PAPE–DAWSON

Specifications for

GUAJOLOTE RANCH COLLECTOR PHASE 1

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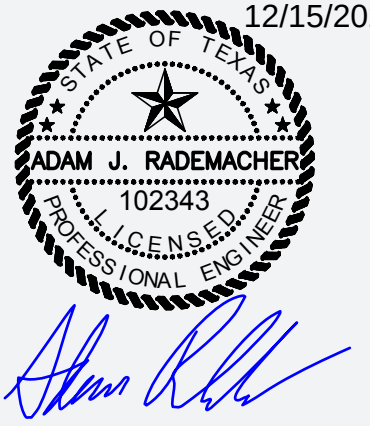
12/15/2025



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END OF SECTION

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

B. Documentation of changes in Contract Sum and Contract Time.

C. Change procedures.

D. Correlation of Contractor submittals based on changes.

E. Procedures for preparation and submittal of application for final payment.

1.02 RELATED REQUIREMENTS

A. Section 00 52 00 - Agreement Form: Contract Sum, retainages, payment period, monetary values of unit prices.

B. Section 00 72 00 - General Conditions: Additional requirements for progress payments, final payment, changes in the Work.

C. Section 00 73 00 - Supplementary Conditions: Percentage allowances for Contractor's overhead and profit.

D. Section 01 21 00 - Allowances: Payment procedures relating to allowances.

E. Section 01 22 00 - Unit Prices: Monetary values of unit prices; Payment and modification procedures relating to unit prices.

F. Section 01 78 00 - Closeout Submittals: Project record documents.

1.03 SCHEDULE OF VALUES

A. Use Schedule of Values Form: _____.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Engineer for approval.

C. Forms filled out by hand will not be accepted.

D. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.

E. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.

F. Include within each line item, a direct proportional amount of Contractor's overhead and profit.

G. Revise schedule to list approved Change Orders, with each Application For Payment.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.

B. Use Form _____.

C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Engineer for approval.

D. Forms filled out by hand will not be accepted.

E. For each item, provide a column for listing each of the following:
   1. Item Number.
   2. Description of work.
   3. Scheduled Values.
   4. Previous Applications.
   5. Work in Place and Stored Materials under this Application.
   6. Authorized Change Orders.
   7. Total Completed and Stored to Date of Application.

8. Percentage of Completion.
9. Balance to Finish.
10. Retainage.

F. Execute certification by signature of authorized officer.

G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.

H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.

I. Submit one hard-copies or digital copy of each Application for Payment.

J. Include the following with the application:
1. Construction progress schedule, revised and current as specified in Section 01 30 00.
2. Current construction photographs specified in Section 01 30 00.
3. Partial release of liens from major subcontractors and vendors.
4. Project record documents as specified in Section 01 78 00, for review by Owner which will be returned to the Contractor.

K. When Engineer requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.05 MODIFICATION PROCEDURES

A. For required changes, Engineer will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
2. Promptly execute the change.

B. For changes for which advance pricing is desired, Engineer will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 14 days.

C. Contractor may propose a change by submitting a request for change to Engineer, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation.

D. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
1. For change requested by Engineer for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Engineer.
3. For pre-determined unit prices and quantities, the amount will be based on the fixed unit prices.
4. For change ordered by Engineer without a quotation from Contractor, the amount will be determined by Engineer based on the Contractor's substantiation of costs as specified for Time and Material work.

E. Substantiation of Costs: Provide full information required for evaluation.
1. On request, provide the following data:
a. Quantities of products, labor, and equipment.
b. Taxes, insurance, and bonds.
c. Overhead and profit.
d. Justification for any change in Contract Time.
e. Credit for deletions from Contract, similarly documented.

2. Support each claim for additional costs with additional information:
    a. Origin and date of claim.
    b. Dates and times work was performed, and by whom.
    c. Time records and wage rates paid.
    d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

F. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

G. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

H. Promptly enter changes in Project Record Documents.

1.06 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:
1. All closeout procedures specified in Section 01 70 00.
2. Owner's punch list.

