

1. Dispose of all materials cleared and grubbed from the designated areas at locations shown on the drawings or in a manner specified in Section G. The contractor is responsible for complying with all local rules and regulations and the payment of any fees that may result from disposal at locations away from the project site.

F. Measurement and Payment

1. Method 1.
 - a. For items of work for which specific unit prices are established in the contract, the cleared and grubbed area is measured to the nearest 0.1 acre. Payment for clearing and grubbing is made for the total area within the designated limits at the contract unit price. Such payment will constitute full compensation for all labor, equipment, tools, and other items necessary and incidental to the completion of the work.
2. Method 2.
 - a. For items of work for which specific unit prices are established in the contract, the length of the cleared and grubbed area is measured to the nearest full station (100 feet) along the line designated on the drawing or identified in the specifications. Payment for clearing and grubbing is made for the total length within the designated limits at the contract unit price. Such payment will constitute full compensation for all labor, equipment, tools, and other items necessary and incidental to the completion of the work.
3. Method 3.
 - a. For items of work for which specific unit prices are established in the contract, each tree, stump, and snag having a diameter of 4 inches or larger and each log having a diameter of 4 inches or larger and a length of 10 feet are measured before removal. The size of each tree and snag is determined by measuring its trunk at breast height above the natural ground surface. The size of each log is determined by measuring the butt and measuring its length from butt to tip. The size of each stump is measured at the top. Diameter is determined by dividing the measured circumference by 3.14.
 - b. Payment for clearing and grubbing each tree, stump, and snag having a diameter of 4 inches or larger and each log having a diameter of 4 inches or larger and a length of 10 feet or larger is made at the contract unit price for its size designation as determined by figure 2-1.

Figure 2-1 Size Designation for Tree Removal

Measured Diameter (in)	Size Designation (in)
4 to 8	6
8 to 12	10
12 to 24	18
24 to 36	30
36 to 60	48

- c. The sum of such payments constitutes full compensation for clearing and grubbing (including the clearing and grubbing of smaller trees, stumps, snags, logs, brush, shrubs, and roots), applicable permits and associated fees, and rubbish removal. Such payment constitutes full compensation for all labor, equipment, tools, and other items necessary and incidental to the completion of the work.
- 4. Method 4. For items of work for which specific lump-sum prices are established in the contract, payment for clearing and grubbing is made at the contract lump-sum price. Such payment constitutes full compensation for all labor, equipment, tools, and other items necessary and incidental to the completion of the work
- 5. All Methods. The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section G.

G. Items of Work and Construction Details

1. Bid Item #2

- a. This item shall consist of removing trees, shrubs, logs, and all other organic materials from the work area and disposing of them off site or onsite as directed. The Engineer shall mark the vegetation clearing area prior to commencement of the project; the Contractor shall not remove vegetation outside of the marked clearing area.
- b. Material shall become property of the Contractor and be disposed of properly offsite in compliance with all applicable laws and regulations. No additional payment shall be made for loading, hauling, disposal, cleanup, and related incidentals to dispose of material.
- c. Items of work subsidiary to this bid item include:
 - Structure Removal, Construction Specification 3
- d. Payment shall be by Method 4 of Section F.

Construction Specification 3 — Structure Removal

A. Scope

1. The work consists of the removal, salvage, and disposal of structures (including fences) from the designated areas.

B. Marking

1. Method 1. Each structure or structure part to be removed will be marked with stakes, flags, paint, or other suitable methods.
2. Method 2. The area boundaries from which structures must be removed will be marked using stakes, flags, paint, or other suitable methods. Structures to remain undisturbed or to be salvaged will be designated by special markings.

C. Removal

1. Method 1. Remove all structures designated for removal in the contract to the specified extent and depth.
2. Method 2. Within the areas so marked, remove all visible and buried structures identified to the specified extent and depth.

D. Salvage

1. Structures or structure parts that are designated to be salvaged must be carefully removed and neatly placed in the specified or approved storage location. Salvaged structures that are capable of being disassembled must be dismantled into individual members or sections. Such structures must be neatly and systematically matchmarked with paint before disassembly. Mark all connectors and other parts to indicate their proper location within the structure and fasten to the appropriate structural member or packed in suitable containers.
2. Material from fences designated to be salvaged must be placed outside the work area on the property that the fence was originally located. Fence wire must be rolled into uniform rolls of suitable size and neatly piled with other salvaged materials. Neatly stack posts and rails.

E. Disposal of Refuse Materials

1. Dispose of refuse materials resulting from structure removal in a manner and at locations specified in Section G of this specification or in an acceptable manner and at locations approved by the Engineer. Disposal by burning must be in accordance with local rules and regulations.

F. Measurement and Payment

1. Method 1.

- a. For items of work for which specific unit prices are established by the contract, payment for the removal of each structure unit, except fences, is made at the contract unit price. Fences removed or removed and salvaged are measured to the nearest linear foot. Payment for fence removal or removal and salvage is made at the contract unit prices for each type and size of fence.
 - b. Such payment will constitute full compensation for all labor, equipment, tools, applicable permits and associated fees for burning and disposal of refuse, and other items necessary and incidental to the completion of the work.
2. Method 2.
- a. For items of work for which specific lump-sum prices are established by the contract, payment for structure removal is made at the contract lump-sum price.
 - b. Such payment will constitute full compensation for all labor, equipment, tools, applicable permits and associated fees for burning and disposal of refuse, and other items necessary and incidental to the completion of the work.
3. All Methods. The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed as a contract line-item number in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and items to which they are made subsidiary are identified in Section G of this specification.

G. Items of Work and Construction Details

1. Subsidiary Item – Existing Structure Removal

- a. This item shall consist of removing concrete, timber, and steel elements of the existing intake structure from the site. This will include all concrete, CMP, and steel present, including the materials already removed during the 2026 flood and piled onsite.
- b. Material shall become property of the Contractor and be disposed of properly offsite in compliance with all applicable laws and regulations. No additional payment shall be made for loading, hauling, disposal, cleanup, and related incidentals to dispose of material.
- c. Section F will not apply to these items. All items listed in this section shall be considered incidental to Bid Item 2 – Clearing, Grubbing, Structure Removal.

Construction Specification 5 — Pollution Control

A. Scope

1. The work consists of installing measures or performing work to control erosion and minimize the production of sediment and other pollutants to water and air from construction activities.
2. The following BioPreferred® product categories are applicable to this specification:
 - a. Mulch and compost materials
 - b. Erosion control materials
 - c. Fertilizers
 - d. Dust suppressants
 - e. Agricultural spray adjuvants

B. Material

1. Silt fence conforms to the requirement of Materials Specification 592, Geotextile. All other material furnished meet the requirements of the material specifications listed in Section G of this specification.
2. Erosion and Sediment Control Measures and Works. The measures and works includes, but are not limited to, the following:
 - a. Staging of Earthwork Activities. Scheduling the excavation and moving of soil materials to minimize the size of areas disturbed and unprotected from erosion for the shortest reasonable time.
 - b. Seeding. Seeding to protect disturbed areas occur as soon as reasonably possible following completion of that earthwork activity.
 - c. Mulching. Mulching to provide temporary protection of the soil surface from erosion.
 - d. Diversions. Diversions to divert water from work areas and to collect water from work areas for treatment and safe disposition. These are temporary and must be removed and the area restored to its near-original condition when the diversions are no longer required or when permanent measures are installed.
 - e. Stream Crossings. Culverts or bridges where equipment must cross streams. These are temporary must and be removed and the area restored to its near-original condition when the crossings are no longer required or when permanent measures are installed.
 - f. Sediment Basins. Sediment basins for collecting, settling, and eliminating sediment from eroding areas that impact properties and streams below the construction sites. These basins are temporary and must be removed and the area restored to its original condition when they are no longer required or when permanent measures are installed.

- g. Sediment Filters. Straw bale filters or geotextile sediment fences for trapping sediment from areas with limited runoff. Sediment filters must be properly anchored to prevent erosion under or around them. Silt fences must be installed and maintained in accordance with ASTM D6462. These filters are temporary and must be removed and the area restored to its original condition when they are no longer required or when permanent measures are installed.
- h. Waterways. Waterways for the safe disposal of runoff from fields, diversions, and other structures or measures. These works are temporary and must be removed and the area restored to its original condition when they are no longer required or when permanent measures are installed.
- i. Other. Additional protection measures as specified in Section G of this specification or required by the federal, state, or local government.

C. Chemical Pollution

- 1. The contractor must provide watertight tanks or barrels or construct a sump sealed with plastic sheets to collect and temporarily contain chemical pollutants, such as drained lubricating or transmission fluids, grease, soaps, concrete mixer wash water, or asphalt, produced as a by-product from the construction activities. Dispose of pollutants in accordance with appropriate state and federal regulations. At the completion of the construction work, remove tanks, barrels, and sumps and restore the area to its original condition as specified in Section H of this specification. Sump removal must be conducted without causing pollution.
- 2. Sanitary facilities, such as chemical toilets, and septic tanks must not be located next to live streams, wells, or springs. They must be located at a distance sufficient to prevent contamination of any water source. At the completion of construction activities, facilities must be disposed of without causing pollution as specified in Section H of this specification.

D. Air Pollution

- 1. The burning of brush or slash and the disposal of other materials must adhere to state and local regulations.
- 2. Fire prevention measures must be taken to prevent the start or spreading of wildfires that may result from project activities. Firebreaks or guards must be constructed and maintained at locations shown on the drawings.
- 3. All public access or haul roads used by the contractor during construction of the project must be sprinkled or otherwise treated to fully suppress dust. All dust control methods must ensure safe construction operations at all times. If chemical dust suppressants are applied, the material must be a commercially available product specifically designed for dust suppression, and the application must follow the manufacturer's requirements and recommendations. A copy of the product data sheet and manufacturer's recommended application procedures must be provided to the engineer 5 working days before the first application.

E. Maintenance, Removal, and Restoration

1. All pollution-control measures and temporary works must be adequately maintained in a functional condition for the duration of the construction period. Remove all temporary measures and restore the site to near-original condition.

F. Measurement and Payment

1. Method 1. For items of work for which specific unit prices are established in the contract, each item is measured to the nearest unit applicable. Payment for each item is made at the contract unit price for that item. For water or chemical suppressant items used for dust control for which items of work are established in Section H of this specification, measurement for payment will not include water or chemical suppressants that are used inappropriately or excessively. Such payment will constitute full compensation for the completion of the work.
2. Method 2. For items of work for which lump-sum prices are established in the contract, payment is made as the work proceeds and is supported by invoices presented by the contractor that reflect actual costs. If the total of all progress payments is less than the lump-sum contract price for this item, the balance remaining for this item will be included in the final contract payment. Payment of the lump-sum contract price will constitute full compensation for completion of the work.
3. Method 3. For items of work for which lump-sum prices are established in the contract, payment will be prorated and provided in equal amounts on each monthly progress payment estimate. The number of months used for prorating must be the number estimated to complete the work as outlined in the contractor's approved construction schedule. The final month's prorate amount will be provided with the final contract payment. Payment as described will constitute full compensation for completion of the work.
4. All Methods. The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items, and the items to which they are made subsidiary, are identified in Section H of this specification.

G. Items of Work and Construction Details

1. Subsidiary Item – Pollution Control
 - a. The Contractor shall exercise precaution throughout the duration of the project to prevent pollution of the Yakima River and Fogarty Ditch (which is a fish bearing side channel). Chemical, fuels, raw sewage, and other harmful wastes shall not be discharged onsite.
 - b. The Contractor will be supplied with permits for the project from the U.S. Army Corps of Engineers, WA Dept of Fish and Wildlife, WA Dept of Natural Resources, and Kittitas County. The Contractor is required to keep a copy of these permits onsite at all times and follow all terms and conditions, including the preconstruction conference required with WDFW.

- c. The in-water work period for this project is Sept 1 to Sept 15, 2026. All work on the riverbank and within the riverbed, below the water surface level during construction, must be completed within this time period.
- d. Biodegradable lubricants and fluids will be used on equipment operating in and adjacent to water in the river and irrigation ditch. Equipment will be stored, fueled, and maintained in the staging area noted on sheet 10 of the drawings, at least 50 ft away from the ditch. Equipment will be inspected daily for fluid leaks.
- e. Construction of a containment dike utilizing 1 ton bulk bags filled with gravel to isolate the work area from the Yakima River is required prior to any in-water work on the river. Coordination with WDFW to arrange for aquatic species removal inside the cofferdam prior to initiating construction will be required.
- f. Isolation of Fogarty Ditch from the work area by a containment dike using sandbags and plastic sheeting is required to in-water work on the ditch. Coordination with WDFW to arrange for aquatic species removal inside the cofferdam prior to initiating construction will be required.
- g. Section F will not apply to these items. All items listed in this section shall be considered incidental to Bid Item 1- Mobilization and Demobilization.

Construction Specification 6 — Seeding, Sprigging, and Mulching

A. Scope

1. The work consists of preparing the area for treatment; furnishing and placing seed, sprigs, mulch, fertilizer, inoculant, lime, and other soil amendments; and anchoring mulch in designated areas as specified.
2. The following BioPreferred® product categories are applicable to this specification:
 - a. Mulch and compost materials
 - b. Erosion control materials
 - c. Fertilizers
 - d. Agricultural spray adjuvants

B. Material

1. Seed.
 - a. All seed must conform to the current rules and regulations of the state where it is being used and must be from the latest crop available. It must meet or exceed the standard for purity and germination listed in Section G.
 - b. Seed must be labeled in accordance with the state laws and the U.S. Department of Agriculture rules and regulations under the Federal Seed Act in effect on the date of invitations for bids. Bag tag figures are evidence of purity and germination. No seed will be accepted with a test date of more than 9 months before the delivery date to the site.
 - c. Seed that has become wet, moldy, or otherwise damaged in transit or storage will not be accepted. The percent of noxious weed seed allowable must be as defined in the current state laws relating to agricultural seeds. Each type of seed must be delivered in separate sealed containers and fully tagged unless an exception is granted in writing by the Engineer.
2. Fertilizer. Unless otherwise specified, the fertilizer must be a commercial-grade fertilizer. It must meet the standard for grade and quality specified by state law. Where fertilizer is furnished from bulk storage, the contractor must furnish a supplier's certification of analysis and weight. When required by the contract, a representative sample of the fertilizer must be furnished to the Engineer for chemical analysis.
3. Inoculants. The inoculant for treating legume seeds must be a pure culture of nitrogen-fixing bacteria prepared specifically for the species and must not be used later than the date indicated on the container or as otherwise specified. A mixing medium, as recommended by the manufacturer, must be used to bond the inoculant to the seed. Two times the amount of the inoculant recommended by the

manufacturer must be used (unless seed is applied using a hydraulic seeder; then four times the amount must be used). Seed must be sown within 24 hours of treatment and must not remain in the hydraulic seeder longer than 4 hours.

4. Lime and Other Soil Amendments. Lime must consist of standard ground agriculture limestone or approved equivalent. Standard ground agriculture limestone is defined as ground limestone meeting current requirements of the state's Department of Agriculture. Other soil amendments must meet quality criteria and application requirements specified in Section G.
5. Mulch Tackifiers. Asphalt emulsion tackifiers must conform to the requirements of ASTM D977, Specification for Emulsified Asphalt. The emulsified asphalt may be rapid setting, medium setting, or slow setting. Non-asphaltic tackifiers required because of environmental considerations must be as specified in Section G.
6. Straw Mulch Material. Straw mulch must consist of wheat, barley, oat or rye straw, hay, grass cut from native grasses, or other plants as specified in Section G. The mulch material must be air-dried reasonably light in color and must not be musty, moldy, caked, or otherwise of low quality. The use of mulch that contains noxious weeds is not permitted. The contractor must provide a method satisfactory to the Engineer for determining weight of mulch furnished.
7. Other Mulch Materials. Mulching materials, such as wood cellulose fiber mulch, mulch tackifiers, synthetic fiber mulch, netting, and mesh may be required for specialized locations and conditions. These materials, when specified, must be accompanied by the manufacturer's recommendations for methods of application.

C. Seeding Mixtures, Sod, Sprigs, and Dates of Planting

1. The application rate per acre for seed mixtures, sprigs, or sod and the date of seeding or planting must be as shown on the plans or as specified in Section G.

D. Seedbed Preparation and Treatment

1. Dress areas to be treated to a smooth, firm surface. On sites where equipment can operate on slopes safely, adequately loosen and smooth the seedbed (4 to 6 inches deep). Depending on soil and moisture conditions, disking, cultipacking, or both, may be necessary to properly prepare a seedbed. Where equipment cannot operate safely, prepare the seedbed by methods like scarifying, providing a roughened soil surface by hand so that broadcast seed will remain in place.
2. If seeding is to be accomplished immediately following construction operations, seedbed preparation may not be required except on a compacted, polished, or freshly cut soil surface.
3. Rocks larger than 6 inches in diameter, trash, weeds, and other debris that will interfere with seeding or maintenance operations must be removed or disposed of as specified in Section G.

4. Discontinue seedbed preparation when soil moisture conditions are not suitable for the preparation of a satisfactory seedbed as determined by the responsible engineer.

E. Seeding, Sprigging, Fertilizing, Mulching, and Stabilizing

1. Perform all seeding or sprigging operations in such a manner that the seed or sprigs are applied in the specified quantities uniformly in the designated areas. The method and rate of seed application must be as specified in Section G. Unless otherwise specified, seeding or sprigging must be accomplished within 2 days after final grading is completed and approved.
2. Apply fertilizer, lime, and other soil amendments as specified in Section G. When specified, the fertilizer and soil amendments must be thoroughly incorporated into the soil immediately following surface application.
3. The rate, amount, and kind of mulching or mesh must be as specified in Section G. Apply mulches uniformly to the designated areas. They must be applied to areas seeded not later than 2 working days after seeding has been performed. Stabilize straw mulch material within 24 hours of application using a mulch crimper or equivalent anchoring tool or by a suitable tackifier. When the mulch crimper or equivalent anchoring tool is used, it must have straight blades and be the type manufactured expressly for and capable of firmly punching the mulch into the soil. Where the equipment can be safely operated, it must be operated on the contour. Use hand methods where equipment cannot safely operate to perform the work required.
4. Apply the tackifier uniformly over the mulch material at the specified rate or inject it into the mulch material as it is being applied. Stabilizing materials like mesh or netting must be applied smoothly but loosely on the designated areas. The edges of these materials must be buried or securely anchored using spikes or staples as specified in Section G.
5. The contractor must maintain the mesh or netting areas until all work under the contract has been completed and accepted. Maintenance must consist of the repair of areas damaged by water erosion, wind, fire, or other causes. Such areas must be repaired to reestablish the intended condition and to the design lines and grades required by the contract. The areas must be re-fertilized, reseeded, and re-mulched before the new application of the mesh or netting.

F. Measurement and Payment

1. Method 1. For items of work for which specific unit prices are established in the contract, each area treated is measured as specified in Section G and area is calculated to the nearest 0.1 acre. Payment for treatment is made at the contract unit price for the designated treatment, which will constitute full compensation for completion of the work.
 - a. When specified as an item of work, mesh or netting is measured to the nearest square yard of surface area covered and accepted. Payment is made at the

contract unit price and will constitute full compensation for completion of the work.

