface and its vertical extension, which separates real property owned or controlled by one person from contiguous real property owned or controlled by another person or from any public right-of-way or from any public space.

E. Receiving noise area: Any real property where people live or work and where noise is heard, excluding the project or source area.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 NOISE MANGEMENT

A. Noise Control: Perform **construction** operations to minimize noise. Perform noise-producing work in less sensitive hours of the day or week as directed by the Contracting Officer CO).

B. Repetitive and/or intermittent, high-level noise: Permitted only during Daytime.

1. Do not exceed the following dB(A) limitations at 50 feet:

Sound Level in dB(A)	Time Duration of Impact Noise
70	More than 12 minutes in any hour
80	More than 3 minutes in any hour

2. Maximum permissible construction equipment noise levels at 50 feet:

EARTHMOVING	dB(A)	MATERIALS HANDLING	dB(A)
Front Loaders	75	Concrete Mixers	75
Backhoes	75	Concrete Pumps	75
Dozers	75	Cranes	75
Tractors	75	Derricks Impact	75
Scrapers	80	Pile Drivers	95
Graders	75	Jack Hammers	75
Trucks	75	Rock Drills	80
Pavers, Stationary	80	Pneumatic Tools	80
Pumps	75	Saws	75
Generators	75	Vibrators	75
Compressors	75		

C. Ambient Noise:

1. Maximum noise levels (dB (decibel)) for receiving noise area at property line shall be as follows:

a. Residential receiving area
Daytime: 65 dB
Nighttime: 45 dB

b. Commercial/Industrial receiving area
Daytime: 67 dB
Nighttime: 65 dB

c. In the event the existing local ambient noise level exceeds the maximum allowable receiving noise level (dB), the receiving noise level maximum for construction operations shall be adjusted as follows:

d. Residential receiving area: Maximum 3 additional dB above the local ambient as measured at property line.

e. Commercial/Industrial receiving area: Maximum 5 additional dB above the local ambient as measured at the property line.

3.2 FIELD QUALITY CONTROL

A. Assess potential effects of construction noise on **adjacent neighbors** in accordance with ASTM E1686 and as follows:

1. Ambient noise measurement: Measure at property line at a height of at least four (4) feet above the immediate surrounding surface. Average the ambient noise level over a period of at least 15 minutes.
2. Ambient noise measurement at urban sites: Conduct during morning peak traffic hour between 7 A.M. and 9 A.M. and afternoon peak traffic hour between 4 P.M. and 6 P.M. In addition, conduct a 24-hour measurement at the proposed project site to document the noise pattern throughout the day. Adjust and weight for seasonal and climatic variations.

B. Monitor noise produced from construction operations in accordance with ASTM E1780.

END OF SECTION 01 57 19.12

SECTION 01 57 23 - POLLUTION PREVENTION

PART 1 - GENERAL

1.1 SUMMARY

A. Federal Regulations for controlling discharges of pollutants (including chemicals, erodible material, and trash) from municipal separate storm sewer systems, construction sites, and industrial activities, were brought under the National Pollution Discharge Elimination System (NPDES) permit process by amendments to the Clean Water Act (CWA), and promulgation of federal stormwater regulations issued by the United States Environmental Protection Agency (USEPA). The USEPA uses amount of ground disturbance as a measure of a project potential to generate pollution from erosion. NPDES Phase I regulates discharges from construction sites that disturb 5 acres or more. NPDES Phase II regulations expand existing General Permit requirements under Phase I to include/regulated discharges from construction sites that disturb land equal to or greater than one (1) acre and less than 5 acres, known as Small Construction Activity. Construction disturbances 1 acre and above typically require a formal NPDES permit and a formal Stormwater Pollution Prevention Plan (SWPPP) must be submitted to Agency(ies) with Jurisdiction for review and approval.

B. National Park Service (NPS) Standards and Guidelines require water quality be protected to ensure compliance with Organic Act. Contractor shall adhere to the approved NPDES permit and approved Erosion and Sedimentation Control Plans as approved by Pike County Pennsylvania.

C. The work of this section consists of implementing measures to prevent discharges of pollutants, including temporary storm water pollution during construction activities through compliance with the approved NPDES permit.

D. Work of this section consists of implementing measures to Temporary Storm Water Pollution during construction activities through compliance with the approved NPDES permit.

1.2 DEFINITIONS

A. Definitions pertaining to sustainable development: As defined in ASTM E2114.

B. Environmental Pollution and Damage: The presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances; or degrade utility of the environment for aesthetic, cultural, or historical purposes.

C. National Pollution Discharge Elimination System (NPDES) Phase I: Regulates discharges from construction sites that disturb 5 acres or more.

D. NPDES Phase II: Regulations expand existing General Permit requirements under Phase I to include and regulate discharges from construction sites that disturb land equal to or greater than one (1) acre and less than 5 acres, known as Small Construction Activity.

E. Storm Water Pollution Prevention Plan (SWPPP): Developed and implemented stormwater management measures to protect surface water from pollutants during construction activities

disturbing an acre or more in compliance with federal, state, and local requirements for permit approval under NPDES program.

F. UPPP: Developed and implemented pollution prevention plan (including stormwater management measures, if needed) to protect environment from pollutants on construction projects with less than one acre of disturbance in conformance with NPS guidelines.

1.3 SUBMITTALS

A. Inspection Schedule: Submit schedule for inspection and monitoring of pollution prevention measures.

B. Inspection Schedule: Submit schedule for inspection and monitoring of storm water pollution prevention measures.

C. Erosion Control Products: Submit manufacturer's product information and installation recommendations for silt fence, filter fabric, erosion control blanket, straw bales, and other materials proposed for use on this project.

1.4 QUALITY ASSURANCE

A. Contractor shall prepare and submit a plan to Contracting Officer (CO) for review and concurrence.

B. Orientation Meeting: Contractor shall arrange and conduct an Erosion and Sediment Control meeting/briefing to inform parties, scheduled to be on-site during project, of measures to be implemented for proper erosion and sediment control (may be included as part of Pre-Construction Meeting).

1. Installation of silt fences, storm drain protection, and other forms of erosion and sediment control shall not begin until after this meeting has occurred.

C. Orientation Meeting: Contractor shall be responsible for arranging and conducting Pollution Prevention meeting/briefing to inform parties scheduled to be on-site during project of measures to be implemented for proper pollution prevention and control (may be included as part of Pre-Construction Meeting).

1. Installation of silt fences, storm drain protection, and other forms of pollution prevention controls shall not begin until after this meeting has occurred.

D. Pollution Prevention Manager: Contractor shall designate Pollution Prevention Manager who will be responsible for implementation, inspection, maintenance, and amendments to approved plan.

1. Pollution Prevention Manager shall be familiar with UPPP procedures and Best Management Practices (BMPs) and shall ensure emergency procedures and plan are updated as needed and available for inspection.

2. When changes in approved plan are required, Pollution Prevention Manager shall prepare and certify an amendment and submit to Contracting Officer for review and concurrence.

E. Pollution Prevention and Erosion Control Manager: Contractor shall designate Pollution Prevention and Erosion Control Manager responsible for implementation, inspection, maintenance, and amendments to approved plan.

1. Pollution Prevention and Erosion Control Manager shall be familiar with temporary storm water pollution prevention procedures and Best Management Practices and ensure emergency procedures and plan are updated as needed and available for inspection.

2. When changes in approved plan are required, Pollution Prevention and Erosion Control Manager shall prepare and certify an amendment and submit to Contracting Officer for review and concurrence.

PART 2 - PRODUCTS

2.1 TEMPORARY STORM WATER POLLUTION PREVENTION PLAN

A. Contractor shall adhere to approved SWPPP and NPDEA plans and specifications as approved by Pike County, Pennsylvania

B. Contractor shall provide the following at or before the Orientation Meeting:
1. Maintenance and inspection procedures and forms.
2. Description of potential non-storm water discharges at site, if any.
3. Contractor and Sub-contractor Certification forms.
4. Other record keeping forms and procedures.
5. Housekeeping Best Management Practices, including vehicle wash-down areas, protection of equipment storage and maintenance areas, and sweeping of roadways related to hauling activities.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL PROTECTION

A. Protection of Natural Resources: Comply with applicable regulations and these specifications. Preserve natural resources within project boundaries and outside limits of work performed under this Contract in their existing condition or restore to an equivalent or improved condition as

approved by Contracting Officer.

B. Construction Zone: Arrange construction activities to minimize pollution (i.e., erosion, trash, etc.) to maximum practical extent.

1. Clearing, excavation, and grading shall be limited to those areas of project site necessary for construction. Minimize area exposed and unprotected.
2. Clearly mark and delineate limits of work activities.
3. Equipment shall not be allowed to operate outside limits of work or to disturb existing vegetation.
4. Excavation and grading shall be completed during dry season to maximum extent possible.
5. Material shall be stored away from locations where water is present to greatest extent practicable.

3.2 REGULATORY REQUIREMENTS

A. Permits: Contractor shall operate in compliance with the approved NPDES permit.

1. Implement requirements of NPDES permit for erosion control due to storm water runoff during construction.
2. Implement good housekeeping practices, inspections and record keeping.
3. Prior to construction, Contractor and Subcontractors shall sign certifications that they understand requirements of NPDES permit.
4. Subcontractors shall comply with requirements of NPDES under supervision of Contractor.

B. Contracting Officer Notification: Contractor shall notify Contracting Officer in writing and by telephone of these events:

1. Erosion and sediment control meeting/briefing.
2. Following installation of required sediment control structures.
3. Prior to removal of or modification to sediment control structures.
4. Prior to removal of sediment control structures.

3.3 SITE INSPECTIONS AND PLAN REVISIONS

A. Inspections: Contractor and Contracting Officer will perform a weekly inspection onsite.

1. Inspection shall include disturbed areas not completely stabilized, areas used for storage of materials, locations where vehicles enter or exit site, and other erosion and sediment controls included in the Plan.
2. Inspections shall be documented.
3. Inspection forms shall be retained onsite in Plan notebook throughout construction period.

B. Plan Revisions: It may be necessary to revise Plan during construction to make necessary improvements, revisions, or to respond to unforeseen conditions noted during construction or site inspections.

1. Plan shall specify mechanism whereby revisions may be proposed by Contractor or Contracting Officer.

2. Contractor and Contracting Officer will jointly review each revision to Plan before changes incorporated and implemented. Contractor will then provide revised copy of Plan to Contracting Officer.
3. Accepted modifications will be implemented within 7 calendar days following date of inspection when deficiencies or necessary corrections are first noted.

C. Negligence: Provide additional temporary erosion and pollution controls made necessary by Contractor's errors or negligence at no additional cost to Government.

3.4 HOUSEKEEPING AND SITE MANAGEMENT

A. Store materials onsite in conformance to Federal, state, local, and manufacturer's regulations and specifications. Use Best Management Practices to minimize risk of materials coming into contact with environmental conditions (i.e. water and wind) that could disperse them.

B. Manage solid waste in conformance to Federal, state, and local regulations. Best Management Practices should be used to minimize risk of materials coming into contact with environmental conditions (i.e. water and wind) that could disperse them.

C. Include a spill prevention and control plan with provisions placed in SWPPP.

D. Manage hazardous waste (including contaminated soil) in conformance to Federal, state, local and NPS regulations and guidelines.

3.5 EROSION CONTROL MEASURES

A. Erosion control measures shall consist of Best Management Practices for storm water discharges, including, but not limited to, silt fencing, barrier protectors, , temporary soil retention blankets, excelsior drainage filters, sediment traps and berms.

B. Berms and excelsior drainage filters shall be used to form sediment traps and control run-on and run-off into other areas, including creeks, streams, marshes, access roads, well areas, and staging areas.

C. Erosion control measures shall be used to contain only direct precipitation in construction zone. Contained water shall be allowed to percolate into ground or drain slowly through drainage filter sediment traps.

D. Earthen sediment traps or holding ponds shall not be used unless accepted by Contracting Officer.

E. Reduce runoff velocity and direct surface runoff around and away from fuel containment, storage, and borrow areas.

F. Divert surface runoff around and away from cut and fill slopes.

G. Place drainage filters around catch basins to create sediment traps to control run-off from construction area.

H. Excess water used for dust control shall be contained within demolition areas by erosion control measures.

I. Contractor shall prevent deposition of materials onto paved areas. Contractor shall inspect paved areas for deposited materials weekly and remove materials immediately.

J. Furnish, install, maintain, and operate necessary control measures and other equipment necessary to prevent erosion as described in approved SWPPP.

K. Before work begins, sufficient equipment shall be available on site to assure operation and adequacy of erosion control system can be maintained.

3.6 MAINTENANCE OF TEMPORARY FACILITIES

A. Ensure erosion and sediment control structures remain effective throughout excavation and grading operations. Relocate structures as necessary.

B. Inspect control structures after each significant rainfall. Promptly repair breaches which occur.

C. Contractor shall remove entrapped sediment from behind excelsior drainage filter after each storm.

3.7 REPORTING

A. If a discharge occurs or if project receives written notice or order from regulatory agency, Contractor shall immediately notify Contracting Officer and shall file written report to Agency(ies) with Jurisdiction within 7 days of discharge event, notice, or order. Corrective measures shall be implemented immediately following discharge, notice, or order. The report to the Agency(ies) with Jurisdiction shall contain:

1. Date, time, location, nature of operation, and type of discharge, including cause or nature of notice or order.
2. Best Management Practices deployed before discharge event, or prior to receiving notice or order.
3. Date of deployment and type of Best Management Practices deployed after discharge event, or after receiving notice or order, including additional Best Management Practices installed or planned to reduce or prevent re-occurrence.
4. An implementation and maintenance schedule for affected Best Management Practices.

3.8 SEDIMENT DISPOSAL

A. Sediment excavated from temporary sediment control structures shall be disposed on site with general fill, or with topsoil. Sediment shall be allowed to dry out as required before reuse.

B. Contractor shall place sediment removed from traps and other structures where it will not enter a storm drain or watercourse and where it will not immediately reenter the basin.

3.9 REMOVAL OF TEMPORARY STORM WATER POLLUTION CONTROL MEASURES

A. Temporary control measures shall be removed with permission of Contracting Officer within 20 working days after final acceptance of project, and/or once grading is complete and slopes have stabilized.

END OF SECTION 01 57 23

SECTION 01 67 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and environmental requirements.

1.2 DEFINITIONS

A. Products: Items purchased for incorporating into Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number and other designation shown or listed in manufacturer's published product literature, current as of date of Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Approved Equals: Product demonstrated and approved through submittal process, or where indicated as a product substitution, to have indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Definitions pertaining to sustainable development: As defined in ASTM E2114.

C. Biobased Materials: As defined in Farm Security and Rural Investment Act, for purposes of Federal procurement of biobased products, "biobased" means a "commercial or industrial product (other than food or feed) composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials." Biobased materials also include fuels, chemicals, building materials, or electric power or heat produced from biomass as defined by The Biomass Research and Development Act of 2000.

1. Biobased content: Amount of biobased carbon in material or product as a percentage of weight (mass) of total organic carbon in material or product.

D. Chain-of-Custody: Process whereby a product or material is maintained under physical possession or control during its entire life cycle.

E. Environmentally preferable products: Products and services with lesser or reduced effect on the environment in comparison to conventional products and services. Refer to Environmental

Protection Agency's (EPA) Final Guidance on Environmentally Preferable Purchasing for more information.

F. Stewardship: Responsible use and management of resources in support of sustainability.

G. Sustainability: Maintenance of ecosystem components and functions for future generations.

1. Recycled Content Materials: Products containing pre-consumer or post-consumer materials as all or part of their feedstock. Recycled content claim shall be consistent with International Organization for Standardization (ISO) 140001 Standard for the Use of Environmental Marketing Claims.
2. Rapidly Renewable Material: Material made from plants typically harvested within a ten-year cycle.
3. Regional Materials: Materials manufactured and extracted, harvested, or recovered within a radius of 500 miles from Project location.

1.3 SUBMITTALS

A. Record Submittals as specified in – Sustainable Design Close-Out Documentation, submit:

1. Affirmative Procurement Reporting Form. Submit on form in Appendix A of this Section, or similar form as approved by Contracting Officer (CO).

Material Safety Data Sheets (MSDS): For each product required by OSHA to have a MSDS, submit an MSDS. MSDS shall be prepared **no earlier than June 2020**. Include information for MSDS Sections 1 to 16 in accordance with ANSI Z400.1 and as follows:

a. Section 1: Chemical Product and Company Identification
b. Section 2: Composition/Information on Ingredients
c. Section 3: Hazards Identification
d. Section 4: First Aid Measures
e. Section 5: Fire Fighting Measures
f. Section 6: Accidental Release Measures
g. Section 7: Handling and Storage
h. Section 8: Exposure Controls/Person Protection
i. Section 9: Physical and Chemical Properties
j. Section 10: Stability and Reactivity Data
k. Section 11: Toxicological Information. Include data used to determine the hazards cited in Section 3. Identify acute data, carcinogenicity, reproductive effects, and target organ effects. Provide written description of the process used in evaluating chemical hazards relative to preparation of the MSDS.
l. Section 12: Ecological Information. Include data regarding environmental impacts during raw materials acquisition, manufacture, and use. Include data regarding environmental impacts in event of accidental release.
m. Section 13: Disposal Considerations. Include data regarding proper disposal of the chemical. Include information regarding recycling and reuse. Indicate whether or not product is considered to be "hazardous waste" according to United States EPA Hazardous Waste Regulations 40 CFR 261 (Code of Federal Regulations).
n. Section 14: Transportation Information. Identify hazard class for shipping.
o. Section 15: Regulatory Information. Identify federal, state, and local regulations applicable to the material.
p. Section 16: Other Information. Include additional information relative to recycled

content, biobased content, and other information regarding environmental and health impacts. Identify the date MSDS was prepared**.**

4. Chain of Custody: Submit chain-of-custody documentation for sustainable forestry for these products:

    a. Rough Carpentry
    b. Finish Carpentry
    c. Wood Doors
    d. Windows
    e. Wood Flooring
    f. Furnishings & Accessories

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in undamaged condition; in manufacturer's original sealed container or other packaging system; complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with Contract Documents. Ensure products are undamaged and properly protected.
5. Obtain materials in biodegradable or recyclable/reusable packaging which uses minimum amount of packaging possible.

C. Storage:

1. Allow for inspection and measurement of quantity or counting of units.
2. Store materials in manner to not endanger Project structure.
3. Store products subject to damage by the elements, under cover in weather tight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

8. Store loose granular materials in well-drained area on solid surfaces to prevent mixing with foreign matter.

1.6 PACKAGING

A. Where Contractor has option to provide one of listed products or equal, preference shall be given to products with minimal packaging and easily recyclable packaging as defined in ASTM D5834.

B. Maximize use of source reduction and recycling procedures outlined in ASTM D5834.

C. Provide minimum **45** percent post-consumer recycled content and minimum 100 percent recovered fiber content of industrial paperboard in accordance with EPA's Comprehensive Procurement Guidelines and ASTM D5663.

D. Provide minimum **10** percent post-consumer recycled content and minimum **100** percent recovered fiber content of carrier board in accordance with EPA's Comprehensive Procurement Guidelines and ASTM D5663.

E. Provide minimum **5** percent post-consumer recycled content and minimum **5** percent recovered fiber content of brown papers (e.g., wrapping papers and bags) in accordance with EPA's Comprehensive Procurement Guidelines and ASTM D5663.

1.7 ENVIRONMENTALLY PREFERABLE PRODUCTS

A. Provide environmentally preferable products to greatest extent possible.

1. To greatest extent possible, provide products and materials with a lesser or reduced effect on the environment considering raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, and/or disposal of the product.
2. Eliminate use of ozone depleting compounds during and after construction where alternative environmentally preferable products are available, consistent with either Montreal Protocol and Title VI or Clean Air Act Amendments of 1990, or equivalent overall air quality benefits that take into account life cycle impacts.
3. Use products meeting or exceeding EPA's recycled content recommendations for EPA-designated products. Use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 10% (based on cost) of total value of the materials in project.

1.8 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of Contract Documents.

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for product specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by or incorporated into Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare written document containing appropriate terms and identification, ready for execution. Submit draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with Specifications, prepare written document using appropriate form properly executed.
3. Refer to Divisions 2 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 01 77 00 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products to comply with Contract Documents, undamaged and, unless otherwise indicated, new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types produced and used successfully in similar situations on other projects.
3. Government reserves right to limit selection to products with warranties not in conflict with requirements of Contract Documents.
4. Where products are accompanied by term "as selected," Contracting Officer will make selection.
5. Where products are accompanied by term "match sample," sample to be matched is Governments.
6. Descriptive, performance, and reference standard requirements in Specifications establish "salient characteristics" of products.

B. Product Selection Procedures:

1. Product: Where Specifications name single product and manufacturer, provide named product that complies with requirements or approved equal.
2. Manufacturer/Source: Where Specifications name single manufacturer or source, provide product by named manufacturer or source that complies with requirements or approved equal.
3. Products: Where Specifications include list of names of both products and manufacturers, provide one of the products listed that complies with requirements or approved equal.
4. Manufacturers: Where Specifications include list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements or approved equal.
5. Available Products: Where Specifications include list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Products" Articles for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies

with requirements. Comply with provisions in Part 2 "Products" Articles for consideration of an unnamed product.

7. Product Options: Where Specifications indicate sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide specified product, system, or approved equal.
8. Visual Matching Specification: Where Specifications require matching an established Sample, select product that complies with requirements and matches Architect's sample. Contracting Officers decision will be final on whether a proposed product matches.
    a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
9. Visual Selection Specification: Where Specifications include phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
    a. Standard Range: Where Specifications include phrase "standard range of colors, patterns, textures" or similar phrase, Contracting Officer will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
    b. Full Range: Where Specifications include phrase "full range of colors, patterns, textures" or similar phrase, Contracting Officer will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 APPROVED EQUAL PRODUCTS

A. Conditions: Contracting Officer will consider Contractor's request when the following conditions are satisfied. If following conditions are not satisfied, Contracting Officer will return requests without action, except to record noncompliance with these requirements:

1. Evidence proposed product does not require revisions to Contract Documents, that it is consistent with Contract Documents and will produce indicated results and is compatible with other portions of Work.
2. Detailed comparison of significant qualities of proposed product with those named in Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION

3.1 PROTECTION AFTER INSTALLATION

A. Provide adequate coverings as necessary to protect installed materials from damage resulting from natural elements, traffic, and subsequent construction. Remove when no longer needed.

END OF SECTION 01 67 00

AFFIRMATIVE PROCUREMENT REPORTING FORM
Recycled Content Materials & Biobased Content Materials

Project Name: Safety and Pavement Improvememts to Route 209

Project Number: PMIS 310424 Contractor Name: _____

License Number: _____ Contractor Address: _____

_____

Product	Total $ value provided	Total $ value with recycled content Pre-consumer	Total $ value with recycled content Post-consumer	Total $ value with biobased content	Exempted indicate 1,2,3,4	Comments
Compost						
Parking Stops (Concrete w/ fly ash, slag cement or low cement content)						
Parking Stops (Plastic/Rubber)						
Concrete with fly ash						
Concrete with slag cement						
Concrete with low cement content						
High Fly Ash Flowable Fills						
Traffic cones made from PVC, LDPE, crumb Rubber						
Traffic Barricades (Type I and II only) made from HDPE, LDPE, PET, steel, fiberglass						
Channelizers, Plastic						
Channelizers, rubber base						
Delineators, plastic						
Delineators, rubber base						
Delineators, Steel base						
Flexible plastic delineators						
HDPE Pipe						
Recycled Asphalt						

Pavement						
Plastic Sign Posts and Supports						
Steel Sign Posts and Supports						
Guide Rail						
Other						

CERTIFICATION

I hereby certify the information provided herein is accurate and that the requisition/procurement of all materials listed on this form comply with current EPA standards for recycled/recovered materials content. The following exemptions may apply to the non-procurement of recycled/recovered content materials:

1. The product does not meet appropriate performance standards.
2. The product is not available within a reasonable time frame.
3. The product is not available competitively (from two or more sources).
4. The product is only available at an unreasonable price (compared with a comparable non-recycled content product.)

Signature: _____ Date: _____

END OF
AFFIRMATIVE PROCUREMENT REPORTING FORM
Recycled Content Materials & Biobased Content Materials

SECTION 01 73 40 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general procedural requirements governing execution of Work including:

1. Coordination with utility service providers
2. Construction layout
3. Field engineering and surveying
4. General installation of products
5. Progress cleaning
6. Starting and adjusting
7. Protection of installed construction
8. Correction of the Work

1.2 SUBMITTALS

A. Certificates: Submit certificate signed by land surveyor certifying location and elevation of improvements comply with requirements.

B. Landfill Receipts: Submit copy of receipts issued by landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

C. Certified Surveys: Submit two copies signed by land surveyor.

D. Quantity Surveys: Submit 2 copies showing quantities of work performed and actual construction completed in place.

1.3 QUALITY ASSURANCE

A. Land Surveyor Qualifications: Professional land surveyor legally qualified to practice in jurisdiction where Project is located and-is experienced in providing land-surveying services of kind indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: Existence and location of site improvements and other construction indicated as existing are not guaranteed.

1. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

2. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: Existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify existence and location of underground utilities and other construction affecting Work.

1. Before construction, verify location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Field Measurements: Take field measurements as required to fit Work properly. Recheck measurements before installing each product. Where portions of Work are indicated fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying Work.

B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

C. Review of Contract Documents and Field Conditions: Immediately on discovery of need for clarification of the Contract Documents caused by differing field conditions outside control of

Contractor, submit request for information to Contracting Officer in accordance with Section 01 31 00 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Verify layout information shown on Drawings, in relation to the existing benchmarks before proceeding to lay out Work. Notify Contracting Officer promptly if discrepancies are discovered.

B. General: Engage a land surveyor to lay out Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines of construction and elsewhere as needed to locate each element of Project.
2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
3. Inform installers of lines and levels to which they must comply.
4. Check location, level and plumb, of every major element as Work progresses.
5. Notify Contracting Officer when deviations from required lines and levels exceed allowable tolerances.
6. Close site surveys with an error of closure equal to or less than the established standard.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make log available for review by National Park Service (NPS).

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning Work. Preserve and protect permanent benchmarks and control points during construction operations. Controls destroyed by Contractor will be replaced by Contractor at their expense.

1. Existing Monuments: All benchmarks, land corners, and triangulation points, established by other surveys, existing within construction area shall be preserved. If existing monuments interfere with Work, secure written permission before removing them.

B. Benchmarks: Establish and maintain a minimum of **two** permanent benchmarks on Project site, referenced to data established by survey control points. Comply with NPS requirements for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.5 INSTALLATION

A. General: Locate Work and components of Work accurately in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions for best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of Work.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Contracting Officer.
2. Allow for building movement, thermal expansion, and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors to be embedded in concrete or masonry. Deliver to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials not considered hazardous.

J. Quantity surveys: Shall be conducted, and data derived from these surveys shall be used in computing quantities of work performed and actual construction completed and in place.

1. Contractor shall conduct original and final surveys and surveys for any periods for which progress payments are requested. These surveys shall be conducted under direction of a representative of the Contracting Officer, unless Contracting Officer waives requirement in a specific instance. Government shall make such computations as are necessary to determine quantities of work performed or finally in place. Contractor shall make computations based on surveys for any periods for which progress payments are requested.
2. Promptly upon completing a survey, Contractor shall furnish originals of field notes and other records relating to survey or layout of Work to Contracting Officer. Contractor shall retain copies of all such material furnished to Contracting Officer.

3.6 PROGRESS CLEANING

A. General: Clean Project site, work areas, and common areas daily. Coordinate progress cleaning for joint-use areas where more than one Installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in National Fire Protection Association (NFPA) 241 for removal of combustible waste materials and debris at the end of every work session.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 degrees Fahrenheit (27 degrees Celsius).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to level of cleanliness necessary for proper execution of Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of Work, broom-clean or vacuum entire work area, as appropriate.
3. Contractor shall provide progress cleaning that minimizes sources of food, water, and harborage available to pests.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials not hazardous to health or property and will not damage exposed surfaces.

1. Utilize non-toxic cleaning materials and methods.

a. Comply with Green Seal Standard (GS) 37 for general purpose cleaning and bathroom cleaning.
b. Use natural cleaning materials where feasible. Natural cleaning materials include:

1) Abrasive cleaners: substitute 1/2 lemon dipped in borax.
2) Ammonia: substitute vinegar, salt and water mixture, or baking soda and water.
3) Disinfectants: substitute 1/2 cup borax in gallon water.

4) Drain cleaners: substitute 1/4 cup baking soda and 1/4 cup vinegar in boiling water.
5) Upholstery cleaners: substitute dry cornstarch.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

H. Clean and protect construction in progress and adjoining materials already in place during handling and installation. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations so that no part of construction completed or in progress, is subject to harmful, dangerous, damaging, or deleterious exposure during construction period.

K. Final Cleaning: At completion of Work, remove remaining waste materials, rubbish, tools, equipment, machinery and surplus materials. Clean exposed surfaces and leave Project clean and ready for occupancy.

1. Provide final cleaning in accordance with ASTM E1971.

3.7 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to specified condition.

C. Remove and replace damaged surfaces exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 40

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

1.2 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Solid Waste: Garbage, debris, sludge, or other discharged material (except hazardous waste) including solid, liquid, semisolid, or contained gaseous materials resulting from domestic, industrial, commercial, mining, or agricultural operations.

D. Debris: Non-hazardous solid waste generated during construction, demolition, or renovation of a structure which exceeds 2.5 inch (60 millimeter) particle size that is: a manufactured object; plant or animal matter; or natural geologic material (e.g. cobbles and boulders). A mixture of debris and other material such as soil or sludge is also subject to regulation as debris if mixture is comprised primarily of debris by volume, based on visual inspection.

E. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

F. Environmental Pollution and Damage: Presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances; or degrade utility of environment for aesthetic, cultural, or historical purposes.

G. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

H. Hazardous Materials: Material regulated as a hazardous material in accordance with 49 CFR 173 (Code of Federal Regulations), requires a Material Safety Data Sheet (MSDS) in accordance with 29 CFR 1910.1200, or which during end use, treatment, handling, storage, transportation or

disposal meets or has components which meet or have potential to meet the definition of Hazardous Waste in accordance with 40 CFR 261.

I. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

J. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

K. Single-use plastic products: Plastic items intended to be disposed of immediately after use, including plastic and polystyrene food and beverage containers, bottles, straws, cups, cutlery, and disposable plastic bags.

1.3 PERFORMANCE REQUIREMENTS

A. General: Project shall minimize creation of construction, deconstruction, and demolition waste to protect and restore natural habitat and resources. Minimize factors contributing to waste such as over packaging, improper storage, ordering error, poor planning, breakage, mishandling, single-use plastic products, and contamination. A Waste Management Plan shall be developed to ensure that existing site and building materials are reused, salvaged, or recycled. Minimize waste disposal in landfills.

B. Salvage /Recycle Requirements: Develop waste management plan resulting in end-of-Project rates for salvage/recycling of **50** percent by weight of total waste generated by the Work. The following waste categories, at a minimum, shall be diverted from a landfill:

1. Land clearing debris (chipped debris can be used on site for mulch or erosion control)
2. Clean dimensional wood, palettes
3. Plywood, OSB (oriented strand board), and particle board
4. Concrete (can be ground and used for fill on site)
5. Asphaltic concrete (can be ground and used for fill on site)
6. Cardboard, paper, packaging, newsprint
7. Metals (from banding, stud trim, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze)
8. Gypsum drywall - unpainted
9. Non-hazardous paint and paint cans
10. Beverage containers: Aluminum, glass, and plastic containers
11. Insulation
12. Ceiling grid and tiles
13. Ductwork
14. Wiring
15. Other mixed construction and demolition waste as appropriate.

C. If waste materials encountered during deconstruction/demolition or construction phase are found to contain lead, asbestos, polychlorinated biphenyls (PCBs), (such as fluorescent lamp ballasts), or other harmful substances, they are to be handled and removed in accordance with local, state, and federal laws and requirements concerning hazardous waste.

D. Existing items and material to be removed during deconstruction/demolition phase shall be reused in construction phase of the Project. Items that cannot be reused shall be recycled. Items

considered for reuse must be in refurbishable condition and must meet quality standards set forth in these specifications. Contractor shall ensure quality of the item(s) in question will meet or exceed accepted industry or trade standards for first quality commercial grade application. During construction, deconstruction, or demolition Contracting Officer (CO) may designate other objects or materials for reuse.

1.4 Salvage/Recycle Requirements: Government goal is to salvage and recycle as much nonhazardous demolition and construction waste as possible. SUBMITTALS

A. Waste Management Plan: After award of contract and prior to scheduled Pre-Construction Conference, Contractor shall submit a draft Waste Management Plan to Contracting Officer for approval. Submit [**3**] copies of plan. Revise and resubmit Plan as required by Contracting Officer. Approval of Contractor's Plan will not relieve Contractor of responsibility for compliance with applicable environmental regulations.

B. Progress Documentation: Supplemental to Waste Management Plan, document solid waste disposal, diversion, and cost/revenue analysis and submit completed worksheet on a monthly basis. See Project Waste Management Plan Worksheet Sample, attached to the end of the Division 1 Specifications, and report totals to date for column headings.

C. Waste Reduction Calculations: Before request for Substantial Completion, submit [**three**] copies of calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

D. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

F. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

H. Qualification Data: For [Waste Management Coordinator] [and] [refrigerant recovery technician].

I. Progress payment requirements:

1. With each Application for payment, submit an updated Project Waste Management Plan worksheet for solid waste disposal and diversion.
2. With each Application for Payment, submit manifests, weight tickets, receipts, and invoices specifically identifying the Project and waste material.

J. Closeout Submittals

1. With Closeout Submittals, submit a summary of a Project Waste Management Plan worksheet for solid waste disposal and diversion.

1.5 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, with record of successful waste management coordination of projects with similar requirements, that employs a LEED™-Accredited Professional, certified by USGBC, as waste management coordinator.

B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Waste Management Meeting: Conduct separate meeting or cover in Pre-Construction Conference and comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to waste management including:

1. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review procedures for reduction of single-use plastic products on site.
6. Review waste management requirements for each trade.

PART 2 - PRODUCTS

2.1 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste identification and waste reduction work plan. Indicate quantities by weight or volume but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of **demolition**, **site-clearing and construction** waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials salvaged and reused in Project, describe methods for preparing salvaged materials before incorporation into the Work.

2. Salvaged Materials for Sale: For materials sold to individuals and organizations, include list of names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials donated to individuals and organizations, include list of names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.
7. Reduction of single-use plastic products: Include methods for water distribution to include bottle refilling stations if available for personnel.

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include:

1. Landfill tip fees per ton.
2. If diverted, tip fee savings from landfill diversion.
3. Costs of recycling, salvage, or reuse.
4. Revenue from recycling, salvage, or reuse.
5. Total cost or savings from diversion. (Calculate by using tip fee savings and subtracting costs of recycling or adding revenue from recycling.)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by Contracting Officer. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during entire duration of Contract.

B. Waste Management Coordinator: Engage waste management coordinator responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

C. Contractor shall establish contacts with local recycling and reuse companies to set up lines of responsibility. Contractor shall be responsible for coordination in terms of identifying materials, pickup schedules, and standard quality for recycled materials.

D. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute waste management plan to everyone concerned within **three** days of submittal return.
2. Distribute waste management plan to entities when they begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

E. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

F. Separation facilities:

1. Contractor shall designate and Contracting Officer shall approve specific area or areas to facilitate separation of materials for potential reuse, salvage, recycling, and return.
2. Place waste and recycling bins near each other, and close to point of waste generation but out of traffic pattern.
3. Keep recycling and waste bin areas neat, clean, and clearly marked in order to avoid co-mingling of materials.
4. Protect bins during non-working hours from off-site contamination.
5. Check garbage dumpsters periodically for recyclables being thrown away and undocumented materials that could be recycled.

G. Materials handling procedures: Material to be recycled shall be protected from contamination and shall be handled, stored, and transported in a manner that meets requirements set by designated facilities for acceptance. Establish defined area for operations of each trade, especially woodcutting so off-cuts are kept in one area and can be sorted by dimension for future reuse.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for **Sale and Donation**: **Not permitted** on Project site.

C. Salvaged Items for Governments Use:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Allow for inspection if necessary.
4. Store items in secure area until delivery to Government.
5. Transport items to storage area **on-site**.
6. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Receivers and Processors: List below is provided for information only; available recycling receivers and processors will be established at construction kick-off meeting.

C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be the responsibility Contractor.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to maximum extent practical.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off ground and protect from weather.
5. Remove recyclable waste off Government property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Asphaltic Concrete Paving: Grind asphalt to maximum 1-1/2 inch (38 millimeter) size.

B. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility.

1. Crush asphaltic concrete paving and screen to comply with requirements in Division 31 Section "Earth Moving".

C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 4 inch (100 millimeter) size.

D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Pulverize masonry to maximum 4 inch (100 millimeter) size.
2. Clean and stack undamaged, whole masonry units on wood pallets.

E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

F. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Site-Clearing Wastes: Chip brush, branches, and trees at landfill facility.

C. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust not containing painted or treated wood.

D. Gypsum Board: Stack large clean pieces on wood pallets and store in dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose in landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials to accumulate on-site.
2. Remove and transport debris in manner preventing spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Burning: Burning of waste materials allowed only at designated areas on Government property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

D. Disposal: Transport waste materials off Government property and legally dispose of them.

END OF SECTION 01 74 19

Project Waste Management Plan Worksheet Sample

National Park Service (NPS) - Denver Service Center (DSC) | 10-13-21

	A	B	C	D	E	F	G	H	I	J
Material	**Quantity Recycled (in tons)**	**Quantity Salvaged or Reused (in tons)**	**A + B = Total Quantity Diverted from Landfill**	**Quantity to Landfill (in tons)**	**C + D = Total Quantity Generated (in tons)**	**Tip Fee/Ton at Landfill**	**C x F = Tip Fee Savings resulting from Landfill Diversion**	**Cost of Recycling (R), Salvage (S), or Reuse (Re)** (Specify R, S, or Re)	**Revenue from Recycling (R), Salvage (S), or Reuse (Re)** (Specify R, S, or Re)	**G - H + I = Total Cost (-) or Savings (+) from Diversion**
Asphalt/Concrete										
Brick/Masonry/Tile										
Building Materials (doors, windows, fixtures, shingles, lumber, insulation, sheet goods, etc.)										
Carpet										
Carpet Padding, Foam Only										
Cardboard										
Ceiling Tile										
Drywall										
Glass										
Scrap Metal Aluminum										
Copper										
Steel										
Unpainted Wood & Pallets										
Yard Trimmings, Brush, Trees, Stumps, etc.										
Garbage/Trash										
Other										
Column Totals										
	Total Quantity Recycled	Total Quantity Reused or Salvaged	Total Quantity Diverted from Landfill	Total Quantity to Landfill	Total Quantity Generated		Tip Fee Savings from Diversion	Total Cost of Recycling, Salvage, or Reuse	Revenue from Recycling, Salvage, or Reuse	Total Cost (-) or Savings (+) from Diversion

Percentage Diverted = _____ (C divided by E from Column Totals). Should meet 60% diversion goal.

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including:

1. Project Record Drawings
2. Closeout Submittals
3. Substantial Completion and Final Inspection
4. Permit Closure and Transfer
5. Final Acceptance of the Work
6. Warranties

1.2 PROJECT RECORD DRAWINGS

A. Maintain one complete full-size set of contract drawings and one full-size set of vendor-supplied drawings. Clearly mark changes, deletions, and additions using National Park Service (NPS) drafting standards to show actual construction conditions. Show additions in red, deletions in green and special instructions in blue.

B. Keep record drawings current. Make record drawings available to Contracting Officer (CO) for inspection at the time of monthly progress payment requests. If project record drawings are not current, Contracting Officer may retain an appropriate amount of progress payment.

C. Submit complete record drawings on completion of total project. Include shop drawings, sketches, and additional drawings to be included in final set, with clear instructions showing the location of these drawings.

1.3 CLOSEOUT SUBMITTALS

A. A list of closeout requirements has been attached at the end of the Division 1 Specifications for your convenience. The intent is to provide an overall summary of requirements and not a comprehensive list. Terms and conditions of the contract require satisfaction of requirements of individual specification sections regardless of what is shown on the list. Submit the following before requesting final inspection:

1. Specific warranties, guarantees, workmanship bonds, final certifications, and similar documents.
2. NPS required forms for occupancy, Fire Sprinkler/Alarm acceptance, and other similar forms or certificates.
3. Project Record Documents, operation and maintenance manuals, final completion construction digital images recorded on CD-R (compact disc-recordable) or DVD-R

(digital video disc-recordable) with index and descriptions, and similar final record information.

4. Terminate and remove temporary facilities, mockups, construction tools, and similar elements from Project site, complete final cleaning requirements, including touchup painting.
5. Touch up and repair and restore marred exposed finishes to eliminate visual defects.

1.4 FINAL INSPECTION, SUBSTANTIAL COMPLETION AND ACCEPTANCE PROCEDURES

A. Request final inspection in writing when project or designated portion of project is substantially complete. Contracting Officer will proceed with inspection within 10 days of receipt of written request or will advise Contractor of items that prevent project from being substantially complete.

B. If work is determined substantially complete, following final inspection, Contracting Officer will prepare Punch List and issue a Letter of Substantial Completion.

C. If work is not determined substantially complete following final inspection, Contracting Officer will notify Contractor in writing. Contractor shall request new final inspection after completing work. Re-inspection costs may be charged against Contractor in accordance with Inspection of Construction contract clause.

D. Contractor shall complete Punch List within 30 calendar days, documented weather permitting.

E. If Contractor completes items of work on Punch List and contractually required items, Contracting Officer will issue Letter of final acceptance of work.

F. If Contractor fails to complete work within the time frame, Contracting Officer may correct work with an appropriate reduction in contract price or charge for re-inspection costs in accordance with Inspection of Construction contract clause.

1.5 PERMIT CLOSURE AND TRANSFER

A. When work covered by the permits is complete, create list of tasks required to close or transfer permits to Park. Submit to Contracting Officer for approval.

B. After substantial completion and Punch List completion, permits shall be closed and documented by Agency(ies) with Jurisdiction for the permit.

C. If responsibility for permits is to be transferred to Park, Park shall be informed of permit provisions completed and responsibilities transferring to Park staff.

1.6 WARRANTIES

A. Submittal Time: Submit written warranties on request of Contracting Officer for designated portions of Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Organize warranty documents into an orderly sequence based on table of contents of Project Manual.

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2 by 11 inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify product or installation. Provide typed description of product or installation, including name of product and name, address, and telephone number of Installer.
3. Identify each binder on front and spine with typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF (portable document format) file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

C. Provide additional copies of each warranty in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. See Division 1 Specification Section "Execution" for information on cleaning agents.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Conduct final cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.

e. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
f. Remove labels that are not permanent.
g. Touch up, repair, and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
h. Leave Project clean and ready for occupancy.

C. Pest Control: Engage experienced, licensed exterminator to make a final inspection and rid project of rodents, insects, and other pests. Provide Government with report.

D. Waste Disposal: Comply with requirements of Section 01 74 19 "Construction Waste Management and Disposal."

END OF SECTION 01 77 00

Closeout and Operation & Maintenance (O&M) Requirements **Template**

National Park Service (NPS) - Denver Service Center (DSC) | 1-27-21

Topic	Specification Section	Requirement	Submittal Date	Completed	Received by Park
Project Record Drawings					
System Demonstration and Training					
Tools Spare Parts Equipment					
Extra Stock					
Reports					
Keys & Keying Schedule					
O&M Data Warranties Guarantees					

SECTION 01 90 00 – ACCEPTANCE OF WORK

PART 1 - GENERAL

1.1 CONFORMITY WITH CONTRACT

A. 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 work according to the contract requirements. 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 stricter.

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.

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 price. Four methods of determining conformity and accepting work are described in Subsections 1.2 to 1.4 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 and replace work that does not conform to the contract, or to prevailing industry standards where no specific contract requirements are noted, at no cost to the Government.

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.

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.

1.2 VISUAL INSPECTION

A. Acceptance is based on visual inspection of the work for compliance with the contract and prevailing industry standards.

1.3 CERTIFICATION

A. For material manufactured off-site, use a manufacturer with an ISO 9000 certification or an effective testing and inspection system. Require the manufacturer to clearly mark the material or packaging with a unique product identification or specification standard to which it is produced.

Material accepted by certification may be sampled and tested at any time. If found not in conformance with the contract, the material will be rejected whether in place or not.

One of the following certifications may be required:

1. Production certification. Material requiring a production certification is identified in the Acceptance Subsection of each Section. Require the manufacturer to furnish a production certification for each shipment of material. Include the following with each production certification:

    a) Date and place of manufacture;

    b) Lot number or other means of cross-referencing to the manufacturer's inspection and testing system; and

    c) Substantiating evidence that the material conforms to the contract quality requirements as required by FAR 46.105(a)(4), including:

        i. Test results on material from the same lot and documentation of the inspection and testing system;

        ii. A statement from the manufacturer that the material complies with all contract requirements; and

        iii. Manufacturer's signature or other means of demonstrating accountability for the certification.

2. Commercial certification. When a certification is required, but not a production certification, furnish one commercial certification for all similar material from the same manufacturer.

A commercial certification is a manufacturer's or Contractor's representation that the material complies with all contract requirements. The representation may be labels, catalog data, stamped specification standards, or supplier's certifications indicating the material is produced to a commercial standard or specification.

1.4 MEASURED OR TESTED CONFORMANCE

A. Provide all necessary production and processing of the work and control performance of the work so that all of the work complies with the contract requirements.

Results from inspection or testing shall have values within the specified tolerances or specification limits. When no tolerance values are identified in the contract, the work will be accepted based on customary manufacturing and construction tolerances.

1.5 PARTIAL AND FINAL ACCEPTANCE

A. Maintain the work during construction and until the project is accepted. Damage caused by the Contractor prior to final acceptance of the entire project will be repaired at the Contractor's expense. See FAR Clause 52.236-11 Use and Possession Prior to Completion.

1. Partial acceptance. When a separate portion of the project is completed, a final inspection of that portion may be requested. If the portion is complete and in compliance with the contract, it may be accepted. If accepted, the CO will relieve the Contractor of further responsibility for maintenance of the completed portion. Partial acceptance does not void or alter any of the terms of the contract.

   When public traffic is accommodated through construction and begins using sections of roadway as they are completed, continue maintenance of such sections until final acceptance.

2. Final acceptance. When notified that the entire project is complete, an inspection will be scheduled. If all work is determined to be complete, the inspection will constitute the final inspection and the Contractor will be notified in writing of final acceptance as of the date of the final inspection. Final acceptance relieves the Contractor of further responsibility for the maintenance of the project.

   If the inspection discloses any unsatisfactory work, the CO will provide to the Contractor a list of the work that is incomplete or requires correction. Immediately complete or correct the work. Furnish notification when the work has been completed as provided above.

END OF SECTION 01 90 00.

SECTION 02 41 13 – SELECTIVE SITE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Work under this section consists of salvaging, removing, and disposing or transporting of pavements, culverts, utilities, guardrail (including historic concrete posts) and other obstructions.

B. Measurement Procedures
   1. Items under this specification shall be measured for units in place.

C. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work.

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials

1. AASHTO M 145 - Standard Specification for Classification of Soils and Soil–Aggregate Mixtures for Highway Construction Purposes
2. AASHTO T 310 - Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)
3. AASHTO T 99 - Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

B. FAR - Federal Acquisition Regulations

1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

PART 2 – MATERIALS

2.1 MATERIALS

A. Backfill Material. Furnish a well-graded, compactable material free of excess moisture, muck, frozen lumps, roots, sod, or other deleterious material conforming to the following:

1. For all structures and pipes other than plastic pipe:
   a. Maximum particle size — 3 inches
   b. Soil classification, AASHTO M 145 — A-1, A-2, or A-3
2. For plastic pipe:
   a. Maximum particle size — 1½ inches
   b. Soil classification, AASHTO M 145 — A-1, A-2-4, A-2-5,or A-3

PART 3 – EXECUTION

3.1 PREPARATION

A. Salvaging Material:
   1. Salvage, with reasonable care, all material designated to be salvaged. Salvage in readily transportable sections or pieces. Replace or repair all members, pins, nuts, plates, and related hardware damaged, lost, or destroyed during the salvage operation. Wire all loose parts to adjacent members or pack them in sturdy boxes with the contents clearly marked. Match mark members of salvaged structures. Furnish one set of drawings identifying the members and their respective match marks.

   2. All concrete guardrail posts shall be delivered to the Dingmans Ferry Maintenance Facility. Concrete posts shall be stacked at a location and in a manner directed by a representative of the CO.

B. Removing Material
   1. Saw cut pavements when partial removal is required.

   2. Construct structurally adequate debris shields to contain debris within the construction limits. Do not permit debris to enter waterways, travel lanes open to public traffic, or areas designated not to be disturbed.

   3. Remove all pavements and other obstructions interfering with the work and not designated to remain.

   4. Except in excavation areas, backfill and compact cavities left by structure removal with backfill material to the level of the finished ground. Backfill excavated areas. Compact backfill.

   5. Backfill as follows:
      a. General. Place backfill in horizontal layers that, when compacted, do not exceed 6 inches in depth. Compact each layer according to Subsection 3.1.B.6.
         Bring backfill up evenly on all sides of the structure, and extend each layer to the limits of the excavation or to natural ground.
         Do not place backfill against concrete less than 7-days-old or until 80 percent of the design strength is achieved.
      b. Pipe culverts. Place and compact material in evenly balanced layers on each side of each pipe culvert. Backfill according to one of the following:
         i. Pipe culverts with compacted backfill. Place and compact backfill material to a height of 12 inches above the top of the pipe. Complete the backfilling of the trench with suitable roadway excavation or unclassified borrow.
            Place the material in layers that, when compacted, do not exceed 6 inches in thickness. Compact each layer according to Subsection 3.1.B.6.

   6. Compacting. Determine optimum moisture content and maximum density according to AASHTO T 99, method C. Adjust the moisture content of the backfill material to a moisture content suitable for compaction.

Compact material placed in all layers 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.

Do not apply density requirements as measured by AASHTO T 310 to material that is incapable of being tested or compacted to maximum values determined by AASHTO T 99. For these materials, fill the voids around the rock in each layer with earth or other fine material. Compact each layer, full width, until there is no visible evidence of further consolidation.

C. Disposing of Material

1. Dispose of debris and unsuitable and excess material as follows:
   a. Remove from project. Recycle or dispose of material legally off the project. Furnish a statement documenting the nature and quantity of material processed or sold for recycling. Otherwise, furnish a signed copy of the disposal agreement before disposal begins.
   b. Hazardous material. Furnish a copy of all disposal permits. Dispose of material according to Federal, State, and local regulations.

3.2 FINAL ACCEPTANCE

2. Removal of materials will be evaluated under this specification.

3. Backfilling and compacting cavities left by structures and concrete will be evaluated under Specification 31 00 00.

END OF SECTION 02 41 13.

SECTION 02 41 19 – REMOVAL OF OBSTRUCTIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of salvaging, removing, and disposing or transporting of pavements, culverts, utilities, guardrail (including historic concrete posts) and other obstructions.

B. Measurement Procedures
   1. Removal of structures and obstructions covered under this specification will be measured for by unit of installation.

C. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work described in this section.

1.2 REFERENCES
   A. AASHTO - American Association of State Highway and Transportation Officials
      1. AASHTO M 145 - Standard Specification for Classification of Soils and Soil–Aggregate Mixtures for Highway Construction Purposes
      2. AASHTO T 310 - Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)
      3. AASHTO T 99 - Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

   B. FAR - Federal Acquisition Regulations
      1. FAR 46.105 Contractor responsibilities
      2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
      3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL
   A. The Contractor shall submit the following information to the Contracting Officer's Representative for review before commencing work:
      1. All permits and notices authorizing site clearing and demolition.
      2. Certificates of utility service severances.
      3. Permits for transport and disposal of debris.
      4. Demolition procedures and operational sequence.

PART 2 – MATERIALS

2.1 MATERIALS

A. Backfill Material. Furnish a well-graded, compactable material free of excess moisture, muck, frozen lumps, roots, sod, or other deleterious material conforming to the following:

   1. For all structures and pipes other than plastic pipe:
      a. Maximum particle size 3 inches

b. Soil classification, AASHTO M 145 A-1, A-2, or A-3

2. For plastic pipe:
   a. Maximum particle size 1½ inches
   b. Soil classification, AASHTO M 145 A-1, A-2-4, A-2-5,or A-3

PART 3 – EXECUTION

3.1 PREPARATIONS

A. Salvaging Material:
   1. Salvage, with reasonable care, all material designated to be salvaged. Salvage in readily transportable sections or pieces. Replace or repair all members, pins, nuts, plates, and related hardware damaged, lost, or destroyed during the salvage operation. Wire all loose parts to adjacent members or pack them in sturdy boxes with the contents clearly marked. Match mark members of salvaged structures. Furnish one set of drawings identifying the members and their respective match marks.

   2. All concrete guardrail posts shall be delivered to the Dingmans Ferry Maintenance Facility. Concrete posts shall be stacked at a location and in a manner directed by a representative of the CO.

B. Removing Material
   1. Saw cut pavements when partial removal is required.

   2. Construct structurally adequate debris shields to contain debris within the construction limits. Do not permit debris to enter waterways, travel lanes open to public traffic, or areas designated not to be disturbed.

   3. Remove all pavements and other obstructions interfering with the work and not designated to remain.

   4. Except in excavation areas, backfill and compact cavities left by structure removal with backfill material to the level of the finished ground. Backfill excavated areas. Compact backfill.

   5. Backfill as follows:
      a. General. Place backfill in horizontal layers that, when compacted, do not exceed 6 inches in depth. Compact each layer according to Subsection 3.1.B.6.
         Bring backfill up evenly on all sides of the structure and extend each layer to the limits of the excavation or to natural ground.
         Do not place backfill against concrete less than 7-days-old or until 80 percent of the design strength is achieved.
      b. Pipe culverts. Place and compact material in evenly balanced layers on each side of each pipe culvert. Backfill according to one of the following:
         i. Pipe culverts with compacted backfill. Place and compact backfill material to a height of 12 inches above the top of the pipe. Complete the backfilling of the trench with suitable roadway excavation or unclassified borrow.
            Place the material in layers that, when compacted, do not exceed 6 inches in thickness. Compact each layer according to Subsection 3.1.B.6.

6. Compacting. Determine optimum moisture content and maximum density according to AASHTO T 99, method C. Adjust the moisture content of the backfill material to a moisture content suitable for compaction.

   Compact material placed in all layers 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.

   Do not apply density requirements as measured by AASHTO T 310 to material that is incapable of being tested or compacted to maximum values determined by AASHTO T 99. For these materials, fill the voids around the rock in each layer with earth or other fine material. Compact each layer, full width, until there is no visible evidence of further consolidation.

C. Disposing of Material
   1. Dispose of debris and unsuitable and excess material as follows:
      a. Remove from project. Recycle or dispose of material legally off the project. Furnish a statement documenting the nature and quantity of material processed or sold for recycling. Otherwise, furnish a signed copy of the disposal agreement before disposal begins.
      b. Hazardous material. Furnish a copy of all disposal permits. Dispose of material according to Federal, State, and local regulations.

3.2 ACCEPTANCE

2. Removal of materials will be evaluated under Subsection 02 41 19.2.

3. Backfilling and compacting cavities left by structures and concrete will be evaluated under Specification 31 00 00.

END OF SECTION 02 41 19.

SECTION 02 41 20 – STRUCTURE EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of excavating material for the construction of structures. The work includes excavating, preparing foundations, bedding, and backfilling.

B. Measurement Procedures
   1. Items under this specification shall be measured for units in place.

C. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work.

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials

   1. AASHTO M 145 - Standard Specification for Classification of Soils and Soil–Aggregate Mixtures for Highway Construction Purposes
   2. AASHTO T 310 - Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)
   3. AASHTO T 99 - Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
   4. AASHTO T 11 - Standard Method of Test for Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
   5. AASHTO T 27 - Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates

B. FAR - Federal Acquisition Regulations

   1. FAR 46.105 Contractor responsibilities
   2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
   3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTALS

A. The Contractor shall submit the following information to the Contracting Officer's Representative for review before commencing work:
   1. All permits and notices authorizing site clearing and demolition.
   2. Certificates of utility service severances.
   3. Permits for transport and disposal of debris.
   4. Demolition procedures and operational sequence.

PART 2 - MATERIALS

3.1 MATERIALS

A. Backfill Material. Furnish a well-graded, compactable material free of excess moisture, muck, frozen lumps, roots, sod, or other deleterious material conforming to the following:
   1. For all structures and pipes other than plastic pipe:
      a. Maximum particle size — 3 inches
      b. Soil classification, AASHTO M 145 — A-1, A-2, or A-3

   2. For plastic pipe:
      a. Maximum particle size — 1½ inches
      b. Soil classification, AASHTO M 145 — A-1, A-2-4, A-2-5, or A-3

B. Foundation Fill. Furnish granular material free of excess moisture, frozen lumps, roots, sod, or other deleterious material and conforming to the following:
   1. Maximum particle size — 2 inches
   2. Soil classification, AASHTO M 145 — A-1-a
   3. Material passing No. 200 sieve, AASHTO T 27 and T 11 — 6% max.

C. Bedding Material. Furnish material free of excess moisture, muck, frozen lumps, roots, sod, or other deleterious material conforming to the following:
   1. Maximum particle size — 1/2 inch or half the corrugation depth, whichever is smaller
   2. Soil classification, AASHTO M 145 — A-1, A-2-4, A-2-5, or A-3

D. Unclassified Borrow. Furnish granular material free of excess moisture, muck, frozen lumps, roots, sod, or other deleterious material conforming to the following:
   1. Maximum particle size — 24 inches
   2. Soil classification, AASHTO M 145 — A-1, A-3, or A-2-4

PART 3 - EXECUTION

3.1 PREPARATION

A. General
   1. Clear the area of vegetation and obstructions in accordance with Specification 31 11 00.

3.2 EXECUTION

A. General
   1. Excavate foundation pits to a width and length that allows room for work. When excavation is complete, request approval as to the character and suitability of the foundation material. The foundation shall provide a firm foundation of uniform density throughout its length and width.

      Follow OSHA safety regulations (29 CFR, Part 1926, Subpart P, Excavation) for sloping the sides of excavations, using shoring and bracing, and for using other safety features. Provide one copy of the design that demonstrates conformity with OSHA safety

regulations. Remove safety features when no longer necessary. Remove shoring and bracing to at least 2 feet below the surface of the finished ground.

Saw cut existing pavements or concrete structures adjacent to the area to be excavated that are designated to remain.

Conserve suitable material for backfill from excavated material. Do not deposit excavated material in or near a waterway. Do not stockpile excavated material or allow equipment closer than 2 feet from the edge of the excavation.

Dispose of unsuitable or excess material legally off the project. Shape and compact the waste material in its final location.

Remove all water necessary to perform work

B. Dewatering
   1. While placing concrete, locate and operate pumps outside the foundation form. If pumping is permitted from the interior of any foundation enclosure, pump in a manner to avoid removal or disturbance of concrete material.

C. Bedding
   1. Place bedding as follows:
      a. Construct bedding when required by the contract. Place and shape bedding material in compacted layers not exceeding 6 inches in depth. Compact each layer according to Subsection 3.1 E~~F~~.

D. Backfill
   1. Backfill as follows:
      a. General. Place backfill in horizontal layers that, when compacted, do not exceed 6 inches in depth. Compact each layer according to Subsection 3.1 E~~F~~. Bring backfill up evenly on all sides of the structure, and extend each layer to the limits of the excavation or to natural ground. Do not place backfill against concrete less than 7-days-old or until 80 percent of the design strength is achieved.

   2. Patching existing pavement areas. Construct the top 15 inches with 12 inches of crushed aggregate according to Specification 32 11 23 and 3 inches of asphalt concrete according to Specifications 32 12 16.03 and 32 01 16.71.

E. Compacting
   1. Determine optimum moisture content and maximum density according to AASHTO T 99, method C. Adjust the moisture content of the backfill material to a moisture content suitable for compaction.
      Compact material placed in all layers 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.

      Do not apply density requirements as measured by AASHTO T 310 to material that is incapable of being tested or compacted to maximum values determined by AASHTO T 99. For these materials, fill the voids around the rock in each layer with earth or other

fine material. Compact each layer, full width, until there is no visible evidence of further consolidation.

3.3 ACCEPTANCE

1. See Table 02 41 20-1 for sampling and testing requirements.

2. Material for backfill, bedding, and foundation fill will be evaluated under Subsections 01 90 00 1.2 and 01 90 00 1.4, except concrete for bedding or backfill will be evaluated according to Table 02 41 20 - 2.

3. Structural excavation and backfill work will be evaluated under Subsections 01 90 00 1.2 and 01 90 00 1.4.

4. Shoring, bracing, and cofferdams will be evaluated under Subsections 01 90 00 1.2 and 01 90 00 1.4.

5. Clearing and removal of obstructions will be evaluated under Specification 31 11 00.

Table 02 41 20-1
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Backfill material (31 00 00)	Measured and tested for conformance (101 90 00)	Gradation	—	AASHTO T 27 & T 11	1 per soil type	Source of material	Yes	Before using in work
		Moisture-density	—	AASHTO T 99, method C(1)	"	"	"	"
		Compaction	—	AASHTO T 310 or other approved procedures	2 per lift	In-place	—	Before placing next layer
Bedding material (31 00 00)	Measured and tested for conformance (01 90 00)	Moisture-density	—	AASHTO T 99, method C(1)	1 per soil type	Source of material	Yes	Before using in work
		Compaction	—	AASHTO T 310 or other approved procedures	2 per lift	In-place	—	Before placing next layer

(1) Minimum of 5 points per proctor.

Table 02 41 20 (continued)
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Foundation fill (31 00 00)	Measured and tested for conformance (01 90 00)	Moisture-density	—	AASHTO T 99, method C[1]	1 per soil type	Source of material	Yes	Before using in work
		Compaction	—	AASHTO T 310 or other approved procedures	2 per lift	In-place	—	Before placing next layer
Unclassified borrow (31 00 00)	Measured and tested for conformance (01 90 00)	Moisture-density	—	AASHTO T 99, method C[1]	1 per soil type	Source of material	Yes	Before using in work
		Classification	—	AASHTO M 145	"	"	"	"
		Compaction	—	AASHTO T 310 or other approved procedures	2 per lift	In-place	—	Before placing next layer

(1) Minimum of 5 points per proctor.

END OF SECTION 02 41 20.

Table 02 41 20-2
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Concrete	Measured and tested for conformance (01 90 00)	Unit mass	—	AASHTO T 121	1 set per 30 yd^3 but not less than 1 per day	Point of discharge	—	Upon completing tests
		Air content	—	AASHTO T 152 or T 196	"	"	—	"
		Slump	—	AASHTO T 119	"	"	—	"
		Temperature	—	Field measured	"	"	—	"
		Compressive strength	—	AASHTO T 23 & T 22	"	Discharge stream at point of placing	—	"

SECTION 03 30 53 – MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of constructing minor concrete structures.

B. Measurement Procedures
1. Concrete, not covered by another specification, will be measured for by the unit of cubic yard.
2. Aggregate Base will be measured for by the unit of cubic yard.

C. Payment Procedures
1. The accepted work will be paid at the contract lump sum price for all work

1.2 REFERENCES
A. AASHTO - American Association of State Highway and Transportation Officials
1. AASHTO M 148 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
2. AASHTO M 153 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
3. AASHTO M 154 - Standard Specification for Air-Entraining Admixtures for Concrete
4. AASHTO M 157 - Standard Specification for Ready-Mixed Concrete
5. AASHTO M 171 - Standard Specification for Sheet Materials for Curing Concrete
6. AASHTO M 173 - Standard Specification for Concrete Joint-Sealer, Hot-Poured Elastic Type
7. AASHTO M 182 - Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats
8. AASHTO M 195 - Standard Specification for Lightweight Aggregates for Structural Concrete
9. AASHTO M 213 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
10. AASHTO M 220 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
11. AASHTO M 221 - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
12. AASHTO M 225 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
13. AASHTO M 240 - Standard Specification for Blended Hydraulic Cement
14. AASHTO M 295 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
15. AASHTO M 301 - Standard Specification for Joint Sealants, Hot-Poured, for Concrete and Asphalt Pavements
16. AASHTO M 32 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement

17. AASHTO M 33 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
18. AASHTO M 43 - Standard Specification for Sizes of Aggregate for Road and Bridge Construction
19. AASHTO M 54 - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
20. AASHTO M 55 - Standard Method of Test for Steel Welded Wire Reinforcement, Plain, for Concrete
21. AASHTO M 6 - Standard Specification for Fine Aggregate for Hydraulic Cement Concrete
22. AASHTO M 85 - Standard Specification for Portland Cement
23. AASHTO M 194 - Standard Specification for Chemical Admixtures for Concrete
24. AASHTO M 31 - Standard Specification for Deformed and Plain Carbon and Low-Alloy Steel Bars for Concrete Reinforcement
25. AASHTO M 42 - Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
26. AASHTO M 53 - Standard Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
27. AASHTO T 11 - Standard Method of Test for Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
28. AASHTO T 119 - Standard Method of Test for Slump of Hydraulic Cement Concrete
29. AASHTO T 121 - Standard Method of Test for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
30. AASHTO T 152 - Standard Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method
31. AASHTO T 176 - Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
32. AASHTO T 196 - Standard Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method
33. AASHTO T 22 - Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens
34. AASHTO T 23 - Standard Method of Test for Making and Curing Concrete Test Specimens in the Field
35. AASHTO T 26 - Standard Method of Test for Quality of Water to Be Used in Concrete
    AASHTO T 96 - Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

B. ASTM – ASTM International
1. ASTM A 493 - Standard Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging
2. ASTM A 706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
3. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants
4. ASTM C 923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
5. ASTM C 979 - Standard Specification for Pigments for Integrally Colored Concrete
6. ASTM C 990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

7. ASTM D 1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber
8. ASTM D 5078 - Standard Specification for Crack Filler, Hot-Applied, for Asphalt Concrete and Portland Cement Concrete Pavements
9. ASTM D 5249 - Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints
10. ASTM D 5711 - Standard Test Method for Determining the Adherent Coating on Coarse Aggregates
11. ASTM D 5893 - Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements
12. ASTM D 624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

C. FAR - Federal Acquisition Regulations
1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL
1. The Contractor shall submit, or shall have his supplier submit, concrete mixture design(s) conforming to the specifications for the class of concrete specified for the Engineer's approval prior to the start of concrete mixing operations.
2. The Contractor shall make trial batches under the observation of the Engineer to verify that concrete of the required workability and consistency is obtained within the specified water content when any of the actions is exercised.
3. Laboratory test reports for concrete materials and mix design test.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Air-entraining admixtures
1. Conform to AASHTO M 154.

B. Chemical admixtures
1. Furnish water-reducing, retarding, set-accelerating, and hydration stabilizing admixtures, or combinations thereof, conforming to AASHTO M 194. For hydration stabilizing admixtures, conform to AASHTO M 194, type B or D.

C. Coarse Aggregate
1. Conform to AASHTO M 80, class A, except as amended or supplemented by the following:
a) Los Angeles abrasion, AASHTO T 96, 40% max.
b) Adherent coating, ASTM D 5711, 1.0% max.
c) Grading, AASHTO M 43. All sizes except numbers 8, 89, 9, or 10

2. For lightweight coarse aggregate, conform to AASHTO M 195.

D. Concrete Coloring Agents

1. Conform to ASTM C 979. Use only coloring agents composed of synthetic or natural inorganic iron oxides.

E. Curing Material
   1. Conform to the following:
      a) Burlap cloth AASHTO M 182
      b) Waterproof paper AASHTO M 171
      c) Polyethylene film AASHTO M 171
      d) Liquid membrane forming compounds AASHTO M 148, type 1-D or 2

F. Fine Aggregate
   1. Furnish sand conforming to AASHTO M 6, class B including the reactive aggregate supplementary requirement, except as amended or supplemented by the following:
      a) Material passing No. 200 sieve, AASHTO T 11, 3.0% max.
      b) Sand equivalent value, AASHTO T 176, alternate method no. 2, reference method 75 min.

   2. For lightweight fine aggregate, conform to AASHTO M 195.

G. Fly Ash
   1. Conform to AASHTO M 295, class C or F.

H. Hydraulic Cement
   1. Do not mix cement brands or types. Furnish cement according to the following:
      a) Portland Cement. Conform to AASHTO M 85, type I, II, or V.
      b) Blended Hydraulic Cement. Conform to AASHTO M 240, type IS, IP P, I(PM), or I(SM).

I. Joint Fillers
   1. Conform to the following:
      a) Joint sealants and crack fillers. Furnish a commercial certification identifying the batch and lot number, material, quantity of batch, date and time of manufacture, and the name and address of the manufacturer.
         1. Concrete joint-sealer, hot-poured elastic type AASHTO M 173
         2. Joint sealants, hot-poured, for rigid and asphalt pavement ASHTO M 301
         3. Crack filler, hot applied, for asphalt concrete and rigid pavements ASTM D 5078
         4. For proprietary asphalt-rubber products, furnish the following:
            a) Source and grade of asphalt binder;
            b) Total granulated rubber content and mass, as percent of the asphalt-rubber mixture;
            c) Granulated rubber type(s) and content of each type (if blend);
               1. Mass as a percent of combined rubber; and
               2. Gradation of granulated rubber.
            d) Type of asphalt modifier, if any;
            e) Quantity of asphalt modifier and mass as a percent of asphalt binder;
            f) Other additives;
            g) Heating and application temperatures; and

h) Manufacturer's recommended application procedures.

5. Multi-component joint sealant, conforming to TT-S-00227E, type I, class A or ASTM C 920, type M, grade P, class 25, use T. Provide sealant matching the color of the adjacent sidewalk. Conform to the sealant manufacturer's recommendations for use of primers.
6. Flexible cellular joint filler ASTM D 1056, type 2, grade 4 or 5

2. Preformed expansion joint fillers. Furnish in a single piece for the depth and width required for the joint.
   a) Preformed expansion joint filler for concrete (bituminous type) AASHTO M 33
   b) Preformed sponge rubber expansion AASHTO M 153 joint fillers for concrete paving and structural construction.
   c) Preformed cork expansion joint fillers for concrete paving and structural construction(1) AASHTO M 153
   d) Preformed expansion joint fillers for concrete paving and structural construction (nonextruding and resilient bituminous types) AASHTO M 213

      Note: (1) Do not use in major concrete structures.

3. Preformed joint seals and sleeves.
   a) Paving applications. Conform to AASHTO M 220. Use a lubricant conforming to ASTM D 2835, which was manufactured within 9 months of use.
   b) Circular concrete sewer and culvert pipes using rubber gaskets. Furnish oil resistant gaskets conforming to AASHTO M 315 and the following:
      1. Minimum thickness Recommendation of drainage element manufacturer
      2. Tear resistance, ASTM D 624 (die B)
         a) Ethylene propylene dimonomer (EPDM) 230 pounds per inch min.
         b) Neoprene 115 pounds per inch min.

   c) Resilient connectors between reinforced concrete manhole structures and pipes. Conform to ASTM C 923.

   d) Preformed flexible joint sealants for concrete pipe, manholes, and precast box sections. Conform to ASTM C 990.

4. Foam filler. Furnish an expanded polystyrene filler having a compressive strength of not less than 10 pounds per square inch.

5. Silicone joint sealer. Conform to ASTM D 5893, type NS.

6. Low-modulus silicone joint sealant. Conform to ASTM D 5893, type SL.

7. Backer rod. Conform to ASTM D 5249, type 1. Use a compatible sealant as recommended by the rod manufacture. For size of backer rod, conform to table below:

Backer Rod Sizes

Joint Width After Preparation	Rod Diameter
5/16 inch	3/8 inch
3/8 inch	1/2 inch
1/2 inch	5/8 inch
5/8 inch	3/4 inch
3/4 inch	1 inch
1 inch	1¼ inch
1¼ inch	1½ inch
1½ inch	2 inch

J. Reinforcing Steel

1. General. Furnish the following information with each shipment of steel to the project:

    a) Name and location of the steel rolling mill;

    b) Manufacturing process;

    c) Heat number(s);

    d) Size(s);

    e) Specifications;

    f) Copies of mill test analyses for chemical and physical tests; and

    g) Consignee and destination of shipment.

2. Reinforcing bars. Furnish deformed, grade 60 bars conforming to AASHTO M 31, M 42, or M 53.

3. Epoxy-coated reinforcing bars. Furnish bars conforming to reinforcing steel section. Conform to AASHTO M 284.

4. Inspect the reinforcing bars after the near white blast cleaning. Reject all bars with steel slivers or scabs. Selective sorting and rejection at the fabricator's shop may avoid unnecessary delays and subsequent rejection of bars during the precoating inspection at the coating applicator's shop.

5. Coat epoxy coated reinforcing steel in a plant certified by CRSI as a fusion bonded epoxy applicator.

6. Tie bars. Furnish deformed, grade 60 bars conforming to AASHTO M 31 or M 42, except do not use AASHTO M 42 steel for tie bars bent and restraightened during construction.

7. Hook bolts. Furnish plain, grade 60 bars conforming to AASHTO M 31 or M 42 with M14 rolled threads or M16 cut threads. Furnish a threaded sleeve nut capable of sustaining a minimum axial load of 15,000 pounds.

8. Dowel bars. Conform to AASHTO M 254, type A or B. Use plain round bars, free from burring or other deformation restricting free movement in the concrete. Paint half the length of each dowel bar with one coat of tar paint. When the paint dries and immediately before placing the dowels, lubricate the painted end to prevent concrete from bonding to the painted end.

   For expansion joints, furnish a dowel cap that snugly covers 2±1/4 inches of the dowel, has a closed end, and has a suitable stop to hold the closed end 1 inch from the end of the dowel bar.

   Lubricants for type B dowels may be rapid-curing cut-back asphalt, medium setting emulsified asphalt, or a flaked graphite and vehicle. Lubricants are not required for type A coated dowel bars.

   Furnish dowel assemblies that hold dowel bars within 1/4-inch tolerance vertically and horizontally during concrete placement and permit unrestricted movement of the pavement slab.

   Use wire conforming to AASHTO M 32 for dowel assemblies. Coat dowel assemblies with the same material as the dowel bar. Recoat or repair damaged coatings equivalent to the manufacturer's original coating.

   a) Deformed steel wire. Conform to AASHTO M 225.

   b) Welded steel wire fabric. Conform to AASHTO M 55.

   c) Cold-drawn steel wire. Conform to AASHTO M 32.

   d) Welded deformed steel wire fabric. Conform to AASHTO M 221.

   e) Fabricated deformed steel bar or rod mats. Conform to AASHTO M 54.

   f) Low alloy steel deformed bars. Conform to ASTM A 706.

K. Water

1. Conform to the following:
   a) Water for mixing or curing cement concrete, mortar, or grout. Conform to AASHTO M 157. Potable water of known quality may be used without testing according to AASHTO T 26. Potable water is safe for human consumption as defined by the public health authority having jurisdiction.
   b) Water for planting or care of vegetation. Furnish water that is free of substances injurious to plant life such as oils, acids, alkalies, or salts.

   c) Water for earthwork, pavement courses, dust control, and incidental construction. Furnish water free of substances detrimental to the work.

2.2 MIXES

1. Conform to Composition of Minor Structure Concrete Table. Before batching concrete, submit the proposed concrete proportions for approval on Form FHWA 1606 *Minor Concrete Mix Design Trial Batch Summary* or other approved form. As a minimum, submit the following:

    a) Type and source(s) of all material proposed for use.

    b) Material certification for all material proposed for use.

    c) Saturated surface dry mass of the fine and coarse aggregate per cubic yard of concrete.

    d) Gradation of fine and coarse aggregate.

    e) Mass of mixing water per cubic yard of concrete.

    f) Mass of cement per cubic yard of concrete. Fly ash, ground iron blast-furnace slag, or silica fume may partially replace cement according to the following:

        1. Fly Ash

            a) *Class F.* Not more than 20 percent of the minimum mass of portland cement in Composition of Concrete Table below may be replaced with class F fly ash at the rate of 1.5 parts fly ash per 1 part portland cement.

            a) *Class C.* Not more than 25 percent of the minimum mass of portland cement in Composition of Concrete Table below may be replaced with class C fly ash at the rate of 1 part fly ash per 1 part portland cement.

        2. Ground iron blast-furnace slag. Not more than 50 percent of the minimum mass of portland cement in Composition of Concrete Table below may be replaced with ground iron blast-furnace slag at the rate of 1 part slag per 1 part portland cement.