END OF SECTION

ALLOWANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Contingency allowance.

B. Inspecting and testing allowances.

C. Payment and modification procedures relating to allowances.

1.02 RELATED REQUIREMENTS

A. Section 01 20 00 - Price and Payment Procedures: Additional payment and modification procedures.

1.03 CONTINGENCY ALLOWANCE

A. Contractor's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from this Contingency Allowance.

B. Funds will be drawn from the Contingency Allowance only by Change Order.

C. At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Change Order.

1.04 INSPECTING AND TESTING ALLOWANCES

A. Costs Included in Inspecting and Testing Allowances: Cost of engaging an inspecting or testing agency; execution of inspecting and tests; and reporting results.

B. Costs Not Included in the Inspecting and Testing Allowances:
   1. Costs of incidental labor and facilities required to assist inspecting or testing agency.
   2. Costs of testing services used by Contractor separate from Contract Document requirements.
   3. Costs of retesting upon failure of previous tests as determined by Engineer.

C. Payment Procedures:
   1. Submit one copy of the inspecting or testing firm's invoice with next application for payment.
   2. Pay invoice on approval by Architect or Engineer.

D. Differences in cost will be adjusted by Change Order.

1.05 ALLOWANCES SCHEDULE

A. Section _____-_____: Include the stipulated sum of $_____ for purchase and delivery of _____.

B. Section _____-_____: Include the stipulated sum of $_____ for purchase and delivery of _____.

C. Section _____-_____: Include the stipulated sum of $_____ for purchase and delivery of _____.

D. Section _____-_____: Include the stipulated sum of $_____ for purchase and delivery of _____.

E. Section _____-_____: Include the stipulated sum of $_____ for installation of _____.

F. Section _____-_____: Include the stipulated sum of $_____ for installation of _____.

G. Section _____-_____: Include the stipulated sum of $_____ for installation of _____.

H. Section _____-_____: Include the stipulated sum of $_____ for installation of _____.

I. Contingency Allowance: Include the stipulated sum/price of $_____ for use upon Owner's instructions.

J. Inspecting and Testing Allowance: Include the sum of $_____ for payment of inspecting services specified in Section 01 40 00 - Quality Requirements.

K. Soils Testing Allowance: Include the sum of $_____ for testing compacted soils specified in Section 31 22 00.

L. Concrete Testing Allowance: Include the sum of $_____ for testing concrete specified in Section 03 30 00.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

UNIT PRICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. List of unit prices, for use in preparing Bids.

B. Measurement and payment criteria applicable to Work performed under a unit price payment method.

C. Defect assessment and non-payment for rejected work.

1.02 RELATED REQUIREMENTS

A. Document 00 21 13 - Instructions to Bidders: Instructions for preparation of pricing for Unit Prices.

B. Document 00 43 22 - Unit Prices Form: List of Unit Prices as supplement to Bid Form

C. Section 01 20 00 - Price and Payment Procedures: Additional payment and modification procedures.

1.03 COSTS INCLUDED

A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.04 UNIT QUANTITIES SPECIFIED

A. Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

1.05 MEASUREMENT OF QUANTITIES

A. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.

B. Take all measurements and compute quantities. Measurements and quantities will be verified by Engineer.

C. Assist by providing necessary equipment, workers, and survey personnel as required.

D. Measurement Devices:

E. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.

F. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.

G. Measurement by Area: Measured by square dimension using mean length and width or radius.

H. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.

I. Stipulated Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.

J. Perform surveys required to determine quantities, including control surveys to establish measurement reference lines. Notify Engineer prior to starting work.

K. Contractor's Engineer Responsibilities: Sign surveyor's field notes or keep duplicate field notes , calculate and certify quantities for payment purposes.

1.06 PAYMENT

A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Engineer, multiplied by the unit price.

B. Payment will not be made for any of the following:
   1. Products wasted or disposed of in a manner that is not acceptable.
   2. Products determined as unacceptable before or after placement.
   3. Products not completely unloaded from the transporting vehicle.
   4. Products placed beyond the lines and levels of the required Work.
   5. Products remaining on hand after completion of the Work.
   6. Loading, hauling, and disposing of rejected Products.