2. Method 2. For items of work for which specific lump-sum prices are established in the contract, the quantity of work will not be measured for payment. Payment for this item is made at the contract lump-sum price for the item and will constitute full compensation for the completion of the work.
3. Method 3. For items of work for which lump-sum prices are established in the contract, payment is made as the work proceeds. Progress payments will be determined as specified in Section G. Payment of the lump-sum contract price will constitute full compensation for completion of the work.
4. All Methods. The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section G.

G. Items of Work and Construction Details

1. Subsidiary Item – Willow Bundle Joint Plantings
 - a. This item shall consist of acquisition, preparation, and installation of live willow bundles into the riprap blanket on the river side of the levee.
 - b. Willow cuttings will be coyote willow, with stem diameters between ¼” and ½”, at least 4 ft long.
 - c. Cuttings will be freshly harvested, stripped of their leaves, and soaked for at least 2 days prior to installation. Bundle ~6 stems together to form a ~3” diameter bundle and tie loosely with biodegradable twine, at 2-4 ft intervals.
 - d. Place bundles 6 ft on center within the riprap blanket, at an angle of approximately 45 degrees, between elevations 1493.4 and 1498.2. Stems should protrude 6-12” from face of riprap.
 - e. Section F will not apply to these items. All items listed in this section shall be considered incidental to Bid Item 6 – Riprap & Live Willow Placement.
2. Bid Item #14 – Turf Reinforcement Mat
 - a. This item shall consist of acquisition and placement of turf reinforcement mat, associated anchors, and grass seed.
 - b. Broadcast grass seed at a rate of 20 lbs/ac, with a species mix of: 30% Streambank Wheatgrass (*Elymus lanceolatus*), 30% Shermans Big Blue grass (*Poa secunda*: *Shermans selection*), 30% Blue Bunch Wheatgrass (*Pseudoregneria spicata*: *Anatone selection most xeric*), 10% Great Basin wild rye (*Leymus cinereus*).
 - c. Provide certified seed tags to the Engineer documenting conformance with requirements or pre-approved alternative mix if needed.

- d. Rake topsoil over seed and smooth slope to ensure good contact of the TRM with the ground.
- e. Turf reinforcement mat (TRM) will be 8 ft wide VMAX S200, or an approved substitute meeting the following requirements:
 - Minimum mass/area (ASTM 6566) of 12 oz/sy.
 - Minimum UV stability (ASTM D4355 / 1000 hr) of 80%.
 - Minimum tensile strength (ASTM D6818) of 450 lbs/ft.
 - Minimum rated permissible velocity, of 8.5 ft/sec (unvegetated) and 18 ft/sec (vegetated) on a 1.5H:1V slope.
- f. TRM will be placed in a 12"x12" anchor trench at the top of the slope, with 12" placed under the fill above the riprap as shown on sheet 7 of the drawings.
- g. Anchor TRM using Falcon HR-12 twist pins, or approved substitute with minimum pull out resistance of 150 lbs suitable for rocky ground. Place anchors at 20" on center on face of slope, 18" on center in anchor trench.
- h. Any overlaps required on the TRM shall be at least 12". Ensure that overlaps are "shingled" so that the upstream mat sits above the downstream.
- i. Payment shall be by Method 2 of Section F, using the quantities shown on the drawings.

3. Bid Item #15 – Grass Seeding

- a. This item will consist of areas disturbed by the project that are not covered by riprap or TRM. The top of the levee is also excluded.
- a. Spread stripped topsoil over the area.
- b. Broadcast grass seed at a rate of 20 lbs/ac, with a species mix of: 30% Streambank Wheatgrass (*Elymus lanceolatus*), 30% Shermans Big Blue grass (*Poa secunda*: *Shermans selection*), 30% Blue Bunch Wheatgrass (*Pseudoregneria spicata*: *Anatone selection most xeric*), 10% Great Basin wild rye (*Leymus cinereus*).
- c. Provide certified seed tags to the Engineer documenting conformance with requirements or pre-approved alternative mix if needed.
- c. Payment shall be by Method 1 of Section F, measured based on actual installed surface area.

4. Bid Item #16 – Live Staking

- a. This item will consist of acquisition, preparation, and installation of live red osier dogwood and cottonwood stakes at the locations noted on sheet 10 of the drawings.
- b. Red osier dogwood cuttings will be freshly harvested, with stem diameters ¼" to ½", stripped of their leaves and soaked for at least 2 days prior to

installation. Stems will be at least 3 ft long and installed in pre-driven holes, with ~6" protruding above ground. Plant at 24" on center in the disturbed area shown.

- c. Cottonwood cuttings will be freshly harvested in the fall, after leaves have naturally fallen off the stem. Plant in the disturbed areas and within natural openings in the existing vegetation in the area shown, with approximate spacing of 5 ft on center.
- d. Payment shall be by Method 1 of Section F, measured based on actual installed surface area.

Construction Specification 8 — Mobilization and Demobilization

A. Scope

1. The work consists of the mobilization and demobilization of the contractor's forces and equipment necessary for performing the work required under the contract. It does not include mobilization and demobilization for specific items of work for which payment is provided elsewhere in the contract. Mobilization will not be considered as work in fulfilling the contract requirements for commencement of work.

B. Equipment and Material

1. Mobilization includes all activities and associated costs for transportation of contractor's personnel, equipment, and operating supplies to the site; establishment of offices, buildings, and other necessary general facilities for the contractor's operations at the site; premiums paid for performance and payment bonds including coinsurance and reinsurance agreements as applicable; and other items specified in Section D of this specification.
2. Demobilization includes all activities and costs for transportation of personnel, equipment, and supplies not required or included in the contract from the site, including the disassembly, removal, and site cleanup of offices, buildings, and other facilities assembled on the site specifically for this contract.
3. This work includes mobilization and demobilization required by the contract at the time of award. If additional mobilization and demobilization activities and costs are required during the performance of the contract as a result of changed, deleted, or added items of work for which the contractor is entitled to an adjustment in contract price, compensation for such costs will be included in the price adjustment for the item or items of work changed or added.

C. Payment

1. Payment will be made as the work proceeds after presentation of paid invoices or documentation of direct costs by the contractor showing specific mobilization and demobilization costs and supporting evidence of the charges of suppliers, subcontractors, and others. When the total of such payments is less than the lump-sum contract price, the balance remaining will be included in the final contract payment. Payment of the lump sum contract price for mobilization and demobilization will constitute full compensation for completion of the work.
2. Payment will not be made under this item for the purchase costs of materials having a residual value, the purchase costs of materials to be incorporated in the project, or the purchase costs of operating supplies.

D. Items of Work and Construction Details

1. Bid Item #1 – Mobilization and Demobilization

- a. Work covered by this bid item consists of, but is not limited to, furnishing all supervision, labor, equipment, and materials and performing all operations necessary to:
 - Move personnel, equipment, supplies, and incidentals to the project site.
 - Maintain access roads as needed for the duration of the project.
 - Perform all preparations necessary to commence performance of the project, including identifying, locating, and protecting utilities.
 - Provide oversight and supervision of the Contractor's personnel, including any subcontractors on site, full time.
 - Perform project coordination, provide updates, and attend project meetings.
 - Develop, maintain, and provide for on-site health and safety measures for both construction personell and the general public.
 - Provide temporary facilities and work area security.
 - Furnish all submittals described in these specifications.
 - Maintain a clean and orderly work site on a daily basis throughout the duration of this project.
 - Restore all access roads to their pre-existing condition prior to construction activities.
- b. Items of work subsidiary to this bid item include:
 - Pollution Control, Construction Specification 5
 - Removal of Water, Construction Specification 11
- c. Payment shall be by Method 1 of Section C.

Construction Specification 11 — Removal of Water

A. Scope

1. The work consists of the removal of surface water and ground water as necessary to perform the construction required by the contract in accordance with the specifications. It must include: (1) constructing, installing, building, and maintaining all necessary temporary water containment facilities, channels, and diversions; (2) furnishing, installing, and operating all necessary pumps, piping, and other facilities and equipment; and (3) removing all such temporary works and equipment after their intended function is no longer required.

B. Diverting Surface Water

1. The contractor must install, maintain, and operate all cofferdams, channels, flumes, sumps, and all other temporary diversion and protective works needed to divert streamflow and other surface water through or around the construction site. Control of surface water must be continuous during the period that damage to construction work could occur. Unless otherwise specified or approved, the diversion outlet must be into the same drainageway that the water would have reached before being diverted.
2. The contractor must furnish the Engineer, in writing, a proposed plan for diverting surface water before beginning any construction activities for which a diversion is required, unless waived in Section H of this specification. Acceptance of this plan or the waiving of the plan requirement will not relieve the contractor of the responsibilities related to this activity during the process of completing the work as specified.

C. Dewatering the Construction Site

1. Foundations, cutoff trenches, and all other parts of the construction site must be dewatered and kept free of standing water and muddy conditions as necessary for the proper execution of the work. The contractor must furnish, install, operate, and maintain all drains, sumps, pumps, casings, well points, and all other equipment required to properly dewater the site as specified. Dewatering systems that cause a loss of soil fines from the foundation areas will not be permitted.
2. The contractor must furnish the Engineer, in writing, a proposed plan for dewatering before commencing with any construction activity for which dewatering may be required unless waived in Section H of this specification. Acceptance of this plan or the waiving of the plan requirement will not relieve the contractor of the responsibilities for completing the specified work.

D. Dewatering Borrow Areas

1. The contractor must maintain all borrow areas free of surface water or otherwise provide for timely and effective removal of surface and subsurface water that

accumulates within the borrow area unless waived in Section H of this specification. Process borrow material as necessary to achieve proper and uniform moisture content at the time of placement.

2. If pumping to dewater borrow areas is included as a bid item of work in the bid schedule, equip each pump discharge pipe with a water meter. The meter must be such that the measured quantity of water is accurate within 3 percent of the true quantity. The contractor must provide necessary support to perform accuracy tests of the water meter when requested by the Engineer.

E. Erosion and Pollution Control

1. Removal of water from the construction site, including the borrow areas, must be accomplished so that erosion and the transporting of sediment and other pollutants are minimized. Dewatering activities must be accomplished in a manner that the water table water quality is not altered. Pollution control activities must not conflict with the requirements of Construction Specification 5, Pollution Control, if it is a part of this contract.

F. Removal of Temporary Works

1. When temporary works are no longer needed, the contractor must remove and return the area to a condition similar to that which existed before construction. Areas where temporary works were located must be graded for slightly appearance and proper functioning and access to the installed works of improvement and may not obstruct natural surface waterflows. The contractor must exercise extreme care during the removal stages to minimize the loss of soil sediment and debris that was trapped during construction.
2. Pipes, casings, and any other material used to dewater the site must be removed from temporary wells. Fill the wells to ground level with clean gravel or other suitable material approved by the Engineer. The contractor must exercise extreme care to prevent pollution of the ground water by these actions.

G. Measurement and Payment

1. Method 1.
 - a. Items of work listed in the bid schedule for removal of water, diverting surface water, and dewatering construction sites and borrow areas are paid for at the contract lump-sum prices. Such payment will constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work.
2. Method 2.
 - a. Items of work listed in the bid schedule for removal of water, diverting surface water, dewatering construction sites, and dewatering borrow areas are paid for at the contract lump-sum prices. Such payment will constitute full compensation for furnishing, installing, operating, and maintaining the necessary trenches, drains, sumps, pumps, piping, and for all labor, equipment, tools, and all other items necessary and incidental to the completion of the

work. The exception is that additional payment for pumping to dewater borrow areas and the removal of water will be made as described in the following paragraph.

- b. If pumping to dewater borrow areas is a contract bid item, payment is made at the contract unit price, which must be the price per 1,000 gallons shown in the bid schedule. Such payment will constitute full compensation for pumping only. Compensation for equipment, preparation, and other costs associated with pumping is included in the lump-sum payment for removal of water or the lump-sum payment for dewatering the borrow areas. Payment is made only for pumping that is necessary to dewater borrow areas that cannot be effectively drained by gravity or that must have the water table lowered to be usable as a suitable borrow source. Pumping for other purposes will not be included for payment under this item.
3. All Methods. The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule is included in the payment for the contract line item to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section H of this specification.

H. Items of Work and Construction Details

1. Subsidiary Item – Removal and Diversion of Water

- a. This item shall consist of water removal and diversion of water as necessary for construction of the project. Contractor to submit a Dewatering/Diversion Plan to the Engineer prior to commencement of excavation operations below water level. The Dewatering/Diversion Plan will outline:
 - Pump, with pump curve and information on suction/discharge lines, to be utilized for diversion to Fogarty Ditch. Provide details on fish screen to be utilized.
 - How subsurface seepage will be controlled within the pipe trench for construction of the riser and 38 ft section of CMP.
 - Schedule of construction and associated water control and pollution control work.
 - Contingency plan for an unanticipated rise in river water surface elevations.
- b. The diversion pump will operate continuously, to deliver 2 cfs of clean water, during the time period when flow through the intake is blocked for construction.
- c. Discharge from dewatering pumps must be on a well vegetated area behind the levee, at least 100 feet from Fogarty Ditch.

Section G will not apply to these items. All items listed in this section shall be considered incidental to Bid Item 8 – Mobilization and Demobilization.

Construction Specification 13 — Piling

A. Scope

1. The work consists of furnishing and installing the specified kinds and types of piles at the locations shown on the drawings.

B. Material

1. Piles must conform to the requirements of the following material specifications as appropriate to the kinds of piles specified. For piles of materials other than these listed, the material requirements outlined in Section N of this specification applies.
 - a. 511, Steel Piles
 - b. 512, Wood Piles
 - c. 513, Precast Concrete Piles
 - d. 514, Cast-in-Place Concrete Piles

C. Site Preparation

1. Before the bearing piles are driven, complete all excavation within the area to be occupied by the piles.

D. Protection of Pile Heads

1. Protect the heads of all piles with suitable caps, rings, heads, blocks, mandrels, and other devices during driving.
2. Fit the heads of timber piles into a steel head block or fit with heavy steel, wrought iron rings, or wire wrapping.
3. Cut the heads of steel piles square and fit with a steel driving cap.
4. Fit the heads of precast concrete piles and casings into cushion-type drive caps with a rope or other suitable cushion next to the pile head and a casting that supports a timber shock block.
5. Driving heads, mandrels, and other devices must be provided by the contractor as needed for special types of piles and must conform to the recommendations of the pile manufacturer.

E. Piles, General

1. The contractor must notify the engineer before pile-driving operation commences. Such notice must be far enough in advance—a minimum of 24 hours—to provide the engineer adequate time to be present for the driving operations. Drive piles only in the presence of the engineer or authorized representative.
2. The determination of piling order lengths is the contractor's responsibility unless otherwise specified.

3. Unless otherwise approved, drive piles with steam-, air-, or diesel-powered hammers or a combination of hammers, or by vibration or water jets. Water jets may only be used when specifically authorized by the engineer. Where jetting is authorized, withdraw the jets before the specified depth or bearing capacity is obtained, and drive the piles with the hammer to the final penetration.
4. When drop hammers are permitted, the height of drop must not be more than 8 feet for concrete piles or 12 feet for steel and timber piles unless otherwise specified.
5. The driving of piling with followers is allowed only when expressly approved by the engineer.
6. Piles must not be driven within 20 feet of concrete less than 7 days after placement, including concrete in cast-in-place piles with or without pre-driven shells or casings.
7. The contractor must not attempt to drive piles beyond the point of refusal, as indicated by excessive bouncing of the hammer or kicking of the pile.

F. Bearing Piles

1. Drive bearing piles to the position, line, and batter specified on the drawings. Drive each pile continuously and without interruption to the specified depth or until the specified bearing capacity is obtained. Deviation from this procedure is permitted only when interruption of driving is caused by conditions that could not reasonably be anticipated.
2. When a diesel hammer is used, operate it at full throttle when blows are counted for determination of bearing capacity, adjusting the throttle as necessary to prevent the non-striking parts of the hammer from rising from the pile on the ram upstroke.

G. Sheet Piles

1. Drive the piling in a manner that ensures perfect interlocking throughout the entire length of each pile. Hold the piles in proper alignment during driving by assembling frames or other suitable, temporary guide structures. Remove temporary guide structures when they have served their purpose.
2. Any time the forward edge of the sheet pile wall is found to be out of correct alignment the already assembled and partly driven piling must be driven to the required depth. Taper piles must then be driven to bring the forward edge into correct alignment before additional regular piling is assembled and driven. The maximum permissible taper in a single pile must be 0.25 inch per foot of length.

H. Estimating Bearing Capacity

1. When load tests are not required, the bearing capacity of each pile must be estimated using one of the following formulas as appropriate:
 - a. Gravity hammers:

$$R = \frac{2WH}{S + 1}$$

Eq. 13-1

- b. Single-acting steam or air hammers and diesel hammers having unrestricted rebound of the ram:

$$R = \frac{2WH}{S + 0.1}$$

Eq. 13-2

- c. Double-acting steam or air hammers and diesel hammers having enclosed rams:

$$R = \frac{2H(W + AP)}{S + 0.1}$$

Eq. 13-3

$$\text{or } R = \frac{2E}{S + 0.1}$$

Eq. 13-4

- d. where:

R = safe bearing capacity in pounds

W = weight of striking parts of hammer in pounds

H = height of fall in feet

A = area of piston in square inches

P = pressure of steam, air, or other gas exerted on the hammer piston or ram in pounds per square inch

E = the manufacturer's rating for foot-pounds of energy developed by double-acting steam or air hammers or 90 percent of the average equivalent energy developed by diesel hammers having enclosed rams as evaluated by gauge and chart readings in foot-pounds

S = average penetration for the last 5 to 10 blows of a gravity hammer or the last 10 to 20 blows for steam-, air-, or diesel-powered hammers in inches per blow

2. These formulas are applicable when:

- The hammer has a free fall.
- The head of the pile is not crushed.
- The penetration is reasonably quick and uniform.
- There is no sensible bounce after the blow.
- A follower is not used.

3. Deduct twice the height of the bounce from H to determine its value in the formula.
4. If case water jets are used in conjunction with the driving, these formulas are used to determine the bearing power from the results of driving after the jets have been removed.

I. Load Tests

1. When load tests are specified, apply the test loads gradually, without impact, and in a manner that no lateral forces are applied to the pile. Load testing must not be started until 24 hours after driving of the test pile is completed unless otherwise specified in Section N of this specification. Except as otherwise specified, load tests must be performed according to the following procedures.
2. The total test load must be twice the specified working load and must be applied to the pile in increments equal to 25 percent of the working load. Measure settlement of the top of the pile to an accuracy of 0.01 inch before and after the application of each load increment and at 2, 4, 8, 15, 30, and 60 minutes after, then every 2 hours until the next load increment is applied. Additional load must not be applied until the rate of settlement is less than 0.01 inch in 1 hour.
3. The total test load must remain on the pile for a minimum of 24 hours. Measure settlement at 6-hour intervals during and at the end of the period, at least twice during removal of the load, and immediately after all of the test load is removed. Measure the net settlement about 24 hours after the total load has been removed.
4. If settlement continues in excess of 0.01 inch per hour under less than the total test load, no additional load must be applied. However, the load that has been applied must remain on the pile for a minimum of 24 hours, and settlement measurements while the load is on the pile and during and after removal of the load must be made as if it were the total test load.