        3. Silica fume (microsilica). Not more than 10 percent of the minimum mass of portland cement in Composition of Concrete Table below may be replaced with silica fume at the rate of 1 part silica fume per 1 part portland cement.

    For concrete exposed to deicing chemicals, fly ash will constitute no more than 25 percent and silica fume no more than 10 percent of the total replacement weight. Additionally, fly ash, slag, and silica fume will constitute no more than 50 percent of the total replacement weight.

    The water/cement ratio for modified concrete is the ratio of the mass of water to the combined masses of hydraulic cement and cement substitute.

Composition of Concrete

Class of Concrete	Minimum Cement Content (pounds per cubic yard)	Maximum W/C Ratio	Slump(1) (inches)	Nominal Maximum Aggregate Size (inches)
A	611	0.49	2 to 4	1½
A(AE)	611	0.44	1 to 4	1½
B	517	0.58	2 to 4	2½
B(AE)	517	0.58	2 to 4	2½
C	658	0.49	2 to 4	3/4
C(AE)	658	0.44	1 to 3	3/4
D(AE)(2)	611	0.40	1 to 3	1½
E(AE)(3)	611	0.40	4 to 6(4)	3/4
P (Prestressed)	658	0.44	0 to 4	1
Seal	658	0.54	4 to 8	1½

(1) Maximum slump is 8 inches if approved mix design includes a high-range water reducer.

(2) Concrete with a water reducing and retarding admixture conforming to AASHTO M 194, type D.

(3) A latex modified concrete with 0.037 gallons of modifier per pound of cement.

(4) Measure the slump 4 to 5 minutes after the concrete is discharged from the mixer.

g) Entrained air content of plastic concrete in percent by volume.

h) Maximum slump of plastic concrete in inches.

i) When colored concrete is required, submit preliminary samples of the colored concrete. Prepare a 3-foot by 3-foot by 4-inch panel for each acceptable mix that is to be colored. Finish and cure the panels in the same manner as the concrete will be finished and cured on the project.

Composition of Minor Structure Concrete

Property	Specification
Cement content	611 pounds per cubic yard minimum
Water/cement ratio	0.49 maximum
Slump	5 inches maximum
Air content	4 % minimum

Size of coarse aggregate	AASHTO M 43 with 100% passing the 1½-inch sieve
28-day compressive strength	3,000 pounds per square inch minimum

PART 3 – EXECUTION

3.1 PREPARATION

1. Excavate and backfill according to applicable specifications. When concrete is cracked, spalling, or scaling, remove concrete to the nearest joint.

2. Design and construct forms that are free of bulge and warp and allow for removal without injuring the concrete. When concrete contains a retarding admixture, fly ash, or other pozzolan replacement for cement, design the forms for a lateral pressure equal to that exerted by a fluid weighing 150 pounds per cubic foot.

3. Use wood, metal, or other suitable material for forms. Keep forms clean and coat with a form release agent or form oil before placing concrete.

4. Place and fasten reinforcing steel according to the following:

    a) Support the bars on precast concrete blocks or metal supports according to the CRSI *Manual of Standard Practice.* Attach concrete block supports to the supported bar with wire cast in the center of each block. Use class 1 (plastic protected) or class 2, type B (stainless steel protected) metal supports in contact with exposed concrete surfaces. Use stainless steel conforming to ASTM A 493, type 430.

    b) Coat chairs, tie wires, and other devices used to support, position, or fasten epoxy-coated reinforcement with a dielectric material. Do not use plastic supports.

    c) Space slab bar supports no more than 4 feet apart transversely or longitudinally. Do not use bar supports either directly or indirectly to support runways for concrete buggies or other similar construction loads.

    d) Space parallel bars within 1½ inches of the required location. Do not cumulate spacing variations. The average of any two adjacent spaces shall not exceed the required spacing.

    e) Provide 2 inches clear cover for all reinforcement except as otherwise shown on the plans.

    f) Tie bundle bars together at intervals not exceeding 6 feet. Do not bundle bars unless the location and splice details are specified.

    g) Do not place concrete in any member until the placement of the reinforcement is approved.

3.2 PLACING CONCRETE

1. Temperature and Weather Conditions. Maintain the temperature of the concrete mixture just before placement between 50 and 90 ºF.

   a) Cold weather. Cold weather is defined as a period when, for more than 3 consecutive days, the following conditions exist: (1) the average of the highest and the lowest temperatures occurring during the period from midnight to midnight is less than 40 °F and (2) the air temperature is not greater than 50 °F for more than one-half of any 24-hour period.

      When cold weather is reasonably expected or has occurred within 7 days of anticipated concrete placement, submit a detailed plan for the producing, transporting, placing, protecting, curing, and temperature monitoring of concrete during cold weather. ACI 306 may be used for guidance in developing the plan. Include procedures for accommodating abrupt changes in weather conditions. Do not commence placement until plan is accepted. Acceptance of a plan will take at least 1 day.

      Have all material and equipment required for protection available at or near the project before commencing cold weather concreting.

      Remove all snow, ice, and frost from the surfaces, including reinforcement and subgrade, against which the concrete is to be placed. The temperature of any surface that comes into contact with fresh concrete shall be at least 35 ºF and shall be maintained at a temperature of 35 ºF or above during the placement of the concrete.

      Place heaters and direct ducts so as not to cause concrete drying or fire hazards. Vent exhaust flue gases from combustion heating units to the outside of any enclosures. Heat the concrete components in a manner that is not detrimental to the mix. Do not heat cement or permit the cement to come into contact with aggregates that are hotter than 100 ºF. Concrete at the time of placement shall be of uniform temperature and free of frost lumps. Do not heat aggregates with a direct flame or on sheet metal over fire. Do not heat fine aggregate by direct steam. The addition of salts to prevent freezing is not permitted.

      During cold weather, protect all concrete for at least 72 hours according to Cold Weather Concrete Surface Temperatures Table. Protect concrete exposed in the final construction for at least 7 days according to Cold Weather Concrete Surface Temperatures Table.

      Furnish and place continuously recording surface temperature measuring devices that are accurate within ±2 ºF.

      At the end of the protection period, allow the concrete to cool gradually over 24 hours at a rate not to exceed the maximum values shown in Cold Weather Concrete Surface Temperatures Table. All protection may be removed when the concrete surface temperature is within 25 ºF of the ambient air temperature.

Cold Weather Concrete Surface Temperatures

Minimum section size dimension, inches	< 12	12 - 36	36 - 72	> 72
Minimum temperature of concrete during protection period	55 ºF	50 ºF	45 ºF	40 ºF

Maximum allowable temperature drop in any 24-hour period after end of protection	50 ºF	40 ºF	30 ºF	20 ºF

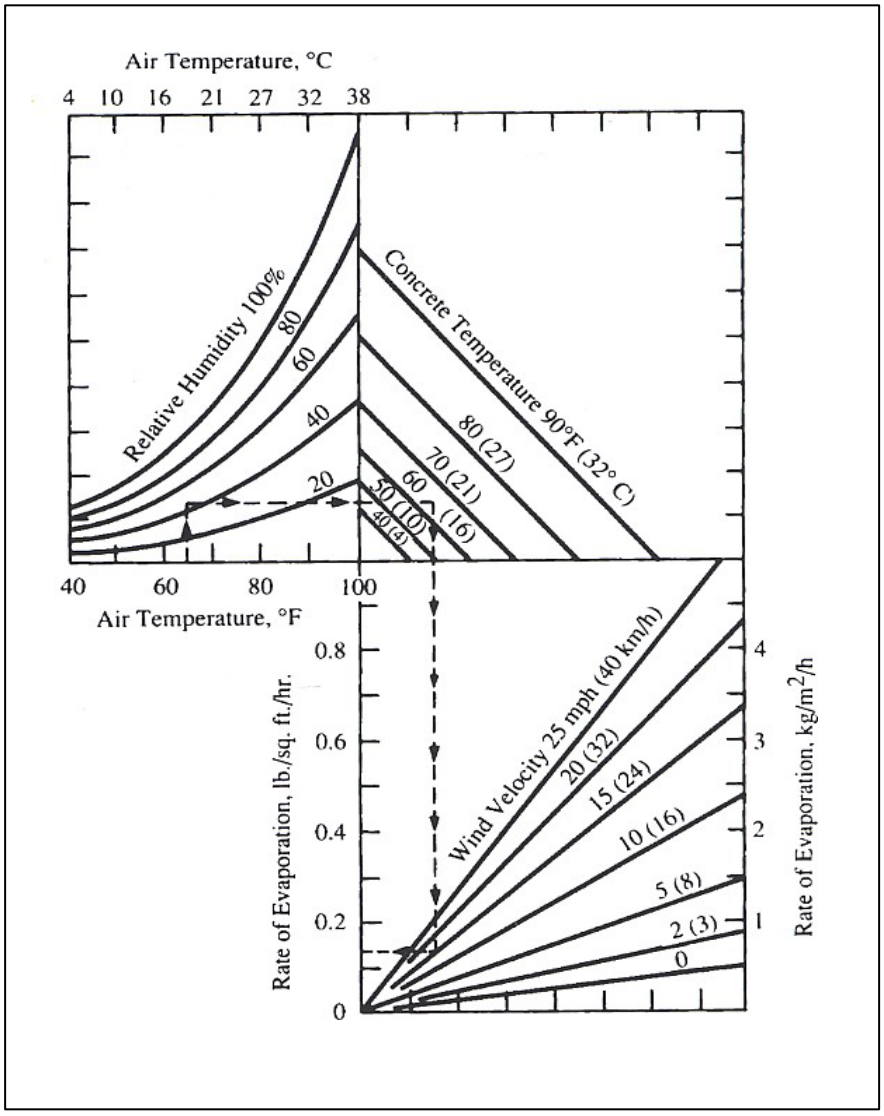
b) Hot weather. Hot weather is any time during the concrete placement that the ambient temperature at the work site is above 90 ºF.

In hot weather, cool all surfaces that come in contact with the mix to below 90 ºF. Cool by covering with wet burlap or cotton mats, fog spraying with water, covering with protective housing, or by other approved methods.

During placement, maintain concrete temperature by using any combination of the following:

1. Shade the material storage areas or production equipment;
2. Cool aggregate by sprinkling; and
3. Cool aggregate and water by refrigeration or replacing a portion or all of the mix water with flaked or crushed ice to the extent that the ice completely melts during mixing of the concrete.

c) Evaporation. Limit expected evaporation rate as determined by the Evaporation Rate of Surface Moisture figure below.



Evaporation Rate of Surface Moisture

Note: Example shown by dashed lines is for an air temperature of 65 ºF, relative humidity of 45 percent, concrete temperature of 65 ºF, and a wind velocity of 15 miles per hour. This results in a rate of evaporation of 0.13 pounds per square foot per hour.

When necessary, take one or more of the following actions:

1. Construct windbreaks or enclosures to effectively reduce the wind velocity throughout the area of placement.
2. Use fog sprayers upwind of the placement operation to effectively increase the relative humidity.
3. Reduce the temperature of the concrete according to (b) above.

d) Rain. At all times during and immediately after placement, protect the concrete from rain.

2. Moisten the forms and foundation immediately before placing concrete. Discharge concrete within the time limit shown in Concrete Remixing and Discharge Time Limits table below.

Concrete Remixing and Discharge Time Limits

Cement Type	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	AASHTO M 194, type B, D, or G	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 (1)	None	0.50	0.75
Type III (1)	AASHTO M 194, type B, D, or G	1.00	1.25

(1) AASHTO M 85, type III.

3. Place concrete to avoid segregation of material. Consolidate with vibrators according to the following:

   a) Provide sufficient hand-held internal concrete vibrators suitable for the conditions of concrete placement. Use vibrators conforming to Hand Held Vibratory Requirements table below. Provide rubber-coated vibrators when epoxy-coated reinforcement is used.

   Provide a sufficient number of vibrators to consolidate each batch as it is placed. Provide a spare vibrator at the site in case of breakdown. Use external form vibrators only when the forms have been designed for external vibration and when internal vibration is not possible.

Hand Held Vibratory Requirements

Head Diameter (inches)	Frequency (vibrations/minute)	Radius of Action (inches)
3/4 to 1½	10,000 to 15,000	3 to 5
1¼ to 2½	9,000 to 13,500	5 to 10
2 to 3½	8,000 to 12,000	7 to 9

   Consolidate all concrete by mechanical vibration immediately after placement. Manipulate vibrators to thoroughly work the concrete around reinforcement, embedded fixtures, corners, and angles in the forms. Do not cause segregation. Do not consolidate concrete placed underwater. Supplement vibration with spading, as necessary, to ensure smooth surfaces and dense concrete along form surfaces, in corners, and at locations impossible to reach with the vibrators.

Vibrate the concrete at the point of deposit and at uniformly spaced points not farther apart than 1.5 times the radius over which the vibration is visibly effective. Insert vibrators so that the affected vibrated areas overlap. Do not use vibrators to move concrete. Insert vibrators vertically and slowly withdraw from the concrete. The vibration shall be of sufficient duration and intensity to thoroughly consolidate the concrete but not to cause segregation. Do not vibrate at any one point long enough to cause localized areas of grout to form. Do not vibrate reinforcement.

Do not use aluminum pipe for transporting or placing concrete. The intervals between deliveries of batches for a single pour on a structure shall not exceed 30 minutes.

4. Do not apply water to plastic concrete surfaces during finishing operations.

3.3 CURING CONCRETE

1. Cure concrete a minimum of 7 days. If high early strength cement is used, cure concrete a minimum of 3 days.

   Begin curing immediately after the free surface water has evaporated and the finishing is complete. If the surface of the concrete begins to dry before the selected cure method can be implemented, keep concrete surface moist using a fog spray without damaging the surface.

   Keep surfaces to be rubbed moist after forms are removed. Cure immediately following the first rub.

   Cure all concrete uninterrupted for at least 7 days. If pozzolans in excess of 10 percent by mass of the hydraulic cement is used in the mix, cure uninterrupted for at least 10 days.

   a) Forms inplace method. For formed surfaces, leave the forms inplace without loosening. If forms are removed during the curing period to facilitate rubbing, only strip forms from those areas able to be rubbed during the same shift. During rubbing, keep the surface of the exposed concrete moist. After the rubbing is complete, continue curing process using the water method for the remainder of the curing period.

   b) Water method. Keep the concrete surface continuously wet by ponding, spraying, or covering with material that is kept continuously and thoroughly wet. Covering material may consist of cotton mats, multiple layers of burlap, or other approved material that does not discolor or otherwise damage the concrete.

      Cover the covering material with a waterproof sheet material that prevents moisture loss from the concrete. Use the widest sheets practical. Lap adjacent sheets at least 6 inches, and tightly seal all seams with pressure sensitive tape, mastic, glue, or other approved methods. Secure all material so that wind does not displace it. Immediately repair sheets that are broken or damaged.

   c) Liquid membrane curing compound method. Do not use the liquid membrane method on surfaces to receive a rubbed finish. Use on construction joint surfaces is permitted only if the compound is removed by sandblasting before placement of concrete against the joint.

      Use type 1 or 1-D clear curing compounds on surfaces.

Mix membrane curing solutions containing pigments before use. Continue to agitate during application. Use equipment capable of producing a fine spray. Apply the curing compound at a minimum rate of 1 gallon per 150 square feet in one or two uniform applications. If the solution is applied in 2 applications, follow the first application with the second application within 30 minutes, and apply at right angles to the first application.

If the membrane is damaged by rain or other means during the curing period, immediately apply a new coat over the damaged areas.

d) Steam curing method. Prepare and cure precast members according to ACI 517.2R.

2. Finish exposed concrete surfaces according to the following, as applicable.

a) Class 1 — Ordinary surface finish. Finish the following surfaces with a class 1, ordinary surface finish:

1. Surfaces to be buried and culvert surfaces above finished ground that are not visible from the traveled way or a walkway.

Begin finishing as soon as the forms are removed. Remove fins and irregular projections from all surfaces that are exposed or will be waterproofed. Remove bulges and offsets with carborundum stones or discs. Remove localized, poorly-bonded rock pockets or honeycombed concrete, and replace with sound concrete or packed mortar in an approved manner.

Clean and point all form tie cavities, holes, broken corners and edges, and other defects. Saturate the area with water. Finish the area with mortar that is less than 1-hour-old. After the mortar is set, rub it (if required) and continue curing. Match exposed surfaces to surrounding concrete.

Carefully tool and remove free mortar and concrete from construction and expansion joints. Leave joint filler exposed for its full length with clean, true edges.

Rub or grind bearing surfaces on piers and abutments to the specified elevation and slope.

If the final finished surface is not true and uniform, rub it according to Class 2 – Rubbed Finish below.

b) Class 2 — Rubbed finish. Finish the following surfaces with a class 2, rubbed finish:

1. Surfaces above finished ground of culvert headwalls and endwalls when visible from the traveled way or walkway;
2. Inside surfaces of culvert barrels higher than 4 feet that are visible from the traveled way. Finish for a distance inside the barrel at least equal to the height of the culvert; and
3. All surfaces of railings.

Complete a class 1 finish according to paragraph (a) above. Saturate the concrete surface with water. Rub the surface with a medium coarse carborundum stone using a small amount of mortar on its face. Use mortar composed of cement and fine sand mixed in the same proportions as the concrete being finished. Continue rubbing until form marks, projections, and irregularities are removed and a uniform surface is obtained. Leave the paste produced by this rubbing in place.

After other work, which could affect the surface, is complete, rub with a fine carborundum stone, and water until the entire surface has a smooth texture and uniform color. After the surface has dried, rub it with burlap to remove loose powder. Leave it free from all unsound patches, paste, powder, and objectionable marks.

3.4 FINAL ACCEPTANCE

1. See Sampling and Testing requirements table below for sampling and testing requirements.

Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Concrete	Measured and tested for conformance	Unit mass	—	AASHTO T 121	1 set per 30 yd^3 but not less than 1 per day	Point of discharge	—	Upon completing tests
		Air content	—	AASHTO T 152 or T 196	"	"	—	"
		Slump	—	AASHTO T 119	"	"	—	"
		Temperature	—	Field measured	"	"	—	"
		Compressive strength	—	AASHTO T 23 & T 22	"	Discharge stream at point of placing	—	"

2. Material for minor concrete structures including reinforcing steel, and structural steel for minor structures will be evaluated the following:

a) Visual Inspection. Acceptance is based on visual inspection of the work for compliance with the contract and prevailing industry standards.

b) Certification**.** For material manufactured off-site, use a manufacturer with an ISO 9000 certification or an effective testing and inspection system. Require the manufacturer to clearly mark the material or packaging with a unique product identification or specification standard to which it is produced.

Other than references in or to the FAR or Federal Law, when these Standard Specifications reference certifications; certificates; or certified documents, equipment, or individuals, these references are not certifications under Section 4301 of Public Law 104-106, National Defense Authorization Act for Fiscal Year 1996. These references refer to documentation of non-regulatory, peripheral contract requirements that are required to be validated by an individual or organization having unique knowledge or qualifications to perform such validation.

Material accepted by certification may be sampled and tested at any time. If found not in conformance with the contract, the material will be rejected whether in place or not.

One of the following certifications may be required:

1. Production certification. Material requiring a production certification is identified in the Acceptance Subsection of each Section. Require the manufacturer to furnish a production certification for each shipment of material. Include the following with each production certification:

    a) Date and place of manufacture;

    b) Lot number or other means of cross-referencing to the manufacturer's inspection and testing system; and

    c) Substantiating evidence that the material conforms to the contract quality requirements as required by FAR 46.105(a)(4), including all of the following:

    Test results on material from the same lot and documentation of the inspection and testing system;

    A statement from the manufacturer that the material complies with all contract requirements; and

    Manufacturer's signature or other means of demonstrating accountability for the certification.

2. Commercial certification. When a certification is required, but not a production certification, furnish one commercial certification for all similar material from the same manufacturer.

    A commercial certification is a manufacturer's or Contractor's representation that the material complies with all contract requirements. The representation may be labels, catalog data, stamped specification standards, or supplier's certifications indicating the material is produced to a commercial standard or specification.

3. The concrete mixture's slump, air content, compressive strength, unit mass, and temperature will be evaluated under the following:

    a) Visual Inspection. Acceptance is based on visual inspection of the work for compliance with the contract and prevailing industry standards.

    b) Measured or Tested Conformance. Provide all necessary production and processing of the work and control performance of the work so that all of the work complies with the contract requirements.

    Results from inspection or testing shall have values within the specified tolerances or specification limits. When no tolerance values are identified in the contract, the work will be accepted based on customary manufacturing and construction tolerances.

4. Excavation and backfill will be evaluated under Specification 31 00 00.

5. Construction of minor concrete structures will be evaluated under the following:

    a) Visual Inspection. Acceptance is based on visual inspection of the work for compliance with the contract and prevailing industry standards.

    b) Measured or Tested Conformance. Provide all necessary production and processing of the work and control performance of the work so that all of the work complies with the contract requirements.

    Results from inspection or testing shall have values within the specified tolerances or specification limits. When no tolerance values are identified in the contract, the work will be accepted based on customary manufacturing and construction tolerances.

END OF SECTION 03 30 53.

SECTION 03 41 40 – ELEVATED PRECAST CONCRETE BOARDWALK

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Work of this Section includes design, fabrication, and installation, necessary to construct a precast concrete boardwalk to the limits shown on the Drawings.
   1. Design shall include boardwalk layout, analysis, and fabrication detailing, as well as a supplemental subsurface investigation to support foundation type selection in coordination with the boardwalk design.
   2. Installation shall include labor, equipment, survey control, supervision, tools, appliances, selection and implementation of means and methods

B. The Work shall be coordinated with the following:
   1. Section 06 90 01 Boardwalk and Trail Rail
   2. Section 31 62 16.16: Steel H-Piles
   3. Section 31 66 15: Helical Foundation Piles
   4. Section 31 63 29 Drill Shaft

C. Measurement Procedures
   1. Precast concrete boardwalk shall be paid for at the contract lump sum price as listed in the bid proposal for "Elevated Precast Concrete Boardwalk". This price shall include but is not limited to, a supplemental subsurface investigation, design, plant fabrication, labor, materials, tools, equipment, survey control, supervision, appliances, incidentals, and selection of the means and methods for the installation.

D. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work described in this section.

1.2 REFERENCES

A. Where the specification and reference documents conflict, the Owner's designated representative will make the final determination of the applicable document.

B. AASHTO LRFD Guide Specifications for The Design of Pedestrian Bridges, 2nd Edition.

C. AASHTO LRFD Bridge Design Specifications, 9th Edition.

D. American Concrete Institute Building Code and Commentary, ACI 318-19 and ACI 318R-19

E. ASCE: American Society of Civil Engineers, ASCE 7-22, Minimum Design Loads and Associated Criteria for Buildings and Other Structures

F. ASTM: Specifications of the American Society for Testing and Materials, latest edition.

1. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
2. ASTM C33 – Standard Specification for Concrete Aggregates
3. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
4. ASTM C94 – Standard Specification for Ready-Mixed Concrete.
5. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
6. ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete.
7. ASTM C150 – Standard Specification for Portland Cement
8. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
9. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
10. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
11. ASTM C666 – Standard Test Method for Concrete Resistance to Rapid Freezing and Thawing.
12. ASTM C979 Standard Specification for Pigments for Integrally Colored Concrete.
13. ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete.

G. BUILDING CODE: Pennsylvania State/International Building Code (IBC), 2018 Edition.

H. OSHA: Occupational Health and Safety Administration.

1.3 DESIGN REQUIREMENTS

The boardwalk system shall have the following minimum characteristics:

A. Boardwalk system: walking surface (treads) supported by reinforced precast concrete beams shall be reinforced precast concrete. A change in boardwalk material (treads and beams) shall not be allowed.

B. The precast system shall be designed as a modular flexible system allowing a prescribed settlement at pier locations. Joints shall be designed for such movement to occur without damage to the structural integrity of the system.

C. Walking surface (finish) of top surface of treads shall have a formliner finish texture. Texture must be integral with the concrete and shall not be an applied post pour wearing surface.

D. Precast concrete treads shall be structural load bearing elements and shall interlock with one another via a “tongue and groove” connection.

E. All precast shall consist of integrally colored concrete in a color selected by the Owner from one of Suppliers “standard colors”. All color pigment shall meet ASTM C979

F. Treads shall have a width-to-length ratio ranging from a minimum of 3:1 to a maximum of 14:1. Width is defined as the tread dimension perpendicular to the normal direction of travel. Length is defined as the tread dimension measured in the direction of travel.

G. Tread width shall be as noted on the Drawings. Alignment should follow the horizontal and vertical alignment a determined from the Drawing.

H. All tread-to-beam connectors shall be non-corrosive and hidden from view. Metallic tread-to-beam connectors shall not be allowed

I. Boardwalk supplier shall provide a field representative on site for a minimum of 2 days. Field representative shall be knowledgeable in the installation of precast concrete boardwalks.03 41 40

1.4 PROJECT CONDITIONS:

A. The project involves construction of a McDade (pedestrian) Trail adjacent to US Route 209. Portions of the Trail will be a pile supported boardwalk, portions will be wall supported, and portions will be at grade.

B. Existing Site and Subsurface Information:
   1. Subsurface investigation data are available from the OWNER in a report titled “Geotechnical Engineering Report, DEWA 310424 Route 209 Potential Slope Failure Delaware and Dingman Township, Pennsylvania” prepared by Terracon Consultants, Inc., dated 29 June 2023.

C. Review of Existing Information:
   1. Prior to submitting a bid, the CONTRACTOR shall review and understand the information referenced herein and other applicable resources. The referenced report is made available to the CONTRACTOR for information only. The subsurface information presented in the document is for information only and shall not be interpreted as a warranty of subsurface conditions whether interpreted from written text, boring logs, test results, or other data.

2. The CONTRACTOR shall draw their own conclusions regarding site conditions based upon site visit(s) and from available sources, for which the OWNER and its consultants assume no responsibility. The CONTRACTOR shall assume that subsurface conditions between subsurface explorations could differ from conditions shown in the test boring logs.

D. Subsurface Conditions
   1. The CONTRACTOR is advised that the subsurface conditions may vary across the site.
   2. The CONTRACTOR shall conduct supplemental subsurface investigation as necessary to finalize the type, size and length of the foundation piles
      a) The contractor shall engage a Geotechnical Engineer licensed in the Commonwealth of Pennsylvania to perform a supplemental subsurface investigation
      b) The limits of the supplemental subsurface investigation, if required, shall encompass the boardwalk segments as shown on the plans. Borings shall be taken with the footprint of the respective boardwalk segments.
      c) The contractor shall submit the proposed subsurface investigation plan, if required, to the National Park Service for review and approval.
      d) The subsurface investigation shall be sufficient for boardwalk pile type selection and design for the boardwalk segments.

1.5 QUALITY ASSURANCE

A. The contractor or their subcontractor installing the precast concrete boardwalk shall have installed similar precast concrete boardwalks to those shown on the drawings for a minimum of three (3) years prior to the bid date for this project. The contractor shall submit a list containing at least three (3) projects completed in the last three (3) years on which the contractor has installed piles of a size and length similar to those shown on the plans. The list of projects shall contain names and phone numbers of owner's representatives who can verify the Contractor's participation on those projects.

B. Manufacturer Qualifications: Not less than 10 years experience in the actual production of precast products as described below.
   1. Components shall be factory fabricated and engineered by single entity. This entity shall be registered to do business in the Commonwealth of Pennsylvania
   2. Boardwalk supplier (Precaster) for the boardwalk shall have in-house color mixing facilities for color pigmentation.
   3. Boardwalk supplier (Precaster) shall have either a minimum experience of 5 years or 50 boardwalk projects in design, production, and field consultation.
   4. Boardwalk supplier (Precaster) must be certified by PCI or NPCA.
   5. Precast components must be manufactured with the use of hot rolled steel skin in reinforced steel forms. Temporary (i.e., Timber) and/or single use forms are not allowed unless approved in writing by the Boardwalk Design Engineer.

C. Acceptability Criteria for Treads: The finished visible (in the final installed position) surface shall have no obvious imperfections other than minimal color or texture variations from the approved samples or evidence of repairs when viewed in good typical daylight illumination with the unaided naked eye at a 20 ft. viewing distance. Appearance of the surface shall not be evaluated when light is illuminating the surface from an extreme angle as it tends to accentuate the minor surface irregularities. The following is a list of finish defects that shall be properly repaired, if obvious when viewed at a 20 ft. distance. Patching (by a trained skilled concrete repair person) is an acceptable repair method.

1. Ragged or irregular surfaces.
2. Excessive air voids (commonly called bug holes) larger than ¼ in. evident on the top surface of the tread or curbs (if applicable).
3. Adjacent flat and return surfaces with greater texture and/or color differences than the approved samples or mockups.
4. Casting and/or aggregate segregation lines evident from different concrete placement lifts and consolidation.
5. Visible mold joints or irregular surfaces.
6. Rust stains on exposed surfaces.
7. Units with excessive variation in texture and/or color from the approved samples, within the unit or compared with adjacent units.
8. Blocking stains evident on exposed surfaces.
9. Areas of backup concrete bleeding through the facing concrete.
10. Foreign material embedded in the surface.
11. Visible repairs at a 20 ft. viewing distance.
12. Reinforcement shadow lines.
13. Cracks visible at a 20 ft. viewing distance.

D. Installer Qualifications: Firm with 3 years experience in installation of systems similar in complexity to those required for this Project.

E. Fabrication Materials

1. Concrete mix design with test data to confirm compressive strength.
2. Rebar material certification
3. Production Concrete testing
   a) 28-day concrete compression tests,
   b) concrete batch slump
   c) entrained air test result

1.6 DESIGN

A. For applications requiring minimum disturbance due to tree roots or other existing objects specified by the Owner to be avoided during construction, the Boardwalk Manufacturer requires the Contractor or Engineer/Architect to provide a survey of the proposed boardwalk location identifying items of interest including tree roots that cannot be disturbed per the Owner.

B. The designer of the boardwalk, foundation and railing system shall be a qualified registered Professional Engineer licensed in the Commonwealth of Pennsylvania and having a minimum of 20 years of experience in the design of concrete structures.

C. The foundation design shown on the boardwalk drawings are based upon limited subsurface information.
   1. Boardwalk segment pile type, sizes, and length shown on the Drawings are based on limited subsurface investigation along the trail corridor and are presented for bidding purposes only. Boardwalk Design shall coordinate with the pile type, size and length determined by any or all of the following foundation type options:
      a) Section 31 66 15: Helical Foundation Piles
      b) Section 31 62 16.16: Steel H-Piles
      c) Section 31 63 29: Drill Shaft

D. Design Codes and Criteria:
   1. The design of the precast concrete boardwalk system shall be in accordance with:
   2. AASHTO LRFD Guide Specifications for The Design of Pedestrian Bridges, 2nd Edition.
   3. AASHTO LRFD Bridge Design Specifications, 9th Edition.
   4. American Concrete Institute Building Code and Commentary, ACI 318-19 and ACI 318R-19.
   5. ASCE: American Society of Civil Engineers, ASCE 7-22, Minimum Design Loads and Associated Criteria for Buildings and Other Structures
   6. BUILDING CODE: Pennsylvania State Building Code, IBC 2018.
   7. Designed for the live load listed on the plans
   8. Where conflicting requirements occur, the more stringent shall govern. Design shall consider Service, Strength, and Extreme Limit States.

1.7 SUBMITTAL:

A. Product Data
   1. Submit manufacturer's product data sheets for each precast concrete component, including concrete mix design, compressive strength, and material properties that conform to the requirements noted above
   2. Submit a full range of standard colors from the manufacturer for selection and approval by the Government
   3. Textures: Submit a full range of textures for approval and selection and approval by the Government

B. DESIGN: Prior to the start of fabrication or construction, the Contractor shall submit to the Engineer a design package, which shall include but not limited to the following:

1. DESIGN COMPUTATIONS:
   a) Shall be signed and sealed by a licensed Professional Engineer in Commonwealth of Pennsylvania
   b) Clearly refer to the applicable Design Code provisions.
   c) Include documentation of computer programs including all design parameters.
   d) Clearly show that all reinforced precast treads and beams meet Design Code requirements for the loading per Section 1.6.D.
   e) Include sketches of reinforcement in treads and beams, shear and moment diagrams, and all equations used shall be referenced to applicable code.

2. DETAILED PLANS:
   a) Shall be signed and sealed by a licensed Professional Engineer in Commonwealth of Pennsylvania
   b) PLAN VIEW: Full plan view of the boardwalk to scale clearly showing foundation and railing locations. The plan view must reflect the proposed horizontal alignment as shown on the drawings.
   c) ELEVATION VIEW: Partial elevation view of the boardwalk to scale clearly showing foundation and railing locations and reflect the actual vertical alignment. Elevation or plan view shall indicate the elevation at the top and bottom of the boardwalk and foundation system components, horizontal and vertical break points, and location of the finished grade.
   d) DETAILS: Details of all boardwalk and railing system connections such as the length, size and where changes occur.
   e) CODE REFERENCE: Notes listing design parameters used along with Design Code references

3. INSTALLATION REQUIREMENT:
   a) Construction and installation requirements specific to the boardwalk supplier.
   b) Details on connection of boardwalk units and foundation system such that assurance of uniform load transfer shall be checked.
   c) Details on connection of boardwalk units and railing system such that assurance of fit up between railing segments and adjacent construction.
      - Field Measurements: Where railings are indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication; show recorded measurements on final shop drawings
      - Where field measurements cannot be made without delaying the railing fabrication and delivery, obtain guaranteed dimensions in writing by the Contractor and proceed with fabrication of products so as not to delay fabrication, delivery and installation.

C. SHOP DRAWINGS: Shop drawings shall:

1. signed and sealed by a licensed Professional Engineer in Commonwealth of Pennsylvania
2. State concrete compressive strength, reinforcing steel type and strength, and a listing of all component weights including lifting locations.
3. Show actual field conditions and true elevation and location supplied after field verification.
4. Detail reinforcement in beams and treads including clear dimension from concrete edge, size and amount of rebar in the form of callouts and bar schedule

D. FINAL SUBMISSION: Once a boardwalk, foundation and railing system design has been reviewed and accepted, the Contractor shall submit one set of all approved shop drawings to the Engineer's permanent records. The designer of is responsible for the review of any drawings prepared for fabrication. The contractor is responsible for verifying compatibility the boardwalk, foundation and railing system.

E. MATERIAL TEST
1. At least 30 days prior to fabrication, submit Concrete mix design with test data to confirm compressive strength for review and acceptance
2. At least 30 days prior to fabrication, rebar material certification for record
3. 60 days following fabrication, the results of the 28-day concrete compression tests, concrete batch slump test results, and air entrainment test result, taken once daily per fabrication or for every 50 CY of concrete production for record.
    d) Failure to meet requirements during fabrication will result in the batch of concrete being rejected and removed from production.
    e) The next two batches of concrete will then be tested.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Boardwalk supplier shall coordinate fabrication and delivery schedule of precast elements with overall construction schedule and progress and sequence to avoid delay in installation.

B. The Contractor shall immediately inspect the materials upon delivery to ensure that the proper type, grade and color of materials have been delivered. Material not meeting the requirements of the drawing and specifications shall be removed from the site and returned to the fabricator or with written permission from the fabricator legally disposed.

C. Precast concrete pieces that are stored at the manufacturer's facility
1. Precast concrete piece stored at the manufacturer's facility for any amount of time shall be handled and stored in a manner that will not result in damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, UV exposure or other causes.
2. Damaged materials shall not be incorporated into the work

D. Precast elements that are stored on site.
   1. On site storage shall be coordinated with the contractor and not interfere with construction activities.
   2. Precast concrete piece stored shall be handled and stored in a manner that will not damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, UV exposure or other causes. Damaged materials shall not be incorporated into the work, shall be removed from the site, and returned to the fabricator or with written permission from the fabricator legally disposed.

E. Precast elements damaged in storage or during installation shall be replaced at no additional cost to the owner.

1.9 WARRANTY:

A. Contractor will be responsible for installation defects associated with the boardwalk and abutment components, foundation system, and railings for a period of 12 calendar months from the date of final acceptance by the Owner.

B. Boardwalk manufacturer shall warranty all precast concrete components against defects in material and workmanship for a period of 10 years.

PART 2 - PRODUCTS

2.1 MATERIALS

A. PRECAST CONCRETE

1. Shall contain Type I, Type II or Type I/II cement, fine and course aggregates, admixtures and potable water
2. Shall contain fiber reinforcing conforming to ASTM C1165 as well as structural steel reinforcement shall conform to ASTM A615 as designed by the Engineer of Record
3. Shall meet production mix requirements of ASTM C94 and exhibit the following properties following:
   a) The minimum compressive strength of the concrete shall be 4000 psi at 28 days.
   b) Maximum Water to cement ratio (w/c) of 0.45
   c) Nominal maximum aggregate sizes of ¾”
   d) Air entrainment of 5.5% +/- 1.5%. The air-entraining may be obtained by the use of either an air entraining Portland cement or an air entraining admixture.

PART 3 - EXECUTION

3.1 PREPARATION

A. General
   1. Perform subsurface investigation as required

2. Design precast concrete boardwalk components
3. Coordinate layout and design with selected foundation type and design
4. Furnish elevated precast concrete boardwalk.

3.2 INSTALLATION

A. Installation of the precast concrete boardwalk system shall be performed in accordance to the approved plans and manufacturers installation instructions. Boardwalk supplier shall provide a field representative to review installation instructions with the Contractor and Engineer and to certify that the installation has been performed according to the approved drawings and manufacturer's instructions.

3.3 FINAL ACCEPTANCE

All components of elevated precast concrete boardwalk are to be evaluated under this specification

END SECTION 03 41 40

SECTION 06 90 01 – BOARDWALK AND TRAIL RAIL

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Work of this Section shall include furnishing, fabricating with respective protective coatings and treatments, preparing and erecting new rail along the boardwalk and wall supported trail segments to the limits shown on the Drawings.

B. The Work shall be coordinated with the following:
   1. Section 03 41 40 Elevated Precast Concrete Boardwalk
   2. Section 32 32 15 Precast Modular Block Gravity Retaining Wall

C. Measurement Procedure
   1. Boardwalk and Trail Rail shall be paid for at the contract lump sum price as listed in the bid proposal for "Elevated Precast Concrete Boardwalk" or "Precast Modular Block Gravity Retaining Wall". This price shall include but is not limited to, fabrication, labor, materials, tools, equipment, survey control, supervision, material testing required by the contract, appliances, incidentals, and selection of the means and methods for the installation.

D. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work described in 03 41 40 Elevated Precast Concrete Boardwalk or 32 32 15 Precast Modular Block Gravity Retaining Wall.

1.2 REFERENCES

A. Where the specification and reference documents conflict, written word shall govern. Immediately alert Contracting Office for resolution

B. AISC: American Institute of Steel Construction, Steel Construction Manual 15th Edition, 2017.

C. ASCE: American Society of Civil Engineers, ASCE 7-22, Minimum Design Loads and Associated Criteria for Buildings and Other Structures

D. ASTM: Specifications of the American Society for Testing and Materials, latest edition.
   1. ASTM A36 Standard Specification for Carbon Structural Steel
   2. ASTM A123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   3. ASTM A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

4. ASTM A307: Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod, Grade A
5. ASTM A563: Standard Specification for Carbon and Alloy Steel Nuts, Grade A
6. ASTM A992: Standard Specification for Structural Steel Shapes
7. ASTM A1060: Standard Specification for Zinc-Coated (Galvanized) Steel Welded Wire Reinforcement, Plain and Deformed, for Concrete
8. ASTM B117: Standard Practice for Operating Salt Spray (Fog) Apparatus
9. ASTM B571: Standard Practice for Qualitative Adhesion Testing of Metallic Coatings
10. ASTM D245: Standard Practice for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber
11. ASTM D1760: Standard Specification for Pressure Treatment of Timber Products
12. ASTM D1990: Standard Practice for Establishing Allowable Properties for Visually-Graded Dimension Lumber from In-Grade Tests of Full-Size Specimens
13. ASTM E3: Standard Practice for Preparation of Metallographic Specimens
14. ASTM F436: Standard Specification for Hardened Steel Washers
15. ASTM F844: Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
16. ASTM F3125 Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, Grade A325 Type 1
17. F1667 Standard Specification for Driven Fasteners: Nails, Spikes, and Staples

E. APWA: American Wood Preservative Association
1. AWPA U1: Use Category System: User Specification for Treated Wood
2. AWPA P5: Standard for Water-Borne Preservatives

F. AWS: American Welding Society D1.1 Structural Welding Code – Steel, 2020.

G. BUILDING CODE: Pennsylvania State Building Code, IBC 2018.

H. NDS: National Design Specification for Wood Construction, American Wood Council, 2018 and Supplements

I. OSHA: Occupational Health and Safety Administration.

J. SPIB: Southern Pine Inspection Bureau

1.3 SUBMITTAL

A. The Contractor shall submit the following for approval before commencing fabrication and applying protective coating
1. The manufacturer's product data sheet for the specified protective coating system(s).
2. Material Safety Data Sheets (MSDS)
3. Mill test reports and material test reports for structural steel and hardware

4. Welding procedures (WPS) and welder qualifications (WPQ) for Welded Wire Reinforcement
5. Detailed process descriptions for hot-dip galvanizing of structural plates and shape, and hardware.
6. Detailed process descriptions for timber pressure treatment
7. Quality Control Plan
   a) structural steel fabrication
   b) hot dip galvanizing of structural steel and hardware
8. Reactive Color Treatment for Galvanized Surfaces
   a) Two (2) samples 2”x2” or greater that have been galvanized and have had Reactive Color Treatment applied. One (1) shall be sent to the Contracting Office and the other to the Park (Delaware Water Gap National Recreation Area)
   b) Bend Test results showing that the galvanized steel, treated by the reactive color treatment, exhibits no lifting or separation from mechanical stress as per ASTM B571
   c) Cross-sectional metallographic examinations, in accordance with ASTM E3, conclude an average conversion depth of 0.18 mil and no decrease in total thickness
   d) Corrosion resistance showing the performance of the galvanized steel, treated with the reactive color treatment, meets or exceeds the corrosion resistance of un-treated galvanized steel after 50 hours of salt spray as per ASTM B117.
9. Quality Control Inspector (QCI) qualifications

B. Shop Drawings
1. PLAN VIEW: Full plan view of the railing on both the precast concrete boardwalk and block wall supported trail drawn to scale clearly showing railing locations in coordination with the precast concrete boardwalk supplier’s layout and the modular block wall supplier’s layout. The plan view must reflect the proposed horizontal alignment as shown on the drawings.
2. ELEVATION VIEW: Partial elevation view of the railing to scale clearly showing foundation and railing locations and reflect the actual vertical alignment. Elevation or plan view shall indicate the elevation at the top and bottom of the rail post and panels, horizontal and vertical break points, and location of the finished grade.
3. DETAILS: Details of all the railing system connections to the boardwalk and mounting methods such as the length, size and where changes occur.
4. CODE REFERENCE: Notes listing design parameters used along with Design Code references

1.4 QUALITY ASSURANCE

A. The contractor shall employ highly skilled workers with experience in timber and steel construction for the boardwalk and rail fabrication and installation.

B. Material Certification

1. The Contractor shall submit manufacturers' or supplier's written certification of the timber species and grade.
2. The Contractor shall submit manufacturers' or supplier's written certification of the structural steel and hardware.

C. Test Panel Mock-Up:
1. Provide, a mock-up for evaluation two adjacent railing panels for both boardwalk mounted segments and block wall mounted segments showing the installation techniques and application workmanship.
2. Apply colorant to a minimum 12-inch sample section of galvanized metal. In the event more than one (1) sample section is required by the OWNER/ENGINEER, each additional sample section will be paid for as change order work.
3. Use the OWNER/ENGINEER sample as the standard of comparison in determining acceptability of final color.
   a) Note that there are many variables that can impact the finished appearance such as: variances in galvanizing, time of year that the sample and project items were galvanized, time of year that colorant was applied, etc. Due to this, the sample will not necessarily match perfectly with the final project but should be an approximate representation of the rustic/weathered finish.
   b) Do not proceed with remaining work until mock-up is accepted by the ENGINEER or OWNER.
   c) Refinish mock-up area as required to produce acceptable work.

D. Field Measurements: Where RAIL is indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication; show recorded measurements on final shop drawings:

E. Where field measurements cannot be made without delaying the railing fabrication and delivery, obtain guaranteed dimensions in writing by the CONTRACTOR and proceed with fabrication of products so as not to delay fabrication, delivery and installation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Railing supplier shall coordinate fabrication and delivery schedule of railing elements with block wall and precast boardwalk and overall construction schedule and progress and sequence to avoid delay in installation.

B. The Contractor shall immediately inspect the materials upon delivery to ensure that the proper type, grade and color of materials have been delivered. Material not meeting the requirements of the drawing and specifications shall be removed from the site and returned to the fabricator or with written permission from the fabricator legally disposed.

C. Storage at the fabricator's facility
   1. Railing components stored at the manufacturer's facility for any amount of time shall be handled and stored in a manner that will not result in damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, UV

exposure or other causes.

2. Damaged materials shall not be incorporated into the work

D. Storage on site.
   1. On site storage shall be coordinated with the contractor and not interfere with construction activities.
   2. Railing components stored shall be handled and stored in a manner that will not damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, UV exposure or other causes. Damaged materials shall not be incorporated into the work, shall be removed from the site, and returned to the fabricator or with written permission from the fabricator legally disposed.

E. Railing in storage or during installation shall be replaced at no additional cost to the owner.

PART 2 - PRODUCTS

2.1 TIMBER RAIL and RAIL CAPS

A. Species: Southern Yellow Pine

B. Commercial Grade: #1 per SPIB and NDS

C. Surfacing: Surfaced Four Sides (S4S) Timber must be sawn through in one pass. No kerfs, misalignments, or scorching will be accepted.

D. Dimensions: All timber dimensions shall be standard "dressed" dimension for lumber as defined by SPIB.

E. Timber must be square, true, and free from warping over 1/8 inch per foot. Rotational warping greater than 1/4 inch over the length of the finished timber is unacceptable. Checking over 1/4 inch and through checks are not acceptable. Butt ends shall be free from splits.

2.2 WOOD TREATMENT (PRESSURE TREATMENT)

A. Wood treatment chemical shall be compatible with human contact

B. The AWPA use category for wood treatment shall by UC3B. All treated timber shall have a pressure treatment retention level consistent with this category and timber species.

C. When possible, pre-cut and drill wood before treatment. Dry lumber after treatment to a maximum moisture content of 19 percent before installation.

2.3 RAIL PANEL HARDWARE

A. Hardware associated with the timber fabrication and installations shall be as follows:
   1. Bolts: round head ASTM A307 Grade A

2. Nuts: ASTM A563 Hex Grade A
3. Washers: ASTM F844
4. Nails: ASTM F1667 ring shank

2.4 STRUCTURAL STEEL

A. All structural steel, including steel rail posts, post anchor rolled shapes and plates, shall conform to the requirements ASTM A992

B. Structural steel members shall be cut, shaped, and formed to the required dimensions, ensuring proper fit-up for welding or bolting. Flame cutting and mechanical cutting methods must be controlled to prevent material distortion and comply with AISC standards.

C. Holes for bolts shall be produced by drilling or sub-punching and reaming. Hole sizes and tolerances shall conform to AISC.

D. Burrs on the surfaces shall be removed by a method that leaves the hole free of burrs inside and out. The method shall not dish-out (reduce its thickness) the metal in the vicinity of the hole.

2.5 STRUCTURAL STEEL HARDWARE

A. Hardware associated with the timber fabrication and installations shall be as follows:
1. Bolts: ASTM F3125 Grade A325
2. Nuts: ASTM A563 Heavy Hex Grade A
3. Washers: ASTM F436 Hardened Washer

2.6 WELDED WIRE MESH

A. Shall have a minimum 10 gage carbon steel wire with a maximum opening size of 2”(H) x 4”(V) and shall conform to the requirements ASTM A1060.

B. The welded wire mesh shall be manufactured by welding the intersecting wires at each intersection, ensuring all wires are securely fused together to produce a consistent and durable mesh.

C. Each RAIL panel will be made up of a single piece of welded wire mesh. Splices will not be allowed.

D. Welded wire mesh panels shall be free of damage and bend. Any defective panels or damaged mesh discovered shall be replaced at no additional cost to the OWNER.

2.7 SELF CLOSING GATE HINGES

A. Hinges shall be full surface mounted with backing plates suitable for outdoor use.
1. Size and number of hinges shall be sufficient to support 150% of the gate weight.
2. Fasteners shall be tamper resistant.

3. Shall have a weather resistant cap.

B. Hinges shall be made of Type 316 Stainless Steel with a dark bronze powder coat finish.

C. Closing Mechanisms
1. Shall be spring powered. Hydraulic powered and hydraulic damping will not be accepted.
2. Shall not have adjustable swing or latch speed control.
3. Shall not have a door stop or hold open capability.

2.8 STEEL PROTECTIVE COATINGS

A. All structural steel, including steel rail posts, post anchor rolled shapes and plates, shall Hot-Dip Galvanized conform to the requirements ASTM A123.

B. All steel hardware, bolts, nuts, and washer shall be Hot-Dip Galvanized conform to the requirements ASTM A153.

C. Welded Wire Mesh shall be Hot-Dip Galvanized conform to the requirements ASTM A123.

D. The following items shall receive an environmentally safe reactive color treatment, specifically formulated for galvanized metal. Product shall achieve a rustic brown color (mostly dark brown with some lighter brown hues and characteristics that produce an aged/rustic look), with matte finish:
1. Exposed surfaces of structural steel rail post
2. Rail post anchor rolled shapes and hardware
3. Welded wire mesh, and hardware for the fabrication and installation of the rail panels

E. Environmentally Safe Reactive Color Treatment
1. Reactive color treatment must not include volatile organic compounds (VOC's) or chromate compounds.
2. The colorant must be a soluble solution (never in powdered form) and must contain organic acids to slightly etch into galvanized surfaces without affecting the protection of the galvanized layer. Organic acids used will have no negative effects on the environment. The product must react with the target surface to produce a rustic brown/weathered finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. General
1. Construct all Boardwalk and Trail Rail as shown within the drawings

3.2 INSTALLATION

A. The Contractor shall construct two complete test panel mock-up of the rail, for review and approval before beginning production of the Boardwalk and Trail Rail. The two sections shall include three posts and two panel assemblies including all associated timber and hardware. The sample panel protective coating may be limited at noted in Section 1.3 C1.

B. Environmentally Safe Reactive Color Treatment

1. Application
   a) After areas to be treated have been prepared and the sample approved, apply colorant to target galvanized surfaces. Apply product according to the manufacturer′s instructions to achieve a color consistent with the approved sample.
   b) Colorant must be applied uniformly. Irregularities (above and beyond those that the product naturally produces) must be corrected according to the product manufacturer′s recommendations.
      - Treated surfaces must be kept dry for a period of 5 days following the application of colorant or additional coats may be required.
   c) Material should be applied outdoors with daytime temperatures above 60 degrees and nighttime temperatures above 45 degrees (lower temperatures may be okay in some situations. Please contact the manufacturer for more information).
2. Storage
   a) Treated surfaces must be stored properly at the construction yard after delivery and before, and up to, time of installation per American Galvanizers Association (AGA) Guidelines.
   b) Items should be stacked perpendicular to the ground slope to allow for proper drainage.
   c) Items should be elevated so they do not come into direct contact with soil or plant matter.
   d) If components stack spacers should be placed between rows to allow for necessary airflow.
   e) All other standard storage procedures for galvanized metal should be met.
   f) It is the responsibility of the CONTRACTOR to ensure that all components are stored properly on site.

C. Carriage bolts shall not be overtightened. Connections shall be tightened so that the flat washer just starts to press into the wood substrate.

D. Steel shims between the post and in-fill panel may be used to get a tight fit connection between the in-fill panel and the railing post.

1. A single shim on each side of the in-fill panel at the railing post.
2. Steel shims shall be the same material (A36 steel) and have the same protective coating (galvanized) as the railing post.

3. Steel shims should not project beyond the railing post flanges.

E. Core holes for railing posts in the concrete block wall units shall maintain a minimum of 3” clear distance to all edges of the block. Any core hole that results in less than the minimum clear distance shall be removed and replaced at no additional cost and shall be disposed of off site in a legal manner.

3.3 FINAL ACCEPTANCE

A. All components of boardwalk and trial rail are to be evaluated under this specification

END OF SECTION 06 90 01

SECTION 10 14 53 – TRAFFIC SIGNAGE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of constructing permanent traffic control signs, supports, delineators, and object markers, and removing and resetting permanent traffic control devices. All requirements for traffic signs shall be in accordance with the latest version of Manual of Uniform Traffic Control Devices (MUTCD), National Park Service UniGuide Signs, and the PennDOT Construction Specifications and all referenced sections:
   1. PennDOT Section 900 Traffic Accommodation and Control
   2. PennDOT Section 1103 – Traffic Signing and Marking

B. Measurement Procedures
   1. Sign Panels will be measured for by the unit of square foot.
   2. Sign Posts will be measured for by the unit of linear foot.
   3. Markers and Delineators, not covered above, will be measured for by the unit of each.

C. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work described in this section.

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials
   1. AASHTO M 111 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   2. AASHTO M 164 - Standard Specification for High-Strength Bolts for Structural Steel Joints
   3. AASHTO M 168 - Standard Specification for Wood Products
   4. AASHTO M 232 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
   5. AASHTO M 253 - Standard Specification for Structural Bolts, Alloy Steel, Heat-Treated, 150 ksi Minimum Tensile Strength
   6. AASHTO M 268 - Standard Specification for Retroreflective Sheeting for Flat and Vertical Traffic Control Applications
   7. AASHTO T 257 - Standard Method of Test for Instrumental Photometric Measurements of Retroreflective Materials and Retroreflective Devices
   8. AASHTO T 310 - Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)
   9. AASHTO T 99 - Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

B. ASTM – ASTM International
   1. ASTM A 1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
   2. ASTM A 242 - Standard Specification for High-Strength Low-Alloy Structural Steel

3. ASTM A 36 - Standard Specification for Carbon Structural Steel
4. ASTM A 499 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
5. ASTM A 588 - Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance
6. ASTM A 635 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirement
7. ASTM A 715 - Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled, and Steel Sheet, Cold-Rolled, High-Strength, Low-Alloy, with Improved Formability
8. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
9. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
10. ASTM D 4956 - Standard Specification for Retroreflective Sheeting for Traffic Control

C. FAR - Federal Acquisition Regulations
1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL
1. The Contractor shall submit Shop Drawings of all signs and supports shall be submitted to the CO for approval. Do not order material or begin fabrication until CO's approval has been obtained.
2. Show sizes and thicknesses of all members, types of materials, methods of construction and assembly, type of surface treatment, complete dimensions, hangers, brackets, anchorage, fasteners, relationship to surrounding work by other trades, shop finishes, sign designs, layouts, and lettering, and other pertinent details of fabrication and installation.
3. The Contractor shall provide a manufacturer's warranty for permanent traffic control signs. Providing a manufacturer's warranty of the type and length specified will be considered incidental to the cost of the sign panel or overlay sign panel.

PART 2 – PRODUCTS

1.1 MATERIALS

A. All requirements for traffic signs shall be in accordance with the latest version of Manual of Uniform Traffic Control Devices (MUTCD), National Park Service UniGuide Signs, and the PennDOT Construction Specifications and all referenced sections:
1. PennDOT Section 900 Traffic Accommodation and Control
2. PennDOT Section 1103 – Traffic Signing and Marking

B. Aluminum Panels. Conform to ASTM B 209, alloy 6061-T6 or 5052-H38.

Fabricate all temporary panels and those permanent panels that are 30 by 30 inches or smaller from 0.080-inch thick aluminum sheets. Fabricate larger permanent panels from 0.125-inch thick aluminum sheets.

The blanks shall be free from laminations, blisters, open seams, pits, holes, or other defects that may affect their appearance or use. The thickness shall be uniform and the blank commercially flat. Perform shearing, cutting, and punching before preparing the blanks for application of reflective material.

Clean, degrease, and chromate the blanks or otherwise properly prepare the panels according to methods recommended by the sheeting manufacturer.

C. Plastic Panels.

1. Plastic. Furnish light, flexible, high-impact, and ultraviolet chemical resistant polycarbonate material, or approved equal that will accept adhesives, coatings, and retroreflective sheeting material as recommended for such material.

   Fabricate panels that are 24 by 24 inches or smaller from 0.08-inch thick plastic blanks. Fabricate larger panels from 0.125-inch thick plastic blanks.

   The panels shall be flat and free of buckles, warps, and other defects. Where multiple panels adjoin, the gap between adjacent panels shall not be greater than 5/8 inches. Signs larger than 24 by 24 inches shall have reinforcement stiffeners attached on the back for rigidity and for mounting on the supports.

D. Extruded Aluminum Panels. Furnish panels conforming to ASTM B 221, aluminum alloy 6063-T6. For panel thickness and fabrication, conform to Section 2.1 A. The maximum allowable deviation from flat on the face is 0.05 inches per foot.

E. Signposts. Furnish wood, steel, or aluminum signposts as specified.

1. Wood posts. Furnish posts from dry no. 1 grade Douglas fir, southern or Ponderosa pine, hemlock, spruce, or western larch conforming to AASHTO M 168. Treat the posts with water-borne preservative ACA, ACZA, or according to AWPA Standard C14 except the minimum preservative retention is 0.40 pounds per cubic foot.

2. Galvanized steel posts. Furnish posts that are straight, smooth, and free from defects affecting strength, durability, or appearance. Conform to the following:
   a) U-channel steel posts. Furnish flanged, channel, galvanized steel posts conforming to ASTM A 499, grade 60, and dimensions of U cross-section

(1) Width of opened end of U including flanges	3.0 – 3.5 inches
(2) Width of closed end of U	1.0 – 1.6 inches
(3) Depth of U	1.0 – 2.0 inches
(4) Thickness of steel	0.12 – 0.20 inches

b) Punching. Starting 1 inch from the top and extending the full length of the post, drill or punch 3/8-inch holes on 1-inch centers along the centerline of the bottom of the U. Remove all burrs and sharp edges.

c) Galvanizing after punching — AASHTO M 111

3. Square tubular steel posts. Furnish square tubular galvanized steel posts conforming to ASTM A 1011, grade 55, or ASTM A 715, grade 60, and the following:

a) Dimensions

(1) Outside dimensions	1¾ by 1¾ inches or 2 by 2 inches
(2) Wall thickness	0.083 inches
(3) Mass	1.7 – 2.0 pounds per foot

b) Punching. Starting 1 inch from the top and extending the full length of the post, drill or punch 7/16-inch holes on 1-inch centers along the centerline of all four sides, in true alignment and opposite each other directly and diagonally. Remove all burrs and sharp edges.

c) Galvanizing after punching (inside and outside of post) — ASTM A 635, coating Z275 designation

4. Aluminum posts. Furnish approved standard shapes and thicknesses conforming to ASTM B 221, alloy 6061-T6, 6351-T5, 6063-T6, or 6005-T5.

5. Corrosion resistant steel posts. Furnish posts conforming to ASTM A 588 or ASTM A 242

F. Paint:

1. All posts and sign backs are to be painted "NPS Brown"
2. Benjamin Moore, Moorgard, Exterior Latex, Low Luster Paint, Federal Standard: 595B, Color Number 20059 (Brown) shall be used for NPS Brown or equal approved by CO. Approved paint can be used on any surface with the appropriate primer; Wood, Non-Ferrous Metal, Ferrous Metal.

G. Object Marker and Delineator Posts. Furnish wood, steel, or aluminum object marker and delineator posts. Delineator posts may also be fabricated from plastic.

1. Wood posts. Furnish 4- by 4-inch wooden posts conforming to Subsection 2.1.F.
2. Steel posts. Furnish flanged U-channel steel posts weighing not less than 2 pounds per foot and conforming to ASTM A 36. Galvanize the posts according to AASHTO M 111.
3. Aluminum posts. Furnish standard shaped 1/8-inch thick aluminum posts conforming to ASTM B 221, alloy 356.0-T6.
4. Plastic posts. Furnish flexible delineator posts made with high impact resistant polymer material.

H. Hardware. For lag screws, washers, clip angles, wood screws, shear plates, U-bolts, clamps, bolts, nuts, and other fasteners, use galvanized steel or aluminum alloy.

For high-strength steel bolts, nuts, and washers, conform to AASHTO M 164 or M 253. Galvanize steel hardware according to AASHTO M 232.

For aluminum alloy bolts, nuts, and washers, conform to *Specifications for Aluminum Structures*.

Furnish oversize bolt heads and oversize neoprene or nylon washers for plastic sign panels.

I. Letters, Numerals, Arrows, Symbols, and Borders. Colors will be specified in the contract and shall conform to Subsection 2.1.H.

Form letters, numerals, and other units to provide a continuous stroke width with smooth edges. Make the surface flat and free of warp, blisters, wrinkles, burrs, and splinters. Conform to one of the following:

1. Type L-1 (screen process). Apply letters, numerals, arrows, symbols, and borders on the retroreflective sheeting or opaque background of the sign by direct or reverse screen process. Apply messages and borders of a color darker than the background to the paint or the retroreflective sheeting by direct process. Produce messages and borders of a color lighter than sign background by the reverse screen process.

   Use opaque or transparent colors, inks, and paints in the screen process of the type and quality recommended by the retroreflective sheeting manufacturer.

   Perform the screening in a manner that results in a uniform color and tone, with sharply-defined edges of legends and borders, and without blemishes on the sign background that will affect intended use.

   Air dry or bake the signs after screening according to manufacturer's recommendations to provide a smooth hard finish. Any signs with blisters or other blemishes will be rejected.

2. Type L-3 (direct applied characters). Cut letters, numerals, symbols, borders, and other features of the sign message from the type and color of the retroreflective sheeting specified, and apply to the sign background's retroreflective sheeting according to the retroreflective sheeting manufacturer's instructions. For the retroreflective sheeting minimum coefficient of retroreflection (RA), conform to AASHTO M 268.

J. Delineator and Object Marker Retroreflectors. Furnish type 1 or type 2 retroreflectors that are ready for mounting. Furnish antitheft hardware for mounting as required.

1. Type 1 (acrylic plastic lens). Furnish a 7-square inch minimum acrylic plastic lens with prismatic optical elements and a smooth, clear, transparent face. Fabricate the back from similar material and fuse it to the lens around the entire perimeter to form a homogenous unit. Permanently seal the units against the intrusion of dust, water, or air. Conform to Table 10 14 53-1 regardless of the orientation angle.

Table 10 14 53-1
Minimum Coefficient of (Retroreflective) Luminous Intensity (R_I) (1)
Candelas per Footcandle

Observation Angle °	Entrance Angle °	White(2)	Yellow	Red
0.1	0	115	70	30
0.1	20	45	25	12

(1) See AASHTO T 257.
(2) Crystal, clear, or colorless are acceptable color designations.

Mount the retroreflector unit in a housing fabricated from 0.063-inch aluminum alloy 3003-H-14 or similar, or from cold rolled, hot dip, galvanized steel, having a thickness of 0.064 inches. Provide antitheft attachment hardware.

2. Type 2 (retroreflective sheeting). Furnish a fungus resistant type III, V, VII, VIII, or IX retroreflective sheeting with a class 1 or 2 adhesive backing conforming to ASTM D 4956. Attach the sheeting to an aluminum or plastic support panel (target plate) of the size and dimension specified.

K. Sign panels are designated as plywood, aluminum, steel, plastic, or fiberglass reinforced plastic.

L. Sign retroreflective sheeting type conforms to ASTM D 4956 Supplemental Requirement S1, Fungus Resistance, if specified. For reboundable retroreflective sheeting, conform to ASTM D 4956 including Supplemental Requirement S2, Reboundable Sheeting Requirements.

When an adhesive is used, use ASTM D 4956, backing class 1, 2, or 3.

M. Posts are designated as wood, aluminum, galvanized steel, or corrosion resistant steel.

N. National Park Service Signs shall have 4”x4: pressure treated (non-painted) wood posts.

O. National Park Service signs shall have the back of the sign painted to match NPS Brown.

PART 3 – EXECUTION

3.1 PREPARATION

A. General
1. Perform all work for furnishing and installing traffic signs in accordance with the latest version of Manual of Uniform Traffic Control Devices (MUTCD), National Park Service UniGuide Signs, and the PennDOT Construction Specifications and all referenced sections:
   a) PennDOT Section 900 Traffic Accommodation and Control
   b) PennDOT Section 11103 – Traffic Signing and Marking
2. Contractor shall stake all locations for NPS approval for exact location review prior to installation

3.2 INSTALLATION

A. Supports

1. Sign locations may be changed to fit field conditions as approved by the Contracting Officer (CO). Determine sign support lengths at time of staking. Install supports plumb and according to the manufacturer's instructions. Make all supports within the clear zone crashworthy.
2. Drive posts with a suitable driving head or set posts in drilled or punched holes. Replace all damaged posts.
3. Construct concrete footings according to Specification 03 30 53. Excavate and backfill:

    c) Place backfill in horizontal layers that, when compacted, do not exceed 6 inches in depth. Compact each layer according to (b) below.
    Bring backfill up evenly on all sides of the structure, and extend each layer to the limits of the excavation or to natural ground.
    Do not place backfill against concrete less than 7-days-old or until 80 percent of the design strength is achieved.

    d) Compact material placed in all layers to at least 95 percent of the maximum density. Determine the inplace density and moisture content according to AASHTO T 310 or other approved test procedures.
    Do not apply density requirements as measured by AASHTO T 310 to material that is incapable of being tested or compacted to maximum values determined by AASHTO T 99. For these materials, fill the voids around the rock in each layer with earth or other fine material. Compact each layer, full width, until there is no visible evidence of further consolidation.

B. Panels

1. Use type III, VII, VIII, or IX retroreflective sheeting. For permanent sign panels, use type L-1 letters, numerals, arrows, symbols, and borders. Cut panels to size and shape and drill or punch all holes. Make panels flat and free of buckles, warp, dents, cockles, burrs, and other defects.
2. Clean and degrease the face of metal panels using methods recommended by the retroreflective sheeting manufacturer. Abrade, clean, and degrease the face of the plywood panels using methods recommended by the retroreflective sheeting manufacturer. Treat the edges of the plywood panel with an approved edge sealant. Apply the retroreflective sheeting material to the panels. Package sign panels in protective material and transport them in a vertical position.
3. Mount sign panels with the legend horizontal. Where multiple panels adjoin, limit the gap between adjacent panels to 1/16 inch. To reduce specular glare (mirror reflection), turn the sign panel 3 degrees away from the road in the direction of travel.
4. Use oversized bolt heads and neoprene or nylon washers for fastening plastic sign panels.
5. Do not field drill holes in any part of the panel. Use antitheft fasteners where possible. Paint all bolt heads, screw heads, and washers that are exposed on the sign face. Match the color of the paint to the color of the background or message area at the point where the fitting is exposed.

6. If a sign message is not applicable, completely cover the face of the sign with an opaque material. Maintain the covering in good condition until the message becomes applicable. Do not use adhesive tape on the sign face.
7. Repair or replace damaged parts including sheeting.

C. Delineators and Object Markers
   1. Attach delineators and object markers to posts according to the manufacturer's recommendation.

D. Removing and Resetting Permanent Traffic Control Devices
   1. Remove and store the existing signs, delineators, and object markers. Replace all devices, posts, and hardware damaged during removal, storage, and raising.

3.3 FINAL ACCEPTANCE

1. Material (including signs panels, retroreflective sheeting, supports, delineators, object markers, and hardware) for traffic control devices will be evaluated under this specification**.**

2. Installation of traffic control devices will be evaluated under this specification.

3. Excavation and backfill will be evaluated under Specification 31 00 00.

4. Concrete will be evaluated under Specification 03 30 53.

END OF SECTION 10 14 53.

SECTION 31 00 00 – EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of excavating material. This includes furnishing, hauling, stockpiling, placing, disposing, sloping, shaping, compacting, and finishing material.
B. Measurement Procedures
    1. Excavation shall be measured by units of cubic yards.
    2. Select Material shall be measured by units of cubic yards.
    3. The lump sum contract bid price for erosion control will include:
        - all testing required by the contract.
        - all materials, labor and equipment required to meet required and sedimentation control requirements.

C. Payment Procedures
    1. The accepted work will be paid at the contract lump sum price for all work.

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials
    1. AASHTO M 145 - Standard Specification for Classification of Soils and Soil–Aggregate Mixtures for Highway Construction Purposes
    2. AASHTO M 157 - Standard Specification for Ready-Mixed Concrete
    3. AASHTO T 11 - Standard Method of Test for Materials Finer Than 75-μm (No. 200) Sieve in Mineral Aggregates by Washing
    4. AASHTO T 180 - Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
    5. AASHTO T 224 - Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test
    6. AASHTO T 26 - Standard Method of Test for Quality of Water to Be Used in Concrete
    7. AASHTO T 27 - Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
    8. AASHTO T 310 - Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)
    9. AASHTO T 99 - Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
B. FAR - Federal Acquisition Regulations
    1. FAR 46.105 Contractor responsibilities
    2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
    3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL

A. Submit material certificate to the Engineer, signed by the material producer and Contractor, certifying that materials comply with these specifications and the construction plans.

1.4 DEFINITION

A. Excavation. Excavation consists of the following:

1. Roadway excavation. All material excavated from within the right-of-way or easement areas, except subexcavation covered in (2) below and structure excavation. 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 groundline in embankment sections. Subexcavation does not include topsoil, rock cuts, or earth cuts.

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

B. Conserved topsoil

1. Excavated material conserved from the roadway excavation areas that is suitable for growth of grass, cover crops, or native vegetation.

C. Waste

1. Excess and unsuitable roadway excavation and subexcavation that cannot be used.

PART 2 – MATERIALS

2.1 MATERIALS

A. Conform to the following section and subsections:

1. Backfill material – Furnish a well-graded, compactable material free of excess moisture, muck, frozen lumps, roots, sod, or other deleterious material conforming to the following:
(a) For all structures and pipes other than plastic pipe:
(1) Maximum particle size 3 inches
(2) Soil classification, AASHTO M 145 A-1, A-2, or A-3
(b) For plastic pipe:
(1) Maximum particle size 1½ inches
(2) Soil classification, AASHTO M 145 A-1, A-2-4, A-2-5, or A-3

2. Select borrow – Furnish granular material free of excess moisture, muck, frozen lumps, roots, sod, or other deleterious material conforming to the following:
(a) Gradation Table 31 00 00-1
(b) Liquid limit, AASHTO T 89 30 max.

Table 31 00 00-1
Select Borrow Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & T 11)
3 inch	100
1 inch	70-100
No. 4	30-70
No. 200	0-5

3. Water – Conform to the following:
   (a) Water for mixing or curing cement concrete, mortar, or grout. Conform to AASHTO M 157. Potable water of known quality may be used without testing according to AASHTO T 26. Potable water is safe for human consumption as defined by the public health authority having jurisdiction.
   (b) Water for planting or care of vegetation. Furnish water that is free of substances injurious to plant life such as oils, acids, alkalies, or salts.
   (c) Water for earthwork, pavement courses, dust control, and incidental construction. Furnish water free of substances detrimental to the work.

PART 3 – EXECUTION

3.1 PREPARATION

1. Clear the area of vegetation and obstructions within the clearing limits as follows:
   a. Cut all trees so they fall within the clearing limits.
   b. In areas of cut slope rounding, cut stumps flush with or below the final groundline.
   c. In areas outside the excavation and slope rounding limits, cut stumps to within 6 inches of the ground.
   d. Trim tree branches that extend over the road surface and shoulders to attain a clear height of 20 feet. If required, remove other branches to present a balanced appearance. Trim according to accepted tree surgery practices. Treat wounds with tree wound dressing.

3.2 PROCESS

A. Conserved Topsoil
   1. Conserve topsoil from excavated areas. Stockpile conserved topsoil at an approved location.

B. Roadway Excavation
   1. Excavate as follows:
      a. General. Do not disturb material and vegetation outside the construction limits.
      b. Replace any shortage of suitable material caused by premature disposal of roadway excavation.
      c. Dispose of unsuitable or excess material legally off the project.

d. At the end of each day's operations, shape to drain and compact the work area to a uniform cross-section. Eliminate all ruts and low spots that could hold water.

C. Compaction. For the purpose of compaction, use AASHTO T 27 to determine the amount of material retained on a No. 4 sieve. Compact as follows:

1. More than 80 percent retained on a No. 4 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 per second and vibratory rollers at speeds less than 3 feet 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 impact per vibration and a minimum frequency of 1000 vibrations per minute.
   b. Eight roller passes of a 20-ton compression-type roller.
   c. Eight roller passes of a vibratory roller having a minimum dynamic force of 30,000 pounds impact per vibration and a minimum frequency of 1000 vibrations per minute.

   Increase the compactive effort for layers deeper than 12 inches as follows:

   - For each additional 6 inches or fraction thereof, increase the number of roller passes in (a) above by four passes.
   - For each additional 6 inches or fraction thereof, increase the number of roller passes in (b) and (c) above, by eight passes.

2. 50 to 80 percent retained on a No. 4 sieve. Use AASHTO T 99 to determine the optimum moisture content of the portion of the material passing a No. 4 sieve. Multiply this number by the percentage of material passing a No. 4 sieve, and add 2 percent to determine the optimum moisture content of the material. 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 rollers at speeds less than 6 feet per second and vibratory rollers at speeds less than 3 feet per second. Compact each layer of material full width according to (1) above.

3. Less than 50 percent retained on a No. 4 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 180, method D. For other material classifications, determine the optimum moisture content and 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.

D. Earth cuts

1. Scarify earth cuts to 6 inches below subgrade within the roadbed limits. Compact the scarified material according to Subsection 3.1.D.

E. Subexcavation

1. Excavate material to the limits designated by the Contracting Officer (CO).
   a. Take roadway cross-sections normal to centerline. When the centerline curve radius is less than or equal to 500 feet, take cross-sections at a maximum centerline spacing of 25 feet. When the centerline curve radius is greater than 500 feet, take cross-sections at a maximum centerline spacing of 50 feet. Take additional cross-sections at significant breaks in topography and at changes in the typical section. Along each cross-section, measure and record points at breaks in topography, but no further apart than 20 feet. Measure and record points to at least the anticipated slope stake and reference locations. Reduce all cross-section distances to horizontal distances from centerline.
2. Prevent unsuitable material from becoming mixed with the backfill.
   a. Dispose of unsuitable or excess material legally off the project.
   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.
3. Backfill the subexcavation with topping, or other suitable material. Compact the material according to Subsection 3.1.D.

F. Borrow Excavation

1. Use all suitable roadway excavation in construction. Do not use borrow excavation when it results in excess roadway excavation. Deduct excess borrow excavation from the appropriate borrow excavation quantity.

2. Obtain borrow source acceptance. Develop and restore borrow sources. Do not excavate beyond the established limits. When applicable, shape the borrow source to permit accurate measurements when excavation is complete.
   a. Notify the CO 14 days before starting pit operations. Develop and operate within a material source according to the accepted plan of operation or written agreement for developing the source.
   Before developing a material source, measure the sediment content of bodies of water adjacent to the work area that will receive drainage from the work area. Control all erosion so the sediment levels in the bodies of water within the drainage area of the work area do not increase. Control erosion so that sediment does not leave the work area.

G. Disposal of Unsuitable or Excess Material

1. Dispose of unsuitable or excess material legally off the project.

3.3 FINAL ACCEPTANCE

1. See Table 31 00 00-1 for sampling and testing requirements.
2. Conserved topsoil will be evaluated under Specification 32 91 19.12.
3. Excavation and embankment construction will be evaluated under this specification.
4. Clearing and removal of obstructions will be evaluated under Specification 02 41 13.
5. Placing of conserved topsoil will be evaluated under Specification 32 91 19.12.

END OF SECTION 31 00 00.

SECTION 31 11 00 – CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of clearing and grubbing within the clearing limits designated on the plans.

B. Measurement Procedures
   1. Clearing and Grubbing will be measured by a lump sum basis.

C. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work described in this section.

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials
   1. AASHTO T 310 - Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)
   2. AASHTO T 99 - Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

PART 2 – PRODUCTS

2.1 MATERIALS

A. Backfill Material – Furnish a well-graded, compactable material free of excess moisture, muck, frozen lumps, roots, sod, or other deleterious material conforming to the following:
   a. Maximum particle size — 3 inches
   b. Soil classification, AASHTO M 145 — A-1, A-2, or A-3

PART 3 – EXECUTION

1.1 CONSTRUCTION REQUIREMENTS

A. General
   1. Establish limits of clearing by staking the Limits of Disturbance as noted on the plan drawings.
   2. Construct erosion control measures according to Section 31 25 00. Perform work within designated limits of excavation, as shown on the plans. Do not damage vegetation and trees designated to remain. If vegetation designated to remain is damaged or destroyed, repair or replace the vegetation in an acceptable manner. Treat cuts or scarred surfaces of trees and shrubs with tree wound dressing.