1.07 DEFECT ASSESSMENT

A. Replace Work, or portions of the Work, not complying with specified requirements.

B. If, in the opinion of Engineer, it is not practical to remove and replace the Work, Engineer will direct one of the following remedies:
   1. The defective Work may remain, but the unit price will be adjusted to a new unit price at the discretion of Engineer.
   2. The defective Work will be partially repaired to the instructions of the Engineer, and the unit price will be adjusted to a new unit price at the discretion of Engineer.

C. If, in the opinion of Owner, it is not practical to remove and replace the Work, Owner will direct one of the following remedies:
   1. The defective Work may remain, but the unit price will be adjusted to a new unit price at the discretion of Owner.
   2. The defective Work will be partially repaired to the instructions of the Owner, and the unit price will be adjusted to a new unit price at the discretion of Owner.

D. The individual specification sections may modify these options or may identify a specific formula or percentage price reduction.

E. The authority of Owner to assess the defect and identify payment adjustment is final.

1.08 SCHEDULE OF UNIT PRICES

A. Item: _____; Section _____.

B. Item: _____; Section _____.

C. Item: _____; Section _____.

D. Item: _____; Section _____.

E. Item: _____; Section _____.

F. Item: _____; Section _____.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Dewatering

B. Temporary utilities.

C. Temporary telecommunications services.

D. Temporary sanitary facilities.

E. Temporary Controls: Barriers, enclosures, and fencing.

F. Security requirements.

G. Vehicular access and parking.

H. Waste removal facilities and services.

I. Project identification sign.

J. Field offices.

1.02 RELATED REQUIREMENTS

A. Section 01 51 00 - Temporary Utilities.

B. Section 01 52 13 - Field Offices and Sheds.

C. Section 01 55 00 - Vehicular Access and Parking.

D. Section 01 58 13 - Temporary Project Signage.

1.03 DEWATERING

A. Provide temporary means and methods for dewatering all temporary facilities and controls.

B. Maintain temporary facilities in operable condition.

1.04 TEMPORARY UTILITIES - SEE SECTION 01 51 00

A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.

1.05 TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.

B. Telecommunications services shall include:

1.06 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

B. Maintain daily in clean and sanitary condition.

1.07 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide protection for plants designated to remain. Replace damaged plants.

C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.08 FENCING

A. Construction: Commercial grade chain link fence.

B. Provide 6 foot (1.8 m) high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.09 SECURITY - SEE SECTION 01 35 53

A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

B. Coordinate with Owner's security program.

1.10 VEHICULAR ACCESS AND PARKING - SEE SECTION 01 55 00

A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.

B. Coordinate access and haul routes with governing authorities and Owner.

C. Provide and maintain access to fire hydrants, free of obstructions.

D. Provide means of removing mud from vehicle wheels before entering streets.

E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

F. Do not allow vehicle parking on existing pavement.

1.11 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

B. Provide containers with lids. Remove trash from site periodically.

C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.12 PROJECT SIGNS - SEE SECTION 01 58 13

1.13 PROJECT IDENTIFICATION

A. Provide project identification sign of design, construction, and location approved by Owner.

B. No other signs are allowed without Owner permission except those required by law.

1.14 FIELD OFFICES - SEE SECTION 01 52 13

A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.

B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.

C. Locate offices a minimum distance of 30 feet (10 m) from existing and new structures.

1.15 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.

B. Remove underground installations to a minimum depth of 2 feet (600 mm). Grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing facilities used during construction to original condition.

E. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

VEHICULAR ACCESS AND PARKING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Access roads.