J. Cutting off Piles

1. The contractor must cut the piles at the specified elevations. The length of pile cut off must be sufficient to permit the removal of all damaged material. Steel shells or concrete casings for cast-in-place concrete piles must be cut off at the specified elevation before being filled with concrete.
2. Cut off steel bearing piles in clean, straight lines as shown on the drawings. Level off any irregularities with deposits of weld metal or by grinding before placement of bearing caps.
3. Cut off precast concrete piles and concrete casings in a manner that prevents damage to the rest of the pile, casing, or projecting reinforcement required for connecting the piles to the structure.
4. Timber piles that are to be capped must be accurately cut off so that true bearing is obtained on every pile without the use of shims.

K. Defective Piles

1. Any pile damaged in driving, driven out of proper location, driven below the specified cutoff elevation, or inaccurately cut off must be corrected by one of the following methods, as approved by the engineer:
 - a. The defective pile must be pulled and replaced or re-driven.
 - b. A new pile must be driven adjacent to the defective pile.
 - c. The defective pile must be spliced or built up or a sufficient part of the footing must be extended to properly embed the pile.
2. Pile shells abandoned in place after driving must be filled with concrete or sand-cement grout as appropriate to the conditions that are present.
3. All piles pushed up by the driving of adjacent piles or by any other cause must be re-driven to the final grade.
4. Any sheet pile ruptured in the interlock or otherwise damaged during driving must be pulled and replaced.

L. Correcting Surface Heave

1. Remove any excess material resulting from displacement of earth by pile driving. Materials disturbed by pile driving must be conditioned and compacted to a minimum density equal to adjacent, undisturbed material.

M. Measurement and Payment

1. Method 1.
 - a. For items of work for which specific unit prices are established in the contract, each type, kind, and length of pile driven in place is counted. Payment for furnishing and driving each type, kind, and length of pile is made at the contract unit price. Such payment will constitute full compensation for all labor, equipment, materials, and all other items necessary and incidental to the completion of the work.
2. Method 2.
 - a. For items of work for which specific unit prices are established in the contract, each type, kind, and length of pile furnished, accepted, and stockpiled in good condition at the site of the work is counted. Payment for furnishing each type, kind, and length of pile is made at the contract unit price. Payment for driving each type and kind of pile is made at the contract unit price. Such payment will constitute full compensation for all labor, equipment, materials, and other items necessary and incidental to the completion of the work.
3. Method 3.
 - a. For items of work for which specific unit prices are established in the contract, the length of each type and kind of pile driven is computed to the nearest foot as the difference between the measured length of pile before driving and the measured length of pile cut off after driving. Payment for furnishing and driving each type and kind of pile is made at the contract unit price. Such

payment will constitute full payment for all labor, equipment, materials, and other items necessary and incidental to the completion of the work.

4. Method 4.

- a. For items of work for which specific unit prices are established in the contract, the area of sheet pile walls, acceptably placed according to and within the neat lines shown on the drawings, is computed to the nearest square foot. Payment is made at the contract unit price for each type, kind, and weight of piling. Such payment will constitute full payment for all labor, equipment, materials, and other items necessary and incidental to the completion of the work.

5. All Methods. The following provisions apply to all methods of measurement and payment:

- a. The measurement of the number of linear feet of piles (or number of piles) furnished and the number of piles driven must include test and tension piles specified in the contract. Piles furnished and driven at the option of the contractor are not included. No payment is made for furnishing or driving piles, including test piles, to replace piles lost or damaged before the completion of the contract while in stockpile or during handling and driving.
- b. When load tests are specified, payment for each test is made at the contract unit price per test. Such payment will constitute full compensation for all labor, equipment, materials, and other items necessary and incidental to perform the test, except furnishing and driving piling.
- c. When splices are specified, payment for each splice is made at the contract unit price. Such payment constitutes full compensation for all labor, equipment, materials, and other items necessary and incidental to the completion of the work.
- d. Compensation for any item of work described in the contract but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section N of this specification.

N. Items of Work and Construction Details

1. Bid Item #7 – Steel H-Pile

- a. This item shall consist of furnishing, transporting, and installing Steel H-Piles as described in this specification and shown on the drawings.
- b. Piles will be 36 ksi ASTM A36 steel, HP12x53 and will meet Material Specification 511- Steel Piles. Splicing of H-Pile will not be allowed on the project.
- c. Load tests are not required on this project and there is no minimum bearing value.
- d. Pile will be installed utilizing an excavator mounted vibratory driver. The Engineer will be present during driving. If large boulders or bedrock prevent successful installation of 1 or more of the piling, only then will the alternative piling installation method on page 9 be utilized.
- e. Horizontal H-pile will be bolted to vertical piles with 1” diameter ASTM A325 bolts with heavy plate washers.
- f. Payment will be by Method 2 of Section M, for all H-pile required. Payment includes cost of pile-to-pile connections. No additional compensation will be provided if initial driving is unsuccessful and the excavated method with footings must be utilized for one or more piles.

Construction Specification 21 — Excavation

A. Scope

1. The work consists of the excavation required by the drawings and specifications, as well as the disposal of the excavated materials.

B. Classification

1. Excavation is classified as common excavation, rock excavation, or unclassified excavation in accordance with the following definitions.
2. Common excavation is defined as the excavation of all materials that (1) can be excavated, transported, and unloaded using heavy ripping equipment and wheel tractor-scrapers with pusher tractors or (2) can be excavated and dumped into place or loaded onto hauling equipment by excavators having a rated capacity of 1 cubic yard or larger and equipped with attachments (shovel, bucket, backhoe, dragline, or clam shell) appropriate to the material type, character, and nature of the materials.
3. Rock excavation is defined as the excavation of all hard, compacted, or cemented materials that require blasting or the use of ripping and excavating equipment larger than defined for common excavation. The excavation and removal of isolated boulders or rock fragments larger than 1 cubic yard encountered in materials otherwise conforming to the definition of common excavation must be classified as rock excavation. The presence of isolated boulders or rock fragments larger than 1 cubic yard is not in itself sufficient cause to change the classification of the surrounding material.
 - a. For the purpose of these classifications, the following definitions apply:
 - (1) Heavy ripping equipment is a rear-mounted, heavy-duty, single-tooth, ripping attachment mounted on a track-type tractor having a power rating of at least 250-flywheel horsepower, unless otherwise specified in Section J.
 - (2) A wheel tractor-scraper is a self-loading (not elevating) and unloading scraper having a struck-bowl capacity of at least 12 cubic yards.
 - (3) A pusher tractor is a track-type tractor having a power rating of at least 250-flywheel horsepower equipped with appropriate attachments.
4. Unclassified excavation is defined as the excavation of all materials encountered, including rock materials, regardless of their nature or the manner in which they are removed.

C. Blasting

1. The transportation, handling, storage, and use of dynamite and other explosives must be directed and supervised by someone of proven experience and ability who is authorized and qualified to conduct blasting operations.
2. Blasting must be done in a manner that prevents damage to the work or unnecessary fracturing of the underlying rock materials. It must conform to any special requirements in Section J of this specification. When specified in Section J, the contractor must furnish the engineer, in writing, a blasting plan before blasting operations begin.

D. Use of Excavated Material

1. Method 1. To the extent they are needed, all suitable material from the specified excavations must be used in the construction of required permanent earthfill or rockfill. The suitability of material for specific purposes is determined by the engineer. The contractor must not waste or otherwise dispose of suitable excavated material.
2. Method 2. Suitable material from the specified excavations may be used in the construction of required earthfill or rockfill. The suitability of material for specific purposes is determined by the engineer.

E. Disposal of Waste Materials

1. Method 1. All surplus or unsuitable excavated materials are designated as waste and must be disposed of at the locations shown on the drawings.
2. Method 2. All surplus or unsuitable excavated materials are designated as waste and disposed of by the contractor at chosen sites away from the site of the work. The disposal must be in an environmentally acceptable manner that does not violate local rules and regulations.

F. Excavation Limits

3. Excavations must comply with the Occupational Safety and Health Administration Construction Industry Standards Subpart P, Excavations, Trenching, and Shoring (29 CFR pt. 1926). All excavations must be completed and maintained in a safe and stable condition throughout the total construction phase. Structure and trench excavations must be completed to the specified elevations and to the length and width required to safely install, adjust, and remove any forms, bracing, or supports necessary for the installation of the work. Excavations outside the lines and limits shown on the drawings or specified herein are required to meet safety requirements and must be the responsibility of the contractor in constructing and maintaining a safe, stable excavation.

G. Borrow Excavation

1. When the quantities of suitable material obtained from specified excavations are insufficient to construct the specified earthfills and earth backfills, obtain additional material from the designated borrow areas. The extent and depth of borrow pits within the limits of the designated borrow areas are as specified in Section J or as approved by the engineer.

2. Borrow pits must be excavated and finally dressed to blend with the existing topography. They are sloped to prevent ponding and to provide drainage.

H. Over Excavation

1. Correct excavation in rock beyond the specified lines and grades by filling the resulting voids with Portland Cement concrete. Materials and mix proportions must be approved by the engineer. Concrete that will be exposed to the atmosphere when construction is completed must meet the requirements of concrete selected for use under Construction Specification 31, Concrete for Major Structures, or 32, Structure Concrete, as appropriate.
2. Concrete that will be permanently covered must contain not less than five bags of cement per cubic yard. The concrete must be placed and cured as specified by the engineer.
3. Correct excavation in earth beyond the specified lines and grades by filling the resulting voids with approved compacted earthfill. The exception to this is that if the earth will become the subgrade for riprap, rockfill, sand or gravel bedding, or drainfill, the voids may be filled with material conforming to the specifications for the riprap, rockfill, bedding, or drainfill. Before correcting an over excavation condition, the contractor must review the planned corrective action with the engineer and obtain approval of the corrective measures.

I. Measurement and Payment

1. Unit Price Methods. For items of work for which specific unit prices are established in the contract, the volume of each type and class of excavation within the specified pay limits is measured and computed to the nearest cubic yard by the method of average cross-sectional end areas or by methods outlined in Section J of this specification. Regardless of quantities excavated, the measurement for payment is made to the specified pay limits except when excavation outside the specified lines and grades directed by the engineer to remove unsuitable material is included. Excavation required because unsuitable conditions result from the contractor's improper construction operations, as determined by the engineer, is not included for measurement and payment.
2. Method 1. The pay limits are as designated on the drawings.
3. Method 2. The pay limits are defined as follows:
 - a. The upper limit is the original ground surface as it existed before the start of construction operations, unless excavation is performed within areas designated for previous excavation or earthfill; then the upper limit is the modified ground surface resulting from the specified previous excavation or earthfill.
 - b. The lower and lateral limits are the neat lines and grades shown on the drawings.
4. Method 3. The pay limits are defined as follows:

- a. The upper limit is the original ground surface as it existed before the start of construction operations, unless excavation is performed within areas designated for previous excavation or earthfill; then the upper limit is the modified ground surface resulting from the specified previous excavation or earthfill.
 - b. The lower and lateral limits is the true surface of the completed excavation as directed by the engineer.
- 5. Method 4. The pay limits are defined as follows:
 - a. The upper limit is the original ground surface as it existed before the start of construction operations, unless excavation is performed within areas designated for previous excavation or earthfill; then the upper limit is the modified ground surface resulting from the specified previous excavation or earthfill.
 - b. The lower limit is at the bottom surface of the proposed structure.
 - c. The lateral limits are 18 inches outside of the outside surface of the proposed structure or are the vertical planes 18 inches outside of and parallel to the footings, whichever gives the larger pay quantity, except as provided in paragraph d below.
 - d. For trapezoidal channel linings or similar structures that are to be supported by the sides of the excavation without intervening forms, the lateral limits are at the underside of the proposed lining or structure.
 - e. For the purposes of the definitions in paragraphs b, c, and d above, any specified bedding or drainfill directly beneath or beside the structure will be considered to be a part of the structure.
- 6. All Methods. The following provisions apply to all methods of measurement and payment.
 - a. Payment for each type and class of excavation is made at the contract unit price for that type and class of excavation. Such payment will constitute full compensation for all labor, materials, equipment, and other items necessary and incidental to the performance of the work with the exception that extra payment for backfilling over excavation will be made in accordance with the following provisions.
 - b. Payment for backfilling over excavation, as specified in Section H of this specification, is made only if the excavation outside specified lines and grades is directed by the engineer to remove unsuitable material and the unsuitable condition is not a result of the contractor's improper construction operations as determined by the engineer.
 - c. Compensation for any item of work described in the contract but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section J of this specification.

J. Items of Work and Construction Details

1. Bid Item #3 – Excavation

- a. This item will consist of excavating portions of the existing levee and riverbed and banks and stockpiling suitable materials for use on the project. It also consists of hauling and spreading excess materials outside of the floodplain, in an area designated by the owner.
- b. Materials are unclassified, as described in Section B, and may include fine grained soils, gravel, cobble, boulder, and/or sandstone.
- c. It is currently unknown if a clay core is present in the levee. If one is identified during construction, materials will be stockpiled separately to allow reconstruction of it to match the existing levee.
- d. Payment shall be by Method 1 of Section I.

Construction Specification 23 — Earthfill

A. Scope

1. The work consists of the construction of earth embankments, other earthfills, and earth backfills required by the drawings and specifications.
2. Earthfill is composed of natural earth materials that can be placed and compacted by construction equipment operated conventionally.
3. Earth backfill is composed of natural earth material placed and compacted in confined spaces or adjacent to structures (including pipes) by hand tamping, manually directed power tampers or vibrating plates, or their equivalent.

B. Material

1. All fill material must be obtained from required excavations and designated borrow areas. The selection, blending, routing, and disposition of material in the various fills must be subject to approval by the engineer.
2. Fill materials must contain no frozen soil, sod, brush, roots, or other perishable material. Rock particles larger than the maximum size specified for each type of fill must be removed prior to compaction of the fill.
3. The types of material used in the various fills must be as listed and described in the specifications and drawings.

C. Foundation preparation

1. Foundations for earthfill must be stripped to remove vegetation and other unsuitable material or must be excavated as specified.
2. Except as otherwise specified, earth foundation surfaces must be graded to remove surface irregularities and must be scarified parallel to the axis of the fill or otherwise acceptably scored and loosened to a minimum depth of 2 inches. The moisture content of the loosened material must be controlled as specified for the earthfill and the surface material of the foundation must be compacted and bonded with the first layer of earthfill as specified for subsequent layers of earthfill.
3. Earth abutment surfaces must be free of loose, uncompacted earth in excess of 2 inches in depth normal to the slope and must be at such a moisture content that the earthfill can be compacted against them to produce a good bond between the fill and the abutments.
4. Rock foundation and abutment surfaces must be cleared of all loose material by hand or other effective means and must be free of standing water when fill is placed upon them. Occasional rock outcrops in earth foundations for earthfill, except in dams and other structures designed to restrain the movement of water, must not require special treatment if they do not interfere with compaction of the

foundation and initial layers of the fill or the bond between the foundation and the fill.

5. Foundation and abutment surfaces must be no steeper than one horizontal to one vertical unless otherwise specified. Test pits or other cavities must be filled with compacted earthfill conforming to the specifications for the earthfill to be placed upon the foundation.

D. Placement

1. Earthfill must not be placed until the required excavation and foundation preparation have been completed and the foundation has been inspected and approved by the engineer. Earthfill must not be placed upon a frozen surface nor have snow, ice, or frozen material incorporated in the earthfill matrix.
2. Earthfill must be placed in approximately horizontal layers. The thickness of each layer before compaction must not exceed the maximum thickness specified in section J or shown on the drawings. Materials placed by dumping in piles or windrows must be spread uniformly without exceeding the specified thickness before being compacted.
3. Hand-compacted earth backfill must be placed in layers whose thickness before compaction does not exceed the maximum thickness specified for layers of earth backfill compacted by manually directed power tampers.
4. Place earth backfill in a manner that prevents damage to the structures and allows the structures to assume the loads from the earth backfill gradually and uniformly. The height of the earth backfill adjacent to a structure must be increased at approximately the same rate on all sides of the structure.
5. Meet the following additional requirements for earthfill and earth backfill in dams, levees, and other structures designed to restrain the movement of water.
 - a. The distribution of materials throughout each zone must be essentially uniform and the earthfill free from lenses, pockets, streaks, or layers of material differing substantially in texture, moisture content, or gradation from the surrounding material. Zone earthfills must be constructed concurrently unless otherwise specified.
 - b. Scarified the surface of each layer parallel to the axis of the fill to at minimum a depth of 2 inches before the next layer is placed.
 - c. The top surface of embankments must be maintained approximately level during construction with two exceptions: a crown or cross-slope of about 2 percent must be maintained to ensure effective drainage, or as otherwise specified for drainfill or sectional zones.
 - d. Construct dam embankments in continuous layers from abutment to abutment except where openings to facilitate construction or to allow the passage of streamflow during construction are specifically authorized in the contract.
 - e. Embankments built at different levels as described under paragraphs c or d above must be constructed so that the slope of the bonding surfaces between embankments in place and embankments to be placed is not steeper than 3 feet horizontal to 1 foot vertical. The bonding surface of the embankment in

place must be stripped of all material not meeting the requirements of this specification and must be scarified, moistened, and recompacted when the new earthfill is placed against it. This ensures a good bond with the new earthfill and obtains the specified moisture content and density at the contact of the in-place and new earthfills.

E. Control of moisture content

1. During placement and compaction of earthfill and earth backfill, the moisture content of the material being placed must be maintained within the specified range.
2. The application of water to the earthfill material must be accomplished at the borrow areas insofar as practicable. Water may be applied by sprinkling the material after placement on the earthfill, if necessary. Obtain a uniform moisture distribution by disking.
3. Material that is too wet when deposited on the earthfill must either be removed or dried to the specified moisture content prior to compaction.
4. If the top surface of the preceding layer of compacted earthfill or a foundation or abutment surface in the contact zone with the earthfill becomes too dry to permit suitable bond, it must either be removed or scarified and moistened by sprinkling to an acceptable moisture content before placement of the next layer of earthfill.

F. Compaction

1. Earthfill. Earthfill must be compacted according to the following requirements for the class of compaction specified:
 - a. Class A compaction. Compact each layer of earthfill as necessary to provide the density of the earthfill matrix not less than the minimum density specified in Section J or identified on the drawings. The earthfill matrix is defined as the portion of the earthfill material finer than the maximum particle size allowed in the reference compaction test method specified (ASTM D698 or ASTM D1557).
 - b. Class B compaction. Compact each layer of earthfill to a mass density not less than the minimum density specified.
 - c. Class C compaction. Compact each layer of earthfill by the specified number of passes of the type and weight of roller or other equipment specified or by an equivalent approved method. Each pass must consist of at least one passage of the roller wheel or drum over the entire surface of the layer.
2. Earth backfill. Compact earth backfill adjacent to structures to a density equivalent to that of the surrounding in-place earth material or adjacent required earthfill or earth backfill. Compaction must be accomplished by hand tamping or manually directed power tampers, plate vibrators, walk-behind, miniature, or self-propelled rollers. Unless otherwise specified, heavy equipment, including backhoe-mounted power tampers or vibrating compactors, and manually directed vibrating rollers must not be operated within 3 feet of any structure. Towed or self-propelled vibrating rollers must not be operated within 5 feet of any structure.