B. Tree Protection Zones
   1. After completion of setting of the clearing stakes, allow 14 calendar days for the CO, in consultation with the park, to identify the locations where vegetation is to be preserved within the construction zone. Identification will consist of flagging, staking, etc.

2. Once the CO has identified locations for vegetation preservation, erect fence enclosures around trees to be protected. These fenced enclosures are considered tree protection zones (TPZs).
3. Do not allow equipment, materials or construction activities to contact foliage, crowns or branching structure for vegetation within the TPZs. Preserve roots and soil conditions in an intact and non- compacted state for vegetation within the TPZs.
4. No soil disturbance is permitted and construction activities are restricted within the TPZs unless otherwise approved by the CO.
5. Establish TPZs using highly visible orange fencing at least 36-inches in height, secured with stakes of equal or greater height, prior to the start of any ground disturbance.
6. Establish the TPZs outside of the drip line of the tree, or as directed by the co in consultation with the park representative.
7. Do not alter grade within the TPZs, store construction materials, equipment, soil, construction waste or debris.
8. Do not dispose of any liquids within the TPZ.
9. Do not park vehicles or equipment within the TPZ.
10. Erect TPZ fencing before any ground disturbance, demolition, grading, or construction begins, and maintain the TPZ fencing for the duration of the project.
11. Maintain the TPZ fencing in place until final inspection of the project.
12. If TPZ temporary fencing is damaged, knocked down or destroyed, suspend work in the area until the identification and/or protection is repaired to the satisfaction of the co at no additional cost to the government.
13. If any of the landscape that is designated to be protected or to remain is disturbed, the contractor will restore, mitigate, or compensate for the area as determined by the co, at no additional cost to the government.

C. Clearing
1. Within the clearing limits, clear brush, downed timber, and other vegetation.
2. Downed timber less than 12" diameter at clearing limits: Downed timber shall be cut at clearing limits. Remove all portions of downed timber within the clearing limits.
3. Downed timber 12" diameter or greater: Contracting Officer shall determine, on an individual basis, whether downed timber may be cut and removed within clearing limits or if entire length of downed timber shall be removed
4. Contractor shall notify Contracting Officer prior to clearing downed timber and shall coordinate government inspection of all downed timber 12" diameter or greater before removal.
5. Contractor shall cut and remove all stumps within clearing limits. Contractor shall remove stump and root wad in locations where new work will interfere or expose the root wad. All other stumps within clearing limits shall be cut at or below proposed finish grade.
6. All timber removed from the site shall become the contractor's property and shall be disposed of outside the park.

D. Grubbing
1. Grub deep enough to remove stumps, roots, buried logs, moss, turf, or other vegetative debris as follows:
   a. Grub all areas to be excavated except for cut slope rounding areas.
   b. Grub all embankment areas. Undisturbed stumps may be left in place if they protrude less than 6 inches above the original ground and will be covered with more than 4 feet of embankment.

c. Grub pits, channel changes, and ditches only to the depth necessary for the excavation.
d. Backfill stump holes and other grubbing holes with backfill material to the level of the surrounding ground. Compact backfill.
    i. Backfill – Place backfill in horizontal layers that, when compacted, do not exceed 6 inches in depth. Compact each layer according to Section 02 41 20. Bring backfill up evenly on all sides of the structure, and extend each layer to the limits of the excavation or to natural ground.
    ii. Compaction – Compact material placed in all layers 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.
    Do not apply density requirements as measured by AASHTO T 310 to material that is incapable of being tested or compacted to maximum values determined by AASHTO T 99. For these materials, fill the voids around the rock in each layer with earth or other fine material. Compact each layer, full width, until there is no visible evidence of further consolidation.

D. Acceptance

1. Clearing and grubbing will be evaluated under Subsection 01 90 00 1.2

END OF SECTION 31 11 00

SECTION 31 22 19 - LINEAR GRADING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of constructing roadbeds or trails within the specified alignment and grade tolerances.

B. Measurement Procedures
1. Linear Grading will be measured per square yard.
2. The lump sum contract bid price for grading will include:
a. all materials, labor and equipment required to grade within tolerances in accordance with the construction plans.

C. Payment Procedures
1. The accepted work will be paid at the contract lump sum price for all work.

1.2 REFERENCES
A. FAR - Federal Acquisition Regulations
1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

PART 2 – MATERIALS

None.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. Roadway Preparation
1. Clear the area of vegetation and obstructions according to Specification 31 11 00.

B. Conserved Topsoil. 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 topsoil from other excavated material.

Place conserved topsoil on completed slopes according to Specification 32 91 19.13.

C. Roadway Excavation. Excavate as follows:
1. General. Do not disturb material and vegetation outside the construction limits. Incorporate only suitable material into embankments. Replace any shortage of suitable material caused by premature disposal of roadway excavation. Dispose of unsuitable or excess excavation material according to Subsection J 3.C. .

At the end of each day's operations, shape to drain and compact the work area to a uniform cross-section. Eliminate all ruts and low spots that could hold water.

2. Earth cuts. Scarify earth cuts to 6 inches below subgrade within the roadbed limits. Compact the scarified material according to Subsection 3.1.H.

D. Subexcavation. Excavate material to the limits designated by the Contracting Officer (CO). Prevent unsuitable material from becoming mixed with the backfill. Dispose of unsuitable material according to Subsection 3.1.K. Backfill the subexcavation with topping, or other suitable material. Compact the material according to Subsection 3.1.H.

1. Roadway cross-sections. Take roadway cross-sections normal to centerline. When the centerline curve radius is less than or equal to 500 feet, take cross-sections at a maximum centerline spacing of 25 feet. When the centerline curve radius is greater than 500 feet, take cross-sections at a maximum centerline spacing of 50 feet. Take additional cross-sections at significant breaks in topography and at changes in the typical section. Along each cross-section, measure and record points at breaks in topography, but no further apart than 20 feet. Measure and record points to at least the anticipated slope stake and reference locations. Reduce all cross-section distances to horizontal distances from centerline.

E. Borrow Excavation. Use all suitable roadway excavation in embankment construction. Do not use borrow excavation when it results in excess roadway excavation. Deduct excess borrow excavation from the appropriate borrow excavation quantity.

Obtain borrow source acceptance according to the following:

1. Government-provided sources. The Government will acquire the permits and rights to remove material from provided sources identified in the contract and to use such property for a plant site and stockpiles. Test reports and available historical performance data verifying the presence of acceptable material are available upon request.

   Do not perform work within a Government-provided source until a plan of operation for the development of the source is accepted. Perform all work necessary to produce acceptable material including site development, preparation, erosion control, and restoration.

   The quality of material in provided sources is acceptable in general, but may contain layers or pockets of unacceptable material. It is not feasible to ascertain from samples the quality of material for an entire deposit, and variations may be expected. Determine the quantity and type of equipment and work necessary to select and produce acceptable material.

   Strip and stockpile the overburden. After operations are complete, move all waste back into the source. Neatly trim and flatten the side slopes to the extent practicable. Spread the stockpiled overburden uniformly over the sides and bottom of the mined area. Shape the mined area to blend into the surrounding natural terrain.

2. Contractor-located sources. The Contractor is responsible for located sources, including established commercial sources. Use sources that fulfill the contract quantity and quality requirements. Determine the quantity and types of equipment and work necessary to select and produce acceptable material. Secure all permits and clearances for use of the source and provide copies of the documents.

Provide laboratory test reports and available historical performance data indicating that acceptable material is available from the source. Do not use material from a source that is unacceptable to the Government. Dispose of unacceptable material and locate another source at no cost to the Government.

Develop and restore borrow sources according to the following:

1. Notify the CO 14 days before starting pit operations. Develop and operate within a material source according to the accepted plan of operation or written agreement for developing the source.

2. Before developing a material source, measure the sediment content of bodies of water adjacent to the work area that will receive drainage from the work area. Control all erosion so the sediment levels in the bodies of water within the drainage area of the work area do not increase. Control erosion so that sediment does not leave the work area.

Do not excavate beyond the established limits. When applicable, shape the borrow source to permit accurate measurements when excavation is complete.

F. Preparing Foundation for Embankment Construction. Prepare foundation for embankment construction as follows:

1. Embankment less than 4 feet high over natural ground. Remove topsoil and break up the ground surface to a minimum depth of 6 inches by plowing or scarifying. Compact the ground surface according to Subsection 3.1.H.

2. Embankments over an existing asphalt, concrete, or gravel road surface. Scarify gravel roads to a minimum depth of 6 inches. Scarify or pulverize asphalt and concrete roads to 6 inches below the pavement. Reduce all particles to a maximum size of 6 inches and produce a uniform material. Compact the surface according to Subsection 3.1.H.

3. 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.

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

G. 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. Construct embankments as follows:

1. General. At the end of each day's operations, shape to drain and compact the embankment surface to a uniform cross-section. Eliminate all 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.

Where placing embankment on one side of abutments, wing walls, piers, or culvert headwalls, compact the material using methods that prevent excessive pressure against the structure.

Where placing embankment material on both sides of a concrete wall or box structure, conduct operations so compacted embankment material is at the same elevation on both sides of the structure.

Where structural pilings are placed in embankment locations, limit the maximum particle size to 4 inches.

2. Embankment within the roadway prism. Place embankment material in horizontal layers not exceeding 12 inches in compacted thickness. Incorporate oversize boulders or rock fragments into the 12-inch layers by reducing them in size or placing them individually as required by (c) below. Compact each layer according to Subsection 3.1.H before placing the next layer.

   Material composed predominately of boulders or rock fragments too large for 12-inch layers may be placed in layers up to 24 inches thick. Incorporate oversize boulders or rock fragments into the 24-inch layer by reducing them in size or placing them individually according to (c) below. Place sufficient earth and smaller rocks to fill the voids. Compact each layer according to Subsection 3.1.H before placing the next layer.

3. Individual rock fragments and boulders. Place individual rock fragments and boulders greater than 24 inches in diameter as follows:
   a. Reduce rock to less than 48 inches in the largest dimension.
   b. Distribute rock within the embankment to prevent nesting.
   c. Place layers of embankment material around each rock to a depth not greater than that permitted by (b) above. Fill all the voids between rocks.
   d. Compact each layer according to Subsection 3.1.H before placing the next layer.

4. Embankment outside of roadway prism. Where placing embankment outside the staked roadway prism, place material in horizontal layers not exceeding 24 inches in compacted thickness. Compact each layer according to Subsection 3.1.H.

H. Compaction. Adjust the moisture content of embankment material to a moisture content suitable for compaction. Place embankment material in 12-inch layers and compact each layer. Where compacting with rollers is not practical, use approved mechanical or vibratory compaction equipment.
   1. More than 80 percent retained on a No. 4 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 per second and vibratory rollers at speeds less than 3 feet 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 impact per vibration and a minimum frequency of 1000 vibrations per minute.
b. Eight roller passes of a 20-ton compression-type roller.
c. Eight roller passes of a vibratory roller having a minimum dynamic force of 30,000 pounds impact per vibration and a minimum frequency of 1000 vibrations per minute.

Increase the compactive effort for layers deeper than 12 inches as follows:

- For each additional 6 inches or fraction thereof, increase the number of roller passes in (a) above by four passes.
- For each additional 6 inches or fraction thereof, increase the number of roller passes in (b) and (c) above, by eight passes.

Construct approach connections to all existing roads, parking areas, and trails. Construct all new approaches.

I. Ditches. Slope, grade, and shape ditches. Remove all projecting roots, stumps, rock, or similar matter. Maintain all ditches in an open condition and free from leaves, sticks, and other debris.

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

J. Sloping, Shaping, and Finishing. Complete slopes, ditches, culverts, riprap, and other underground minor structures before placing aggregate courses. Slope, shape, and finish as follows:

1. Sloping.
   A. Leave all earth slopes with uniform roughened surfaces, except as described in (B) below, with no noticeable break as viewed from the road. Except in solid rock, round tops and bottoms of all slopes including the slopes of drainage ditches. Round material overlaying solid rock to the extent practical. Scale all rock slopes.
   B. If a slide or slipout occurs on a cut or embankment slope, remove or replace the material, and repair or restore all damage to the work. Bench or key the slope to stabilize the slide. Reshape the cut or embankment slope to an acceptable condition.

1. Stepped slopes. Where required by the contract, construct steps on slopes of 1⅓V:1H to 1V:2H. Construct the steps approximately 18 inches high. Blend the steps into natural ground at the end of the cut. If the slope contains nonrippable 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.

2. 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.

3. Finishing. Remove all material larger than 6 inches from the top 6 inches of the roadbed. Remove unsuitable material from the roadbed, and replace it with suitable material.

Finish roadbeds that are compacted according to Subsection 3.1.H(b) and (c) to within ±0.05 feet of the staked line and grade. Finish roadbeds that are compacted according to Subsection 3.1.H(a) to within ±0.10 feet of the staked line and grade. Finish ditch cross-sections to within ±0.10 feet of the staked line and grade. Maintain proper ditch drainage.

C. Disposal of Unsuitable or Excess Material. Dispose of unsuitable or excess material legally off the project.

Do not mix clearing or other material not subject to payment with the waste material.

D. Grading Tolerance

1. Do not encroach on stream channels, impact wetlands, or extend beyond right-of-way or easement limits. Do not make alignment or profile grade adjustments that adversely affect drainage. Construct the roadbed within the following grading tolerances:
   a. Alignment (centerline). Alignment may be shifted a maximum of 1 feet left or right of the planned centerline. Curve radii may be reduced by up to 50 percent. Do not construct curves with radii less than 100 feet. Compound curves are permitted.
   b. Profile grade. Profile grade may be shifted a maximum of 1 feet up or down from the plan elevation provided the new grade tangent does not vary more than 2 percent from the plan grade tangent. Connect revised forward and back grade tangents with a uniform vertical curve consistent with the design.

NEED TESTING REQUIREMENTS

3.2 FINAL ACCEPTANCE

1. Linear grading will be evaluated under this specification.

2. Clearing and removal of obstructions will be evaluated under Specification 31 11 00.

END OF SECTION 31 22 19.

SECTION 31 23 17 – ROADWAY RECONDITIONING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of rebuilding of roadbeds and aggregate surfaces.

B. Measurement Procedures
1. Roadway reconditioning will be measured per square yard.
2. The lump sum contract bid price for reconditioning will include:
a. all materials, labor and equipment required to reconditioning in accordance with the construction plans.

C. Payment Procedures
1. The accepted work will be paid at the contract lump sum price for all work.

1.2 REFERENCES
A. FAR - Federal Acquisition Regulations
1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

PART 2 – PRODUCTS

2.1 MATERIALS

A. Water. Conform to the following:
1. Water for earthwork, pavement courses, dust control, and incidental construction. Furnish water free of substances detrimental to the work.

PART 3 – EXECUTION

3.1 EXCAVATION & COMPACTION

A. Excavate material to the limits designated by the Contracting Officer (CO). Take cross-sections: Take roadway cross-sections normal to centerline. When the centerline curve radius is less than or equal to 500 feet, take cross-sections at a maximum centerline spacing of 25 feet. When the centerline curve radius is greater than 500 feet, take cross-sections at a maximum centerline spacing of 50 feet. Take additional cross-sections at significant breaks in topography and at changes in the typical section. Along each cross-section, measure and record points at breaks in topography, but no further apart than 20 feet. Measure and record points to at least the anticipated slope stake and reference locations. Reduce all cross-section distances to horizontal distances from centerline.

B. Prevent unsuitable material from becoming mixed with the backfill. Dispose of unsuitable or excess material legally off the project. 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. Backfill the

subexcavation with topping, or other suitable material. Compact the material according to Subsection 3.1.B.

C. Compaction. For the purpose of compaction, use AASHTO T 27 to determine the amount of material retained on a No. 4 sieve. Compact as follows:

1. More than 80 percent retained on a No. 4 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 per second and vibratory rollers at speeds less than 3 feet 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 impact per vibration and a minimum frequency of 1000 vibrations per minute.
    b) Eight roller passes of a 20-ton compression-type roller.
    c) Eight roller passes of a vibratory roller having a minimum dynamic force of 30,000 pounds impact per vibration and a minimum frequency of 1000 vibrations per minute.

    Increase the compactive effort for layers deeper than 12 inches as follows:
    - For each additional 6 inches or fraction thereof, increase the number of roller passes in (a) above by four passes.
    - For each additional 6 inches or fraction thereof, increase the number of roller passes in (b) and (c) above, by eight passes.

2. 50 to 80 percent retained on a No. 4 sieve. Use AASHTO T 99 to determine the optimum moisture content of the portion of the material passing a No. 4 sieve. Multiply this number by the percentage of material passing a No. 4 sieve, and add 2 percent to determine the optimum moisture content of the material. 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 rollers at speeds less than 6 feet per second and vibratory rollers at speeds less than 3 feet per second. Compact each layer of material full width according to (1) above.

3. Less than 50 percent retained on a No. 4 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 180, method D. For other material classifications, determine the optimum moisture content and 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.

3.2 RECLAIMED ASPHALT/AGGREGATE

A. Roadbed Reconditioning

1. Repair soft and unstable areas according to Subsection 3.1.A. Remove all organic, deleterious, or oversize material larger than 6 inches from the top 6 inches of subgrade. Dispose of waste legally off the project. 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. Scarify to a 6-inch depth, remove surface irregularities, and shape to provide a uniform surface. Finish earth surfaces to within 0.05 feet and rock surfaces to within 0.10 feet of the required line, cross-section, and grade. Compact according to Subsection 3.1.B.

B. Aggregate Surface Reconditioning

1. Repair soft and unstable areas to the full depth of the aggregate surface and according to Subsection 3.1.A. Scarify to the depth of the aggregate surface or to a depth of 8 inches, whichever is less, and remove surface irregularities. Reshape, finish, and compact the entire aggregate surface according to Subsection 3.3.

C. Roadway Reconditioning

1. Perform all the applicable work described in Subsections 3.2.A through 3.2.B.

D. Compacting and Finishing Crushed Aggregate.

1. Roadway aggregate. Compact using the specified method. When no method is specified, use either method. Finish the surface according to Subsection 3.2.D.4.
   a) Method 1. Compact each layer according to Subsection 3.1.B. Roll from the sides to the center, parallel to the centerline of the road. Along curbs, headers, and walls, and all places not accessible to the roller, compact the material with approved tampers or compactors.
      Compactive effort may be decreased if in-place densities show that less compactive effort is required under Method 2.
   b) Method 2. Compact each layer according to 3.2.D.3.
2. Bedding and backfill aggregate. Compact each layer according to Subsection 3.1.B.
3. Compaction. Determine the maximum density of the mixture according to AASHTO T 180, method D.
   Compact each layer full width. Roll from the sides to the center, parallel to the centerline of the road. Along curbs, headers, walls, and all places not accessible to the roller, compact the material with approved tampers or compactors.
4. Surface Tolerance. If grade finishing stakes are required, finish the surface to within ±0.05 feet from staked line and grade elevation.
   If grade finishing stakes are not required, shape the surface to the required template and check the surface with a 10-foot straightedge. Defective areas are surface deviations in excess of 1/2 inch in 10 feet between any two contacts of the straightedge with the surface.
   Correct all defective areas by loosening the material, adding or removing material, reshaping, and compacting.

3.3 FINAL ACCEPTANCE

1. See Table 31 23 17-1 for sampling and testing requirements. Road reconditioning work will be evaluated under this specification.

END OF SECTION 31 23 17.

Table 31 23 17-1
Sampling and Testing and Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Existing roadbed	Measured and tested for conformance (01 90 00)	Classification	—	AASHTO M 145	1 per soil type	Roadbed	Yes, when requested	Before using in work
		Moisture-density	—	AASHTO T 180, method D (1)	1 for each mixture or change in material	Processed material before incorporating in work	—	Before using in work
		In-place density & moisture content	—	AASHTO T 310 or other approved procedures	1 per 3000 yd^2	Compacted material	—	End of shift

(1) Minimum 5 points per proctor.

SECTION 31 23 19 – DEWATERING

PART 1 – GENERAL

1.1 Description

A. This work shall consist of furnishing, transporting, installing, and maintaining a pump around diversion, including dikes and sediment bags, of stream flow in the immediate construction area and dewatering of the bore and jack pipe work area..

B. Measurement Procedures

1. Items under this specification shall be measured for units in place.
2. The lump sum contract bid price for pump around will include:
   - all testing required by the contract.
   - all materials, labor and equipment required to meet pump around operation requirements.

C. Payment Procedures

1. The accepted work will be paid at the contract lump sum price for all work.

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials
1. AASHTO M 288 - Standard Specification for Geosynthetic Specification for Highway Applications
2. AASHTO T 210 - Standard Method of Test for Aggregate Durability Index
   AASHTO T 85 - Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate

B. ASTM - ASTM International, formerly known as American Society for Testing and Materials
1. ASTM D 276 - Standard Test Methods for Identification of Fibers in Textiles
2. ASTM 3776 - Standard Test Methods for Mass Per Unit Area (Weight) of Fabric
3. ASTM D 3786 - Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method
4. ASTM D 4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus
5. ASTM D 4362 - Standard Specification for Propane Thermophysical Property Tables
6. ASTM D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity
7. ASTM D 4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles
8. ASTM 4595 – Standard Test Methos for Tensile Properties of Geotextiles by the Wide-Width Strip Method
9. ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

10. ASTM D 4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile
11. ASTM D 4833 - Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
12. ASTM D 5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles

C. FAR - Federal Acquisition Regulations

1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL

A. Submit material certificate to the Engineer, signed by the material producer and Contractor, certifying that materials comply with these specifications and the construction plans.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Pump - The Contractor will provide a portable pump and adequate hoses (maximum 4" diameter) to divert normal stream flow around work area and dewatering of work area.

B. Special Stilling Basin

1. Provide special stilling basin of a bag constructed to a minimum size of 10 feet x 15 feet made from a nonwoven geotextile. Provide a sewn-in 8 inches (maximum) spout for receiving pump discharge. Sew the bag seams with a double needle machine using a high strength thread. The seams shall have a minimum wide width strength of 60 lbs. per inch in accordance with ASTM D4884.

2. Geotextile - Special stilling basin shall be constructed of drainage geotextile Type II (A-C) as that meets the requirements of specification section 31 25 00 and table 31 23 19 – 01.

TABLE 31 23 19 - 01
ADDITIONAL GEOTEXTILE PROPERTIES

Property	Minimum Requirement	Test Method
Weight	8.0 oz/yd	ASTM D3776
Flow rate	80.0 gal/min/sf	ASTM D4491
Permittivity	1.2 1/sec	ASTM D4491
UV Resistance	70.0%	ASTM D4355

3. Sediment Control Stone. Furnish, stockpile if directed by CO, plan and maintain an approved stone for bedding of special stilling basin. Conform to the following:

TABLE 31 23 19 - 02

Sieve	Percent Passing
1 1/2"	100
1”	95 - 100
3/4”	-
1/2"	25 – 60
3/8”	-
No. 4	0 - 10
No. 8	0 - 5

a) Separate aggregate containing rock of more than one identifiable rock type or particles of visibly different degrees of weathering in amounts of 10% or more into each individual type.
b) Aggregate is acceptable only if each type does not exceed the percentage of wear specified for a particular use.
c) Blended aggregates from different sources are allowed if all aggregates meet the Specifications for soundness or resistance to abrasion.
d) Handle and stockpile aggregates in such a manner to minimize segregation.
e) Stockpiled aggregates should be essentially free of clay or shale particles, and should contain dust that is primarily rock dust produced through normal handling of the aggregate.

C. Impervious Dike

1. Acceptable materials shall include, but not be limited to, sheet piles, sandbags, and/or the placement of an acceptable size stone lined with polypropylene or other impervious fabric.
2. Earth material shall not be used to construct an impervious dike when it is in direct contact with the stream
3. Material specifications for selected for impervious dike mut be submitted to NPS CO 14 days prior to purchase for approval.

PART 3 – EXECUTION

A. Install the Special Stilling Basin(s), geotextile and stone in accordance with plans and specifications at locations identified in the plans. Place the Special Stilling Basin(s) on level ground.
B. Construct the Special Stilling Basin(s) such that it is portable and removable.
C. Pump discharge hoses will be attached to the Special Stilling Basin(s) to divert runoff or pumped effluent directly into the special stilling basin(s).
D. The remaining sleeve or spout of the bag, if present, may be used to connect more than one special stilling basin in series as directed. If not used in this manner, the sleeve shall be tied off tightly to allow the bag to contain the effluent and force it to filter through the sides of the special stilling basin.
E. Place the Special Stilling Basin(s) so the pumped effluent flows into and through it without causing erosion to adjacent slopes or streambanks. In areas of turbidity and water quality concern, place the Special Stilling Basin(s) up grade and direct its runoff into a sediment control measure before being allowed to discharge into jurisdictional waters.

F. Replace and dispose of the Special Stilling Basin(s) when it is 3/4 full of sediment or when it is impractical for the bag to filter the sediment out at a reasonable flow rate. Prior approval from the CO shall be received before removal and replacement.
G. Provide a sufficient quantity of bags to contain silt from pumped effluent during construction of the trenchless pipe installation as shown on the plans.
H. The Contractor shall construct an impervious dike of an acceptable material in the locations as noted on the plans or as directed by CO.
I. The impervious dike shall not permit seepage of water into the construction site or contribute to siltation of the stream.

END SECTION 31 23 19

SECTION 31 23 23.33 – FLOWABLE FILL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of providing and placing flowable concrete fill at the locations designated on the plans. This includes furnishing, hauling, placing, disposing, shaping, sampling, and testing material.
B. Measurement Procedures
    1. Flowable fill will be measured for by the unit of cubic yard.
    2. The lump sum contract bid price for flowable fill will include:
        - all testing required by the contract.
        - all materials, labor and equipment required to meet required mixing, transportation, placement, and cleanup requirements.
C. Payment Procedures
    1. The accepted work will be paid at the contract lump sum price for all work.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials
    1. ASTM C33 – Standard Specification for Concrete Aggregates
    2. ASTM C94- Standard Specification for Ready Mix Concrete
    3. ASTM C117 – Standard Test Method for Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
    4. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
    5. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete
    6. ASMT C150 - Standard Specification for Portland Cement
    7. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete
    8. ASTM C495 - Standard Test Method for Compressive Strength of Lightweight Insulating Concrete
    9. ASTM C869 - Standard Specification for Foaming Agents Used in Making Preformed Foam for Cellular Concrete
    10. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
    11. ASTM C796 - Standard Test Method for Foaming Agents for Use in Producing Cellular Concrete Using Preformed Foam
    12. ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material Test Cylinders
    13. ASTM D5971 - Standard Practice for Sampling Freshly Mixed Controlled Low Strength Material
    14. ASTM D6023 – Standard Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low Strength Material
    15. ASTM D6103 - Standard Test Method for Flow Consistency of Controlled Low Strength Material
B. FAR - Federal Acquisition Regulations
    1. FAR 46.105 Contractor responsibilities
    2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements

3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL

A. The Contractor shall submit for approval, in accordance with Section 01 33 00 SUBMITTAL PROCEDURES all working drawings and schedules of materials and methods proposed to follow in the execution of the Work under this item.

1. Mix Design: Submit to CO, no later than 30 days prior to commencing flowable fill operations, the design for each proposed flowable fill mix, including:
   a. Proposed flowable fill mix design(s), including weights of all materials, water, and admixtures, expressed in terms of quantity per cubic yard.
   b. Description, and source of all materials and water.
   c. Material certificates for each mix constituent, including certificates for admixtures indicating that they comply with specified requirements.
   d. Admixture cut sheets and manufacturer recommendations for use in similar applications.
   e. Certificate, provided by the supplier, identifying fly ash as Class C or Class F, in accordance with ASTM C 618.
   f. Unit weight, and compressive strength (at 7 days) tests results for proposed mix design, based on sampling and testing in accordance with ASTM C 495 (compression tests), ASTM C 869 and ASTM C 796 (foaming agent).
   g. Target water cement ratio
   h. Target strength
   i. Target air content

2. Daily flowable fill installation reports: Prepare flowable fill installation records on a per-shift basis and submit to CO within 24-hours of installing flowable fill. Include:
   a. Batch/delivery tickets.
   b. Volume of flowable fill placed.
   c. Location and depth of filling.
   d. Injection locations, pressures, and time of placement.
   e. Unit weight and testing results, and summary of samples prepared.

1.4 DEFINITION

A. Flowable Fill. Controlled low strength ready mix material used as an alternative to compacted soil, and is also known as controlled density fill, flowable concrete fill, controlled low strength material, or excavatable flowable fill. Flowable fill is a highly flowable, lean concrete mix consisting of a mixture of cement, fly ash, densely graded mineral aggregates, water and admixtures. Characteristics include:
   1. Capable of freely flowing to fill excavations and voids without compaction or other additional effort.

   2. Used in trenches and for backfill adjacent to structures where clearance is limited, and in other areas specifically identified on the Drawings or specified.

   3. Low permeability to prevent migration of adjacent fines into the set mix.

   4. Easily excavated after curing with minimum risk of damage to buried utility or structures.

1.5 QUALITY CONTROL

1. Quality Control measurements of air content, mix temperature, and slump shall be performed by the Contractor on the flowable fill batches delivered to the site. At least one set of measurements for air content, temperature, and slump of flowable fill shall be performed per placement or per day, whichever is less frequent.
    1. Air content shall be measured following the requirements of ASTM C231.
    2. Slump shall be measured by the Standard Test Method for Flow Consistency of Controlled Low Strength Materials, ASTM D6103
2. Cylinders. Obtain one set of 3-inch diameter by 6-inch long test cylinders, with a minimum of three (3) cylinders per set, for each Quality Control sample.
    1. Record and mark each set of test cylinders with date and time of casting, batch number, unit weight (wet density), air content, and placement location.
    2. Flowable fill test cylinders: cast in field in accordance with ASTM D 5971 and ASTM D 4832, cure and store in the laboratory and test in accordance with ASTM C 495.
    3. Test schedule, following placement:
        a. 3 days: one test
        b. 7 days: two tests

PART 2 – MATERIALS

2.1 MATERIALS

A. Conform to the following section and subsections:
    1. Cement – Conforming to ASTM C150, Type II or III with total alkali content not more than 0.8 percent.
    2. Water – Clean, potable water.
    3. Fly Ash
        a. Mix Designs used for pipe bedding and trench backfill: Class C in conformance with ASTM C618.
        b. Mix Designs used for Backfill of Excavations: Class F in conformance with ASTM C618.
    4. Aggregate – Provide hard, clean, durable, nonplastic, nonorganic, nonreactive aggregate conforming to Table 31 23 23.33 - 1

Table 31 23 23.33-1
Flowable Fill Aggregate Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (ASTM C136 & C117)
1 inch	100
No. 200	0-10

    5. Chemical Admixtures – Conforming to ASTM C494. Admixtures shall not contain chlorides.

B. Composition of mix. Design a well-graded, flowable, self-leveling mix. Design a mix with a 7-day compressive strength between 75 and 250 pounds per square inch (psi) in accordance with ASTM D4832.

    1. The water cement ratio for flowable fill shall not be high enough to cause segregation of the mix.

2. Air content of 5 to 15% is the target. Higher air contents may be approved by the CO but will result in an increased set time. All flowable fill shall be air entrained by the addition of an air entraining admixture or other chemical admixtures.

PART 3 – EXECUTION

3.1 PREPARATION

A. Verify that all bulkheads, tanks, pipes, or other members to be encased in flowable fill are secure before commencing flowable fill placement.

B. Remove and prevent standing or flowing water in the culvert or pipe prior to placement. Pipes must be dry; no flowing or standing water.

C. Flowable fill shall not be placed, if, in the judgement of the CO, weather conditions are unsuitable.

D. Flowable fill shall not be placed when the trench bottom or walls are frozen or contain frozen materials. Do not place flowable fill if the air temperature is below 40 degrees Fahrenheit.

E. Repair all joint separations and/or pipe perforations ¼-inch and larger.

F. Provide and maintain clear breather pipes/vents as necessary to prevent air pockets and to monitor placement and filling.

G. Provide working pressure gauges in flowable fill pipes for monitoring and controlling injection pressures, and values at the point of injection for sample collection.

H. Inform CO at least 24 hours in advance of placement.

3.2 MIXING AND CONSISTENCY

A. Mix Design shall produce a consistency that will result in a flowable product at the time of placement which does not require manual means to move it into place.

B. Slump: Between 6 inches and 8 inches when tested in accordance with ASTM C143.

C. Mixing method and time: As required to produce a uniform mixture of cement, fly ash, aggregate, admixtures, and water

D. Uniform consistency and appearance.

3.3 PLACEMENT

A. Thoroughly settle and consolidate flowable fill as the material is placed in excavations. Fill the entire depth of the layer that is being consolidated, into a dense, homogeneous mass, filling all spaces and voids and bringing only a slight excess of water to the exposed surface. Place and consolidate flowable fill by means that will no cause segregation of the mix.

B. Prevent flotation of pipes by placing flowable fill in two or more lifts, with each lift reaching an initial set before the succeeding lift is placed. Correct any flotation and displacement.

C. Flowable concrete fill shall be discharged directly from the truck into the space to be filled. The drop height of the flowable concrete fill shall be as low as practicable. Flowable concrete fill shall not flow down the vertical face of a trench causing erosion of the trench face

D. Place flowable fill in multiple lifts, as required, to prevent failure of bulkheads.

E. Prevent accumulation of flowable fill in the downstream culvert and remove all spilled materials.

F. Control groundwater to prevent groundwater contact with the existing host pipe and flowable fill during placement and for a minimum of 24-hours after placement of flowable fill.

G. Flowable fill will not be opened to traffic or covered with structural concrete or pavement for a minimum of 24 hours. Wait at least 4 hours before backfilling over flowable fill.

H. Collect, remove, and treat all waste flowable fill and wastewater.

3.4 FINAL ACCEPTANCE

1. Flowable fill will be evaluated under this specification and Subsections 01 90 00 1.2 and 01 90 00 1.4

2. Salvaged topsoil will be evaluated under Specification 32 91 19.12.

3. Clearing and removal of obstructions will be evaluated under Specification 02 41 13 and 02 41 19.

4. Placing of salvaged topsoil will be evaluated under Specification 32 91 19.12

5. Material for backfill, bedding, and foundation fill will be evaluated under Subsections 01 90 00 1.2 and 01 90 00 1.4, except backfill concrete for bedding or backfill will be evaluated according to Table 02 41 20 - 2.

6. Structural excavation and backfill work will be evaluated under Subsections 01 90 00 1.2 and 01 90 00 1.4.

7. Shoring, bracing, and cofferdams will be evaluated under Subsections 01 90 00 1.2 and 01 90 00 1.4.

8. Clearing and removal of obstructions will be evaluated under Specification 31 11 00.

END OF SECTION 31 23 23.33

SECTION 31 25 00 – EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.4 DESCRIPTION

A. This work consists of furnishing, constructing, and maintaining permanent and temporary erosion and sediment control measures.

B. Measurement Procedures

1. Items under this specification shall be measured for units in place.
2. The lump sum contract bid price for erosion control will include:
   - all testing required by the contract.
   - all materials, labor and equipment required to meet erosion and sedimentation control requirements.

C. Payment Procedures

1. The accepted work will be paid at the contract lump sum price for all work.

1.5 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials
   1. AASHTO M 288 - Standard Specification for Geosynthetic Specification for Highway Applications
   2. AASHTO T 210 - Standard Method of Test for Aggregate Durability Index
      AASHTO T 85 - Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate

B. ASTM - ASTM International, formerly known as American Society for Testing and Materials
   1. ASTM D 276 - Standard Test Methods for Identification of Fibers in Textiles
   2. ASTM D 3786 - Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method
   3. ASTM D 4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus
   4. ASTM D 4362 - Standard Specification for Propane Thermophysical Property Tables
   5. ASTM D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity
   6. ASTM D 4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles
   7. ASTM 4595 – Standard Test Methos for Tensile Properties of Geotextiles by the Wide-Width Strip Method

8. ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
9. ASTM D 4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile
10. ASTM D 4833 - Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
11. ASTM D 5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles

C. FAR - Federal Acquisition Regulations

1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

1.6 SUBMITTAL

A. Submit material certificate to the Engineer, signed by the material producer and Contractor, certifying that materials comply with these specifications and the construction plans.

PART 2 – PRODUCTS

2.2 MATERIALS

A. Erosion control bales, wattles, logs, and rolls

1. Silt Sock. Furnish a three-dimensional tubular sediment control and stormwater runoff device filled with compost. Conform to the following:

a) Inner Material	Mulch as specified below
b) Minimum Diameter	12 inches
c) Minimum Length	10 feet
d) Mesh Opening	1/8 inch
e) Net Material	Multi-Filament Polypropylene
f) MD Tensile Strength	670 lbs
g) TD Tensile Strength	423 lbs

2. Coir Fiber Wattle Barrier. Furnish coir fiber wattles consisting of coir fibers (coconut fibers) encased in tubular coir fiber netting. Conform to the following:

a) Inner Material	100% Coir (Coconut) Fiber
b) Minimum Diameter	12 inches
c) Minimum Length	10 feet
d) Minimum Density	5 lb/cf ± 10%
e) Net Material	Coir (Coconut)
f) Net Openings	2 inches x 2 inches
g) Net Strength	90 lbs
h) Minimum Weight	10 lb/ft ± 10%

B. Coir Fiber Matting.

1. Furnish coir matting consisting of coir fibers (coconut fibers) encased in coir fiber netting. Conform to the following:

a)	Material	100% Coir (Coconut) Fiber
b)	Mass/Unit Area	23 oz/yd^2 (700 g/m^2)
c)	Thickness	0.35 inches (9.0 mm)
d)	Tensile Strength - MD	1575 lb/ft (23.0 kN/m)
e)	Elongation – MD	50%
f)	Tensile Strength – TD	925 lb/ft 13.5 kN/m)
g)	Elongation – TD	36%
h)	Shear Stress	4.50 lbs/ft^2 (215Pa)
i)	Velocity	10.0 ft/s (3.0 m/s)
j)	C Factor	0.003
k)	Open Area – Calculated	50%
l)	Net Opening	3/8” (10mm) x 3/8” (11mm)

C. Stakes

1. Stakes shall be used as anchors. Provide hardwood stakes a minimum of 2-ft long with a 2" x 2" nominal square cross section. One end of the stake shall be sharpened or beveled to facilitate driving down into the underlying soil.

D. Staples

1. Provide staples made of 8 gauge new steel wire formed into a U-shape not less than 10" in length with a throat of 1" in width.

E. Mulch.

1. Wood fiber. Furnish processed wood fiber from wood chips conforming to the following:

   a) Colored with a green dye non injurious to plant growth;
   b) Readily dispersible in water;
   c) Nontoxic to seed or other plant material;
   d) Free of growth or germination inhibiting substances;
   e) Free of weed seed;
   f) Air dried to an equilibrium moisture content of 12±3 percent;
   g) Packaged in new labeled containers; and
   h) Packaged in a condition appropriate for mixing in a homogeneous slurry suitable for application with power spray equipment

2. Mature compost. Furnish partially decomposed organic material, such as leaves, grass, shrubs, and yard trimmings, cured for 4 to 8 weeks. Maturity is indicated by temperature stability and soil-like odor. Furnish friable, dark brown, weed-free, and pathogen-free mature compost conforming to the following:

a)	Carbon/nitrogen ratio	25/1 to 35/1
b)	Carbon/phosphorus ratio	120/1 to 240/1
c)	pH	6.0 to 7.8
d)	Water content	40% max.

e)	Particle size	
	Seeding and sodding	1/2 inch max.
	Erosion control	2 inch max.
f)	Organic material	50% min.
g)	Man-made inserts (plastic, glass, metal)	2% max.

3. Bonded fiber matrix hydromulch. Furnish a mixture of long-wood fibers and bonding agent which, when hydraulically applied and dried, produce a matrix conforming to the following:

   a) Does not dissolve or disperse when wetted;
   b) Holds at least 10 ounces of water per ounce of dry matrix;
   c) Has no germination or growth inhibiting factors;
   d) Forms no water insensitive crust;
   e) Contains material that is 100 percent biodegradable; and
   f) Is colored with a green dye non injurious to plant growth.

4. Recycled pulp fiber. Furnish cellulose fiber mulch products manufactured from natural material diverted from the waste-stream of manufacturing processes or produced from recycled material. These include newsprint, chipboard, corrugated cardboard, wood chips, and similar material. Process the material to eliminate substances that inhibit seed germination and plant growth. Add a colored dye that is non-injurious to plant growth and fades rapidly with exposure to light. The fiber shall readily blend with water, grass seed, fertilizer, and other additives to for a slurry suitable for application with power spray equipment. Furnish a homogeneous mixture conforming to the following:

a)	Synthetic, plastic, metal, or glass material	0%
b)	Weed Seed	0%
c)	Moisture content	15% max.
d)	Ash content	7% max.
e)	Organic matter	90% min.
f)	Boron	250 ppm max.
g)	Water-holding capacity	800 to 1200% by mass
h)	pH	4.0 to 8.5

F. Seed. Conform to the Federal Seed Act, the Federal Noxious Weed Act, and applicable State and local seed and noxious weed laws. Do not use wet, moldy, or otherwise contaminated or damaged seed. Furnish each seed type in separate sealed container. Clearly label each container with the following:
   1. Name and type of seed;
   2. Lot number;
   3. Net mass;
   4. Percent of purity, germination, and hard seed;
   5. Percent of maximum weed seed content;
   6. Seed Origin;
   7. Noxious weeds present;
   8. Other crop seed;
   9. Inert matter;
   10. Name and address of seed distributor; and

11. Mixture percent of each component.

Inoculate legume seed with approved cultures according to the manufacturer's instructions.

G. Super Silt fence – Conform to the following:

1. Filter fabric shall meet Geotextile specifications below in section I.

2. 2.5 inch diameter galvanized or aluminum Poles shall be used for support.

3. Backing fence shall be galvanized No. 115 gauge steel wire chain link with 2.25-inch openings, No. 11 gauge aluminum coated steel wire in accordance with ASTM-A-491 or galvanized No. 9 gauge steel wire top and bottom with No. 11 gauge steel intermediate wire

H. Water – Conform to the following:

1. Water for mixing or curing cement concrete, mortar, or grout. Conform to AASHTO M 157. Potable water of known quality may be used without testing according to AASHTO T 26. Potable water is safe for human consumption as defined by the public health authority having jurisdiction.

2. Water for planting or care of vegetation. Furnish water that is free of substances injurious to plant life such as oils, acids, alkalies, or salts.

3. Water for earthwork, pavement courses, dust control, and incidental construction. Furnish water free of substances detrimental to the work.

I. Geotextile – Use long-chain, synthetic polymers, composed at least 95 percent by mass of polyolefins or polyesters, to manufacture geotextile or the threads used to sew geotextile. Form the geotextile, including selvedges, into a stable network such that the filaments or yarns retain their dimensional stability relative to each other.

1. Physical requirements. Conform to the following tables for the type of geotextile specified:

a)	Type I (A - F) Subsurface drainage	Table 31 25 00-1
b)	Type II (A - C) Separation	Table 31 25 00-2
c)	Type III (A - B) Stabilization geotextile	Table 31 25 00-3
d)	Type IV (A - F) Permanent erosion control	Table 31 25 00-4
e)	Type V (A - C) Temporary silt fence	Table 31 25 00-5
f)	Type VI Paving fabric	Table 31 25 00-6

2. All property values, with the exception of apparent opening size (AOS), in these specifications represent minimum average roll values in the weakest principal direction (i.e., average test results of any roll in a lot sampled for conformance or quality assurance testing shall meet or exceed the specified values). Values for AOS represent maximum average roll values.

   Elevate and protect rolls with a waterproof cover if stored outdoors. When using a geotextile for a permanent installation, limit the geotextile exposure to ultraviolet radiation to less than 10 days.

3. Evaluation procedures. Geotextile will be evaluated under Subsection 01 90 00 1.3. Furnish a commercial certification including the name of the manufacturer, product name, style number, chemical composition of the filaments or yarns, and other

pertinent information to fully describe the geotextile.

When samples are required, remove a 3-foot long, full-width sample from beyond the first outer wrap of the roll. Label the sample with the lot and batch number, date of sampling, project number, item number, manufacturer, and product name.

Table 31 25 00-1
Physical Requirements for Subsurface Drainage Geotextile

Property	Test Method ASTM	Units	Specifications (1)					
			Type I-A	Type I-B	Type I-C	Type I-D	Type I-E	Type I-F
Grab strength	D 4632	N	1100/700	1100/700	1100/700	800/500	800/500	800/500
Sewn seam strength	D 4362	N	990/630	990/630	990/630	720/450	720/450	720/450
Tear strength	D 4533	N	400(3)/250	400(3)/250	400(3)/250	300/175	300/175	300/175
Puncture strength	D 4833	N	400/250	400/250	400/250	300/175	300/175	300/175
Burst strength	D 3786	kPa	2750/1350	2750/1350	2750/1350	2100/950	2100/950	2100/950
Permittivity	D 4491	s^{-1}	0.5	0.2	0.1	0.5	0.2	0.1
Apparent opening size	D 4751	mm	0.43 (2)	0.25 (2)	0.22 (2)	0.43 (2)	0.25 (2)	0.22 (2)
Ultraviolet stability	D 4355	%	50 % after 500 hours of exposure					

(1) The first values in a column apply to geotextiles that break at < 50 percent elongation (ASTM D 4632). The second values in a column apply to geotextiles that break at ≥ 50 elongation (ASTM D 4632).

(2) Maximum average roll value.

(3) The minimum average roll tear strength for woven monofilament geotextile is 245 N.

In addition, when geotextile joints are sewn, submit the seam assembly description and a sample of the sewn material. This description shall include the seam type, seam allowance, stitch type, sewing thread tex ticket number(s) and type(s), stitch density, and stitch gauge. If the production seams are sewn in both the machine and cross-machine directions, provide sample sewn seams that are oriented in both the machine and cross-machine directions. Furnish a sewn sample that has at least 2 meters of sewn seam and is at least 1.5 meters wide. Sew the sample seams with the same equipment and procedures that are used to sew the production seams. For seams sewn on-site, conform to the manufacturer's recommendations. Obtain approval of the seam before installation.

Table 31 25 00-2
Physical Requirements For Separation Geotextile

Property	Test Method ASTM	Units	Specifications (1)		
			Type II-A	Type II-B	Type II-C
Grab strength	D 4632	N	1400/900	1100/700	800/500
Sewn seam strength	D 4632	N	1260/810	990/630	720/450
Tear strength	D 4533	N	500/350	400(3)/250	300/180
Puncture strength	D 4833	N	500/350	400/250	300/180
Burst strength	D 3786	kPa	3500/1700	2700/1300	2100/950
Permittivity	D 4491	s^{-1}	0.02	0.02	0.02
Apparent opening size	D 4751	mm	0.60 (2)	0.60 (2)	0.60 (2)
Ultraviolet stability	D 4355	%	50% after 500 hours of exposure		

(1) The first values in a column apply to geotextiles that break at < 50 percent elongation (ASTM D 4632). The second values in a column apply to geotextiles that break at ≥ 50 percent elongation (ASTM D 4632).
(2) Maximum average roll value.
(3) The minimum average tear strength for woven monofilament geotextile is 245 N.

Table 31 25 00-3
Physical Requirements For Stabilization Geotextile

Property	Test Method ASTM	Units	Specifications (1)	
			Type III-A	Type III-B
Grab strength	D 4632	N	1400/900	1100/700
Sewn seam strength	D 4632	N	1260/810	990/630
Tear strength	D 4533	N	500/350	400(3)/250
Puncture strength	D 4833	N	500/350	400/250
Burst strength	D 3786	kPa	3500/1700	2700/1300
Permittivity	D 4491	s^{-1}	0.05	0.05
Apparent opening size	D 4751	mm	0.43 (2)	0.43 (2)
Ultraviolet stability	D 4355	%	50% after 500 hours of exposure	

(1) The first values in a column apply to geotextiles that break at < 50 percent elongation (ASTM D 4632). The second values in a column apply to geotextiles that break at ≥ 50 percent elongation (ASTM D 4632).
(2) Maximum average roll value.
(3) The minimum average tear strength for woven monofilament geotextile is 245 N.

Table 31 25 00-4
Physical Requirements for Permanent Erosion Control Geotextile

Property	Test Method ASTM	Units	Specifications (1)					
			Type IV-A	Type IV-B	Type IV-C	Type IV-D	Type IV-E	Type IV-F
Grab strength	D 4632	N	1400/900	1400/900	1400/900	1100/700	1100/700	1100/700
Sewn seam strength	D 4632	N	1260/810	1260/810	1260/810	990/630	990/630	990/630
Tear strength	D 4533	N	500/350	500/350	500/350	400(3)/250	400(3)/250	400(3)/250
Puncture strength	D 4833	N	500/350	500/350	500/350	400/250	400/250	400/250
Burst strength	D 3786	kPa	3500/1750	3500/1750	3500/1750	2750/1350	2750/1350	2750/1350
Permittivity	D 4491	s^{-1}	0.7	0.2	0.1	0.7	0.2	0.1
Apparent opening size	D 4751	mm	0.43 (2)	0.25 (2)	0.22 (2)	0.43 (2)	0.25 (2)	0.22 (2)
Ultraviolet stability	D 4355	%	50 % after 500 hours of exposure					

(1) The first values in a column apply to geotextiles that break at <50 percent elongation (ASTM D 4632). The second values in a column apply to geotextiles that break at ≥ 50 elongation (ASTM D 4632).

(2) Maximum average roll value.

(3) The minimum average roll tear strength for woven monofilament geotextile is 245 N.

Table 31 25 00-5
Physical Requirements For Temporary Silt Fence

Property	Test Method ASTM	Units	Specifications		
			Type V-A	Type V-B (2)	Type V-C (3)
Grab strength	D 4632	N			
Machine direction			400	550	550
Cross direction			400	450	450
Permittivity	D 4491	s^{-1}	0.05	0.05	0.05
Apparent opening size	D 4751	mm	0.60 (1)	0.60 (1)	0.60 (1)
Ultraviolet stability	D 4355	%	70% after 500 hours of exposure		

(1) Maximum average roll value.
(2) Elongation at break ≥ 50 percent elongation (ASTM D 4632).
(3) Elongation at break < 50 percent elongation (ASTM D 4632).

Table 31 25 00-6
Physical Requirements For Paving Fabric

Property	Test Method	Units	Specifications Type VI
Grab strength	ASTM D 4632	N	500
Ultimate elongation	ASTM D 4632	%	50% at break
Asphalt retention	ASTM D 6140	L/m^2	0.90
Mass per unit area	ASTM D 5261	g/m^2	140
Melting point	ASTM D 276	ºC	150

A. Riprap rock – Furnish hard, durable, angular rock that is resistant to weathering and water action and free of organic or other unsuitable material. 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 the following:

1. Apparent specific gravity, AASHTO T 85 — 2.50 min.
2. Absorption, AASHTO T 85 — 4.2% max.
3. Coarse durability index, AASHTO T 210 — 50 min.
4. Gradation for the class specified — Table 31 25 00-7

Table 31 25 00-7
Gradation Requirements for Riprap

Class	Percent of Rock by Mass	Mass (pounds)	Approximate Cubic Dimension(2)(3) (inches)
1	20	22 to 33	6 to 8
	30	11 to 22	5 to 6
	40	1 to 11	2 to 5
	10 (1)	0 to 1	0 to 2
2	20	55 to 110	8 to 10
	30	22 to 55	6 to 8
	40	2 to 22	3 to 6
	10 (1)	0 to 2	0 to 3
3	20	220 to 330	14 to 16
	30	110 to 220	10 to 14
	40	11 to 110	5 to 10
	10 (1)	0 to 11	0 to 5
4	20	550 to 770	18 to 20
	30	220 to 550	14 to 18
	40	22 to 220	6 to 14
	10 (1)	0 to 22	0 to 6
5	20	1540 to 2200	26 to 28
	30	770 to 1540	20 to 26
	40	55 to 770	8 to 20
	10 (1)	0 to 55	0 to 8
6	20	1870 to 3530	28 to 34
	30	1100 to 1870	22 to 28
	40	110 to 1100	10 to 22
	10 (1)	0 to 110	0 to 10

(1) Furnish spalls and rock fragments graded to provide a stable dense mass.
(2) The volume of a rock with these cubic dimensions has a mass approximately equal to the specified rock mass.
(3) Furnish rock with breadth and thickness at least one-third its length.

PART 3 – EXECUTION

3.1 PREPARATION

A. General

1. Provide permanent and temporary erosion control measures to minimize erosion and sedimentation during and after construction according to the state and local standards and this Section. Contract permits amend the requirements of this Section.

2. When erosion control measures are not functioning as intended, immediately take corrective action.

3.2 INSTALLATION

1. Before clearing and/or grubbing construct erosion controls for the project

2. Construct erosion control and sediment control measures as follows:
   a. Construct temporary erosion controls in incremental stages as construction proceeds.
   b. Construct temporary slope drains, diversion channels, and earth berms to protect disturbed areas and slopes.
   c. Apply permanent turf establishment to the finished slopes and ditches within 14 days according to Specification 32 92 20.
   d. Construct outlet protection as soon as culverts or other structures are complete.
   e. Construct permanent erosion controls including slope treatments as soon as practical or upon completion of the roadbed.
   f. Construct and maintain erosion controls on and around soil stockpiles to prevent soil loss.
   g. Following each day's grading operations, shape earthwork to minimize and control erosion from storm runoff.

A. Wattle Barries (Coir Fiber and Silt Sock)

1. Construct wattle barriers for filtering sediment from runoff and reducing the velocity of sheet flow.
   a. Align wattle barriers in an overlapping and alternating pattern. Excavate a trench the entire length of each wattle with a depth of 2" to 3" for the wattle to be placed. Secure wattle barriers to the soil by wire staples approximately every linear foot and at the end of each wattle. Install at least 4 stakes on the downslope side of the wattle with a maximum spacing of 2 linear feet and according to the detail. Install at least 2 stakes on the upslope side of the wattle barriers according to the detail provided in the plans. Drive stakes into the ground at least 10" with no more than 2" projecting from the top of the wattle. Drive stakes at an angle according to the detail provided in the plans.
   b. For wattle barriers used to reduce runoff velocity for large slopes, use a maximum spacing of 25 ft. for the barrier measured along the slope.
   c. Maintain the wattle barriers until the project is accepted or until the wattle barriers are removed, and remove and dispose of silt accumulations at the wattle barriers when so directed.

B. Super Silt Fence

1. Excavate an 8-inch-deep trench, minimizing the disturbance on the downslope side, with the bottom of the trench at level grade.
2. Install the chain link fence in the downslope side of the trench with the fence on the upslope side of the support poles. Install 2.5-inch- diameter galvanized or aluminum poles set at 10-foot maximum spacing. Install poles at a minimum depth of 24 inches below the ground surface and extend a minimum of 33 inches above ground. A posthole drill may be necessary to install poles appropriately for most sites. Poles do not need to be set in concrete.
3. Fasten chain link fence securely to fence posts with wire ties.
4. Install No. 7 gage tension wire horizontally through holes at the top of the chain link fence or attach with hog rings, wire fasteners, staples, or preformed clips at 5-foot (maximum) centers.
5. Stretch filter fabric and securely fasten to the fence with wire fasteners, staples, or preformed clips. Extend the fabric a minimum of 33 inches above the ground surface. Ensure the filter fabric width is a minimum of 42 inches.
6. Fasten the filter fabric securely to the chain link fence with fasteners, staples, or preformed clips spaced horizontally 24 inches at the ground surface, top, and midsection.
7. When attaching two super silt fences, the overlap joining method should be used.
8. Place the fabric toe in the bottom of the trench, then backfill and compact the trench.

C. Outlet Protection

1. Construct riprap aprons or basins to reduce water velocity and prevent scour at the outlet of permanent and temporary erosion control measures. Construct riprap according to Subsection 2.1 B.

D. Slope Protection and Stabilization

1. Use riprap, check dams, erosion control blankets and mats, and temporary slope drains as follows:
    a. Riprap. Construct riprap for channel lining according to Subsection 2.1 B.
    b. Check dams. Construct riprap, sandbags, or earth berms for temporary dams to reduce the velocity of runoff in ditches and swales.
    c. Rolled erosion control products. Use rolled erosion control products to stabilize waterways and slopes before or after temporary or permanent seeding.
    d. Temporary slope drains. Use drainpipe, riprap, or plastic lined waterway for temporary slope drains to channel runoff down slopes. Channel water into the slope drain with an earth berm constructed at the top of a cut or fill. Anchor slope drains to the slope. Provide outlet protection.

E. Inspection and Reporting

1. Inspect all erosion control facilities at least every 7 days, within 24 hours after more than 3/8 inch of rain in a 24-hour period, and as required by the contract permits.

2. Within 24 hours, furnish inspection reports to the Contracting Officer (CO) which include all of the following:
    a. Summary of the inspection;
    b. Names of personnel making the inspection;
    c. Date and time of inspection;
    d. Observations made; and

e. Corrective action necessary, action taken, and date and time of action.

F. Maintenance and Cleanup

1. Maintain temporary erosion control measures in working condition until the project is complete or the measures are no longer needed. Clean erosion control measures when half full of sediment. Use the sediment in the work, if acceptable, or dispose of it legally off the project.

2. Replace erosion control measures that cannot be maintained and those that are damaged by construction operations.

3. Remove and dispose of temporary erosion control measures when the vegetation is satisfactorily established and drainage ditches and channels are lined and stabilized. Dispose of debris and unsuitable and excess material as follows:
   a. Remove from project. Recycle or dispose of material legally off the project. Furnish a statement documenting the nature and quantity of material processed or sold for recycling. Otherwise, furnish a signed copy of the disposal agreement before disposal begins.
   b. Hazardous material. Furnish a copy of all disposal permits. Dispose of material according to Federal, State, and local regulations.

4. Restore the ground to its natural or intended condition and provide permanent erosion control measures.

3.3 FINAL ACCEPTANCE

1. Material for soil erosion control measures will be evaluated under this specification.

2. Construction, maintenance, and removal of soil erosion control measures will be evaluated under this specification.

3. Geotextile will be evaluated under this specification.

END OF SECTION 31 25 00.

SECTION 31 32 19.23 – GEOTEXTILE LAYER SEPARATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of furnishing and placing a geotextile as a permeable separator, stabilizer, or permanent erosion control measure. Geotextile types are designated as shown in Subsection 2.1.A.
B. Measurement Procedures
   a. Geotextile will be measured for by the unit of square foot.
C. Payment Procedures
   a. The accepted work will be paid at the contract lump sum price for all work described in this section.

1.2 REFERENCES
A. ASTM – ASTM International
   1. ASTM D 4632 – Standard specification for determining the breaking load and elongation of geotextile fabrics

PART 2 – MATERIALS

2.1 MATERIALS

A. Geotextile – Use long-chain, synthetic polymers, composed at least 95 percent by mass of polyolefins or polyesters, to manufacture geotextile or the threads used to sew geotextile. Form the geotextile, including selvedges, into a stable network such that the filaments or yarns retain their dimensional stability relative to each other.
   1. Physical requirements. Conform to the following tables for the type of geotextile specified:
      a) Type II (A - C) Separation Table 714-1
      b) Type III (A - B) Stabilization geotextile Table 714-2
      c) Type IV (A - F) Permanent erosion control Table 714-3
   2. All property values, with the exception of apparent opening size (AOS), in these specifications represent minimum average roll values in the weakest principal direction (i.e., average test results of any roll in a lot sampled for conformance or quality assurance testing shall meet or exceed the specified values). Values for AOS represent maximum average roll values.
      Elevate and protect rolls with a waterproof cover if stored outdoors. When using a geotextile for a permanent installation, limit the geotextile exposure to ultraviolet radiation to less than 10 days.
   3. Evaluation procedures. Geotextile will be evaluated under Subsection 01 90 00 1.3. Furnish a commercial certification including the name of the manufacturer, product name, style number, chemical composition of the filaments or yarns, and other pertinent information to fully describe the geotextile.
      When samples are required, remove a 3-foot long, full-width sample from beyond the first outer wrap of the roll. Label the sample with the lot and batch number, date of sampling, project number, item number, manufacturer, and product name.

In addition, when geotextile joints are sewn, submit the seam assembly description and a sample of the sewn material. This description shall include the seam type, seam allowance, stitch type, sewing thread tex ticket number(s) and type(s), stitch density, and stitch gauge. If the production seams are sewn in both the machine and cross-machine directions, provide sample sewn seams that are oriented in both the machine and cross-machine directions. Furnish a sewn sample that has at least 2 meters of sewn seam and is at least 1.5 meters wide. Sew the sample seams with the same equipment and procedures that are used to sew the production seams. For seams sewn on-site, conform to the manufacturer's recommendations. Obtain approval of the seam before installation.

Table 714-1
Physical Requirements For Separation Geotextile

Property	Test Method ASTM	Units	Specifications (1)		
			Type II-A	Type II-B	Type II-C
Grab strength	D 4632	N	1400/900	1100/700	800/500
Sewn seam strength	D 4632	N	1260/810	990/630	720/450
Tear strength	D 4533	N	500/350	400(3)/250	300/180
Puncture strength	D 4833	N	500/350	400/250	300/180
Burst strength	D 3786	kPa	3500/1700	2700/1300	2100/950
Permittivity	D 4491	s^{-1}	0.02	0.02	0.02
Apparent opening size	D 4751	mm	0.60 (2)	0.60 (2)	0.60 (2)
Ultraviolet stability	D 4355	%	50% after 500 hours of exposure		

(1) The first values in a column apply to geotextiles that break at < 50 percent elongation (ASTM D 4632). The second values in a column apply to geotextiles that break at ≥ 50 percent elongation (ASTM D 4632).
(2) Maximum average roll value.
(3) The minimum average tear strength for woven monofilament geotextile is 245 N.

Table 714-2

Physical Requirements For Stabilization Geotextile

Property	Test Method ASTM	Units	Specifications (1)	
			Type III-A	Type III-B
Grab strength	D 4632	N	1400/900	1100/700
Sewn seam strength	D 4632	N	1260/810	990/630
Tear strength	D 4533	N	500/350	400(3)/250
Puncture strength	D 4833	N	500/350	400/250
Burst strength	D 3786	kPa	3500/1700	2700/1300
Permittivity	D 4491	s^{-1}	0.05	0.05
Apparent opening size	D 4751	mm	0.43 (2)	0.43 (2)
Ultraviolet stability	D 4355	%	50% after 500 hours of exposure	

(1) The first values in a column apply to geotextiles that break at < 50 percent elongation (ASTM D 4632). The second values in a column apply to geotextiles that break at ≥ 50 percent elongation (ASTM D 4632).
(2) Maximum average roll value.
(3) The minimum average tear strength for woven monofilament geotextile is 245 N.

Table 714-3
Physical Requirements for Permanent Erosion Control Geotextile

Property	Test Method ASTM	Units	Specifications (1)					
			Type IV-A	Type IV-B	Type IV-C	Type IV-D	Type IV-E	Type IV-F
Grab strength	D 4632	N	1400/900	1400/900	1400/900	1100/700	1100/700	1100/700
Sewn seam strength	D 4632	N	1260/810	1260/810	1260/810	990/630	990/630	990/630
Tear strength	D 4533	N	500/350	500/350	500/350	400(3)/250	400(3)/250	400(3)/250
Puncture strength	D 4833	N	500/350	500/350	500/350	400/250	400/250	400/250
Burst strength	D 3786	kPa	3500/1750	3500/1750	3500/1750	2750/1350	2750/1350	2750/1350
Permittivity	D 4491	s^{-1}	0.7	0.2	0.1	0.7	0.2	0.1
Apparent opening size	D 4751	mm	0.43 (2)	0.25 (2)	0.22 (2)	0.43 (2)	0.25 (2)	0.22 (2)
Ultraviolet stability	D 4355	%	50 % after 500 hours of exposure					

(1) The first values in a column apply to geotextiles that break at <50 percent elongation (ASTM D 4632). The second values in a column apply to geotextiles that break at ≥ 50 elongation (ASTM D 4632).

(2) Maximum average roll value.

(3) The minimum average roll tear strength for woven monofilament geotextile is 245 N.

PART 3 – EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. General

1. Where placing a geotextile on native ground, cut the trees and shrubs flush with the ground surface. Do not remove the topsoil and vegetation mat. Remove all sharp objects and large rocks. Fill depressions or holes with suitable material to provide a firm foundation. Replace or repair all geotextile that is torn, punctured, or muddy. Remove the damaged area and place a patch of the same type of geotextile overlapping 3 feet beyond the damaged area.

B. Separation and Stabilization Applications

1. Placing a geotextile on a subgrade

a) 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.

b) Finishing. Remove all material larger than 6 inches from the top 6 inches of the roadbed. Remove unsuitable material from the roadbed, and replace it with suitable material. Finish roadbeds that are compacted to within ±0.05 feet of the staked line and grade. Finish ditch cross-sections to within ±0.10 feet of the staked line and grade. Maintain proper ditch drainage.

Place the geotextile smooth and free of tension, stress, or wrinkles. Fold or cut the geotextile to conform to curves. Overlap in the direction of construction. Overlap the geotextile a minimum of 2 feet at the ends and sides of adjoining sheets, or sew the geotextile joints according to the manufacturer's recommendations. Do not place longitudinal overlaps below anticipated wheel loads. Hold the geotextile in place with pins, staples, or piles of cover material.

End dump the cover material onto the geotextile from the edge of the geo-textile or from previously placed cover material. Do not operate equipment directly on the geotextile. Spread the end-dumped pile of cover material maintaining a minimum lift thickness of 12 inches. Compact the cover material with rubber-tired or nonvibratory smooth drum rollers. Avoid sudden stops, starts, or turns of the construction equipment. Fill all ruts from construction equipment with additional cover material. Do not regrade ruts with placement equipment.

Place subsequent lifts of cover material in the same manner. Vibratory compactors may be used for compacting subsequent lifts. If foundation failures occur, repair the damaged areas and revert to the use of nonvibratory compaction equipment.

C. Permanent Erosion Control Applications

1. Place and anchor the geotextile on an approved smooth-graded surface. For slope or wave protection, place the long dimension of the geotextile down the slope. For stream bank protection, place the long dimension of the geotextile parallel to the centerline of the channel.

Overlap the geotextile a minimum of 12 inches at the ends and sides of adjoining sheets or sew the geotextile joints according to the manufacturer's recommendations. Overlap the uphill or upstream sheet over the downhill or downstream sheet. Offset end joints of adjacent sheets a minimum of 5 feet. Pins may be used to hold the geotextile sheets in place. Space pins along the overlaps at approximately 3-foot centers.

Place aggregate, slope protection, or riprap on the geotextile starting at the toe of the slope and proceed upward. Place riprap onto the geotextile from a height of less than 12 inches. Place slope protection rock or aggregate backfill onto the geotextile from a height less than 3 feet. In underwater applications, place the geotextile and cover material in the same day.

D. Acceptance

1. Material for earthwork geotextile will be evaluated under Subsections 01 90 00 1.2, 01 90 00 1.3 and Subsection 2.1.A.3.

2. Earthwork geotextile installation will be evaluated under Subsections 01 90 00 1.2 and 01 90 00 1.4.

END OF SECTION 31 32 19

SECTION 31 37 00 – RIPRAP

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of furnishing and placing riprap for bank protection, slope protection, drainage structures, and erosion control.
   1. Riprap classes are designated as shown in Table 31 37 00-1.

B. Measurement Procedures
   1. Riprap will be measured at the unit per ton.

   2. The lump sum contract bid price for riprap will include:

      - all testing required by the contract

      - all materials, labor and equipment required to install riprap.

C. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work.

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials
   1. AASHTO T 210 - Standard Method of Test for Aggregate Durability Index
   2. AASHTO T 85 - Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate

B. ASTM – ASTM International – formerly known as American Society for Testing and Materials
   1. ASTM D 276 - Standard Test Methods for Identification of Fibers in Textiles
   2. ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
   3. ASTM D 5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles
   4. ASTM D 6140 - Standard Test Method to Determine Asphalt Retention of Paving Fabrics Used in Asphalt Paving for Full-Width Applications

C. FAR - Federal Acquisition Regulations
   1. FAR 46.105 Contractor responsibilities
   2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
   3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL
   A. Submit material certificate to the Engineer, signed by the material producer and Contractor, certifying that materials comply with these specifications and the construction plans.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Conform Geotextile type IV

Physical Requirements For Paving Fabric

Property	Test Method	Units	Specifications Type VI
Grab strength	ASTM D 4632	N	500
Ultimate elongation	ASTM D 4632	%	50% at break
Asphalt retention	ASTM D 6140	L/m^2	0.90
Mass per unit area	ASTM D 5261	g/m^2	140
Melting point	ASTM D 276	ºC	150

B. Cement grout – Furnish 1 part hydraulic cement and 3 parts sand. Thoroughly mix with water to produce a thick, creamy consistency.

C. Riprap rock – Furnish hard, durable, angular rock that is resistant to weathering and water action and free of organic or other unsuitable material. 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 the following:

1. Apparent specific gravity, AASHTO T 85 — 2.50 min.
2. Absorption, AASHTO T 85 — 4.2% max.
3. Coarse durability index, AASHTO T 210 — 50 min.
4. Gradation for the class specified — Table 31 37 00-1

Table 31 37 00-1
Gradation Requirements for Riprap

Class	Percent of Rock by Mass	Mass (pounds)	Approximate Cubic Dimension(2)(3) (inches)
1	20	22 to 33	6 to 8
	30	11 to 22	5 to 6
	40	1 to 11	2 to 5
	10 (1)	0 to 1	0 to 2
2	20	55 to 110	8 to 10
	30	22 to 55	6 to 8
	40	2 to 22	3 to 6
	10 (1)	0 to 2	0 to 3
3	20	220 to 330	14 to 16
	30	110 to 220	10 to 14
	40	11 to 110	5 to 10
	10 (1)	0 to 11	0 to 5
4	20	550 to 770	18 to 20
	30	220 to 550	14 to 18
	40	22 to 220	6 to 14
	10 (1)	0 to 22	0 to 6
5	20	1540 to 2200	26 to 28
	30	770 to 1540	20 to 26
	40	55 to 770	8 to 20
	10 (1)	0 to 55	0 to 8
6	20	1870 to 3530	28 to 34
	30	1100 to 1870	22 to 28
	40	110 to 1100	10 to 22
	10 (1)	0 to 110	0 to 10

(1) Furnish spalls and rock fragments graded to provide a stable dense mass.
(2) The volume of a rock with these cubic dimensions has a mass approximately equal to the specified rock mass.
(3) Furnish rock with breadth and thickness at least one-third its length.

PART 3 – EXECUTION

3.1 PREPARATION

1. Perform the work under Specification 31 00 00. Dress the slope to produce a smooth surface. If earthwork geotextile is required, place according to Specification 31 32 19.23.

3.2 APPLICATION

A. Placed Riprap
   1. Placed riprap is rock placed on a prepared surface to form a well-graded mass. Place riprap to its full thickness in one operation to avoid displacing the underlying material. Do not place riprap material by methods that cause segregation or damage to the prepared surface. Place or rearrange individual rocks by mechanical or hand methods to obtain a dense uniform blanket with a reasonably smooth surface.
   2. For Rip Rap outlet pads, install topsoil layer, seed mix, and coir fabric as detailed in the construction drawings. Ensure coir fabric is secured either with staples or anchored under outer edge of stone.

B. Keyed Riprap
   1. Keyed riprap is rock placed on a prepared surface and set into place by impact pressure. Place rock for keyed riprap according to Subsection 3.1.B. Set the riprap into place by exerting impact pressure with a hydraulic-powered bucket or an approximate 5000-pound flat-faced mass. Repeated impacts should be made until the rock is firmly seated and forms a reasonably uniform surface without reducing the effective sizes of the rocks. Do not use impact pressure on riprap below the water surface.

C. Grouted Riprap
   1. Grouted riprap is rock placed or keyed on a prepared surface with the voids filled with grout. Place rock for grouted riprap according to Subsections 3.1.B or 3.1.C. Thoroughly moisten the rocks and wash excess fines from the riprap or to the underside of the riprap. Place grout only when the air temperature is no less than 35 ºF within the near-surface voids of the riprap. Place the grout in a manner to prevent segregation. Begin placing grout at the lowest elevation of the riprap. Fill all voids without unseating the rocks. Do not exceed 5-foot thickness for each layer of grouted riprap. Allow 3 days curing time before adding the next layer of riprap and grout. Provide weep holes through the grouted riprap as required. Keep the grouted riprap moist for 3 days after the work is completed and protect it from freezing for a minimum of 7 days after grouting.

3.3 FINAL ACCEPTANCE

1. See Table 31 37 00-2 for sampling and testing requirements.

2. Rock for riprap will be evaluated under this specification.

3. Rock placement for riprap will be evaluated under this specification.

4. Structure excavation and backfill will be evaluated under Specification 02 41 13.

5. Geotextile will be evaluated under Specification 31 32 19.23.

6. Material for grout will be evaluated under Subsections 01 90 00 1.2 and 01 90 00 1.3. Grout will be evaluated under Subsections 01 90 00 1.2 and 01 90 00 1.4. Grout placement will be evaluated under Subsection 01 90 00 1.2.

Table 31 37 00-2
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Riprap (705.02)	Measured and tested for conformance (01 90 01.4)	Apparent specific gravity & absorption	—	AASHTO T 85	1 per material type	Source of material	Yes	Before using in work
		Coarse durability index	—	AASHTO T 210	"	"	"	"
		Sodium sulfate soundness	—	AASHTO T 104	"	"	"	"
		LA abrasion	—	AASHTO T 96	"	"	"	"
Mortar	Measured and tested for conformance (01 90 01.4)	Making test specimens Compressive strength	—	AASHTO T 23 & T 22	1 per mix design	—	Yes, when requested	Before using in work

END OF SECTION 31 37 00.

SECTION 31 51 15 – SLOPE STABILIZATION - COIR WRAPPED SOILS LIFTS

PART 1 - GENERAL

1.1 DESCRIPTION

The work covered by this section consists of preparation, excavation and installation of all materials required for proper installation of Coir Wrapped Soil Lifts, as specified in the Contract Documents, or as directed by the Engineer. Coir Wrapped Soil Lifts, which are also referred to as soil lifts, are slope structures composed of compacted soil wrapped in erosion control matting and planted.

A. Measurement Procedures

1. The quantity of Soil Lift to be constructed will be affected by actual conditions that occur during the construction of the project. The type and quantity of Soil Lift may be increased or decreased at the direction of the Engineer. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

2. The quantity of Soil Lift measured shall be the actual number of square yards measured horizontally along the surface of the ground over which the Soil Lift is properly installed and accepted by the Engineer. Material not properly installed shall not be paid.

3. There shall be no separate measurement for stakes, grading, coir matting, and the placement and compaction of soil or amendments to the soil.

4. There shall be no separate measurement for Topsoil and Mulch required for the Soil Lift.

5. The lump sum contract bid price for Soil Lift will include:

- all testing and analysis required by the contract
- all materials, labor and equipment required to install soil lifts

B. Payment Procedures

1. The quantity of trees planted will be measured and paid for separately under “Planting”.

2. The Soil Lift measured as provided above will be paid for at the contract unit price per square yard of Soil Lift installed and accepted by the NPS. Such payment will be full compensation for all work covered in this special provision, including, but not limited to grading, compaction, stockpiling, mixing, installation, harvesting, preparation, hauling, staking, repair, replacements, maintenance, and for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work as specified in the Contract Documents or as directed by the Engineer.

1.2 REFERENCES

A. ASTM – ASTM International – formerly known as American Society for Testing and Materials

1. ASTM D5261: Standard Test Method for Measuring Mass per Unit Area of Geotextiles

2. ASTM D5199: Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
3. ASTM D6567: Standard Test Method for Measuring the Light Penetration of a Rolled Erosion Control Product
4. ASTM D1777: Standard Test Method for Thickness of Textile Materials
5. ASTM D6818: Standard Test Method for Tensile Properties of Rolled Erosion Control Products
6. ASTM D4595: Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Method

B. FAR - Federal Acquisition Regulations
1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTALS:

A. Submit material certificates to the Engineer, signed by the material producer and Contractor, certifying that all materials comply with these specifications and the construction plans.

B. Geotechnical Analysis
The CONTRACTOR shall employ a duly licensed geotechnical engineering firm to prepare a geotechnical analysis and report with recommendations for, but not limited to, anchor designs, anchor depths, lift heights and stabilizing materials.