B. Parking.

C. Existing pavements and parking areas.

D. Permanent pavements and parking facilities.

E. Construction parking controls.

F. Flag persons.

G. Haul routes.

H. Traffic signs and signals.

I. Maintenance.

J. Removal, repair.

K. Mud from site vehicles.

1.02 RELATED REQUIREMENTS

A. Section 01 58 13 - Temporary Project Signage: Post Mounted and Wall Mounted Traffic Control and Informational Signs.

B. Section 31 22 00 - Grading: Specifications for earthwork and paving bases.

PART 3 EXECUTION

2.01 PREPARATION

A. Clear areas, provide surface and storm drainage of road, parking, area premises, and adjacent areas.

2.02 ACCESS ROADS

A. Use of existing on-site streets for construction traffic is not permitted.

B. Tracked vehicles not allowed on paved areas.

C. Construct new temporary all-weather access roads from public thoroughfares to serve construction area, of a width and load bearing capacity to provide unimpeded traffic for construction purposes.

D. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.

E. Extend and relocate as work progress requires, provide detours as necessary for unimpeded traffic flow.

F. Location as indicated.

G. Provide unimpeded access for emergency vehicles. Maintain 20 foot (6 m) width driveways with turning space between and around combustible materials.

H. Provide and maintain access to fire hydrants free of obstructions.

2.03 PARKING

A. Use of existing parking facilities by construction personnel is not permitted.

B. Use of new parking facilities by construction personnel is not permitted.

C. Arrange for temporary parking areas to accommodate use of construction personnel.

D. When site space is not adequate, provide additional off-site parking.

2.04 PERMANENT PAVEMENTS AND PARKING FACILITIES

A. Prior to Substantial Completion the base for permanent roads and parking areas may be used for construction traffic.

B. Avoid traffic loading beyond paving design capacity. Tracked vehicles not allowed.

2.05 CONSTRUCTION PARKING CONTROL

A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and Owner's operations.

B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.

C. Prevent parking on or adjacent to access roads or in non-designated areas.

2.06 FLAG PERSONS

A. Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

2.07 HAUL ROUTES

A. Consult with authority having jurisdiction, establish public thoroughfares to be used for haul routes and site access.

B. Confine construction traffic to designated haul routes.

C. Provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.

2.08 TRAFFIC SIGNS AND SIGNALS

A. At approaches to site and on site, install at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.

B. Relocate as work progresses, to maintain effective traffic control.

2.09 MAINTENANCE

A. Maintain traffic and parking areas in a sound condition free of excavated material, construction equipment, products, mud, snow, and ice.

B. Maintain existing paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

2.10 REMOVAL, REPAIR

A. Remove temporary roads when permanent paving is usable.

B. Remove underground work and compacted materials to a depth of 2 feet (600 mm); fill and grade site as specified.

C. Repair existing facilities damaged by use, to original condition.

D. Remove equipment and devices when no longer required.

E. Repair damage caused by installation.

2.11 MUD FROM SITE VEHICLES

A. Provide means of removing mud from vehicle wheels before entering streets.

END OF SECTION

TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Prevention of erosion due to construction activities.

B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.

C. Restoration of areas eroded due to insufficient preventive measures.

D. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 RELATED REQUIREMENTS

A. Section 31 10 00 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.

B. Section 31 22 00 - Grading: Temporary and permanent grade changes for erosion control.

C. Section 31 37 00 - Riprap: Temporary and permanent stabilization using riprap.

1.03 REFERENCE STANDARDS

A. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2017 (Reapproved 2021).

B. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.

C. FHWA FLP-94-005 - Best Management Practices for Erosion and Sediment Control; 1995.

1.04 PERFORMANCE REQUIREMENTS

A. Comply with requirements of EPA (NPDES) for erosion and sedimentation control, as specified by the NPDES, for Phases I and II, and in compliance with requirements of Construction General Permit (CGP).

B. Comply with requirements of State of TX Erosion and Sedimentation Control Manual.

C. Comply with all requirements of TPDES for erosion and sedimentation control.

D. Best Management Practices Standard: FHWA FLP-94-005.

E. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.

F. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
   1. Obtain and pay for permits and provide security required by authority having jurisdiction.
   2. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.

G. Timing: Put preventive measures in place before disturbance of surface cover and before precipitation occurs.

H. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
   1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
   2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.

I. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
   1. Control movement of sediment and soil from temporary stockpiles of soil.