Compaction by means of drop weights operating from a crane or hoist is not permitted.

3. Heavy Equipment. The passage of heavy equipment will not be allowed:
 - a. Over cast-in-place conduits within 14 days after placement of the concrete
 - b. Over cradled or bedded precast conduits within 7 days after placement of the concrete cradle or bedding
 - c. Over any type of conduit until the backfill has been placed above the top surface of the structure to a height equal to one-half the clear span width of the structure or pipe or 3 feet, whichever is greater, except as may be specified in Section J.
4. Compacting adjacent to structures. Compacting of earth backfill adjacent to structures must not be started until the concrete has attained the strength specified in Section J for this purpose. The strength is determined by compression testing of test cylinders cast by the contractor's quality control personnel for this purpose and cured at the worksite in the manner specified in ASTM C31 for determining when a structure may be put into service.
5. Placement Interval Against Concrete. When the required strength of the concrete is not specified as described above, compaction of earth backfill adjacent to structures must not be started until the following time intervals shown in figure 23-1 have elapsed after placement of the concrete.

Figure 23-1 Time interval before placing backfill

Structure	Time interval (days)
Vertical or near-vertical walls with earth loading on one side only	14
Walls backfilled on both sides simultaneously	7
Conduits and spillway risers, cast-in-place (with inside forms in place)	7
Conduits and spillway risers, cast-in-place (inside forms removed)	14
Conduits, pre-cast, cradled	2
Conduits, pre-cast, bedded	1
Cantilever outlet bents (backfilled both sides simultaneously)	3

G. Reworking or removal and replacement of defective earthfill

1. Earthfill placed at densities lower than the specified minimum density or at moisture contents outside the specified acceptable range of moisture content, or otherwise not conforming to the requirements of the specifications must be reworked to meet the requirements or removed and replaced by acceptable earthfill. The replacement earthfill and the foundation, abutment, and earthfill surfaces upon which it is placed must conform to all requirements of this specification for foundation preparation, approval, placement, moisture control, and compaction.

H. Testing

1. During the course of the work, the contractor must perform quality control tests, as applicable, to identify earthfill and earth backfill materials; determine the reference maximum density and optimum moisture content; and document that the moisture content of material at the time of compaction and the density of earthfill and earth backfill in place conform to the requirements of this specification.
2. Determining Reference Maximum Density and Optimum Moisture Content. For Class A compaction, the reference maximum density and optimum moisture content must be determined in accordance with the compaction test and method specified on the drawings or in section J.
3. Documenting Specification Conformance. In-place densities of earthfill and earth backfill requiring Class A compaction must be measured in accordance with ASTM D1556, D2167, D2937, D6938, or D8167. Moisture contents of earthfill and earth backfill at the time of compaction must be measured in accordance with ASTM D2216, D4643, or D6938. Values of moisture content determined by ASTM D2216 are considered the true value of the soil moisture. Values of moisture content determined by ASTM D4643 or D6938 must be verified by comparison to values obtained by ASTM D2216. Values of in-place density and moisture content determined by these tests must be compared to the minimum density and moisture content range specified on the drawings or in Section J.
4. Correction for Oversize Particles. If the materials to be used for earthfill or earth backfill contain more than 5 percent by dry weight of oversize rock particles (particles larger than those allowed in the specified compaction test and method), corrections for oversize particles must be made using the appropriate procedures explained in ASTM D4718.

I. Measurement and payment

1. Unit Price Methods. For items of work for which specific unit prices are established in the contract, the volume of each type and compaction class of earthfill and earth backfill within the specified zone boundaries and pay limits is measured and computed to the nearest cubic yard by the method of average cross-sectional end areas. Unless otherwise specified in Section J, no deduction in volume is made for embedded items such as, but not limited to, conduits, inlet structures, outlet structures, embankment drains, sand diaphragm and outlet, and their appurtenances.
2. Pay Limits. The pay limits must be as defined below, with the further provision that earthfill required to fill voids resulting from over excavation of the foundation, outside the specified lines and grades, will be included in the measurement for payment only under the following conditions:
 - a. Where such over excavation to remove unsuitable material is directed by the engineer
 - b. Where the unsuitable condition is not a result of the contractor's improper construction operations as determined by the engineer.

3. Beyond Specified Lines and Grades. Earthfill beyond the specified lines and grades to backfill excavation required for compliance with OSHA requirements will be considered subsidiary to the earthfill bid items.
4. Method 1. The pay limits must be as designated on the drawings.
5. Method 2. The pay limits must be the measured surface of the foundation when approved for placement of the earthfill and the specified neat lines of the earthfill surface.
6. Method 3. The pay limits must be the measured surface of the foundation when approved for placement of the earthfill and the measured surface of the completed earthfill.
7. Method 4. The pay limits must be the specified pay limits for excavation and the specified neat lines of the earthfill surface.
8. Method 5. The pay limits must be the specified pay limits for excavation and the measured surface of the completed earthfill.
9. Method 6. Payment for each type and compaction class of earthfill and earth backfill is made at the contract unit price for that type and compaction class of earthfill. Such payment will constitute full compensation for all labor, material, equipment, and other items necessary and incidental to the performance of the work.
10. Method 7. Payment for each type and compaction class of earthfill and earth backfill is made at the contract unit price for that type and compaction class of earthfill. Such payment will constitute full compensation for all labor, material, equipment, and other items necessary and incidental to the performance of the work except furnishing, transporting, and applying water to the foundation and earthfill material. Water applied to the foundation and earthfill material is measured and payment made as specified in Construction Specification 10.
11. All methods. The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section J of this specification.

J. Items of work and construction details

1. Bid Item #4 - Earthfill
 - a. This item will consist of transport, spreading, and compaction of stockpiled materials to backfill the new intake structure and reconstruct the levee.
 - b. Compaction will be Class C, made via 6" loose lifts of material with at least 4 passes of manually directed power tampers, plate vibrators, and/or excavator mounted power tampers. Density of fill will be equivalent to that of adjacent levee materials.

- c. Compaction of earthfill against adjacent undisturbed levee material will be made at slopes no steeper than 3H:1V. Follow foundation preparation guidance outlined in Section C for the slope on existing levee material.
- d. If a clay core in the levee was identified during excavation, carefully reconstruct the core using the stockpiled materials, matching the elevations/extents of the adjacent levee section.
- e. No additional compensation will be provided for provision or incorporation of water needed for moisture control during earthfill placement.
- f. Payment shall be by Method 1 of Section I.

Construction Specification 24 — Drainfill

A. Scope

1. The work consists of furnishing, placing, and compacting drainfill required in the construction of structures and drainage systems.

B. Material

1. Method 1. Drainfill material must conform to the requirements of Material Specification 521, Aggregates for Drainfill and Filters. At a minimum of 30 days before delivery of materials to the site, the contractor must inform the engineer, in writing, of the source(s) from which drainfill material will be obtained. The contractor must provide the engineer free access to the source(s) for the purpose of obtaining samples for testing.
2. Method 2. Drainfill material must be sand, gravel, or crushed stone (or mixtures thereof) obtained from the specified sources. Select the material as necessary to avoid the inclusion of organic matter, clay balls, excessive fine particles, or other substances that would interfere with its free-draining properties.

C. Base Preparation

1. Foundation surface and trenches must be clean and free of organic matter, loose soil, foreign substances, and standing water when the drainfill is placed. Earth surfaces upon or against which drainfill will be placed must not be scarified.

D. Placement

1. Drainfill must not be placed until the subgrade has been inspected and approved by the engineer. Drainfill must not be placed over or around pipe or drain tile until the installation of the pipe or tile has been inspected and approved.
2. Place drainfill uniformly in layers not exceeding 12 inches in thickness before compaction. When compaction is accomplished by manually controlled equipment, the layers must not exceed 8 inches in thickness. Place the material to avoid segregation of particle sizes and to ensure the continuity and integrity of all zones. No foreign material must be allowed to become intermixed with or otherwise contaminate the drainfill.
3. Traffic must not be permitted to cross over drains at random. Equipment cross overs must be maintained and the number and location of such cross overs must be established and approved before beginning drainfill placement. Each cross over must be cleaned of all contaminating material and must be inspected and approved by the engineer before the placement of additional drainfill material.
4. Any damage to the foundation surface, trench sides, or bottom occurring during placement of drainfill must be repaired before drainfill placement is continued.

5. The upper surface of drainfill constructed concurrently with adjacent zones of earthfill must be maintained at a minimum elevation of 1 foot above the upper surface of adjacent earthfill.
6. Place drainfill over and around pipe or drain tile to avoid any displacement in line or grade of the pipe or tile.
7. Drainfill must not be placed adjacent to structures until the concrete has attained the strength specified in Section I of this specification. Determine the strength by compression testing of concrete test cylinders cast and field cured at the project site in accordance with ASTM C31 for determining when a structure may be placed into service.
8. When the required strength of the concrete is not specified as described above, placement of drainfill adjacent to concrete structures must not commence until the time intervals specified in figure 24-1 have elapsed following placement of the concrete.

Figure 24-1 Elapsed Time Before Fill Can be Place Near Concrete Structures

Structure Type	Time Interval (Days)
Vertical or near-vertical wall with earth loading on one side only (retaining walls and counterforts)	14
Walls backfilled on both sides simultaneously	7
Conduits and galleries, cast-in-place (with inside forms in place)	7
(inside forms removed)	14
Conduits, precast, cradled	2
Conduits, precast, bedded	1
Cantilever outlet bents backfilled on both sides simultaneously	3

E. Control of Moisture

1. Control the moisture content of drainfill material as specified in Section I of this specification. When additional water is required, apply it in a manner to avoid excessive wetting to adjacent earthfill. Except as specified in Section I of this specification, control of moisture content will not be required.

F. Compaction

1. All Items. Compact drainfill according to the following requirements for the class of compaction specified. A pass in this section is defined as at least one complete coverage of the roller wheel, tire, or drum over the entire surface for each layer.
2. Class A Compaction. For drainfill materials with more than 70 percent passing the 3/4-inch sieve, compact each layer of drainfill to the minimum dry density specified in Section I of this specification as determined by ASTM D698. For drainfill materials with 70 percent or less passing the 3/4-inch sieve, compact each layer of drainfill to a relative density of not less than 70 percent as determined by ASTM D4254.
3. Class I Compaction. Compact each layer of drainfill by making a minimum of two passes over the entire surface with a steel drum vibrating roller weighing at least 5 tons and exerting a vertical vibrating force of not less than 20,000 pounds

at a minimum frequency of 1,200 times per minute or by an approved equivalent method.

4. Class II Compaction. Compact each layer of drainfill by one of the following methods or by an approved equivalent method.
 - a. A minimum of two passes over the entire surface with a pneumatic-tired roller exerting a minimum pressure of 75 pounds per square inch.
 - b. A minimum of four passes over the entire surface with the track of a crawler-type tractor weighing at least 20 tons.
 - c. Controlled movement of the hauling equipment so that the entire surface is traversed by not less than one tread track of the loaded hauling equipment.
5. Class III Compaction. No compaction will be required beyond that resulting from the placing and spreading operations.
6. Class I and II. When compaction other than Class III compaction is specified, material placed in trenches or other locations inaccessible to heavy equipment must be compacted by manually controlled pneumatic or vibrating tampers as specified in Section I of this specification.
7. Heavy Equipment Limits. Heavy equipment must not be operated within 2 feet of any structure. Vibrating rollers must not be operated within 5 feet of any structure. Compaction by means of drop weights operating from cranes, hoists, or similar equipment will not be permitted.

G. Testing

1. The contractor must conduct such tests as necessary to verify that the drainfill material and the in-place drainfill meets the specification requirements.
2. The engineer must be granted access to perform such tests as are required to verify that the drainfill materials and the drainfill in place meets the requirements of the specifications. These tests are not intended to provide the contractor with information needed to ensure that the materials and workmanship meet the specification requirements. These verification tests will not relieve the contractor of the responsibility of performing required tests for that purpose.

H. Measurement and Payment

1. Method 1.
 - a. For items of work for which specific unit prices are established in the contract, the volume of drainfill within the neat lines shown on the drawings are measured and computed to the nearest cubic yard. Where the engineer directs placement of drainfill outside the neat lines to replace unsuitable foundation material, the volume of such drainfill is included. The volume included is only to the extent that the unsuitable condition is not a result of the contractor's improper construction operation as determined by the engineer.
 - b. Payment for drainfill is made at the contract unit price for each type of drainfill, complete and in place. Except as otherwise specified in Section I of this specification, such payment will constitute full compensation for all labor,

equipment, material, and other items necessary and incidental to the performance of the work.

2. Method 2. For items of work for which specific unit prices are established in the contract, the quantity of drainfill placed within the specified limits is computed to the nearest 0.1 ton by actual weight. Where the engineer directs placement of drainfill outside the neat lines to replace unsuitable foundation material, the weight of such drainfill is included. The weight included is only to the extent that the unsuitable condition is not a result of the contractor's improper construction operation as determined by the engineer.
3. Exceptions. Payment for drainfill is made at the contract unit price for each type of drainfill, complete and in place. Except as otherwise specified in Section I of this specification, such payment will constitute full compensation for all labor, equipment, material, and other items necessary and incidental to the performance of the work.
4. All Methods. Compensation for any item of work described in the contract but not included in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section I of this specification.

I. Items of Work and Construction Details

1. Bid Item #8 – Intake Structure Bedding and Select Backfill

- a. This item shall consist of furnishing, transporting, and placing pea gravel for culvert bedding and initial backfill, as well as the subgrade materials for the riser footing. This item also consists of furnishing, transporting, and placing ASTM C-33 sand for the filter diaphragm.
- b. Pea gravel will consist of 3/8" minus rounded rock particles that function as a flowable fill. Pea gravel will meet Material Specification 521 – Aggregates for Drainfill and Filters and the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8"	85 - 100
No. 4	10 – 30
No. 8	0 – 10

- c. Payment shall be by Method 1 of Section H.

Construction Specification 32 — Concrete Structures

A. Scope

1. The work consists of furnishing, forming, placing, finishing, and curing Portland Cement concrete as required to build the structures described in section X of this specification.
2. The following BioPreferred® product category is applicable to this specification:
 - a. Concrete release fluids (aka form-release agents)

B. Material

1. Aggregates must conform to the requirements of Material Specification 522, Aggregates for Portland Cement Concrete, unless otherwise specified. The grading of coarse aggregates must be as specified in section X.
2. Portland Cement must conform to the requirements of Material Specification 531, Portland Cement, for the specified type.
3. Fly ash must conform to the requirements of Material Specification 532, Supplementary Cementitious Materials.
4. Air-entraining admixtures must conform to the requirements of Material Specification 533, Chemical Admixtures for Concrete. If air-entraining cement is used, any additional air-entraining admixture must be of the same type as that in the cement.
5. Water reducing and/or retarding admixtures must conform to the requirements of Material Specification 533, Chemical Admixtures for Concrete.
6. Curing compound must conform to the requirements of Material Specification 534, Concrete Curing Compound.
7. Preformed expansion joint filler must conform to the requirements of Material Specification 535, Preformed Expansion Joint Filler.
8. Waterstops must conform to the requirements of Material Specifications 537, Nonmetallic Waterstops, and 538, Metal Waterstops, for the specified kinds.
9. Water used in mixing and curing concrete must be clean and free from injurious amounts of oil, salt, acid, alkali, organic matter, or other deleterious substances.

C. Class of concrete

1. Concrete for structure concrete is classified as follows in figure 32-1:

Figure 32-1 Concrete classification

Class of concrete	Maximum net water content	Minimum cement content
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	(gal/bag)	(bags/yd ³)
3000M	6	5.5
4000M	6	6

D. Air content and consistency

1. Unless otherwise specified, the slump must be 3 to 5 inches. If air entrainment is specified, the air content, by volume, must be 4 to 7 percent of the volume of the concrete. When specified, directed, or approved by the engineer, a water-reducing, set-retarding, or other admixture must be used. High-range water-reducing agents (superplasticizers) may be used to increase workability, reduce water content, and control concrete temperature in hot weather. The maximum slump after adding high range water reducing agents must be 7.5 inches.

E. Design of the concrete mix

1. The proportions of the aggregates must be such as to produce a concrete mixture that works readily into the corners and angles of the forms and around reinforcement when consolidated, but does not segregate or exude free water during consolidation.
2. Fly ash may be used as a partial substitution for Portland Cement in an amount of no more than 25 percent (by weight) of the cement in the concrete mix, unless otherwise specified.
3. The maximum water to cement ratio is 0.5 unless otherwise specified. When more than one cementitious material is used, the maximum water to cementitious materials ratio is 0.5 unless otherwise specified.
4. Before the concrete is placed, the contractor must furnish the Engineer, for approval, a statement of the materials and mix proportions (including admixtures, if any) intended for use. The statement must include evidence satisfactory to the Engineer that the materials and proportions will produce concrete conforming to this specification. The materials and proportions so stated must constitute the job mix. After a job mix has been approved, neither the source, character, or grading of the aggregates nor the type or brand of cement or admixture may be changed without prior notice to the Engineer. If such changes are necessary, no concrete containing such new or altered material may be placed until the Engineer has approved a revised job mix.

F. Inspection and testing

1. The engineer is to have free entry to the plant and equipment furnishing concrete under the contract. Provide proper facilities for the engineer to inspect materials, equipment, and processes and to obtain samples of the concrete. All tests and inspections will be conducted so as not to interfere unnecessarily with manufacture and delivery of the concrete.

G. Handling and measurement of material

1. Materials must be stockpiled and batched by methods that prevent segregation or contamination of aggregates and ensure accurate proportioning of the ingredients of the mix. Except as otherwise provided in section H, measure cement and aggregates as follows.
 - a. Measure cement by weight or in bags of 94 pounds each. When cement is measured in bags, no fraction of a bag may be used unless weighed.
 - b. Measure aggregates by weight. Base mix proportions on saturated, surface-dry weight. The batch weight of each aggregate is the required saturated, surface-dry weight plus the weight of surface moisture it contains.
 - c. Measure water by volume or weight to an accuracy within 1 percent of the total quantity of water required for the batch.
 - d. Measure admixtures within a limit of accuracy of 3 percent.

H. Mixers and mixing

1. Concrete must be uniform and thoroughly mixed when delivered to the work site. Variations in slump of more than 1 inch within a batch are considered evidence of inadequate mixing and must be corrected by increasing mixing time or other acceptable alternative.
2. For stationary mixers, the mixing time after all cement and aggregates are in the mixer drum must be not less than 1.5 minutes. When concrete is mixed in a truck mixer, the number of revolutions of the drum or blades at mixing speed must be not less than 70 nor more than 100.
3. Unless otherwise specified, volumetric batching and continuous mixing at the construction site are permitted. To produce concrete meeting the specified proportioning and uniformity requirements, the batching and mixing equipment must conform to the requirements of ASTM C685 and must be demonstrated by tests with the job mix before the concrete is placed. Concrete made by this method must be produced, inspected, and certified in conformance with sections 6, 7, 8, 13, and 14 of ASTM C685.
4. No mixing water in excess of the amount called for by the job mix must be added to the concrete during mixing or hauling or after arrival at the delivery point.