If required, additional field data collection shall be performed within the defined and permitted Limits of Disturbance on the contract drawings. Contractor shall submit a field data collection plan for review and approved prior to mobilization.

C. Shop Drawings
The CONTRACTOR shall provide detailed shop drawings including means and methods of installation for review and approval prior to installation.

D. Marine Grade Earth Anchors
The CONTRACTOR shall prepare and submit to the Engineer design calculations signed and stamped by a licensed Professional Engineer licensed in the Commonwealth of Pennsylvania indicating type, size, and length of anchor embedment to support the proposed coir wrapped soil lifts and the requirements noted below.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Matting
1. Coir Fiber Matting. Furnish coir matting consisting of coir fibers (coconut fibers) encased in coir fiber netting. Conform to the following:

a) Material	100% Coir (Coconut) Fiber
b) Mass/Unit Area	26.7 oz/yd^2 (906.0g/m^2)

c)	Thickness	0.37 inches (9.7mm)
d)	Dry Tensile Strength - MD	1915 lb/ft (28.0kN/m)
e)	Dry Elongation – MD	26%
f)	Dry Tensile Strength – TD	1640 lb/ft (24.0kN/m)
g)	Dry Elongation – TD	29%
h)	Wet Tensile Strength – MD	1790 lb/ft (26.2kN/m)
i)	Wet Elongation – MD	40%
j)	Wet Tensile Strength – TD	1750 lb/ft (25.6 kN/m)
k)	Wet Elongation – TD	40%
l)	Shear Stress	5.50 lbs/ft^2 (263Pa)
m)	Velocity	16.0 ft/s (4.88 m/s)
n)	C Factor	0.002
o)	Open Area – Calculated	36%
p)	Net Opening	3/8” (10mm) x 3/8” (11mm)

2. Coir / Jute Blanket. Furnish blanket consisting of internal matting of 100% coir (coconut fibers) wrapped in double-jute netting. Conform to the following:

a)	Inner Material	100% Coir (Coconut) Fiber
b)	Netting material	Biodegradable double jute
c)	Thread Material	Biodegradable Jute Yarn
d)	Mass/Unit Area	11 oz/yd^2 (373.0g/m^2)
e)	Thickness	0.31 inches (7.9mm)
f)	Tensile Strength - MD	240 lb/ft (3.5 kN/m)
g)	Elongation – MD	10.9%
h)	Tensile Strength – TD	164 lb/ft (2.4 kN/m)
i)	Elongation – TD	16%
j)	Shear Stress	2.25 lbs/ft^2 (108Pa)
k)	Velocity	9.0 ft/s (2.7 m/s)

B. Brush Layering with Live Sakes
1. Furnish live stakes of select native species for layering between each soil lift to achieve a natural appearance and aid in revegetation.
2. Species to be used for brush layering include:
   a. Populus deltoides (cottonwood),
   b. Populus grandidentata (large-toothed aspen),
   c. Cornus amomum (silky dogwood).
3. Eight (8) ft minimum length live stakes preferred, 4ft up to 10 ft length acceptable depending on the length of the step.
4. All live stakes/live brush layering material shall be soaked for ten (10) days prior to installation and kept wet until final installation.

C. Stakes
1. Stakes shall be used to anchor matting in place prior to soil placement. Provide hardwood stakes a minimum of 2-ft long with a 2" x 2" nominal square cross section. One end of the stake shall be sharpened or beveled to facilitate driving down into the underlying soil.

D. Staples
1. Provide staples made of 0.125" diameter new steel wire formed into a U-shape not less than 12" in length with a throat of 1" in width.

E. Logs

1. Logs to be used for footer logs should be a native hardwood species (no tap roots will be accepted) and have a minimum main stem diameter of 24 inches (measured at any point along the log) and should have a minimum of 10 feet of the main stem length remaining.

F. Cables

1. Provide ¼" diameter stainless steel cable with matching 316 stainless steel rope clips.Marine Grade Earth Anchors
2. Provide marine grade earth anchors that conform to the following:
   a. Maximum Safe Working Load (2:1 FS) 20 kips (89 kN)
   b. Anchor Rod Diameter 3/4 inch
   c. Min Weight per Anchor 22 lbs (10 kg)
   d. Working capacity 7 – 9 kips

G. Mulch – see Seeding specification 32 92 20

H. Seed - See Seeding specification 32 92 20

PART 3 – EXECUTION

3.1 PREPARATION

A. General

1. Cut the trees and shrubs in direct conflict with slope stabilization measures flush with the ground surface. Do not remove the topsoil and vegetation mat. Remove all sharp objects and large rocks.

2. 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.

3.2 PROCESS

Installation should follow the procedure below:

a) Clean and grade the base of the slope to create a level and compact soil surface for the footer logs at or above elevation 385 ft and at approximate elevation 400 as shown on the plans.

b) Place two (2) rows of footer logs at or above elevation 385 as shown on plans and one (1) row of footer logs at approximate elevation 400.
   i) Logs shall be bound together with stainless steel cabling.
   ii) Strapping shall be placed at each end of the logs as well as spaced at a maximum five (5') center along the length of the logs.
   iii) Ends of logs shall overlap a minimum of three (3) feet and be strapped within one (1) foot of each end of the splice.

c) Install a minimum of four (4) marine grade earth anchors for the front footer log spaced equally along the length of the log and within two (2) feet of each end.

d) Footer log installation shall be reviewed by the C.O. prior to proceeding with the work.

e) Grade/excavate the soil above the installed footer logs to provide a smooth and even surface prior to applying the matting. The surface shall be reviewed by the C.O. prior to proceeding with the

work.

f) Place a three (3) foot high stabilizer board of ¾-inch plywood vertically on the outside face of the base lift. Secure stabilizer board using 2” x 2” wooden stakes or #4 rebar pins.

g) Unroll 900g coir mat parallel to the face of the slope and overlay with coir/jute blanket.

h) Drape matting over stabilizer board so that it forms a 90 degree angle where the inner face of the stabilizer board meets the soil surface. Keep a minimum embedment length of three (3) feet.

i) Anchor matting sing 2” x 4” wedge stakes at three (3) foot spacing along the stabilizer board and along the slope edge of the matting.

j) Backfill with well graded mixture of rock and soil.

k) Compact soil and stretch matting over the compacted soil and extend towards the slope.

l) Anchor top layer of matting with wedge stakes at three (3) foot spacing in a key trench. This base lift forms the foundation for the upper lifts.

m) Base lift installation shall be reviewed by the C.O. prior to proceeding with the work. Once approved, move to step ‘n’.

n) Wet matting and top with two (2) inches of topsoil or compost.

o) Spread seed mix as specified in the construction drawings on the portion of the lift that will be exposed to sunlight.

p) Arrange live stakes along trenches perpendicular to the slope prior to adding the next layer of wrap.

    i) Stakes shall be randomly dispersed in bundles to achieve a natural appearance and six (6) to 15 stakes installed per meter of wrap length.
    ii) Placement of live stakes shall be at 10 – 20 degree incline upwards from horizontal to promote root and branch development.
    iii) Live stakes shall be placed such that 80% of the length is between the soil layers and 20% is exposed.

q) Repeat the same procedure for the upper lifts.

    i) Offset each lift a minimum of one (1) foot from the face of the previous lift.
    ii) Site conditions may require slight deviation from the planting plan and shall be approved by the Engineer.
    iii) The face of the completed Soil Lift shall match the design bank slope.

r) Lift installation shall be reviewed by the C.O. after each third lift is installed and prior to proceeding with the work

s) Upon reaching the top of the proposed design slope the matting shall be secured with wedge stakes and roadway/trail fill installed.

t) Erosion control matting shall be neatly secured around any project elements, undisturbed trees/shrubs, and existing structures to prevent any loose or frayed edges. There shall be no loose ends or unsecured erosion control fabric on the completed work.

3.3 FINAL ACCEPTANCE

Installation of Permanent Slope Stabilization will be evaluated under this specification.

Backfill will be evaluated under Section 31 00 00.

END OF SECTION 31 51 15.

SECTION 31 62 16.16 – STEEL H-PILES

PART 1 - GENERAL

1.1 DESCRIPTION:`

A. The Work of this Section includes, but is not limited to, design, plant fabrication, selection and implementation of means and methods for the pile installation and testing to complete the following work:

1. Design the size and dimension, furnish and install steel foundation piles based on design loads shown on the Contract Drawings (herein referred to as "Drawings"). Installing steel H-piles of types and sizes and length as designed by the CONTRACTOR's Engineer at locations associated with the boardwalk segments and coordinated with the precast concrete boardwalk supplier.
2. Supplemental subsurface investigation to support foundation type, size and length design in coordination with the boardwalk design criteria.
3. All steel piles shall be fitted with diving shoes.
4. Mobilizing to the site with all equipment, hammers, templates, support equipment and personnel needed to complete the work specified herein.
5. Piles will be installed vertically. Contactor shall be responsible for all rigs set-up designed, templates, and support needed to install the piles.
6. Installing the following types and sizes of steel piles:

Pile Type	Pile Size
Steel H-Pile	HP14

7. Conducting computer wave equation analyses using WEAP (Wave Equation Analyses for Piles) prior to mobilization and import of pile materials to the site to demonstrate that the proposed hammer and driving system delivers the required energy per blow to the pile and that driving stresses in the piles with the proposed hammer-pile-soil systems will not exceed the allowable tensile and compressive stresses of the piles during driving.
8. Installing indicator piles at designated production pile locations and performing Dynamic Pile (PDA) Testing on all of the indicator piles at locations. PDA testing shall be conducted prior to the start of production pile driving to confirm pile design capacities, evaluate the driving energy transferred to the pile during installation, determine stresses induced in the piles during driving, determine range of installed pile lengths, and evaluate performance of the pile driving equipment.
9. Conducting 48-hour restrikes of all indicator piles using PDA equipment to determine pile setup/relaxation characteristics of the soils at the site.
10. PDA testing of piles will be required at non-indicator pile locations, in addition to indicator pile locations. The frequency and number of non-indicator piles required for PDA testing will depend on the condition of driving at individual pile locations.

11. Perform CAPWAP analyses on a minimum of three (3) of the indicator piles at locations determined by the ENGINEER.
12. Installing production piles based on the WEAP analyses and the results of the dynamic testing.
13. Cutting off piles at design cut-off length and disposing pile cut-offs at approved off-site locations. Preparing the exposed end of the pile to receive the structural connection,
14. Demobilize all equipment and other materials, personnel, temporary works used to complete the work and other support materials from the site. All temporary materials used to install the piles shall be removed from the site after completion of the work.

B. The Work shall be coordinated with the following:
   1. Section 03 41 40 Elevated Precast Concrete Boardwalk

C. The CONTRATOR is responsible to provide qualified personnel for onsite installation, inspection, and record keeping as specified herein.

D. The Contractor shall hire a Professional Engineer licensed in the Commonwealth of Pennsylvania to evaluate the subsurface information to complete and finalize the pile design

E. Measurement Procedures
   1. Steel H-piles shall be paid for at the contract lump sum price as listed in the bid proposal for "Elevated Precast Concrete Boardwalk". This price shall include but is not limited to, a supplemental subsurface investigation, design, plant fabrication, labor, materials, tools, equipment, survey control, supervision, appliances, incidentals, and selection of the means and methods for the installation.

F. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work described in Section 03 41 40 – Elevated Precast Concrete Boardwalk

G. PAYMENT PROCEDURES

   1. The accepted work will be paid at the contract lump sum price for all work described in this section.

1.2 REFERENCES:

A. Where the specification and reference documents conflict, the Owner's designated representative will make the final determination of the applicable document.

B. AISC: American Institute of Steel Construction, Steel Construction Manual 16th Edition, 2023.

C. ASCE: American Society of Civil Engineers, ASCE 7-22, Minimum Design Loads and Associated Criteria for Buildings and Other Structures

D. ASTM: Specifications of the American Society for Testing and Materials, latest edition.

1. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Product

2. ASTM A 992 - Standard Specification for Steel for Structural Shapes

E. AWS: AWS D1.1 Structural Welding Code – Steel, 2020.

F. BUILDING CODE: International Building Code, IBC 2024.

G. OSHA: Occupational Health and Safety Administration

1.3 DESIGN REQUIREMENTS

A. Piles shall be designed to support the service design loads shown on the Drawings with a service life of not less than 75 years.

B. Piles shall be designed and installed in accordance with:

1. International Building Code, IBC 2024.

2. ASCE 7-22, Minimum Design Loads and Associated Criteria for Buildings and Other Structures

3. The requirements as specified herein.

4. The Drawings.

C. Loads on the Drawings are service level design loads. A maximum resistance factor of 0.70 shall be used to determine the required ultimate tensile and compressive resistance of the steel pile with regard to their interaction with soil upon successful completion of static load testing.

D. Design of the steel piles shall be based on Load Resistance Factor Design (LRFD)

1. Piles shall be designed to provide the minimum service design loads as shown on the Drawings.

2. Maximum resistance factor of 0.70 may be utilized upon successful completion of a preproduction verification load test. The design loads shall be confirmed with pile load tests as specified herein.

3. The pile design shall consider pile spacing, soil stratification, corrosion, and strain compatibility.

E. Where conflicting requirements occur, the more stringent shall govern. Design shall consider Service, Strength, and Extreme Limit States.

1.4 PROJECT CONDITIONS:

A. The project involves construction of a McDade (pedestrian) Trail adjacent to US Route 209. Portions of the Trail will be a pile supported boardwalk, portions will be wall supported, and portions will be at grade.

B. Existing Site and Subsurface Information:

1. Subsurface investigation data are available from the OWNER in a report titled "Geotechnical Engineering Report, DEWA 310424 Route 209 Potential Slope Failure Delaware and Dingman Township, Pennsylvania" prepared by Terracon Consultants, Inc., dated 24 June 2023.

C. Review of Existing Information:

1. Prior to submitting a bid, the CONTRACTOR shall review and understand the information referenced herein and other applicable resources. The referenced report is made available to the CONTRACTOR for information only. The subsurface information presented in the document is for information only and shall not be interpreted as a warranty of subsurface conditions whether interpreted from written text, boring logs, test results, or other data.

2. The CONTRACTOR shall draw their own conclusions regarding site conditions based upon site visit(s) and from available sources, for which the OWNER and its consultants assume no responsibility. The CONTRACTOR shall assume that subsurface conditions between subsurface explorations could differ from conditions shown in the test boring logs.

D. Subsurface conditions

1. The CONTRACTOR is advised that the subsurface conditions may vary across the site.

2. The CONTRACTOR shall conduct supplemental subsurface investigation as deemed necessary to finalize the size and length of the steel H-piles.

E. Protection of Adjacent Property and Utilities:

1. The CONTRACTOR shall protect adjacent structures (above ground and buried) from damage associated with pile driving and other related operations. Damage due to pile driving or other construction activities shall be repaired immediately by the CONTRACTOR at its own expense.

1.5 QUALITY ASSURANCE:

A. All labor, materials, equipment, permits, notifications and services necessary to make the work comply with such requirements shall be provided by the CONTRACTOR.

B. Field Monitoring and Testing:

1. In accordance with the requirements of the Building Code, the ENGINEER will provide full-time monitoring of the CONTRACTOR'S pile driving operations. No piles shall be tested or driven except in the presence of the ENGINEER.

a) Project name structure name, and contract number,
b) Name of Contractor, and name of supervisor during installation,
c) Pile location and pile number,
d) Date and time of installation.
e) Pile type, size, and dimensions,
f) Design pile capacity,
g) Type and size of hammer used,
h) Pile reveal.
i) Material type, dimensions, and thickness of any pile driving cushion between the hammer and pile,
j) Rate of operation of pile driving equipment,
k) Elevation of tip, and butt before and after cut-off,
l) Number of blows for each foot of penetration and final penetration resistance.
m) Pile uplift and redrive information.
n) Comments pertaining to interruptions, obstructions, or other relevant and unusual occurrences information

2. The Contractor shall also submit within 2 weeks after installation of all piles, an as-built plan, certified by a surveyor, showing the as-installed location of all piles to the nearest ½ inch.

C. Certification of quality and source of pile materials to be used in the work shall be furnished, in a form acceptable to the ENGINEER, at the time of delivery of materials to the site. Pile materials shall also be subject to on-site inspection by the ENGINEER for conformance with specifications.

D. Approvals given by the ENGINEER or OWNER shall not relieve the CONTRACTOR of the Contractor's responsibility for performing the work in accordance with the Contract Documents, nor shall they be construed to relieve the CONTRACTOR from its full responsibility for the means and methods of construction and for safety on the construction site and compliance with all laws and regulations applicable to the work included in this section.

E. The CONTRACTOR shall employ a Professional Engineer licensed in the Commonwealth of Pennsylvania who specializes in geotechnical engineering to perform WEAP Analyses for all pile driving systems and types of steel piles, to conduct PDA testing, 48-hour restrikes, and to perform related CAPWAP analyses. The Registered Professional Engineer shall have not less than 5 years' experience within the last 10 years in making consulting engineering recommendations, design, or supervising installation of pile foundations, and shall have completed WEAP analyses, PDA testing and CAPWAP analyses on not less than five unrelated, independent projects, in which piles were successfully installed using the pile driving criteria developed from the wave equation analyses and/or the PDA testing results.

F. Qualifications of CONTRACTOR:

1. CONTRACTOR shall have a minimum of 3 years experience within the last 10 years in pile driving of similar type, scope and complexity as the indicated pile foundations included in this project.

2. CONTRACTOR shall have completed not less than 2 successful pile foundations of similar type, scope and complexity as the indicated pile foundations within the past 5 years.

G. All welding shall be performed by operators who have been previously qualified by tests as prescribed in AWS Evidence that welders meet qualification requirements shall be submitted to the ENGINEER before welding has begun. Monitoring of welding and welds may be performed by an independent testing agency employed by the OWNER. The CONTRACTOR shall fully cooperate with the agency to facilitate inspection, notifying it at least one working day in advance when welding operations are to be performed. Welds that do not conform to applicable specifications shall be repaired as directed by the OWNER or its authorized representative.

1.6 SUBMITTALS:

A. GENERAL

1. The CONTRACTOR shall submit the information specified herein to the ENGINEER for review. All submittals and data shall be legible and stamped by a Professional Engineer licensed in the Commonwealth of Pennsylvania and retained by the CONTRACTOR.

2. The CONTRACTOR shall adhere to the approved submittal schedule, making every effort for timely submissions and allowing adequate time for the ENGINEER to review, evaluate and respond to the CONTRACTOR, in accordance with the requirements of Part III-General Conditions of the Contract and Part IV-Special Conditions of the Contract. The CONTRACTOR is responsible for scheduling specified submittals and resubmittals so as to prevent delays in the work.

3. Unless otherwise specified, submittals shall be made not less than 30 days before the start of the work. No work shall be started until the necessary review and approvals have been given.

4. No work shall begin and no materials shall be ordered until all submittals have been received, reviewed, and accepted in writing by the ENGINEER. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the CONTRACTOR.

B. PILES

The CONTRACTOR shall prepare and submit to the Engineer: design calculations, shop drawings, steel H-pile installation plan, construction procedures, load testing procedures, and equipment calibration for review and acceptance in accordance with these Specifications. The CONTRACTOR shall conduct his own survey to verify information shown on the Drawings. No work shall begin and no materials shall be ordered until all submittals have been received, reviewed, and accepted in writing by the ENGINEER. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the CONTRACTOR.

The pile submittals shall include:

1. Design

Design computations demonstrating compliance with the criteria specified herein and shown on the Drawing, prepared, and signed and stamped by a licensed Professional Engineer licensed in the Commonwealth of Pennsylvania.

The design calculations shall include but not be limited to:

a) Statement of all assumptions made and copies of all references used in the calculations.
b) A written summary report describing the overall pile design.
c) A statement of applicable code requirements and design references.
d) Pile structure critical design cross-section(s) geometry, including soil strata and piezometric levels and location, magnitude and direction of applied loadings, including slope or external surcharge loads.

e) A description of design criteria to be applied to the work, including, soil shear strengths (friction angle and cohesion), unit weights for each soil stratum and driving criteria for installation to bearing resistance refusal
f) All design calculations performed by hand, spreadsheet, or computer program and references used.
g) Design calculation sheets with the Project number, Steel H-pile structure location, designation, date of preparation, initials of designer and checker, and page number at the top of each page. Provide an index page for the design calculations.
h) Design notes including a list of symbols and computer program used in the design.
i) Pile-to-pile plate connection calculations.

2. Shop Drawings:

a) Pile number, location, and pattern by assigned identification number in coordination with the precast concrete boardwalk supplier.
b) Pile design load, service and factored
c) Pile sizes, driving shoe, pile tip details, pile plate, and other items pertinent and as applicable to particular pile design and handling.
d) Minimum overall length.

C. PILE DRIVING AND DYNAMIC LOAD TEST EQUIPMENT:

1. Manufacturer's literature, including technical and performance literature for pile driving hammer(s), cushions, hoses, and other equipment for piles.

2. Qualifications and experience of CONTRACTOR'S Professional Engineer performing the PDA testing and CAPWAP analyses.

3. Description, plan, details and methods of templates, falsework, surveying, procedures for locating piles and leads proposed to properly locate and install piles at locations shown on the Drawings.

4. Description of dynamic testing equipment and procedures.
5. Complete reports of PDA measurements/analyses (including 48-hour restrikes) and CAPWAP analyses performed during the indication pile program at least three working days prior to the commencement of production pile driving.
6. If diesel hammers are proposed to be used, provide apparatus to be used to measure gas pressure inside the hammer and total hammer energy for closed hammers, or ram bounce height in the case of open hammers.

D. PILE AND MATERIAL SUPPLIERS:

1. Name and address of pile manufacturer/supplier.

2. With each delivery of steel piles and steel reinforcing, mill certificates containing results of material tests conducted by a certified laboratory, including the chemical composition, yield strength and ultimate strength of the steel. The OWNER may reject any delivery of steel materials that is not accompanied with applicable mill certificates.

E. WAVE EQUATION (WEAP) ANALYSES:

1. Qualifications and experience of CONTRACTOR'S Professional Engineer performing the WEAP analyses.

2. For piles designed to support structures in axial compression, the CONTRACTOR shall propose final driving criteria (blow count) as the minimum number of hammer blows for each inch of the final 6 in. of pile penetration in the bearing stratum. The proposed criteria shall be submitted to the ENGINEER for review and acceptance. Piles shall not be installed prior to acceptance of the criteria by the ENGINEER.

3. Results of WEAP analyses performed and stamped by a licensed Professional Engineer in the Commonwealth of Pennsylvania, which demonstrate that the equipment, cushions and cap are capable of obtaining the required pile ultimate capacity (as shown on the Drawings) in accordance with the Building Code without damage to the particular pile type due to driving stresses. The WEAP analysis shall model bearing conditions in soil and bedrock, and anticipated pile lengths across the site using the proposed piles shown on the Drawings. The submittal shall also include any additional applicable assumptions used in the analyses.

   a) Analyses should be performed based on an overall pile allowable design capacity. Allowable pile capacity is equal to the ultimate pile capacity shown on the Drawings, divided by 2.25.
   b) Analyses over a range of final pile penetration resistance, from to 2 to 18 blows per inch.
   c) The minimum allowable toe quake used in the analyses shall be 0.15.
   d) The minimum allowable toe damping used in the analyses shall be 0.15.
   e) The maximum allowable compressive stress in the pile during driving shall not exceed 90 percent of the steel yield strength.
   f) The maximum allowable tensile stress in the pile during driving shall not exceed 90 percent of the steel yield strength.
   g) The minimum resistance from the pile tip shall be 90 percent.
   h) The hammer efficiency shall be selected based on the wave equation program default for the selected hammer.

4. CONTRACTOR shall submit a separate WEAP analysis for each different pile-hammer system.

5. Prior to installing indicator piles, submit a tabular summary of anticipated indicator pile lengths. The tabular summary shall include pile designation and estimated length as determined from the anticipated length below existing grade and cutoff elevation.

F. Pile Dynamic (PDA) Testing: Report summarizing the results of the PDA testing (including 48-hour restrikes) and CAPWAP analyses conducted by the CONTRACTOR'S Engineer.

G. Pile Coating Plan: a description of proposed pile coating and manufacture cut sheets, a written narrative/explanation of how (i.e. on-site, at yard, at plant, inside, outside, or other) the coating will be applied and a table including each pile and the length of pile to be coated. Also required is a written plan, details and notes of what and how the Contractor proposes to protect piles where the coating does not extend to the required depth below finished grade (such as placing permanent casing and concrete in the annular space between the casing and piles, or other methods).

PART 2 – PRODUCTS

2.1 MATERIALS

A. GENERAL

1. Pile materials shall be new and of uniform quality. Manufactured or assembled pile materials shall be of sufficient strength and rigidity to withstand all driving stresses.

2. Length of piles to be ordered shall be determined by the CONTRACTOR. Ordering, delivery and use of piles shall be planned and performed in such a manner that minimizes delays or interruption of driving and precludes the need for splices.

B. STEEL H-PILES

3. Steel H-piles shall conform to ASTM A992 and shall have a minimum yield strength of 50 ksi. Accompanying certificates shall state the chemical composition and yield point of the steel. The piles shall be identified to permit rapid correlation with the appropriate mill certificates.
4. Steel H-piles shall be of sufficient strength and rigidity to withstand all driving and handling stresses and to maintain initial shape within the tolerances specified hereinafter. Pile materials shall be new and of uniform quality.
5. Steel H-piles shall be the sizes and types shown on the drawings.
6. All steel piles shall be fitted with a minimum 50 ksi steel driving shoe fully welded to the tip of each pile.
7. Steel H-piles shall be protected from corrosion at each pile location in conformance with ASTM A123. Length of corrosion protection shall be determined by the Geotechnical Engineer based on the data obtained during the subsurface investigation. At a minimum the corrosion protection shall extend from the top of pile to a minimum distance of 5 feet below finished grade.

8. Pile splices shall not be allowed.

C. PILE TIP/DRIVING SHOE

1. Fit and weld cast steel, prefabricated pointed pile tip/drive shoe fabricated of Grade 50 steel to tip of each pile with a 5/16-in. groove weld, or equivalent, along each flange and pipe. Welding shall be performed as outlined herein.

D. PILE LENGTH MARKING

1. Permanently mark the entire length of each pile with legible horizontal lines (perpendicular to long axis of pile) measured from the pile tip at 1 ft. intervals. In addition, footage shall be marked and designated at 5-ft intervals, starting from the tip of the pile. Markings shall be sufficiently large and clearly written/marked with contrasting color from the pile such that the markings can be clearly seen from a distance from the pile of 100 ft.

PART 3 - EXECUTION

3.1 PREPARATION

A. GENERAL

1. The CONTRACTOR shall verify that site conditions will allow for access of the proposed installation equipment and will support equipment for helical pile installation.

2. The Contractor is responsible for coordinating with PA One Call (811) and for field locating and verifying the location of all utilities shown on the plans prior to starting the work.

3. Furnishing and installing drilled shafts of the size, quality and dimensions, at the locations, and to the lines and grades in coordination with the precast concrete boardwalk supplier. All steel piles shall be fitted with diving shoes.

4. Steel foundation piles shall be located and marked using survey and a template by the Contractor who shall maintain and be responsible for all location and elevation stakes.

5. The CONTRACTOR shall coordinate its pile installation operations with other work on the site.

3.2 INSTALLATION

A. SEQUENCE OF OPERATIONS AND EQUIPMENT REQUIREMENTS:

1. Prior to production pile installation, the CONTRACTOR shall drive three (3) pre-production indicator piles, one (1) at each boardwalk segment. The location shall be selected by the Contractor and accepted by the Engineer.
2. The CONTRACTOR'S Engineer shall perform dynamic (PDA) testing during installation of each indicator pile to aid in estimating the required pile lengths and to evaluate hammer performance, acceptable driving stresses, and to determine the final driving criteria based on the measured hammer energy transferred to the pile.

B. PILE DRIVING CRITERIA:

1. The CONTRACTOR shall furnish and install steel H-piles to design length or deeper, if needed to obtain required lateral capacity, and to the approved final penetration resistance needed to develop the required overall design compression capacity.

2. Contractor shall drive piles to not less than an approved final penetration resistance over the final 6 in. of driving as determined by the WEAP analyses and confirmed or revised by the PDA testing.

3. To limit the potential for overstressing of the pile during driving, if less than 1/2 in. of penetration is achieved in 10 successive hammer blows with the hammer at maximum stroke, driving should be stopped and the pile shall be evaluated by the ENGINEER (herein referred to as "refusal"). When piles advance less than 1/2 in. for 10 successive hammer blows with the hammer at maximum stroke, and the pile tip is more than 5 ft above the design pile length below existing grade, the CONTRACTOR shall complete the steps outlined in Article 3.5.N.

C. CONSTRUCTION TOLERANCE

1. Piles shall be plumb within 2 degrees.

2. The top elevations of the steel H-piles shall be within +1 inch to –2 inches of the design vertical elevation.

3.3 INDICATOR PILE INSTALLATION:

A. A minimum of three (3) indicator piles shall be driven one (1) at each boardwalk segment by the CONTRACTOR using the proposed production pile driving equipment and hammer settings, to the final driving criteria and stated in the CONTRACTOR'S approved WEAP analyses.

B. No piles shall be driven or tested except in the presence of the ENGINEER.

3.4 DYNAMIC PILE (PDA) TESTING:

A. During driving of the indicator piles, the CONTRACTOR'S Engineer shall conduct PDA testing on all indicator piles to evaluate the performance of the hammer/pile driving system, calculate stresses in the pile during driving, assess the structural integrity of the pile, and evaluate pile capacity/pile driving criteria. All of the indicator piles shall be restruck between 48 and 72 hours after completion of driving while being monitored with the PDA equipment as determined by the ENGINEER to assess "false driving resistance" and "setup" of the piles. The CONTRACTOR'S Engineer shall perform CAPWAP analyses on four of the piles as selected by the ENGINEER (both at the end of initial driving and at the start of re-driving).

B. The CONTRACTOR shall plan adequate time for PDA testing and CAPWAP analyses to be performed during driving of the indicator piles.

C. If based on the results of the PDA testing, the ENGINEER determines the hammer is not working adequately; the hammer shall be repaired or replaced by the CONTRACTOR at no additional cost to the OWNER. In this instance, the CONTRACTOR shall redrive all previously driven piles and possibly additional indicator piles and repeat the dynamic testing, as required by the ENGINEER, at no additional cost to the OWNER.

D. If, at any time during production pile driving, the CONTRACTOR proposes to change the pile installation equipment (including the individual hammer or hammer type) from that used to install the indicator piles, PDA testing shall be performed by the CONTRACTOR'S Engineer at the CONTRACTOR'S expense to confirm that the new hammer can transfer the minimum required energy to the pile and that pile stresses are within acceptable limits. Dynamic testing of a minimum of an additional four piles will be required in this case.

3.5 PRODUCTION PILE INSTALLATION:

A. Piles shall be installed with approved modern equipment in good working order. The proposed pile installation equipment and methods shall be subject to approval of the ENGINEER and approval shall be secured before the start of installation.

B. All piles shall be installed using survey control and markings sufficient to install each pile at locations indicated on the Drawings.

C. All piles shall be installed using leads on the pile driving rig in order to maintain the pile and hammer in axial alignment at the correct plan location during the entire driving operation. The leads shall extend down to the lowest point at which the hammer must operate. Piles shall be installed using fixed leads or swinging leads sufficient to safely install the piles at the locations shown on the drawings and to the pile driving criteria.

D. Piles shall be driven with a single-acting, double-acting, or differential-acting steam, hydraulic, air, or diesel hammer as approved based on the WEAP analyses, PDA testing and CAPWAP analyses. When the determination of the final driving resistance is being made, the steam, hydraulic, air or diesel hammer shall be operated at a speed not less than 90 percent of the maximum blows per minute for which the hammer is rated by the manufacturer. The CONTRACTOR shall maintain the boiler or air pressure recommended by the manufacturer and shall employ the proper size hose and connections. When the determination of final driving resistance is being made with a diesel hammer, the energy being delivered to the pile shall be determined as the product of the weight of the ram times the observed or equivalent stroke for open diesel hammers; for closed diesel hammers, the energy shall be that indicated by an output gauge calibrated to measure total hammer energy. The ENGINEER will monitor hammer performance of an open-ended diesel using a saximeter which measures the rate of hammer operation.

E. Special Requirement for Diesel Hammers: In the case of a diesel hammer, the CONTRACTOR shall provide an apparatus approved by the ENGINEER to measure gas pressures inside the hammer and total hammer energy for closed hammers, or ram bounce height in the case of open hammers.

F. An aluminum micarta cushion block or other cushion material consistent with WEAP analyses and PDA testing and if approved by the ENGINEER, shall be used in the hammer for driving piles. Cushions shall be replaced when burned or otherwise worn.

G. Hammers and all ancillary pile driving equipment used to install production piles shall be the same physical equipment used to install the indicator piles.

H. The use of followers will not be permitted unless authorized in writing by the ENGINEER.

I. Piles shall be installed systematically such that piles are installed at indicated locations. The CONTRACTOR shall replace or supplement any piles that are misplaced by size as required by the ENGINEER.

J. Piles that are unsatisfactory installed shall be removed, or repaired at no additional cost to the OWNER.

K. Driving:

1. As part of preparation for driving, each pile shall be marked as specified herein.

2. All piles shall be driven at the indicated locations and orientations. The CONTRACTOR shall utilize a pile alignment system to position the piles at the correct location and orientation. Pile location and orientation shall be checked

during driving and appropriate measures taken, as necessary, to maintain the correct pile position.

3. Each pile shall be driven to the design pile length or deeper if needed to meet the minimum pile driving criteria.

4. Pile driving shall be continuous and without interruption for the final 5 ft of penetration. If pile driving is interrupted during the final 5 ft of driving, the ENGINEER shall be the sole judge of whether the pile driving resistance is impacted by frictional resistance above the bearing stratum.

5. Pile driving resistance shall be constant or increasing during achievement of the final driving criteria. If pile driving resistance decreases during final driving, the pile shall be driven until the driving resistance is constant or increases and achieve the final driving criteria.

6. During pile driving, the maximum compressive and tensile stresses in the piles shall not exceed 90 percent of the steel yield strength.

7. When driving piles through soft soils, the hammer ram velocity at impact shall be reduced to avoid damage of the pile due to tensile stresses in the piles.

8. Immediately after a pile is driven and before a pile is driven within the radius of uplift of the pile, the CONTRACTOR shall establish a durable and reliable reference point on the pile and its elevation on the pile for the purpose of checking uplift (heave) of the pile tip as additional piles are driven.

9. After all piles within the radius of uplift have been driven, the CONTRACTOR shall determine the elevation of the reference points on each of the piles in the group. If uplift of 0.04 ft or more has occurred, the pile shall be redriven to its original elevation, and deeper if necessary, to the specified final driving resistance. After redriving each pile, the CONTRACTOR shall re-establish the elevation of the reference point. Redriving shall be repeated as often as necessary until the measured uplift on any pile is less than 0.04 ft.

10. The radius of uplift shall be initially assumed to be 25 ft. This radius may be expanded or contracted by the ENGINEER based on actual field measurements and is defined as the maximum distance between piles such that pile driving causes uplift of 0.04 ft or more in the affected pile.

L. Mislocated Piles: The CONTRACTOR shall inform the ENGINEER if piles are installed at locations other than the locations shown on the drawings and inform the ENGINEER of the length below existing grade. The ENGINEER will direct the CONTRACTOR whether to abandon the pile in-place or to remove the pile. All abandoned pipe piles shall be filled with concrete. Mislocated piles will not be paid

for by the OWNER and additional work associated with Mislocated piles shall be completed by the CONTRACTOR at no additional cost to the OWNER.

Piles installed at locations shown on the Drawings which subsequently 'walk' off location or otherwise move off location due to driving through or against cobbles/boulders will not be considered Mislocated piles.

M. Cutting Off Piles:

1. Pile tops shall be cut off square and within 1 in. of the elevations shown on the Drawings relative to the boardwalk walking surface at each pile pent location. The pile cut-offs shall be stockpiled in a designated area of the site and shall be removed from the site by the CONTRACTOR at no additional cost to the OWNER.

2. If piles are driven below the design elevation and cannot be satisfactorily built-up in the opinion of the ENGINEER, these piles shall be cutoff a minimum of 1 ft below finished grade and abandoned at no additional cost to the OWNER. Additional piles required to compensate for an abandoned pile shall be driven as directed by the ENGINEER, at no additional cost to the OWNER.

3. Prepare all pile types to receive connection to pile top plate, or other details shown on the drawings.

3.6 FINAL ACCEPTANCE

A. As Driven Pile Location Data: Submit final as driven pile location plan, certified by a Registered Land Surveyor in the Commonwealth of Pennsylvania, within four (4) weeks of completion of pile driving.

B. Piles that are damaged below cut-off elevation during driving will be rejected. If, upon comparing pile performance during driving with that of other driven piles, and based on the ENGINEER'S knowledge of subsurface conditions, the ENGINEER determines that a pile has been unacceptably damaged, the ENGINEER may reject the pile.

C. Piles indicating sudden or peculiar decrease in penetration resistance during driving will be assumed to be broken or damaged, and will be rejected unless the ENGINEER'S review of available data indicates that sudden decrease in driving resistance is due to natural subsurface conditions and continued acceptable driving behavior is observed.

D. Piles that are rejected because of damage, mislocation or misalignment, or failure to meet the driving criteria due to causes other than the presence of cobbles/boulders shall be cut off a minimum of 1 ft below finished grade and abandoned or removed at the direction of the ENGINEER. Additional piles shall be driven as directed by the

ENGINEER at no additional cost to the OWNER.

E. When otherwise acceptable installed piles exceed the specified tolerances, the ENGINEER will analytically determine the total loads on individual piles, based on a survey by the CONTRACTOR'S Surveyor. If the load on any pile exceeds 110 percent of the specified load capacity, corrections shall be made by adding piles, or other procedures, in accordance with a design provided by the ENGINEER.

F. The installation of replacement piles and other corrective measures shall in all cases be in accordance with designs provided by the ENGINEER or designs approved by the ENGINEER.

G. All helical foundation piles are to be evaluated under this specification

END OF SECTION 31 62 16.16

SECTION 31 63 29 DRILLED SHAFT

PART 1 - GENERAL

1.1 Description of Work:

A. The Work of this Section includes, but is not limited to, design, plant fabrication, labor, materials, equipment, survey control, supervision, appliances and incidentals necessary, and selection of the means and methods for the installation to complete the following work:

1. Design the size and dimension, furnish and install concrete drilled shaft piled based on design loads shown on the Contract Drawings (herein referred to as "Drawings"). Installing drilled shafts of sizes and length as designed by the CONTRACTOR's Engineer at locations associated with the boardwalk segments and coordinated with the precast concrete boardwalk supplier.
2. Mobilizing to the site with all equipment, hammers, templates, support equipment and personnel needed to complete the work specified herein.
3. Piles will be installed at vertical Contactor shall be responsible for all rigs set-up designed, templates, and support needed to install the piles.
4. Performing static load testing on all of the indicator piles. testing shall be conducted prior to the start of production pile installation to confirm pile design capacities.
5. Terminate drilled shaft at a required elevation to maintain profile in coordination with the precast concrete boardwalk supplier.
6. Demobilize all equipment and other materials, personnel, temporary works used to complete the work and other support materials from the site. All temporary materials used to install the piles shall be removed from the site after completion of the work.

B. The Work shall be coordinated with the following:
1. Section 03 41 40 Elevated Precast Concrete Boardwalk

C. The CONTRATOR is responsible to provide qualified personnel for design, and onsite installation, inspection, and record keeping as specified herein.

D. Measurement Procedures
1. Helical piles shall be paid for at the contract lump sum price as listed in the bid proposal for "Elevated Precast Concrete Boardwalk". This price shall include but is not limited to, a supplemental subsurface investigation, design, plant fabrication, labor, materials, tools, equipment, survey control, supervision, appliances, incidentals, and selection of the means and methods for the installation.

E. Payment Procedures

1. The accepted work will be paid at the contract lump sum price for all work described in Section 03 41 40 – Elevated Precast Concrete Boardwalk

1.2 REFERENCES:

A. AASHTO LRFD Guide Specifications for The Design of Pedestrian Bridges, 2nd Edition.

B. AASHTO LRFD Bridge Design Specifications, 9th Edition.

C. ACI: American Concrete Institute 318-19, Building Code for Structural Concrete

D. ASCE: American Society of Civil Engineers, ASCE 7-22, Minimum Design Loads and Associated Criteria for Buildings and Other Structures

E. ASTM: Specifications of the American Society for Testing and Materials, latest edition.

1. ASTM A252, Standard Specification for Welded and Seamless Steel Pipe Piles

2. ASTM A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

3. ASTM C33 – Standard Specification for Concrete Aggregates

4. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

5. ASTM C94 – Standard Specification for Ready-Mixed Concrete.

6. ASTM C109 – Standard Specification for Standard Test Method for Compressive Strength of Hydraulic Cement Mortars

7. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

8. ASTM C143, Standard Test Method for Slump of Hydraulic-Cement Concrete

9. ASTM C150, Standard Specification for Portland Cement

10. ASTM C 231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

11. ASTM C 404, Standard Specification for Aggregates for Masonry Grout

12. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.

13. ASTM C666 – Standard Test Method for Concrete Resistance to Rapid Freezing and Thawing.

14. ASTM D 1143 - Standard Test Methods for Deep Foundation Elements Under Static Axial Compressive Load

F. AWS: AWS D1.1 Structural Welding Code – Steel, 2020.

G. BUILDING CODE: International Building Code, IBC 2024.

H. OSHA: Occupational Health and Safety Administration

1.3 DESIGN REQUIREMENTS

A. Drilled shafts shall be designed to support the service design loads shown on the Drawings with a service life of not less than 75 years.

B. Drilled shafts shall be designed and installed in accordance with:

1. International Building Code, IBC 2024.

2. ASCE 7-22, Minimum Design Loads and Associated Criteria for Buildings and Other Structures

3. The requirements as specified herein.

4. The Drawings.

C. Loads on the Drawings are service level design loads. A maximum resistance factor of 0.70 shall be used to determine the required ultimate tensile and compressive resistance of the steel pile with regard to their interaction with soil upon successful completion of static load testing.

D. Design of the drilled shafts shall be based on Load Resistance Factor Design (LRFD)

1. Piles shall be designed to provide the minimum service design loads as shown on the Drawings.

2. Maximum resistance factor of 0.70 may be utilized upon successful completion of a preproduction verification load test. The design loads shall be confirmed with pile load tests as specified herein.

3. The pile design shall consider pile spacing, soil stratification, corrosion, and strain compatibility.

E. Where conflicting requirements occur, the more stringent shall govern. Design shall consider Service, Strength, and Extreme Limit States.

1.4 PROJECT CONDITIONS:

A. The project involves construction of a McDade (pedestrian) Trail adjacent to US Route 209. Portions of the Trail will be a pile supported boardwalk, portions will be wall supported, and portions will be at grade.

B. Existing Site and Subsurface Information:

1. Subsurface investigation data are available from the OWNER in a report titled "Geotechnical Engineering Report, DEWA 310424 Route 209 Potential Slope Failure Delaware and Dingman Township, Pennsylvania" prepared by Terracon Consultants, Inc., dated 24 June 2023.

C. Review of Existing Information:

1. Prior to submitting a bid, the CONTRACTOR shall review and understand the information referenced herein and other applicable resources. The referenced report is made available to the CONTRACTOR for information only. The subsurface information presented in the document is for information only and shall not be interpreted as a warranty of subsurface conditions whether interpreted from written text, boring logs, test results, or other data.

2. The CONTRACTOR shall draw their own conclusions regarding site conditions based upon site visit(s) and from available sources, for which the OWNER and its consultants assume no responsibility. The CONTRACTOR shall assume that subsurface conditions between subsurface explorations could differ from conditions shown in the test boring logs.

D. Subsurface conditions

1. The CONTRACTOR is advised that the subsurface conditions may vary across the site.

2. The CONTRACTOR shall conduct supplemental subsurface investigation as deemed necessary to finalize the size and length of the drill shafts.

E. Protection of Adjacent Property and Utilities:

1. The CONTRACTOR shall protect adjacent structures (above ground and buried) from damage associated with drilled shaft installation and other related operations. Damage due to with drilled shaft installation or other construction activities shall be repaired immediately by the CONTRACTOR at its own expense.

1.5 QUALITY ASSURANCE:

A. All labor, materials, equipment, permits, notifications and services necessary to make the work comply with such requirements shall be provided by the CONTRACTOR.

B. Field Monitoring and Testing:

1. In accordance with the requirements of the Building Code, the ENGINEER will provide full-time monitoring of the CONTRACTOR'S pile driving operations. No piles shall be tested or driven except in the presence of the ENGINEER.

2. The CONTRACTOR will prepare and provide to the ENGINEER full-length installation records for each drilled shaft installed. The records shall be submitted within one work shift after that shaft installation is completed. The data shall be recorded on a drilled shaft installation log. A separate log shall be provided for each drilled shaft. The log for each drilled shaft shall contain the following minimum information:

a) Project name and number,
b) Name of Contractor, and name of Contractor's supervisor during installation.
c) Pile location and number,
d) Pile size,
e) Design pile capacity,
f) Pile reveal,
g) Pile dimensions,
h) Elevation of tip and the top,
i) Comments pertaining to interruptions, obstructions, or other relevant and unusual occurrences information.

3. The Contractor shall also submit within 2 weeks after installation of all piles, an as-built plan, certified by a surveyor, showing the as-installed location of all piles to the nearest ½ inch.

C. QUALIFICATIONS

1. The Contractor shall have experience in the design, construction, and load testing of drilled shaft and have successfully constructed minimum five (5) projects in the last five (5) years. The Contractor shall have experience with similar subsurface materials, groundwater conditions, drilled shaft sizes, and be thoroughly familiar with any specialty type of equipment needed to perform work of this type.

2. The Contractor shall provide names of on-site personnel materially involved with the work. At a minimum, these personnel shall include foreman, machine operator, and project engineer/manager.

3. The on-site foremen shall have minimum experience of at least 3 years installing drilled shafts of equal or greater size than required. The machine operators and tester shall have minimum experience of 2 years installing and testing drilled shafts of equal or greater size than required.

4. The Contractor shall employ a Professional Engineer licensed in the Commonwealth of Pennsylvania to design the drilled shaft; load test set-up, and instrumentation for the pile load tests; monitor, record, and evaluate the test results; and prepare the report of the pile load tests. The engineer shall have at least five (5) years' experience in drilled shaft design, installation and pile load test setup, monitoring, and analysis.

D. Certification of quality and source of materials, cement, sand, aggregate, steel casing, steel reinforcement to be used in the work shall be furnished, in a form acceptable to the ENGINEER, at the time of delivery of materials to the site. Materials shall also be subject to on-site inspection by the ENGINEER for conformance with specifications.

E. Approvals given by the ENGINEER or OWNER shall not relieve the CONTRACTOR of the Contractor's responsibility for performing the work in accordance with the Contract Documents, nor shall they be construed to relieve the CONTRACTOR from its full responsibility for the means and methods of construction and for safety on the construction site and compliance with all laws and regulations applicable to the work included in this section.

F. Qualifications of CONTRACTOR:

1. Due to the special requirements for installation of drilled shafts and the requirements for proper performance of drilled shafts, CONTRACTOR shall have a minimum of 3 years experience within the last 10 years in pile driving of similar type, scope and complexity as the indicated pile foundations included in this project.
2. CONTRACTOR shall have completed not less than 2 successful pile foundations of similar type, scope and complexity as the indicated pile foundations within the past 5 years.
3. The on-site foremen shall have minimum experience of at least 3 years installing drilled shafts of equal or greater resistance than required. The machine operators and testers shall have minimum experience of 2 years installing and testing drilled shafts of equal or greater resistance than required.
4. The Contractor shall employ a Professional Engineer licensed in the Commonwealth of Pennsylvania to design the drilled shafts, the load test set-up,

and instrumentation for the load tests; monitor, record, and evaluate the test results; and prepare the report of the load tests. The engineer shall have at least five (5) years' experience in drilled shaft design, installation and pile load test setup, monitoring, and analysis.

G. Fabrication Materials

1. Concrete mix design with test data to confirm compressive strength.
2. Rebar material certification
3. Production Concrete testing at a at a frequency of no less than three sets of three 6" diameter test cylinders from each day of operation or per every 10 piles, whichever occurs more frequently.
   a) 28-day concrete compression tests
   b) concrete batch slump
   c) entrained air test result

H. Load Testing Procedures and Equipment Calibration

1. A compression load test will be performed on each indicator pile. The load test proposal shall be in general conformance with ASTM D1143. The following minimum information shall be provided for review:
   a) Type and accuracy of load equipment.
   b) Type and accuracy of load measuring equipment.
   c) Type and accuracy of helical pile head deflection equipment.
   d) Description of load reaction system, including description of reaction piles.
   e) Calibration report for complete load test equipment, including hydraulic jack, pump, pressure gage, hoses, and fittings.

2. Copies of equipment calibration reports for all load test equipment to be used on the project. The calibration tests shall have been performed within forty-five (45) working days of the date submitted. Static load testing shall not proceed until the Engineer has received the calibration reports. These calibration reports shall include, but are not limited to, the following information:
   a) Name of Project and Contractor
   b) Name of testing agency
   c) Identification (serial number) of device calibrated
   d) Description of calibrated testing equipment
   e) Date of calibration
   f) Calibration data

1.6 SUBMITTALS:

A. GENERAL

1. The CONTRACTOR shall submit the information specified herein to the ENGINEER for review. All submittals and data shall be legible and signed and sealed by a Professional Engineer licensed in the Commonwealth of Pennsylvania and retained by the CONTRACTOR.

2. The CONTRACTOR shall adhere to the approved submittal schedule, making every effort for timely submissions and allowing adequate time for the ENGINEER to review, evaluate and respond to the CONTRACTOR, in accordance with the requirements of Part III-General Conditions of the Contract and Part IV-Special Conditions of the Contract. The CONTRACTOR is responsible for scheduling specified submittals and resubmittals so as to prevent delays in the work.

3. Unless otherwise specified, submittals shall be made not less than 30 days before the start of the work. No work shall be started until the necessary review and approvals have been given.

4. No work shall begin and no materials shall be ordered until all submittals have been received, reviewed, and accepted in writing by the ENGINEER. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the CONTRACTOR.

B. DRILLED SHAFT

The CONTRACTOR shall prepare and submit to the Engineer: design calculations, shop drawings, drilled shaft installation plan, construction procedures, load testing procedures, and equipment calibration for review and acceptance in accordance with these Specifications. The CONTRACTOR shall conduct his own survey to verify information shown on the Drawings. No work shall begin and no materials shall be ordered until all submittals have been received, reviewed, and accepted in writing by the ENGINEER. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the CONTRACTOR.

The submittals shall include:

1. Design

   Design computations demonstrating compliance with the criteria specified herein and shown on the Drawing, prepared, and signed and stamped by a licensed Professional Engineer licensed in the Commonwealth of Pennsylvania.

   The design calculations shall include but not be limited to:

   a) Statement of all assumptions made and copies of all references used in the calculations.

b) A written summary report describing the overall pile design.
c) A statement of applicable code requirements and design references.
d) Pile structure critical design cross-section(s) geometry, including soil strata and piezometric levels and location, magnitude and direction of applied loadings, including slope or external surcharge loads.
e) A description of design criteria to be applied to the work, including, soil shear strengths (friction angle and cohesion), unit weights for each soil stratum and driving criteria for installation to bearing resistance refusal
f) All design calculations performed by hand, spreadsheet, or computer program and references used.
g) Design calculation sheets with the Project number, drilled shaft structure location, designation, date of preparation, initials of designer and checker, and page number at the top of each page. Provide an index page for the design calculations.
h) Design notes including a list of symbols and computer program used in the design.

2. Shop Drawings:

a) Pile number, location, and pattern by assigned identification number in coordination with the precast concrete boardwalk supplier.
b) Pile design load, service and factored
c) drilled sizes, reinforcement detail and barlist, and other items pertinent and as applicable to particular pile design and handling.
d) Minimum overall length.

C. DRILLED SHAFT INSTALLATION:

1. Details of overall construction operation sequence and the sequence of shaft construction.
2. The drilled shaft Contractor's quality control plan, including methods to monitor the shaft installations to determine that they are installed in accordance with this specification. Provide sample inspection forms, including at a minimum: drilled shaft soil and rock excavation log, obstruction log, drilled shaft inspection log, drilled shaft inspection device log, concrete placement log, and concrete volume form with concreting curve.
3. List of proposed equipment to be used including temporary work platforms or cranes, falsework, drills, augers, baling buckets, final cleaning equipment, core sampling equipment, tremies or concrete pumps, casing, etc. Include a review of equipment suitability based on the Contractor's understanding of site and subsurface conditions.
4. Dimensions (i.e., inside diameter and thickness) of permanent casing.
5. If temporary casing is proposed, include dimensions and detailed procedures for installation and removal, including grouting annular space between temporary and permanent casings.

6. Details of shaft excavation methods in soils and rock, including methods for seating the casing in sloping bedrock, methods for excavating sloping bedrock, methods of maintaining shaft vertical and horizontal alignment, methods of advancing casing, methods of removing any obstructions such as boulders and cobbles.
7. Details of methods to advance permanent casing several feet into rock as necessary to develop a positive seal for rock socket drilling.
8. Methods of handling and disposition of drilling fluids, spoil materials, and contaminated/excess concrete. Discharge of such into any water body is prohibited.
9. If slurry use is proposed, provide a quality control plan with details of the methods to mix, circulate and desand slurry. Include required properties, tests and test methods to ensure synthetic slurry performs as intended. Submit to the ENGINEER the name and current phone number of the synthetic slurry manufacturer's representative who will provide technical assistance during construction.
10. Methods and procedures to clean the bottom of the drilled shaft excavations and determine the thickness of sediment in the bottom of drilled shafts. Also describe methods and procedures to determine length, diameter and alignment of the rock socket, and the cleanliness and soundness of the rock socket bearing surface.
11. Details of the drilled shaft inspection device to be used to inspect the bearing surface at each shaft. The drilled shaft inspection device shall be capable of measuring the sediment thickness on the bottom of the rock socket, and viewing and recording the condition of the bottom of the prepared rock socket.
12. Details of reinforcement placement including support, centralization materials/methods and concrete reinforcement cage supports at bottom of socket.
13. Manufacturer's literature, including technical and performance literature for equipment for the installation of drilled shaft, including equipment used for casing installation, drilling, and concrete placement.
14. Description, plan, details and methods of templates, falsework, surveying, procedures for locating piles and leads proposed to properly locate and install piles at locations as coordinated with the precast concrete boardwalk supplier.

PART 2 – PRODUCTS

2.1 MATERIALS

A. GENERAL

1. Drilled shaft materials shall be new and of uniform quality. Temporary and permanent materials shall be of sufficient strength and rigidity to withstand all driving stresses.

2. Length of pile casing to be ordered shall be determined by the CONTRACTOR. Ordering, delivery and use of pile casing shall be planned and performed in such a manner that minimizes delays or interruption of driving and precludes the need for splices.

B. DRILLED SHAFT

1. Steel for the permanent drilled shaft casings with a minimum thickness of 1/2-inch and shall conform to ASTM A-252, Grade 3.

2. Steel reinforcement, consisting of longitudinal bars, spirals, ties, cage stiffener bars, spacers, centralizers and other appurtenances shall conform to ASTM A615 Grade 60, sized as designed by the Engineer of Record.
   a) Tie and support reinforcing steel in the shaft so that the reinforcing steel. Use concrete spacers or other approved non-corrosive spacing devices at sufficient intervals (near the bottom, top and at intervals not exceeding 10 feet up the shaft) to ensure concentric spacing for the entire cage length.

3. Concrete shall meet production mix requirements of ASTM C94 and exhibit the following properties following:
   a) Concrete shall contain Type I, Type II or Type I/II cement, fine and course aggregates, admixtures and potable water
   b) The minimum compressive strength of the concrete shall be 5000 psi at 28 days.
   c) Maximum Water to cement ratio (w/c) of 0.41
   d) Nominal maximum aggregate sizes of ½”
   e) Air entrainment of 5.5% +/- 1.5%. The air-entraining may be obtained by the use of either an air entraining Portland cement or an air entraining admixture.
   f) The use of a water-reducing admixture is permissible to provide a workable mix that will surround the reinforcement bars without the use of vibrators. Actual slump shall be 8 to 10 inches with water-reducing admixture

PART 3 - EXECUTION

3.1 PREPARATION

A. GENERAL

1. The CONTRACTOR shall verify that site conditions will allow for access of the proposed installation equipment and will support equipment for helical pile installation.

2. The Contractor is responsible for coordinating with PA One Call (811) and for field locating and verifying the location of all utilities shown on the plans prior to starting the work.

3. Furnishing and installing drilled shafts of the size, quality and dimensions, at the locations, and to the lines and grades in coordination with the precast concrete boardwalk supplier.

4. Drilled shafts shall be located and marked using survey and a template by the Contractor who shall maintain and be responsible for all location and elevation stakes.

5. The CONTRACTOR shall coordinate its pile installation operations with other work on the site.

3.2 INSTALLATION

A. SEQUENCE OF OPERATIONS AND EQUIPMENT REQUIREMENTS:

1. Prior to production pile installation, the CONTRACTOR shall select three (3) pre-production indicator piles, one (1) at each boardwalk segment. The location shall be selected by the Contractor and accepted by the Engineer.

2. The CONTRACTOR'S Engineer shall perform static load testing during installation of each indicator pile to confirm pile design capacities.

B. PILE INSTALLATION CRITERIA:

1. The CONTRACTOR shall furnish and install drilled shafts to design diameter, length or deeper, if needed to obtain required lateral capacity, and to the required vertical design compression capacity.
2. The contractor shall select the drilling equipment and methods. The drilling equipment and methods shall be suitable for drilling through the conditions to be encountered, without causing damage to any overlying or adjacent structures or services. The drillhole must be open along its full length to at least the design minimum drillhole diameter prior to placing reinforcement and concrete.
3. Temporary casing or other accepted method of pile drillhole support may be required in soil to permit the pile shaft to be formed to the minimum design drillhole diameter and prevent caving. For rock-socketed piles, the casing shall be seated into bedrock. Use of drilling fluid containing bentonite is not allowed.
4. During construction, the Contractor shall observe the conditions in the vicinity of the drilled shaft construction site on a daily basis for signs of ground heave or subsidence. The Contractor shall immediately notify the Engineer if signs of movements are observed. The Contractor shall immediately suspend or modify drilling or concrete placement operations if ground heave or subsidence is observed, if the drilled shaft structure is adversely affected, or if adjacent structures are damaged from the drilling or grouting. If the Engineer determines that the movements require corrective action, the Contractor shall take corrective actions necessary to stop the movement or perform repairs.

5. Reinforcement shall be placed into the drillhole prior to concrete placement and before temporary casing is withdrawn. Reinforcement surface shall be free of deleterious substances such as soil, mud, grease or oil that might contaminate the grout or coat the reinforcement and impair bond. Pile cages and reinforcement groups, if used, shall be sufficiently robust to withstand the installation and concrete placement and the withdrawal of the drill casings without damage or disturbance.

6. The Contractor shall check pile top elevations and adjust all installed micropiles to the planned elevations.

7. Centralizers and spacers shall permit the free flow of grout without misalignment of the reinforcing bar(s) and permanent casing.

8. The reinforcing steel shall be inserted into the drill hole to the desired depth without difficulty. Partially inserted reinforcing bars shall not be driven or forced into the hole. The Contractor shall redrill and reinsert reinforcing steel when necessary to facilitate insertion.

9. Lengths of casing and reinforcing bars to be spliced shall be secured in proper alignment and in a manner to avoid eccentricity or angle between the axis of the two lengths to be spliced. Splices shall meet the requirements of this specification. When multiple bars are used, bar splices shall be staggered at least 12” between adjacent bars.

10. Immediately prior to concrete placement, the hole shall be flushed with clean water to remove all contaminated water and cuttings. The drilled shaft shall be tremie placement until all contaminated water and cuttings are removed and clean concrete exits at the top of the drill casing.

11. The concrete shall be injected from the lowest point of the drill hole and injection shall continue until uncontaminated grout flows from the top of the pile. Temporary casing shall be extracted in stages ensuring that, after each length of casing is removed, the concrete level is brought back up to the ground level before the next length is removed. The tremie pipe and casing shall always extend below the level of the existing concrete in the drillhole.

12. Concrete within the micropiles shall be allowed to attain the required design strength prior to being loaded.

C. CONSTRUCTION TOLERANCE

1. The vertical alignment of a vertical shaft excavation shall not vary from plumb by more than ¼ inch per foot of depth.
2. Excavation equipment and methods shall result in a completed shaft excavation with a planar bottom. The cutting edges of excavation equipment shall be normal

to the vertical axis of the equipment within a tolerance of +/- 3/8 inch per foot of diameter.

3. The top elevations of the drilled shaft shall be within ½" +/- of the design vertical elevation.
4. Centerline of reinforcing steel shall not be more than ¾" from center of pile.

D. OBSTRUCTIONS:

When obstructions, such as cobbles and bolders, are encountered during the installation of drilled shaft, the Contractor shall make all reasonable efforts to install the piles at the location required by the precast concrete boardwalk layout and to the proper depth. The Contractor shall excavate to remove the obstruction or shall resort to all usual methods to install piles including rotary drilling and down- the-hole hammer. Piles shall not be relocated.

3.3 INDICATOR PILE INSTALLATION:

A. A minimum of three (3) indicator piles shall be installed, one (1) at each boardwalk segment by the CONTRACTOR using the proposed production equipment and procedures

B. No piles shall be installed or tested except in the presence of the ENGINEER.

3.4 STATIC LOAD TEST:

A. GENERAL

1. The load tests shall conform to the requirements of ASTM D1143. The maximum test loads shall be 150% of the Factored Design Load (FDL), but not more than 80% of the ultimate structural capacity of the drilled shaft's structural elements, including steel yield and concretet crushing in compression.The Factored Design Load is defined as the Factored Axial Design Load based on the loads shown on the Drawings. The Alignment Load (AL) should not be more than 0.04 FDL.
2. Before starting the work, the Contractor shall submit to the Engineer for acceptance, a drilkled shaft load test plan including a written description of the equipment and methods which are intended to be used. The methods must be of an accepted type and shall be altered as necessary to meet the acceptance of the Engineer. The pile load test plan and description shall be prepared and signed and stamped by a Professional Engineer licensed in the Commonwealth of Pennsylvania.
3. If the load test fails to meet the design requirements, the Contractor shall modify the drilled shaft pile design and/or installation methods and retest the modified pile at no additional cost to the Owner.
4. The Contractor shall provide all personnel and equipment needed to perform the test, measure loads and movements, and record test data. A representative of the

National Park Service may observe and witness the test and record data independently. No testing is to be performed unless all the agreed representatives are present.

B. LOAD TEST EQUIPMENT

1. Testing equipment shall include dial gauges, dial gauge support, jack and pressure gauge, electronic load cell, and a reaction frame. The Contractor shall provide a description of test setup and jack, pressure gauge and load cell calibration curves, in accordance with the Submittals Section.
2. Design the testing reaction frame to be sufficiently rigid and of adequate dimensions such that excessive deformation of the testing equipment does not occur. Provide a reaction frame capable of safely supporting 125 percent of the maximum test load. Align the jack, bearing plates, and stressing anchorage such that un-loading and repositioning of the equipment will not be required during the test. The direction of the applied load shall be collinear with the drilled shaft at all times.
3. Apply and measure the test load with a hydraulic jack and pressure gauge. The pressure gauge shall be graduated in 100 psi increments or less. The jack pressure gauge shall have a pressure range not exceeding twice the anticipated maximum test pressure. The jack shall be positioned at the beginning of the test such that unloading and repositioning during the test will not be required. The jack shall also be positioned co-axial with respect to the drilled shaft so as to minimize eccentric loading.
4. Calibrate the test load jacking system including the hydraulic jack couplings, gas pump, pressure gauge, and hydraulic load cell prior to the test so that the load applied is controlled to within 3 percent of the total applied load. Submit calibration reports prior to the start of the pile load test.
5. Monitor the creep test load hold during verification tests with both the pressure gauge and the electronic load cell. Use the load cell to accurately maintain a constant load hold during the creep test load hold increment of the test.
6. Readings of settlement and rebound shall be referred to a fixed benchmark and shall be made using dial gauges (micrometer dial extensometers) graduated to 0.001 inches and located so its stem is parallel with the axis of the drilled shaft. The stem may rest on a smooth plate located at the drilled shaft head and positioned perpendicular to the axis of the drilled. The gauges shall be mounted on a reference beam supported at each end by reliable supports located at least 10 feet from the center of the test pile and independent from the jack, pile, or reaction frame.
7. The dial gauges shall have a travel sufficient to allow the test to be done without having to reset the gauges. Readings shall be taken at intervals specified in the Load Test Section.
8. Protect the settlement measuring system against rain, wind, frost, and any other disturbances that could affect the reliability of the settlement observations. Provide sun shading for the measuring system for the duration of the test and for a minimum of 1 hour prior to the start of the test.

C. LOAD TEST

1. Testing shall be performed in compression in accordance with ASTM D1143 except as modified herein.

2. Load tests shall be performed to verify that the drilled shaft will meet the required FDL and load test acceptance criteria.

3. The static load test results must verify the design and installation methods and be reviewed and accepted by the Engineer prior to beginning installation of production drilled shafts.

4. Test verification pile to a maximum Test Load of 150% of the Factored Design Load (FDL) defined above, as indicated on the Drawings. The verification pile load test shall be made by incrementally loading the drilled shaft in accordance with the following cyclic load schedule:

Loading Cycle	Step	Applied Load	Hold Time (min)
Cycle 1	1	AL	2.5
	2	0.075 FDL	2.5
	3	0.15 FDL	2.5
	4	0.225 FDL	2.5
	5	0.30 FDL	2.5
	6	0.375 FDL	2.5
Cycle 2	7	AL	1
	8	0.15 FDL	1
	9	0.20 FDL	1
	10	0.30 FDL	1
	11	0.45 FDL	2.5
	12	0.525 FDL	2.5
	13	0.60 FDL	2.5
	14	0.675 FDL	2.5
	15	0.75 FDL	2.5

Loading Cycle	Step	Applied Load	Hold Time (min)
Cycle 3	16	AL	1
	17	0.30 FDL	1
	18	0.60 FDL	1
	19	0.675 FDL	1
	20	0.75 FDL	1
	21	0.825 FDL	2.5
	22	0.90 FDL	2.5
	23	1.00 FDL	10 or 60 (creep test)
Cycle 4	24	AL	1
	25	0.30 FDL	1
	26	0.60 FDL	1
	27	0.90 FDL	1
	28	0.975 FDL	2.5
	29	1.05 FDL	2.5
	30	1.125 FDL	2.5
	31	1.20 FDL	2.5
	32	1.275 FDL	2.5
	33	1.35 FDL	2.5
	34	1.425 FDL	2.5
	35	1.50 FDL	2.5
	36	1.20 FDL	5
	37	0.90 FDL	5
	38	0.60 FDL	5
	39	0.30 FDL	5
	40	AL	5

Test Notes:

1. Pile top movement shall be measured at each load increment. The load-hold period shall start as soon as each test load increment is applied. The verification test pile shall be monitored for displacement creep at the 1.0 FDL increment. Displacement readings shall be recorded at 1, 2, 3, 5, 6, and 10 minutes.

2. Where the pile top movement between 1 and 10 minutes exceeds 0.040 inch, the 1.0 FDL load shall be maintained an additional 50 minutes. Displacement readings shall be recorded at 20, 30, 50, and 60 minutes.

3. Dial gauges shall be reset to zero after the initial AL is applied.

D. STATIC TEST RESULTS

5. The acceptance criteria for the static load test is:

   a) The drilled shall sustain the compression and tension design loads (1.0 FDL) with no more than 0.5-inch total vertical movement of the shaft head as measured relative to the top of the shaft prior to the start of testing.

   b) Creep rate at the end of the 1.0 FDL load increment not exceeding 0.04 inch/log cycle time (1 to 10 minutes) or 0.08 inch/ log cycle time (6 to 60 minutes or the last log cycle if held longer). The creep rate shall be linear or decreasing throughout the hold period.

   c) Failure does not occur at the 1.50 FDL maximum compression test loads. The failure load shall be defined by the point at which the slope of the load versus deflection (at end of increment) curve exceeds 0.025 inches/kip. If failure occurs by this criterion but the pile meets acceptance criteria a) and b), then the nominal geotechnical resistance shall be taken as the highest load increment before failure occurred.

6. If a drilled shaft test pile fails to meet the acceptance criteria,

   a) The contractor shall notify the Engineer in writing within 3 working days of the load test completion

   b) The Contractor shall modify the design, the construction procedure, or both. Modification shall be submitted as a revision to the Working Drawings and require the Engineer's review and acceptance. Additional load testing may be required until an acceptable pile load test meets the designated load test requirements.

      The failed pile shall not be used in production and shall be removed 2 feet below finished grade

      A replacement pile or piles shall be installed at a location coordinated with the boardwalk supplier. The replacement piles and any modifications to the precast boardwalk shall be at no additional cost.

3.5 PRODUCTION PILE INSTALLATION:

A. Piles shall be installed with approved modern equipment in good working order. The proposed pile installation equipment and methods shall be subject to approval of the ENGINEER and approval shall be secured before the start of installation.

B. All piles shall be installed using survey control and markings sufficient to install each pile at locations indicated on the Drawings.

C. Concrete placement within a drilled shaft continuous and without interruption

3.6 FINAL ACCEPTANCE

A. As Installed Pile Location Data: Submit final pile location plan, certified by a Registered Land Surveyor in the Commonwealth of Pennsylvania, within four (4) weeks of completion installation.

B. When otherwise acceptable installed piles exceed the specified tolerances, the ENGINEER will analytically determine the total loads on individual piles, based on a survey by the CONTRACTOR'S Surveyor. If the load on any pile exceeds 110 percent of the specified load capacity, corrections shall be made by adding piles, or other procedures, in accordance with a design provided by the ENGINEER.

C. Drilled shafts that are rejected because of mislocation or misalignment, shall be removed a minimum of 1 ft below finished grade and abandoned. An additional drilled shaft shall be installed as directed by the ENGINEER at no additional cost to the OWNER.

D. All drilled shafts are to be evaluated under this specification

END OF SECTION 31 62 16.16

SECTION 31 66 15 – HELICAL FOUNDATION PILES

PART 1 - GENERAL

1.1 DESCRIPTION:

A. The Work of this Section includes, but is not limited to, design, plant fabrication, and selection and implementation of the means and methods for pile installation and testing necessary to complete the following work:

1. Design, furnish, install and test helical piles based on design loads shown on the Contract Drawings (herein referred to as "Drawings"). Installing helical piles of types and sizes and length as designed by the CONTRACTOR's Engineer at locations associated with the boardwalk segments and coordinated with the precast concrete boardwalk supplier.
2. Supplemental subsurface investigation to support foundation type, size and length design in coordination with the boardwalk design criteria.
3. Mobilizing to the site with all installation equipment, test equipment, templates, support equipment and personnel needed to complete the work specified herein.
4. Helical Piles shall be installed vertically. The Contactor shall be responsible for all rigs set-up designed, templates, and support needed to install the piles as such.
5. The helical pile resistance shall be confirmed by pre-production verification static load testing using installation torque indicative of the design factored resistance as described herein.
6. Terminate helical piles at a required cutoff elevation to maintain profile in coordination with the precast concrete boardwalk supplier. Disposing pile cut-offs at approved off-site locations. Preparing the exposed end of the pile to receive the structural connection to precast concrete boardwalk.
7. Demobilize all equipment and other materials, personnel, temporary works used to complete the work and other support materials from the site. All temporary materials used to install the piers shall be removed from the site after completion of the work.

B. The Work shall be coordinated with the following:
1. Section 03 41 40 Elevated Precast Concrete Boardwalk

C. The CONTRATOR is responsible to provide qualified personnel for design, and onsite installation, inspection, and record keeping as specified herein.

D. Measurement Procedures
1. Helical piles shall be paid for at the contract lump sum price as listed in the bid proposal for "Elevated Precast Concrete Boardwalk". This price shall include but is not limited to, a supplemental subsurface investigation, design, plant fabrication,

labor, materials, tools, equipment, survey control, supervision, appliances, incidentals, and selection of the means and methods for the installation.

E. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work described in Section 03 41 40 – Elevated Precast Concrete Boardwalk

1.2 REFERENCES:

A. AISC: Specification of the American Institute of Steel Construction, 16th Edition, 2023.

B. ASCE: American Society of Civil Engineers, ASCE 7-22, Minimum Design Loads and Associated Criteria for Buildings and Other Structures

C. ASTM: Specifications of the American Society for Testing and Materials, latest edition.

   1. ASTM A36 - Standard Specification for Carbon Structural Steel

   2. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Product

   3. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

   4. ASTM A185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

   5. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

   6. ASTM A500– Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

   7. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

   8. ASTM A618 – Standard specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing

   9. ASTM A656 - Standard Specification for Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability

10. ASTM A1018 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

11. ASTM A 3125 - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated

12. ASTM D 1143 - Standard Test Methods for Deep Foundation Elements Under Static Axial Compressive Load

D. AWS: AWS D1.1 Structural Welding Code – Steel, 2020.

E. BUILDING CODE: International Building Code, IBC 2024.

F. OSHA: Occupational Health and Safety Administration.

1.3 DESIGN REQUIREMENTS

A. The helical piles shall be designed to support the service design loads shown on the Drawings with a service life of not less than 75 years.

B. Helical pile systems shall be designed and installed in accordance with:

1. International Building Code, IBC 2024.

2. ASCE 7-22, Minimum Design Loads and Associated Criteria for Buildings and Other Structures

3. The manufacturer's requirements.

4. The requirements as specified herein.

5. The Drawings.

C. Loads on the Drawings are service level design loads. A maximum resistance factor of 0.70 shall be used to determine the required ultimate tensile and compressive resistance of the helical piles with regard to their interaction with soil upon successful completion of static load testing. Helical pile resistance in soil depends on the geometric configuration of the helical blades about the lead section and the subsurface conditions. The torque applied during installation provides an indirect verification of axial resistance. Manufacturer's recommendations should be followed regarding he torque and the tensile/bearing resistance relationship for the particular helical pile selected. The number and size of blades shall be determined by the Helical Pile Contractor so as to achieve the required torque and tensile/bearing

resistance for the soil conditions at the site. However, the ratio of factored design resistance to the total area of the helical blades shall not exceed the subsurface material factored bearing resistance.

D. Design of the helical piles shall be based on Load Resistance Factor Design (LRFD) and conform to the following minimum design criteria:

1. Helical anchor manufacturer shall furnish a guarantee for a period of ten (10) years from date of delivery against defects due to manufacturing of helical pile and bracket assemblies. Helical pile manufacturer must carry product liability insurance.

2. Helical piles shall be designed to provide the minimum service design loads as shown on the Contract Drawings.

3. The overall length, helix configuration, and minimum torsional resistance of a helical pile shall be such that the required nominal resistance is developed by the helix plate(s) in the bearing stratum.

4. Maximum resistance factor of 0.70 may be utilized upon successful completion of a preproduction verification load test. The design loads shall be confirmed with pile load tests as specified herein.

5. The pile design shall consider pile spacing, soil stratification, corrosion, and strain compatibility.

E. Where conflicting requirements occur, the more stringent shall govern. Design shall consider Service, Strength, and Extreme Limit States.

1.4 PROJECT CONDITIONS:

A. The project involves construction of a McDade (pedestrian) Trail adjacent to US Route 209. Portions of the Trail will be a pile supported boardwalk, portions will be wall supported, and portions will be at grade.

B. Existing Site and Subsurface Information:

1. Subsurface investigation data are available from the OWNER in a report titled "Geotechnical Engineering Report, DEWA 310424 Route 209 Potential Slope Failure Delaware and Dingman Township, Pennsylvania" prepared by Terracon Consultants, Inc., dated 29 June 2023.

C. Review of Existing Information:

1. Prior to submitting a bid, the CONTRACTOR shall review and understand the information referenced herein and other applicable resources. The referenced report is made available to the CONTRACTOR for information only. The subsurface information presented in the document is for information only and shall not be interpreted as a warranty of subsurface conditions whether interpreted from written text, boring logs, test results, or other data.

2. The CONTRACTOR shall draw their own conclusions regarding site conditions based upon site visit(s) and from available sources, for which the OWNER and its consultants assume no responsibility. The CONTRACTOR shall assume that subsurface conditions between subsurface explorations could differ from conditions shown in the test boring logs.