2. Prevent development of ruts due to equipment and vehicular traffic.
3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

J. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
1. Prevent windblown soil from leaving the project site.
2. Prevent tracking of mud onto public roads outside site.
3. Prevent mud and sediment from flowing onto sidewalks and pavements.
4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

K. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.

L. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.

M. Open Water: Prevent standing water that could become stagnant.

N. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.05 SUBMITTALS

A. Erosion and Sedimentation Control Plan:
1. Submit not less than 30 days prior to anticipated start of clearing, grading, or other work involving disturbance of ground surface cover.
2. Include:
a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
e. Other information required by law.
f. Format required by law is acceptable, provided any additional information specified is also included.
3. Obtain the approval of the Plan by authorities having jurisdiction.

B. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.

C. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

D. Maintenance Instructions: Provide instructions covering inspection and maintenance for temporary measures that must remain after Substantial Completion.

PART 2 PRODUCTS

2.01 MATERIALS

A. Mulch: Use one of the following:
   1. Straw or hay.
   2. Wood waste, chips, or bark.
   3. Erosion control matting or netting.

B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.

C. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams.
   1. Color: Manufacturer's standard.

D. Silt Fence Posts: One of the following, minimum 5 feet (1500 mm) long:
   1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot (1.98 kg per linear m).

E. Gravel: See Section 31 23 23 for aggregate.

F. Riprap: See Section 31 37 00.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.

B. Construction Entrances: Traffic-bearing aggregate surface.
   1. Width: As required; 20 feet (7 m), minimum.
   2. Length: 50 feet (16 m), minimum.
   3. Provide at each construction entrance from public right-of-way.
   4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.

C. Linear Sediment Barriers: Made of silt fences or rock berms.
   1. Provide linear sediment barriers:
      a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
      b. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
      c. Along the toe of cut slopes and fill slopes.
      d. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space as indicated on drawings.
      e. Across the entrances to culverts and catch basins that receive runoff from disturbed areas.
   2. Space sediment barriers with the following maximum slope length upslope from barrier:
      a. Slope of Less Than 2 Percent: 100 feet (30 m)..
      b. Slope Between 2 and 5 Percent: 75 feet (23 m).
      c. Slope Between 5 and 10 Percent: 50 feet (15 m).
      d. Slope Between 10 and 20 Percent: 25 feet (7.5 m).
      e. Slope Over 20 Percent: 15 feet (4.5 m).

D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
   1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
   2. Straw bale row blocking entire inlet face area; anchor into pavement.

E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.

F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.

G. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.
   1. Wood Waste: Use only on slopes 3:1 or flatter; no anchoring required.

H. Temporary Seeding: Use where temporary vegetated cover is required.

3.04 INSTALLATION

A. Traffic-Bearing Aggregate Surface:
   1. Excavate minimum of 6 inches (150 mm).
   2. Place geotextile fabric full width and length, with minimum 12 inch (300 mm) overlap at joints.
   3. Place and compact at least 6 inches (150 mm) of 1 1/2 to 3 1/2 inch (40 to 90 mm) diameter stone.

B. Silt Fences:
   1. Store and handle fabric in accordance with ASTM D4873/D4873M.
   2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch (405 mm) high barriers with minimum 36 inch (905 mm) long posts spaced at 6 feet (1830 mm) maximum, with fabric embedded at least 4 inches (100 mm) in ground.
   3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch (710 mm) high barriers, minimum 48 inch (1220 mm) long posts spaced at 6 feet (1830 mm) maximum, with fabric embedded at least 6 inches (150 mm) in ground.
   4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet (6 m), use nominal 32 inch (810 mm) high barriers with woven wire reinforcement and steel posts spaced at 4 feet (1220 mm) maximum, with fabric embedded at least 6 inches (150 mm) in ground.
   5. Install with top of fabric at nominal height and embedment as specified.
   6. Embed bottom of fabric in a trench on the upslope side of fence, with 2 inches (50 mm) of fabric laid flat on bottom of trench facing upslope; backfill trench and compact.
   7. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches (460 mm), with extra post.
   8. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.
   9. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches (300 mm) high with post spacing not more than 4 feet (1220 mm).