I. Forms

1. Forms must be of wood, plywood, steel, or other approved material and must be mortar tight. The forms and associated falsework must be substantial and unyielding and must be constructed so that the finished concrete will conform to the specified dimensions and contours. Form surfaces must be smooth and free from holes, dents, sags, or other irregularities. Forms must be coated with a nonstaining form release agent before being set into place.
2. Equip metal ties or anchorages within the forms with cones, she-bolts or other devices that permit their removal to a depth of at least 1 inch without injury to the concrete. Ties designed to break off below the surface of the concrete must not be used without cones.

3. All edges that will be exposed to view when the structure is completed must be chamfered unless finished with molding tools as specified in Section R.

J. Preparation of forms and subgrade

1. Prior to placement of concrete, the forms and subgrade must be free of chips, sawdust, debris, water, ice, snow, extraneous oil, mortar, or other harmful substances or coatings and the temperature of all surfaces to be in contact with the new concrete must be not be less than 40 degrees Fahrenheit. Any oil on the reinforcing steel or other surfaces required to be bonded to the concrete must be removed. Clean rock surfaces by air-water cutting, wet sandblasting, or wire-brush scrubbing, as necessary, and wet immediately before placement of concrete. The earth surface must be firm and damp. Placement of concrete on mud, dried earth, or uncompacted fill or frozen subgrade is not permitted.
2. Position items to be embedded in the concrete accurately and anchored firmly.
3. Form weepholes in walls or slabs with nonferrous material.

K. Conveying

1. Deliver concrete to the site and discharge it into the forms within 1.5 hours after the introduction of the cement to the aggregates. In hot weather or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge must not exceed 45 minutes.
2. The engineer may allow a longer time, provided the setting time of the concrete is increased a corresponding amount by the addition of an approved set-retarding admixture. In any case, concrete must be conveyed from the mixer to the forms as rapidly as practicable by methods that prevent segregation of the aggregates and ensure no loss of mortar occurs.

L. Placing

1. Concrete must not be placed until the subgrade, forms, steel reinforcement, and embedded items have been inspected and approved. No concrete may be placed except in the presence of the engineer. The contractor must give reasonable notice to the engineer each time concrete is to be placed. Such notice must provide sufficient time for the engineer to inspect the subgrade, forms, steel reinforcement, and other preparations for compliance with the specifications. Other preparations include, but are not limited to, the concrete mixing plant; delivery equipment system; placing, finishing, and curing equipment and system; schedule of work; workforce; and heating or cooling facilities, if applicable. Deficiencies are to be corrected before concrete is delivered for placing.
2. Deposit the concrete as closely as possible to its final position in the forms. Work concrete into the corners and angles of the forms and around all reinforcement and embedded items in a manner to prevent segregation of aggregates or excessive laitance. Place formed concrete in horizontal layers not more than 20 inches thick. Concrete must not be dropped more than 5 feet vertically unless suitable equipment is used to prevent segregation. When high-range water-

reducing agents are used, the concrete must not be allowed to drop more than 10 feet. Hoppers and chutes, pipes, or "elephant trunks" must be used as necessary to prevent segregation and the splashing of mortar on the forms and reinforcing steel above the layer being placed.

3. Immediately after the concrete is placed in the forms, it must be consolidated by spading, hand tamping, or vibration as necessary to ensure a smooth surface and dense concrete. Each layer must be consolidated to ensure monolithic bond with the preceding layer. If the surface of a layer of concrete in place sets to the degree that it will not flow and merge with the succeeding layer when spaded or vibrated, the contractor must discontinue placing concrete and must make a construction joint according to the procedure specified in section M.
4. If placing is discontinued when an incomplete horizontal layer is in place, the unfinished end of the layer must be formed by a vertical bulkhead.

M. Construction joints

1. Make construction joints at the locations shown on the drawings. If construction joints are needed that are not shown on the drawings, they must be placed in locations approved by the engineer.
2. Where a feather edge would be produced at a construction joint, such as the top surface of a sloping wall, use an insert form so that the resulting edge thickness on either side of the joint is not less than 6 inches.
3. In walls and columns, as each lift is completed, the top surface must be immediately and carefully protected from any condition that might adversely affect the hardening of the concrete.
4. Steel tying and form construction adjacent to concrete in place must not be started until the concrete has cured at least 12 hours. Before new concrete is deposited on or against concrete that has hardened, the forms must be retightened. New concrete must not be placed until the hardened concrete has cured at least 12 hours.
5. Clean the surface of construction joints of all unsatisfactory concrete, laitance, coatings, or debris by washing and scrubbing with a wire brush or wire broom or by other means approved by the engineer. Keep the surface moist for at least 1 hour before the new concrete is placed.

N. Expansion and contraction joints

1. Make expansion and contraction joints only at locations shown on the drawings.
2. Exposed concrete edges at expansion and contraction joints must be carefully tooled or chamfered and the joints must be free of mortar and concrete. Joint filler must be left exposed for its full length with clean and true edges.
3. Hold preformed expansion joint filler firmly in the correct position as the concrete is placed.

4. When open joints are specified, construct them by the insertion and subsequent removal of a wooden strip, metal plate, or other suitable template in such a manner that the corners of the concrete are not chipped or broken. Finish the edges of open joints with an edging tool before the joint strips are removed.

O. Waterstops

1. Hold waterstops firmly in the correct position as the concrete is placed. Joints in metal waterstops must be soldered, brazed, or welded. Joints in rubber or plastic waterstops must be cemented, welded, or vulcanized as recommended by the manufacturer.

P. Removal of forms

1. Forms must not be removed without the approval of the engineer. Remove forms in such a way as to prevent damage to the concrete. Remove supports in a manner that permits the concrete to take the stresses of its own weight uniformly and gradually.

Q. Finishing formed surfaces

1. Immediately after the forms are removed:
 - a. All fins and irregular projections must be removed from exposed surfaces.
 - b. The holes produced on all surfaces by the removal of form ties, cone-bolts, and she-bolts must be cleaned, wetted, and filled with a dry-pack mortar. The mortar will consist of one part Portland Cement, three parts sand that will pass a No. 16 sieve, and just sufficient water to produce a consistency such that the filling is at the point of becoming rubbery when the material is solidly packed.

R. Finishing unformed surfaces

1. All exposed surfaces of the concrete must be accurately screeded to grade and then float finished, unless specified otherwise.
2. Excessive floating or troweling of surfaces while the concrete is soft is not permitted.
3. Adding dry cement or water to the surface of the screeded concrete to expedite finishing is not allowed.
4. Joints and edges on unformed surfaces that will be exposed to view must be chamfered or finished with molding tools.

S. Curing

1. Prevent concrete from drying for a curing period of at least 7 days after it is placed. Exposed surfaces must be kept continuously moist for the entire period or until curing compound is applied as specified below. Moisture must be maintained by sprinkling, flooding, or fog spraying or by covering with continuously moistened canvas, cloth mats, straw, sand, or other approved material. Wood forms left in place during the curing period must be kept continuously wet. A formed surface must be thoroughly wetted immediately after forms are removed and must be kept wet until patching and repairs are completed.

Water or covering must be applied in such a way that the concrete surface is not eroded or otherwise damaged.

2. Concrete, except at construction joints, may be coated with the approved curing compound instead of continued application of moisture, except as otherwise specified in section X. Spray the compound on the moist concrete surface as soon as free water has disappeared but do not apply to any surface until patching, repairs, and finishing of that surface are completed. The compound must be applied at a uniform rate of not less than 1 gallon per 175 square feet of surface and must form a continuous adherent membrane over the entire surface. Curing compound must be thoroughly mixed before applying and continuously agitated during application. Curing compound must not be applied to a surface requiring bond to subsequently placed concrete, such as construction joints, shear plates, reinforcing steel, and other embedded items. If the membrane is damaged during the curing period, the damaged area must be resprayed at the rate of application specified above. Any surface covered by the membrane must not be trafficked unless protected from wear.

T. Removal and replacement or repair

1. When concrete is honeycombed, damaged, or otherwise defective, the contractor must remove and replace the structure or structural member containing the defective concrete or, where feasible, correct or repair the defective parts. The Engineer determines the required extent of removal, replacement, or repair. Before starting repair work, the contractor must obtain the Engineer's approval of the plan for repairs. The contractor must perform all repair work in the presence of the engineer.

U. Concreting in cold weather

1. Concrete must not be mixed nor placed when the daily minimum atmospheric temperature is less than 40 degrees Fahrenheit unless facilities are provided to prevent the concrete from freezing. The use of accelerators or antifreeze compounds is not allowed.

V. Concreting in hot weather

1. The contractor must apply effective means to maintain the temperature of the concrete below 90 degrees Fahrenheit during mixing, conveying, and placing.

W. Measurement and payment

1. For items of work for which specific unit prices are established in the contract, concrete is measured to the neat lines shown on the drawings and the volume of concrete is computed to the nearest 0.1 cubic yard. Measurement of concrete placed against the sides of an excavation without using intervening forms is made only to the neatness or pay limits shown on the drawings. No deduction in volume is made for chamfers, rounded or beveled edges, or for any void or embedded item that is less than 5 cubic feet in volume.

2. Payment for each item of structure concrete is made at the contract unit price or the contract lump sum, whichever is applicable for that item. Such payment constitutes full compensation for all labor, material, equipment, transportation, tools, forms, falsework, bracing, and other items necessary and incidental to the completion of the work except items listed for payment elsewhere in the contract. Compensation for any item of work described in the contract but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section X of this specification.

X. Items of work and construction details

1. Bid Item #9 – Intake Structure Concrete

- a. This item shall consist of furnishing, forming, placing, finishing, and curing the concrete for the riser base and gate wall, as well as under the riser stub haunches.
- b. Concrete shall be 4000M as outlined in this specification, with maximum water to cement ratio, by mass, of 0.5. Air content shall be 5 to 8% of concrete volume. Materials Specification 522 – Aggregates for Portland Cement Concrete will be met in the supplied mix. Type II cement will be utilized, per Materials Specification 531 – Portland Cement.
- c. Items of work subsidiary to this bid item include:
 - Steel Reinforcement, Construction Specification 34
- d. Payment shall be by Section W.

Construction Specification 34 — Steel Reinforcement

A. Scope

1. The work consists of furnishing and placing steel reinforcement for reinforced concrete or pneumatically applied mortar.

B. Material

1. Steel reinforcement must conform to the requirements of Material Specification 539, Steel Reinforcement (for concrete). Before reinforcement is placed, the surface of the bars and fabric and any metal supports must be cleaned to remove any loose, flaky rust, mill scale, oil, grease, or other undesirable coatings or foreign substances. Epoxy-coated steel reinforcement must be free of surface damage. After placement, the reinforcement must be maintained in a clean and serviceable condition until it is completely embedded within the concrete.

C. Bar schedule, lists and diagrams

1. Any supplemental bar schedules, bar lists, or bar-bending diagrams required in section J of this specification for the fabrication and placement of steel reinforcement must be provided by the contractor. Before reinforcement is placed, the contractor must furnish four copies of any such lists or diagrams to the Engineer for approval. Acceptance of the reinforcement is not based on approval of these lists or diagrams but on inspection of the steel reinforcement after it has been placed, tied, and supported and is ready to receive concrete.

D. Bending

1. Reinforcement must be cut and bent in compliance with the requirements of the American Concrete Institute (ACI) Standard 315. Bars must not be bent or straightened in a manner that will injure or weaken the material. Bars with kinks, cracks, or improper bends must be rejected.

E. Splicing bar reinforcement

1. Method 1. Splices of reinforcement may only be made at locations shown on the drawings and provided by the steel schedule. Placement of bars at the lap splice locations shown, when not in contact, must not be farther apart than one-fifth the shown lap length and, in all cases, no greater than 6 inches.
2. Method 2. Splices of reinforcement must be limited to those locations shown on the drawings. Splice lengths must be determined before fabrication and meet the requirements of ACI Standard 318, Building Code Requirements for Reinforced Concrete, based on design information in section J of this specification. Bar placement drawings and schedules must be provided for approval before fabrication. The drawings must show all splice locations, layouts, and lap dimensions.

F. Splicing welded wire reinforcement

1. Unless otherwise specified, welded wire reinforcement must be spliced in the following manner:
 - a. End-to-end. Adjacent sections must be spliced end-to-end (longitudinal lap) by overlapping a minimum of one full mesh plus 2 inches plus the length of the two end overhangs. The splice length is measured from the end of the longitudinal wires in one piece of fabric to the end of the longitudinal wire in the lapped piece of fabric.
 - b. Side-to-side. Adjacent sections must be spliced side-to-side (transverse lap) a minimum of one full mesh plus 2 inches. The splice length must be measured from the centerline of the first longitudinal wire in one piece of fabric to the centerline of the first longitudinal wire in the lapped piece of fabric.

G. Placing

1. Reinforcement must be accurately placed and secured in position to prevent its displacement during the placement of concrete. Tack welding of bars is not permitted. Metal chairs, metal hangers, metal spacers, and concrete chairs may be used to support the reinforcement. Metal hangers, spacers, and ties must be placed in such a manner that they are not exposed in the finished concrete surface. The legs of metal chairs or side form spacers that may be exposed on any face of slabs, walls, beams, or other concrete surfaces must have a protective coating or finish. The coating or finish must be hot dip galvanized, epoxy coated, plastic coated, or stainless steel. Metal chairs and spacers not fully covered by a protective coating or finish must have a minimum cover of 0.75 inch of concrete over the unprotected metal part. The exception is that those with plastic coatings may have a minimum cover of 0.5 inch of concrete over the unprotected metal part. Precast concrete chairs must be manufactured of the same class of concrete as specified for the structure and must have the tie wires securely anchored in the chair or a V-shaped groove at least 0.75 inch in depth molded into the upper surface to receive the steel bar at the point of support. Precast concrete chairs must be clean and moist at the time concrete is placed.
2. High-density or structural plastic rebar accessories designed to ensure maximum concrete bond may be substituted for metal or concrete accessories in spacer applications as approved by the Engineer. Exposure of plastic rebar accessories at the finished concrete surface must be kept to a minimum. Plastic rebar accessories, when used, must be staggered along adjacent parallel bars and placed at intervals no closer than 12 inches. Plastic rebar accessories must not be used in concrete sections 6 inches or less in thickness.
3. Reinforcement must not be placed until the prepared site has been inspected and approved. After placement of the reinforcement, concrete must not be placed until the reinforcement has been inspected and approved by the responsible engineer.

H. Storage

1. Steel reinforcement stored at the work site must be placed on platforms, skids, or other supports. This is done to avoid contact with the ground and to protect the material from mechanical damage and corrosion.

I. Measurement and payment

1. Method 1.

- a. For items of work with specific unit prices established in the contract, the weight of steel reinforcement placed in the concrete in accordance with the drawings is determined to the nearest pound by computation from the placing drawings. Measurement of hooks and bends is based on the requirements of ACI Standard 315. Computation of weights of reinforcement is based on the unit weights established in figures 34–1 and 34–2 of this specification. Computation of weights for welded wire reinforcement not shown in figure 34–2 must be based on ACI Standard 315. The area of welded wire reinforcement placed in the concrete in accordance with the drawings is determined to the nearest square foot by computation from the placing drawings with no allowance for required laps. The weight of steel reinforcing in extra splices or extra-length splices approved for the convenience of the contractor or the weight of supports and ties is not included in the measurement for payment.
- b. Payment for furnishing and placing reinforcing steel is made at the contract unit price. Such payment constitutes full compensation for all labor, material, equipment, and other items necessary and incidental to the completion of the work including preparing and furnishing bar schedules, lists, or diagrams; furnishing and attaching ties and supports; and furnishing, transporting, storing, cutting, bending, cleaning, and securing all reinforcements.

2. Method 2.

- a. For items of work with specific unit prices established in the contract, the weight of bar reinforcement placed in the concrete in accordance with the drawings is determined to the nearest pound by computation from the placing drawings. Measurement of hooks and bends is based on the requirements of ACI Standard 315. Computation of weights of bar reinforcement is based on the unit weights established in figure 34–1 of this specification. The weight of steel reinforcing in extra splices or extra-length splices approved for the convenience of the contractor or the weight of supports and ties is not included in the measurement for payment.
- b. The area of welded wire reinforcement placed in the concrete in accordance with the drawings is determined to the nearest square foot by computation from the placing drawings with no allowance for required laps.
- c. Payment for furnishing and placing bar reinforcing steel is made at the contract unit price for bar reinforcement. Payment for furnishing and placing welded wire reinforcing steel is made at the contract unit price for welded wire reinforcement. Such payment constitutes full compensation for all labor, material, equipment, and other items necessary and incidental to the completion of the work including preparing and furnishing bar schedules,

lists, or diagrams; furnishing and attaching ties and supports; and furnishing, transporting, cutting, bending, cleaning, and securing all reinforcement.

3. **All Methods.** The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items to which they are made subsidiary are identified in section J of this specification.

Figure 34–1 Standard reinforcing bars

Bar Size (English)¹	Bar Size (Metric)²	Weight (lb/ft)
3	10	0.376
4	13	0.668
5	16	1.043
6	19	1.502
7	22	2.044
8	25	2.670
9	29	3.400
10	32	4.303
11	36	5.313
14	43	7.650
18	57	13.600

1/ The bar diameter (inches) equals the bar size number divided by eight. For example, the diameter of a #4 bar is $4 \div 8 = 0.5$ inch.

2/ The metric bar size has been rounded to a whole number that represents the approximate diameter of the bar in millimeters.

Figure 34–2 Rectangular welded wire reinforcement

Style designation - W-number^{1,2}	Style designation - steel wire gauge (former designation)^{1,2}	Weight (lb/100 ft²)
6 × 6 – W1.4 × W1.4	6 × 6 – 10 × 10	21
6 × 6 – W2.1 × W2.1	6 × 6 – 8 × 8	30
6 × 6 – W2.9 × W2.9	6 × 6 – 6 × 6	42
6 × 6 – W4.0 × W4.0	6 × 6 – 4 × 4	58
4 × 4 – W1.4 × W1.4	4 × 4 – 10 × 10	31
4 × 4 – W2.1 × W2.1	4 × 4 – 8 × 8	44
4 × 4 – W2.9 × W2.9	4 × 4 – 6 × 6	62
4 × 4 – W4.0 × W4.0	4 × 4 – 4 × 4	85
4 × 12 – W2.1 × W0.9 ^{2/}	4 × 12 – 8 × 12	25
4 × 12 – W2.5 × W1.1 ^{2/}	4 × 12 – 7 × 11	31

1/ Style designation is defined in ACI Standard 315 of the American Concrete Institute.

2/ Welded smooth wire reinforcement with wires smaller than size W1.4 is manufactured from galvanized wire.

J. Items of work and construction details

1. Subsidiary Item – Reinforcing Steel

- a. This item shall consist of furnishing and placing steel reinforcement for reinforced concrete as shown on the drawings.
- b. Reinforcing steel will meet Materials Specification 539 – Steel Reinforcement.
- c. Section I will not apply to these items. All items listed in this section shall be considered incidental to Bid Item 9 – Intake Structure Concrete.