D. Subsurface conditions

1. The CONTRACTOR is advised that the subsurface conditions may vary across the site.

2. The CONTRACTOR shall conduct supplemental subsurface investigation as deemed necessary to finalize the size and length of the helical piles

E. Protection of Adjacent Property and Utilities:

1. The CONTRACTOR shall protect adjacent structures (above ground and buried) from damage associated with helical pile installation and other related operations. Damage due to helical pile installation or other construction activities shall be repaired immediately by the CONTRACTOR at its own expense.

1.5 QUALITY ASSURANCE:

A. All labor, materials, equipment, permits, notifications and services necessary to make the work comply with such requirements shall be provided by the CONTRACTOR.

B. Field Monitoring and Testing:

1. In accordance with the requirements of the Building Code, the ENGINEER will provide full-time monitoring of the CONTRACTOR'S pile installation operations. No piles shall be tested or installed except in the presence of the ENGINEER.

2. The CONTRACTOR shall prepare and provide to the ENGINEER full-length installation records for each helical pile installed. The records shall be submitted within one work shift after that pile installation is completed. The data shall be recorded on a helical pile installation log. A separate log shall be provided for each helical pile. The log for each helical pile shall contain the following minimum information:

a) Project name, structure name, and contract number.
b) Name of Contractor, and name of Contractor's supervisor during installation.
c) Helical pile location and pile number,
d) Date and time of installation.
e) Design pile capacity,
f) Installation equipment name and model, and operator name.
g) Type of torque indicator used.
h) Pile reveal.
i) As-built helical pile type and configuration, including manufacturer's catalogue number for lead section (number and size of helix plates), number and type of extension sections, and associated hardware used to make shaft connections and bracket connections to deck.
j) Total length of installed helical pile.
k) Helical pile installation duration and observations.
l) Cut-off elevation.
m) Installation torque measurements at one-foot intervals for the final 10 feet of installed length, at a minimum.
n) Effective torsional resistance and calculated geotechnical resistance as derived from the pre-production load test program.
o) Comments pertaining to interruptions, obstructions, or other relevant and unusual occurrences information.

3. The Contractor shall also submit within 2 weeks after installation of all piles, an as-built plan, certified by a surveyor, showing the as-installed location of all piles to the nearest ½ inch.

C. QUALIFICATIONS

1. Due to the special requirements for installation of helical piles and the requirements for proper performance of the helical pile system, devices, and bracket assemblies shall be installed by a specialized Helical Pile Contractor. The Helical Pile Contractor shall have experience in the design, construction, and load testing of helical piles and have successfully constructed minimum five (5) projects in the last five (5) years totaling at least 100 helical piles with similar design, loads, and requirements specified in these Drawings and Specifications. The Helical Pile Contractor shall have previous helical pile installation experience with similar subsurface materials, groundwater conditions, helical pile sizes, and be thoroughly familiar with the specialized type of equipment needed to perform work of this type.

2. The Helical Pile Contractor shall be trained and certified by the helical pile manufacturer in the proper methods of design and installation of helical piles. The Helical Pile Contractor shall provide names of on-site personnel materially involved with the work, including those who carry documented certification from

the manufacturer. At a minimum, these personnel shall include foreman, machine operator, and project engineer/manager.

3. The on-site foremen shall have minimum experience of at least 3 years installing helical piles of equal or greater resistance than required. The machine operators and tester shall have minimum experience of 2 years installing and testing helical piles of equal or greater resistance than required.

4. The Helical Pile Contractor shall employ a Professional Engineer licensed in the Commonwealth of Pennsylvania to design the helical piles; load test set-up, and instrumentation for the pile load tests; monitor, record, and evaluate the test results; and prepare the report of the pile load tests. The engineer shall have at least five (5) years' experience in helical anchor design, installation and pile load test setup, monitoring, and analysis.

1.6 SUBMITTALS:

A. GENERAL

1. The CONTRACTOR shall submit the information specified herein to the DESIGN ENGINEER for review. All submittals and data shall be legible and signed and stamped by a Professional Engineer licensed in the Commonwealth of Pennsylvania and retained by the CONTRACTOR.

2. The CONTRACTOR shall adhere to the approved submittal schedule, making every effort for timely submissions and allowing adequate time for the ENGINEER to review, evaluate and respond to the CONTRACTOR, in accordance with the requirements of Part III-General Conditions of the Contract and Part IV-Special Conditions of the Contract. The CONTRACTOR is responsible for scheduling specified submittals and resubmittals so as to prevent delays in the work.

3. Unless otherwise specified, submittals shall be made not less than 30 days before the start of the work. No work shall be started until the necessary review and approvals have been given.

4. No work shall begin and no materials shall be ordered until all submittals have been received, reviewed, and accepted in writing by the ENGINEER. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the CONTRACTOR.

B. QUALIFICATIONS

1. Prior to the Pre-construction Meeting, the Helical Pile Contractor shall submit the following information to verify the firm's experience, and the qualifications of personnel scheduled to perform the helical pile design and construction:

a) Submit a list of at least five helical pile projects successfully completed in the last five years. Include construction details, structural details, load test reports, and client contact for each project listed.
b) Submit a list of the equipment and resources the Helical Pile Contractor drawing to mobilize and utilize for the performance of the project.
c) Provide the names and detail the experience of the helical pile designer, on-site supervisor, foremen, and drill rig operators for this project.
d) A signed statement that the Helical Pile Contractor has inspected both the project site and all the subsurface information including any subsurface materials samples made available in the Contract Documents.

2. Work on any helical piles shall not be started, nor materials ordered until the qualifications and submittals have been accepted by the Engineer. The Engineer may suspend the helical pile construction if the Helical Pile Contractor substitutes unapproved personnel during construction. Requests for substitution of field personnel shall be submitted to the Engineer for acceptance. Additional costs resulting from the suspension of work will be the Helical Pile Contractor's responsibility, and no extension in contract completion date resulting from the suspension of work will be allowed.

C. HELICAL PILE

The CONTRACTOR shall prepare and submit to the Engineer: design calculations, shop drawings, helical pile installation plan, construction procedures, load testing procedures, and equipment calibration for review and acceptance in accordance with these Specifications. The CONTRACTOR shall conduct his own survey to verify information shown on the Drawings. No work shall begin and no materials shall be ordered until all submittals have been received, reviewed, and accepted in writing by the ENGINEER. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the CONTRACTOR.

The helical pile submittals shall include:

1. Design

Design computations demonstrating compliance with the criteria specified herein and shown on the Drawing, prepared, and signed and stamped by a licensed Professional Engineer licensed in the Commonwealth of Pennsylvania and specializing in helical pile design and construction with a minimum of 5 years of design experience.

The design calculations shall include but not be limited to:

a) Statement of all assumptions made and copies of all references used in the calculations.
b) A written summary report describing the overall helical pile design.
c) A statement of applicable code requirements and design references.
d) Helical pile structure critical design cross-section(s) geometry, including soil strata and piezometric levels and location, magnitude and direction of applied loadings, including slope or external surcharge loads.
e) A description of design criteria to be applied to the work, including, soil shear strengths (friction angle and cohesion), unit weights for each soil stratum, and helix plate diameter(s), helix plate pitch, and installation torque to nominal resistance assumptions for the design bearing stratum.
f) All design calculations performed by hand, spreadsheet, or computer program and references used.
g) Design calculation sheets with the Project number, helical pile structure location, designation, date of preparation, initials of designer and checker, and page number at the top of each page. Provide an index page for the design calculations.
h) Design notes including a list of symbols and computer program used in the design.
i) Pile-to-pile plate connection calculations.

2. Shop Drawings:

a) Helical pile number, location, and pattern by assigned identification number in coordination with the precast concrete boardwalk supplier.
b) Helical pile design loads, service and factored.
c) Type and size of central steel shaft for helix segments and riser segments, including transition bars.
d) Helix configuration (number and diameter of helix plates) on lead segment and extension segment(s), if required.
e) Minimum effective installation torque.
f) Minimum overall length.
g) Helical pile bracket assembly and connection to pile plate, including thread bars (if used).

3. Construction Procedures

a) A detailed description of the construction procedures and equipment proposed for installation of the helical piles. Include description of methods to maintain alignment of the piles during installation. Procedures shall include a description of mitigating measures to be taken if the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to achieving the minimum overall length required and if the helical pile is refused or deflected by a subsurface obstruction.

b) Example field log to be used for recording installation details for each helical pile installation.
c) Information on space requirements for installation equipment that verify the proposed equipment can perform at the site.
d) If welding is proposed, submit the welding procedure. All welding shall be done in accordance with the current AWS D1.1, 2020 Structural Welding Code.
e) Mill test reports for the central steel shaft for the materials delivered to the site for record purposes. The ultimate strength, yield strength, percent elongation, and chemistry composition shall be provided.

4. Load Testing Procedures

Procedures, equipment, and set up for pre-production static load testing for the helical piles. Locations of the load tests shall be selected by the Contractor and accepted by the Engineer. The purpose of the tests is to determine the load versus displacement response of the helical pile and provide an estimation/confirmation of nominal resistance. A compression load test will be performed on each of the helical piles to be load tested. The load test proposal shall be in general conformance with ASTM D1143. The following minimum information shall be provided for review:

a) Type and accuracy of load equipment.
b) Type and accuracy of load measuring equipment.
c) Type and accuracy of helical pile head deflection equipment.
d) Description of load reaction system, including description of reaction piles.
e) Calibration report for complete load test equipment, including hydraulic jack, pump, pressure gage, hoses, and fittings.

5. Equipment Calibration

Copies of calibration reports for each torque indicator or torque motor, and all load test equipment to be used on the project. The calibration tests shall have been performed within forty-five (45) working days of the date submitted. Helical pile installation and testing shall not proceed until the Engineer has received the calibration reports. These calibration reports shall include, but are not limited to, the following information:

a) Name of Project and Contractor
b) Name of testing agency
c) Identification (serial number) of device calibrated
d) Description of calibrated testing equipment
e) Date of calibration
f) Calibration data

6. Qualifications Documents - Qualifications of the Helical Pile Contractor and qualifications of the Contractor's Engineer, who will design the helical piles and design, monitor, evaluate and prepare report(s) for pile load tests. Qualifications shall satisfy the requirements of the Qualifications Section of these specifications.

7. Materials Documents - ISO9001 certificate or helical pile manufacturer or complete description of product testing and manufacturing quality assurance programs used to assess and maintain product quality.

8. With each delivery of helical piles, mill certificates containing results of material tests conducted by a certified laboratory, including the chemical composition, yield strength and ultimate strength of the steel. The OWNER may reject any delivery of steel materials that is not accompanied with applicable mill certificates and documentation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. GENERAL:

1. The Helical Pile Contractor shall be responsible for the selection, purchase, or manufacture of the appropriate size and type of helical piles and bracket assemblies, and all other necessary components to support the factored loads stated on the Drawing. These specifications provide minimum requirements to aid the Helical Pile Contractor in making appropriate materials selections. The size and number of helical blades (helices) must be such that the helical piles achieve the appropriate torque and resistance in the soils at this site. Failure to achieve proper torque and resistance shall result in the Contractor replacing helical piles as appropriate to support the required factored loads. All installation procedures, materials, and replacements shall be acceptable to the Engineer.

2. Helical pile components as specified herein shall be manufactured by a facility whose quality systems comply with ISO (International Organization of Standards) 9001 requirements. Certificates of Registration denoting ISO Standards Number shall be submitted to the Engineer for review and acceptance. Acceptance will be at the sole discretion of the Engineer.

3. Pile materials shall be new and of uniform quality. Manufactured or assembled pile materials shall be of sufficient strength and rigidity to withstand all installation stresses.

4. Length of piles to be ordered shall be determined by the CONTRACTOR. Ordering, delivery and use of piles shall be planned and performed in such a manner that minimizes delays or interruption of pile installation.

B. HELICAL PILES:

1. Helical pile material and fabrication shall be of sufficient strength and rigidity to withstand all installation and handling stresses and to maintain initial shape within the tolerances specified hereinafter.

2. Helical piles sizes, type, helix spacing, and installation parameters shall be determined by the CONTACTOR'S Engineer.

3. Central Steel Shaft

   a) Steel shaft consisting of lead helical segments, steel shaft helical extensions, steel couplers to connect extension shafts to mounting brackets, and adjustable steel mounting brackets.
   b) Helical pile shaft shall be per ASTM A618 or A500 Grade C with a minimum yield strength of 50ksi 3.5 inch O.D. minimum. Wall thickness shall be 0.300 inch (Schedule 80). Accompanying certificates shall state the chemical composition and yield point of the steel. The piles shall be identified to permit rapid correlation with the appropriate mill certificates.
   c) Lead sections lengths shall be nominally between 7' and 10' long, Extension sections, with or without helix or shall be nominally between 3.5' and 10' in length.

4. Helical Bearing Plate

   a) Helix bearing plate shall be hot rolled carbon steel sheet, strip, or plate formed on matching metal dies to true helical shape and uniform pitch. Bearing plate material shall meet or exceed the properties of ASTM A572 or ASTM A1018 as applicable, with minimum yield strength of 50 ksi.
   b) Plate thickness shall be minimum 3/8 inch.
   c) Helix spacing shall not exceed three (3) times the diameter of the smallest diameter helix

5. Bolts used to connect anchor shaft sections together and anchor shafts to bracket assembly plates shall be minimum 1-inch diameter and conform to ASTM F3125 Grade A325. Bolts, nuts and washers shall be galvanized in accordance to ASTM A153.

6. Couplings

   a) Couplings for square shafts shall be formed as an integral part of the helical extension segment and riser segment as hot upset forged sockets.
   b) Couplings for structural steel pipe sections shall either be formed as an integral part of the riser as hot forge expanded sockets, or as internal sleeve wrought

steel connectors. The steel connectors can be either tubing or solid steel bar with holes for connecting shaft sections together.

7. Pile plates, shapes and steel assemblies

   Vertical and angled bracket assembly plates shall be rated for the design loads specified herein and the strength of the structure they support. The bracket assembly shall be bolted to the riser section to resist a minimum of 4.0 kips tension loading. Threaded bars shall be used to form the connection between the riser section and angled brackets for battered helical piles. Structural steel plates and shapes for pile top attachments shall conform to ASTM A36 or ASTM A572 Grade 50.

8. All welding shall be performed by welders certified under Section 5 of AWS D1.1

9. All components of the helical pile including central shafts, helical bearing plates, coupling hardware, pile plates and steel assemblies shall be hot dip galvanized per ASTM A123

PART 3 – EXECUTION

3.1 PREPARATION

A. General

1. The CONTRACTOR shall verify that site conditions will allow for access of the proposed installation equipment and will support equipment for helical pile installation.

2. The Contractor is responsible for coordinating with PA One Call (811) and for field locating and verifying the location of all utilities shown on the plans prior to starting the work.

3. Furnishing and installing helical piles of the size, quality and dimensions and at the locations and to the lines and grades in coordination with the precast concrete boardwalk supplier.

4. Helical piles shall be located and marked using survey and a template by the Contractor who shall maintain and be responsible for all location and elevation stakes.

5. The CONTRACTOR shall coordinate its pile installation operations with other work on the site.

3.2 INSTALLATION

A. INSTALLATION EQUIPMENT

1. Each helical pile shall be advanced into the ground by application of rotational force using a hydraulic torque converter. Installation equipment shall include a direct means of determining the installation torque being applied to the helical pile. Percussion drilling methods shall not be permitted. The equipment shall be capable of continuous position adjustment to maintain proper helical pile alignment.

2. Where load testing is required, installation equipment shall include a means for applying and measuring loads and deflections of helical piles. Acceptable methods of load testing include a calibrated hydraulic jack or other means acceptable to the Engineer. Current evidence of calibration of Contractor's load testing and torque monitoring equipment shall be provided upon request of the Engineer.

3. Equipment shall be re-calibrated during helical pile installation, if in the opinion of the Engineer and/or Contractor, reasonable doubt exists as to the accuracy of the torque measurements. Recalibrations shall be at the cost of the Contractor.

4. All drive tools and equipment shall be in accordance with the manufacturer's written installation instructions.

5. All helical pile installation equipment and materials shall be acceptable to the Engineer prior to delivery to the site. Acceptance will be based upon submission of records and data, as discussed in this specification. Once accepted, changes in installation equipment and materials will not be permitted without additional acceptance and will be considered only after the Contractor has submitted all information requested by the Engineer.

B. TEST PILES INSTALLATION:

1. The Contractor shall install three (3) pre-production test pile, one (1) at each boardwalk segment. The location shall be selected by the Contractor and accepted by the Engineer. The location of the test pile shall be within the footprint of a boardwalk segment but at least 5 feet away from any production pile.

C. PRODUCTION PILE INSTALLATION:

1. All piles shall be installed using survey control and markings sufficient to install each pile at locations indicated on precast boardwalk fabrication drawings.

2. Helical piles shall be advanced into the ground until the required minimum overall length criteria and minimum effective torsional resistance criteria are achieved to accommodate the nominal tensile and bearing resistance plus an additional distance to ensure proper embedment. For the helical piles, the embedment length shall be

achieved by continuing advancement while maintaining or exceeding the required torsional resistance for the last three (3) feet of penetration.

3. Constant normal pressure shall be applied while screwing helical piles into the ground. The pressure applied shall be sufficient to ensure that, during each revolution, the helical pile progresses into the ground a distance equal to at least 80% of the blade pitch. Rate of helical pile rotation shall not exceed 20 revolutions per minute.

D. CONSTRUCTION TOLERANCE

1. Piles shall be plumb within 2 degrees.
2. The top elevations of helical piles shall be within +1 inch to –2 inches of the design vertical elevation.
3. Bracket assembly placement shall be within 1 inch in both directions perpendicular to the pile shaft and 1/4 inch in a direction parallel with the pile shaft.

3.3 CONSTRUCTION QUALITY CONTROL

LOAD TESTS

A. GENERAL

Installation methods, procedures, equipment, and overall lengths for the pre-production test helical pile shall be identical to those proposed for use in installing production helical pile to the extent practical.

The load tests shall conform to the requirements of ASTM D1143. The maximum test loads shall be 150% of the Factored Design Load (FDL) for the Helical Pile Verification Test. The Factored Design Load is defined as the Factored Axial Design Load based on the loads shown on the Drawings. The Alignment Load (AL) should not be more than 0.04 FDL.

Before starting the work, the Contractor shall submit to the Engineer for acceptance, a pile load test plan including a written description of the equipment and methods which are intended to be used. The methods must be of an accepted type and shall be altered as necessary to meet the acceptance of the Engineer. The pile load test plan and description shall be prepared and signed and stamped by a Professional Engineer licensed in the Commonwealth of Pennsylvania.

If the load test fails to meet the design requirements, the Contractor shall modify the helical pile design and/or installation methods and retest the modified pile at no additional cost to the Owner.

The Contractor shall provide all personnel and equipment needed to perform the test, measure loads and movements, and record test data. A representative of the National Park

Service may observe and witness the test and record data independently. No testing is to be performed unless all the agreed representatives are present.

B. LOAD TEST EQUIPMENT

Testing equipment shall include dial gauges, dial gauge support, jack and pressure gauge, electronic load cell, and a reaction frame. The Contractor shall provide a description of test setup and jack, pressure gauge and load cell calibration curves, in accordance with the Submittals Section.

Design the testing reaction frame to be sufficiently rigid and of adequate dimensions such that excessive deformation of the testing equipment does not occur. Provide a reaction frame capable of safely supporting 125 percent of the maximum test load. Align the jack, bearing plates, and stressing anchorage such that un-loading and repositioning of the equipment will not be required during the test. The direction of the applied load shall be collinear with the helical pile at all times.

Apply and measure the test load with a hydraulic jack and pressure gauge. The pressure gauge shall be graduated in 100 psi increments or less. The jack pressure gauge shall have a pressure range not exceeding twice the anticipated maximum test pressure. The jack shall be positioned at the beginning of the test such that unloading and repositioning during the test will not be required.

The jack shall also be positioned co-axial with respect to the helical pile head so as to minimize eccentric loading.

Calibrate the test load jacking system including the hydraulic jack couplings, gas pump, pressure gauge, and hydraulic load cell prior to the test so that the load applied is controlled to within 3 percent of the total applied load. Submit calibration reports prior to the start of the pile load test.

Monitor the creep test load hold during verification tests with both the pressure gauge and the electronic load cell. Use the load cell to accurately maintain a constant load hold during the creep test load hold increment of the verification test.

Readings of settlement and rebound shall be referred to a fixed benchmark and shall be made using dial gauges (micrometer dial extensometers) graduated to 0.001 inches and located so its stem is parallel with the axis of the helical pile. The stem may rest on a smooth plate located at the helical pile head and positioned perpendicular to the axis of the helical pile. The gauges shall be mounted on a reference beam supported at each end by reliable supports located at least 10 feet from the center of the test pile and independent from the jack, pile, or reaction frame.

The dial gauges shall have a travel sufficient to allow the test to be done without having to reset the gauges. Readings shall be taken at intervals specified in the Verification Test Section.

Protect the settlement measuring system against rain, wind, frost, and any other disturbances that could affect the reliability of the settlement observations. Provide sun shading for the measuring system for the duration of the test and for a minimum of 1 hour prior to the start of the test.

C. HELICAL PILE VERIFICATION TEST

The Contractor shall perform pre-production verification pile load testing on sacrificial piles at a location selected by the Contractor and accepted by the Engineer. The location of the verification tests shall be within 10 feet of footprint of a substructure unit but at least 5 feet away from any production pile. Testing shall be performed in compression in accordance with ASTM D1143 except as modified herein.

Verification load tests shall be performed to verify that the Contractor installed helical pile will meet the required FDL and load test acceptance criteria and to verify the nominal resistance to the average installing torque of the helical pile for the project site.

The helical pile verification load test results must verify the helical pile design and installation methods and be reviewed and accepted by the Engineer prior to beginning installation of production helical piles. The verification test pile and reaction piles shall not be used as production piles.

Test verification pile to a maximum Test Load of 150% of the Factored Design Load (FDL) defined above, as indicated on the Drawings. The verification pile load test shall be made by incrementally loading the helical pile in accordance with the following cyclic load schedule:

Step	Loading	Applied Load	Hold Time (min)
1	Cycle 1	AL	1
		0.15 FDL	4
		0.30 FDL	4
		0.45 FDL	4
		0.60 FDL	4
		0.75 FDL	4
		0.525 FDL	4
		0.375 FDL	4
		0.20 FDL	4
		AL	1
2	Cycle 2	AL	1
		0.25 FDL	4
		0.75 FDL	4
		0.90 FDL	4
		1.00 FDL	1

Test Notes: Pile top movement shall be measured at each load increment. The load-hold period shall start as soon as each test load increment is applied. The verification test pile shall be monitored for displacement at the 1.5 FDL increment. Displacement readings shall be recorded at 1, 2, 3, 5, 6, and 10 minutes. Dial gauges shall be reset to zero after the initial AL is applied.

The acceptance criteria for helical pile verification load test are:

1. The helical pile shall sustain the compression and tension design loads (0.75 FDL) with no more than 3/4-inch total vertical movement of the helical pile head as measured relative to the top of the helical pile prior to the start of testing.

2. Failure does not occur at the 1.50 FDL maximum compression test loads. The failure load shall be defined by one of the following definitions, whichever results in the lesser load:

    a) The point at which the movement of the helical pile tip exceeds the elastic compression/tension of the anchor shaft by 0.08 B, where B is defined as the diameter of the largest helix.
    b) The point at which the slope of the load versus deflection (at end of increment) curve exceeds 0.05 inches/kip.

3. Both of the above acceptance criteria shall be met.

At the completion of verification testing, test pile shall be removed to 2-feet below finished grade

D. HELICAL PILE VERIFICATION LOAD TEST REPORT

For the verification load tests, reports must be written and submitted to the Engineer within 3 working days of the load test completion. This report will either confirm the helical piles' resistance as specified on the approved Working Drawings or reject the piles based upon the test results.

This report shall be reviewed and accepted by the Engineer prior to beginning installation of production helical piles. The contents of the verification load test report shall include:

1. Brief project description.

2. Description of site and subsurface conditions including information on the ground conditions at the location of the load test and a comparison to actual conditions encountered.

3. Key personnel including the installation equipment operator, the superintendent, and any other personnel involved in the installation and testing of the helical pile.

4. Helical pile installation data including information such as length of the helical pile, geology encountered (e.g. soil material, rock material, and water levels) during installation, and all relevant helical test pile information specified for production helical pile installation in Construction Quality Control Section C. Installation Records, above.

5. A scale drawing of helical test piles showing all relevant construction details and subsurface conditions encountered during installation of the helical test piles and helical reaction piles.

6. Results of load test including load-movement curves/figures and filled-out data sheets.

7. Statement of load test requirements and acceptance criteria.

8. Comparison of load test requirements and acceptance criteria.

9. Summary statement on the load test results.

10. Report shall be signed and stamped by a Professional Engineer licensed in the Commonwealth of Pennsylvania.

If a tested helical pile fails to meet the acceptance criteria, the Contractor shall modify the design, the construction procedure, or both. These modifications may include but not limited to de-rating the helical pile resistance, modifying the installation methods and equipment, increasing the minimum effective installation torque, changing the helix configuration, or changing the helical pile material (for example central steel shaft). Modification shall be submitted as a revision to the Working Drawings and require the Engineer's review and acceptance. Additional load testing may be required until an acceptable pile load test meets the designated load test requirements.

NON CONFORMING PILES

Non-conforming helical piles include piles that are installed out of tolerance, are damaged, are not installed to the minimum required torque, or are not installed to the minimum required depth, shall be removed, or repaired at no additional cost to the OWNER. The Contractor shall submit a written remedial action plan to the Engineer for approval. To mitigate or remediate nonconforming helical piles, the Contractor may be required to provide additional helical piles or supplement helical piles to meet specified requirements at no additional cost to the Owner. Reuse of components of helical piles that had been previously installed and removed shall be at the acceptance of the Engineer.

FIELD MODIFICATIONS

Modification of manufactured helical anchor shaft, helical blades, bracket assemblies, and shaft connections is prohibited and shall not be performed without written approval of product manufacturing company and acceptance by the Engineer.

3.3 FINAL ACCEPTANCE

A. As Installed Pile Location Data: Submit final as driven pile location plan, certified by a Surveyor licensed in the Commonwealth of Pennsylvania, within four (4) weeks of completion of pile installation.

B. When otherwise acceptable installed piles exceed the specified tolerances, the ENGINEER will analytically determine the total loads on individual piles, based on a survey by the CONTRACTOR'S Surveyor. If the load on any pile exceeds 110 percent of the specified load capacity, corrections shall be made by adding piles, or other procedures, in accordance with a design provided by the ENGINEER.

C. All helical foundation piles are to be evaluated under this specification

END OF SECTION 31 66 15

SECTION 32 01 16.71 – COLD MILLING ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This work consists of removal of hot mix asphalt (HMA) including cold mix, and/or surface treatment pavement by cold milling; hauling of cuttings; cleaning of asphaltic concrete pavement and concrete pavements (if applicable) in preparation for an overlay in conformity with these specifications, and to the lines, grades, and cross sections shown on the plans or drawings or as established by the National Park Service (NPS) or the Contracting Officer (CO). This work includes milling of intersecting streets to the limits shown on the plans or drawings or as ordered by the CO.

B. All salvaged pavement shall become the property of the Contractor and shall be removed from the site unless otherwise negotiated by the NPS.

C. The Contractor shall visit the site of the proposed work and fully acquaint themselves with the existing conditions relating to construction, labor, and traffic. The Contractor shall be fully informed as to the facilities involved and the difficulties and restrictions regarding the performance of the contract.

D. Areas shall not be left in a milled condition for more than ten (10) calendar days prior to paving, unless otherwise approved by the NPS. The NPS may further restrict the time limits when conditions warrant.

E. Measurement Procedures
   1. Micro-milling will be measured per square yard.
   2. The lump sum contract bid price for milling will include:
      - all materials, labor and equipment required to mill in accordance with the construction plans.

F. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work.

1.2 REFERENCES

A. FAR - Federal Acquisition Regulations
   1. FAR 46.105 Contractor responsibilities
   2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
   3. FAR 52.246-12 Inspection of Construction

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Pavement Profilers: The Contractor shall furnish one (1) or more machine(s) operated by experienced operators. The equipment for removing the pavement surface shall be a cold planing (milling) machine specifically designed for automatically controlled profiling and adequate to perform the work according to the lines, grades and tolerances.

1. The Equipment shall be maintained in a satisfactory working condition so as not to cause delays, and the machine must be equipped with taillights, headlights, and necessary reflectors so that it can be operated in traffic with complete safety.
2. Pavement profilers shall have a means of loading by an integral loading belt, and it shall have the ability to cold mill concrete patches when encountered in the pavement.

B. Restrictions: Track-mounted cold milling equipment will be required for primary operations on HMA surfaces in which the Contractor anticipates pavement milling down to within three quarters (3/4) of an inch of an unbound base course. Either track or conventional wheeled milling machines will be acceptable on work requiring only partial-depth milling of the bound materials such that sufficient pavement materials exist after removal to support the cold milling operation. Wheeled machines of sufficient size will be permitted for trimming operations.

C. Grade Control: The automatic controls on the milling machine shall provide accurately established profile grades at each edge of the machine by referencing from the existing pavement or an independent grade reference, where required, or be capable of automatically maintaining a designated cross slope from a single reference.

1. The milling machine shall be equipped with a built-in automatic grade control system that can control the longitudinal profile and the transverse cross-slope to produce the specified results. The longitudinal controls shall be capable of operating from any longitudinal grade reference, including string line, ski (30 foot minimum), mobile string line (30 foot minimum), or matching shoe. The transverse controls shall have an automatic system for controlling cross-slope at a given rate.
2. The rotary drum of the machine shall utilize carbide tip tools spaced not more than $^{5}/_{8}$ inches apart.
3. The milling machine shall be self-propelled and shall have sufficient power, traction, and stability to maintain an accurate depth of cut.

D. Documentation: The Contractor shall provide to the CO at the Pre-Construction meeting full details concerning the machine to be used, including type, weight, milling width (sixty (60) inch minimum for primary operations), milling depth per pass (two (2) inch minimum), operating speeds, air pollution control, and dust suppression.

E. Sweepers: The textured surface shall be left clean and dust free by the use of self-propelled power sweepers with spray bar, vacuums, hand sweepers, or other methods approved by the CO. All equipment shall be equipped with or provide a means of effectively limiting the amount of dust escaping during the milling and removal operation.

F. All equipment must meet the current standards set by the Air Quality Act of noise and air pollution as well as any additional local, state, or federal pollution laws and regulations.

G. Dust Control: Wet suppression equipment shall consist of sprinkler pipelines, tanks, tank trucks, or other devices capable of providing regulated flow, uniform spray, and positive shut-off.

PART 3 - EXECUTION

3.1 PREPARATION

A. Caution shall be taken to ensure that any vehicle used to transport milled material intended for use in any recycled asphalt concrete will be free from any foreign matter (such as dirt, debris, leaves, solvents, etc). Disposal of the sweepings or oversized pieces of pavement will not be permitted near the cold milling stockpiles of a HMA production plant.

3.2 PROCESS

A. Pavement Milling: Remove HMA to a depth as noted in the plans or exhibits, and indicated by the CO. Variable milling depths may be required to improve drainage and cross slope.

1. The cutting tools on the revolving cutting drum must be continually maintained and shall be replaced as warranted to provide a uniform pavement texture. A test strip may be ordered by the CO which shall be a maximum length of 500 feet and shall meet the criteria for surface tolerance and cross slope as noted in this specification.
2. The Contractor shall be responsible for the maintenance of the milled roadway. Exposed granular material shall be compacted to proper lines and grades. The exposed granular material shall be patched with HMA in accordance with procedures outlined in the Partial Depth Specification prior to paving. Included in this item will be all labor, equipment, materials and maintenance necessary to provide a satisfactory surface for paving.
3. Where a surface delamination between HMA layers or a surface delamination of HMA on Portland cement concrete causes a non-uniform texture to occur, the depth of milling shall be adjusted +/- ½ inch or until delamination is eliminated under the direction of the CO and at no additional cost to NPS.
4. Care shall be utilized by the Contractor to insure that the milling operation does not disturb or damage pavement areas to remain. If milling operations begin to displace or damage pavement to remain, then the Contractor shall cease milling operations and make adjustments as required and as approved by the CO. Any damage caused by the milling operations shall be repaired at the Contractor's expense and as directed by the CO.
5. Asphalt concrete that cannot be removed by cold planning equipment shall be removed by other methods acceptable to the CO.

B. Transition Milling: Where the milling area terminates and abuts the existing adjacent pavement, a neat straight line shall be cut with suitable power-driven equipment before commencing the pavement removal with a milling machine. It is the intention of this

operation and the obligation of the Contractor to produce a uniform straight line at the joint. The resulting joint shall be filled with cold patch material and maintained by the Contractor as necessary to provide a safe transition from the milled surface to the adjacent pavement for the traveling public at all times.

C. Structures: Care shall be utilized by the Contractor to insure that no damage occurs to curbing, median barriers, bridge scuppers, parapets, manholes, utility valve boxes, loop detectors, traffic counters, and/or similar structures installed in or adjacent to the street. The Contractor shall, at no additional cost to the NPS, repair or replace any structures damaged.

1. If concrete pavement base is present within the construction limits, the Contractor shall inform the CO of the location. Milling of the various asphaltic pavement overlays on the concrete base shall be performed where directed by the CO in a manner that does not damage the concrete base. This work shall be included in the various milling items and no additional payment or compensation shall be made for work necessary due to the concrete pavement base.

D. Joints: All butt joints created by the milling operation at driveways which are greater than two (2) inches in depth shall be filled with millings or cold patch material and maintained by the Contractor to allow a safe egress and ingress for the traveling public at all times. All butt joints created by the milling operation at intersecting streets which are greater than one-and-one-half ($1^1/_2$) inches in depth shall be filled with cold patch material and maintained by the Contractor to allow a safe egress and ingress for the traveling public at all times.

3.3 FIELD QUALITY CONTROL

A. Safety: The Contractor will provide all necessary labor, materials, and equipment for protection of motorists and pedestrians from any protruding structures that may result from the milling operation. The Contractor shall also be responsible for the protection of motorists and pedestrians from any irregularities and pavement drop-offs that may result from the milling operation.

1. In the event of rain or inclement weather, the Contractor shall suspend milling operations. The Contractor shall make necessary allowances such as for drainage of water that may pond in areas where the milling was completed and the paving has not been completed. Those areas that are to be opened to traffic shall have drainage outlets cut through the shoulder at locations designated by the CO. The Contractor shall plan and prosecute the milling operation to avoid the trapping of water on the roadway. Drainage outlets shall be restored to original grade, unless otherwise directed by the CO. Cost for cutting and restoring the drainage slots in the roadway shoulder shall be included in the price bid for other items of work.
2. The Contractor shall provide a means to effectively limit the amount of airborne dust created during trafficking. The use of self-propelled sweepers may be necessary during the time in which the street is left in a milled state.
3. The milling operation shall not proceed until the Contractor is prepared to overlay the milled section with its intended wearing or surface course. A street may be left in a milled condition for no more than ten (10) calendar days, unless otherwise approved by the CO.

B. Sweeping: The Contractor shall sweep and remove loose cuttings, dust or other objectionable material from the roadway at the end of each working day using power brooms, power vacuums or both; and ancillary equipment, tools and labor necessary to properly prepare the road for subsequent tack coat and paving.

C. Patching: During the cold-milling operation, any localized areas of exposed base materials will be repaired by the Contractor at no additional cost to the NPS. The area of base exposure shall be repaired by placing a minimum of 1 inch of compacted HMA, or as otherwise directed by the CO. Any patching required shall be repaired before the end of the working day, and in a manner satisfactory to the CO.

D. Pollution Control: All equipment will be operated such that it will effectively control dust generated by cutting, loading, and/or cleaning operations. To prevent the infiltration of milled materials into any storm water system the Contractor shall take special care to prevent the milled material from falling through structures. Any material that has fallen through the structures shall be removed at the Contractor's expense.

E. Dust Control: The Contractor is responsible for controlling dust at all times, including nonworking hours, weekends, nights, and holidays. Dust control procedures shall be conducted when particulate matter concentrations exceed the National Air Quality Standard of 150 micro-grams/m3 on a 24 hour average basis or when ordered by the CO.

3.4 FINAL ACCEPTANCE

A. Grades: Any deviations in the profile or cross-slope that exceed $^{3}/_{8}$ inch under a 10-foot stringline or straightedge placed parallel or transversely to the centerline will be corrected to the satisfaction of the CO.

B. Surface Texture: The milled surface shall provide a riding surface with a uniform textured appearance. The milled surface shall be free from gouges, longitudinal grooves and ridges, oil film, and other imperfections that are a result of defective equipment, improper use of equipment, or poor workmanship. The variation of the top of two ridges from the testing edge of the straightedge, between any two ridge contact points, shall not exceed $^{3}/_{8}$ inch. The variation of the top of any ridge to the bottom of the groove adjacent to that ridge shall not exceed $^{3}/_{8}$ inch. Any unsatisfactory surfaces produced are the responsibility of the Contractor and shall be corrected at the Contractor's expense and to the satisfaction of the CO.

C. Depth: The depth of removal will be verified by taking a measurement every 250 feet per each pass of the milling machine, or as directed by the CO. These depth measurements shall be used to monitor the average depth of removal.

D. The CO may require re-milling of any area where a non-uniform surface has resulted from the Contractor's operations; these areas will be corrected at no additional expense to the NPS. All corrections will be made with approved methods and materials. Any areas that require corrective measures will be subject to the same acceptance tolerances. Excess material that becomes bonded to the milled surface will be removed to the NPS's satisfaction before the area is accepted.

END OF SECTION 32 01 16.71.

SECTION 32 01 17.61 - SEALING CRACKS IN ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of identifying, measuring, preparing, cleaning, and treating cracks in asphalt pavement using two treatment typologies determined solely by measured crack width in the field.

B. Contractor shall determine crack width using a crack-measurement gauge or graduated crack card. The contractor shall take three measurements over a 12-inch segment, record the average crack width, and enter results into the Daily Crack Log for verification by the CO.

C. This work consists of sealing cracks and joints in asphalt pavement
   1. Crack Seal: Cracks with an average measured width ≥ 1/4 inch and < 1 inch. Treatment shall consist of hot-poured, polymer-modified rubberized crack sealant conforming to AASHTO M324 Type II. Sealant shall be used only in this width range.
   2. Crack Fill: **(Hot-Pour Mastic)** Cracks with an average measured width **≥ 1 inch and ≤ 4 inches**. Treatment shall consist of **hot-poured, aggregate-modified mastic** specifically formulated for wide-crack repair. Mastic is required for all cracks 1–4 inches and shall not be substituted with asphalt concrete.

D. The work covered under this item shall consist of performing all operations and furnishing all materials, labor, and equipment necessary for preparing, cleaning, drying, and sealing cracks in the existing. Vegetation removal from cracks shall be completed where necessary.

E. Measurement Procedures
   1. Crack Seal will be measured for at the unit price per linear foot.
   2. Crack Fill will be measured for at the unit price per linear foot.
   3. The lump sum contract bid price for crack sealing and filling will include:

      - all testing required by the contract

      - all materials, labor and equipment required to seal and fill cracks.

F. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials
   1. M17 – Mineral Filler for Bituminous Paving Mixtures
   2. M173 – Concrete Joint Sealer, Hot-Poured Elastic Type
   3. M20 – Penetration-Graded Asphalt Cement
   4. M226 – Viscosity-Graded Asphalt Cement
   5. M301 – Hot-Poured Joint Sealants
   6. M320 – Performance-Graded Asphalt Binder
   7. M324 – Hot-Applied Joint & Crack Sealants (Type II)

B. ASTM - ASTM International, formerly known as American Society for Testing and Materials
   1. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants
   2. ASTM D 1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber
   3. ASTM D 5329 - Standard Test Methods for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphalt Pavements and Portland Cement Concrete Pavements

C. FAR - Federal Acquisition Regulations
   1. FAR 46.105 Contractor responsibilities
   2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
   3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTALS

A. Contracting Officer (CO) approval is required for submittals listed below before performing and installing any crack seal or crack fill treatment.
   1. Product installation data;
   2. Certified test reports for sealant materials, performance graded asphalt binder, and fiber;
   3. Cover materials
   4. Crack fill material, source and location.
   5. Proposed equipment list
   6. Daily crack logs

PART 2 - PRODUCTS

2.1 MATERIALS

A. Crack Seal (1/4 to <1 inch)
   1. AASHTO M324 Type II compliant.
   2. Hot-poured, polymer-modified rubberized sealant.

B. Crack Fill – Hot-Pour Mastic (1–4 inches)
   1. Aggregate-modified, hot-poured mastic designed for structural crack repair.
   2. Material shall contain asphalt binder, mineral fillers, polymers, and graded aggregate.
   3. Asphalt concrete or cold patch is not permitted for cracks 1–4 inches.

C. Blotter Material
   1. Stone screenings or approved equivalent, non-tracking.

D. Water
   1. Clean and free of contaminants.

E. Mineral Filler
   1. AASHTO M17

2.2 EQUIPMENT

A. Crack width measurement tools (gauge or crack card).

B. Power saw and blades. Saw and blades of such size and configuration that saw cuts can be made with one pass. Spacers are not allowed.

C. Hot-compressed air lance. A lance capable of providing clean, oil-free compressed air at a volume of 100 cubic feet per minute at a pressure of 120 pounds per square inch and at a temperature of 2000 ºF.

D. Application wand. A crack sealant applicator wand attached to a heated hose that is attached to a heated sealant chamber. The temperature controls shall maintain temperature of the sealant within manufacturer's tolerances.

E. Heating kettle. An indirect-heating-type double boiler with the space between the inner and outer shells filled with oil or other heat transfer medium capable of constant agitation. Provide an accurate and calibrated thermometer having a range from 200 to 600 ºF in 5 ºF graduations. Locate the thermometer such that the temperature of the joint sealant may be safely checked.

F. Squeegee. A hand-held squeegee for ensuring that the crack is filled to the existing surface.

G. Mastic melter-applicator unit (for 1–4 inch cracks).

PART 3 - EXECUTION

3.1 FIELD MEASUREMENT & CLASSIFICATION

A. Contractor shall measure every crack to determine treatment typology:
   1. Measure crack width at three points over a 12-inch length.
   2. Compute the average width.
   3. Enter data into the Daily Crack Log.
   4. Mark crack using paint dots: blue = seal, orange = mastic fill.
   5. CO may audit measurements at any time.

3.2 PREPARATION

A. Clean cracks using hot-compressed air.
B. Remove vegetation, debris, and loose asphalt.
C. Cracks shall be dry prior to material placement.
D. No work when pavement is wet or ambient temperature < 40°F.

3.3 APPLICATION

A. Crack Seal (1/4 to <1 inch)
   1. Heat sealant per manufacturer tolerances.
   2. Apply with wand to fill from bottom up.
   3. Overband 1–2 inches each side; thickness 0.06–0.10 inch.
   4. Finished seal shall be within 1/8 inch of pavement surface.
   5. Apply blotter if required.

B. Crack Fill – Hot-Pour Mastic (1–4 inches)
   1. Melt mastic per manufacturer’s recommendations.
   2. Fill crack to match surrounding pavement elevation (within 1/8 inch).
   3. Compact or tool mastic as needed.
   4. Overband using sealant when required.
   5. Avoid overfilling more than 1/16 inch.

3.4 FINAL CLEANING

A. Remove excess or spilled material from pavement

END OF SECTION 32 01 17.61.

SECTION 32 01 17.62 – STRESS ABSORBING MEMBRANE INTERLAYER

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of furnishing and placing an Asphalt Rubber Chip surface treatment with precoated aggregate.

1. This work consists of applying a combined reacted mixture of hot paving grade asphalt binder and ground rubber followed immediately with a hot, pre-coated aggregate.
2. Asphalt Material shall be PG 58-28 or PG 64-28 AASHTO M320; the grade selected shall be based on laboratory testing by the asphalt-rubber supplier.
3. Anti-Strip Additive, if required by the job mix formula to produce appropriate water resistance, conforming to Section 2.1.
4. Aggregate including all referenced sections and conforming to Section 2.1.
5. Rubber – The granulated rubber shall be vulcanized rubber product from the ambient temperature processing of scrap, pneumatic tires conforming to Section 2.1.

1.2 SUBMITTALS

A. NPS approval is required for submittals listed below before the application of any seal coat.

1. Composition. Submit information and samples for approval at least 21 days before placement:
   a. Aggregate samples - 80 pounds from each stockpile produced and the gradation range represented by each.
   b. Aggregate gradation target values - The proposed percentage of each stockpile to be used and the proposed target value for each sieve size.
   c. Asphalt samples - Two 1-quart samples of asphalt binder or emulsified asphalt from the same source and of the type to be used for the surface treatment.
   d. Asphalt temperature – The temperature of the asphalt binder shall be between 350^0F and 425^0F at the time of addition of the granulated reclaimed rubber. The asphalt rubber mixture shall then be reacted for a minimum of one hour. The asphalt-rubber mixture shall be applied at a temperature between 338°F to 419°F.
   e. Spread rates – The asphalt-rubber mixture shall be applied at a rate of 0.50 to 0.65 gallons per square yard; exact rate to be determined by the aggregate gradation, traffic volume and pavement condition.

f. Anti-Strip Additive - Shall be heat stable, approved for use by the CO, and incorporated into the asphalt-rubber material at the dosage required by the job mix formula up to 1.0% by weight of asphalt binder. It shall be added to the asphalt binder prior to blending with the granulated rubber.

g. Job-Mix Formula (JMF) - Furnish mixes of aggregate, asphalt binder, and additives that meet the applicable material requirements and the appropriate gradation parameters in Table 1 and are capable of being placed as specified.

(1) Target values:

(a) Target value for percent passing each sieve size for the aggregate blend; and

(b) Designate target values within the gradation band shown in Table 1.

(c) Target asphalt binder content;

(2) Source and percentage of each aggregate stockpile to be used.

(3) Average gradation of each aggregate stockpile.

(4) Representative samples from each aggregate stockpile, asphalt binder and antistrip. Use split samples of material taken at the same time samples are taken for testing by the Contractor's laboratory.

(a) 80 pounds of aggregates proportioned by stockpile according to the stockpile's proportion in the mix;

(b) Five 1-gallon samples of the asphalt binder to be used in the mix. Do not include antistrip additives in these samples;

(c) 1 pint of liquid antistrip additive or 10 pounds of cement, fly ash, or lime antistrip additive;

(i) Name of product;

(ii) Manufacturer;

(iii) Material safety data sheet; and

(iv) Dosage rate.

(5) Recent test results from the manufacturer for the asphalt binder including a temperature-viscosity curve;

(6) Material safety data sheets for asphalt and antistrip; and

(7) Mixing temperature range and minimum compaction temperature for the performance grade asphalt to be used in the mix.

The percent of rubber shall be 15-20% by weight of total mixture, that is, by total weight of asphalt binder plus granulated rubber. The exact granulated rubber content shall be determined by the mix design submitted by the asphalt rubber supplier based on laboratory testing. The asphalt and rubber shall be combined and mixed together in a blender unit and reacted for a minimum of one hour. The temperature of the asphalt rubber mixture shall be above 325^0F during the reaction period.

Viscosities shall be run by the asphalt rubber supplier on each blended load of asphalt rubber in accordance with ASTM D2669 or by using a Rion Viscotester. The viscosity of the final product shall be in the range of 1,500 to 3,500 centipoises.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Binder Material.

1. Asphalt Material including all referenced sections shall be PG 58-28 AASHTO M320; the grade selected shall be based on laboratory testing by the asphalt-rubber supplier. The physical requirements for the asphalt-rubber binder shall conform to ASTM D6114, Table 1, Type 2.

2. Anti-Strip Additive, if required by the job mix formula to produce appropriate water resistance. An Anti-Strip additive that is heat stable and approved for use by the Contracting Officer (CO) shall be incorporated into the asphalt-rubber material at the dosage required by the job mix formula up to 1.0% by weight of asphalt. It shall be added to the asphalt binder prior to blending with the granulated rubber.

B. Coarse Aggregate.

1. Crushed stone shall be used. Crushed Portland cement concrete, lightweight aggregate, slag, crushed glass, or crushed gravel stone shall not be used.

2. Furnish hard, durable particles or fragments of crushed stone, crushed slag, or crushed gravel. Use only one type of aggregate on a project.

   Size, grade, and combine the aggregate fractions in mix proportions conforming to the following:

a.	Gradation	Table 1
b.	Los Angeles abrasion, AASHTO T 96	35% max.
c.	Sodium sulfate soundness loss,	12% max. AASHTO T 104
d.	Fractured faces, ASTM D 5821	90% min.
e.	Flat and elongated particles,	10% max.
	1:3 ratio & 3/8-inch sieve calculated by mass, weighted average	
	ASTM D 4791	
f.	Durability index (coarse), AASHTO T 210	35 min.
g.	Durability index (fine), AASHTO T 210	35 min.
h.	Clay lumps and friable particles, AASHTO T 112	1.0% max.

   Do not use lightweight aggregate according to AASHTO M 195.

TABLE 1

SIEVE SIZE	% PASSING
½ inch	100
3/8 inch	85 – 100 (3)
#4	0 – 8 (5)
#8	0 – 4 (3)
#200	0 – 2

( ) The value in the parenthesis is the allowable Deviation (+/-) from the target values

C. Pre-coated Aggregate.

1. The aggregate shall be pre-heated to a temperature between 200^0F and 300^0F and be pre-coated in a mixing plant with 0.4% to 0.8% (by weight of aggregate) of PG 64-28, PG 64-22, PG 58-28 or PG 52-34 asphalt binder prior to application. Samples of the PG asphalt binder selected shall be submitted to the CO as well as certified test reports. Split samples of the pre-coated aggregate shall be tested by the Contractor with test results submitted to the CO within 24 after production. The CO split shall be taken under the direction of the CO who will take immediate possession.

D. Rubber.

2. The granulated rubber shall be vulcanized rubber product from the ambient temperature processing of scrap, pneumatic tires. The granulated rubber shall meet the gradations as noted in Table 2, no substitutions will be accepted:

Table 2

SIEVE SIZE	% PASSING
#10	100
#16	90 – 100
#30	25 – 100
#80	0 - 20

Note: The Contractor may use rubber of multiple types from multiple sources provided that the overall blend of rubber meets the gradation requirements. All types and sources must be detailed in the JMF.

PART 3 - EXECUTION

3.1 ASPHALT RUBBER CHIP SEAL

A. Immediately prior to the application of the asphalt rubber binder, the surface shall be clean in order to insure adequate adhesion of the Asphalt Rubber Chip Seal to the existing pavement surface.

1. Equipment for Surface Treatments:

a. Asphalt distributor - Capable of heating asphalt evenly; Adjustable full circulation spray bar to 15-foot width; Positive controls including

tachometer, pressure gauge, volume measuring device, or calibrated tank to uniformly deposit asphalt over the full width within 0.02 gallons per square yard of the required rate; and thermometer for measuring the asphalt temperature in the tank.

b. Rotary Power Broom – Self propelled; Minimum of 4 pneumatic tires on 2 axles; and positive controls to uniformly deposit the aggregate over the full width of asphalt within 10 percent by mass of the required rates.

c. Mechanical Blender - A mechanical blender for proper proportioning and thorough mixing of the asphalt-binder and granulated rubber is required. This unit shall be equipped with: an asphalt totaling meter (gallons); a flow rate meter (gallons per minute); a positive displacement auger to feed the rubber properly to mixing chamber within a 1% tolerance of the specified rate; and a static motionless mixer. Blender will have a separate asphalt cement feed pump and finished product pump to maximize production. Blender shall be capable of providing 100% proportional mix at any given time during the blending cycle and documentation from the manufacturer, supporting this, shall be submitted to the CO if requested.

d. Distributor Truck - Two pressure-type asphalt distributor trucks in good condition will be required. The distributor shall be equipped with an internal heating device capable of heating the material evenly up to 425° F; an internal mixing unit capable of maintaining a proper mixture of asphalt cement and granulated rubber; have adequate pump capacity to maintain a high rate of circulation in the tank and to spray the asphalt-rubber at a viscosity of 1,500 to 5,000 centipoises; have adequate pressure devices and suitable manifolds to provide constant positive cut- off to prevent dripping from the nozzles. Distributor shall be equipped with an electronically controlled computerized compensation unit for controlling application rates at various width and speed changes. The application unit shall have electronic controls and a digital read out installed and operated from the inside of the cab of the distributor. The distribution bar on the distributor shall be fully circulating. Any distributor that produces a streaked or irregular distribution of the material shall be promptly repaired or removed from the project.

e. Distributor equipment shall include a tachometer, pressure gauges, volume measuring devices, and a thermometer for reading temperature of tank contents. Controls for spray bar shall be located in cab of truck, for controlling width and rate of spray of product. It shall be so constructed that uniform applications may be made at the specified rate per square yard with a tolerance of plus or minus 0.05 gal. / Sq. yd.

f. A “bootman” shall accompany the distributor and ride in a position so that all spray bar nozzles are in his full view and readily accessible for unplugging.

g. Hauling Equipment -Trucks for hauling cover material shall be rear discharge conveyor-fed or “live bottom” trucks and shall be equipped

with a device to lock onto the hitch at the rear of the chip spreader to prevent aggregate spillage.

h. Sufficient hauling vehicles will be available to ensure continuous operation of the distributor and chip spreader.

i. Aggregate Spreader - The aggregate spreader shall be hydrostatically driven and self propelled. It must be equipped with a hydraulically controlled variable adjustable head that is capable of spreading stone in widths from 4.5 to 18 feet. The spreader shall be mounted on pneumatic tires, and shall apply the stone on the road surface in a manner that ensures that the tires do not contact the road surface until after the stone has been applied. The unit shall be equipped with an electronic radar type sensor used to measure ground speed and will automatically adjust the stone application rate depending on width of application and the speed of chip spreader. It shall have the ability to apply stone on any grade from 0 - 6%. The spreader shall be equipped with an integral hopper with a minimum capacity of 5 tons of stone which shall be filled by trucks in a manner which ensures that the truck tires never come in contact with asphalt treated road surfaces until the stone has been properly applied. To maintain constant stone application, a self-locking truck hitch will permit towing of aggregate trucks without stopping the chip spreader. It will be capable of maintaining positive engagement over irregular terrain.

j. Pneumatic-Tired Roller - Two (2) self-propelled, multiple wheel, pneumatic-tired rollers shall be used and shall weigh between 7 and 12 tons. Each roller shall have a total compacting width of at least 56 inches, have a minimum tire pressure of 60 psi, and be equipped with a watering system.

k. Steel-Wheel Roller - One (1) self-propelled, 2-axle (tandem) steel-wheel roller shall be used and shall weigh between 8 and 12 tons and be equipped with scrapers, wetting pads and watering system. Combination pneumatic and steel drum-type rollers are acceptable, as one unit only.

2. Surface Preparation – On existing asphalt surfaces, ensure that the surface is dry. Immediately before placing the asphalt rubber binder remove loose dirt, pavement markings or objectionable material from the surface by approved methods, at no additional cost to the NPS. Fog seal patches using a slow setting emulsion diluted with an equal part water. Apply the diluted emulsion at a rate of 0.17 gallons per square yard.

1. Pavement markings shall be removed by approved methods which include:
   a. High pressure water.
   b. Steam or superheated water.
   c. Mechanical devices such as grinders, sanders, scrapers, scarifiers and wire brushers.

2. Any depression left by pavement marking removal shall be filled to within a 1/16” of the existing pavement surface at no additional cost to the NPS.

3. Depressions created by pavement marking removal greater than 1/2” shall be milled to a 1” depth and repaired with hot mix asphalt.

4. Depressions that are 1/2” or less, may be repaired with a material designed to repair medium to large cracks, smooth out rough spots and fill minor depressions. Repair material shall be a polymer composite fiber reinforced high friction pothole repair material, such as Mega-Patch® *Asphalt Repair Compound*, supplied by Partsmaster, NCH Corp., Dallas, Texas, and applied in accordance with the manufacturer’s recommendations. An equal repair material may be submitted for approval. The polymer composite fiber reinforced high friction pothole repair materials shall conform to the following:

   1. Compressive Strength ASTM C-109 - see note 1 4,000 PSI

   2. Flexural Strength ASTM C-238 - see note 2 1835 PSI

   3. Tensile Strength ASTM C-190 - see note 1 786 PSI

   4. Shear Bond Adhesion ASTM C-882 >650 PSI

   5. Chemical Resistance ASTM C-2299 Unaffected

   6. Accelerated Weathering (4000 hours) ASTM G-233 - see note 3 Unaffected

   7. Fuel Resistance ASTM D-2939 - see note 3 No effect

   8. Resistance to deicing chemicals ASTM C-672 - see note 3 No effect

   9. Abrasion Resistance ASTM D-3910 - see note 3 No stat loss

   10. Freeze / Thaw See note 3 No effect

   11. Coefficient of Friction ASTM E-274 - see note 4 FN 51.8

   Notes: 1) The data shown is representative of laboratory tests (28 days moisture cured samples). Reasonable variations from results shown may be experienced as a result of atmospheric and job site conditions. Mix entire sample kit of MEGAPATCH material when preparing compressive strength specimens. 2) Composite beam prepared by overlaying 3” (76.2 mm) of product in PVC 2” sleeve 3) Test performed by United States Army Corp of Engineers, (USACE). 4) Tests performed by International Cybernetics Pavement Friction Tester. 5) Test performed by NCAT (National Center for Asphalt Technology - Auburn, AL)

5. Weather Limitations – Apply surface treatments with aggregate only when ambient air and surface temperatures are above 60 °F and rising, when the weather is not foggy or rainy, and when rain is not anticipated for at least 24 hours after application.

   Complete all surface treatment applications 2 hours before sunset.

6. Production Start-up Procedures for Surface Treatments:

   a. Discuss proposed aggregate stockpile location. Aggregates shall be handled, hauled, and stored in a manner that will minimize segregation and avoid contamination. Aggregates shall be stockpiled in the vicinity of the project and on ground that has been cleared of vegetation, hard, well drained, or otherwise prepared to protect the aggregate from contamination. Placing aggregate directly from the crusher bins into the aggregate spreader shall not be permitted.

   b. Proposed schedule of operations.

c. List of all equipment and personnel to be used in the production and construction of the work.

d. Proposed traffic control plan.

e. Discuss Section 153, minimum frequency schedule for process control sampling and testing (to be performed by the Contractor).

f. Discuss Subsections 3.1.A.4, 3.1.A.5, and 3.1.A.6.

g. Discuss spill prevention and safety contingency plan.

7. Asphalt Application - The asphalt-rubber mixture shall be applied at a temperature of 338°F to 419°F, at a rate of 0.50 to 0.65 gallons per square yard. Exact rate to be determined by the aggregate gradation, traffic volume and pavement condition.

   Longitudinal joints shall be reasonably true to line and parallel to centerline. Where any construction joint occurs, the edges shall be broomed back and blended so there are no gaps and the elevations are the same, and free from ridges and depressions. Longitudinal joints shall be overlapped from 4 to 6 inches.

   During application, adequate provision shall be made to prevent marring and discoloration of adjacent pavements, structures, vehicles, foliage or personal property.

8. Aggregate Application - The application of aggregate shall follow as close as possible behind the application of the hot asphalt-rubber which shall not be spread further in advance of the aggregate spread that can be immediately covered. Construction equipment or other vehicles shall not drive on the uncovered asphalt-rubber. The hot-precoated aggregate shall be spread uniformly by a self-propelled spreader at a rate of spread generally between 30 to 40 pounds per square yard. Any deficient areas shall be covered with additional material.

9. Rolling – A minimum of three (3) rollers shall be used for aggregate compaction into the hot asphalt-rubber. Two rollers must be pneumatic-tired and one must be steel-wheel. Rolling shall commence immediately following spread of aggregate. There shall be at least three coverages by the pneumatic-tired rollers to embed the aggregate particles firmly into the asphalt-rubber. A coverage shall be as many passes as are necessary to cover the entire width being spread with a pass being one movement of a roller in either direction. Additional coverage of the steel-wheel roller will follow. Water shall be applied to the tires or wheels as required to limit sticking of the asphalt-rubber and aggregate to the rollers.

   a. Sweeping - When the maximum amount of aggregate has been embedded into the asphalt-rubber and the pavement has cooled, all loose material shall be swept or otherwise removed. This will be done at a time and in a manner which will not displace any embedded aggregate or damage the asphalt-rubber. Pre and post sweeping is the responsibility of the Contractor.

10. Acceptance - Table 3 Sampling and Testing Requirements: Provide all necessary production and processing of the work and control performance of the work so that all of the work complies with the contract requirements.

11. Performance Warrantee – Contractor shall warrant the application of the Asphalt Rubber Chip Seal for a period of one year from the installation date. The surface is to remain in a uniform condition with no raveling of the pavement surface and no flushing (bleeding) of the pavement surface.

END OF SECTION 32 01 17.62

Table 3
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Aggregate surface treatment source quality (1)	Measured and tested for conformance	LA abrasion	—	AASHTO T 96	1 per type & source of material	Source of material	Yes, when requested	Before using in work
		Sodium sulfate soundness loss (course & fine)	—	AASHTO T 104	"	"	"	"
		Fractured faces	—	ASTM D 5821	"	"	"	"
		Flat & elongated particles	—	ASTM D 4791	"	"	"	"
		Durability index (course & fine)	—	AASHTO T 210	"	"	"	"
		Clay lumps & friable particles	—	AASHTO T 112	"	"	"	"
Aggregate surface treatment aggregate (1)	Measured and tested for conformance	Gradation. See Table 1 for applicable sieves.	I	AASHTO T 27 & T 11	1 per 750 tons	Production belt or spreader discharge	Yes	24 hours
	Measured and tested for conformance	Fractured faces	—	ASTM D 5821	1 per 750 tons	Production belt or spreader discharge	Yes	24 hours
		Liquid limit (2)	—	AASHTO T 89	"	"	"	"
Asphalt binder (3) or emulsified asphalt (3)	Measured and tested for conformance	Quality	—	Subsection 409.13	1 per tanker truck including trailer	Point of shipment delivery	2 — 1-quart samples	—

(1) Applies to each aggregate grade furnished.
(2) For blotter material only.
(3) Applied to each asphalt material furnished.

SECTION 32 01 17.71 - PARTIAL DEPTH PATCHING OF ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of constructing pavement repairs at select locations involving milling followed by the placement of new hot asphalt concrete.

B. Partial depth patch repair shall be performed as shown on the plans or exhibits, and as directed by the Contracting Officer (CO). This work may be undertaken on existing HMA surfaces prior to milling or after the milling operations.

C. Measurement Procedures
1. Partial Depth Patching of Asphalt Paving will be measured per square yard. The lump sum contract bid price for partial depth patching will include:

- all testing required by the contract
- all materials, labor, and equipment required to construct the asphalt pavement course(s).

D. Payment Procedures
1. The accepted work will be paid at the contract lump sum price for all work

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials

1. AASHTO M 140 - Standard Specification for Emulsified Asphalt
2. AASHTO M 208 - Standard Specification for Cationic Emulsified Asphalt
3. AASHTO T 51 - Standard Method of Test for Ductility of Asphalt Materials
4. AASHTO T 53 - Standard Method of Test for Softening Point of Bitumen (Ring-and-Ball Apparatus)
5. AASHTO T 59 - Standard Method of Test for Emulsified Asphalts

B. ASTM - ASTM International, formerly known as American Society for Testing and Materials

1. ASTM D 2397 - Standard Specification for Cationic Emulsified Asphalt

C. FAR - Federal Acquisition Regulations

1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements

3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL

A. National Parks Service (NPS) approval is required for submittals listed below before excavation of partial depth patch and production and placement of any HMA pavement.
   1. Proposed Job Mix Formula (JMF) and related certifications;
   2. Testing Laboratory Certification of Compliance;
   3. Quality Control Technician Certifications;
   4. Production Plant Certification;
   5. Manufacturer's certificate for emulsified asphalt

PART 2 - PRODUCTS

2.1 MATERIALS

A. Emulsified Asphalt: When specified for tack coat, an equivalent anionic grade emulsion may be substituted for a cationic grade and vice versa. The sieve test in AASHTO M 140 and M 208 is not required.
   1. Anionic emulsions. Conform to AASHTO M 140. For RS-1h and RS-2h, conform to AASHTO M 140 for RS-1 and RS-2, except conform the following for the penetration on the residue.

      Ductility, 77 ºF, 2 inches/min, AASHTO T 51 40 mm min.

   2. Cationic emulsions. Conform to AASHTO M 208. For CRS-1h and CRS-2h, conform to AASHTO M 208 for CRS-1 and CRS-2, except conform to the following for the penetration on the residue.

      Ductility, 77 ºF, 2 inches/min, AASHTO T 51 40 mm min.

   3. Quick-setting emulsions. Conform to AASHTO M 208.

   4. Polymer modified emulsions. Mill or blend the polymer material into the asphalt or emulsifier solution before the emulsification process. Use a polymer quick set emulsified asphalt conforming to AASHTO M 208, ISSA 143, and the following:

      a) Residue by distillation, AASHTO T 59 62 %min.

      b) Softening point, AASHTO T 53 135 °F min.

      c) Penetration at 77 °F, ASTM D 2397 40-90

B. Composition of Mix
   1. Provide a hot asphalt concrete mix composed of crushed stone or gravel and asphalt binder mixed in an approved plant, in accordance with Section 32 12 16.01 Minor Asphalt Pavement. Use an aggregate gradation and asphalt binder of a quality conforming to those normally used locally by either Federal or State agencies for the type of work being constructed.

2.2 EQUIPMENT
   1. Milling Machine. Furnish equipment with the following capabilities:
      a) Self-propelled;
      b) Sufficient power, traction, and stability to accurately maintain depth of cut;

c) Capable of removing the pavement thickness to provide profile and cross slope;
d) System to effectively limit dust and other particulate matter from escaping removal operations;
e) Loading system or adequate support equipment to completely recover milled material at removal rate.
f) The patch excavation shall be a minimum of 18 inches with perpendicular sides such that the placement and compaction of HMA can be accommodated.

2. The Contractor may use pavement saw-cutting or milling or equipment approved by the CO such that no damage occurs to the finished pavement edge. A handheld pavement cutter will not be allowed for cutting the perimeter of the patch at the pavement surface.

PART 3 - EXECUTION

3.1 PREPARATION

A. Use a longitudinal reference to accurately guide the machine. References may include a curb, edge of pavement, or string attached to the pavement surface. Mill in a longitudinal direction.

B. Mill the transverse slope to within 1/4 inch in 10 feet of the required slope. Transition from one transverse slope to another at a uniform rate. Uniformly mill the entire roadway lane width so the cross-section of the new surface forms a straight line.

C. Transition between different depths of cut at a uniform rate of 1/2 inch of depth per 10 feet. At the beginning and end of the milling work, construct a smooth transition to the original surface at this rate. Do not leave an exposed vertical edge perpendicular to the direction of travel. When the pavement remains open to traffic, limit differences in elevation between adjacent lanes to 2 inches.

D. Use a 10-foot metal straightedge to measure at right angles and parallel to the centerline. Defective areas are surface deviations in excess of 1/4 inch in 10 feet between any two contacts of the straightedge with the surface. Correct defective areas using approved methods.

E. Use a rotary broom and vacuum immediately behind the milling operations to remove and completely recover all loose material. Minimize the escape of dust into the air. Dispose of asphalt material in a manner consistent with State and local regulations. Asphalt material may be considered hazardous waste. Furnish copies of the disposal permits.

3.2 APPLICATION

A. Surface Preparation. Clean the existing surface of all loose material, dirt, or other deleterious substances by approved methods.

B. Weather Limitations. Place asphalt concrete on a dry, unfrozen surface when the air temperature in the shade is at least 35 ºF and rising.

C. Hauling. Use vehicles with tight, clean, and smooth metal beds for hauling asphalt concrete mixes.

Thinly coat the beds with an approved material to prevent the mix from adhering to the beds. Do not use petroleum derivatives or other coating material that contaminates or alters the characteristics of the mix. Drain the bed before loading.
Equip each truck with a canvas cover or other suitable material of sufficient size to protect the mix from the weather. When necessary to maintain temperature, use insulated truck beds and securely fastened covers. Provide access ports or holes for checking temperature of asphalt mix in the truck.

D. Placing. Place the hot asphalt concrete with a mechanical paver. Intermediate courses, when specified, shall not be placed in lifts thicker than 2 inches, or in lifts less than twice the nominal maximum size of the aggregate. All surface course paving will be placed with a mechanical paver. In areas where mechanical spreading and finishing is impractical, the intermediate course may be placed by hand raking, screeding, or by other methods approved by the CO. Construct a surface that is uniform in texture and cross-section.

E. Compacting
1. Compact the intermediate course to a minimum of 90 percent and the surface course to a minimum of 92 percent of maximum specific gravity (density). Complete compaction before the mix temperature falls below 160 oF. Determine density by nuclear gauge or as directed by the CO.
2. Non- Hot asphalt concrete mixtures to be used for this item shall be as stated in Table 1 – Minimum Hot Asphalt Concrete Thickness as noted below or as approved by the CO:

Table 1 – Minimum Hot Asphalt Concrete Thickness

Intermediate Course	Surface Course(s)
1.5 inches Minimum Superpave 3/8 inch	1.5 inches Minimum Superpave 3/8 inch

Compact areas that are not accessible to rollers by other approved methods.

F. Pavement Smoothness. Use a 10-foot metal straightedge to measure at right angles and parallel to the centerline. Defective areas are surface deviations in excess of 1/4 inch in 10 feet between any two contacts of the straightedge with the surface. Correct defective areas using approved methods.

G. Asphalt Application
1. Calibrate the asphalt distributor spray bar height, nozzle angle, and pump pressure and check longitudinal and transverse spread rates weekly according to ASTM D 2995. If different asphalt distributors are used, calibrate each before use on the project. Ensure that the length of the spread is no more than can be covered with aggregate immediately after application.
Protect the surfaces of nearby objects to prevent spattering or marring. Spread building paper on the surface for a sufficient distance from the beginning and end of each application so the flow through the distributor nozzles may be started and stopped on the paper.

The CO will approve the exact application rate, temperature, and area to be treated before application and may make adjustments for variations in field conditions.
Apply the asphalt uniformly with an asphalt distributor. Move distributor forward at

the proper application speed at the time the spray bar is opened. Use care not to apply excess asphalt at the junction of spreads.

Correct skipped areas or deficiencies. Remove and dispose of paper or other material used.

2. Apply the asphalt at a rate of 0.03 - 0.05 gallons per square yard for newly paved surfaces, 0.05 - 0.06 gallons per square yard for existing hot mix asphalt surfaces, and 0.07 – 0.10 gallons per square yard for milled surfaces.
   When a tack coat cannot be applied with an asphalt distributor spray bar, apply the tack coat uniformly and completely by fogging with a hand spray attachment or by another approved method.
   If excess asphalt material is applied, squeegee the excess from the surface. Allow the tacked surfaces to completely cure before placing the covering course. Place the covering course within 4 hours of placing the tack coat.

3. Pressurized asphalt distributor with a spray bar must be capable of applying a triple overlap spray pattern.

4. Swab or paint the entire vertical face. Tack coat material shall also be applied between hot asphalt concrete courses.

5. The perimeter of the patch at the finished surface shall be painted with tack coat such that a 4" wide strip will be equally spaced on the new and existing pavement. The tack coat material shall be dusted with stone screenings or stone dust such that no tracking or pick-up of the seal will occur.

H. Complete pavement construction of the intermediate course paving within 24 hours of excavation. If drop-offs are left overnight, sign the drop-offs in excess of 1-1/2 inches with *"Uneven Lanes"* warning signs, but in no case will a drop-off greater than 2 inches be allowed.

3.6 FINAL ACCEPTANCE

Asphalt mixture will be evaluated under Section 32 12 16.

END OF SECTION 32 01 17.71.

SECTION 32 01 17.72 - FULL DEPTH PATCHING OF FLEXIBLE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This work consists of the following:
   1. Removal of pavement structures.
   2. Constructing one or more courses of aggregate on a prepared surface.
   3. Constructing minor hot asphalt concrete for roadways.
   4. Applying an emulsified asphalt tack coat. Tack coat emulsified asphalt grade is designated as shown in AASHTO M 140 or M 208.

B. Full depth patch repair shall be performed as shown on the plans or exhibits, and as directed by the Contracting Officer (CO). This work may be undertaken on existing HMA surfaces prior to milling or after the milling operations.

C. Measurement Procedures
   1. Full Depth Patching of Asphalt Paving will be measured per square yard. The lump sum contract bid for Full Depth Patching of Flexible Paving will include:
      - all sampling and testing required by the contract.
      - all materials, labor, and equipment required to construct the asphalt pavement course(s).

D. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work.

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials
   1. AASHTO M 140 - Standard Specification for Emulsified Asphalt
   2. AASHTO M 208 - Standard Specification for Cationic Emulsified Asphalt
   3. AASHTO T 51 - Standard Method of Test for Ductility of Asphalt Materials
   4. AASHTO T 53 - Standard Method of Test for Softening Point of Bitumen (Ring-and-Ball Apparatus)
   5. AASHTO T 59 - Standard Method of Test for Emulsified Asphalts
   6. AASHTO M 195 - Standard Specification for Lightweight Aggregates for Structural Concrete
   7. AASHTO T 104 - Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
   8. AASHTO T 11 - Standard Method of Test for Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
   9. AASHTO T 112 - Standard Method of Test for Clay Lumps and Friable Particles in Aggregate
   10. AASHTO T 180 - Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
   11. AASHTO T 210 - Standard Method of Test for Aggregate Durability Index

12. AASHTO T 27 - Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
13. AASHTO T 310 - Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)
14. AASHTO T 89 - Standard Method of Test for Determining the Liquid Limit of Soils
15. AASHTO T 90 - Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
16. AASHTO T 96 - Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

B. ASTM - ASTM International, formerly known as American Society for Testing and Materials
1. ASTM D 2397 - Standard Specification for Cationic Emulsified Asphalt
2. ASTM D 4791 - Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
3. ASTM D 5821 - Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate

C. FAR - Federal Acquisition Regulations

1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL

National Parks Service (NPS) approval is required for submittals listed below before excavation of partial depth patch and production and placement of any HMA pavement.

1. Proposed Job Mix Formula (JMF) and related certifications;
2. Testing Laboratory Certification of Compliance;
3. Quality Control Technician Certifications;
4. Production Plant Certification;
5. Manufacturer's certificate for emulsified asphalt
6. Certified test reports for approval not less than 30 days before material is required for the work. Test reports shall be provided for base and subbase material and shall include as a minimum gradation and optimum density information.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Emulsified Asphalt: When specified for tack coat, an equivalent anionic grade emulsion may be substituted for a cationic grade and vice versa. The sieve test in AASHTO M 140 and M 208 is not required.

1. Anionic emulsions. Conform to AASHTO M 140. For RS-1h and RS-2h, conform to AASHTO M 140 for RS-1 and RS-2, except conform the following for the penetration on the residue.
   Ductility, 77 ºF, 2 inches/min, AASHTO T 51 40 mm min.

2. Cationic emulsions. Conform to AASHTO M 208. For CRS-1h and CRS-2h, conform to AASHTO M 208 for CRS-1 and CRS-2, except conform to the following for the penetration on the residue.
   Ductility, 77 ºF, 2 inches/min, AASHTO T 51 40 mm min.

3. Quick-setting emulsions. Conform to AASHTO M 208.

4. Polymer modified emulsions. Mill or blend the polymer material into the asphalt or emulsifier solution before the emulsification process. Use a polymer quick set emulsified asphalt conforming to AASHTO M 208, ISSA 143, and the following:
   a) Residue by distillation, AASHTO T 59 62 %min.
   b) Softening point, AASHTO T 53 135 °F min.
   c) Penetration at 77 °F, ASTM D 2397 40-90

B. Composition of Mix
1. Provide a hot asphalt concrete mix composed of crushed stone or gravel and asphalt binder mixed in an approved plant, in accordance with Section 32 12 16.01 Minor Asphalt Pavement. Use an aggregate gradation and asphalt binder of a quality conforming to those normally used locally by either Federal or State agencies for the type of work being constructed.

C. Base Aggregate.
1. General. Furnish hard, durable particles or fragments of crushed stone, crushed slag, or crushed gravel conforming the following:
   a) Los Angeles abrasion, AASHTO T 96 50% max.
   b) Sodium sulfate soundness loss (5 cycles), AASHTO T 104 12% max.
   c) Durability index (coarse), AASHTO T 210 35 min.
   d) Durability index (fine), AASHTO T 210 35 min.
   e) Fractured faces, ASTM D 5821 50% min.
   f) 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.

2. Sub base or base aggregate. In addition to (1) above, conform to the following:
   a) Gradation Table 32 01 17.72-1
   b) Liquid limit, AASHTO T 89 25 max.

Table 32 01 17.72-1
Target Value Ranges for Sub base and Base Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 and T 11)				
	Grading Designation				
	A (Sub base)	B (Sub base)	C (Base)	D (Base)	E (Base)
2½ inch	100(1)				
2 inch	97 – 100(1)	100(1)	100(1)		
1½ inch		97 – 100(1)			
1 inch	65 – 79 (6)		80 – 100 (6)	100(1)	
3/4 inch			64 – 94 (6)	86 – 100 (6)	100(1)
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)	436 – 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)

(1) Statistical procedures do not apply.

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

D. Surface course aggregate. In addition to (1) above, conform to the following:

1. Gradation and plasticity index, AASHTO T 90 — Table 32 01 17.72-2
2. Liquid limit, AASHTO T 89 — 35 max.

Do not furnish material that contains asbestos fibers.

Table 32 01 17.72-2
Target Value Ranges for
Surface Course Gradation and Plasticity Index

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & T 11)
1 inch	100(1)
3/4 inch	97 - 100(1)
No. 4	41 - 71 (7)
No. 40	12 - 28 (5)
No. 200	9 - 16 (4)
Plasticity index	8 (4)

(1) Statistical procedures do not apply.
( ) The value in the parentheses is the allowable deviation (±) from the target values.

E. Crushed Aggregate. Furnish hard, durable particles or fragments of crushed stone or gravel conforming to the size and quality requirements for crushed aggregate material normally used locally in the construction and maintenance of highways by Federal or State agencies. Furnish crushed aggregate with a maximum size of 1 inch as determined by AASHTO T 27 and T 11. Furnish crushed aggregate uniformly graded from coarse to fine and free of organic matter, lumps or balls of clay, and other deleterious matter.

F. Asphalt Surface Treatment Aggregate. Furnish hard, durable particles or fragments of crushed stone, crushed slag, or crushed gravel. Use only one type of aggregate on a project. Size, grade, and combine the aggregate fractions in mix proportions conforming to the following:

1. Gradation — Designation C
2. Los Angeles abrasion, AASHTO T 96 — 40% max.
3. Sodium sulfate soundness loss, AASHTO T 104 — 12% max.
4. Fractured faces, ASTM D 5821 — 90% min.
5. Flat and elongated particles, 1:3 ratio & 3/8-inch sieve calculated by mass, weighted average, ASTM D 4791 — 10% max.
6. Durability index (coarse), AASHTO T 210 — 35 min.
7. Durability index (fine), AASHTO T 210 — 35 min.
8. Clay lumps and friable particles, AASHTO T 112 — 1.0% max.

Do not use lightweight aggregate according to AASHTO M 195.

Table 32 01 17.72-3
Target Value Ranges for
Single and Multiple Course Surface Treatment Aggregate Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & T 11)					
	Grading Designation					
	A	B	C	D	E	F
1½ inch	100(1)					
1 inch	90-100(3)	100(1)				
3/4 inch	0-35(5)	90-100(3)	100(1)			
1/2 inch	0-8(3)	0-35(5)	90-100(3)	100(1)		
3/8 inch	—	0-12(3)	0-35(5)	85-100(3)	100(1)	100(1)
No. 4	—	—	0-12(3)	0-35(5)	85-100(3)	85-100(1)
No. 8	—	—	—	0-8(3)	0-23(4)	—
No. 200	0-1(1)	0-1(1)	0-1(1)	0-1(1)	0-1(1)	0-10(1)

(1) Statistical procedures do not apply.
( ) The value in the parentheses is the allowable deviation (±) from the target values.

PART 3 - EXECUTION

3.1 PREPARATION

A. Removing Material. Saw cut sidewalks, curbs, pavements, and structures when partial removal is required.
Construct structurally adequate debris shields to contain debris within the construction limits. Do not permit debris to enter waterways, travel lanes open to public traffic, or areas designated not to be disturbed.

B. Disposing of Material. Dispose of debris and unsuitable and excess material as follows:
1. Remove from project. Recycle or dispose of material legally off the project. Furnish a statement documenting the nature and quantity of material processed or sold for recycling. Otherwise, furnish a signed copy of the disposal agreement before disposal begins.

C. Make the excavation square or rectangular with faces straight and vertical to a depth that will allow the placement of a minimum of 9” of crushed aggregate base beneath the hot asphalt concrete thickness stated in Table 1 Minimum Hot Asphalt Concrete Thickness.
1. Crushed Aggregate – Furnish hard, durable particles or fragments of crushed stone or gravel conforming to the size and quality requirements for crushed aggregate material normally used locally in the construction and maintenance of highways by Federal or State agencies. Furnish crushed aggregate with a maximum size of 1 inch as determined by AASHTO T 27 and T 11. Furnish crushed aggregate

uniformly graded from coarse to fine and free of organic matter, lumps or balls of clay, and other deleterious matter.

Crushed aggregate base shall conform to the limits stated in Table 32 01 17.72-1 Grading C.

3.2 APPLICATION

A. The Contractor may use pavement saw-cutting or milling or equipment approved by the CO such that no damage occurs to the finished pavement edge. A hand held pavement cutter will not be allowed for cutting the perimeter of the patch at the pavement surface Remove the existing bound pavement an additional 12" in width from the limits of the proposed soil excavation as indicated on the plans and as directed by the CO.

B. After a representative quantity of aggregate is produced and when requested by the COR, submit proposed target values for the appropriate sieve sizes along with a representative 300-pound sample at least 14 days before incorporating the aggregate into the work.

C. Mixing and Spreading. Determine the optimum moisture content according to AASHTO T 180, method D. Mix the aggregate and adjust the moisture content to obtain a uniform mixture with a moisture content within 2 percent of the optimum moisture content. Spread and shape the mixture on the prepared surface in a uniform layer.
Do not place the mixture in a layer exceeding 6 inches in compacted thickness. When more than one layer is necessary, compact each layer according to Subsection 301.05 before placing the next layer. Route hauling equipment uniformly over the full width of the surface to minimize rutting or uneven compaction.

D. Compacting. Determine the maximum density of the mixture according to AASHTO T 180, method D.
Compact each layer full width. Roll from the sides to the center, parallel to the centerline of the road. Along curbs, headers, walls, and all places not accessible to the roller, compact the material with approved tampers or compactors.
Compact each layer to at least 95 percent of maximum density. Determine the inplace density and moisture content according to AASHTO T 310 or other approved test procedures.

E. Surface Tolerance. If grade finishing stakes are required, finish the surface to within ±0.05 feet from staked line and grade elevation.
If grade finishing stakes are not required, shape the surface to the required template and check the surface with a 10-foot straightedge. Defective areas are surface deviations in excess of 1/2 inch in 10 feet between any two contacts of the straightedge with the surface.
Correct all defective areas by loosening the material, adding or removing material, reshaping, and compacting.

F. Maintain the aggregate course to the correct line, grade, and cross-section by blading, watering, rolling, or any combination thereof until placement of the next course. Correct all defects according to Subsection G above.

G. Place the hot asphalt concrete with a mechanical paver. Intermediate courses, when

specified, shall not be placed in lifts thicker than 3 inches, or in lifts less than twice the

nominal maximum size of the aggregate. All surface course paving will be placed with a mechanical paver. In areas where mechanical spreading and finishing is impractical the intermediate course may be placed by hand raking, screeding, or by other methods approved by the CO. Construct a surface that is uniform in texture and cross-section.

H. Compacting.

1. Compact the intermediate course to a minimum of 90 percent and the surface course to a minimum of 92 percent of maximum specific gravity (density). Complete compaction before the mix temperature falls below 160 oF. Determine density by nuclear gauge or as directed by the CO.

2. Hot asphalt concrete mixtures to be used for this item shall be as stated in Table 1 – Minimum Hot Asphalt Concrete Thickness as noted below or as approved by the CO:

Table 1 – Minimum Hot Asphalt Concrete Thickness

Intermediate Course [1]	Surface Course(s)
3.0 inches Minimum Superpave 3/4 inch	1.5 inches Minimum Superpave 3/8 inch

(1) *At locations where the existing bound pavement depths exceed the minimum depths specified in Table 1, additional Hot Asphalt Concrete material shall be placed to match the existing pavement depths. Additional material shall be Intermediate Course material placed in lifts not greater than 3" per lift.*

3. Compact areas that are not accessible to rollers by other approved methods.

I. Complete pavement construction of the aggregate base and intermediate course paving within 24 hours of excavation. If drop-offs are left overnight, sign the drop-offs in excess of 1-1/2 inches with "Uneven Lanes" warning signs, but in no case will a drop-off greater than 2 inches be allowed.

J. Pavement Smoothness. Use a 10-foot metal straightedge to measure at right angles and parallel to the centerline. Defective areas are surface deviations in excess of 1/4 inch in 10 feet between any two contacts of the straightedge with the surface. Correct defective areas using approved methods.

K. Asphalt Application. Where using slow-setting emulsified asphalt, dilute by adding an equal amount of water to the emulsified asphalt.

Apply the asphalt according to appropriate asphalt section at a rate of 0.03 to 0.15 gallons per square yard. When a tack coat cannot be applied with an asphalt distributor spray bar, apply the tack coat uniformly and completely by fogging with a hand spray attachment or by another approved method.

If excess asphalt material is applied, squeegee the excess from the surface. Allow the tacked surfaces to completely cure before placing the covering course. Place the covering course within 4 hours of placing the tack coat.

L. Swab or paint the existing vertical faces of the pavement with approved emulsified asphalt such that full coverage (100%) of the entire vertical face is achieved which will provide a uniform film of asphalt remains when cured. Tack coat material shall also be applied between hot asphalt concrete courses.

M. The perimeter of the patch at the finished surface shall be painted with tack coat such that a 4" wide strip will be equally spaced on the new and existing pavement. The tack coat material shall be dusted with stone screenings or stone dust such that no tracking or pick-up of the seal will occur.

3.3 FINAL ACCEPTANCE

Asphalt mixture will be evaluated under Section 32 12 16.

END OF SECTION 32 01 17.72.

SECTION 32 11 23 - AGGREGATE BASE COURSE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of constructing one or more courses of aggregate on a prepared surface. The work consists of constructing one or more courses of aggregate on a prepared surface for Gravel Aprons and Aggregate Shoulders.

B. Measurement Procedures

1. Aggregate Base Course will be measure for at the unit price per ton.

2. The lump sum contract bid price for aggregate base course will include:

- all testing required by the contract
- all materials, labor and equipment required to place aggregate.

C. Payment Procedures

1. The accepted work will be paid at the contract lump sum price for all work

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials

1. AASHTO M 144 - Standard Specification for Calcium Chloride
2. AASHTO T 104 - Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
3. AASHTO T 180 - Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
4. AASHTO T 210 - Standard Method of Test for Aggregate Durability Index
5. AASHTO T 227 - Standard Method of Test for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
6. AASHTO T 27 - Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
7. AASHTO T 310 - Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)
8. AASHTO T 89 - Standard Method of Test for Determining the Liquid Limit of Soils
9. AASHTO T 96 - Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

B. ASTM – ASTM International – formerly known as American Society of Testing and Materials

1. ASTM D 5821 - Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate

B. FAR - Federal Acquisition Regulations

1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTALS

A. National Park Service (NPS) approval is required for submittals listed below before placement and installation of any base material.

1. Submit certified test reports to the Contracting Officer (CO) for approval not less than 30 days before material is required for the work. Test reports shall be provided for base material.

2. Submit a representative 100-pound sample of aggregate proposed for use if requested by the CO.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Untreated Aggregate Courses as shown in Table 32 11 23-1.

B. Water

1. Water for mixing or curing cement concrete, mortar, or grout. Conform to AASHTO M 157. Potable water of known quality may be used without testing according to AASHTO T 26. Potable water is safe for human consumption as defined by the public health authority having jurisdiction.

2. Water for planting or care of vegetation. Furnish water that is free of substances injurious to plant life such as oils, acids, alkalis or salts.

3. Water for earthwork, pavement courses, dust control, and incidental construction. Furnish water free of substances detrimental to the work.

C. Subbase, Base, and Surface Course Aggregate

1. General. Furnish hard, durable particles or fragments of crushed stone, crushed slag, or crushed gravel conforming the following:

a)	Los Angeles abrasion, AASHTO T 96	50% max.
b)	Sodium sulfate soundness loss (5 cycles), AASHTO T 104	12% max.
c)	Durability index (coarse), AASHTO T 210	35 min.
d)	Durability index (fine), AASHTO T 210	35 min.
e)	Fractured faces, ASTM D 5821	50% min.
f)	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.

2. Subbase or base aggregate. In addition to (1) above, conform to the following:

a)	Gradation	Table 32 11 23-1
b)	Liquid limit, AASHTO T 89	25 max.

D. Blotter – Furnish sound durable particles of gravel or crushed stone conforming to the following:

1. Material passing 3/8-mm sieve, AASHTO T 27 100%

2. Liquid limit, AASHTO T 89 25 max.

3. Free of organic matter and clay balls

E. Calcium Chloride, Calcium Chloride Flakes and Magnesium Chloride

1. Calcium chloride liquid. Conform to AASHTO M 144, type L for the specified concentration.

2. Calcium chloride flakes. Conform to AASHTO M 144, type S, grade 1, 2, or 3, class A.

3. Magnesium chloride. Furnish a brine solution conforming to the following:

a) Magnesium chloride by mass	28% minimum
b) Water by mass	72% maximum
c) Specific gravity, AASHTO T 227	1.290 to 1.330

Table 32 11 23-1
Target Value Ranges for Sub base and Base Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 and T 11)				
	Grading Designation				
	A (Sub base)	B (Sub base)	C (Base)	D (Base)	E (Base)
2½ inch	100(1)				
2 inch	97 – 100(1)	100(1)	100(1)		
1½ inch		97 – 100(1)			
1 inch	65 – 79 (6)		80 – 100 (6)	100(1)	
3/4 inch			64 – 94 (6)	86 – 100 (6)	100(1)
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)	436 – 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)

(1) Statistical procedures do not apply.

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

PART 3 - EXECUTION

3.1 APPLICATION

A. Mixing and Spreading – Determine the optimum moisture content according to AASHTO T 180, method D. Mix the aggregate and adjust the moisture content to obtain a uniform mixture with a moisture content within 2 percent of the optimum moisture content. Spread and shape the mixture on the prepared surface in a uniform layer.
Do not place the mixture in a layer exceeding 6 inches in compacted thickness. When more than one layer is necessary, compact each layer according to Subsection 3.1.B before placing the next layer. Route hauling equipment uniformly over the full width of the surface to minimize rutting or uneven compaction.

B. Surface Tolerance – If grade finishing stakes are required, finish the surface to within ±0.05 feet from staked line and grade elevation.
If grade finishing stakes are not required, shape the surface to the required template and check the surface with a 10-foot straightedge. Defective areas are surface deviations in excess of 1/2 inch in 10 feet between any two contacts of the straightedge with the surface. Correct all defective areas by loosening the material, adding or removing material, reshaping, and compacting.

C. Maintenance – Maintain the aggregate course to the correct line, grade, and cross-section by blading, watering, rolling, or any combination thereof until placement of the next course.

D. Roadbed Reconditioning – Excavate soft and unusable areas to the limits designated by the CO. Prevent unsuitable material from becoming mixed with the backfill. Backfill the subexcavation with topping or other suitable material.
Remove all organic, deleterious, or oversize material larger than 6 inches from the top 6 inches of subgrade. Scarify to a 6-inch depth, remove surface irregularities, and shape to provide a uniform surface. Finish earth surfaces to within 0.05 feet and rock surfaces to within 0.10 feet of the required line, cross-section, and grade.
Dispose of unsuitable or excess material legally off the project.
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.
Compact according to Subsection 3.1.H.

E. Aggregate Surface Reconditioning – Excavate soft and unusable areas to the limits designated by the CO. Scarify to the depth of the aggregate surface or to a depth of 8 inches, whichever is less, and remove surface irregularities.
Dispose of unsuitable or excess material legally off the project.
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.
Compact according to Subsection 3.1.H.

F. Gravel Aprons – Excavate soft and unusable areas to the limits and depths designated by the CO. Place aggregate base and subbase in accordance with Table 32 11 23 -2:

Table 32 11 23-2

Depth of Excavation/Fill:	Base	Subbase
Less than or equal to 4.0”	Grading E (Base)	-
Greater than 4.0”	2” Grading E (Base)	2+” Grading C (Subbase)

Dispose of unsuitable or excess material legally off the project.
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.
Compact according to Subsection 3.1.H.

G. Aggregate Shoulders - Excavate soft and unusable areas to the limits and depths designated by the CO. Place a minimum of 2” of Grading “E” aggregate (Base) for the Aggregate Shoulder.
Dispose of unsuitable or excess material legally off the project.
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.
Compact according to Subsection 3.1.H.

H. Compacting – Determine the maximum density of the mixture according to AASHTO T 180, method D.
Compact each layer full width. Roll from the sides to the center, parallel to the centerline of the road. Along curbs, headers, walls, and all places not accessible to the roller, compact the material with approved tampers or compactors.
Compact each layer to at least 95 percent of maximum density. Determine the inplace density and moisture content according to AASHTO T 310 or other approved test procedures.

I. Aggregate shall be delivered as uniform mixtures of fine and coarse aggregate and shall be spread in layers or windrows without segregation. Segregated materials shall be remixed until uniform.

J. The Contractor shall request an inspection by the CO and obtain acceptance of the prepared subgrade before proceeding with placement of the aggregate base.

K. Dust Control – If in the opinion of the CO there is excessive dust being generated by the aggregate course, the CO may require the Contractor to apply a dust.

3.2 FINAL ACCEPTANCE

A. Acceptance – Acceptance will be based on aggregate quality characteristics for gradation, Los Angeles abrasion, fractured faces, organic matter, clay and percent compaction.

END OF SECTION 32 11 23.

SECTION 32 12 13.13 – ASPHALT TACK COAT

PART 1 - GENERAL

1.1 SUMMARY

A. This work consists of applying an emulsified asphalt tack coat. Tack coat emulsified asphalt grade is designated as shown in AASHTO M 140 or M 208.

B. Measurement Procedures
1. Asphalt tack coat will be measured in the unit gallons.

C. Payment Procedures
1. The accepted work will be paid at the contract lump sum price for all work.

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials
1. AASHTO M 208 - Standard Specification for Cationic Emulsified Asphalt
2. AASHTO T 209 - Standard Method of Test for Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt (HMA)
3. AASHTO T 51 - Standard Method of Test for Ductility of Asphalt Materials
4. AASHTO T 53 - Standard Method of Test for Softening Point of Bitumen (Ring-and-Ball Apparatus)
5. AASHTO T 59 - Standard Method of Test for Emulsified Asphalts

B. ASTM - ASTM International, formerly known as American Society for Testing and Materials
1. ASTM D 2397 - Standard Specification for Cationic Emulsified Asphalt
2. ASTM D 2995 - Standard Practice for Estimating Application Rate and Residual Application Rate of Bituminous Distributors

C. ISSA – International Slurry Surfacing Association
1. ISSA 143 - Recommended Performance Guidelines for Micro-Surfacing

D. FAR - Federal Acquisition Regulations
1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL
A. Contractor shall submit a material certification from the manufacturer for the CO's approval.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Emulsified Asphalt: When specified for tack coat, an equivalent anionic grade emulsion may be substituted for a cationic grade and vice versa. The sieve test in AASHTO M 140 and M 208 is not required.

1. Anionic emulsions. Conform to AASHTO M 140. For RS-1h and RS-2h, conform to AASHTO M 140 for RS-1 and RS-2, except conform the following for the penetration on the residue.

   Ductility, 77 ºF, 2 inches/min, AASHTO T 51 40 mm min.

2. Cationic emulsions. Conform to AASHTO M 208. For CRS-1h and CRS-2h, conform to AASHTO M 208 for CRS-1 and CRS-2, except conform to the following for the penetration on the residue.

   Ductility, 77 ºF, 2 inches/min, AASHTO T 51 40 mm min.

3. Quick-setting emulsions. Conform to AASHTO M 208.

4. Polymer modified emulsions. For micro-surfacing, mill or blend the polymer material into the asphalt or emulsifier solution before the emulsification process. Use a polymer quick set emulsified asphalt conforming to AASHTO M 208, ISSA 143, and the following:

   a) Residue by distillation, AASHTO T 59 62 %min.
   b) Softening point, AASHTO T 53 135 °F min.
   c) Penetration at 77 °F, ASTM D 2397 40-90

2.2 EQUIPMENT

1. Asphalt distributor.
   a) Capable of heating asphalt evenly;
   b) Adjustable full circulation spray bar to 15-foot width;
   c) Positive controls including tachometer, pressure gauge, volume measuring device, or calibrated tank to uniformly deposit asphalt over the full width within 0.02 gallons per square yard of the required rate; and
   d) Thermometer for measuring the asphalt temperature in the tank.

2. Rotary power broom.
   a) Self-propelled; and
   b) Capable of controlling the vertical broom pressure.

3. Pneumatic-tire rollers. Furnish a minimum of two pneumatic-tire rollers both with the following capabilities:
   a) Self-propelled;
   b) Minimum compacting width – 5 feet; and
   c) Gross weight adjustable within the range of 200 to 360 pounds per inch of compaction width.

4. Aggregate spreader
   a) Self-propelled;
   b) Minimum of 4 pneumatic tires on 2 axles; and
   c) Positive controls to uniformly deposit the aggregate over the full width of asphalt within 10 percent by mass of the required rates.

PART 3 – EXECUTION

3.1 PREPARATION

A. Surface Preparation. Clean the existing surface of all loose material, dirt, or other deleterious substances by approved methods. When the surface is concrete, remove excess joint and crack filler.

B. Weather Limitations. Apply asphalt tack coat on a dry, unfrozen surface when the air temperature in the shade is above 35 ºF and rising.

3.2 APPLICATION

1. Calibrate the asphalt distributor spray bar height, nozzle angle, and pump pressure and check longitudinal and transverse spread rates weekly according to ASTM D 2995. If different asphalt distributors are used, calibrate each before use on the project. Ensure that the length of the spread is no more than can be covered with aggregate immediately after application.

   Protect the surfaces of nearby objects to prevent spattering or marring. Spread building paper on the surface for a sufficient distance from the beginning and end of each application so the flow through the distributor nozzles may be started and stopped on the paper.

   The Contracting Officer (CO) will approve the exact application rate, temperature, and area to be treated before application and may make adjustments for variations in field conditions. Apply the asphalt uniformly with an asphalt distributor. Move distributor forward at the proper application speed at the time the spray bar is opened. Use care not to apply excess asphalt at the junction of spreads.

   Correct skipped areas or deficiencies. Remove and dispose of paper or other material used.

2. Apply the asphalt at a rate of 0.03 - 0.05 gallons per square yard for newly paved surfaces, 0.05 - 0.06 gallons per square yard for existing hot mix asphalt surfaces, and 0.75 – 1.0 gallons per square yard for milled surfaces.

   When a tack coat cannot be applied with an asphalt distributor spray bar, apply the tack coat uniformly and completely by fogging with a hand spray attachment or by another approved method.

   If excess asphalt material is applied, squeegee the excess from the surface. Allow the tacked surfaces to completely cure before placing the covering course. Place the covering course within 4 hours of placing the tack coat.

3. Pressurized asphalt distributor with a spray bar must be capable of applying a triple overlap spray pattern.

END OF SECTION 32 12 13.13.

SECTION 32 12 16 – STANDARD ASPHALT PAVEMENT

PART 1 – GENERAL

1.1 SUMMARY

A. Work under this Section includes constructing one or more courses of asphalt pavement. Furnish all labor, material, equipment, tools, transportation and supplies necessary to complete the work according to the contract.

B. Furnish asphalt pavement (pavement) composed of mineral aggregate, performance-graded asphalt binder, recycled asphalt, mineral filler, anti-strip additives and, if applicable, manufactured warm mix asphalt (WMA) additive and/or WMA plant process modifications that are mixed in a central mixing plant and placed on a prepared surface in accordance with these specifications and in conformance to the lines, grades, compacted thicknesses and typical cross sections shown on the contract drawings or as directed by the Contracting Officer.

C. Related Sections.

1. 332 10 16.71 Cold Milling Asphalt Paving
2. 32 10 1.61 Sealing Cracks in Asphalt Paving
3. 32 10 17.62 Stress Absorbing Membrane Interlayer
4. 32 10 17.71 Partial Depth Patching of Flexible Paving
5. 32 10 17.72 Full Depth Patching of Flexible Paving
6. 32 11 23 Aggregate Base Course
7. 32 12 13.13 Asphalt Tack Coat

D. Measurement Procedures

Asphalt Pavement will be measured by the lump sum for all work required. Work constructed outside of the planned lines and grades, or exceeding the dimensions as detailed in the contract, will not be measured for payment. The lump sum contract bid price for Asphalt Pavement will include:

- cost of the Performance-Graded Asphalt Binder (including any binder modifiers)
- anti-strip additive (if required by the Job Mix Formula)
- warm mix additives and technologies, if used
- pre-construction conference
- construction of control test section(s)
- development and implementation of the Quality Control Plan, including revisions or modification as may be required
- joint treatments
- removal of cores and filling voids left by cores
- all sampling and testing required by the contract
- all materials, labor, and equipment required to construct the asphalt pavement course(s)

E. Payment Procedures

The accepted work will be paid at the contract lump sum price for all work described in this section if all test parameters meet the specified results.

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials

1. AASHTO M 140 - Standard Specification for Emulsified Asphalt
2. AASHTO M 156 - Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
3. AASHTO M 208 - Standard Specification for Cationic Emulsified Asphalt
4. AASHTO M 303 - Standard Specification for Lime for Asphalt Mixtures
5. AASHTO M 320 - Standard Specification for Performance-Graded Asphalt Binder
6. AASHTO M 323 - Standard Specification for Superpave Volumetric Mix Design
7. AASHTO R 026 - Standard Practice for Certifying Suppliers of Performance-Graded Asphalt Binders
8. AASHTO R 035 - Standard Practice for Superpave Volumetric Design for Asphalt Mixtures
9. AASHTO T 011 - Standard Method of Test for Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
10. AASHTO T 027 - Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
11. AASHTO T 030 - Standard Method of Test for Mechanical Analysis of Extracted Aggregate
12. AASHTO T 051 - Standard Method of Test for Ductility of Asphalt Materials
13. AASHTO T 096 - Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
14. AASHTO T 104 - Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
15. AASHTO T 166 - Standard Method of Test for Bulk Specific Gravity (G mb) of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens
16. AASHTO T 176 - Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
17. AASHTO T 209 - Standard Method of Test for Theoretical Maximum Specific Gravity (G mm) and Density of Asphalt Mixtures
18. AASHTO T 269 - Standard Method of Test for Percent Air Voids in Compacted Dense and Open Asphalt Mixtures
19. AASHTO T 283 - Standard Method of Test for Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage
20. AASHTO T 304 - Standard Method of Test for Uncompacted Void Content of Fine Aggregate
21. AASHTO T 308 - Standard Method of Test for Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
22. AASHTO T 312 - Standard Method of Test for Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor
23. AASHTO T 329 - Standard Method of Test for Moisture Content of Asphalt Mixtures by Oven Method
24. AASHTO T343 – Standard Method of Test for Density of In-Place Hot Mix Asphalt (HMA) Pavement by Electronic Surface Contact Devices

B. ASTM - ASTM International, formerly known as American Society for Testing and Materials

1. ASTM D 2950 - Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
2. ASTM D 3042 - Standard Test Method for Insoluble Residue in Carbonate Aggregates
3. ASTM D 3549 - Standard Test Method for Thickness or Height of Compacted Asphalt Mixture Specimens

4. ASTM D 3666 - Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
5. ASTM D 4791 - Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate Active Only
6. ASTM D 5821 - Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate Scope

1.3 SUBMITTALS

A. Job Mix Formula (JMF): No pavement shall be placed on the project site until a JMF has been submitted by the Contractor, approved by the Contracting Officer, and a pre-paving meeting conducted. The JMF shall be submitted in writing by the Contractor at least thirty (30) days prior to the start of paving operations. The submittal shall be a signed statement prepared by the Contractor's testing laboratory that certifies the proposed JMF meets the requirements of the contract and can be placed and compacted in the field during production. For each JMF submit the following:

1. Individual bin/stockpile percentages including average percent passing each specified sieve size, resulting blend gradations and proposed designated sieve Target Values (TV) for specified gradation. Gradation shall be performed using AASHTO T 11 procedure B.
2. Percent of performance-graded asphalt binder (PGAB) required by the JMF to meet the specified design parameters.
3. PGAB production Certificate of Compliance (COC) certifying the specified binder grade and properties are in accordance with AASHTO M 320 and R 26. State the type of modification, if applicable.
4. Mixing temperature: Conform to recommendations of PGAB supplier. Do not heat above 350°F.
5. Compaction temperature requirements for the asphalt binder grade specified for either hot mix asphalt (HMA) or warm mix asphalt (WMA).
6. Percent and type of anti-stripping additive, if required.
7. At the time of JMF submittal, if requested by the Contracting Officer, the Contractor shall provide samples of aggregates, binder, mineral filler, bag house fines (if used in the submitted JMF), and antistrip additive (if used in the submitted JMF). Provide sufficient quantity of each component for JMF verification by the Contracting Officer. This may require up to 800 pounds of aggregates, proportioned according to individual bin combinations, five individual gallons of PGAB, and proportionate amounts of the other components necessary to complete JMF verification. Confirm with the Contracting Officer the actual quantities required before delivering samples for JMF verification. Allow the Contracting Officer the opportunity to witness sampling and splitting of JMF submittal samples.
8. WMA: If proposed for use, include a full description of the WMA technology and the target dosage rate together with the submission of applicable material safety data sheets (MSDS) information for the additive and submission of either enough of the additive for the laboratory mix design verification, or the additive pre-blended in the PGAB binder at the correct dosage. If the additive is not pre-blended into the PGAB binder, include directions for properly incorporating the additive into the laboratory made mixture. Include documentation of at least three (3) successful past WMA technology field applications including project type, project owner, tonnage placed, mix design, mixture volumetrics and performance, temperature range for laboratory mixing and compacting, asphalt binder performance grade test data over the range of WMA additive percentages proposed for use, if applicable, evidence of compatibility of WMA additive with asphalt binder and anti-strip agent and temperature range for field mix production, delivery, laydown and compaction.

9. The JMF shall identify the specific part of the work for which it is intended to be used (i.e., base course, intermediate course, surface course, sidewalk, etc.). The JMF shall also indicate minimum criteria listed above for each JMF. If multiple mixing plants are proposed to be used, submit a separate JMF for each plant.
10. Submit a list of materials proposed for use in the work under this subsection including the name and address of the materials producers and the locations from which the materials are to be obtained.
11. Submit aggregate quality test results and furnish certificates of compliance signed by the materials producers or subcontractors and suppliers, stating that materials when tested according to specified test method(s) meet or exceed the specified contract requirements.

B. Laboratory facility accreditations/certification.

C. Qualifications for inspection and testing personnel.

D. Sample copies of all forms to be used for reporting data and information as required by the contract.

1.4 QUALITY ASSURANCE & CONTROL

A. Provide and implement a Quality Control Plan (QCP) that will ensure all asphalt pavement materials and workmanship meet contract requirements for the project. Provide qualified personnel and laboratory facilities to support the QCP. The QCP shall, at a minimum, include and address the following elements:

- Scope and Applicable Specifications
- Submittal Requirements
- Quality Control Organization
  - QC Organizational Chart
  - QC Personnel
- Quality Control Laboratories
  - Primary QC Laboratory, with qualification documents
  - Alternate QC Laboratories
- Materials Control, as applicable for each item of work
  - Material Types and Source(s)
  - Material Properties & Mix Designs
  - Processing of Materials at the Production Site
  - Material Storage and Handling
  - Materials Certifications
- Quality Control Sampling and Testing
  - Frequency of sampling
  - Testing procedures
  - Random Sampling Plan
  - Sample Identification System and numbering
  - Quality Control Sampling & Testing
  - Split Sample procedures
  - Reporting
  - Sample Storage and Retention
- Production Facilities
  - Production Facilities & Equipment lists with calibration records
  - Production Facility QC Activities, sampling and testing
  - Production Facility Control Chart(s)

- Evaluation of test data from the production facility
- Reporting

- Field Operations
  - Placement Equipment and Procedures
  - Placement QC Sampling, Testing process
  - Evaluation of test data from placement operations
  - Reporting

B. Personnel Qualifications - The Contractor's organization shall, at a minimum, include the personnel outlined below that meet the described minimum qualifications. Include personnel by name in the QCP. If changes in QC personnel occur, submit personnel qualifications for review.

Quality Control Manager (QCM). Provide a QCM according to (1) below during all asphalt pavement operations and related sections. If neither is specified, conform to (1).

(1) Full-time, on-site QCM. Provide a QCM with no additional responsibilities for performing testing and inspection, managing the project, or performing operations other than managing quality control and the following:

a) One year experience managing quality control on construction projects of similar type and scope, and

b) One of the following:

i. Two years' experience as a construction project manager or superintendent on construction projects of similar type and scope;

ii. Three years' experience as a project engineer, resident engineer, foreman, construction inspector, or equivalent on construction projects of similar type and scope; or

iii. National Institute for Certification in Engineering Technologies (NICET) Level III certification or equivalent in highway construction or highway material.

(2) Part-time, on-site QCM. Furnish a QCM who has at least 3 years' experience in highway construction, pavement inspection, quality control, and asphalt material testing.

Quality Control Technician(s) - All Contractor QC sampling, testing, and inspections performed at the production facility or at the project site shall be performed by qualified Quality Control Technicians (QCTs) who have 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.

C. Laboratory Facility Requirements

1. All Contractor testing shall be performed in certified laboratories either accredited through the AASHTO Accreditation Program (AAP) or meeting the requirements of ASTM D 3666 or state DOT approved facilities. Laboratory facilities shall be kept clean, and all equipment shall be maintained in proper working condition. This includes providing required AASHTO and ASTM and agency reference documents and ensuring that all required equipment, sampling platforms, and tools are properly functioning, calibrated, and certified. Provide evidence of all certifications, accreditations and calibrations to the Contracting Officer.

2. The Contracting Officer shall be permitted unrestricted access to inspect and review the Contractor's laboratory facility. The Contracting Officer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. Deficiencies shall be grounds for the Contracting Officer to order an immediate stop to incorporating materials into the work until deficiencies are corrected.

D. Inspection

1. The Contractor shall perform inspection of all work required by this contract. At a minimum, schedule pre-work meetings with the Contracting Officer, production and placement personnel, and subcontractors and suppliers at the following phases of the work: Preparatory - at least fourteen (14) days prior to beginning any work element: Start-Up - at beginning of each work type; Production and Placement - periodically throughout the work.
2. The minimum frequency for inspections shall be as shown in the approved QCP. The results and findings of QC inspections shall be documented on Inspector Daily Reports (IDRs).

E. Sampling and Testing Requirements

1. Take samples and test per Table 3-2 for quality assurance acceptance testing, verification (correlation), or other purposes and deliver to the Contracting Officer immediately after sampling and splitting. All sampling and testing shall be in accordance with applicable AASHTO, ASTM, or agency procedures as designated in the contract. Furnish industry standard containers for all material samples. Provide the Contracting Officer the opportunity to monitor and witness all sampling, splitting and testing. Complete QC and QA tests on production and deliver test results to the Contracting Officer within twenty-four (24) hours of taking each sample, but preferably before the next day's paving operation begins.

F. Documentation and Reporting

1. Document all inspection, sampling and testing activities on IDR forms and/or Test Report Forms (TRF), as appropriate. Deliver to the Contracting Officer within one working day of those activities occurring. The QC Manager shall review and evaluate IDRs and TRFs daily to assure that all work conforms to contract requirements. Include, at a minimum, the following information:
   - Daily weather or environmental conditions
   - A summary of production or placement activities completed, including equipment used and hours worked
   - Any non-conforming material or workmanship identified.
   - Any corrective actions recommended or taken
   - Discussions with subcontractors or the Contracting Officer
   - Visitors to the production facility or project site
2. Use Control Charts as part of the QCP. Include examples of the Control Charts to be used in the QCP. Plot test results for each sublot tested. Control charts during placement shall at a minimum include gradations, density, VMA, air voids, VFA, and binder content. Update Control Charts within 24 hours of completing tests for each sublot. Post Control Charts in an accessible location and submit to the Contracting Officer daily.
3. Corrective Action: Describe in the QCP what action will be taken when inspection or test results indicate that non-conforming work is being produced. Correct all areas of unacceptable pavement at no additional cost to the Government. Submit corrective plan to the Contracting Officer for approval.

G. Plan Review and Modifications

1. Review of the QCP will be based on the inclusion of the required information. Revisions to the QCP may be required prior to work startup for any part of the QCP that is determined by the Contracting Officer to be

insufficient. Review of the QCP does not imply any warranty by the Contracting Officer that the QCP will result in completed work that complies with the specifications. It remains the responsibility of the Contractor to demonstrate such compliance. The Contractor shall modify the QCP as work progresses when circumstances necessitate changes in Quality Control personnel, laboratories, or procedures. In such case, the Contractor shall submit an amended QCP to the Contracting Officer for review a minimum of three (3) calendar days prior to the proposed changes being implemented. The Contracting Officer may require changes or improvements to the QCP for initial review, or if during the progress of the work it becomes evident that the QCP is not resulting in work that conforms to contract requirements; work may be suspended on affected items if the Contracting Officer determines that the QCP is not adequately being implemented for specification compliance.

1.5 DELIVERY & HANDLING

A. Asphalt mixture deliveries shall be scheduled so that placing and compacting is continuous, with minimal stopping and starting of the paver.

B. Coordinate trucks dispatched from the plant to ensure that all asphalt mixture delivered to the project is placed in accordance with these specifications. Provide for reliable two-way radio or cellular phone communication between the project site and the plant.

C. Do combine asphalt mixes produced from different plants.

D. The temperature range of the asphalt mixture when delivered to the project site will be established in the Contractor QCP utilizing the approved JMF. Monitor the temperature of the mixture for each load, in the haul vehicles, in the paver hopper, and behind the laydown. Use approved methods and instruments for measuring temperature. Record results on IDRs. Visually inspect the delivered asphalt mixture for crusting or segregation. Reject material that is crusted, segregated, or which is not within the delivery temperature range established in the Contractor QCP.

1.6 PROJECT SITE CONDITIONS

A. Place HMA on a dry, unfrozen surface when the air temperature in the shade is above 35ºF and rising, and the temperature of the road surface in the shade conforms to Table 1-1. Place WMA on a dry, unfrozen surface and only when weather conditions allow for proper production, placement, handling, and compaction for the specific WMA technology used.

Table 1-1
HMA Placement Temperatures

HMA Placement Temperature Compacted Lift Thickness Road Surface Temperature ºF	**< 2 Inches**	**2 to 3 Inches**	**>3 Inches**
	Minimum Lay-Down Temperature (1) ºF		
< 35	(2)	(2)	(2)
35 - 39.9	(2)	(2)	280
40 - 49.9	(2)	285	275
50 - 59.9	295	280	270
60 - 69.9	285	275	265

70 - 79.9	280	270	265
80 – 89.9	270	265	260
≥ 90	265	260	255

(1) Never heat the asphalt concrete mix above the temperature specified in the approved mix design.
(2) Paving not allowed.

B. Rain and Surface Conditions: Immediately cease transportation of asphalt mixtures from the plant when rain begins at the project. Do not place pavement while rain is falling, or when there is water on the surface. Placing pavement may continue, when the rain has stopped, water has been removed from the tacked surface to the satisfaction of the Contracting Officer, and the temperature of the asphalt mixture meets the specification requirements.

C. Information regarding the air temperature, average wind speed, overcast conditions, mix delivery temperature, and existing moisture conditions shall be evaluated by the Contractor prior to placement. The Contractor is responsible for constructing the pavement to meet compaction, bonding and all specification requirements.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Performance-Graded Asphalt Binders: Refer to the Project Typical Sections for specific Performance Graded Asphalt Binders (PGAB) to be utilized for each asphalt surface proposed. All asphalt binders shall be a Performance-Graded Asphalt Binder (PGAB) which meets the specification requirements of AASHTO M320 and AASHTO R26. The PG binder for hot mix asphalt shall be achieved by the use of Neat Asphalt with elastomer polymer modification if needed. Acceptance of the PGAB will be in accordance with AASHTO R26. PGAB shall be provided by a supplier listed on the local state DOT's approved products/suppliers list (https://docs.penndot.pa.gov/public/Bureaus/BOCM/BOCM_MTD_LAB/Publications/PUB_35/Current_Edition/Bulletin15.pdf). Provide a Certification of Compliance (COC) for the specified PGAB with each bulk delivery to the mixing plant during the production of asphalt. Sample in accordance with Table 3-2 and provide samples to the Contracting Officer. Sample identification shall include sample number, time and date of sampling, applicable copies of the PGAB bulk delivery COCs, and the quantity of material in the asphalt liquid asphalt storage tanks at the time of delivery.

The blending at the asphalt plants of PG binders from different suppliers is strictly prohibited.

The Certificate of Compliance for binder shall be a production certificate. All materials requiring a production certification shall require the manufacturer to furnish a production certification for each shipment of material. Include the following with each production COC:

1. Date and place of manufacture
2. Lot number or other means of cross-referencing to the manufacturer's inspection and testing system
3. Substantiating evidence that the material conforms to the contract quality requirements as required by FAR 46.105(a)(4), including all of the following:
   a. Test results on material from the same lot and documentation of the inspection and testing system
   b. A statement from the manufacturer that the material complies with all contract requirements
   c. Manufacturer's signature or other means of demonstrating accountability for the certification

All other manufactured, non-project produced materials shall require Commercial Certification such as mineral filler, antistrip additives, and WMA additives.

B. Recycled Asphalt Pavement (RAP) Material

1. General Requirements: RAP may be used as a component of the asphalt mixture if approved by the Contracting Officer. Usage of RAP is subject to the following requirements: a maximum of twenty percent (20%) for surface courses; and a maximum of twenty-five percent (25%) for all other courses. Percent RAP is computed by mass.

C. When required by the JMF, furnish lime conforming to AASHTO M 303.

D. Aggregates shall be hard, durable particles or fragments of crushed stone, crushed slag, or crushed gravel conforming to the following:

(a) Los Angeles abrasion, AASHTO T 96	40% max.
(b) Soundness of aggregate using sodium sulfate, AASHTO T 104 (5 cycles):	
(1) Coarse aggregate	12% loss max.
(2) Fine aggregate	12% loss max.
(c) Fractured faces, ASTM D5821	See Table 2-3
(d) Fine aggregate angularity, AASHTO T 304, Method A	40% min.
(e) Flat and elongated particles, ASTM D4791 (1:5 ratio, plus ⅜-inch sieve, calculated by mass, weighted average)	10% max.
(f) Sand equivalent, AASHTO T 176, Alternative Method No. 2, Reference Method	40 min.

(g) Gradation. Size, grade and combine the aggregate fractions in mix proportions that result in a composite blend conforming to the specified gradation. Nominal maximum size is one sieve size greater than the first sieve to retain more than 10 percent of the combined aggregate. Test according to AASHTO T 27 and AASHTO T 11. Volumetric asphalt concrete aggregate gradation. See Table 2-2.

E. WMA: If WMA is proposed, use a WMA technology that has been approved by the state DOT in which the project is being constructed. Provide evidence of the state approval.

2.2 EQUIPMENT

A. Mixing Plant: Use mixing plants conforming to AASHTO M 156 supplemented as follows:

1. All plants
   a. Automated controls: Control the proportioning, mixing, and discharging of the mix automatically.
   b. Dust collector: AASHTO M 156, Requirements for All Plants, Emission Controls is amended as follows: Equip the plant with a dust collector. Dispose of the collected material. In the case of bag house dust collectors, dispose of the collected material or return the collected material uniformly. Use of bag house fines in asphalt concrete mixes requires approval unless included as part of the approved JMF.
   c. Recycled asphalt pavement: When recycled asphalt pavement material is incorporated into the mixture, modify plants according to the plant manufacturer's recommendations to process reclaimed material, and according to any state specific specifications related to processing RAP.
   d. WMA: When proposed and approved, modify the asphalt plant as required by the manufacturer to introduce the WMA technology.

2. Drum dryer-mixer plants
   a. Bins: Provide a separate bin in the cold aggregate feeder for each individual aggregate stockpile in the mix. Use bins of sufficient size to keep the plant in continuous operation and of proper design to prevent overflow of material from one bin to another.
   b. Stockpiling procedures: Separate aggregate into at least 2 stockpiles with different gradations. As a minimum, stockpile mostly coarse material in one stockpile and mostly fine material in another.
3. Batch and continuous mix plants
   a. Hot aggregate bin: Provide a bin with 3 or more separate compartments for storage of the screened aggregate fractions to be combined for the mix. Make the partitions between the compartments tight and of sufficient height to prevent spillage of aggregate from one compartment into another.
   b. Load cells: Calibrated load cells may be used in batch plants instead of scales.
   c. Recycled asphalt pavement: Modify batch plants so the recycled asphalt pavement is introduced into the mix after bypassing the dryer. Design the cold feed bin, conveyor system, and special bin adjacent to the weigh hopper, if used, to avoid segregation and sticking of the recycled asphalt pavement material. Heat aggregate to a temperature that will transfer sufficient heat to the recycled asphalt pavement material to produce a mix of uniform temperature within the range specified in the approved JMF.

B. Hauling Equipment

1. Use vehicles with tight, clean, and smooth metal beds for hauling asphalt mixture. Thinly coat the beds with an approved material to prevent the mix from adhering to the beds. Do not use petroleum derivatives or other coating material that contaminates or alters the characteristics of the mix. Drain the bed before loading. Equip each truck with a canvas cover or other suitable material of sufficient size to protect the mix from the weather and thermal segregation during hauling. When necessary to maintain temperature, use insulated truck beds and securely fastened covers. Provide access ports or holes for checking temperature of asphalt mix in the truck.

C. Pavers

1. Self-contained, power-propelled units with adjustable vibratory screeds with full width screw augers.
2. Heated for the full width of the screed.
3. Capable of spreading and finishing courses of asphalt mix in widths at least twelve inches (12”) more than the width of one lane.
4. Equipped with a receiving hopper having sufficient capacity to ensure a uniform spreading operation.
5. Equipped with automatic feed controls, which are properly adjusted to maintain a uniform depth of material ahead of the screed.
6. Operable at forward speeds consistent with satisfactory mix lay down.
7. Capable of producing a finished surface of the required smoothness and texture without segregating, tearing, shoving, or gouging the mix.
8. Equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line, sensing the transverse slope of the screed, and providing the automatic signals that operate the screed to maintain grade and transverse slope. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent.
9. Do not use diesel during paving operations as release agent on any parts that come in contact with the mix.

D. Rollers

1. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. They shall be in good condition, capable of reversing direction without backlash, and shall be operated at speeds and vibration amplitudes and frequencies which avoid detrimental displacement of the pavement.

2. The Contractor shall exercise caution when using vibratory rollers so as not to cause damage to buried infrastructure or adjacent infrastructure. Damage to buried or adjacent infrastructure will be the responsibility of the Contractor. Oscillation type rollers are acceptable for use for compaction rolling. Oscillation rolling is allowed on bridge decks with a low frequency setting.

2.3 MIXES

A. Composition of Asphalt Mixture: Furnish mixes of aggregate, asphalt binder, recycled asphalt pavement, and additives that meet applicable material specifications and the design requirements as designated in Table 2-1.

Volumetric mix properties will be determined and approved at N_{design} according to AASHTO T 312 and R 35 after all additives/technologies have been incorporated. This includes meeting PGAB specification requirements. The Design ESAL for this project is 0.3 to <3.0 M ESALs.

Table 2-1
Asphalt Pavement Design Requirements

Design ESAL (Million)	Gyratory Compaction Level (% Theoretical Maximum Specific Gravity, G_{mm}) AASHTO T 312(4)			Minimum Voids-in-the Mineral Aggregate (VMA), % (1)				Voids Filled with Asphalt (VFA), %	Dust-to-Binder Ratio (3)	Minimum Tensile Strength Ratio, AASHTO T 283(4)
				Nominal Maximum Size Aggregate (2)						
	$N_{initial}$	N_{design}	N_{max}	1 inch (25 mm)	¾ inch (19 mm)	½ inch (12.5 mm)	⅜ inch (9.5 mm)			
0.3 to < 3	7 (≤90.5%)	75 (96.0%)	115 (≤98.0%)	12.0	13.0	14.0	15.0	65.0 - 78.0	0.8 -1.6	0.80

(1) When mineral filler or hydrated lime is used, include in the calculation for compliance with the VMA.
(2) The nominal maximum size aggregate is one size greater than the first sieve to retain more than ten percent (10%) of the combined aggregate.
(3) Dust to binder ratio is the effective asphalt content divided by the total percent of material passing the No. 200 (75 µm) sieve. Dust includes lime, bag house fines, and other mineral matter. Use washed sieve analysis.
(4) Prepare specimens in accordance with AASHTO T 312. AASHTO T 283 specimens are recommended to be four inches (4") in diameter for freeze thaw. Use AASHTO T 166 regardless of the volume of water absorbed.

B. Aggregate Gradation: Furnish nominal maximum size aggregate gradation(s) as specified in Table 2-2.

Table 2-2 (based on local DOT approved mix)
Asphalt Concrete Aggregate Gradation

Sieve Size	Nominal Maximum Aggregate Size – Percent Passing											
	Gradation Designation											
	1.5 inch		1 inch		¾ inch		½ inch		3/8 inch		No. 4	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
2 inch	100											
1 ½ inch	90	100	100									
1 inch	*	9	90	100	100							
¾ inch	*	*	*	89	90	100	100					
½ inch	*	*	*	*	*	89	90	100	100		100	
3/8 inch	*	*	*	*	*	*	*	89	90	100	95	
No. 4	*	*	*	*	*	*	*	*	*	89	90	100
No. 8	15	41	19	45	23	49	28	58	32	67	*	*
No. 16	*	*	*	*	*	*	*	*	*	*	30	55

No. 200	0	6	1.0	7	2	8	2	10	2	10	6	13
* - Contractor specified target values.												

C. Fractured Faces Coarse Aggregate, Uncompacted Void Content of Fine Aggregate (% min), Sand Equivalent (% min), and Flat and Elongated (% min)

Table 2-3
Aggregate Properties Requirements

Design ESALs[a] (Million)	Fractured Faces, Coarse Aggregate,[c] % Minimum		Uncompacted Void Content of Fine Aggregate, % Minimum		Sand Equivalent, % Minimum	Flat and Elongated,[c] % Maximum
	Depth from Surface		Depth from Surface			
	≤4 inches	>4 inches	≤4 inches	>4 inches		
<0.3						
0.3 to <3	75 / --	50/--	40[e]	40	40	10
3 to <10						
10 to <30						
≥30						

[a] The anticipated project traffic level expected on the design lane over a 20-yr period. Regardless of actual design life of the roadway, determine the design ESALs for 20 yr.

[b] 85/80 denotes that 85 percent of the coarse aggregate has one fractured face and 80 percent has two or more fractured faces.

[c] This criterion does not apply to No. 4 nominal size mixtures.

[d] For No. 4 nominal maximum size mixtures designed for traffic levels below 0.3 million ESALs, the minimum Uncompacted Void Content is 40.

[e] For No. 4 nominal maximum size mixtures designed for traffic levels equal to or above 0.3 million ESALs, the minimum Uncompacted Void Content is 45.

D. Furnish hard durable particles or fragments of crushed stone, crushed slag or crushed gravel conforming to the following:

1. Los Angeles abrasion, AASHTO T 96 — 40% max.
2. Sodium sulfate soundness loss, AASHTO T 104 (5-cycles):
   a. Coarse Aggregate — 12% max.
   b. Fine aggregate — 12% max.

E. For the surface course, do not use aggregates known to polish or carbonate aggregates containing less than 25 percent by mass of insoluble residue when tested according to ASTM D3042.

F. WMA: Comply with the manufacturer's recommendations for incorporating the WMA technology. Test specimens may be made from plant produced or laboratory prepared WMA. Test specimens must be made from plant produced WMA if adding the WMA technology in the laboratory does not simulate the production process.

3.1 PREPARATION

A. Notification: Notify the Contracting Officer at least fourteen (14) days prior to beginning paving work. A pre-paving conference will be scheduled at least seven (7) days prior to starting placement. All submittals listed herein are required to be approved prior to scheduling said pre-paving conference. The Contracting Officer, Contractor, and supplier representatives critical to the paving operation will be required to attend this meeting. At this meeting be prepared to discuss work schedule, traffic control, proposed equipment to be used, control test section construction and acceptance, production and placement, quality control, final acceptance procedures and requirements, and any other elements critical to the successful execution of paving operations.

B. The Contractor shall place pavement at the locations, widths, thickness, and to the grades shown on the contract drawings. The Contractor shall furnish, set, and maintain all line and grade stakes, string lines, or other controls necessary to guide and control the paving equipment.

C. Maintain all equipment in safe and satisfactory operating condition.

D. Protection and Restoration of Property and Landscape: Follow the requirements of FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements. If damage occurs, repairs shall be made to the satisfaction of the Contracting Officer at no additional cost to the Government. In addition:

1. Protect adjacent work from contamination by paving materials and placement activities. Remove any stains or damage from adjacent work, structures, curbing, or other facilities, resulting from such contamination. Remove and dispose of all waste and spillage.
2. Do not damage or disturb existing improvements, facilities, features, or vegetation. Provide suitable protection where required before starting work and maintain protection throughout the course of the work.
3. Check frames, covers, grates, water valve boxes, and other miscellaneous castings that are in the proposed pavement areas to ensure that they have been correctly positioned and set to the proper slope and elevation.

E. Preparation of the Underlying Surface

1. The underlying course shall be thoroughly cleaned of all dust and debris by a self-propelled sweeper immediately before placing pavement. Areas inaccessible by power sweepers shall be broom swept manually until the surface is clean. Ensure that the surface to receive the pavement has been approved by the Contracting Officer, is properly compacted and free from soft areas or other deficiencies that might affect the quality of the final pavement course.
2. On bridge decks or concrete pavement, remove excess crack and joint material by trimming the excess material flush with the pavement surface prior to placing pavement. Remove all excess joint or crack material on any pavement surface in excess of one-sixteenth inch (1/16”) in depth prior to placing new pavement courses.
3. If the plans call for pre-paving repair work, such as milling, patching of failed/damaged areas, crack sealing, etc., this work shall be done in accordance with the plans, details and applicable section(s) of these specifications.
4. Apply an asphalt tack coat to contact surfaces of pavements, curbs, gutters, manholes, and other structures in accordance with section 32 12 13. When asphalt pavement will be placed on subgrade or aggregate base, apply an asphalt prime coat in accordance with section 32 12 13.

3.2 CONTROL TEST SECTION

A. After the JMF has been approved, a Control Test Section (CTS) shall be placed, and accepted, prior to beginning full production. The purpose of the CTS is to demonstrate the Contractor’s ability to produce, place and compact the mixture as designed, specified, and approved. If WMA is proposed and approved, use anti-strip additives, silicone additives, WMA additives and WMA technologies as specified, and comply with the

approved mix design proportions and material properties. Confirm the mix proportions and additive rates through field tests performed during production. Ensure silicone additive compatibility when asphalt binder foaming processes are used to produce WMA. If necessary, during this time, adjustments to the mix design may be made according to these specifications. Target value adjustments to the JMF greater than those designated in Table 3-1 may require a completely new mix design submittal and verification, if requested by the Contracting Officer.

Table 3-1
Allowable JMF Revision Limits

Test Property	**Verification and Adjustment Limits, %**
Asphalt Binder Content	+/- 0.4
Gradation: 2.36mm & Larger 600um & 300um	+/- 3.0 +/- 2.0
Gradation: 0.075mm	+/- 1.0
Voids in Mineral Aggregate, VMA,	Min. per Table 2-1
Voids Filled with Asphalt, VFA,	Range per table 2-1

B. The CTS will be a minimum of five-hundred feet (500') long and two lanes wide. If the design thickness is one and a half inches (1½") or greater include a Longitudinal Joint-Wedge as described in these specifications. It shall be of the same depth, and placed on the same underlying material, as the work that it represents. The equipment used in construction of the CTS shall be the same type and weight(s) to be used on the remainder of the work. Place the test section as part of the project pavement, as approved by the Contracting Officer.

C. Take three (3) random samples from behind the laydown machine. The samples shall be split, and the split portion shall be delivered to the Contracting Officer for verification testing. Testing shall include: VMA, VFA, density, aggregate gradation, and asphalt binder content. The Contractor shall test its portion of the samples and report data to the Contracting Officer. Test samples according to contract specified testing methods. PGAB shall be verified using approved production COCs meeting the specified grade. If all test results meet the specified requirements, the test section shall remain as part of the project pavement. If test results exceed the tolerances shown, the test section shall be removed and replaced at no cost to the Government, and another test section shall be constructed.

D. Take five (5) randomly selected cores from the finished pavement mat and five (5) randomly selected cores from the longitudinal joint in the CTS. Provide splits to the Contracting Officer for evaluation. Test samples according to contract specified testing methods. Correlation of density equipment with cores will be as described in the QCP and approved by the Contracting Officer. Provide correlation data between the density gauge and the cores to the Contracting Officer.

E. The Control Test Section shall be considered acceptable and allowed to remain in place if:

1. Mixture and Density: The mix is acceptable if all test results are within specification limits for gradation, asphalt content, air voids, VMA, and density.
2. Smoothness: Pavement mat is uniform in texture and smoothness, with no surface deviations in excess of ¼-inch in 10-feet.

F. If the initial CTS is unacceptable as described above, adjust the JMF, plant operations, or placing and compacting procedures as necessary and construct another CTS.

Additional CTS, as required, shall be constructed and evaluated until an acceptable CTS is constructed. All unacceptable CTS shall be removed at the Contractor's expense. Costs incurred by the Government, if any, for additional sampling, testing and inspection required due to unacceptable CTS will be deducted from payments owed the Contractor.

Full production shall not begin until an acceptable CTS has been constructed.

3.3 APPLICATION

A. Production

Do not heat asphalt binder above 350°F unless approved by the manufacturer.

Weigh or meter aggregates, additives, and asphalt binder material and introduce into the mixer in the proportions specified by the JMF. Take corrective action as outlined in the QCP when testing results indicate the material is not in compliance with the requirements of the contract and the approved JMF and when the test results fall outside of the action limits noted in these specifications.

Mix the combined materials until all aggregate particles are uniformly coated with asphalt binder and thoroughly distributed throughout the mixture.

The temperature of the mixture shall be in accordance with the Performance-Graded Asphalt Binder (PGAB) and, if applicable, WMA technology allowable mixing and compaction temperature range. The temperature of the mixture when discharged from the mixer or silo shall be + 25°F from the value stated in the JMF. Mixtures exceeding these limits shall be subject to rejection.

B. Aggregate Preparation

For batch plants, heat, dry, and deliver aggregate for pug mill mixing at a temperature sufficient to produce an asphalt concrete mix temperature within the approved range. Adjust flames used for drying and heating to prevent damage to and contamination of the aggregate.

Control plant operations so the moisture content of the asphalt concrete mix behind the paver is 1/2 percent (0.5%) or less according to AASHTO T 329.

Before starting asphalt concrete mix production, obtain approval of synchronized metering and weighing devices used to introduce a constant rate of lime and water.

When lime is used as an anti-strip, adjust the aggregate moisture to at least four percent (4%) by mass of aggregate. Mix the lime uniformly with the aggregate before introducing the aggregate into the dryer or dryer drum. Use calibrated weighing or metering devices to measure the amount of lime added to the aggregate.

Add lime to the aggregate by one of the following methods:

Method A: Add lime to the combined cold feed aggregate using an enclosed in-line cold feed mechanical pug mill mixer. Use a twin-shaft, continuous mixing pug mill with adjustable mixing paddles. Adjust the retention time of the mixture in the pug mill so no unmixed lime is visible after the lime and aggregate exit the pug mill.

Method B: Add lime to the produced aggregates during stockpiling using a pug mill. Distribute the lime per the stockpile ratios stated in the asphalt concrete mix design.

A minimum moisture content of two percent (2%) by dry weight for coarse aggregate and four percent (4%) by dry weight for fine aggregate is required at the time the aggregates and lime are mixed. Marinate treated

aggregate in stockpiles from twenty-four (24) hours to sixty (60) days before using in asphalt concrete mix. Do not use aggregate marinated longer than sixty (60) days.

Method C: Add lime to the combined cold feed aggregate by introducing the lime between aggregate layers as the aggregate flows from the cold feed bins. Mix the lime and aggregate on the conveyor belt by placing a minimum of six paddles over the conveyor belt. Make the paddles protrude into the aggregate flow and direct the aggregate to fold over itself causing the material to migrate from one side of the conveyor belt to the other. Space the paddles to provide complete mixing. Provide a water spray over the conveyor belt as necessary to control dust and to maintain minimum moisture content.

C. Mix Design Revisions

During production, the Contractor may request target value revisions to the approved JMF. Proposed changes are subject to meeting the following requirements: (1) the changed target value(s) must be within the limits defined in Table 3-1, test results from the new mixture indicate that the proposed JMF changes will produce asphalt mixtures with the specified density, VMA, VFA and F/A ratio, and the resulting gradations are within the grading band for the specified nominal maximum size grading.

Proposed changes must include new and revised maximum unit weights (AASHTO T 209) for controlling mat density.

Any proposed changes to the approved JMF, along with supporting documentation, shall be submitted in writing to the Contracting Officer for approval a minimum of 72 hours prior to placement on the project.

Changes to the approved JMF may necessitate and require additional evaluation and verification of the mix by the Contracting Officer prior to final approval.

D. Tack Coat/Prime Coat

Apply tack/prime coat per plans and associated specification sections.

E. Transportation, Placing, and Finishing

Set string line or other fixed controls to ensure proper alignment of pavement centerline, joints, and edges.

Verify the depth of each layer at frequent intervals behind the laydown machine and make adjustments if the compacted thickness does not meet the specified thickness. The average compacted depth will be verified by calculating yield using known bulk specific gravity values from the acceptance tests. Furnish daily calculated yields to the Contracting Officer at the end of each day for the day's production. The final paved thickness will be confirmed by cores taken after the final lift has been completed.

The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least six inches (6"). The joint in the top layer shall be at the designed centerline of the pavement. Transverse joints in one layer shall be offset by at least two feet (2') from transverse joints in the previous layer.

Unless otherwise permitted by the Contracting Officer for special conditions and circumstances, only machine methods of placement shall be used. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be placed using hand tools. Luting shall be performed in such a manner as to prevent segregation.

Immediately after placement, and before the initial roller pass, the surface shall be checked, and any irregularities corrected. Irregularities in alignment and grade along outside edges shall be corrected by the addition or removal of mixture before the edges are rolled.

The newly placed pavement surface shall be free of visible segregation or other irregularities. Inspect the uncompacted mat behind the paver for longitudinal streaks, segregation, or other irregularities. Correct as necessary before initial compaction.

If material segregation or irregularities in the mat behind the paver are noted, the Contractor shall review the production, transportation, and placement operations and take corrective action. The Contractor's QCP shall fully outline procedures for inspecting the mat during placement, identifying and troubleshooting material segregation or temperature related segregation, and implementing corrective action.

1. Joints, Edges, and Cleanup
   a. Transverse Joints: The roller shall not pass over the unprotected end of the freshly laid mixture except when necessary to form a transverse paving joint. When necessary to form a temporary transverse paving joint, it shall be made by means of placing a bulkhead or by temporarily tapering the course, in which case the edge shall be cut back to its full depth and width on a straight line to expose a vertical face. In both methods, all contact surfaces shall be given a tack coat of asphaltic material before placing any fresh mixture against the joint.
   b. Longitudinal Joint-Wedge: For placement depths greater than or equal to one and a half inches (1½"), use a Notched Wedge plate attachment on the screed such as the Trans Tech notch wedge, or approved equal. The attachment must provide, for the first paver pass, a half inch (½") notch at the top of the wedge, followed by a diagonal slope down to the underlying surface where a step is formed equal to the nominal maximum aggregate size. The width of the joint shall be a minimum of six inches (6"). The attachment will include a mechanism to provide compaction of the sloped surface of the notched wedge. If no mechanism exists in the attachment, the diagonal shall be compacted by other means satisfactory to the Contracting Officer. The subsequent paver pass will place mix at a depth equal to the lane being matched, plus the appropriate roll-down, to result in a fully compacted joint meeting the smoothness requirement of these specifications.
   c. Longitudinal Joints-Confined Edge: For pavement depths less than one and a half inches (1½"), use a confined-edge longitudinal joint. This is the most typically constructed longitudinal joint which attempts to confine the outside edge of the first paver pass of the mat as much as possible to create a near vertical edge.

F. Asphalt Pavement Compaction

1. Thoroughly and uniformly compact the asphalt surface by rolling. In places inaccessible to rollers, use alternate equipment approved by the Contracting Officer. Do not cause cracking, shoving, or undue displacement.
2. Monitor the compaction process with density gauges in accordance with ASTM D2950 or AASHTO T343. Calibrate nuclear density gauges according to the ASTM D2950 calibration section within six (6) months before use. Check the standard and reference on each day of use according to the ASTM D2950 standardization and reference check sections. Electrical Impedance devices shall be calibrated in accordance with Pennsylvania Test Method (PTM) No. 403. Compact to at least ninety-two percent (92.0%) of the maximum specific gravity (density) determined in the asphalt pavement design requirements.
3. Continue compaction until surface marks are eliminated and cracks are sealed.

G. Pavement Uniformity and Roughness: The finished mat and surfaces of the pavement shall be smooth, dense and uniform in appearance, free from irregularities in contour and texture and shall present a smooth-riding surface. Construct all pavement surfaces to meet the requirements of these specifications.

H. Opening to Traffic: No vehicular traffic or construction loads shall be permitted on the newly completed pavement until the material has cooled to a temperature of 140°F or less.

3.4 FIELD QUALITY CONTROL

A. General: In addition to performing QC testing during production and placement of asphalt pavement the Contractor shall perform acceptance testing as specified in Table 3-2. Contractor QC test results may be used by the Contracting Officer for acceptance if through verification (correlation) and validation, the Contractor QC test results are deemed acceptable by the Contracting Officer. The Contracting Officer has sole discretion to include Contractor QC test results in the acceptance determination or to use only results from tests performed by the Contracting Officer or the Contracting Officer's agent. The Contracting Officer shall have access at any time to all parts of the production and material storage facilities and to all parts of the project site, to perform inspections and tests, as deemed necessary to ensure the quality of the final product.

B. Utilize stratified random sampling of each lot produced and placed to assure that all material within the lot has an equal probability of being selected for testing. The Contracting Officer will provide random numbers as required for each day's sampling, based on the anticipated production for that day. Adjustments in sampling locations and times necessary due to differences between anticipated and actual production quantities will be made by the Contracting Officer. The Contracting Officer may at any time, notwithstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of asphalt mixture and/or pavement which is deemed unfit for use due to contamination, segregation, incomplete coating of aggregate, non-specification temperature, or other indication of defective material. Such rejection may be based on only visual inspection or temperature measurements. Similarly, the Contracting Officer may at any time, notwithstanding field acceptance for mat or longitudinal joint density, reject and require the Contractor to correct any asphalt pavement that was placed with unacceptable mat uniformity or paving joints, due to low density, lack of bond, segregation, improper elevation, tearing or other material or workmanship defects. In the event of such rejection, the Contractor and Contracting Officer may take split samples of the area(s), and if it can be demonstrated by testing that such material or constructed pavement was erroneously rejected, payment will be made for the material at the contract unit price.

C. All samples of PGAB, asphalt mixture, and pavement cores shall be split samples and the split portion delivered to the Contracting Officer. Samples shall be split in accordance with applicable AASHTO or ASTM procedures. Deliver to the Contracting Officer all core samples taken from the compacted pavement after testing. Protect cores from damage before delivering to the Contracting Officer.

D. Lots and Sublots: The entire quantity of production for each asphalt mixture type will be considered one lot and an individual sublot will be considered 700 tons.

E. Selective Sampling: The Contracting Officer may sample the work at any time to verify the quality of the work being performed. Work represented by these samples will be removed and replaced at no cost to the Government if, through further evaluation, the tests indicate that the represented work does not conform to contract requirements.

F. Independent Assurance Sampling: The Contracting Officer or their authorized agent may sample the work at any time to verify the quality of the sampling and testing and equipment used in the Acceptance determination. This will include the Contractor's quality of the sampling and testing and equipment calibrations if Contractor QC tests are used in the Agency Acceptance.

Table 3-2
Sampling, Testing, and Acceptance Requirements during placement

Material or Product	Type of Acceptance	Characteristic	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time	Remarks
Asphalt concrete pavement	Measured and tested for conformance	Asphalt Content(1)	AASHTO T 308	1 per 700 tons	Behind the paver before compaction	Yes	6 hours	
		Air voids	AASHTO T 312 & T 166	1 per 700 tons	Behind the paver before compaction	Yes	6 hours	
		VMA	AASHTO R 35	1 per 700 tons	Behind the paver before compaction	Yes	6 hours	
		Core density(2)	AASHTO T 166	1 per 700 tons	In-place after Compacting	Yes	24 hours	Deliver cores to CO after testing is completed
		Core density Longitudinal Joint(5)	AASHTO T 166	1 per 700 tons	In-place after Compacting	Yes	24 hours	Deliver cores to CO after testing is completed
		Density	ASTM D 2950 or AASHTO T343	1 per 500 feet	In-place after Compacting	No	24 hours	
Asphalt concrete pavement	Measured and tested for conformance	Placement Temperature	—	First load and as determined by CO thereafter	Hauling vehicle before dumping, in hopper or windrow before pickup, or behind laydown	—	Immediately upon completion of measurement	
		Maximum specific gravity(3)(4)	AASHTO T 209	Minimum 1 per day	Behind the paver before compaction	Yes	24 hours	
Asphalt Binder	Measured and tested for conformance	Quality	AASHTO M 320	After each delivery and mixing	In line between tank and mixing plant	two 1-quart samples	See remarks	Test by Government
Asphalt concrete pavement	Measured and tested for Conformance, information and control	Gradation	AASHTO T 30	1 per 500 tons of mix	Behind the paver before compaction	No	24 hours	

(1) Use AASHTO T 308, Method A. Calculate the asphalt binder content by weighing the sample before and after the burn using a calibrated external balance.
(2) Cut two 6-inch diameter side by side cores. Remove them with a core retriever and fill and compact the core holes with asphalt concrete mixture. Label the cores and protect them from damage due to handling and temperature. Submit one core for verification testing. Dry the other core to constant mass at 125±5 °F or vacuum dry it according to ASTM D7227 before performing the core density and measuring the thickness. Use 62.245 pounds per cubic foot to convert specific gravity to density.
(3) After production paving has begun, use the average maximum specific gravity value (AASHTO T 209) for each day to adjust the percent compaction for the cores that represent that day's paving.
(4) Do not use the supplemental procedure for mixtures containing porous aggregate (dry back method) of AASHTO T 209).
(5) The six-inch diameter core shall be taken on the centerline of the longitudinal joint. For the notched-wedge joint, the lower specification limit is ninety-two percent (92%) of the maximum specific gravity with the cores taken on the wedge portion of the joint with the core centered on the diagonal.
(6) The core density samples may be used to determine core thickness, minimizing the number of total cores taken.

G. Smoothness: Measure the completed paved surface after the final lift is placed and compacted, and prior to placement of any surface seal.

1. Straightedge Measurement: Use a 10-foot metal straight edge to measure at right angles and parallel to the centerline. Defective areas are deviations between the surface and the bottom of the straightedge in excess of one quarter inch (1/4") measured between any two contacts of the straightedge, or deviations in excess of one quarter inch (1/4") measured at the end of the straightedge.

H. Thickness: Measure the full depth thickness, as specified in Table 3-2, after the final lift of pavement has been constructed. In addition, obtain cores randomly in parking areas, approach roads and pullouts as directed by the Contracting Officer.

3.5 ADJUSTING

A. Smoothness: Correct defective areas at no additional cost to the Government. Either grind, mill a minimum of one half (1/2) the pavement depth and fill with an approved asphalt mix, or cut and remove the pavement and repave with an approved asphalt mix. When correction by any other method is proposed, submit a proposal to the Contracting Officer for approval.

1. If grinding is proposed, use a diamond blade machine and specify the manufacturer and model of the equipment to be used. Identify the beginning and ending station of each grind location, the grinding depth and lateral extent of grinding. Specify the type of seal to be placed after grinding is completed. Place all seals in a manner acceptable to the Contracting Officer. The Contracting Officer may take up to seven (7) days to approve, modify, or reject the proposal. Do not begin corrective work until Contracting Officer approval is obtained.
2. After corrections are made, re-measure the pavement surface according to these specifications.

B. Thickness: Correct all areas where the final pavement surface, prior to placement of any corrective layers, is less than the design pavement thickness. The method of correction will meet or exceed the structural and roughness requirements for the contract. Obtain approval, in writing, from the Contracting Officer for the proposed method of correction.

3.6 FINAL ACCEPTANCE

A. General: Test results from random sampling will be used to determine acceptance as provided for in this subsection. Contractor QC test results may be included in this evaluation, if the Contracting Officer has determined that they will be used for acceptance, as provided for in this subsection. The materials acceptance parameters and characteristics as noted in Table 3-2 will be accepted based on the conformance tests, materials certifications and by visual acceptance for workmanship and material quality as provided in the contract.

B. Acceptability of materials and workmanship will be according to the following Specification Limits. If test results fall outside of the Specification Limits described herein, make corrections as necessary to bring the applicable mix or pavement characteristic back into specification. If any individual test result falls outside of the Limits described herein, the material represented by that test result will be subject to rejection and replacement, at no additional cost to the government.

Acceptance will be based upon the average of test results for the Lot for each quality characteristic.

1. Asphalt Content: The upper and lower specification limits are the approved JMF target value plus or minus zero-point four percent (0.4%).
2. VMA: The lower specification limit is the value specified for the nominal maximum size aggregate designated. After the JMF has been verified the Contractor's combined coarse and fine bulk specific gravity of aggregate Gsb values shall be used to calculate VMA on field produced HMA.
3. Mat Density and Notched Wedge Longitudinal Joint Density: The lower specification limit is ninety-two percent (92.0%) of the maximum specific gravity (density) determined according to AASHTO T 166 and T

209. The percent compaction will be determined using the average maximum specific gravity (AASHTO T 209) from all samples tested each day. The longitudinal joint cores shall be taken on the wedge portion of the joint with the core centered on the diagonal.

4. Confined Edge Longitudinal Joint Density: For the confined edge joint, the lower specification limit is ninety-two percent (92.0%) of the maximum specific gravity (density) determined according to AASHTO T 166 and T 209. The percent compaction will be determined using the average maximum specific gravity (AASHTO T 209) from all samples tested each day. The six-inch (6") diameter core shall be taken on the centerline of the longitudinal joint.
5. Air Voids: The upper and lower specification limits are five percent (5%) and three percent (3%) respectively. Air voids are determined by AASHTO T 269, AASHTO T 209, and AASHTO T 166 of the compacted specimen.
6. Asphalt Binder Grading: The Contracting Officer will determine acceptability based upon sampling and conformance to specification limits for each test property. The Contracting Officer may test split liquid asphalt samples taken as part of the Contractor's required QC sampling and use those results as part of the final acceptance process.

END OF SECTION 32 12 16

SECTION 32 16 23 – GRAVEL TRAILS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section consists of constructing one or more courses of aggregate on a prepared surface for a new section of trail as shown on the Contract Plans.

B. Measurement Procedures
   1. Aggregate subbase course and aggregate wearing course will be measured for at the unit price per ton.
   2. The lump sum contract bid price for aggregate subbase course and aggregate wearing course will include:
      i. All testing required by the contract
      ii. All materials, labor, and equipment required to install, grade, and compact the aggregate

C. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials
   1. AASHTO M 157 - Standard Specification for Ready-Mixed Concrete
   2. AASHTO M 43 - Standard Specification for Sizes of Aggregate for Road and Bridge Construction
   3. AASHTO M 80 - Standard Specification for Coarse Aggregate for Hydraulic Cement Concrete
   4. AASHTO T 26 - Standard Method of Test for Quality of Water to Be Used in Concrete
   5. AASHTO T 267 - Standard Method of Test for Determination of Organic Content in Soils by Loss on Ignition
   6. AASHTO T 289 - Standard Method of Test for Determining pH of Soil for Use in Corrosion Testing
   7. AASHTO T 310 - Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)
   8. AASHTO T 88 - Standard Method of Test for Particle Size Analysis of Soils
   9. AASHTO T 99 - Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
   10. AASHTO M 144 - Standard Specification for Calcium Chloride
   11. AASHTO T 104 - Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
   12. AASHTO T 180 - Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
   13. AASHTO T 210 - Standard Method of Test for Aggregate Durability Index
   14. AASHTO T 227 - Standard Method of Test for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
   15. AASHTO T 27 - Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
   16. AASHTO T 89 - Standard Method of Test for Determining the Liquid Limit of Soils

17. AASHTO T 96 - Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

B. ASTM – ASTM International – formerly known as American Society of Testing and Materials
1. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

C. U.S. Environmental Protection Agency
1. Method 9045D: Soil and Waste pH

D. FAR - Federal Acquisition Regulations
1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTALS

A. National Park Service (NPS) approval is required for submittals listed below before placement and installation of any aggregate topsoil material.