Construction Specification 51 — Corrugated Metal Pipe

A. Scope

1. The work consists of furnishing and placing circular, arched, or elliptical corrugated metal pipe and the necessary fittings.

B. Material

1. Pipe and fittings must conform to the requirements of Material Specification 551, Coated Corrugated Steel Pipe, or Material Specification 552, Aluminum Corrugated Pipe, whichever is specified.
2. Unless otherwise specified in Section K of this specification, perforated pipe furnished must conform to the requirements for Class I perforations as described in ASTM A760 or A762.

C. Coupling Bands and Hardware

1. Provide pipe joint coupling bands to meet the requirements specified in Section K of this specification.
2. Hardware consisting of coupling bands and band-fastening devices, such as connecting bolts, rods, lugs, and angles used in conjunction with zinc-coated iron or steel pipe, must be galvanized by the hot-dip method. Hardware used in conjunction with aluminum pipe and aluminum or aluminum-zinc alloy-coated iron and steel pipe must be of the same material as the pipe except that hot-dip galvanized or cadmium-plated fasteners may be used. Coat the surface of all band-fastening devices for pipe specified with bituminous or polymer coating with asphalt-mastic material meeting the requirements of ASTM A849. Coat the coupling similar to that specified for the pipe unless otherwise specified in Section K of this specification.
3. Install coupling bands to provide straight alignment of the connecting pipe ends. Unless otherwise specified in Section K of this specification, the bandwidth must be as specified in ASTM A760 and A762. The bands must be positioned to overlap adjacent pipe ends equally. The coupling bands must be corrugated to match the corrugations of the pipe section ends being connected.

D. Fabrication

1. Fabrication of appurtenant sections must be performed as shown on the drawings and described in Section K of this specification. The items may consist of inlet sections, outlet sections, end sections, elbows, skew or beveled sections, rod-reinforced ends, cut-off collars, or headwalls. Fabrication of these appurtenant sections must be made from metallic-coated material identical to that from which the attached pipe is fabricated. Fabrication must be of a quality and finished workmanship equal to that required for the pipe.

E. Handling the Pipe

1. The contractor must furnish equipment as necessary to install the pipe without damaging the pipe or coating. The pipe must be transported and handled in a manner that prevents damage to the pipe and coating.

F. Laying and Bedding the Pipe

1. Install pipe to the line and grade shown on the drawings. Unless otherwise specified, install the pipe so that there are no reversals of grade between joints. Install in accordance with the manufacturer's recommendations. Install the pipe with the outside laps of circumferential joints pointing upstream and with longitudinal laps at the sides near the vertical mid-height of the pipe.
2. Field welding of corrugated galvanized iron or steel pipe is not permitted. The pipe sections must be joined with fabricator-supplied coupling bands meeting the specified joint requirements. Install the coupling as recommended by the fabricator.
3. The pipe must be firmly and uniformly bedded throughout its full length to the depth and in the manner specified on the drawings.
4. Install perforated pipe with the perforations down and oriented symmetrically about a vertical centerline. Perforations must be clear of any obstructions at the time the pipe is installed in its final position.
5. The pipe must be loaded sufficiently during backfilling to prevent displacement from line and grade and to maintain full contact with the bedding during the placement operations.

G. Strutting

1. When required, install struts or horizontal ties in the manner specified on the drawings. Struts and ties must remain in position until the backfill has been placed above the top of the pipe to a height of 5 feet or the pipe diameter, whichever is greater, or to the surface of the completed earth backfill when the fill height is less than 5 feet above the top of the pipe. The contractor must remove the struts or ties following completion of the earth backfill requirements that apply.

H. Embedment in Concrete

1. Special treatment must be provided to the pipe surface when it is embedded or attached to concrete and its material is aluminum or aluminum-coated and aluminum-zinc alloy-coated. Potential contact surfaces in contact with concrete and masonry surfaces must be coated with two coats of cutback-type bituminous paint. Placement of the pipe must be such that direct metal-to-metal contact with other metallic material, such as embedded steel reinforcement or water control gates, is prevented.

I. Repair of Damaged Coating

1. Any damage to the metallic coating must be repaired by cleaning the damaged surface area by sand blasting, power disk sanding, or wire brushing. All loose and

cracked coating, dirt, and any corrosive products must be removed before application of paint. Oil and grease material must be removed with a solvent. The surface must be clean and dry during the painting period and until the coating has completely dried.

2. Painting must be accomplished by one of the following options based on installed exposure conditions of the pipe as determined by the engineer.
3. Normal exterior or interior atmospheric exposure:
 - a. Zinc dust-zinc oxide primer, ASTM D79 and D520
 - b. Single-package, moisture-cured urethane prime in silver metallic color
 - c. Zinc-rich, cold galvanized compound, brush, or aerosol application
4. Submergence in water exposure:
 - a. Zinc dust-zinc oxide primer, ASTM D79 and D520
 - b. Zinc dust paint, ASTM D4146
5. When the metallic coating is damaged in any individual area larger than 12 square inches or if more than 0.2 percent of the total surface area of a single pipe section is damaged, that section of pipe will be rejected.
6. Breaks or scuffs in bituminous coatings that are less than 36 square inches must be repaired by applying two coats of hot asphaltic paint or a coating of cold-applied bituminous mastic. The repair coating must be a minimum of 0.05 inch thick after hardening and must bond securely and permanently to the pipe and coating. The material must meet the minimum physical requirements for bituminous coating in ASTM A849. Whenever individual breaks exceed 36 square inches in area or when the total area of breaks exceeds 0.5 percent of the total surface area of an individual pipe section, that section of pipe will be rejected.
7. Bituminous coating damaged by welding of coated pipe or pipefittings must be repaired as specified in this section for breaks or scuffs in bituminous coatings.
8. Breaks or scuffs in polymer coatings that are less than 36 square inches in area must be repaired by the application of a polymer material similar to and compatible with the durability, adhesion, and appearance of the original polymer coating as described in ASTM A849, paragraph 6.8. The repair coating must be a minimum thickness of 0.010 inch (10 mils) after drying. Whenever individual breaks exceed 36 square inches in area or when the total area of breaks exceeds 0.5 percent of the total surface area of the individual pipe section, that section of pipe will be rejected.

J. Measurement and Payment

1. Method 1. For items of work for which specific unit prices are established in the contract, the quantity of each type, class, size, and gauge of pipe is determined to the nearest 0.1 foot by measurement of the laid length of the pipe along the centerline of the pipe. Payment for each type, class, size, and gauge of pipe is made at the contract unit price for that type, class, size and gauge of pipe. Such payment constitutes full compensation for furnishing, transporting, and installing

the pipe and fittings and all other items necessary and incidental to the completion of the work except items designated as special fittings. Special fittings are those sections of pipe requiring special fabrication to meet layout requirements. Payment for special fittings is made at the contract unit price for special fittings, CMP.

2. Method 2. For items of work for which specific unit prices are established in the contract, the quantity of each type, class, size, and gauge of pipe is determined as the sum of the nominal laying lengths of the pipe sections installed. Payment for each type, class, size, and gauge of pipe is made at the contract unit price for that type, class, size, and gauge of pipe. Such payment constitutes full compensation for furnishing, transporting, and installing the pipe and fittings and all other items necessary and incidental to the completion of the work except items designated as special fittings. Special fittings are those sections of pipe requiring special fabrication to meet layout requirements. Payment for special fittings is made at the contract unit price for special fittings, CMP.
3. Method 3. For items of work for which specific lump-sum prices are established in the contract, payment for corrugated metal pipe structures is made at the contract lump-sum price. Such payment constitutes full compensation for furnishing, fabricating, transporting, and installing the pipe structure, complete with metal pipe, fittings, appurtenances, and all other items necessary and incidental to completion of the work that includes, except as otherwise specified, required excavation, dewatering, and earth backfill.
4. All Methods. The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and items to which they are made subsidiary are identified in Section K of this specification.

K. Items of Work and Construction Details

1. Bid Item #10 – Intake Structure CMP
 - a. This item shall consist of furnishing, fabricating, transporting, and installing the pipe structure, complete with metal pipe, fittings, appurtenances, and all other items necessary and incidental to completion of the work.
 - b. All CMP will be polymer coated to 10 mil, inside and out, as outlined in Material Specification 642 – Coated Corrugated Steel Pipe.
 - c. The riser will be fabricated by the pipe supplier, as shown on the drawings.
 - d. Payment shall be by Method 3 of Section J.

Construction Specification 61 — Rock Riprap

A. Scope

1. The work consists of the construction of rock riprap revetments and blankets, including filter or bedding where specified.

B. Material

1. Rock riprap must conform to the requirements of Material Specification 523, Rock for Riprap, or, if so specified, must be obtained from designated sources. It must be free from dirt, clay, sand, rock fines, and other material not meeting the required gradation limits.
2. At least 30 days before rock is delivered from other than designated sources, the contractor must designate in writing the source from which rock material will be obtained and provide information satisfactory to the Engineer that the material meets contract requirements. The contractor must provide the responsible engineer free access to the source for the purpose of obtaining samples for testing. The size and grading of the rock must be as specified in section H.
3. Rock from approved sources must be excavated, selected, and processed to meet the specified quality and grading requirements at the time the rock is installed.
4. Based on a specific gravity of 2.65 (typical of limestone and dolomite) and assuming the individual rock is shaped midway between a sphere and a cube, typical size/weight relationships are given in figure 61-1:

Figure 61-1 Typical riprap size/weight relationship

Sieve Size of Rock	Approx. Weight of Rock	Weight of Test Pile
16 inches	300 pounds	6,000 pounds
11 inches	100 pounds	2,000 pounds
6 inches	15 pounds	300 pounds

5. When specified in section H or when it is necessary to verify the gradation of the rock riprap, a particle size analysis must be performed in accordance with ASTM D5519, Test Method A or B. The analysis must be performed at the worksite on a test pile of representative rock. The mass of the test pile must be at least 20 times the mass of the largest rock in the pile. The results of the test are compared to the gradation required for the project. Test pile results that do not meet the construction specifications must be cause for the rock to be rejected. The test pile that meets contract requirements must be left on the jobsite as a sample for visual comparison. The test pile must be used as part of the last rock riprap to be placed.
6. Filter or bedding aggregates, when required, must conform to Material Specification 521, Aggregates for Drainfill and Filters, unless otherwise specified. Geotextiles must conform to Material Specification 592, Geotextile.

C. Subgrade preparation

1. The subgrade surface on which the rock riprap, filter, bedding, or geotextile is to be placed must be cut or filled and graded to the lines and grades shown on the drawings. When fill to subgrade lines is required, it must consist of approved material and conform to the requirements of the specified class of earthfill.
2. Rock riprap, filter, bedding, or geotextile must not be placed until the foundation preparation is completed and the subgrade surface has been inspected and approved.

D. Equipment-placed rock riprap

1. The rock riprap must be placed by equipment on the surface and to the depth specified. It must be installed to the full course thickness in one operation and in such a manner as to avoid serious displacement of the underlying material. The rock for riprap must be delivered and placed in a manner that ensures the riprap in place is reasonably homogeneous with the larger rocks uniformly distributed and firmly in contact one to another with the smaller rocks and spalls filling the voids between the larger rocks. Some hand placing may be required to provide a neat and uniform surface.
2. Rock riprap must be placed in a manner to prevent damage to structures. Hand placing is required as necessary to prevent damage to any new and existing structures.

E. Hand-placed rock riprap

1. The rock riprap must be placed by hand on the surface and to the depth specified. It must be securely bedded with the larger rocks firmly in contact one to another without bridging. Spaces between the larger rocks must be filled with smaller rocks and spalls. Smaller rocks must not be grouped as a substitute for larger rock. Flat slab rock must be laid on its vertical edge except where it is laid like paving stone and the thickness of the rock equals the specified depth of the riprap course.

F. Filter or bedding

1. When the contract specifies filter, bedding, or geotextile beneath the rock riprap, the designated material must be placed on the prepared subgrade surface as specified. Compaction of filter or bedding aggregate is not required, but the surface of such material must be finished reasonably smooth and free of mounds, dips, or windrows.

G. Measurement and payment

1. Method 1.
 - a. For items of work for which specific unit prices are established in the contract, the quantity of each type of rock riprap placed within the specified limits is computed to the nearest ton by actual weight. The volume of each type of filter or bedding aggregate is measured within the specified limits and computed to the nearest cubic yard by the method of average cross-sectional

end areas. For each load of rock riprap placed as specified, the contractor must furnish to the responsible engineer a statement-of-delivery ticket showing the weight to the nearest 0.1 ton.

- b. Payment is made at the contract unit price for each type of rock riprap, filter, or bedding. Such payment is considered full compensation for completion of the work.

2. Method 2.

- a. For items of work for which specific unit prices are established in the contract, the quantity of each type of rock riprap placed within the specified limits is computed to the nearest 0.1 ton by actual weight. The quantity of each type of filter or bedding aggregate delivered and placed within the specified limits is computed to the nearest 0.1 ton. For each load of rock riprap placed as specified, the contractor must furnish to the engineer a statement-of-delivery ticket showing the weight to the nearest 0.1 ton. For each load of filter or bedding aggregate, the contractor must furnish to the responsible engineer a statement-of-delivery ticket showing the weight to the nearest 0.1 ton.
- b. Payment is made at the contract unit price for each type of rock riprap, filter, or bedding. Such payment is considered full compensation for completion of the work.

3. Method 3.

- a. For items of work for which specific unit prices are established by the contract, the volume of each type of rock riprap and filter or bedding aggregate is measured within the specified limits and computed to the nearest cubic yard by the method of average cross-sectional end areas.
- b. Payment is made at the contract unit price for each type of rock riprap, filter, or bedding. Such payment is considered full compensation for completion of the work.

4. Method 4.

- a. For items of work for which specific unit prices are established by the contract, the volume of each type of rock riprap, including filter and bedding aggregate, is measured within the specified limits and computed to the nearest cubic yard by the method of average cross-sectional end areas.
- b. Payment is made at the contract unit price for each type of rock riprap, including filter and bedding. Such payment is considered full compensation for completion of the work.

5. Method 5.

- a. For items of work for which specific unit prices are established by the contract, the quantity of each type of rock riprap placed within the specified limits is computed to the nearest ton by actual weight. For each load of rock for riprap placed as specified, the contractor must furnish to the responsible engineer a statement-of-delivery ticket showing the weight to the nearest 0.1 ton.

- b. Payment is made at the contract unit price for each type of rock riprap, and includes compensation for any aggregate or geotextile installed as specified for filter or bedding. Such payment is considered full compensation for completion of the work.
- 6. Method 6.
 - a. For items of work for which specific unit prices are established by the contract, the volume of each type of rock riprap is measured within the specified limits and computed to the nearest cubic yard by the method of average cross-sectional end areas.
 - b. Payment is made at the contract unit price for each type of rock riprap and includes compensation for any aggregate or geotextile installed as specified for filter or bedding. Such payment is considered full compensation for completion of the work.
- 7. All methods.
 - a. The following provision applies to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section H.
 - b. No separate payment is made for testing the gradation of the test pile. Compensation for testing is included in the appropriate bid item for riprap.

H. Items of work and construction details

- 1. Bid Item #5 – Riprap Acquisition
 - a. This item consists of furnishing rock for blanket riprap and bank keys, including ballast rock over large woody debris.
 - b. Riprap will meet Material Specification 523 – Rock Riprap and the gradation shown on the drawings. Contractor will submit rock testing information from the pit to the Engineer prior to commencement of hauling operations.
 - c. Payment shall be by Method 1 of Section G. A conversion of weight to volume will be developed jointly by the Engineer and Contractor, utilizing scale weight versus constructed sample section of riprap.
- 2. Bid Item #6 – Riprap
 - a. This item consists of placing rock for blanket riprap and bank keys, including ballast rock over large woody debris. It also consists of over-excavating the slope as needed to place onsite sand and gravel material to act as a filter.
 - b. Payment shall be by Method 4 of Section G.

Construction Specification 71 — Water Control Gates

A. Scope

1. The work consists of furnishing and installing water control gates including gate stems, hoists, lifts, and other appurtenances.

B. Material

1. The gates furnished must conform to the requirements of Material Specifications 571, 572, and 573, as appropriate, and as specified in Section H of this specification and on the drawings. All gates must be furnished, complete with hoisting equipment and other specified appurtenances.

C. Installing Gates

1. The contractor must install the gates in a manner that prevents leakage around the seats and binding of the gates during normal operation.
2. Surfaces of metal that concrete will be placed against must be free from oil, grease, loose mill scale, loose paint, surface rust, and other debris or objectionable coatings.
3. Secure anchor bolts, thimbles, and spigot frames in true positions within the concrete forms and maintain them in alignment during concrete placement.
4. Finish concrete surfaces that rubber seals will bear or that flat frames or plates are to be installed against to provide a smooth and uniform contact surface.
5. When a flat frame is installed against concrete, place a layer of concrete mortar between the gate frame and the concrete.
6. When a gate is attached to a wall thimble, apply a mastic or resilient gasket between the gate frame and the thimble in accordance with the recommendations of the gate manufacturer.
7. Adjust wall plates, sills, and pin brackets for radial gates and fasten them by grouting and bolting after the gates have been completely assembled in place.

D. Installing Hoists and Lifts

1. Align gate stems, stem guides, and gate lifts carefully so that the stem is parallel to the guide bars or angles on the gate frame following installation.

E. Radial Gate Seals

1. Install the rubber seals for radial gates so that the seals contact the walls or wall plates throughout the entire gate length when the gate is in the closed position.

F. Operational Tests

1. After the gates and hoists (or lifts) have been installed, they must be cleaned, lubricated, and otherwise serviced by the contractor in accordance with the

manufacturer's instructions. The contractor must test the gate and hoist by operating the system several times throughout its full range of operation. The contractor must make any changes or adjustments necessary to ensure satisfactory operation of the complete gate system.

G. Measurement and Payment

1. The number of each type, size, and class of gate is counted. Payment for furnishing and installing each type, size, and class of gate must be made at the contract unit price for that type, size, and class of gate. Such payment constitutes full compensation for all labor, equipment, material, and other items necessary and incidental to the completion of the work including furnishing and installing anchor bolts and all specified appurtenances and fittings.
2. Compensation for any item of work described in the contract but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and items to which they are made subsidiary are identified in Section H of this specification.

H. Items of Work and Construction Details

1. This item consists of furnishing and installing the stainless steel slide gate and associated frame, operator, wall thimble, and all associated hardware.
2. Payment shall be by Section G.

Construction Specification 81 — Metal Fabrication and Installation

A. Scope

1. The work consists of furnishing, fabricating, and erecting metalwork, including the metal parts and fasteners of the composite structures.

B. Material

1. Unless otherwise specified, material must conform to the requirements of Material Specification 581, Metal. Steel must be of structural quality unless otherwise specified. Castings must be thoroughly cleaned and subjected to careful inspection before installation. Finished surfaces must be smooth and true to ensure proper fit. Galvanizing must conform to the requirements of Material Specification 582, Galvanizing.

C. Fabrication

1. Fabrication of structural steel must conform to the requirements of the American Institute of Steel Construction's Specification for the Design, Fabrication and Erection of Structural Steel for Buildings (Riveted, Bolted and Arc-Welded Construction).
2. Fabrication of structural aluminum must conform to the requirements in the Aluminum Design Manual available from the Aluminum Association.

D. Erection

1. Install the frame of metal structures true and plumb. Place temporary bracing wherever necessary to resist all loads to which the structure may be subjected, including those applied by the installation and operation of equipment. Such bracing must be left in place as long as necessary for safety.
2. As erection progresses, the work must be securely bolted up or welded to resist all dead load, wind, and erection stresses. The contractor must furnish such installation, assisting with bolts, nuts, and washers as required.
3. No riveting or welding must be performed until the structure is stiffened and properly aligned.
4. Rivets driven in the field must be heated and driven with the same care as those driven in the shop.
5. Perform all field welding in conformance to the requirements for shop fabrication except those that apply to shop conditions only.

E. Protective Coatings

1. Items to be galvanized must be completely fabricated for field assembly before the application of the zinc coatings. Galvanized items must not be cut, welded, or drilled after the zinc coating is applied.
2. Items to be painted must be painted in conformance to the requirements of Construction Specification 82 for the specified paint systems.

F. Measurement and Payment

1. Method 1. The work is not measured. Payment for metal fabrication and installation is made at the contract lump-sum price in the contract. Such payment constitutes full compensation for all labor, equipment, material, and other items necessary and incidental to the completion of the work, including connectors and appurtenances such as rivets, bolts, nuts, pins, studs, washers, hangers, and weld metal.
2. Method 2. The weight of metal installed complete in place is determined to the nearest pound. Unless otherwise specified, the weight of metal must be computed by the method specified in the American Institute of Steel Construction's Code of Standard Practice for Steel Buildings and Bridges, Section 3, except that the following unit weights may also be used, as appropriate, as the basis of computation:

Figure 81-1 Typical Unit Weight of Various Metals

Material	Unit Weight (lb/ft³)
Aluminum alloy	173
Bronze or copper alloy	536
Iron, malleable	470
Iron, wrought	487

Payment for furnishing, fabricating, and installing metalwork is made at the contract unit price for the specified types of labor, material, equipment, and all other items necessary and incidental to the completion of the work.

3. Method 3. The work is not measured. Payment for furnishing, fabricating, and installing each item of metalwork is made at the contract price for that item. Such payment constitutes full compensation for all labor, equipment, material, and other items necessary and incidental to the completion of the work, including connectors and appurtenances such as rivets, bolts, nuts, pins, studs, washers, hangers, and weld metal.
4. All Methods. The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section G of this specification.

G. Items of Work and Construction Details

1. Bid Item #11 – Trash Rack, Walkway, Riser Cover

- a. This item will consist of furnishing, fabricating, and erecting the metal portions of the trash rack, walkway, and riser cover.
- b. Materials will meet requirements listed in the drawings and in Material Specification 581 – Metal.
- c. Items of work subsidiary to this bid item include:
 - Timber Fabrication and Installation, Construction Specification 83
- d. Payment shall be by Method 1 of Section F.

Construction Specification 83 — Timber Fabrication and Installation

A. Scope

1. The work consists of the construction of timber structures and timber parts of composite structures.

B. Material

1. Structural timber and lumber must conform to the requirements of Material Specification 584. Treated timber and lumber must be impregnated with the specified type and quantity of preservative and in the manner specified in Material Specification 585.
2. Hardware, except cast iron, must be galvanized as specified for iron and steel hardware in Material Specification 582. Unless otherwise specified, structural steel shapes, plates, and rods must not be galvanized. Nuts, driftbolts, dowels, and screws must be either wrought iron or steel.
3. Steel bolts must conform to the requirements of ASTM A307. When galvanized or zinc-coated bolts are specified, the zinc coating must conform to the requirements of Material Specification 582.
4. Washers must be ogee gray iron castings or malleable iron castings unless washers cut from medium steel or wrought iron plate are specified on the drawings or in Section G of this specification. Cast washers must have a thickness equal to the diameter of the bolt and a diameter equal to four times the thickness. The thickness for plate washers must be equal to half the diameter of the bolt, and the sides of the square must be equal to four times the diameter of the bolt. Holes in washers must have a maximum diameter of 1/8 inches larger than the diameter of the bolt. Split ring connectors, tooth ring connectors, and pressed steel shear plate connectors must be manufactured from hot-rolled, low-carbon steel conforming to the requirements of ASTM A711, Grade 1015. Malleable iron shear plate connectors and spike grid connectors must be manufactured in conformance with the requirements of ASTM A47, Grade No. 35018. All connectors must be of approved design and the type and size specified.
5. Structural shapes, rods, and plates must be structural steel conforming to the requirements of Material Specification 581. No welds are permitted in truss rods or other main members of trusses or girders.

C. Workmanship

1. All framing must be true and exact. Cut timber and lumber accurately and assembled to a close fit to have an even bearing over the entire contact surface. No open or shimmed joints will be accepted. Nails and spikes must be driven with

sufficient force to set the heads flush with the surface of the wood. Deep hammer marks in wood surfaces will be considered evidence of poor workmanship and may be sufficient cause for rejection of the work.

2. Bore holes for round driftpins and dowels with a bit 1/16 inches smaller in diameter than that of the driftpin or dowel to be installed. The diameter of holes for square driftpins or dowels must be equal to one side of the driftpin or dowel. Bore holes for lag screws with a bit not larger than the body of the screw at the base of the thread.
3. Use washers in contact with all bolt heads and nuts that would otherwise be in contact with wood. Cast iron washers must be used when the bolt will be in contact with earth. All nuts must be checked or burred effectively with a pointed tool after being finally tightened.
4. Unless otherwise specified, surfacing, cutting, and boring of timber and lumber must be completed before treatment. If field cutting or field repair of treated timber and lumber is approved, all cuts and abrasions must be carefully trimmed and coated with copper naphthenate preservative containing a minimum of 2 percent copper metal. The preservative treatment must be applied according to the product label. Any excess preservative not absorbed by the wood member must be cleaned from the surface prior to the use of the member. Bored holes for connectors or bolts may be treated by pumping coal tar roofing cement meeting ASTM D5643 into the holes using a caulking gun or similar device. After timber assembly, plug any unfilled holes with tightly fitting wooden plugs that have been treated with preservative as specified.

D. Handling and Storing Material

1. Neatly stack all timber and lumber stored at the site of the work on supports a minimum of 12 inches above the ground surface and protected from the weather by suitable coverings. Untreated material must be staked and stripped to permit free circulation of air between the tiers and courses. Treated timber may be close-staked. The ground surface for the stockpile of timber and lumber must be free of weeds and rubbish. The use of cant hooks, peavies, or other pointed tools except end hooks is not permitted in the handling of structural timber or lumber. Treated timber must be handled with rope slings or by other methods that prevent the breaking or bruising of outer fibers or penetration of the surface in any manner.

E. Painting

1. Except as otherwise specified, surfaces designated for painting must be prepared and painted in accordance with Construction Specification 84.

F. Measurement and Payment

1. Method 1.
 - a. The unit of measurement of lumber and timber is the number of thousand feet board measure (MBM) for each type, size, species, and grade of lumber and timber installed in the completed structure. The quantity of each type, size, species, and grade is computed from the nominal dimensions and actual

lengths of the pieces in the completed structure and does not include waste timber used for erection purposes (such as falsework or temporary sheeting and bracing) or any part of any pile or other round timber. The total quantity of lumber and timber in each type, size, species, and grade is computed to the nearest 0.01 MBM.

- b. The unit of measurement of plywood is the number of square feet of each type, species, grade, and thickness installed in the completed structure.
 - c. Payment for each type, size, species, and grade of lumber and timber is made at the contract unit price for that type, size, species, and grade. Payment for each type, species, grade, and thickness of plywood is made at the contract unit price for that type, species, grade, and thickness. Such payment is considered full compensation for completion of the work.
2. Method 2. No measurement of material quantities is made. Payment for each structure, complete in place, is made at the contract lump-sum price for that structure. Such payment is considered full compensation for completion of the work.
 3. Method 3. For items of work for which specific unit prices are established in the contract, measurement and payment for each structure unit (except those for which a linear foot payment is established) is counted and payment made at the contract unit price. Items for which a linear foot payment is established are measured to the nearest linear foot and payment is made at the contract unit prices as appropriate. Such payment is considered full compensation for completion of the work.
 4. All Methods. The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section G of this specification.

G. Items of Work and Construction Details

1. Bid Item #13 – Large Woody Debris
 - a. This item consists of furnishing and placing logs with attached rootwads.
 - b. Large wood shall be composed of sound, disease free, Douglas Fir or Ponderosa Pine logs with attached rootwads.
 - c. Payment shall be by Method 2 of Section F.
2. Subsidiary Item – Trash Rack, Walkway, and Riser Cover
 - a. This item consists of furnishing and installing treated timber for the riser cover.

- b. Section F will not apply to these items. All items listed in this section shall be considered incidental to Bid Item 11 – Trash Rack, Walkway, and Riser Cover.

Material Specification 511—Steel Piles

A. Scope

This specification covers the type and quality of steel piles.

(1) Bearing Piles

- (i) Steel bearing piles shall be structural steel H-piles *conforming* to the requirements of ASTM A36.
- (ii) The required length of pile may be fabricated by butt-welding shorter lengths of pile stock. Unless otherwise specified, the cross-section of each pile shall be constant throughout its length. The axis of the pile shall be straight, and the number of welded joints in the length of the pile shall be as few as practicable. Pieces below the top piece shall have a minimum length of 10 feet.

(2) Sheet Piles

- (i) Steel sheet piles shall conform to the requirements of ASTM A328, ASTM A572, or ASTM A690.
- (ii) Fabrication of piles from shorter lengths of pile stock is not permitted.

Material Specification 522—Aggregates for Portland Cement Concrete

A. Scope

This specification covers the quality of fine aggregate and coarse aggregate for use in the manufacture of Portland cement concrete.

B. Quality

Aggregate shall conform to the requirements of ASTM C33 for the specified sizes. Aggregates that fail to meet any requirement may be accepted only when either:

- (i) The specified alternate conditions of acceptance can be proven before the aggregates are used on the job and within a period such that no work under the contract will be delayed by the requirements of such proof or,
- (ii) The specification for concrete expressly contains a provision of special mix requirements to compensate for the effects of the deficiencies.

C. Reactivity with alkalis

(1) The potential reactivity of aggregates with the alkalis in cement shall be evaluated by petrographic examination as per ASTM C295, or by the results of previous tests or service records of concrete made from similar aggregates from the same source. The standards for evaluating potential reactivity shall be as described in ASTM C1778

(2) Aggregates indicated by any of the above to be potentially reactive shall not be used except under one of the following conditions:

- (i) Applicable test results of mortar bar tests made according to ASTM Method C 1567 are available which indicate an expansion of less than 0.10 percent at 16 days.
- (ii) The concrete mixture complies with the appropriate testing procedures and mitigations measures established in ASTM C1778.
- (iii) Concrete made from similar aggregates from the same source has been demonstrated to be sound after 3 years or more of service under conditions of exposure to moisture and weather similar to those anticipated for the concrete under these specifications.

(3) Aggregates indicated to be potentially reactive, but within acceptable limits as determined by mortar bar test results or service records, shall be used only with low alkali cement, containing less than 0.60 percent alkalis expressed as sodium oxide.

D. Sulfur in Aggregate

(1) There is currently not an ASTM standard on the acceptable level of sulfur in concrete aggregate.

(2) To prevent concrete cracking from iron sulfide expansion, perform petrographic testing per ASTM C295 and use the following limits for sulfur (S) in aggregate based on the American Concrete Institute Technical Paper 113-M31 and the Concrete Society BS EN 12620:

- (i) When S is less than 0.1 percent, the aggregate is acceptable.
- (ii) When S is between 0.1 and 1.0 percent, perform further testing to determine if iron sulfide minerals such as pyrrhotite, gypsum, pyrite, or marcasite are present:
 - If the additional testing shows pyrrhotite, gypsum, pyrite, or marcasite are present, reject the aggregate and use an acceptable aggregate.

- If the additional testing shows pyrrhotite, gypsum, pyrite, or marcasite are not present, the aggregate is acceptable.
- (iii) Aggregate with S greater than 1 percent is not acceptable.

E. Storing and Handling

Aggregates of each class and size shall be stored and handled by methods that prevent segregation of particles sizes or contamination by intermixing with other material.

Material Specification 523—Rock for Riprap

A. Scope

This specification covers the quality of rock to be used in the construction of rock riprap.

B. Quality

- (1) Individual rock fragments must be dense, sound, and free from cracks, seams, and other defects conducive to accelerated weathering. Except as otherwise specified, the rock fragments must be angular to subrounded. The least dimension of an individual rock fragment must be not less than one-third the greatest dimension of the fragment. ASTM D4992 provides guidance on selecting rock from a source.
- (2) Except as otherwise provided, the rock must be tested and must have the following properties:
 - (i) Rock type 1
 - Bulk specific gravity (saturated surface-dry basis)—Not less than 2.5 when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
 - Absorption—Not more than 2 percent when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
 - Soundness—The weight loss in 5 cycles must not be more than 10 percent when sodium sulfate is used or more than 15 percent when magnesium sulfate is used.
 - (ii) Rock type 2
 - Bulk specific gravity (saturated surface-dry basis)—Not less than 2.5 when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
 - Absorption—Not more than 2 percent when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
 - Soundness—The weight loss in 5 cycles must be not more than 20 percent when sodium sulfate is used or more than 25 percent when magnesium sulfate is used.
 - (iii) Rock type 3
 - Bulk specific gravity (saturated surface-dry basis)—Not less than 2.3 when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
 - Absorption—Not more than 4 percent when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
 - Soundness—The weight loss in 5 cycles must be not more than 20 percent when sodium sulfate is used or more than 25 percent when magnesium sulfate is used.

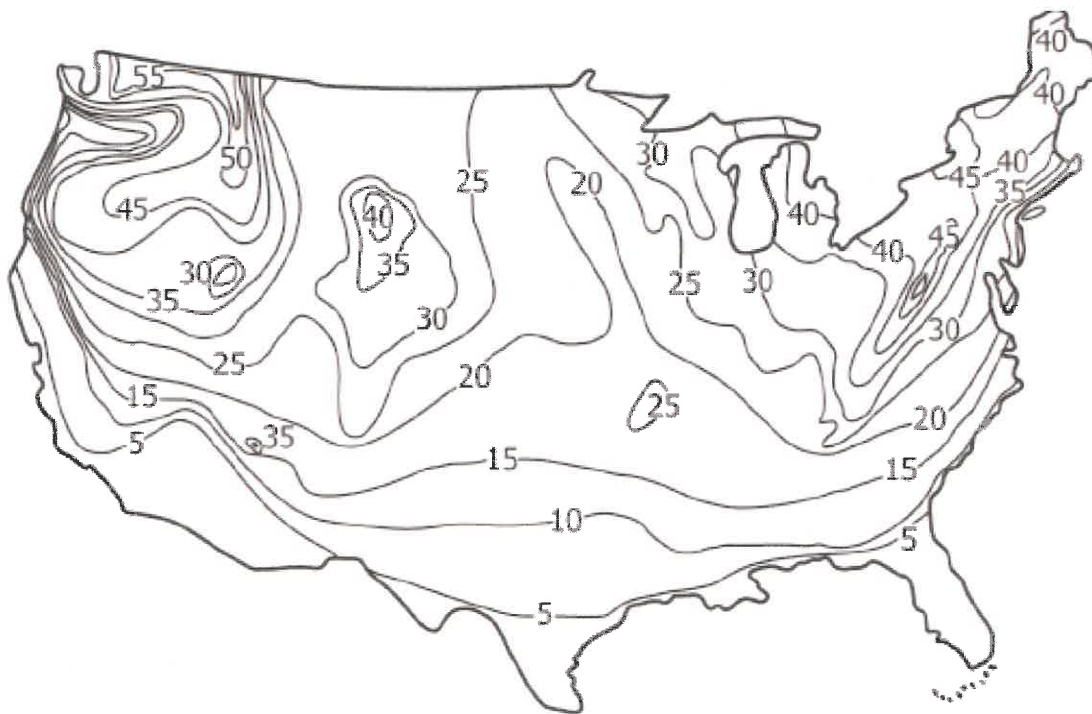
C. Methods of Soundness Testing

- (1) Rock cube soundness—
 - (i) The sodium or magnesium sulfate soundness test for all rock types (1, 2, or 3) must be performed on a test sample of $5,000 \pm 300$ grams of rock fragments, reasonably uniform in size and cubical in shape, and weighing, after sampling, about 100 grams each. They must be obtained from rock samples that are representative of the total rock mass, as noted in ASTM D4992, and that have been sawed into slabs as described in ASTM

D5121. The samples must further be reduced in size by sawing the slabs into cubical blocks. The thickness of the slabs and the size of the sawed fragments must be determined by the size of the available test apparatus and as necessary to provide, after sawing, the approximate 100-gram samples. The cubes must undergo five cycles of soundness testing in accordance with ASTM C88.

- (ii) Internal defects may cause some of the cubes to break during the sawing process or during the initial soaking period. Do not test any of the cubes that break during this preparatory process. Such breakage, including an approximation of the percentage of cubes that break, must be noted in the test report.
 - (iii) After the sample has been dried following completion of the final test cycle and washed to remove the sodium sulfate or magnesium sulfate, the loss of weight must be determined by subtracting from the original weight of the sample the final weight of all fragments that have not broken into three or more fragments.
 - (iv) The test report must show the percentage loss of the weight and the results of the qualitative examination.
- (2) Rock slab soundness—
- (i) When specified, the rock must also be tested in accordance with ASTM D5240. Deterioration of more than 25 percent of the number of blocks must be cause for rejection of rock from this source. Rock must also meet the requirements for average percent weight loss stated below.
 - (ii) For projects located north of the Number 20 Freeze-Thaw Severity Index Isoline (fig. 523–1 below), unless otherwise specified, the average percent weight loss for Rock Type 1 must not exceed 20 percent when sodium sulfate is used or 25 percent when magnesium sulfate is used. For Rock Types 2 and 3, the average percent weight loss must not exceed 25 percent for sodium sulfate soundness or 30 percent for magnesium sulfate soundness.
 - (iii) For projects located south of the Number 20 Freeze-Thaw Severity Index Isoline, unless otherwise specified, the average percent weight loss for Rock Type 1 must not exceed 30 percent when sodium sulfate is used or 38 percent when magnesium sulfate is used. For Rock Types 2 and 3, the average percent weight loss must not exceed 38 percent for sodium sulfate soundness or 45 percent for magnesium sulfate soundness.