1. Submit certified test reports to the Contracting Officer (CO) for approval not less than 30 days before material is required for the work. Test reports shall be provided for all granular materials.

2. Submit certified seed mix to the CO for approval. Seed shall not be purchased or incorporated until final approval has been given.

3. Submit a representative 50-pound sample of each aggregate proposed for use if requested by the CO.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Aggregate Subbase Course Gravel: Conform to Section 32 11 23 Aggregate Subbase Course Gravel Grading B.

B. Trail Wearing Course: Aggregate shall consist of hard, durable particles or fragments of crushed stone or gravel conforming to the following requirements and gradations:

Los Angeles abrasion, ASTM C 131 and C 535	40% max*
Fractured faces (one face)	95% min*
Fractured faces (two or more faces)	75% min*
Soundnessloss, 5cycles, ASTM C 88 (magnesium)	18% max*

Flat/Elongated, (length towidth >5)ASTMD4791	15% max*
pH (EPA 9045C)	6-12.45
* Based on the portion retained on the 3/8-inch sieve.	

Materials shall be free from organic material and lumps or balls of clay.

Materials passing the No.4 sieve shall consist of natural or crushed sand and fine mineral particles. The material including any blended filler shall have a placsticity index of not more than 6 and a liquid limit of not more than 25 when tested in accordance with ASTM D4318,

Aggregate shall contain a minimum of 5% clay particles but no more than 50% of that portion of material passing the No. 200 sieve size shall by clay. Inorganic clay to be used as binder shall conform to the following:

Passing No.200	75%
LiquidLimit	30 min.
Plastic Index	8 min.

The fraction of material passing the No. 200 sieve size shall be determined by washing as indicated in ASTM D1140, "Amount of Material in Soils Finer than the No. 200 Sieve"; size shall be determined by washing as indicated in ASTM D1140. The fractured faces for the course aggregate portion (retained on the No. 4 sieve) shall have an area of each face equal to at least 75% of the smallest midsectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces. Fractured faces shall be obtained by mechanical crushing.

Gradation shall be obtained by crushing, screening, and blending processes as may be necessary. Material shall meet the following screen analysis requirements by weight.

Sieve Designation	Percent Passing
1/2 inch	100%
3/8 inch	96 – 100%
No. 4	75 – 90%
No. 8	55 – 75%
No. 16	35 – 50%
No. 200	12 – 20%

PART 3 – EXECUTION

3.1 INSTALLING TRAIL

A. Where new trail is called for on the Contract Plans, excavate existing material as necessary to install subbase material to the depth shown in the Contract Plans.

B. Place aggregate subbase course gravel material in layers not exceeding 4 inches in compacted thickness. Compact each layer with at least three passes of a lightweight mechanical tamper, roller, or vibratory system.

C. Place trail wearing course on compacted subbase. Compact the layer with at least three passes of a minimum 3 ton vibratory roller. The initial pass of the roller should be in static mode. Ensure that the wearing course material is at optimum moisture content to achieve maximum density.

END OF SECTION 32 16 23

SECTION 32 17 22 – TEMPORARY PAVEMENT MARKINGS AND MARKERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of providing and installing temporary pavement markings and markers.
B. Measurement Procedures
   1. Pavement Markings will be measured per linear foot.
   2. Pavement Message Markings will be measured each.
   3. Pavement Markers will be measured per each.
   4. The lump sum contract bid price for pavement marking, pavement message markings and pavement markers will include:

      - all testing required by the contract

      - all materials, labor and equipment required to install new pavement markings, pavement message markings, and pavement markers.

C. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work.

1.2 REFERENCES

A. ASTM - ASTM International, formerly known as American Society for Testing and Materials

1. ASTM D 1347 - Test Method For Color And Color-Difference Measurement By Tristimulus Colorimetry
2. ASTM D 1475 - Standard Test Method For Density Of Liquid Coatings, Inks, And Related Products
3. ASTM D 1729 - Standard Practice for Visual Appraisal of Colors and Color Differences of Diffusely Illuminated Opaque Materials
4. ASTM D 2243 - Standard Test Method for Freeze-Thaw Resistance of Water-Borne Coatings
5. ASTM D 2805 - Standard Test Method for Hiding Power of Paints by Reflectometry
6. ASTM D 3335 - Standard Test Method for Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
7. ASTM D 3718 - Standard Test Method for Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy
8. ASTM D 3723 - Standard Test Method for Pigment Content of Water-Emulsion Paints by Low-Temperature Ashing
9. ASTM D 4280 - Standard Specification for Extended Life Type, Nonplowable, Raised Retroreflective Pavement Markers
10. ASTM D 4592 - Standard Specification for Preformed Retroreflective Pavement Marking Tape for Limited Service Life
11. ASTM D 522 - Standard Test Methods for Mandrel Bend Test of Attached Organic Coating

12. ASTM D 562 - Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer
13. ASTM D 711 - Standard Test Method for No-Pick-Up Time of Traffic Paint
14. ASTM D 713 - Standard Practice for Conducting Road Service Tests on Fluid Traffic Marking Materials
15. ASTM D 868 - Standard Practice for Determination of Degree of Bleeding of Traffic Paint
16. ASTM E 1347 - Standard Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry

B. FAR - Federal Acquisition Regulations

1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL – Submit material certificate to the CO, signed by the material producer and Contractor, certifying that materials comply with these specifications and the construction plans.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Waterborne Traffic Paint.

Furnish an acrylic water-based, ready-mixed paint conforming to the following:

1. Composition. Furnish a paint composed of resin solids of 100 percent acrylic polymer with the exact formulation determined by the manufacturer. Conform to the following:

a) Pigment, ASTM D3723	45 to 55 percent by mass
b) Lead, chromium, cadmium, or cobalt ASTM D3335 & ASTM D3718	0 percent by mass
c) Volatile organic compounds, EPA Method 24	20.0 oz/gallon max.
d) Density Paint, ASTM D1475	12.0 lb/gallon min.

2. Viscosity. ASTM D562 75-90 Krebs units

3. Drying time.

a) Dry to no pickup, ASTM D711	10 minutes max.
b) Drying to no track, ASTM D713	90 seconds max.

4. Flexibility. ASTM D522, using the ¼-in cylindrical mandrel	No cracking or flaking

5. Dry opacity. ASTM D2805, contrast ratio at 0.96 min.
319 ft2/gallon spreading rate

6. Color.
    a) White, ASTM D1729 — Match FHWA standard highway white
    b) Yellow, ASTM D1729 — Match FHWA standard highway yellow
7. Daylight reflectance.
    a) White, ASTM E1347 — 84 percent relative to magnesium oxide standard
    b) Yellow, ASTM E1347 — 55 percent relative to magnesium oxide standard
8. Bleeding ratio. ASTM D868. reflectance according to ASTM D1347 immediately after drying. Divide the average of three reflectance readings of the paint over the bleeding surface by the average of three readings over the non-bleeding surface to determine the bleeding ratio — Determine 0.96 min.
9. Freeze-thaw stability. ASTM D2243 — ±5 Krebs units max.
10. Storage stability. During a 12-month storage period, conform to the following:
    a) No excessive setting, caking, or increase in viscosity; and
    b) Readily stirred to a consistency for use in the striping equipment.

B. Preformed retroreflective tape

Furnish appropriately sized tape conforming to ASTM D4592, Type I (removable).

C. Pavement markers

Furnish temporary pavement markers conforming to ASTM D4280 or flexible pavement markers not exceeding approximately 2 inches high, with retroreflective tape on both faces of the vertical section, capable of retroreflecting light from opposite directions, and with an adhesive on the base.

PART 3 – EXECUTION

3.1 GENERAL

Before opening a pavement surface to traffic, remove conflicting pavement markings by sandblasting or other methods that do not damage the surface or texture of the pavement. Make the removal pattern uneven to not perpetuate the outline of the removed pavement markings. Lightly coat sandblasted or removal areas on asphalt surfaces with emulsified asphalt.

Place and maintain temporary pavement markings that are neat, crack free, true, straight, and unbroken.

If temporary signs and pavement markers are substituted for temporary pavement markings, install temporary signs and pavement markers according to the MUTCD and plans.

For temporary pavement markings, use preformed retroreflective tape, traffic paint, or pavement markers as follows:

1. Preformed retroreflective tape. Apply according to the manufacturer's instructions. Remove loose preformed retroreflective tape before placing additional pavement layers.

2. Pavement markers. When chip seals, slurry seals, or tack coats are used after marker placement, protect the markers with an approved protective cover, and remove it after the asphalt material is sprayed.

3. Traffic paint. Do not apply traffic paint to the final surface. Apply traffic paint as the temporary pavement marking if no work will be performed on the project for at least 30 consecutive days. Apply traffic paint at a 15 mil minimum wet film thickness or at a rate of 107 square feet per gallon. Immediately apply Type 1 glass beads on the paint at a minimum rate of 6 pounds per gallon of paint.

Remove temporary pavement markers or markings before placing additional pavement layers or permanent pavement markings. Remove temporary markings after 14 days and apply permanent pavement markings unless approved by the Contracting Officer (CO).

3.2 APPLICATION

A. Temporary Pavement Markings

Temporary markings shall be placed within work zones to provide road users with a clearly defined path of travel through the work zone when the permanent markings are either removed or obliterated during the work activities. Temporary markings are required during construction activities on the road while it is open to traffic, such as overlays or surface treatments or where lanes are temporarily shifted on pavement that is to remain in place.

Warning signs, channelizing devices and delineation shall be used to indicate required road user paths in work zones where it is not possible to provide a clear path by pavement markings.

All temporary broken-line pavement markings shall use the same cycle length as permanent markings and shall have line segments that are at least 2 feet long. All pavement markings and devices used to delineate road user paths shall be reviewed during daytime and nighttime periods.

Half-cycle lengths with a minimum of 2-foot stripes may be used on roadways with severe curvature for broken line center lines in passing zones and for lane lines.

Pavement dotting used for laying out temporary or permanent pavement marking alignment shall not be used as a substitute for temporary pavement markings or temporary pavement markers.

B. Temporary Pavement Markers

Retroreflective or internally illuminated raised pavement markers, or non-retroreflective raised pavement markers supplemented by retroreflective or internally illuminated markers, may be substituted for markings.

If used, the color and pattern of the raised pavement markers shall simulate the color and pattern of the markings for which they substitute.

Temporary pavement markers shall be installed with construction pavement markings (except non-retroreflective removable markings) in transition (lane drop) or lane shift areas of work zones which will encroach upon the traveled way for a period of more than three days and in other areas as required by the CO. Temporary pavement markers shall be installed on twenty-foot centers in lane shift and transition areas. When temporary pavement markers are used in other areas, they shall be installed on forty-foot centers unless otherwise required by CO.

If temporary raised pavement markers are used to substitute for broken line segments, a group of at least three retroreflective markers shall be equally spaced at no greater than N/8. The value of N for a broken or dotted line shall equal the length of one line segment plus one gap.

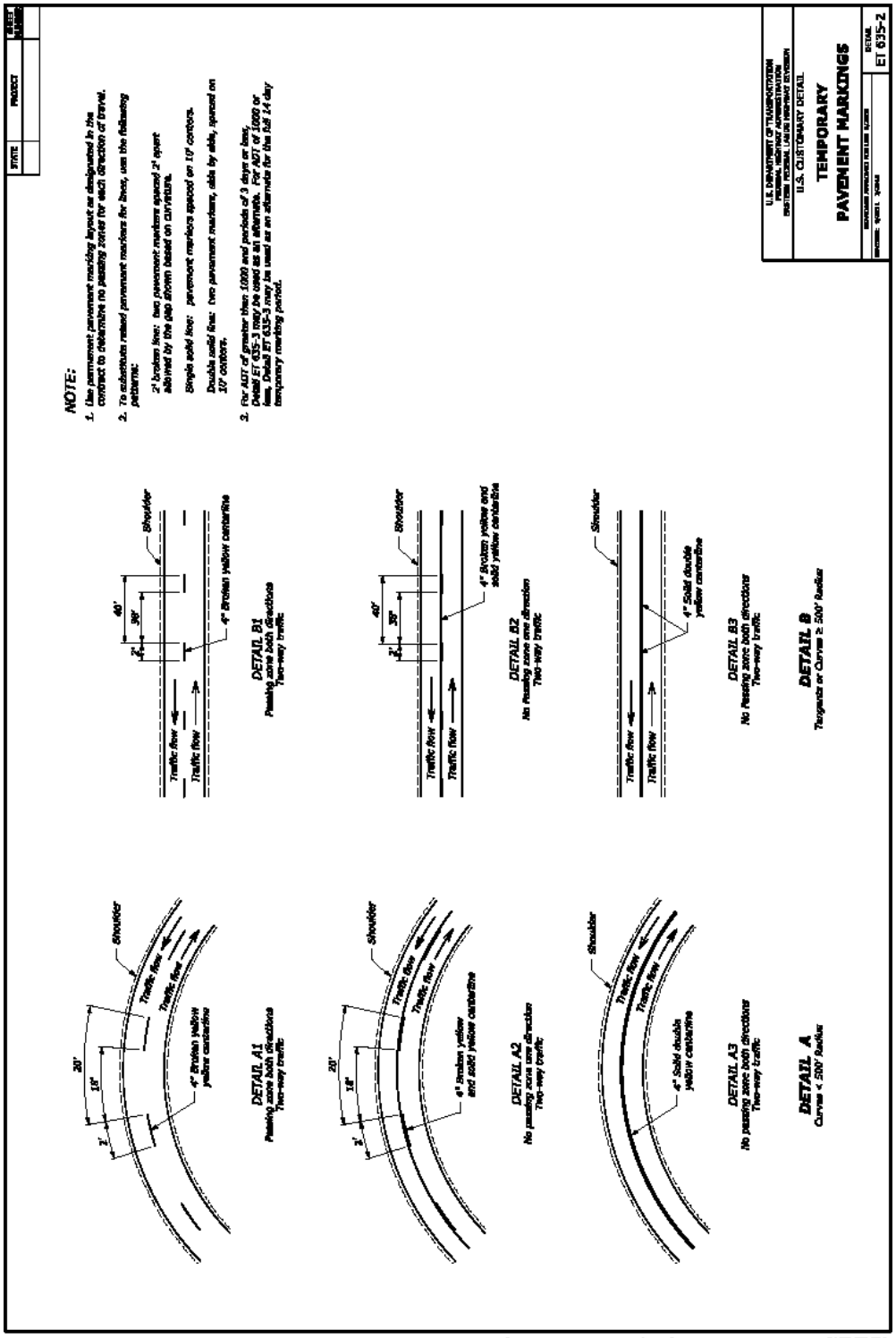
If temporary raised pavement markers are used to substitute for solid lines, the markers shall be equally spaced at no greater than N/4, with retroreflective or internally illuminated units at a spacing no greater than N/2. The value of N referenced for solid lines shall equal the N for the broken or dotted lines that might be adjacent to or might extend the solid lines.

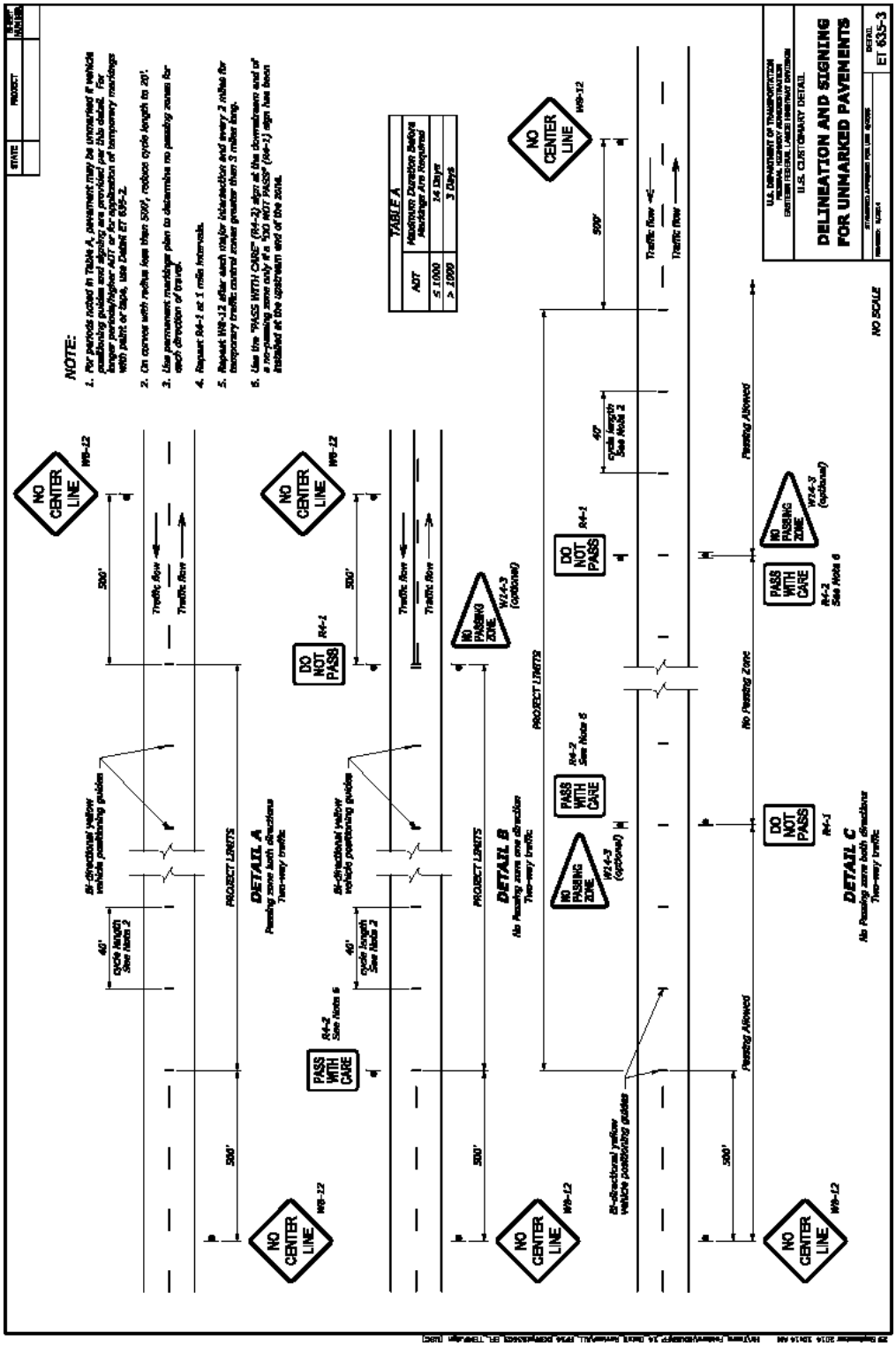
Temporary raised pavement markers may be used to substitute for broken line segments by using at least two retroreflective markers placed at each end of a segment of 2 to 5 feet in length, using the same cycle length as permanent markings. Temporary raised pavement markers used on 2- to 5-foot segments to substitute for broken line segments
should not be in place for more than 14 days unless justified by engineering judgment.
08 Raised pavement markers should be considered for use along surfaced detours or temporary roadways, and other changed or new travel-lane alignments.

3.3 FINAL ACCEPTANCE

1. Material for traffic control devices will be evaluated under this specification.

2. Installation of traffic control devices will be evaluated under this specification.


STATE
PROJECT
SHEET NO.
NOTE:
1. Use permanent pavement marking layout as designated in the contract to determine no passing zones for each direction of travel.
2. To substitute raised pavement markers for lines, use the following patterns:
2' broken line: two pavement markers spaced 2' apart aligned by the gap shown based on curvature.
Single solid line: pavement markers spaced on 10' centers.
Double solid line: two pavement markers, side by side, spaced on 10' centers.
3. For ADT of greater than 1000 and periods of 3 days or less, Detail ET 635-3 may be used as an alternate. For ADT of 1000 or less, Detail ET 635-3 may be used as an alternate for the full 14 day temporary marking period.
Shoulder
Traffic flow
Traffic flow
4" Broken yellow centerline
40'
38'
2'
DETAIL B1
Passing zone both directions
Two-way traffic
Shoulder
Traffic flow
Traffic flow
4" Broken yellow and solid yellow centerline
40'
38'
2'
DETAIL B2
No passing zone one direction
Two-way traffic
Shoulder
Traffic flow
Traffic flow
4" Solid double yellow centerline
DETAIL B3
No passing zone both directions
Two-way traffic
DETAIL B
Tangents or Curves ≥ 500' Radius
Shoulder
Traffic flow
Traffic flow
4" Broken yellow yellow centerline
20'
18'
2'
DETAIL A1
Passing zone both directions
Two-way traffic
Shoulder
Traffic flow
Traffic flow
4" Broken yellow and solid yellow centerline
20'
18'
2'
DETAIL A2
No passing zone one direction
Two-way traffic
Shoulder
Traffic flow
Traffic flow
4" Solid double yellow centerline
DETAIL A3
No passing zone both directions
Two-way traffic
DETAIL A
Curves < 500' Radius
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION
U.S. CUSTOMARY DETAIL
TEMPORARY
PAVEMENT MARKINGS
DETAIL
ET 635-2



END OF SECTION 32 17 22.

SECTION 32 17 23 – PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

A. All This work consists of applying permanent pavement markings and raised pavement markers on the completed pavement.

Pavement markings are designated as follows:
Type A – Solventborne traffic paint with Type 1 glass beads;
Type B – Waterborne traffic paint with Type 1 glass beads;
Type C – High-build waterborne traffic paint with Type 1 and Type 3 glass beads;
Type D – Epoxy markings with Type 1 glass beads;
Type E – Epoxy markings with Type 1 and Type 3 glass beads;
Type H – Thermoplastic markings with Type 1 glass beads;
Type I – Thermoplastic markings with Type 1 and Type 3 glass beads;
Type J – Preformed pavement marking tape; or
Type K – Nonreflectorized markings.

B. Measurement Procedures
1. Pavement Markings will be measured per linear foot.
2. Pavement Message Markings will be measured each.
3. Pavement Markers will be measured per each.
4. The lump sum contract bid price for pavement marking, pavement message markings and pavement markers will include:

- all testing required by the contract

- all materials, labor and equipment required to install new pavement markings, pavement message markings, and pavement markers.

C. Payment Procedures
1. The accepted work will be paid at the contract lump sum price for all work.

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials

1. AASHTO M 247 - Standard Specification for Glass Beads Used in Pavement Markings
2. AASHTO M 249 - Standard Specification for White and Yellow Reflective Thermoplastic Striping Material (Solid Form)
3. AASHTO M 31 - Standard Specification for Deformed and Plain Carbon and Low-Alloy Steel Bars for Concrete Reinforcement
4. AASHTO M 42 - Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
5. AASHTO M 53 - Standard Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement

6. AASHTO T 11 - Standard Method of Test for Materials Finer Than 75-μm (No. 200) Sieve in Mineral Aggregates by Washing
7. AASHTO T 27 - Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
8. AASHTO T 89 - Standard Method of Test for Determining the Liquid Limit of Soils

B. ASTM - ASTM International, formerly known as American Society for Testing and Materials

1. ASTM D 1214 - Standard Test Method for Sieve Analysis of Glass Spheres
2. ASTM D 126 - Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
3. ASTM D 1652 - Standard Test Method for Epoxy Content of Epoxy Resins
4. ASTM D 1729 - Standard Practice for Visual Appraisal of Colors and Color Differences of Diffusely-Illuminated Opaque Materials
5. ASTM D 2074 - Standard Test Methods for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
6. ASTM D 2240 - Standard Test Method for Rubber Property—Durometer Hardness
7. ASTM D 4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
8. ASTM D 4280 - Standard Specification for Extended Life Type, Nonplowable, Raised Retroreflective Pavement Markers
9. ASTM D 4383 - Standard Specification for Plowable, Raised Retroreflective Pavement Markers
10. ASTM D 476 - Standard Classification For Dry Pigmentary Titanium Dioxide Products
11. ASTM D 711 - Standard Test Method for Determination of Trace Elements in Middle Distillate Fuels by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP- AES)
12. ASTM E 1347 - Standard Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry

C. FAR - Federal Acquisition Regulations

1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL – Submit material certificate to the National Park Service (NPS) Contracting Officer, signed by the material producer and Contractor, certifying that materials comply with these specifications and the construction plans.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Epoxy Markings. Furnish a 2-component, 100 percent solids type system for hot-spray application conforming to the following:
   1. Pigments. Component A. Percent by mass.

a) White.
   i. Titanium dioxide (TiO_2), ASTM D 476, type II and type III — 18% min.
   ii. Epoxy resin — 75 to 82%

b) Yellow:
   i. Chrome yellow ($PbCrO_4$), ASTM D 126, type III. — 23% min.
   ii. Epoxy resin — 70 to 77%

c) Non-Lead Yellow:
   i. Titanium dioxide (TiO_2) ASTM D 476, type II and type III. — 14% min.
   ii. Organic yellow — 7 to 8%
   iii. Epoxy resin — 75 to 79%

2. Epoxy content. Component A. Mass per epoxy equivalent, ASTM D 1652 — Manufacturer's target value ±50

3. Amine value. Component B, ASTM D 2074 — Manufacturer's target value ±50

4. Toxicity. Toxic or injurious fumes at application temperature — none

5. Color. 15 mil film thickness specimen(cured).
   a) White, ASTM D 1729 highway white — Match FHWA standard
   b) Yellow, ASTM D 1729 highway yellow — Match FHWA standard

6. Directional reflectance. (Without glass beads)
   a) White, ASTM E 1347 magnesium oxide standard — 84% relative to
   b) Yellow, ASTM E 1347 magnesium oxide standard — 55% relative to

7. Drying time. 15 mil film thickness with beads.
   a) Laboratory at 72 ºF, ASTM D 711 to no-pick-up condition — 30 minutes maximum
   b) Field at 77 ºF, viewed from 50 feet to no-tracking condition — 10 minutes maximum

8. Abrasion resistance. Wear index with a CS-17 wheel under a 35.3 ounce load for 1000 cycles, ASTM D 4060 — 82 max.

9. Hardness. Shore D hardness with 72 to 96-hour cure at 72 ºF, ASTM D 2240 — 75 to 100

10. Storage. When stored for up to 12 months, individual epoxy components shall not require mixing before use.

B. Thermoplastic Markings. Conform to AASHTO M 249.

C. Glass Beads. Conform to AASHTO M 247 for the type specified. Table 1, Gradation of Glass Beads in AASHTO M 247 is supplemented by Table 32 17 23-1. Treat glass beads with an adherence coating as recommended by manufacturer.

Table 32 17 23-1
Gradation of Glass Beads

Sieve Size	Percent by Mass Passing Designated Sieve (ASTM D 1214)		
	Grading Designation		
	Type 3	Type 4	Type 5
No. 8			100
No. 10		100	95 - 100
No. 12	100	95 - 100	80 - 95
No. 14	95 - 100	80 - 95	10 - 40
No. 16	80 - 95	10 - 40	0 - 5
No. 18	10 - 40	0 - 5	0 - 2
No. 20	0 - 5	0 - 2	
No. 25	0 - 2		

For type 3, 4, and 5 glass beads, also conform to the following:

(a) Treat beads with a reactive adherence coating as recommended by the manufacturer.

(b) Roundness, FLH T 520 70% min. per sieve size

(c) Refractive index, AASHTO M 247 1.50 - 1.55

D. Raised Pavement Markers.
1. Plowable, retroreflective, pavement markers. Conform to ASTM D 4383.

PART 3 – EXECUTION

3.1 PREPARATION

A. Before opening a pavement surface to traffic, remove all conflicting pavement markings by sandblasting or other methods that do not damage the surface or texture of the pavement. Make the removal pattern uneven so it does not perpetuate the outline of the removed

pavement markings. Lightly coat sandblasted or removal areas on asphalt surfaces with emulsified asphalt.

Where existing and final pavement marking locations are identical, stake the limits of all existing pavement markings (no-passing zones, edge stripes, etc.) before any pavement work. If the existing pavement markings appear to conflict with those shown in the plans, contact the Contracting Officer (CO) for clarification. Upon completion of the final surface course, establish line limits for the new pavement for approval before marking. Establish markings according to the MUTCD. In curve widening areas, apply the pavement edge markings at the edge of the traveled way and the centerline markings midway between the pavement lines.

Remove loose particles, dirt, tar, grease, and other deleterious material from the surface to be marked. Where markings are placed on rigid pavement less than 1 year old, clean the pavement of all residue and curing compounds. Remove temporary pavement markings the same day permanent pavement markings are applied. Apply markings to a clean, dry surface according to the MUTCD.

At least 7 days before applying pavement markings, furnish a written copy of the marking manufacturer's recommendations for use. A field demonstration may be required to verify the adequacy of recommendations.

Legends and symbols shall be installed per the dimensions shown on the exhibits or the latest edition of the Manual of Uniform Traffic Control Devices (MUTCD).
Ship marking material in appropriate containers plainly marked with the following information, as appropriate, for the material being furnished:

1. Manufacturer's name and address;
2. Name of product;
3. Lot/batch numbers;
4. Color;
5. Net mass and volume of contents;
6. Date of manufacture;
7. Date of expiration;
8. Statement of contents (if mixing of components is required);
9. Mixing proportions and instructions; and
10. Safety information.

3.2 APPLICATION

Apply pavement markings in the direction of traffic according to the manufacturer's recommendations. Apply all markings to provide a clean-cut, uniform, and workmanlike appearance by day and night.

Make broken lines 10 feet long with 30-foot gaps. Make dotted lines 2 feet long with 4-foot gaps. Separate double lines with a 4-inch space.

Protect marked areas from traffic until the markings are dried to no-tracking condition. Remove all tracking marks, spilled marking material, markings in unauthorized areas, and defective markings.

A. Solventborne Traffic Paint (Type A). Apply paint when pavement and air temperatures are at 35 °F and rising. Do not heat the paint above 120 °F. Spray paint at a 15 minimum wet film thickness or at a rate of 107 square feet per gallon.
Apply Type 1 glass beads on the paint at a rate of 6 to 8 pounds per gallon of paint.
On new asphalt pavements or new asphalt surface treatments, apply two applications of paint and glass beads. Apply second application after first application is track free.

B. Waterborne Traffic Paint (Type B and Type C). Apply paint when pavement and air temperatures are 50 °F and rising.
(a) Type B. Do not heat the paint above 120 °F. Spray paint at a 15 mil minimum wet film thickness or at a rate of 107 square feet per gallon.
Apply Type 1 glass beads on the paint at a rate of 6 to 8 pounds per gallon of paint.
On new asphalt pavements or new asphalt surface treatments, apply two coats.

(b) Type C. Spray paint at 25 mil minimum wet film thickness or at a rate of 71 square feet per gallon.
Use two bead dispensers. Apply Type 3 glass beads on the paint at a rate of 6 to 8 pounds per gallon followed by Type 1 glass beads on the paint at a rate of 6 to 8 pounds per gallon of paint.

C. Epoxy Markings (Types D and E). Heat components A and B separately at 110±30 ºF and mix. Discard all material heated over 140 ºF. Apply epoxy when the pavement and air temperatures are above 50 ºF. Apply as a spray at 110±30 ºF (gun tip temperature) at a 15 mil minimum dry film thickness or 107 square feet per gallon.
1. Type D. Immediately apply type 1 glass beads on the epoxy at a minimum rate of 15 pounds per gallon of epoxy.

2. Type E. Use two bead dispensers. Immediately apply type 4 glass beads on the epoxy at a minimum rate of 12 pounds per gallon of epoxy immediately followed by an application of type 1 glass beads at a minimum rate of 12 pounds per gallon.

D. Thermoplastic Markings (Type H and I). On areas to be marked on rigid pavements and old asphalt pavements, apply an epoxy resin primer/sealer according to the thermoplastic manufacturer's recommendations. Allow the primer/sealer to dry.

Apply thermoplastic when the pavement and air temperatures are above 50 ºF. Spray or extrude the thermoplastic at 430±5 ºF. For centerlines and lane lines, spray or extrude 90 mil minimum dry film thickness or at a rate of 17.8 square feet per gallon. For edge lines, spray or extrude 60 mil minimum dry film thickness or at a rate of 26.7 square feet per gallon.
1. Type H. Immediately apply type 1 glass beads on the thermoplastic at a minimum rate of 12 pound per 100 square feet.

2. Type I. Use two bead dispensers. Immediately apply type 5 glass beads on the thermoplastic at a minimum rate of 12 pounds per 100 square feet immediately followed by an application of type 1 glass beads at a minimum rate of 12 pounds per 100 square feet.
   The minimum bond strength of the thermoplastic shall be 175 pounds per square inch on rigid pavements.

E. Preformed Pavement Marking Tape (Type J). Install to form a durable, weather resistant bond to the pavement. Apply preformed markings according to the manufacturer's recommendations. Use preformed marking tape containing retroreflective beads.

F. Nonreflectorized Markings (Type K). Apply solvent borne or waterborne traffic paint without glass beads

G. Raised Pavement Markers. Install raised pavement markers when the pavement and air temperatures are above 50 ºF. Apply raised pavement markers with epoxy resin or asphalt adhesive.

   Heat epoxy components A and B separately with indirect heat, mix, and apply at 70±10 ºF. Discard all material heated over 120 ºF or stiffened by polymerization.

   Heat and apply asphalt adhesives at 412±12 ºF. Discard all material heated over 450 ºF.
   Space and align the markers to within 1/2 inch of the required location. Do not place raised pavement markers over pavement joints.

   The minimum bond strength will be 1.75 pounds per square inch or a total tensile strength of 25 pounds.

3.3 FINAL ACCEPTANCE

All pavement markings, message markings, and pavement markers are to be evaluated under this specification

END OF SECTION 32 17 23.

SECTION 32 17 23.43 – SNOWPLOWABLE RAISED PAVEMENT MARKERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of the furnishing, installation, and replacement of snowplowable, retroreflective, raised pavement markers of the type indicated.

B. Measurement Procedures

1. Snowplowable Raised Pavement Markers will be measured per each.
2. The lump sum contract bid price for snowplowable raised pavement markers will include:

- all testing required by the contract
- all materials, labor and equipment required to install new snowplowable raised pavement markers.

C. Payment Procedures

1. The accepted work will be paid at the contract lump sum price for all work.

a.

1.2 REFERENCES

A. ASTM - ASTM International, formerly known as American Society for Testing and Materials

25. ASTM D 4383 - Standard Specification for Plowable, Raised Retroreflective Pavement Markers

B. FAR - Federal Acquisition Regulations

1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL –

A. Submit material certificate to the National Park Service (NPS) Contracting Officer, signed by the material producer and Contractor, certifying that materials comply with these specifications and the construction plans.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Provide materials listed in PennDOT Bulletin 15. A Certificate of Compliance shall be submitted prior to utilization on the project.

B. Snowplowable Raised Pavement Markers conforming to ASTM D 4383.

C. Adhesive. Adhesive conforming to ASTM D 4383, A1 and X1. A type and formulation, recommended by the pavement marker manufacturer and approved by the CO, for bonding the reflectors or holders to the pavement or the reflectors to the holders.

PART 3 – EXECUTION

3.1 GENERAL

As shown on the Drawings, recommended by the manufacturer, and as follows:

A. Layout. Before installing, lay out the pavement marker locations. Do not place devices on pavement surfaces that show visible evidence of pavement cracking, checking, spalling, or failure of underlying base material. Do not place devices within 100 mm (4 inches) of a pavement joint. During the pre-installation layout, if it is determined that a device would be placed at a point where any of the above conditions exists, relocate it longitudinally to the directed location.

B. Sawing. Cut the depression in the pavement.

C. Installation. Install within 7 days of making the saw cuts. Before applying the adhesive, vacuum or blow the depression to remove loose material, then clean and dry the depression with compressed air. Apply the adhesive and place the unit into the depression. Be certain that markers are properly seated with the leading edges below the roadway surface or reflectors are placed as shown on the Standard Drawings. Secure in place until adhesive is set. At the time of installation, be sure that devices are free of dirt, dust, oil, grease, rust, moisture, or any foreign matter that impairs adhesion to the pavement. Do not apply devices if the pavement surface temperature and the air temperature at the time of application are less than 10 ºC (50F) or as recommended by the manufacturer. Do not install markers if the pavement surface is moist or wet.

D. Replacement. Use the following procedures for the replacement of the holders or reflectors:

- Remove and dispose of any damaged device.
- Cut a new depression when required.
- Ensure the attachment area is smooth and clean.
- Apply adhesive and install the new holder or reflector as indicated above.
- Fill void in pavement left by missing or removed devices with an approved epoxy.

3.2 GUARANTEE

Within 30 calendar days of notification, replace defective holders and/or reflectors if any of the following unsatisfactory conditions exist:

- The holder does not remain in place or does not resist deformation for 180 days after acceptance; has not remained in the exact location and alignment as originally placed; is deformed, cracked or otherwise not able to provide useful service; or shows visible signs of bond failure between the holder and the adhesive.

- Relectors are missing or do not provide full service for a period of 180 days after acceptance.

- Reflectors fail between the date of notification and the replacement date.

3.3 ACCEPTANCE

All snowplowable raised pavement markers and adhesives to be evaluated under this specification

END OF SECTION 32 17 23

SECTION 32 32 15 – PRECAST MODULAR BLOCK GRAVITY RETAINING WALL

PART 1 – GENERAL

1.1 DESCRIPTION

A. The Work of this Section includes design, fabrication, and installation, necessary to construct a precast concrete modular block gravity retaining wall to the limits shown on the Drawings.
   1. Design shall include wall layout, analysis (local and global stability), and fabrication detailing, as well as a supplemental subsurface investigation to support the design
   2. Installation shall include labor, equipment, survey control, supervision, tools, appliances, selection and implementation of means and methods

B. The Work shall be coordinated with the following:
   1. Section 06 90 01 Boardwalk and Trail Rail

C. The CONTRATOR is responsible to provide qualified personnel for onsite installation, inspection, and record keeping as specified herein. To hire a Geotechnical Engineer licensed in the Commonwealth of Pennsylvania to evaluate the subsurface information to provide recommendations to the Retaining Wall Design Engineer (RWDE) for the design of the Precast Modular Block Gravity Wall.

D. Measurement Procedures
   1. Concrete modular block gravity retaining wall shall be paid for at the contract lump sum price as listed in the bid proposal for "Concrete Modular Block Gravity Retaining Wall". This price shall include but is not limited to, a supplemental subsurface investigation, design, plant fabrication, labor, materials, tools, equipment, survey control, supervision, appliances, incidentals, and selection of the means and methods for the installation.

E. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work described in this section.

1.2 REFERENCES

A. Where the specification and reference documents conflict, the Owner's designated representative will make the final determination of the applicable document.

B. AASHTO LRFD Bridge Design Specifications, 9th Edition.

C. National Concrete Masonry Association, Design Manual for Segmental Retaining Walls, 3rd Edition, 2010

D. American Concrete Institute
   1. Building Code and Commentary, ACI 318-19 and ACI 318R-19
   2. Guide to Durable Concrete ACI 201

E. ASCE: American Society of Civil Engineers, ASCE 7-22, Minimum Design Loads and Associated Criteria for Buildings and Other Structures

F. ASTM: Specifications of the American Society for Testing and Materials, latest edition.
   1. Precast Modular Block Units
      a) ASTM C33 – Standard Specification for Concrete Aggregates
      b) ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
      c) ASTM C94 – Standard Specification for Ready-Mixed Concrete.
      d) ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
      e) ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete.
      f) ASTM C150 – Standard Specification for Portland Cement
      g) ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
      h) ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
      i) ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
      j) ASTM C595 - Standard Specification for Blended Hydraulic Cements.
      k) ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
      l) ASTM C666 – Standard Test Method for Concrete Resistance to Rapid Freezing and Thawing.
      m) ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
      n) ASTM C920 – Standard Specification for Elastomeric Joint Sealants.
      o) ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars.
      p) ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete.
      q) ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
      r) ASTM C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.

s) ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
t) ASTM C1611 – Standard Test Method for Slump Flow of Self-Consolidating Concrete.
u) ASTM C1776 – Standard Specification for Wet-Cast Precast Modular Retaining Wall Units.
v) ASTM D6638 – Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks).
w) ASTM D6916 – Standard Test Method for Determining Shear Strength Between Segmental Concrete Units (Modular Concrete Blocks).

2. Soils
a) AASHTO M 145 – AASHTO Soil Classification System.
b) AASHTO T 104 – Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.
c) AASHTO T 267 – Standard Method of Test for Determination of Organic Content in Soils by Loss of Ignition.
d) ASTM C33 – Standard Specification for Concrete Aggregates.
e) ASTM D448 – Standard Classification for Sizes of Aggregates for Road and Bridge Construction.
f) ASTM D698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort. (12,400 ft-lbf/ft)
g) ASTM D1241 – Standard Specification for Materials for Soil-Aggregate Subbase, Base and Surface Courses.
h) ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
i) ASTM D1557 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort. (56,000 ft-lbf/ft).
j) ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
k) ASTM D2488 – Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
l) ASTM D3080 – Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions.
m) ASTM D4254 – Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
n) ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

o) ASTM D4767- Test Method for Consolidated-Undrained Triaxial Compression Test for Cohesive Soils.
p) ASTM D4972 – Standard Test Method for pH of Soils.
q) ASTM D6913 – Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
r) ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Aggregate by Nuclear Methods (Shallow Depth).
s) ASTM G51 – Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing.
t) ASTM G57 – Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method.

3. Geotextile
   a) ASTM D4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat
   b) ASTM D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity
   c) ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles
   d) ASTM D4632 –Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
   e) ASTM D4751 – Standard Test Methods for Determining Apparent Opening Size of a Geotextile
   f) ASTM D6241 – Standard Test Method for Static Puncture Strength of Geotextiles Using a 2” Probe

G. IBC: International Building Code 2024

1.3 DESIGN REQUIREMENTS

A. Piles shall be designed and installed in accordance with:

1. International Building Code, IBC 2024.
2. ASCE 7-22, Minimum Design Loads and Associated Criteria for Buildings and Other Structures
3. The requirements as specified herein.
4. The Drawings.

B. Loads on the Drawings are service level design loads.

1.4 SUBMITTAL

A. Submit material certificate to the Engineer, signed by the material producer and Contractor, certifying that materials comply with these specifications and the construction plans.

B. Product Data. At least 30 days prior to construction, the General Contractor shall submit the retaining wall product submittal package to the Contracting Office and Park (Delaware Water National Gap Recreation Area) for review and approval. The submittal package shall include technical specifications and product data from the manufacturer for the following:

1. Brochure for a Precast Modular Block System with a natural stone appearance. The brochure shall contain options for selection of:
   a) Color
   b) Pattern
   c) Texture
2. Precast Modular Block concrete test results specified in Part 2.1 Paragraph A.3 of this section as follows:
   a) 28-day compressive strength
   b) Air content
   c) Slump or Slump Flow (as applicable)

3. Drainage Pipe
4. Geotextile

C. Installer Qualification Data. At least 30 days prior to construction, the General Contractor shall submit the qualifications of the business entity responsible for installation of the retaining wall, the Retaining Wall Installation Contractor (RWIC), per Part 1.7, Paragraph A of this section.

D. Retaining Wall Design Calculations and Construction Shop Drawings. Prior to construction, the General Contractor shall furnish construction shop drawings and the supporting structural calculations report signed and sealed by a Professional Engineer licensed in the Commonwealth of Pennsylvania for review and approval. Unless specifically requested by the Owner, the submittal may be in electronic format. This submittal shall include the following:
   1. Signed, sealed and dated drawings and engineering calculations prepared in accordance with these specifications.
   2. Qualifications Statement of Experience of RWDE as specified in Part 1.7, Paragraph B of this section.

1.5 PROJECT CONDITIONS:

A. The project involves construction of a McDade (pedestrian) Trail adjacent to US Route 209. Portions of the Trail will be a pile supported boardwalk, portions will be supported by modular block wall (as specified in this section) , and portions will be at grade.

B. Existing Site and Subsurface Information:
   1. Subsurface investigation data are available from the OWNER in a report titled "Geotechnical Engineering Report, DEWA 310424 Route 209 Potential Slope Failure Delaware and Dingman Township, Pennsylvania" prepared by Terracon Consultants, Inc., dated 29 June 2023.

C. Review of Existing Information:
   1. Prior to submitting a bid, the CONTRACTOR shall review and understand the information referenced herein and other applicable resources. The referenced report is made available to the CONTRACTOR for information only. The subsurface information presented in the document is for information only and shall not be interpreted as a warranty of subsurface conditions whether interpreted from written text, boring logs, test results, or other data.
   2. The CONTRACTOR shall draw their own conclusions regarding site conditions based upon site visit(s) and from available sources, for which the OWNER and its consultants assume no responsibility. The CONTRACTOR shall assume that subsurface conditions between subsurface explorations could differ from conditions shown in the test boring logs.

D. Subsurface Conditions

1. The CONTRACTOR is advised that the subsurface conditions may vary across the site.
2. The CONTRACTOR shall conduct supplemental subsurface investigation as necessary to finalize the type, size and length of the foundation piles
   a) The contractor shall engage a Geotechnical Engineer licensed in the Commonwealth of Pennsylvania to perform a supplemental subsurface investigation
   b) The limits of the supplemental subsurface investigation, if required, shall encompass all wall supported trail segments as shown on the Drawings. Borings shall be taken with the footprint of the respective wall segments.
   c) The contractor shall submit the proposed subsurface investigation plan, if required, to the National Park Service for review and approval.
   d) The subsurface investigation shall be sufficient for developing foundation design recommendations for the precast concrete block wall suppliers wall design.

1.6 CONSTRUCTION SHOP DRAWING PREPARATION

A. The RWDE shall coordinate the retaining wall construction shop drawing preparation with the Geotechnical Engineer's recommendation within the limit shown on the Drawings. The General Contractor shall furnish the RWDE the following project information required to prepare the construction shop drawings. This information shall include, but is not limited to, the following:

1. Current versions of the site, grading, drainage, utility, and erosion control
2. Electronic CAD file of the civil site plans listed in (1);
3. Report(s) of geotechnical investigation and all addenda and supplemental reports;
4. Recommendations of the Geotechnical Engineer regarding effective stress shear strength and total stress shear strength (when applicable) parameters for in-situ soils in the vicinity of the proposed retaining wall(s) and for any fill soil that may potentially be used as backfill in retained and/or foundation zones of the retaining wall.
5. Information pertaining to the magnitude, location, and nature of surcharge loadings acting on or near the proposed wall.

B. The RWDE shall note any exceptions to the requirements of this section by listing them at the bottom right corner of the first page of the construction shop drawings.

C. Approval or rejection of the exceptions taken by the RWDE will be made in writing as directed by the Owner.

D. The RWDE shall determine the appropriate standard(s) to be utilized, and to which the precast modular block design shall be based upon, except as noted herein. Refer to Part 1.2

E. In the event that a conflict is discovered between these specifications and a reasonable interpretation of the design specifications and methods referenced in Part 1.6, Paragraph D, these specifications shall prevail. If a reasonable interpretation is not possible, the conflict shall be resolved per the requirements in Part 1.2, Paragraph A of this section.

F. Soil Shear Parameters. The RWDE shall prepare the construction shop drawings based upon soil shear strength parameters from the available project data and the recommendations of the project Geotechnical Engineer. The RWDE shall coordinate with the Geotechnical Engineer regarding the specific data is required to develop the retaining wall design

G. Allowable bearing pressure requirements for each retaining wall shall be clearly shown on the construction drawings.

H. Global Stability. Overall (global) stability shall be evaluated in accordance with the principals of limit equilibrium analysis as set forth in the approved standards, as determined by the RWDE, as referenced in Part 1.6, Paragraph D. The minimum factors of safety shall be as follows, or as otherwise selected as appropriate by the RWDE:

Normal Service (static)	1.5
Seismic	1.1
Rapid Drawdown (if applicable)	1.2

I. Seismic Stability. Seismic loading shall be evaluated in accordance with AASHTO Load and Resistance Factor Design (LRFD) methodology, or NCMA Allowable Stress Design (ASD) methodology as determined by the RWDE as referenced in Part 1.6, Paragraph D.

1.7 QUALITY ASSURANCE

A. RWIC Qualifications. In order to demonstrate basic competence in the construction of precast modular block walls, the RWIC shall document compliance with the following:
   1. Experience.
      a) Construction experience with a minimum of 3,000 square feet of the proposed precast modular block retaining wall system.
      b) Construction of at least three (3) precast modular block (large block) retaining wall structures within the past three (3) years.
      c) Construction of at least 5,000 square feet of precast modular block (large block) retaining walls within the past five (5) years.
   2. RWIC experience documentation for each qualifying project shall include:
      a) Project name and location
      b) Date (month and year) of construction completion
      c) Contact information of Owner or General Contractor

d) Type (trade name) of precast modular block system used
e) Maximum height of the wall constructed
f) Face area of the wall constructed

3. In lieu of the requirements set forth in items 1 and 2 above, the RWIC must submit documentation demonstrating competency in precast modular block retaining wall construction through a training program that is deemed acceptable by the Owner.

B. RWDE Qualifications and Statement of Experience. The RWDE shall submit a written statement affirming that he or she has the following minimum qualifications and experience.

1. The RWDE shall be licensed to practice in the jurisdiction of the project location.
2. The RWDE shall be independently capable of performing all internal and external stability analyses, including those for seismic loading, compound stability, rapid draw-down and deep-seated, global modes of failure.
3. The RWDE shall affirm in writing that he or she has personally supervised the design of the retaining walls for the project, that the design considers all the requirements listed in Part 1.6 and that he or she accepts responsibility as the design engineer of record for the retaining walls constructed on the project.
4. The RWDE shall affirm in writing that he or she has designed a minimum of approximately 3,000 face square feet of modular block earth retaining walls within the previous five (5) years.
5. In lieu of these specific requirements, the engineer may submit alternate documentation demonstrating competency in Precast Modular Block retaining wall design.

C. The Owner reserves the right to reject the design services of any engineer or engineering firm who, in the sole opinion of the Owner, does not possess the requisite experience or qualifications.

1.8 QUALITY CONTROL

A. The Owner's Representative shall review all submittals for materials, design, RWDE qualifications and the RWIC qualifications.

B. The Contactor shall retain the services of an independent Inspection Engineer who is experienced with the construction of precast modular block retaining wall structures to perform inspection and testing.

1. Qualification of the Inspection Engineer firm and staff shall be submitted to the Owner's Representative for review and acceptance.

2. The Inspection Engineering firm and all staff shall have a minimum of five (5) years of experience in the construction of precast modular block walls.

3. The Inspection Engineer firm shall provide a minimum of three (3) projects of similar size and scope performed in the past five (5) years with description and reference contact information.

4. The Inspection Engineer firm shall provide a resume of the lead inspector. The lead inspector shall personally have five (5) years of experience in the construction of precast modular block walls.

5. The cost of inspection shall be the responsibility of the Contractor . Inspection shall be continuous throughout the construction of the retaining walls.

C. The Inspection Engineer shall perform the following duties:

1. Inspect the construction of the precast modular block structure for conformance with construction shop drawings and the requirements of this specification.
2. Verify that soil or aggregate fill placed and compacted in the retained and foundation zones of the retaining wall conforms with Part 2.1, Paragraph B of this section and exhibits the shear strength and bearing capacity parameters specified by the RWDE.
3. Verify that the shear strength of the in-situ soil assumed by the RWDE is appropriate.
4. Inspect and document and submit to the Owner's Representative on a daily basis soil compaction in accordance with these specifications:
   a) Required dry unit weight
   b) Actual dry unit weight
   c) Allowable moisture content
   d) Actual moisture content
   e) Pass/fail assessment
   f) Test location – wall station number
   g) Test elevation
   h) Distance of test location behind the wall face
5. Excavated slopes in the vicinity of the retaining wall are bench-cut to the width and elevation as required by design
6. Notify the RWIC of any deficiencies in the retaining wall construction and provide the RWIC a reasonable opportunity to correct the deficiency.
7. Notify the General Contractor, Owner and RWDE of any construction deficiencies that have not been corrected timely.
8. Document all inspection results.
9. Test compacted density and moisture content of the retained backfill with the following frequency:
   a) At least once every 500 square feet (in plan) per vertical lift, and
   b) At least once per every 18 inches of vertical wall construction.

D. The Contractor's engagement of the Inspection Engineer does not relieve the RWIC of responsibility to construct the proposed retaining wall in accordance with the approved

construction shop drawings and these specifications.

E. The RWIC shall inspect the on-site grades and excavations prior to construction and notify the RWDE and General Contractor if on-site conditions differ from the elevations, assumptions, grading, and soil and groundwater conditions depicted in the retaining wall construction shop drawings.

1.9 DELIVERY, STORAGE AND HANDLING

A. Boardwalk supplier shall coordinate fabrication and delivery schedule of precast elements with overall construction schedule and progress and sequence to avoid delay in installation.

B. The RWIC shall inspect the materials upon delivery to ensure that the proper type, grade and color of materials have been delivered. Material not meeting the requirements of the drawing and specifications shall be removed from the site and returned to the fabricator or with written permission from the fabricator legally disposed

C. The RWIC shall store and handle all materials in accordance with the manufacturer's recommendations as specified herein and in a manner that prevents deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, UV exposure or other causes. Damaged materials shall not be incorporated into the work.

D. Precast Modular Blocks
   1. Precast modular blocks shall be stored in an area with positive drainage away from the blocks. Be careful to protect the block from mud and excessive chipping and breakage. Precast modular blocks shall not be stacked more than three (3) units high in the storage area.

E. Drainage Aggregate and Backfill Stockpiles
   1. Drainage aggregate or backfill material shall not be piled over unstable slopes or areas of the project site with buried utilities.
   2. Drainage aggregate material shall not be staged where it may become mixed with or contaminated by poor draining fine-grained soils such as clay or silt.

PART 2 – MATERIALS

2.1 MATERIALS

A. Precast Modular Block Retaining Wall Units

1. All units shall be wet-cast precast modular retaining wall units conforming to ASTM C1776.

2. All units for the project shall be obtained from the same manufacturer. The manufacturer shall be licensed and authorized to produce the retaining wall units by the precast modular block system patent holder/licensor and shall document compliance with the published quality control standards of the proprietary precast modular block system licensor for the previous three (3) years, or the total time the manufacturer has been licensed, whichever is less.

3. Concrete used in the production of the precast modular block units shall be first-purpose, fresh concrete. It shall not consist of returned, reconstituted, surplus or waste concrete. It shall be an original production mix meeting the requirements of ASTM C94 and exhibit the properties as shown in the following table:

Concrete Mix Properties

Freeze Thaw Exposure Class[1]	Minimum 28-Day Compressive Strength[2]	Maximum Water Cement Ratio	Nominal Maximum Aggregate Size	Aggregate Class Designation[3]	Air Content[4]
Moderate	4,000 psi	0.45	1 inch	3M	4.5% +/- 1.5%
Severe	4,000 psi	0.45	1 inch	3S	6.0% +/- 1.5%
Very Severe	4,500 psi	0.40	1 inch	4S	6.0% +/- 1.5%
Maximum Water-Soluble Chloride Ion (Cl^-) Content in Concrete, Percent by Weight of Cement[5,6]					0.15
Maximum Chloride as Cl^- Concentration in Mixing Water, Parts Per Million					1000
Maximum Percentage of Total Cementitious Materials By Weight [7,9] (Very Severe Exposure Class Only):					
Fly Ash or Other Pozzolans Conforming to ASTM C618					25
Slag Conforming to ASTM C989					50
Silica Fume Conforming to ASTM C1240					10
Total of Fly Ash or Other Pozzolans, Slag, and Silica Fume[8]					50
Total of Fly Ash or Other Pozzolans and Silica Fume[8]					35
Alkali-Aggregate Reactivity Mitigation per ACI 201					
Slump (Conventional Concrete) per ASTM C143[10]				5 inches +/- 1½ inches (125 mm +/- 40 mm)	
Slump Flow (Self-Consolidating Concrete) per ASTM C1611				18 inches – 32 inches (450 mm – 800 mm)	

[1]Exposure class is as described in ACI 318. "Moderate" describes concrete that is exposed to freezing and thawing cycles and occasional exposure to moisture. "Severe" describes concrete that is exposed to freezing and thawing cycles and in continuous contact with moisture. "Very Severe" describes concrete that is exposed to freezing and thawing cycles and in continuous contact with moisture and exposed to deicing chemicals. Exposure class should be specified by owner/purchaser prior to order placement.

[2]Test method ASTM C39.

[3]Defined in ASTM C33 Table 3 *Limits for Deleterious Substances and Physical Property Requirements of Coarse Aggregates for Concrete*.

[4]Test method ASTM C231.

[5]Test method ASTM C1218 at age between 28 and 42 days.

[6]Where used in high sulfate environments or where alkali-silica reactivity is an issue, water soluble chloride shall be limited to no more than trace amounts (from impurities in concrete-making components, not intended constituents.)

[7]The total cementitious material also includes ASTM C150, C595, C845, C1157 cement. The maximum percentages shall include:

(a) Fly ash or other pozzolans in type IP, blended cement, ASTM C595, or ASTM C1157.
(b) Slag used in the manufacture of an IS blended cement, ASTM C595, or ASTM C1157.
(c) Silica fume, ASTM C1240, present in a blended cement.

[8]Fly ash or other pozzolans and silica fume shall constitute no more than 25 and 10 percent, respectively, of the total weight of the cementitious materials.
[9]Prescriptive limits shown may be waived for concrete mixes that demonstrate excellent freeze/thaw durability in a detailed and current testing program.
[10]Slump may be increased by a high-range water-reducing admixture.

4. Each concrete block shall be cast in a single continuous pour without cold joints. With the exception of half-block units, corner units and other special application units, the precast modular block units shall conform to the nominal dimensions listed in the table below and be produced to the dimensional tolerances shown.

Block Type	**Dimension**	**Nominal Value**	**Tolerance**
28” Block	Height	18”	+/- 3/16”
	Length	46-1/8”	+/- 1/2”
	Width*	28”	+/- 1/2”
41” Block	Height	18”	+/- 3/16”
	Length	46-1/8”	+/- 1/2”
	Width*	40-1/2”	+/- 1/2”
60” Block	Height	18”	+/- 3/16”
	Length	46-1/8”	+/- 1/2”
	Width*	60”	+/- 1/2”

* Block tolerance measurements shall exclude variable face texture

5. Individual block units shall have a nominal height of 18 inches

6. With the exception of half-block units, corner units, and other special application units, the precast modular block units shall have two (2) circular dome shear knobs that are 10 inches, 7.5 inches, or 6.75 inches in diameter and 4 inches or 2 inches in height. The shear knobs shall fully index into a continuous semi-cylindrical shear channel in the bottom of the block course above. The peak interface shear between any two (2) vertically stacked precast modular block units, with 10 inch diameter shear knobs, measured in accordance with ASTM D6916 shall exceed 6,500 lb/ft at a minimum normal load of 500 lb/ft, as well as an ultimate peak interface shear capacity in excess of 11,000 lb/ft. The peak interlock shear between any two (2) vertically stacked precast modular block units, with 7.5 inch or 6.75 inch diameter shear knobs, measured in accordance with ASTM D6916 shall exceed 1,850 lb/ft at a minimum normal load of 500 lb/ft, as well as an ultimate peak interface shear capacity in excess of 10,000 lb/ft. Test specimen blocks tested under ASTM D6916 shall be actual, full-scale production blocks of known compressive strength. The interface shear capacity reported shall be corrected for a 4,000 psi concrete compressive strength. Regardless of precast modular block configuration, interface shear testing shall be completed without the inclusion of unit core infill aggregate.

7. In certain configurations and/or combinations of blocks, some minor on-site trimming/partial removal of some of the shear knobs may be necessary to allow for proper alignment.

8. The 28” and 41” precast modular block units may be cast with a 13” wide, continuous vertical core slot completely through the block, or solid concrete.

9. Without field cutting or special modification, the precast modular block units shall be capable of achieving a minimum radius of 14 ft 6 in.

10. The precast modular block units shall be manufactured with integrally cast shear knobs that establish a standard horizontal set-back for subsequent block courses. The precast modular block system shall be available in the four (4) standard horizontal set-back facing batter options listed below:

18-inch High Blocks:

Horizontal Set-Back/Blk. Course	Max. Facing Batter
3/8”	1.2˚
1-5/8”	5.2˚
9-3/8”	27.5˚
16-5/8”	42.7˚

The precast modular block units shall be furnished with the required shear knobs that provide a 1-5/8” set back per course facing batter

11. The precast modular block unit face texture shall be selected by the Owner from the available range of textures available from the precast modular block manufacturer. Each textured block facing unit shall be a minimum of 5.76 square feet with a unique texture pattern that repeats with a maximum frequency of once in any 15 square feet of wall face.

12. The block color shall be selected by the Owner from the available range of colors available from the precast modular block manufacturer. Concrete blocks can also be stained after installation based upon Owner’s selection of concrete stain colors.

13. All precast modular block (PMB) units shall be sound and free of cracks or other defects that would interfere with the proper installation of the unit, impair the strength or performance of the constructed wall. PMB units to be used in exposed wall construction shall not exhibit chips or cracks in the exposed face or faces of the unit that are not otherwise permitted. Chips smaller than 1.5” in its largest dimension and cracks not wider than 0.012” and not longer than 25% of the

nominal height of the PMB unit shall be permitted. PMB units with bug holes in the exposed architectural face smaller than 0.75" in its largest dimension shall be permitted. Bug holes, water marks, and color variation on non-architectural faces are acceptable. PMB units that exhibit cracks that are continuous through any solid element of the PMB unit shall not be incorporated in the work regardless of the width or length of the crack.

B. DRAINAGE AGGREGATE AND WALL INFILL

1. Drainage aggregate (and wall infill for retaining walls designed as modular gravity structures) shall be a durable crushed stone conforming to No. 57 size per ASTM C33 with the following particle-size distribution requirements per ASTM D6913:

U.S. Standard Sieve Size	% Passing
1-½"	100
1"	95-100
½"	25-60
No. 4	0-10
No. 8	0-5

C. LEVELING PAD

1. The precast modular block units shall be placed on a leveling pad constructed from crushed stone or unreinforced concrete. The leveling pad shall be constructed to the dimensions and limits shown on the retaining wall design drawings prepared by the RWDE.

2. Crushed stone used for construction of a granular leveling pad shall meet the requirements of the drainage aggregate and wall infill in Part 2.1 Paragraph B or a preapproved alternate material.

3. Concrete used for construction of an unreinforced concrete leveling pad shall satisfy the criteria for AASHTO Class B. The concrete should be cured a minimum of 12 hours prior to placement of the precast modular block wall retaining units and exhibit a minimum 28-day compressive strength of 2,500 psi.

D. GEOTEXTILE

1. Geotextile separation shall be needle-punched or heat bonded nonwoven.
2. Material shall be Class 2 w/ percent elongation >50%
3. Geotextile shall be evaluated based on the following criteria:
   - Strength
   a) Grab Tensile Strength (ASTM D4632) 157 lbs (min)
   b) Punch Strength (ASTM D6241) 309 lbs (min)
   c) Trapezoid Tensile Strength (ASTM D4533) 56 lbs (lbs)

- Stabilization

d)	Flow Rate (ASTM D4491)	95 pgm
e)	UV Resistance after 500 hrs (ASTM D4355)	70%
f)	Permittivity (ASTM D4491)	0.02 sec^{-1} (min)
g)	Apparent Opening Size (US Std. Sieve D4751)	#30

PART 3 – EXECUTION

3.1 PREPARATION

1. Fill Soil. The Contractor all verify that retained backfill material placed within a horizontal distance of one (1) times the wall height behind the wall blocks satisfies the criteria of this section.
2. The Contractor shall verify that any fill soil installed in the foundation and retained soil zones of the retaining wall satisfies the specification of the RWDE as shown on the construction drawings.

B. Excavation.

1. The Grading Contractor shall excavate to the lines and grades required for construction of the precast modular block retaining wall as shown on the construction drawings. The Grading Contractor shall minimize over-excavation. Excavation support, if required, shall be the responsibility of the Grading Contractor.
2. Over-excavated soil shall be replaced with compacted fill in conformance with the specifications of the RWDE and "Division 31, Section 31 00 00 – Earthwork" of these project specifications.
3. Embankment excavations shall be bench cut as required by the Geotechnical Engineer and inspected by the Inspection Engineer for compliance.

C. Foundation Preparation.

1. Prior to construction of the precast modular block retaining wall, the leveling pad area and undercut zone (if applicable) shall be cleared and grubbed. All topsoil, brush, frozen soil and organic material shall be removed. Additional foundation soils found to be unsatisfactory beyond the specified undercut limits shall be undercut and replaced with approved fill as directed by the Geotechnical Engineer. The Inspection Engineer shall ensure that the undercut limits are consistent with the requirements of the Geotechnical Engineer and that all soil fill material is properly compacted in accordance with project specifications. The Inspection Engineer shall document the volume of undercut and replacement, if required.
2. Following excavation for the leveling pad and undercut zone (if applicable), the Inspection Engineer shall evaluate the in-situ soil in the foundation and retained soil zones.
    - The Inspection Engineer shall verify that the shear strength of the in-situ soil assumed by the RWDE is appropriate. The Inspection Engineer shall immediately stop work and notify the Owner if the in-situ shear strength is found to be inconsistent with the retaining wall design assumptions.

- The Inspection Engineer shall verify that the foundation soil exhibits sufficient ultimate bearing capacity to satisfy the requirements indicated on the retaining wall construction shop drawings per Part 1.6 I of this section.

D. Leveling Pad.
   1. The leveling pad shall be constructed to provide a level, hard surface on which to place the first course of precast modular block units. The leveling pad shall be placed in the dimensions shown on the retaining wall construction drawings and extend to the limits indicated.
   2. Crushed Stone Leveling Pad. Crushed stone shall be placed in uniform maximum lifts of 6". The crushed stone shall be compacted by a minimum of three (3) passes of a vibratory compactor capable of exerting 2,000 lb of centrifugal force and to the satisfaction of the Inspection Engineer.
   3. Unreinforced Concrete Leveling Pad. The concrete shall be placed in the same dimensions as those required for the crushed stone leveling pad. The RWIC shall erect proper forms as required to ensure the accurate placement of the concrete leveling pad according to the retaining wall construction drawings.

3.2 INSTALLATION

A. The precast modular block structure shall be constructed in accordance with the construction drawings, these specifications and the recommendations of the retaining wall system component manufacturers. Where conflicts exist between the manufacturer's recommendations and these specifications, these specifications shall prevail.

B. Drainage components. Pipe, geotextile and drainage aggregate shall be installed as shown on the construction shop drawings.

C. Precast Modular Block Installation
   1. The first course of block units shall be placed with the front face edges tightly abutted together on adjacent blocks, on the prepared leveling pad at the locations and elevations shown on the construction drawings. The RWIC shall take special care to ensure that the bottom course of block units are in full contact with the leveling pad, are set level and true and are properly aligned according to the locations shown on the construction drawings.
   2. Backfill shall be placed in front of the bottom course of blocks prior to placement of subsequent block courses. Nonwoven geotextile fabric shall be placed in the V-shaped joints between adjacent blocks. Drainage aggregate shall be placed in the V-shaped joints between adjacent blocks and extend to a minimum distance of 12" behind the block unit.
   3. Drainage aggregate shall be placed in 9 inch maximum lifts and compacted by a minimum of three (3) passes of a vibratory plate compactor capable exerting a minimum of 2,000 lb (8.9 kN) of centrifugal force.
   4. Unit core fill shall be placed in the precast modular block unit vertical core slot. The core fill shall completely fill the slot to the level of the top of the block unit. The top of the block unit shall be broom-cleaned prior to placement of subsequent

block courses. No additional courses of precast modular blocks may be stacked before the unit core fill is installed in the blocks on the course below.

5. Base course blocks for gravity wall designs may be furnished without vertical core slots. If so, disregard item 4 above, for the base course blocks in this application.

6. Nonwoven geotextile fabric shall be placed between the drainage aggregate and the retained soil as required on the retaining wall construction drawings.
7. Subsequent courses of block units shall be installed with a running bond (approximate half block horizontal course-to-course offset). With the exception of 90 degree corner units, the shear channel of the upper block shall be fully engaged with the shear knobs of the block course below. The upper block course shall be pushed forward to fully engage the interface shear key between the blocks and to ensure consistent face batter and wall alignment. Drainage aggregate, unit core fill, geotextile and properly compacted backfill shall be complete and in-place for each course of block units before the next course of blocks is stacked.
8. The elevation of retained soil fill shall not be less than 1 block course (18") below the elevation of the retained backfill throughout the construction of the retaining wall..

D. Construction Tolerance. Allowable construction tolerance of the retaining wall shall be as follows:
   1. Deviation from the design batter and horizontal alignment, when measured along a 10' straight wall section, shall not exceed 3/4".
   2. Deviation from the overall design batter shall not exceed ½" per 10' of wall height.
   3. The maximum allowable offset (horizontal bulge) of the face in any precast modular block joint shall be ½".
   4. The base of the precast modular block wall excavation shall be within 2" of the staked elevations, unless otherwise approved by the Inspection Engineer.
   5. Differential vertical settlement of the face shall not exceed 1' along any 200' of wall length.
   6. The maximum allowable vertical displacement of the face in any precast modular block joint shall be ½"
   7. The wall face shall be placed within 2" of the horizontal location staked.

3.2.1 WALL INFILL AND BACKFILL PLACEMENT

A. Backfill material placed immediately behind the drainage aggregate shall be compacted as follows:
   1. 98% of maximum dry density at ± 2% optimum moisture content per ASTM D698 standard proctor or 85% relative density per ASTM D4254.

B. Compactive effort within 3' of the back of the precast modular blocks should be accomplished with walk-behind compactors. Compaction in this zone shall be within 95% of maximum dry density as measured in accordance with ASTM D1557 modified proctor or 80% relative density per ASTM D4254. Heavy equipment should not be operated within 3' of the back of the precast modular blocks.

C. Backfill material shall be installed in lifts that do not exceed a thickness of 9 to 12 inches, as specified by Engineer.

D. At the end of each work day, the RWIC shall grade the surface of the last lift of the granular wall infill to a 3% ± 1% slope away from the precast modular block wall face and compact it.

E. The General Contractor shall direct the Grading Contractor to protect the precast modular block wall structure against surface water runoff at all times through the use of berms, diversion ditches, silt fence, temporary drains and/or any other necessary measures to prevent soil staining of the wall face, scour of the retaining wall foundation or erosion of the reinforced backfill or wall infill.

3.2.2 OBSTRUCTIONS IN THE INFILL ZONE

F. The RWIC shall make all required allowances for obstructions behind and through the wall face in accordance with the approved construction shop drawings.

G. Should unplanned obstructions become apparent for which the approved construction shop drawings do not account, the affected portion of the wall shall not be constructed until the RWDE can appropriately address the required procedures for construction of the wall section in question.

3.3 FINAL ACCEPTANCE

A. For walls supporting unpaved areas, a minimum of 12” of compacted, low-permeability fill shall be placed over the granular wall infill zone of the precast modular block retaining wall structure. The adjacent retained soil shall be graded to prevent ponding of water behind the completed retaining wall.

B. For retaining walls with crest slopes of 5H:1V or steeper in any direction, appropriate soil erosion/sedimentation control measures shall be installed along the wall crest immediately following construction and grading of the crest slope. The crest slope above the wall shall be immediately seeded and protected to establish vegetation. The General Contractor shall ensure that the seeded slope receives adequate irrigation and erosion protection to support germination and growth.

C. The General Contractor shall confirm that the as-built precast modular block wall geometries conform to the requirements of this section. The General Contractor shall notify the Owner of any deviations.

END OF SECTION 32 32 15

SECTION 32 91 19.12 SALVAGED TOPSOIL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of salvaging topsoil 4” to 6” deep at the project site.

B. Measurement Procedures
1. Salvaging Topsoil will be measured at the unit per cubic yard.

2. The lump sum contract bid price for salvaged topsoil will include:

- all testing required by the contract

- all materials, labor and equipment required to savaging and storing salvaged topsoil.

C. Payment Procedures
1. The accepted work will be paid at the contract lump sum price for all work.

1.2 REFERENCES

A. FAR - Federal Acquisition Regulations
1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

PART 2 - PRODUCTS

2.1 No products are required. Topsoil for the project is salvaged from the project site.

PART 3 - EXECUTION

3.1 HANDLING

A. Salvage soil 4 to 6 inches deep prior to other soil disturbing operations.
1. Excavate topsoil using hand tools in areas where topsoil cannot be mechanically removed by construction equipment. Excavate topsoil with construction equipment in one pass.
2. Do not mix the top 4-6 inches of salvaged soil with subsoils.
3. Do not compact or drive construction vehicles or equipment on topsoil in situ or in stockpiles.
4. Salvage topsoil with duff (dead and decaying surface plant matter).
5. Remove stones greater than 2” in diameter, woody plant debris greater than ½” in diameter, and all debris from salvaged topsoil.
6. Do not damage existing vegetation adjacent to areas for salvaging topsoil.

3.2 STORAGE

A. Stockpile salvaged topsoil in windrowed piles (less than 3' high and 6' wide) along the outer edge of the clearing limits.

B. Stockpile salvaged topsoil in locations directed by the CO if windrowing is not possible.

C. Install erosion control devices as directed by the CO for salvaged topsoil stockpiled for more than 6 weeks. Provide erosion control devices to prevent topsoil loss by wind and water.

3.3 PLACEMENT

A. Prior to placing salvaged topsoil, remove and properly dispose of all stumps, large soil clods and rocks greater than 2 inches in diameter, and large roots from the graded surface where salvaged topsoil is to be placed.

B. Prior to placing salvaged topsoil, disk or scarify disturbed areas with slopes in a direction perpendicular to the natural flow of water and fill furrows and rills by hand raking.

C. As solely determined by the CO, compacted soils shall be ripped, not to exceed the depth of construction disturbance. Areas temporarily disturbed by the stabilized construction entrances, temporary access roads, and staging areas shall be ripped through discing, broad forking, or tilling in a way that does not increase instability of slopes and minimizes additional compaction and disturbance. Allowable depth is not to exceed maximum depth of the construction disturbance or compaction depth nor 12 inches.

D. Place salvaged topsoil at least 4 to 6 inches deep over all disturbed soil areas.

E. Do not mix salvaged topsoil with subsoils.

F. Evenly distribute salvaged topsoil with the lightest weight equipment practicable.

G. Match the ground surface shape and texture of undisturbed areas adjacent to the project area.

H. Do not disturb salvaged topsoil following placement.

3.4 FINAL ACCEPTANCE

A. Salvaging and storage of salvaged topsoil will be evaluated under this specification.

B. Placement of salvaged topsoil will be evaluated under specification 32 19 23.13.

END OF SECTION 32 91 19.12.

SECTION 32 91 19.13 – TOPSOIL PLACEMENT AND GRADING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of furnishing and placing topsoil and placing conserved topsoil

B. Measurement Procedures

1. Topsoil placement and grading will be measured at the unit per cubic yard.

2. The lump sum contract bid price for topsoil placement will include:

- all testing required by the contract
- all materials, labor and equipment required to install riprap.

C. Payment Procedures

1. The accepted work will be paid at the contract lump sum price for all work.

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials

1. AASHTO T 267 - Standard Method of Test for Determination of Organic Content in Soils by Loss on Ignition
2. AASHTO T 289 - Standard Method of Test for Determining pH of Soil for Use in Corrosion Testing
3. AASHTO T 88 - Standard Method of Test for Particle Size Analysis of Soils

B. FAR - Federal Acquisition Regulations

1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL

A. Prior to ordering the topsoil, submit soil test report to the CO for review and approval. Do not order materials until approval has been obtained. Delivered materials shall closely match the approved samples.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Furnished Topsoil – Furnish fertile, friable, free draining, sandy loam soil that is free of subsoil, refuse, stumps, roots, brush, weeds, rocks larger than 1 inch, or other substances detrimental to the development of vegetative growth. Demonstrate that the soil can sustain healthy crops of grass, shrubs, or other plant growth. Conform to the following:

1. Texture

(a) Organic matter, AASHTO T 267 3 to 10%

(b) Sand, AASHTO T 88	20 to 70%
(c) Silt, AASHTO T 88	10 to 60%
(d) Clay, AASHTO T 88	5 to 30%

2. pH, AASHTO T 289 6 to 8

B. 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.

PART 3 – EXECUTION

3.1 GENERAL

A. Preparing Areas. Shape all slopes and disturbed areas to be covered with topsoil. Disk or scarify slopes 1V:3H or flatter to a depth of 4 inches.

3.2 PLACEMENT

A. Placing Topsoil. Provide at least 7 days notice before the start of topsoil placement. Do not place topsoil when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work. Use all conserved topsoil before furnishing topsoil. Keep the roadway surfaces clean during hauling and spreading operations.

Spread topsoil to a depth that, after settlement, provides the required depth. Break clods and lumps with harrows, disks, or other appropriate equipment to provide a uniform textured soil. Remove and dispose of clods and stones larger than 1 inches, stumps, roots, and other litter. Construct longitudinal depressions at least 2 inches deep perpendicular to the natural flow of water without overly compacting the topsoil surface.

3.3 FINAL ACCEPTANCE

Material for furnished topsoil will be evaluated under this specification.

Material for conserved topsoil will be evaluated under this specification.

Placing furnished and conserved topsoil material will be evaluated under this specification.

END OF SECTION 32 91 19.13

SECTION 32 91 19.14 – AGGREGATE TOPSOIL COURSE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of furnishing and placing an aggregate, topsoil, and seed mixture on a prepared shoulder or other surface. Furnish all labor, material, equipment, tools, transportation and supplies necessary to the complete the work according to the contract.

B. Measurement Procedures
   1. Aggregate Topsoil will be measured at the unit price per cubic yard. The lump sum contract bid price for aggregate topsoil will include:

      - all testing required by the contract

      - all materials, labor and equipment required to install aggregate topsoil.

C. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work .

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials
   1. AASHTO M 157 - Standard Specification for Ready-Mixed Concrete
   2. AASHTO M 43 - Standard Specification for Sizes of Aggregate for Road and Bridge Construction
   3. AASHTO M 80 - Standard Specification for Coarse Aggregate for Hydraulic Cement Concrete
   4. AASHTO T 26 - Standard Method of Test for Quality of Water to Be Used in Concrete
   5. AASHTO T 267 - Standard Method of Test for Determination of Organic Content in Soils by Loss on Ignition
   6. AASHTO T 289 - Standard Method of Test for Determining pH of Soil for Use in Corrosion Testing
   7. AASHTO T 310 - Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)
   8. AASHTO T 88 - Standard Method of Test for Particle Size Analysis of Soils
   9. AASHTO T 99 - Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

B. FAR - Federal Acquisition Regulations
   1. FAR 46.105 Contractor responsibilities
   2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
   3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTALS

A. National Park Service (NPS) approval is required for submittals listed below before placement and installation of any aggregate topsoil material.

1. Submit certified test reports to the Contracting Officer (CO) for approval not less than 30 days before material is required for the work. Test reports shall be provided for base material.

2. Submit certified seed mix to the CO for approval. Seed shall not be purchased or incorporated until final approval has been given.

3. Submit a representative 50-pound sample of aggregate topsoil proposed for use if requested by the CO.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Aggregate for Aggregate-Topsoil Course. Conform to the following:
   1. Gradation AASHTO M 43, size number 57
   2. Quality AASHTO M 80, class E

B. Furnished Topsoil – Furnish fertile, friable, free draining, sandy loam soil that is free of subsoil, refuse, stumps, roots, brush, weeds, rocks larger than 1 inch, or other substances detrimental to the development of vegetative growth. Demonstrate that the soil can sustain healthy crops of grass, shrubs, or other plant growth. Conform to the following:
   1. Texture
      (a) Organic matter, AASHTO T 267 3 to 10%
      (b) Sand, AASHTO T 88 20 to 70%
      (c) Silt, AASHTO T 88 10 to 60%
      (d) Clay, AASHTO T 88 5 to 30%

   2. pH, AASHTO T 289 6 to 8

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. Seed. Conform to the Federal Seed Act, the Federal Noxious Weed Act, and applicable State and local seed and noxious weed laws. Do not use wet, moldy, or otherwise contaminated or damaged seed. Furnish each seed type in separate sealed container. Clearly label each container with the following:
   1. Name and type of seed;
   2. Lot number;
   3. Net mass;
   4. Percent of purity, germination, and hard seed;
   5. Percent of maximum weed seed content;
   6. Seed Origin;
   7. Noxious weeds present;

8. Other crop seed;
9. Inert matter;
10. Name and address of seed distributor; and
11. Mixture percent of each component.

Inoculate legume seed with approved cultures according to the manufacturer's instructions.

E. Water. Conform to the following:

1. Water for mixing or curing cement concrete, mortar, or grout. Conform to AASHTO M 157. Potable water of known quality may be used without testing according to AASHTO T 26. Potable water is safe for human consumption as defined by the public health authority having jurisdiction.

2. Water for planting or care of vegetation. Furnish water that is free of substances injurious to plant life such as oils, acids, alkalies, or salts.

3. Water for earthwork, pavement courses, dust control, and incidental construction. Furnish water free of substances detrimental to the work.

PART 3 – EXECUTION

3.1 PREPARATION

A. Complete the adjoining pavement before placing an aggregate-topsoil mixture on the shoulder. Scarify the area where the mixture is to be placed to a depth of 3 inches. Reduce all clods and sod to a maximum size of 4 inches.

3.2 APPLICATION

A. Furnish a mixture of 50±10 percent aggregate and 50±10 percent topsoil by volume with sufficient water for compaction.

B. Mix the components into a uniform mixture. Spread the mixture on the prepared surface in a uniform layer. Shape the mixture to the line, grade, and cross-section. Remove all clods and stones greater than 2 inches in diameter. Before compaction, dry seed the mixture surface at a rate of 75 pounds per acre.

C. Uniformly compact the mixture so that it does not exhibit heaving, pumping, rutting, or shearing. After compaction, dry seed the surface again at a rate of 75 pounds per acre.

3.3 FINAL ACCEPTANCE

A. See Table 32 91 19.14-1 for sampling and testing requirements.

B. Aggregate for aggregate-topsoil will be evaluated under Subsection 32 11 23.

C. Seed and topsoil will be evaluated under Subsections 32 92 20 and 32 91 19.13.

D. Construction of aggregate-topsoil course will be evaluated under the requirements of this specification.

END OF SECTION 32 91 19.14.

Table 32 91 19.14-1
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Aggregate – Topsoil	Measured and tested for conformance (01 90 01.4)	Moisture-Density	—	AASHTO T 99, method C (1)	1 per soil blend	Production output or stockpile	—	36 hours
		Compaction	—	AASHTO T 310 or other approved procedures	1 per 4000 yd^2	In-place	—	24 hours

(1) Minimum of 5 points per proctor.

SECTION 32 92 20 – SEEDING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of soil preparation, watering, seeding, and mulching. Seeding and mulching methods are designated as dry or hydraulic.
B. Measurement Procedures
    1. Seeding and sodding will be measured for by the unit of square foot
C. Payment Procedures
    1. The accepted work will be paid at the contract lump sum price for all work described in this section

1.2 REFERENCES

A. FAR - Federal Acquisition Regulations
    1. FAR 46.105 Contractor responsibilities
    2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
    3. FAR 52.246-12 Inspection of Construction

PART 2 – PRODUCTS

2.1 MATERIALS

A. Seed. Conform to the Federal Seed Act, the Federal Noxious Weed Act, and applicable State and local seed and noxious weed laws. Only native seed mixes allowed as detailed in the plans. Do not use lawn or turf mixes. Do not use wet, moldy, or otherwise contaminated or damaged seed. Furnish each seed species-type in separate sealed container. Store in cool, dry place free from rodents.

    a. Prior to purchase of seed mix, submit the following information to the CO for review:
        1. Name and type of seed;
        2. Lot number;
        3. Net mass;
        4. Percent of purity, germination, and hard seed;
        5. Percent of maximum weed seed content;
        6. Seed Origin;
        7. Noxious weeds present;
        8. Other crop seed;
        9. Inert matter;
        10. Name and address of seed distributor; and
        11. Mixture percent of each component.

    b. Furnish each seed type in separate sealed container. Clearly label each container with the following:
        1. Name and type of seed;
        2. Lot number;
        3. Net mass;
        4. Percent of purity, germination, and hard seed;
        5. Percent of maximum weed seed content;
        6. Seed Origin;
        7. Noxious weeds present;

8. Other crop seed;
9. Inert matter;
10. Name and address of seed distributor; and
11. Mixture percent of each component.

Inoculate legume seed with approved cultures according to the manufacturer's instructions.

See Planting Plans for species list, seeding sourcing requirements, quantities and rates of application for all seed mixes.

Approved **Road Shoulder Seed Mix:** a non-native, low-growing, low-maintenance, drought tolerant mix suitable for use on mowed road shoulders. Apply to ground between edge of pavement and limits of shoulder grading or ditch section, as directed by the CO. Not suitable for restoring natural areas - refer to the planting plans for species mix, quantities and application rates.

Slope Stabilization Seed Mix: a native seed mix suitable for a variety of site conditions, including steep slopes. Apply to staging areas and other restoration sites as notes on plans or as directed by the CO. Not suitable for road shoulders, lawns, or other sites that will be mowed regularly. For restoration of road shoulders, refer to the accompanying Road Shoulder Seed Mix.

Riparian/Wetland Seed Mix: a native seed mix suitable for flat areas adjacent to open waters and within wetland areas. Apply as designated on the plans or as directed by the CO. Not suitable for road shoulders, lawns, steep slopes, or other sites that will be mowed regularly. For restoration of road shoulders, refer to the accompanying Road Shoulder Seed Mix.

A **cover crop** is needed to assure adequate temporary vegetation cover for the first year. Apply the seed mix along with a cover crop of grain oats (*Avena sativa*) for spring planting or annual rye (*Secale cereale*) for fall planting, at the rate of 10 lbs per acre. The cover crop germinates quickly and helps to assure adequate vegetation cover for site stabilization.

1. Scarify compacted soil base 3-5 inches before adding topsoil layer or compost.
2. Amend topsoil as needed to pH of 6.0-7.0 and organic content of 4% or higher.
3. Apply no fertilizer or lime.
4. Assure that planted seed is covered lightly (1/4-1/2 inch) with good seed-to-soil contact.
5. Mulch with clean, weed-free mulch so that no bare soil shows, approx. 4 tons per acre; do not over-mulch. Crimp or tack mulch to hold in place. Do not mulch with hay, straw, or wood chips.
6. Use 100% natural fiber erosion control blanket on slopes 3H:1V and steeper; and on all surfaces within 50 feet of surface water or wetlands.

B. Mulch.

1. Leaf Mulch: Furnish processed leaf mulch conforming to the following:
   a) Readily dispersible in water;
   b) Nontoxic to seed or other plant material;
   c) Free of growth or germination inhibiting substances;
   d) Free of weed seed;
   e) pH between 5.0 – 6.5
   f) Solvita Maturatity Rating ≥ 6
   g) Air dried to a moisture content of 10±0.2 percent;
   h) Air dried to a uniform mass of ±5 percent;

i) Packaged in new containers labeled with the manufacturer's name and air-dry mass.

2. Bonded fiber matrix hydromulch. Furnish a mixture of long strand virgin wood fibers and non-toxic, natural and biodegradable plant-based psyllium/alpha plantago tackifier which, when hydraulically applied and dried, produce a matrix conforming to the following:

a) Does not dissolve or disperse when wetted;
b) Holds at least 10 ounces of water per ounce of dry matrix;
c) Has no germination or growth inhibiting factors;
d) Forms no water insensitive crust;
e) Contains material that is 100 percent biodegradable; and
f) Is colored with a green dye non-injurious to plant growth.

PART 3 – EXECUTION

SEEDING AND SODDING

A. General. Apply appropriate native seed mix to finished slopes, disturbed areas, and ditches within 14 days after completion of construction on a portion of the site. Do not seed during windy weather or when the ground is excessively wet, frozen, snow covered, extremely dry, cloddy, hard pan, or not friable.

B. Time of seeding: conduct all seeding during either fall window (October 1- January 1) and/or spring window (February 28 - April 30). Seeing may not occur if soil is excessively wet, frozen, or if there is more than 1 inch of snow on the ground. If seeding is to occur during spring window, then the contractor shall ensure seed is properly stratified by seed supplied and provide documentation to verify to co at least 3 weeks prior to seeding. Any adjustments to seeding schedule outside of these windows will require co approval.

C. Preparing Seedbed. Grade the seeding area to line and grade. Remove all weeds, sticks, stones 2 inches in diameter and larger, and other debris detrimental to application, growth, or maintenance of the turf.

Cultivate the seeding area to a minimum depth of 4 inches and prepare a firm but friable seedbed before seeding.

D. Watering. Moisten seeding areas before seeding and maintain the moisture until 10 days after germination. Acceptable water sources include:

E. Apply seed by the following methods:

1. Hand Broadcast Seeding with Erosion Control Blanket Method (ECB) (for slopes flatter than 2H:1V)
2. Hydraulic application of seed with erosion control blanket,
3. Hand broadcast seeding with hydromulch,
4. Hydraulic application of seed with hydromulch.

NOTE: One or more of these seeding methods may be removed from the specifications as the details of the project are refined.

F. Seeding
1. Hand Broadcast Seed Application:

a) In order to ensure that the seed is being applied at the correct rate areas to be seeded shall be marked off/flagged at a minimum of half acre increments prior to seeding.
b) Seed shall be applied by hand or with hand seeders.
c) Seed will be distributed in such a way as to assure all species in the seed mix are evenly distributed across the area, regardless of seed size.
d) Lightly rake the seed into the soil to a depth of ¼". Do not smooth with the backside of the rake, light furrows in the soil are desired.

2. Hydroseed Application:
   a) In order to ensure that the seed is being applied at the correct rate areas to be seeded shall be marked off/flagged at a minimum of half acre increments prior to seeding.
   b) For slopes flatter than 2H:1V, add 500 lbs/acre of tracer material consisting of virgin wood fiber mulch to the water/seed in the hydraulic equipment to provide visible evidence of uniform application. Adding this 500 lbs/acre during seeding, means that only 1500 lbs/acre will be added during the application of just mulch, which would result in a total of 2,000 lbs/acre of mulch applied.
   c) For slopes 2H:1V or steeper, add 500 lbs/acre of tracer material consisting of virgin wood fiber mulch to the water/seed in the hydraulic equipment to provide visible evidence of uniform application. Adding this 500 lbs/acre during seeding, means that only 1,900 lbs/acre will be added during the second application of just mulch, which would result in a total of 2,400 lbs/acre of mulch applied.
   d) The hydroseeding shall proceed following the specifications for the hydromulch application on top of broadcast seed.

G. Erosion Control Blanket Application (Coir Fiber Matting):
   1. After seed has been placed and raked install an erosion control blanket (ECB) over the top of the seed.
   2. The ECB shall meet requirements of specification 31 25 00 and be installed per plans and specifications.
   3. Mulch shall be placed to a thickness of 2" over seeded soil prior to installation of ECB.
   4. The ECB shall be placed under fiber rolls as shown in the erosion control sheets in the plans.

H. Mulching. Apply mulch within 48 hours after seeding or immediately if rain or high winds are expected by the following methods. Mulch by hand areas inaccessible to mulching equipment.

   1. Dry method. Spread all mulch material, except wood and grass cellulose fibers, by a mulch spreader utilizing forced air to blow the mulch material onto the seeded area. Anchor the mulch material with erosion control blanket. Do not mark or deface structures, pavements, utilities, or plant growth with tackifier.

   2. Hydromulch (Hydraulic method). Apply mulch in a separate application from the seed using hydraulic-type equipment.

      a) For slopes 2H:1V or flatter, apply 2,400 lbs./acre of long strand virgin wood fiber and non-toxic, and natural and biodegradable plant-based psyllium/alpha plantago tackifier.
      b) For slopes 2H:1V or steeper, apply 1,900 lbs./acre of long strand virgin wood fiber and non-toxic, and natural and biodegradable plant-based psyllium/alpha plantago tackifier.
      c) Depending on product apply at a rate of 80 lbs./acre on slopes less than 3H:1V and apply at a rate of 100 lbs./acre on slopes greater than 3H:1V.
      d) Non-toxic, 100% environmentally safe tracer dye material at a rate of around 200-300 pounds/acre to provide visible evidence of uniform application.
      e) The hydromulcher must be equipped with a built-in continuous agitation and recirculation system of sufficient operating capacity to produce homogeneous slurry and a discharge

system that will apply slurry to the designated areas at a continuous and uniform rate.

f) No fertilizers, mycorrhizae, or other amendments shall be added to the hydroseed slurry.
g) The Contractor shall spray designated areas with the slurry in a sweeping motion and in an arched stream until a uniform coat is achieved, with no slumping or shadowing, as the material is spread at the required rate.
h) The hydromulch slurry should float down from the arched stream, as opposed to being shot directly at the ground.
i) During hydromulching the existing native vegetation must be protected from damage (including, but not limited to, coating with mulch, damage by direct spray, and dragging hose).
j) Notify the CO/DSC three weeks before hydromulching to ensure that NPS oversight of seeding operations can be coordinated.

I. Protecting and Caring for Seeded Areas. Protect and care for seeded areas including watering when needed and avoiding walking or driving over seeded areas until final acceptance. Repair all damage to seeded areas by reseeding, refertilizing, and remulching.

END OF SECTION 32 92 20

SECTION 32 93 00 – PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plant material including:

a. Woody Plants
b. Shrub Plantings
c. Live Stakes
d. Brush Layering

2. Double Processed Mulch

B. Related Sections:

1. Section 31 10 00 – Site Clearing
2. Section 31 20 00 – Earth Moving
3. Section 31 23 16 – Topsoil

1.3 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Division 01 Section "Unit Prices."

1. Unit prices apply to authorized work covered by quantity allowances.
2. Unit prices apply to additions to and deletions from Work as authorized by Change Orders.

1.4 DEFINITIONS

A. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.

B. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

C. Finish Grade: Elevation of finished surface of planting soil.

D. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

E. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

F. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

G. Planting Area: Areas to be planted.

H. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

I. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

J. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots, the area of transition between the root system and the stem or trunk.

K. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

L. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

M. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated, including soils.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Double Processed Mulch: manufacturer source information.

B. Samples for Verification: For each of the following:

1. Topsoil: 1-gallon volume in sealed plastic bags labeled with source. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
2. Double Processed Mulch: 1-gallon volume in sealed plastic bags labeled with source. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

C. Qualification Data: For qualified Landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

D. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

E. Material Test Reports: For imported or manufactured topsoil.

F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

G. Warranty: Sample of special warranty.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified Landscape Installer whose work has resulted in successful establishment of plants.

1. Experience: Three years' experience in successful landscape installation in addition to requirements in Division 01 Section "Quality Requirements."
2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

B. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1 to Contracting Officer (CO).

D. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree for height and spread; do not measure branches or roots tip to tip.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

E. Plant Material Observation: CO must approve plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. CO retains right to observe trees further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees immediately from Project site.

1. Notify CO of sources of planting materials for approval seven days prior to purchase.

F. Preinstallation Conference: Conduct conference at Project site prior to installation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways, and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

C. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

D. Do not prune trees before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set plants in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.
2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of each service or utility.
2. Do not proceed with interruption of services or utilities without Owner’s written permission.

C. Planting Restrictions: Plant between October 1 and November 30 or March 15 and May 15 when soil temperatures are consistently within the 40-49 degrees F range. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Do not seed on ground that is excessively wet, frozen, or has more than ¼" of snow cover.

1.9 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within a one-year warranty period.

1. Failures include, but are not limited to, the following:

   a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
   b. Structural failures including plantings falling or blowing over.
   c. Faulty performance of tree stabilization and edgings.
   d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods from Date of Planting Completion:

   a. 12 months from date of planting completion.

3. Include the following remedial actions as a minimum:

   a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
   b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
   c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
   d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

1.10 MAINTENANCE SERVICE

A. Initial Maintenance Service for Plants: Provide maintenance by skilled employees of Landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period: 12 months from date of planting completion.

B. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
2. Material used for brush layering may be harvested from within the Limits of Disturbance (LOD) with CO approval.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to CO, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

2.2 PLANTING SOILS

A. Topsoil shall be as defined in Section 31 23 16.

2.3 MULCHES

A. Provide mulch per 31 25 00 Erosion and Sedimentation Controls

2.4 MISCELLANEOUS PRODUCTS

A. Burlap: Non-synthetic, biodegradable

B. Planting Bar

1. Planting bar shall have a blade with a triangular cross section and shall be 12 inches long, 4 inches wide and 1 inch thick at center..

C. Canvas Planting Bag

D. Tree Stake: Douglas Fir, size: as indicated on plans, pencil-pointed end, beveled top

E. Tree Stake Tie: Flat woven polypropylene, flexible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, do not remove any soil unless directed by the CO.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual plant locations. Stake locations and adjust locations when requested and obtain CO's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Wrap trees with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.3 EXCAVATION FOR TREES

A. No excavation into existing grade will be authorized prior to approval from CO.

B. Topsoil removed from excavations may be used as planting soil.

C. Obstructions: Notify CO if unexpected rock or obstructions detrimental to trees are encountered in excavations.

D. Drainage: Notify CO if subsoil conditions evidence unexpected water seepage or retention in tree planting pits.

3.4 TREE and SHRUB PLANTING

A. Before planting all tublings and/or seedlings (seedlings) shall be root pruned, if necessary, so that no roots extend more than 10 inches below the root collar.

B. During planting, seedlings shall be kept in a moist canvas bag or similar container to prevent the root system from drying.

C. Install seedling utilizing the Dibble Bar method:

1. Plunge the dibble bar into the ground at an angle a few inches from where the seedling is to be planted.
2. Push the dibble bar forward to create a hole for the seedling and remove it from the ground. Place the seedling in the hole.
3. The seedling roots must be pointed downward, so you may need to adjust the roots of the seedling. The seedling is planted at the same depth it was planted in the nursery. Look for a dark line just above the root section to see how deep the seedling was planted previously
4. Push the dibble bar straight into the ground 2 inches from the seedling. Pull the dibble bar towards you to push the soil around the bottom of the seedling root system, then push the dibble bar to move the soil over the top of the roots. The seedling should be firmly in place at this time.
5. Leave compaction hole open. Water thoroughly.

D. When planting on slopes, ensure the seedling is upright/vertical and not perpendicular to the slope.

E. If needed, drive stakes on the windward side of trees. Ensure proper depth for stability, considering the size and weight of the plant being supported. Use appropriate ties that won't damage bark, allowing for growth while maintaining security.

3.5 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use Plant Health Care practices including Integrated Pest Management whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

D. Check stake stability regularly, especially after severe weather events. As trees grow, adjust ties to prevent girdling or bark damage. Replace any damaged stakes promptly to maintain consistent support. Once trees are established and showing signs of self-sufficiency, remove the stakes to allow for natural strengthening.

3.6 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.7 DISPOSAL

A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, stakes, ties, and debris and legally dispose of them off Owner's property.

END OF SECTION 32 93 00

SECTION 33 41 00 – STORM DRAINAGE PIPING - HDPE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of furnishing and installing high-density polyethylene (HPDE) culverts.

1.2 SUBMITTAL

A. Submit material certificate to the Engineer, signed by the material producer and Contractor, certifying that materials comply with these specifications and the construction plans

PART 2 – PRODUCTS

1.1 MATERIALS

A. Asphalt Mastic. Conform to AASHTO M 243.

B. High-density polyethylene culvert pipe that meets AASHTO M 294 for Type S or Type D, or ASTM F2881 or ASTM F2764 Double or Triple wall, and has been evaluated by AASHTO Product Evaluation and Audit Solutions

C. Elbows, and pipe tees shall meet AASHTO M 294, Section 7.8. Couplers, if needed, shall meet AASHTO M 294, Section 7.8.

D. Gaskets for Plastic Pipe.

(a) Bell and Spigot joint and elastomeric seals. Conform to ASTM F477.

(b) Thermoplastic elastomeric seals. Conform to ASTM F913.

E. Foundation Conditioning Material shall consists of either:

(a) Course aggregate material meeting the requirements of standard size ABC as described in table 33 41 00 - 01.

(b) Course aggregate material meeting the requirements of standard size 78M as described in table 33 41 00 - 01.

TABLE 33 41 00 - 01

	ABC	**78M**
Sieve	Percent Passing	Percent Passing
1 1/2”	100	-
1”	75 – 97	-
3/4”	-	100
1/2"	55 – 80	98 – 100
3/8”	-	75 – 100
No. 4	35 – 55	20 – 45
No. 8	-	0 – 15
No. 10	25 – 45	-
No. 40	14 – 30*	-
No. 200	4 – 12	-

*For ABC, in addition to the gradation requirements, the soil passing the No. 40 Sieve shall not have a LL in excess of 30 nor a PI in excess of 4. If PI exceeds 4 and is no more than 6, soil

mortar limits apply. If PI is greater than 6, material shall be rejected.

F. Bedding Material is a fine aggregate material consisting of crushed stone screenings (washed or unwashed) meeting the gradation in Table 33 41 00-02.

G. Backfill material is a fine aggregate material consisting of crushed stone screenings (washed or unwashed) meeting the gradation in Table 33 41 00-02.

TABLE 33 41 00 – 02

Sieve	Percent Passing
3/8”	100
No. 4	80 – 100
No. 10	65 – 95
No. 40	25 – 55
No. 200	0 – 20
LL	≤ 30
PI	≤ 6

H. Filtration geotextile shall meet the requirements of geotextile types II or III as described in specification section 31 32 19.23.

I. Foundation conditioning geotextile shall meet the requirements for Type IV-A geotextile as described in specification section 31 32 19.23.

PART 3 – EXECUTION

3.1 GENERAL

Furnish HDPE pipe culvert with a wall thickness per table 33 41 00 – 03. Use the same material and coating on contiguous pipe sections and special sections (such as elbows and branch connections). For culvert extensions, furnish the same material as the existing culvert.

Plans show the size, length, and approximate location of culverts. Contractor shall determine final location, skew, length, elevations, and grade in the field. Do not order culvert material until the CO has accepted the final structure size, length, and alignment.

Place elongated pipes with the minor axis within 5 degrees of vertical.

Construct a piping plug unless the culvert inlet is protected with a full-height headwall, drainage inlet, slope paving, or an embankment consisting of AASHTO M 145 classification A-6 or A-7 material. Construct the piping plug with AASHTO M 145 classification A-6, A-7, or other approved material with a permeability not exceeding 0.004 inches (0.1 millimeters) per second.

Unload and handle pipe with reasonable care. Do not roll or drag pipe over gravel or rock during handling. Take necessary precautions to ensure the method used in lifting or placing the pipe does not induce stress fatigue in the pipe. Use a lifting method that uniformly distributes the weight of the pipe along its axis or circumference. Repair minor damage to pipe when permitted. Remove pipe from the project that is severely damaged or is rejected as being unfit for use. Undamaged portions of a joint or section may be used where partial lengths are required.

Table 33 41 00 - 03

Nominal Inside Diameter (Inches)	Outside Diameter (Inches)	Minimum Wall Stiffness (psi)	Minimum Wall Thickness (Inches)

18	21.5	40.0	0.050
24	27.9	34.0	0.060
30	35.7	29.0	0.060
36	42.1	22.5	0.070
42	48.2	21.0	0.070

3.2 LAYING PIPE

1. Lay pipe according to the pipe manufacturer's recommendation.
2. Prepare pipe foundation
   i. Where material is found to be of poor supporting value or of rock and when an adjustment in the location of the pipe is not possible, undercut existing foundation materials within the limits established in the plans.
   ii. Backfill the undercut with foundation conditioning material.
   iii. Encapsulate the foundation conditioning material with foundation conditioning geotextile before placing bedding material. Overlap all transverse and longitudinal joints in the geotextile at least 18 inches.
   iv. Maintain the pipe foundation in dry conditions.
3. Place pipe carefully on the prepared foundation stating at the downstream end with the inside circumferential laps pointing downstream and with the longitudinal laps at the side or quarter points.
4. Use gasketed bell and spigot connections to join pipe segments.
5. Loosely place bedding material, in a uniform layer, a depth equal to the inside diameter of the pipe divided by 6 or 6 inches, whichever is greater. Leave bedding material directly beneath the pipe uncompacted and allow pipe seating and backfill to accomplish compaction. Excavate recesses to receive the bells where bells and spigot type pipe is used.
6. Place fill around the pipe in accordance with the applicable method shown in the plans in layers not to exceed 6 inches loose unless otherwise permitted by the CO. Compact each layer for its full width to a density equal to at least 95% of that obtained by compacting a sample of the material in accordance with AASHTO T 99. Uniformly bond all layers to preceding layers. Increase or increase moisture content of the material before compacting to produce the maximum density that will provide stable backfill.
7. Approval of the backfill material is required before its use. Use select material as shown in section 1.1 of this specification.
8. Take care during backfill and compaction operations to maintain alignment and prevent damage to the joints. Keep backfill free from stones, frozen lumps, chunks of highly plastic clay or other objectionable material.
9. Grade and maintain all pipe backfill areas in such a condition that erosion or saturation will not damage the pipe foundation or backfill.
10. Flowable fill may be used for backfill when approved by the CO. When using flowable fill, ensure that the pipe is not displaced and does not float during backfill. Submit methods for supporting the pipe and material placement to the CO for review and approval.
11. Do not operate heavy equipment over any pipe until it has been properly backfilled. Place, maintain and finally remove the required cover that is above the proposed finished grade.

Remove and replace pipe that becomes misaligned, shows excessive settlement or has been otherwise damaged by the Contractor's operations.

3.3 INSPECTION AND MAINTENANCE

Ensure proper jointing and that deformations do not exceed 7.5% as measured on the inside pipe diameter supplied by the manufacturer or actual measurements obtained on the project. Maintain all pipe installations in a condition such that they will function continuously from the time the pipe is installed until the project is accepted by the CO. The CO has the right to randomly video, deflection test, and/or manually inspect installations of completed pipelines prior to final acceptance.

Fully join pipe sections with leak-resistant seals using gasket, bell and spigot joints according to ASTM D3212.

3.4 ACCEPTANCE

Construction of storm drainage piping will be evaluated under Subsections 01 90 00 1.2 and 01 90 00 1.4.

Excavation and backfill will be evaluated under Section 02 41 20.

END OF SECTION 33 41 00.

SECTION 33 41 16.19 – PIPE UNDERDRAINS

PART 1 - GENERAL

1.1 SUMMARY

A. This work consists of furnishing and installing underdrains using perforated polyvinyl chloride (PVC) or high density polyethylene (HDPE) pipe.

B. Measurement Procedures
   1. Culvert piping will be measured at the unit price per linear foot.
   2. The lump sum contract bid price for pipe underdrains will include:
      - all testing required by the contract
      - all materials, labor and equipment required to install pipe underdrains.

C. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work.

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials
   1. AASHTO M 145 - Standard Specification for Classification of Soils and Soil–Aggregate Mixtures for Highway Construction Purposes

B. ASTM – ASTM International – formerly known as American Society for Testing and Materials
   1. ASTM D 3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
   2. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
   3. ASTM F 913 - Standard Specification for Thermoplastic Elastomeric Seals (Gaskets) for Joining Plastic Pipe

C. AWWA – American Water Works Association
   1. ANSI/AWWA C900 - PVC Pressure Pipe & Fab. Fittings 4"-12" (100Mm-300Mm) For Wtr. Dist.
   2. ANSI/AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)

D. FAR - Federal Acquisition Regulations
   1. FAR 46.105 Contractor responsibilities
   2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
   3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL

A. Shop Drawings
   1. Materials list of items proposed for the work.

2. Shop drawings or descriptive literature, or both, showing dimensions, joint and other details of all materials proposed for the work. Shop drawings shall be submitted to National Park Service (NPS) CO for approval prior to ordering material.

3. For existing features that are to be replaced to original condition photos shall be substituted in place of shop drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Smooth Wall Polyvinyl Chloride (PVC) Pipe.

PVC pipe (4-inches and over). Furnish pipe and fittings conforming to the requirements of ANSI/AWWA C900 or ANSI/AWWA C905, and listed by Underwriters Laboratories, Inc. Furnish joints conforming to the requirements of ASTM D3139 and using a restrained rubber gasket conforming to ASTM F477.

B. Smooth Wall Polyethylene (HDPE) Pipe

(a) Furnish perforated and nonperforated 4 - to 42-inch diameter pipe conforming to ASTM F714 and minimum cell Class PE335434C according to ASTM D3350.

C. Gaskets for Plastic Pipe.

(a) Elastomeric seals. Conform to ASTM F477.

(b) Thermoplastic elastomeric seals. Conform to ASTM F913.

D. Aggregate Backfill – See Section 32 11 23 Aggregate Base Course

E. Geotextile Fabric – See Section 31 32 19.23 Geotextile Layer Separation

PART 3 – EXCUTION

3.1 GENERAL

Elevate and protect sheets, panels, or rolls of geotextile filter with a waterproof and ultraviolet resistant cover if stored outdoors. Limit geotextile filter exposure to less than 10 days when using for a permanent installation.

Use the same material and coating on contiguous drain sections, extensions, elbows, branch connections, and other special sections.

Drain material, size, and approximate location are shown in the plans. Determine the final location and length in the field.

Do not install drain material until the CO has accepted the final location and length.

Excavate and backfill according to Section 31 00 00.

Smooth the trench surfaces by removing projections that may damage the geotextile filter. Replace geotextile filter damaged during installation.

Do not allow soil or other foreign material to enter the drain systems. Plug the upgrade end of installations.

Furnish nonperforated pipe for outlet pipe. Install outlet pipe according to manufacturer's specifications. Immediately place and secure a screen made of 0.055-inch diameter galvanized wire having approximately ½- by ½-inch mesh openings over the outlet ends of exposed pipes and weep holes.

3.2 PLACING UNDERDRAIN

Join pipe sections securely with coupling fittings or bands. Join PVC and HDPE pipe using either a flexible elastomeric seal or solvent cement. Join polyethylene pipe with snap-on, screw-on, or wrap around coupling bands as recommended by the manufacturer.

Backfill and compact trenches within the limits of the roadbed according to Section 31 00 00, except use granular backfill material.

When underdrain is placed in ditch lines, prevent infiltration of surface water by placing material conforming to AASHTO M 145, classification A-4, A-5, A-6, or A-7 in the top 12 inches of the trench.

(a) Place the long dimension of the geotextile filter parallel to the centerline of the trench. Position the geotextile filter, without stretching, in contact with the trench surface. Overlap the joints at least 24 inches with the upstream geotextile filter placed over the downstream geotextile filter.

Place collector pipe with the perforations facing downward.

Place granular backfill to a height of 12 inches above the top of the collector pipe and compact. Do not displace the collector pipe. Place and compact the remainder of the granular backfill material according to Section 31 00 00.

Fold the geotextile filter over the top of the granular backfill with a minimum overlap of 12 inches.

3.3 FINAL ACCEPTANCE

See Table 33 41 16.19 -1 for sampling, testing, and acceptance requirements.

Material (except granular backfill) for underdrains will be evaluated under this specification.

Granular backfill will be evaluated under Section 32 11 23.

Installation of underdrains will be evaluated under this specification.

Excavation and backfill will be evaluated under Section 31 00 00.

Geotextile filter will be evaluated under Section 31 32 19.23.

Outlet pipes will be evaluated under this specification.

Table 33 41 16.19 -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	Remarks
Source									
Granular backfill	Measured and tested for conformance	Quality	–	Subsection 32 11 23	1 per aggregate type and source of material	Source of material	Yes	Before using in work	Not required when using Government-provided source
Production									
Granular backfill	Measured and tested for conformance	Gradation	–	AASHTO T 27 & T 11	1 per 600 yd^3	Production output or stockpile	Yes	4 hours	–

END OF SECTION 33 41 16.19.

SECTION 33 42 11 – STORMWATER PIPE – WELDED STEEL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of furnishing and installing welded steel pipe culvert.

B. Measurement Procedures
   1. Pipe will be measured at the unit price per linear foot.

   2. The lump sum contract bid price for stormwater gravity piping will include:

      - all testing required by the contract

      - all materials, labor and equipment required to install stormwater piping.

C. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work.

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials
   1. AASHTO M 145 - Standard Specification for Classification of Soils and Soil–Aggregate Mixtures for Highway Construction Purposes

B. ASTM – ASTM International – formerly known as American Society for Testing and Materials
   1. ASTM A139 Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe

C. FAR - Federal Acquisition Regulations
   1. FAR 46.105 Contractor responsibilities
   2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
   3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL

A. Shop Drawings

   1. Materials list of items proposed for the work.

   2. Shop drawings or descriptive literature, or both, showing dimensions, joint and other details of all materials proposed for the work. Shop drawings shall be submitted to National Park Service (NPS) CO for approval prior to ordering material.

   3. Plan sketch and detailed narrative of means and methods for installation shall be submitted to the NPS CO for approval 14 days prior to onset of installation

PART 2 – PRODUCTS

3.1 MATERIALS

A. Welded Steel Pipe: Conform to ASTM A139

PART 3 – EXECUTION

3.1 PREPARATION

Use the same material and coating on contiguous pipe sections and special sections (such as elbows and branch connections). For culvert extensions, furnish the same material as the existing culvert.

Plans show the size, length, and approximate location of culverts. Contractor shall determine final location, skew, length, elevations, and grade in the field. Do not order culvert material until the CO has accepted the final structure size, length, and alignment.

Construct a piping plug unless the culvert inlet is protected with a full-height headwall, slope paving, or an embankment consisting of AASHTO M 145 classification A-6 or A-7 material. Construct the piping plug with AASHTO M 145 classification A-6, A-7, or other approved material with a permeability not exceeding 0.004 inches per second.

3.2 PROCESS

Install the pipe by trenchless construction, true to line and grade and so settlement does not occur. Fill all voids around the pipe. Replace installations that become damaged or have to be abandoned.

Conduct a pre-construction meeting in the presence of the CO at least 48 hours before the beginning of the pipe installation. The meeting shall consist of, but not be limited to:

Reviewing all installation methods to install the pipe true to the line and grade given,

Methods to insure there is no settlement of the pipe or of the completed roadway section and

Methods for filling any potential voids around the pipe.

3.3 FINAL ACCEPTANCE

Construction of storm drainage piping will be evaluated under this specification.

Excavation and backfill will be evaluated under Section 31 00 00.

END OF SECTION 33 42 11.

SECTION 33 42 23 – HEADWALLS AND ENDWALLS FOR STORMWATER PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of constructing, adjusting, shifting, or modifying headwalls and endwalls.

B. Measurement Procedures
1. Cast-in-place units will be measured for by the unit of cubic yard.
2. Precast units will be measured for by the unit of each.
3. Reinforcing Steel, unless otherwise noted, will be measured for by the unit of pounds.
4. Aggregate Base will be measured for by the unit of cubic yard.

C. Payment Procedures
1. The accepted work will be paid at the contract lump sum price for all work

1.2 REFERENCES
A. AASHTO - American Association of State Highway and Transportation Officials
1. AASHTO M 153 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
2. AASHTO M 213 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
3. AASHTO M 221 - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
4. AASHTO M 225 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
5. AASHTO M 254 - Standard Specification for Corrosion-Resistant Coated Dowel Bars
6. AASHTO M 31 - Standard Specification for Deformed and Plain Carbon and Low-Alloy Steel Bars for Concrete Reinforcement
7. AASHTO M 32 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
8. AASHTO M 33 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
9. AASHTO M 54 - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
10. AASHTO M 55 - Standard Method of Test for Steel Welded Wire Reinforcement, Plain, for Concrete
11. AASHTO M 322. - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

B. ASTM – ASTM International, formerly known as American Society for Testing and Materials
1. ASTM A 775 - Standard Specification for Epoxy-Coated Steel Reinforcing Bars
2. ASTM C 1619 - Standard Specification for Elastomeric Seals for Joining Concrete Structures
3. ASTM C 270 - Standard Specification for Mortar for Unit Masonry

4. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants
5. ASTM C 923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
6. ASTM D 1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber
7. ASTM D 5078 - Standard Specification for Crack Filler, Hot-Applied, for Asphalt Concrete and Portland Cement Concrete Pavements
8. ASTM D 6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

C. FAR - Federal Acquisition Regulations
1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL

A. Submit material certificate to the Engineer, signed by the material producer and Contractor, certifying that materials comply with these specifications and the construction plans.
B. Submit samples of concrete staining with a full range of potential colors for approval by the CO and Park prior to purchasing of materials.
C. Stain Test Wall with application of potential concrete stain colors.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Concrete. Conform to specification 03 30 53.

B. Gaskets for Concrete Pipe.

(a) Elastomeric seals. Conform to ASTM C1619, Class C.

(b) Resilient connectors. Conform to ASTM C923.

C. Mortar. Preblend or mix on site. Furnish and proportion mortar according to ASTM C270. Use masonry cement mortar Type M or Type S.

D. Neat hydraulic cement grout for miscellaneous applications. Furnish a grout consisting of a mixture of hydraulic cement, water, and admixtures. Do not exceed a water/cementitious material ratio of 0.44. Do not exceed 20 percent of the cement by mass if fly ash is used. Admixtures to reduce water content, improve the flowability, control bleeding, or control shrinkage may be added according to the manufacturer's recommendations. Furnish admixtures free of chlorides, fluorides, sulphites, and nitrates.

E. Reinforcing Steel

(a) General. Furnish the following information with each shipment of steel to the project:

(1) Name and location of the steel rolling mill;

(2) Manufacturing process;

(3) Heat numbers;

(4) Sizes;

(5) Specifications;

(6) Copies of mill test analyses for chemical and physical tests; and

(7) Consignee and destination of shipment.

(b) Reinforcing bars. Furnish deformed, Grade 60 (420) bars conforming to AASHTO M 31 or AASHTO M 322.

(c) Epoxy-coated reinforcing bars. Furnish bars conforming to reinforcing bars Subsection. Conform to ASTM A775.

Inspect the reinforcing bars after the near white blast cleaning. Reject bars with steel slivers or scabs. Selective sorting and rejection at the fabricator's shop may avoid unnecessary delays and subsequent rejection of bars during the precoating inspection at the coating applicator's shop.

F. Coat epoxy-coated reinforcing steel in a plant certified by CRSI as a fusion bonded epoxy applicator.

(d) Tie bars. Furnish deformed, Grade 60 (420) bars conforming to AASHTO M 31.

(e) Hook bolts. Furnish plain, Grade 60 (420) bars conforming to AASHTO M 31 with M14 rolled threads or M16 cut threads. Furnish a threaded sleeve nut capable of sustaining a minimum axial load of 15,000 pounds (67 kilonewtons).

(f) Dowel bars. Conform to AASHTO M 254, Type A or Type B. Use plain round bars, without burring or other deformation restricting free movement in the concrete. Paint half the length of each dowel bar with one coat of tar paint. When the paint dries and immediately before placing the dowels, lubricate the painted end to prevent concrete from bonding to the painted end.

For expansion joints, furnish a dowel cap that snugly covers 2±¼ inches (50±6 millimeters) of the dowel, has a closed end, and has a suitable stop to hold the closed end 1 inch (25 millimeters) from the end of the dowel bar.

Lubricants for Type B dowels may be medium setting emulsified asphalt or a flaked graphite. Lubricants are not required for Type A coated dowel bars.

Furnish dowel assemblies that hold dowel bars within ¼-inch (6-millimeter) tolerance vertically and horizontally during concrete placement and permit unrestricted movement of the pavement slab.

Use wire conforming to AASHTO M 32 for dowel assemblies. Coat dowel assemblies with the same material as the dowel bar. Recoat or repair damaged coatings equivalent to the manufacturer’s original coating.

(g) Deformed steel wire. Conform to AASHTO M 225.

(h) Steel welded wire reinforcement, plain, for concrete. Conform to AASHTO M 55.

(i) Cold-drawn steel wire. Conform to AASHTO M 32.

(j) Welded deformed steel wire fabric. Conform to AASHTO M 221.

(k) Fabricated deformed steel bar or rod mats. Conform to AASHTO M 54.

(l) Low alloy steel deformed bars. Conform to ASTM A706.

G. Sealants, Fillers, and Seals. Conform to the following:

(a) Joint sealants and crack fillers.

(1) Joint and crack sealant, hot-applied, for concrete and asphalt concrete pavements	ASTM D6690, Type II or Type III
(2) Crack filler, hot-applied, for concrete and asphalt concrete pavements	ASTM D5078

(3) Proprietary asphalt-rubber products, furnish the following:

(a) Source and grade of asphalt binder;

(b) Total quantity of granulated rubber and mass as a percent of asphalt-rubber mixture;

(c) Granulated rubber types and quantity of each type (if blend);

(1) Mass as a percent of combined rubber; and

(2) Gradation of granulated rubber.

(d) Type of asphalt modifier, if any;

(e) Quantity of asphalt modifier and mass as a percent of asphalt binder;

(f) Other additives;

(g) Heating and application temperatures; and

(h) Manufacturer's recommended application procedures.

(4) Elastomeric joint sealant	ASTM C920, Type M, Grade P,Class 25, Use T1 or T2
(5) Flexible cellular joint filler	ASTM D1056, Type 2, Class B or Class C, Grades 3, 4, or 5

(b) Preformed expansion joint fillers. Furnish in a single piece for the depth and width required for the joint.

(1) Preformed expansion joint filler for concrete (bituminous type)	AASHTO M 33
(2) Preformed sponge rubber expansion	AASHTO M 153, Type I

joint filler for concrete paving and structural construction	
(3) Preformed cork expansion joint filler for concrete paving and structural construction	AASHTO M 153
(4) Preformed expansion joint filler for concrete paving and structural construction (nonextruding and resilient bituminous types)	AASHTO M 213

H. Penetrating Stain for Concrete. Provide coatings on the Master Painters Institute (MPI) approved products list #58.

I. Stain Test Wall or Approved Concrete Surface. Prior to stain application, the Contractor shall construct a Stain Test Wall, a minimum of 36" high by 24" wide by 6" deep to evaluate concrete stain. Cast the Test Wall on site using the same forming methods, procedures, form liner, texture configuration, concrete mixture, and stain application proposed for the production work. Demonstrate the quality and consistency of end treatment, top treatment, back treatment, if applicable on the Stain Test Wall. If the Stain Test Wall is rejected by the CO a new test wall shall be constructed. Stain application shall not begin until the Stain Test Wall has been approved by the CO. Dispose of the Stain Test Wall after use.

In lieu of the constructed Stain Test Wall, the CO may approve an on site surface for stain testing evaluation purposes.

PART 3 – EXECUTION

3.1 PREPARATION

Excavate and backfill according to Section 31 00 00.

Construct minor concrete according to Section 03 30 53.

3.2 CONCRETE CONSTRUCTION

Concrete units may be cast-in-place or precast.

Finish the flow line in headwalls and endwalls to match the pipe flow line.

Assemble precast units with flexible gaskets or fillers in the tongue and groove joints. Handle the precast units carefully after the gasket has been attached to avoid damaging the gasket or contaminating the joint. Attain the proper alignment before the joints are forced home. Ensure gasket is uniformly seated. Apply mastic joint filler according to manufacturer's recommendations if mastic is used.

3.3 SHIFTING AND MODIFYING STRUCTURES

Shift structures using methods to ensure structural integrity. Reshape the channel flow line in the headwall or endwall as necessary to match the pipe flow line.

Furnish and install gaskets, seals, and other accessories according to the applicable requirements of Subsections 3.2 Finish mortar joints with a bead on the outside and a smooth finish on the inside.

When modifying a concrete structure, do not cut the concrete and reinforcing steel in a manner that loosen the reinforcement in the wall. Cut the reinforcing steel flush with the opening wall face. Grout joints and openings cut in the wall.

Seal openings no longer required in the structure.

When an existing structure is abandoned, seal pipes entering the structure with a tight-fitting plug of concrete at least 6 inches thick or watertight masonry at least 8 inches thick. Ensure the structure does not entrap water. Obliterate the top of the structure to an elevation at least 36 inches below finished grade and backfill according to 31 00 00.

3.4 FINAL ACCEPTANCE

Material for metal, concrete brick, concrete masonry, precast concrete units, and cast-in-place concrete (except concrete) units will be evaluated under this specification.

Concrete for cast-in-place concrete units will be evaluated under Section 03 30 53.

Construction of metal, concrete brick, concrete masonry, and cast-in-place concrete units will be evaluated under this specification.

Installation of precast concrete units will be evaluated under this specification. Shifting,

modifying, and adjusting units will be evaluated under this specification. Excavation and

backfill will be evaluated under Section 31 00 00.

END OF SECTION 33 42 23.

SECTION 33 42 31 – STORMWATER AREA DRAINS AND INLETS

PART 1 - GENERAL

1.1 DESCRIPTION

D. This work consists of the installation of all drop inlets, catch basins, junction boxes, frames, covers, appurtenant equipment and all work included thereto as shown on the Drawings and specified herein.

E. Measurement Procedures
1. Cast-in-place units will be measured for by the unit of cubic yard.
2. Precast units will be measured for by the unit of each.
3. Reinforcing Steel, unless otherwise noted, will be measured for by the unit of pounds.
4. Aggregate Base will be measured for by the unit of cubic yard.

F. Payment Procedures
1. The accepted work will be paid at the contract lump sum price for all work

1.2 REFERENCES
A. ASTM – ASTM International, formerly known as American Society for Testing and Materials
1. ASTM A 614 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
2. ASTM C 270 - Standard Specification for Mortar for Unit Masonry
3. ASTM C 443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
4. ASTM C 478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
5. ASTM D 4101 - Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials

B. FAR - Federal Acquisition Regulations
1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL
A. Submit material certificate and shop drawings to the Engineer, signed by the material producer and Contractor, certifying that materials comply with these specifications and the construction plans. Shop drawings shall be provided for:
a. Structures
b. Boots
c. Frames, Grates, and Covers
d. Mortar
e. Steps
f. Gaskets

PART 2 – PRODUCTS

2.1 MATERIALS

C. Concrete. Conform to specification 03 30 53.

D. Mortar. Preblend or mix on site. Furnish and proportion mortar according to ASTM C270. Use masonry cement mortar Type M or Type S.

E. Precast Reinforced Concrete Manholes. Where Precast Reinforced Concrete Manholes are specified for drainage inlets, they must be constructed in accordance with these Specifications and as shown on the Drawings

F. Precast Drainage Catch Basin.

a. Dimensions and construction shall be as shown on Plans.

b. Grates and curb boxes shall be as shown on Plans.

c. Structures with full depth of structure walls and a loose top slab shall not be considered acceptable.

PART 3 – EXECUTION

3.4 CONNECTIONS

A. All connections of storm sewer pipes to drainage structures shall be made with a rubber boot.

1. The boot shall be secured to the pipe and drainage structure with stainless steel clamps

B. All joints in drainage structures for storm sewers shall be sealed with rubber gasket “O-rings”.

3.5 ADJUST RING FRAME AND CASTING

A. Adjusting Frames and Ring Castings in Paved Areas.

1.After completion of the PCC Paved areas, the Contractor shall uncover and raise all castings as specified.

2. The castings shall be set within 1/4 to 1 inch below the proposed finished grade of the street.

3. Aggregate base shall be placed around the casting to match the adjacent section and shall be compacted to the required density.

4. Final street surface course material shall then be placed and compacted flush with the adjacent wearing course.

5. The cost of the materials required for backfilling around the castings and/or water valve boxes shall be included in the bid price for the contract and no direct compensation will be made therefor.

B. Adjusting Frame and Ring Castings in Areas with Aggregate Surfacing or Turf

1. In areas with aggregate surfacing, the top of casting shall be approximately 3 to 6 inches below the top of the surface.

2. In areas where there is turf around the casing, the casing shall be flush with the ground.

C. Adjusting castings of new and existing drainage structures shall be considered part of the bid price and no measurement will be made and no additional compensation will be made therefor.

3.6 FINAL ACCEPTANCE

Installation of precast concrete units will be evaluated under this specification.

Shifting, modifying, and adjusting units will be evaluated under this specification.

Excavation and backfill will be evaluated under Section 31 00 00.

END OF SECTION 33 42 31.

SECTION 33 42 41 - GRATINGS AND FRAMES FOR STORMWATER DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal frames and accessories.

B. Related Requirements:

1. Section 33 42 31 – Stormwater Area Drains and Inlets
2. Section 32 12 16.03 – Asphalt Pavement – Statistically Accepted

1.2 DEFINITIONS

A. ADA: Americans with Disabilities Act.

1.3 REFERENCE STANDARDS

A. General: Use most current standard, unless otherwise indicated by specific date.

B. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO M 306 - Standard Specification for Drainage, Sewer, Utility, and Related Castings**.**

C. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A48 - Standard Specification for Grey Iron Castings.
3. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. ASTM E303 - Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester

D. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

1.4 COORDINATION

A. Coordinate Work of this Section with:

1. Placement of frames.
2. Size of cast-in-place curb and pavement openings.
3. Premanufactured drainage assemblies provided under other Sections.

1.5 SUBMITTALS

A. Product Data: Indicate compliance with applicable Reference Standards.

B. Shop Drawings: Indicate details of each type and size of grate, component supports, anchorages, openings, perimeter construction details, and tolerances.

1. Where custom design or layout has been furnished by the Design Professional, submit CAD file, in addition to other Drawings, to indicate compliance with design intent.
2. Where intent of Design Professional cannot be met due to size, material, or casting limitations, clearly indicate exceptions on Submittal documents.
3. Submit grating Shop Drawings in coordination with submittals for drainage assemblies furnished under other Sections.

C. Submit manufacturer information illustrating finish, color, and texture. Provide manufacturer's guide specifications.

D. Delegated Design Submittals: Submit certified AASHTO ratings or signed and sealed Shop Drawings with design calculations for gratings subjected to vehicular loads.

1. Licensed Professional: Engineer experienced in design and anchorage of load-bearing trench grates and licensed at Project location.

1.6 QUALIFICATIONS

A. Welders and Welding Procedures: AWS D.1 qualified within previous 12 months for employed weld types.

1.7 WARRANTY

A. Provide manufacturer's standard one-year warranty on products and assemblies.

1.8 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements of conditions affecting drainage grates prior to fabrication. Indicate field measurements provided by General Contractor or other parties on Shop Drawings

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. General: Conform to local code(s) as indicated on Drawings for applicable loads.

B. Load Designation: 40,000 lb. (178kN) as measured per AASHTO M 306.

2.2 GRATE MATERIALS

A. Cast Iron: ASTM A48, CL 30 or better.

2.3 FABRICATION

A. Fabricate drainage gratings to accommodate design loads and to sizes indicated.

B. Fabricate grates to comply with ADA for maximum opening size, offset of surfaces, and slip resistance. Grates shall have a minimum slip resistance (Pendulum Test Value) of 5.5 or better, per ASTM E303.

2.4 GRATE FINISHES

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Cast Iron - As cast, no finish.

2.5 ACCESSORIES

A. Vandal Resistant Bolts: Stainless steel, 1/4 x 20 fasteners. Prefabricate frames with fasteners where shown on Shop Drawings.

1. Fasteners to attach drainage grates in this Section to drain bodies specified under other Sections must be provided by manufacturers of those products.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that overall opening sizes and dimensional tolerances are acceptable.

B. Verify that fixtures placed by other trades are completed, and that openings and penetrations are accurately positioned.

C. Verify that preparation work is complete, including removal of soil material and trash from trench and area drain assemblies.

3.2 INSTALLATION

A. For cast-in-place frames, furnish to entity responsible for adjacent curbs or pavements.

B. For field-anchored frames, anchor by expansion bolts to prepared openings using anchors of type and number recommended by manufacturer.

C. Ensure that top of [frame] [and] [grating] is flush with, or no greater than 1/8-inch lower than, adjacent pavement surfaces.

D. Place gratings securely in prepared openings, with no warping or slippage.

E. Secure where indicated, or as needed to prevent movement. Allow for maintenance removal.

3.3 TOLERANCES

A. Maximum Space Between Adjacent Sections: 1/4-inch.

B. Maximum Variation from Top Surface Plane of Adjacent Sections: 1/8-inch.

3.4 PROTECTION AND CLEANING

A. Protect completed gratings until time of Substantial Completion.

B. Clean damaged coatings according to manufacturer recommendations.

END OF SECTION 33 42 41

SECTION 33 47 26.09 – REGENERATIVE STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1. DESCRIPTION

A. This work consists of excavation, grading and lining of regenerative stormwater conveyances (RSC).

1.2. REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials
1. AASHTO T 210 - Standard Method of Test for Aggregate Durability Index
2. AASHTO T 85 - Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate

B. ASTM - ASTM International, formerly known as American Society for Testing and Materials
1. ASTM D 276 - Standard Test Methods for Identification of Fibers in Textiles
2. ASTM D 3786 - Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method
3. ASTM D 4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus
4. ASTM D 4362 - Standard Specification for Propane Thermophysical Property Tables
5. ASTM D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity
6. ASTM D 4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles
7. ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
8. ASTM D 4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile
9. ASTM D 4833 - Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
10. ASTM D 5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles
11. ASTM D 6140 - Standard Test Method to Determine Asphalt Retention of Paving Fabrics Used in Asphalt Paving for Full-Width Applications

C. FAR - Federal Acquisition Regulations

1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

1.4 SUBMITTAL

A. Submit material certificate to the Engineer, signed by the material producer and

Contractor, certifying that materials comply with these specifications and the construction plans.

B. Submit samples, actual stone or photographs, of boulder material demonstrating potential colors for approval by the CO and Park prior to purchasing of materials.

PART 2 – PRODUCTS

2.1 MATERIALS

Stone/Rock and Gravel shall conform to the following requirements:

A. Boulders for rock step pools shall be imported imbricated riprap.
B. Boulders for rock step pool shall meet the dimension requirements listed in the plan details.
C. Gravel bed material shall meet the requirements listed in the plan details.
D. Installation shall be in accordance with these specifications and as directed by the Engineer.
E. All filter fabric installed as part of the RSC Structure shall be a non-woven fabric meeting specifications in section 31 25 00 14.

PART 3 – EXECUTION

3.1 GENERAL

Regenerative Stormwater Conveyances (RSC) shall be constructed according to the details shown on the plans or as directed by the CO. The elevation tolerance will be +/-0.1ft of design elevations. Footer rocks shall extend inward toward the center of the pool, past the header rocks so that the footers act as a splash rock.

The Step-Pool structures shall be constructed in a manner such that adjoining rocks taper up in elevation towards the stream bank in a downstream direction. Each side or arm of the structure is to be angled 20 to 30 degrees from the stream bank towards mid-channel.

A trench shall be excavated for the structure. The width of excavation in the direction of flow shall be a minimum of one foot wider than the structure. After the footer rocks are placed in the downstream edge of the trench, the trench shall be backfilled to the proposed invert with the specified gravel mix.

Top rocks shall be placed so that they lean on the footer rocks and fit snugly together in an interlocking fashion. Care should be taken when placing top rocks that the seams between top rocks do not line up with the seams between the footer rocks. The top elevation of the stones placed at the center and lowest portion of the inflowing culvert shall be equal to the elevation of the culvert invert. Adjacent rocks shall taper up to the left and right to create a bowl-shaped rock structure and pool of dimensions specified on the plans.

The finished surface of plunge pools shall not vary more than 1-1/2” when measured with an 8’ metal straight edge parallel to centerline of structure or within 1” when measuring the full width of plunge pool perpendicular to structure center line.

Erosion Control Matting shall be keyed in between the boulder structures and the natural ground , then folded behind and overtop the top boulder. Reshape the slopes to specified elevations and fold the matting over the face of the slope. Key the matting back into the slope as detailed in the plans

3.2 ACCEPTANCE

Construction of Regenerative Stormwater Conveyance will be evaluated under Sections 01 90 00 1.2 and 01 90 00 1.4.

Excavation and backfill will be evaluated under Section 02 41 20.

END OF SECTION 33 47 26.09.

34 01 00 – MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.1 DESCRIPTION

A. All requirements for maintenance of traffic shall be in accordance with the latest edition of the Manual of Uniform Traffic Control Devices and all reference documents

B. This work consists of controlling and protecting public traffic adjacent to and within the project. See FAR Clause 52.236-13 Accident Prevention.

C. Measurement Procedures
   1. Maintenance of traffic measures will be measured by lump sum. The lump sum contract bid price for maintenance of traffic will include all materials, labor and equipment required to maintain traffic.

D. Payment Procedures
   1. The accepted work will be paid at the contract lump sum price for all work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All requirements for maintenance of traffic shall be in accordance with the latest edition of the Manual of Uniform Traffic Control Devices and all reference documents. Commercial grade, and high intensity reflectivity, where applicable.

PART 3 - EXECUTION

3.1 Accommodating Traffic During Work. Accommodate traffic according to the MUTCD, contract traffic control plan, Section 34 01 00, and this Section. An alternate traffic control plan may be submitted for approval Submit alternate traffic control plans at least 30 days before intended use. Perform work in a manner that ensures the safety and convenience of the public and protects the residents and property adjacent to the project. Accommodate public traffic on roads adjacent to and within the project until the project is accepted according to Section 01 90 00. For temporary pavement markings and markers, see Section 32 17 23.13

Noncompliance will result in a reduction in payment to the Contractor. This reduction in payment will be subtracted from the Contractor's progress payments and will be unrecoverable.

3.2 MAINTAINING ROADWAYS DURING WORK.

A. Maintain roadways as follows:

1. Construct and remove roads as required by the traffic control plan;
2. Maintain intersections with trails, roads, streets, businesses, parking lots, residences, garages, farms, and other features;
3. Snow removal to facilitate the work is the Contractor's responsibility. Snow removal to provide public access is the responsibility of the maintaining agency and will be performed at the maintaining agency's discretion. Allow the maintaining agency access to perform snow removal;
4. Maintain a dust-free traveled way such that visibility and air quality are not affected and a hazardous condition is not created;
5. Remove accumulations of soil and other material from traveled way;
6. Do not allow water to pond on the traveled way; and
7. Maintain the roadway, detours, and diversions in a safe and acceptable condition. If corrective action is requested and the corrective action is not taken immediately, the condition may be corrected and the cost of the corrective action deducted from monies due the Contractor.

3.3 MAINTAINING ROADWAYS DURING NON-WORK PERIODS.

A. Maintain roadways and traffic control for public traffic during periods when work is not in progress. Snow removal to provide public access is the responsibility of the maintaining agency.

3.4. LIMITATIONS ON CONSTRUCTION OPERATIONS.

A. When the roadway is open to public traffic, restrict operations as follows:
1. Operate equipment in the direction of traffic, where practical;
2. For shoulder drop-offs of 3 inches (75 millimeters) or less, provide "*Low Shoulder*" warning signs. For shoulder drop-offs in excess of 3 inches (75 millimeters), provide a 1V:3H fillet with "*Shoulder Drop-Off*" warning signs. Complete the construction of shoulders adjacent to traffic lanes to the same elevation within 14 days;
3. Provide minimum lane widths of 10 feet (3 meters). Use barricades, drums, or other acceptable devices to delineate traffic lanes through areas where the edge of pavement or intended path has been obliterated by construction operations;
4. Locate staging areas at least 30 feet (9 meters) from the traveled way or behind acceptable traffic barriers. Obtain approval of the location and access to staging areas. Store unused traffic control devices at staging areas;
5. Park equipment at least 30 feet (9 meters) from the traveled way or behind acceptable traffic barriers;
6. Provide parking areas for employee's personal vehicles in approved areas;
7. Provide uninterrupted two-way communications between flaggers and also between flaggers and pilot cars unless flaggers are able to see each other and communicate. Use communications devices approved by the CO. Citizen band radios are unacceptable. Make communication devices available to the CO as necessary;

8. Where switching traffic to a completed lane, provide adequate personnel and equipment to set or relocate traffic control devices;
9. Limit construction-caused delays to public traffic to a maximum of 30 minutes per passage through the project; and
10. Maintain existing guardrails, barriers, and bridge railings until removal is necessary for construction. Use a temporary barrier or appropriate channelizing devices while the guardrails and bridge rails are absent. Install permanent barriers, guardrails, and bridge rails as soon as possible to minimize risk to the public.
11. Perform work such that no more than one lane in either direction is restricted at any time.

3.5. NIGHTTIME OPERATIONS.

Perform construction operations during the hours of daylight (one-half hour after sunrise to one-half hour before sunset). Where night operations are permitted, submit a night lighting system for approval. Include the light types, locations, and the manner in which the lights will be moved. Submit the proposed system at least 14 days before use. Use an independent source other than vehicle headlights. Do not use incandescent lights. Furnish and install the approved system to illuminate the entire work area. Position the lights so they do not shine directly at motorists traveling from any direction. If the operation is moving, move the lighting with the operation. Provide lighting at each flagger location. Equip vehicles with an exterior flashing yellow dome light.

3.6. TRAFFIC CONTROL SUPERVISOR.

A. Provide a traffic control supervisor Furnish the traffic control supervisor's name, address, and 24-hour telephone numbers at the preconstruction conference. During the contract, including periods of suspensions and work stoppages, perform the following:
1. Implement the traffic control plan.
2. Coordinate traffic control operations, including those of subcontractors and suppliers.
3. Ensure the condition, position, and applicability of traffic control devices in use.
4. Immediately correct traffic control deficiencies.
5. Coordinate traffic control maintenance operations with the CO.
6. Coordinate and ensure that traffic control devices are furnished, installed, maintained, removed, stored, replaced, relocated and cleaned. Ensure unused traffic control devices are properly handled and stored.
7. Conduct weekly traffic safety meetings for construction workers and invite the CO to these weekly meetings.
8. Submit a weekly certification that inspections and reviews were conducted and that the traffic control devices meet contract requirements. Include the number and types of devices in use. Report with the weekly certification, changes or corrective actions taken to ensure the safe passage of public traffic through the project.
9. Inspect traffic control devices, including those in staging, storage, material sources, and disposal areas, as follows:

a. Daily during daylight hours when daylight work is being performed;
b. Daily during hours of darkness when nighttime work is being performed;
c. Weekly during:
   (1.) Daylight hours and hours of darkness when work is suspended for periods of more than one week, except when the project has been shut down for the winter; and
   (2.) Periods of winter suspension, inspect only as requested by the CO.
d. Additional inspections, day or night, as directed by the CO; and
e. Submit reports of inspections in an acceptable format within 2 days.

10. Before winter suspension, conduct an inspection of the project with the CO to ensure proper provisions are made for winter travel during the period of suspension.
11. Provide temporary flagging assistance.

PART 4 – ACCEPTANCE

4.1 ACCEPTANCE

A. Public traffic work will be evaluated under 01 90 00, Acceptance of Work**.**

END OF SECTION 34 01 00.

SECTION 34 71 13.26 — GUARDRAIL

PART 1 – GENERAL

1.1 Description

A. This work consists of installing guardrail systems with Reactive Treatment of Galvanized Surfaces coating and modifying, removing and resetting, and raising existing guardrail systems.

(a) Guardrail systems are designated as follows:

CRG — Curved radius W-beam guardrail
G2 — Type 31 W-beam (Strong Post)
G3 — Box beam
G4 — Blocked-out W-beam standard barrier

(b) Steel guardrail types are designated as follows:

I — Zinc-coated, 1.80 ounces per square foot
II — Zinc-coated, 3.60 ounces per square foot
III — Painted rails

(c) Steel guardrail classes are designated as follows:

A — Metal thickness — 0.105 inches (12-guage)
B — Metal thickness — 0.135 inches (10-guage)

(d) Terminals consist of posts, railing, hardware, and anchorage assembly necessary to construct the type of terminal specified. Terminal types are designated as follows:

Flared — Straight or parabolic flared W beam terminal
G4-BAT — Back slope anchor terminal
G4-CRT — Cable releasing terminal
SBT-BAT — Back slope anchor terminal
SBT-FAT — Flared SBT anchor terminal
SBT-Tangent — Tangent SBT terminal
Tangent — Tangent W beam terminal

B. Measurement Procedures
1. Guardrail will be measured for by the unit of linear foot.
2. Posts will be measured for by the unit of each.
3. End sections will be measured for by the unit of each.

C. Payment Procedures
1. The accepted work will be paid at the contract lump sum price for all work described in this section.

1.2 REFERENCES
A. AASHTO - American Association of State Highway and Transportation Officials
1. AASHTO M 111 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings

on Iron and Steel Products

2. AASHTO M 133 - Standard Specification for Preservatives and Pressure Treatment Processes for Timber
3. AASHTO M 168 - Standard Specification for Wood Products
4. AASHTO M 180 - Standard Specification for Corrugated Sheet Steel Beams for Highway Guardrail
6. AASHTO M 30 - Standard Specification for Metallic-Coated Steel Wire Rope and Fittings for Highway Guardrail
9. AASHTO/AWS D1.5 - Bridge Welding Code D1.5
10. AASHTO-AGC-ARTBA - A Guide to Standardized Highway Barrier Hardware.

B. ASTM – ASTM International

1. ASTM A242 - Standard Specification for High-Strength Low-Alloy Structural Steel
2. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
3. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
4. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
5. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric)
6. ASTM A6 - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
7. ASTM D 4956 - Standard Specification for Retroreflective Sheeting for Traffic Control

C. AWS – American Welding Society

1. AWS D1.1 - Structural Welding Code – Steel

D. FAR - Federal Acquisition Regulations

1. FAR 46.105 Contractor responsibilities
2. FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
3. FAR 52.246-12 Inspection of Construction

1.3 SUBMITTAL

1. Contractor shall submit drawings for typical guardrail post and beam sections.
2. The Contractor shall submit drawings to the CO from the manufacturer for flared or tangent terminals are required for approval. Do not order material or begin fabrication until CO's approval has been obtained.
3. Contractor shall submit Reactive Treatment for Galvanized Surfaces coating for review and approval.

PART 2 - MATERIAL

2.1 Conform to the following Section and Subsections:

(a) Guardrail block

(1) Steel. Furnish steel conforming to Subsection 2.1(d)(1).

(3) Plastic or composite. Furnish blocks that are crashworthy. Provide a new homogeneous block with uniform texture that does not crack, chip, flake, peel, or splinter after fabrication.

(b) Guardrail hardware

Furnish hardware conforming to AASHTO-AGC-ARTBA, *A Guide to Standardized Highway Barrier Hardware*.

For structural tubing for short steel posts, conform to ASTM A500 or ASTM A513, Grade 1008.

Galvanize soil plates and structural tubing according to AASHTO M 111. Do not punch, drill, cut, or weld the metal after galvanizing.

Manufacture reflector tabs from 0.15-inch aluminum or plastic. Use an adhesive that resists peeling with a force of 5 pounds per inch of width. Use mildew-resistant adhesive that has no staining effect on retroreflective sheeting. Furnish retroreflective sheeting conforming to ASTM D4956, including supplementary requirements.

(c) Guardrail nuts, bolts, and cables

(1) Galvanized nuts and bolts. Furnish nuts conforming to ASTM A563, Grade A. Furnish bolts conforming to ASTM A307, Grade A.

(2) Cable. Furnish cable conforming to AASHTO M 30, Type II, Class A.

(d) Guardrail posts

(1) Steel. Furnish posts of the appropriate size shape according to ASTM A6.

(e) Minor concrete

Furnish Minor Concrete conforming to Section 03 30 53, Cast In Place Concrete.

(f) Rail elements

(1) Metal beam rail. Furnish metal beam rail conforming to AASHTO-AGC-ARTBA, *A Guide to Standardized Highway Barrier Hardware*.

A. Galvanized steel. Furnish W-beam or three beam rail fabricated from corrugated sheet steel conforming to AASHTO M 180 for the designated shape, class, type, and mass of coating specified;

(2) Box beam rail. Furnish steel box beam rail conforming to AASHTO-AGC-ARTBA, *A Guide to Standardized Highway Barrier Hardware*.

(g) Coating. Furnish all steel elements coated with a Reactive Treatment for Galvanized Surfaces coating.

PART 3 – EXECUTION

3.1 PREPARATION:

Furnish guardrail systems and terminals that are crashworthy. When flared or tangent terminals are required, submit drawings from the manufacturer for the terminals according to the FAR Clause 52.236-21 Specifications and Drawings for Construction..

Place concrete according to Section 03 30 53, Cast In Place Concrete.

Perform welding according to AASHTO/AWS, *Bridge Welding Code D1.5* for welding, welder qualifications, prequalification of weld details, and inspection of welds. For tubular connections, conform to AWS, *Structural Welding Code – Steel, D1.1 Section 2, Part D*.

Do not weld or tack brackets, clips, shipping devices, or other non-required material to members unless shown on the drawings.

3.2 INSTALLATION

1. Post Installation.

Treat field cuts for wood posts with two coats of preservative specified in Subsection 2.1(d). Do not place field cuts in contact with the ground.

Install the posts plumb and at the location, spacing, and elevation specified, or as directed by the CO.

When the pavement surface is within 36 inches of the guardrail face, install posts before placing the pavement surface. Protect posts from traffic by attaching the rail elements or by a method approved by the CO.

Posts may be installed by either drilling or driving. Ensure posts installed by drilling have sufficiently sized holes to permit thorough compaction of backfill material around the post. Backfill in compacted layers not exceeding 12 inches. Replace posts damaged during driving operations.

When a post cannot be placed at its normal location due to an impenetrable object an additional blockout may be added. If the post cannot be offset, follow the post in rock detail or use the long span detail as shown in the plans or as approved by the CO. Do not change the post lengths or spacings in terminal sections.

When it is not possible to maintain a 24-inch minimum distance between the back of the guardrail post and the top of a 1V:2H or steeper slope, increase the standard post length by 12 inches.

2. Rail Element Installation.

Do not modify specified hole diameters or slot dimensions.

(a) Steel rail. Shop bend curved guardrail with a radius of 150 feet or less.

Install rail elements in a smooth continuous line with the laps in the direction of traffic flow. Use bolts that extend at least ¼ inch, but not more than 1 inch beyond the nuts.

Paint scrapes on galvanized surfaces that expose the base metal with two coats of zinc-oxide paint.

(b) Steel-backed timber and log rail. Treat field cuts with two coats of preservative.

3. Terminal Sections.

Do not connect the guardrail to cast-in-place anchors until the concrete has cured 7 days. Install end anchor cables without slack.

4. Guardrail Construction Exposed to Traffic.

When a roadway is open to traffic during construction, complete guardrail installations within 5 days from the day the structure, pavement, shoulder, or whichever is the controlling item of work is sufficiently completed to allow guardrail installation. In areas where guardrail construction is not restricted by other construction, complete removal of existing guardrail and construct new guardrail within 48 hours of starting work.

At the end of each day, securely bolt a rounded end section to the exposed end of the guardrail.

Schedule guardrail installation so work is finished before work suspension or other extended periods of time.

6. Removing and Resetting Guardrail.

Remove and store the existing rail elements, posts, and appurtenances. Remove and dispose of posts that are set in concrete. Replace guardrail, posts, and hardware damaged during removal, storage, or resetting. Backfill holes resulting from the removal of guardrail posts and anchors with material approved by the CO. Dispose of material not used in resetting guardrail according to Section 02 41 19.

7. Raising Guardrail.

Remove the existing rail elements and appurtenances. Replace and reset posts as needed. Replace rail elements, posts, and hardware damaged during the removal and raising. Dispose of damaged material according to Section 01 74 19.

3.3 ACCEPTANCE

Material for guardrail will be evaluated under Subsection 01 90 00.

Construction of guardrail will be evaluated under Subsections 01 90 00.

Welding will be evaluated under the welding standards listed above.

END OF SECTION 34 71 13.26.

SECTION 44 11 13 – WATERING FOR DUST CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of furnishing and applying water for the control of dust caused by the work and public travel.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Water – Furnish water free of substances detrimental to the work.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide an adequate water supply and apply water uniformly across the traveled way as necessary to control dust. Uniformly apply water using pressure-type distributors, pipelines equipped with spray systems, or hoses with nozzles.

B. Project dust control for public benefit.

1. Control dust within the construction limits as necessary including nights, weekends, and periods of non-work when the project is open to public traffic. When the project is not open to public traffic, control dust in areas of the project that have adjacent residences or businesses. Control dust on approved, active detours established for the project. Apply water at the locations, rates, and frequencies as ordered.

C. Other dust control.

1. Control dust on active haul roads, in pits and staging areas, and on the project during periods not covered in Subsection 3.1.B.(1)

D. Acceptance

1. Removal of existing pavement markings will be evaluated under Subsections 01 90 00 1.2 and 01 90 00 1.4in