Figure 523–1 Isoline Map of the Freeze-Thaw Severity Index for Contiguous 48 United States (map is from ASTM D5312)



D. Field Durability Inspection

- (1) Rock that fails to meet the material requirements stated above (if specified), may be accepted only if similar rock from the same source has been demonstrated to be sound after 5 years or more of service under conditions of weather, wetting and drying, and erosive forces similar to those anticipated for the rock to be installed under this specification.
- (2) A rock source may be rejected if the rock from that source deteriorates in less than 5 years under similar use and exposure conditions expected for the rock to be installed under this specification, even though it meets the testing requirements stated above.
- (3) Deterioration is defined as the loss of more than one-quarter of the original rock volume, or severe cracking that would cause a block to split. Measurements of deterioration are taken from linear or surface area particle counts to determine the percentage of deteriorated blocks. Deterioration of more than 25 percent of the pieces must be cause for rejection of rock from the source.

E. Grading

The rock must conform to the specified grading limits after it has been placed within the matrix of the rock riprap. Grading tests must be performed, as necessary, according to ASTM D5519, Method A, B, or C, as applicable.

Material Specification 531—Portland Cement

A. Scope

This specification covers the quality of Portland cement.

B. Quality

- (1) Portland cement shall conform to the requirements of ASTM C150 for the specific types of cement such as Type I, IA, II, IIA, II(MH), II(MH)A, III, IIIA, IV, and V Portland cement.
- (2) Type IS Portland blast-furnace slag cement, Type IP Portland-pozzolan cement, or Type IL Portland-limestone cement shall conform to the requirements of ASTM C595 and may be used unless prohibited by the specifications.
- (3) When air-entraining cement is required, the contractor shall furnish the manufacturer's written statement providing the source, amount, and brand name of the air-entraining component.

C. Storage at the Construction Site

Cement shall be stored and always protected from weather, dampness, or other destructive elements. Cement that is partly hydrated or otherwise damaged will not be accepted.

Material Specification 539—Steel Reinforcement (for concrete)

A. Scope

This specification covers the quality of steel reinforcement for reinforced concrete.

B. Quality

- (1) All reinforcement shall be free from loose or flaky rust, soil, oil, grease, paint, or other deleterious matter.
- (2) Steel bars for concrete reinforcement shall be grade 40, 50, or 60 deformed bars conforming to one of the following specifications:
 - (i) Deformed and plain billet-steel bars for concrete reinforcement—ASTM A615.
 - (ii) Rail-steel deformed bars for concrete reinforcement—ASTM A996.
 - (iii) Axle-steel deformed bars for concrete reinforcement—ASTM A996.
- (3) Dowels shall be plain round bars conforming to the same specifications listed above for steel bars.
- (4) Fabricated deformed steel bar mats for concrete reinforcement shall conform to the requirements of ASTM A184.
- (5) Deformed and plain steel welded wire reinforcement shall conform to the requirements of ASTM A1064.
- (6) Epoxy-coated steel bars for concrete reinforcement shall conform to the requirements of ASTM A775.

C. Dimensions of Welded Wire Reinforcement

Gauges, diameters, spacing, and arrangement of wires for welded steel wire fabric shall be as defined for the specified style designations.

D. Storage

Steel reinforcement inventories at the site of the work shall be stored above the ground surface on platforms, skids, or other supports and shall be kept clean and protected from mechanical injury and corrosion.

Material Specification 551—Coated Corrugated Steel Pipe

A. Scope

This specification covers the quality of zinc-coated, aluminum-coated, aluminum-zinc alloy-coated, and polymer-coated corrugated steel pipe and fittings.

B. Pipe

All pipe shall be metallic zinc-coated, aluminum-coated, or aluminum-zinc alloy-coated corrugated steel pipe and fittings conforming to the requirements of ASTM A742, A760, A761, A762, A849, A875, and A929 for the specified type, class, fabrication of pipe and coating, and to the following additional requirements:

- (i) When closed riveted pipe is specified:
 - Pipe shall be fabricated with circumferential seam rivet spacing that does not exceed 3 inches except that 12 rivets are sufficient to secure the circumferential seams in 12-inch pipe.
 - Longitudinal seams that will be within the coverage area of a coupling band, the rivets shall have flat heads, or the rivets and holes shall be omitted and the seams shall be connected by welding to provide a minimum of obstruction to the seating of the coupling bands.
- (ii) Double riveting or double spot welding for pipe less than 42 inches in diameter may be required. When double riveting or double spot welding is specified, the riveting or welding shall be performed in a manner specified for pipe 42 inches or greater in diameter.

C. Coatings

- (1) Coatings described herein, unless otherwise specified, equally refer to the inside and outside pipe surfaces.
- (2) When coatings in addition to metallic coatings are specified, they shall conform to the requirements of ASTM A742, A760, A761, A762, A849, A875, and A929 for the specified type.
- (3) Polymer-coated pipe, unless otherwise specified on the drawings or in the construction specifications, shall be coated on each side with a minimum thickness of 0.01 inches (10 mils), designated as grade 10/10 in ASTM A762.

D. Coupling Bands

- (1) Coupling bands are to be provided for each section of pipe. The hardware for fastening the coupling band tightly to the connecting pipe shall be fabricated to permit tightening sufficiently to provide the required joint tensile strength and, if required, watertightness without failure of its fastening.
- (2) Gaskets, if specified, are to be provided for each coupling band. The fabrication of coupling bands and fastening hardware, in addition to the above, shall be sufficient to provide the required gasket seating without warping, twisting, or bending.

E. Fittings

- (1) Fittings shall be fabricated from steel conforming to ASTM A742, A849, A875, and

A929. The coating of fittings shall be the same as that specified for the contiguous corrugated coated pipe.

- (2) Welded surfaces and adjacent surfaces damaged during welding shall be treated by removing all flux residue and weld splatter. The affected surfaces shall be cleaned to bright metal by sand blasting, power disk sanding, or wire brushing. The cleaned area shall extend at least 0.5 inch into the undamaged section of the coated area. Repair and coating application of damaged and uncoated pipe surface areas shall be in accordance with ASTM A780.

Material Specification 571—Slide Gates

A. Scope

This specification covers the quality of metal slide gates for water control.

B. Class and Type of Gate

The class of gate is expressed as an alpha numerical symbol composed of the seating head (L = Light, M = Moderate, H = Heavy, and unseating head (1,2,3). The two are separated by a hyphen with the seating head listed first. For this purpose, the unseating head must be expressed in terms of feet of water. Gates must be of the specified types as defined:

Light duty	
Type MLS-1	Cast iron with cast iron seat facings.
Type MLS-2	Fabricated metal.
Moderate duty	
Type MMS-1	Cast iron with bronze seat facings, cast iron or galvanized structural steel guides, and galvanized steel, bronze, or stainless steel fasteners.
Type MMS-2	Cast iron with bronze seat facings, cost iron or stainless steel guides, and bronze or stainless steel fasteners. Guides and fasteners are stainless steel, when specified.
Heavy duty	
Type MHS-1	Have gray cast iron slides, frames, guides, and yokes, and are fitted with bronze seat facings, bronze wedges and wedge blocks or wedge seat facings, and bronze stem blocks or thrust nuts; bronze or stainless steel fasteners; and cold rolled steel stems except where stainless steel stems are specified.
Type MHS-2	Have gray cast iron slides, frames, guides, and yokes, and are fitted with stainless steel seat facings, wedges, wedge seat facings, stems and fasteners; and austenitic cast iron stem blocks or thrust nuts.
Type MHS-3	Have austenitic gray cast iron slides, frames, guides, and yokes, and are fitted with nickel-copper alloy seat facings, wedges, wedge seat facings, stems and fasteners; and austenitic cast iron stem blocks or thrust nuts.

C. Quality of Material

- (1) Material for slide gates and appurtenances must conform to the requirements of the applicable specifications listed below for the alloy, grade, type, or class of material and the condition and finish appropriate to the structural and operational requirements.
- (2) Galvanizing (zinc coating) must conform to the requirements of Material Specification 582.

Material	ASTM specification
Cast iron and gray cast iron	A48 Class 30, A126 Class B
Austenitic cast iron	A436
Structural steel shapes, plates, and bars	A36
Cold rolled steel	A108
Carbon steel bars	A108 or A575
Stainless steel	A240, A276, A269, A582; Type 302, 303, 304, or 304L
Castings, nickel and nickel alloy	A494
Carbon steel sheets and strips	A1011
Zinc-coated carbon steel sheets	A653 or A924
Bronze bar, rods, and shapes	B21 or B98
Naval bronze	B21
Phosphor bronze	B103 or B139
Manganese bronze	B138 or B584
Silicon bronze	B98 or B584
Cast bronze	B584
Nickel-copper alloy plate, sheet, or strip	B127
Nickel-copper alloy rod or bar	B164
Rubber for gaskets and seals	D395, D412, D471, D572, or D2240

D. Fabricated Metal Gates (Light Duty Gates)

Fabricated metal gates must be built to withstand the seating head expressed by the gate class designation. Unless otherwise specified, the gates must be galvanized steel with flat-back frames.

E. Cast Iron Gates (Light Duty Gates)

- (1) The frame must be cast iron of the specified type. The front face must be machined to receive the gate guides.
- (2) The gate slide must be cast iron and be fabricated to withstand the seating and unseating heads expressed by the gate class designation as defined in section 2 of this specification.

- (3) Grooves must be cast on the vertical sides of the slide to match the guide angles.
- (4) The gate guides must be galvanized structural steel or stainless steel and be fabricated to withstand the total thrust of the gate slide from water pressure and wedge action under maximum operating conditions.
- (5) Wedges and wedge seats must have smooth bearing surfaces. Wedges may be cast as integral parts of the slide. Removable wedges and wedge seats must be fastened to the slide, frame, or guides by means of suitable studs, screws, or bolts and be firmly locked in place after final adjustment. Each interacting set of wedge and wedge seat must be adjustable as needed to ensure accurate and effective contact. Adjusting bolts or screws must be bronze or galvanized steel.
- (6) Seat facings must be machined to a smooth finish to ensure proper watertight contact.

F. Frame or Seat (Moderate and Heavy Duty Gates)

The frame must be cast iron and of the specified type. The front face must be machined to receive the gate guides, and the rear face must be machined as required to match the specified attaching means. For heavy duty gates, a dovetailed groove must be machined on the perimeter of the front face to receive the seat facing.

G. Gate Slide (Moderate and Heavy Duty Gates)

- (1) The gate slide must be cast iron, rectangular in shape, and have horizontal and vertical stiffening ribs of sufficient section to withstand the seating and unseating heads expressed by the gate class designation as defined in section 2 of this specification. For heavy duty gates, a dovetailed groove must be machined on the perimeter of the slide face to receive the seat facing.
- (2) Tongues must be machined on the vertical sides of the slide along its entire height to match the guide grooves and angles with a maximum clearance of 1/16 inch for gates smaller than 54 inches by 54 inches, and 1/8 inch for larger gates.
- (3) A nut pocket with reinforcing ribs must be integrally cast on the vertical centerline and above the horizontal centerline of the slide. The pocket must be of a shape adequate to receive a flat-backed thrust nut or stem block and be built to withstand the opening and closing thrust of the stem.

H. Gate Guides (Moderate and Heavy Duty Gates)

- (1) The gate guides must be built to withstand the total thrust of the gate slide from water pressure and wedge action. The gate guides must be cast iron for heavy duty gates.
- (2) Grooves must be machine-in cast iron guides to receive the tongue on the gate slide throughout the entire length of the guide.
- (3) The guides must be of adequate length to retain a minimum of one-half the height of the gate slide when the gate is fully opened.

I. Wedges and Wedge Seats (Moderate and Heavy Duty Gates)

- (1) Pads for supporting wedges, wedge seats (or blocks), and wedge loops (or stirrups) must be cast as integral parts of the gate frame, slide, or guides and be accurately machined to receive those parts.
- (2) Wedges and wedge seats must have smooth bearing surfaces for moderate duty gates and have machine finish bearing surfaces for heavy duty gates. Removable wedges may be cast as integral part of the slide for moderate duty gates. Wedges must be fastened to the gate slide, frame, or guides with suitable studs, screws, or bolts and be firmly locked in place after final adjustment. Each interacting set of wedge and wedge seat must be adjustable as needed to ensure accurate and effective contact.

J. Seat Facing

- (1) Moderate duty gates—Seat facings must be machined to a smooth finish to ensure proper watertight contact. Bronze facings must be securely attached by welding or other approved methods.
- (2) Heavy duty gates—Seat facings must be pressed or impacted into the machined dovetailed grooves on the gate slide and frame and machined to a smooth finish to ensure proper watertight contact.

K. Yoke

When a self-contained gate is specified, the yoke must be of such design as to withstand the loads resulting from normal operation of the gate. For moderate and heavy duty gates, cast iron yokes must be provided with machined pads for connecting to the ends of gate guides and to receive the stem thrust cap or handwheel lift.

L. Flush Bottom Seal (Heavy Duty Gate)

When a flush bottom sealing gate is specified, a solid, square-corner type rubber seal must be provided at the bottom of the gate opening. It must be securely attached either to the bottom of the slide or to the frame. Metal surfaces bearing on the rubber seal must be smooth and rounded as necessary to prevent cutting of the seal during gate operation.

M. Gate Stem and Lift (or Hoist)

- (1) The gate stem and lift/hoist must be of the specified type, size, and capacity and, if hand operated, must be capable of moving the gate slide under normal conditions, following unseating from the wedging device, with a pull on the handwheel or crank of not more than 25 pounds with the specified seating and/or unseating head of water against the gate.
- (2) Unless otherwise specified, the stem must be carbon steel and be furnished in sections as necessary to permit reasonable ease in installation. Couplings must be bolted, pinned, or keyed to the stem. The stem must be furnished with rolled or machine-cut 29 degree Acme threads of sufficient length to completely open the gate. The threads must be smooth and of uniform lead and cross-section, such that the nut can travel the full length without binding or excessive friction. For moderate and heavy duty gates, the stem must be threaded for connection to the stem block or thrust nut on the gate slide.
- (3) The lift must be compatible with the type of stem furnished. Unless otherwise specified, the lift nut must be cast bronze for light and moderate duty gates and cast manganese bronze for heavy duty gates and be fitted with ball or roller thrust bearings designed to withstand the normal thrust developed during opening and closing of the gate at the maximum operating heads. All gears, sprockets, and pinions must be machine-cut, with ratios and strength adequate to withstand expected operating loads. Sufficient grease fittings must be provided to allow lubrication of all moving parts. An arrow and the word "open" must be cast on the rim of the handwheel or on the lift housing to indicate the direction of gate opening. Unless otherwise specified, the lift for the nonrising-stem gate must be provided with an indicator capable of showing both when the gate is fully open and when it is fully closed for the moderate and heavy duty gates.
- (4) Provisions must be made to prevent stem rotation within the stem block or thrust nut or at the connection of the gate slide.
- (5) Stop collars must be provided to prevent overtravel in opening and closing the gate.

N. Stem Guides

Unless otherwise specified, stem guides must be cast iron for light duty gates and cast iron with bronze bushed collars for moderate and heavy duty gates. They must be fully adjustable in two directions.

O. Wall Thimble (Moderate and Heavy Duty Gates)

- (1) When a wall thimble is specified, it must be of the same cast iron used in the gate frame and of the section, type, and depth specified. The front flange must be machined to match the gate frame and drilled and tapped to accurately receive the gate attachment studs.
- (2) Gaskets or mastic to be installed between the thimble and the gate frame must conform to the recommendations of the gate manufacturer and be furnished with the thimble.

P. Fasteners

Unless otherwise specified, all anchor bolts and other fasteners must be galvanized steel or bronze for light duty gates; galvanized steel or stainless steel or bronze for moderate duty gates; and, of the quality and size as recommended by the gate manufacturer for heavy duty gates. All anchor bolts, assembly bolts, screws, nuts, and other fasteners must be of ample section to withstand the forces created by operation of the gate while subjected to the specified seating and unseating heads. Anchor bolts must be furnished with two nuts to facilitate installation.

Q. Installation Instructions

Before installation, provide the engineer with the manufacturer's complete installation data, instructions for adjustments, and drawings or templates showing the location of all anchor bolts for each gate.

R. Painting

When specified, gates and accessories must be painted by the designated paint system.

S. Certification

The supporting data submitted to the engineer must include the name of the manufacturer, the manufacturer's model number (for standard catalogue items), or the seating and unseating heads for which the gate is designed together with such drawings and specifications as may be necessary to show that the gate conforms to the requirements of this specification.

Material Specification 581—Metal

A. Scope

This specification covers the quality of steel, stainless steel, and aluminum alloys.

B. Structural Steel

- (1) Structural steel must conform to the requirements of ASTM A36.
- (2) High-strength low-alloy structural steel must conform to ASTM A242 or A588.
- (3) Carbon steel plates of structural quality to be bent, formed, or shaped cold must conform to ASTM A283, Grade C.
- (4) Carbon steel sheets of structural quality must conform to ASTM A1011, Grade 40, or A1008, Grade 40.
- (5) Carbon steel strip of structural quality must conform to ASTM A1011, Grade 36.
- (6) Stainless steel must conform to ASTM A240, A320, A276, A269, A582; Type 302, 303, 304, or 304L.

C. Commercial or Merchant Quality Steel

Commercial or merchant quality steel must conform to the requirements of the applicable ASTM listed below:

Product	ASTM standards
Carbon steel bars	A575, Grade M 1015 to Grade M 1031
Carbon steel sheets	A1011
Carbon steel strips	A1011
Zinc-coated carbon steel sheets	A653 or A924

D. Aluminum Alloy

Aluminum alloy products must conform to the requirements of the applicable ASTM standard listed below. Unless otherwise specified, alloy 6061-T6 must be used.

Product	ASTM standards
Standard structural shape	B308
Extruded structural pipe and tube	B429
Extruded bars, rods, shapes, and tubes	B221
Drawn seamless tubes	B210
Rolled or cold-finished bars, rods, and wire	B211
Sheet and plate	B209

E. Bolts

- (1) Steel bolts must conform to the requirements of ASTM A307. If high-strength bolts are specified, they must conform to the requirements of ASTM F3125.
- (2) When galvanized or zinc-coated bolts are specified, the zinc coating must conform to the requirements of ASTM A153, except that bolts 0.5 inch or less in diameter may be coated with electro-deposited zinc or cadmium coating conforming to the requirements of ASTM B633, Service Condition SC 3, or ASTM B766, unless otherwise specified.
- (3) Stainless steel bolts must conform to ASTM A320.

F. Rivets

Unless otherwise specified, steel rivets must conform to the requirements of ASTM A31, Grade B. Unless otherwise specified, aluminum alloy rivets must be Alloy 6061 conforming to the requirements of ASTM B316.

G. Welding Electrodes

- (1) Steel welding electrodes must conform to the requirements of American Welding Society Specification AWS A5.1, "Specification for Mild Steel Covered Arc-Welding Electrodes," except that they must be uniformly and heavily coated (not washed) and must be of such a nature that the coating does not chip or peel while being used with the maximum amperage specified by the manufacturer.
- (2) Aluminum welding electrodes must conform to the requirements of American Welding Society Specification AWS A5.10, "Specification for Aluminum and Aluminum-Alloy Welding Rods and Bare Electrodes."
- (3) Stainless steel electrodes must conform to the requirements of AWS A5.22/A5.22M:2012 Specification for Stainless Steel Electrodes for Flux Cored Arc Welding and Stainless Steel Flux Cored Rods for Gas Tungsten Arc Welding.