C. Mulching Over Large Areas:
   1. Dry Straw and Hay: Apply 2-1/2 tons per acre (6350 kg per hectare); anchor using dull disc harrow or emulsified asphalt applied using same spraying machine at 100 gallons of water per ton of mulch.
   2. Wood Waste: Apply 6 to 9 tons per acre (15,200 to 20,800 kg per hectare).
   3. Erosion Control Matting: Comply with manufacturer's instructions.

D. Mulching Over Small and Medium Areas:
   1. Dry Straw and Hay: Apply 4 to 6 inches (100 to 150 mm) depth.
   2. Wood Waste: Apply 2 to 3 inches (50 to 75 mm) depth.

3. Erosion Control Matting: Comply with manufacturer's instructions.

E. Temporary Seeding:
   1. When hydraulic seeder is used, seedbed preparation is not required.
   2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
   3. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch (12 to 25 mm) deep.
   4. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
   5. Repeat irrigation as required until grass is established.

3.05 MAINTENANCE

A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches (13 mm) or more rainfall at the project site, and daily during prolonged rainfall. Follow the requirements of the SWPPP.

B. Repair deficiencies immediately.

C. Silt Fences:
   1. Promptly replace fabric that deteriorates unless need for fence has passed.
   2. Remove silt deposits that exceed one-third of the height of the fence.
   3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

D. Clean out temporary sediment control structures weekly and relocate soil on site.

E. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Engineer.

B. Clean out temporary sediment control structures that are to remain as permanent measures.

C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

TEMPORARY PROJECT SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project identification sign.

B. Project informational signs.

1.02 QUALITY ASSURANCE

A. Design sign and structure to withstand 50 miles/hr (80 km/hr) wind velocity.

B. Sign Painter: Experienced as a professional sign painter for minimum three years.

C. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

1.03 SUBMITTALS

A. Shop Drawing: Show content, layout, lettering, color, foundation, structure, sizes and grades of members.

PART 2 PRODUCTS

2.01 SIGN MATERIALS

A. Structure and Framing: New, wood, structurally adequate.

B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch (19 mm) thick, standard large sizes to minimize joints.

C. Rough Hardware: Galvanized.

D. Paint and Primers: Exterior quality, two coats; sign background of _____ color.

E. Lettering: Exterior quality paint, contrasting colors.

2.02 PROJECT IDENTIFICATION SIGN

A. One painted sign of construction, design, and content indicated on drawings, location designated.

B. Content:

1. Project number, title, logo and name of Owner as indicated on Contract Documents.
2. Name of Prime Contractor and major Subcontractors.

2.03 PROJECT INFORMATIONAL SIGNS

A. Painted informational signs of same colors and lettering as Project Identification sign, or standard products; size lettering to provide legibility at 100 foot (30 m) distance.

B. Provide at each field office, storage shed , and directional signs to direct traffic into and within site. Relocate as Work progress requires.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install project identification sign within 30 days after date fixed by Notice to Proceed.

B. Erect at designated location.

C. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.

D. Install sign surface plumb and level, with butt joints. Anchor securely.

E. Paint exposed surfaces of sign, supports, and framing.

3.02 MAINTENANCE

A. Maintain signs and supports clean, repair deterioration and damage.

3.03 REMOVAL

A. Remove signs, framing, supports, and foundations at completion of Project and restore the area.

END OF SECTION

FIELD ENGINEERING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Field engineering services by Contractor.

B. Land surveying services by Contractor.

C. Boundary demarcations.

D. Construction surveying by Contractor.

1.02 RELATED REQUIREMENTS

A. Section 01 21 00 - Allowances: Cash, testing, and contingency allowances for field engineering services.

1.03 DESCRIPTION OF SERVICES

A. Specific services listed in this section are in addition to, and do not supersede, general Execution and Closeout Requirements.

B. Sole responsibility for establishing all locations, dimensions and levels of items of work.

C. Sole responsibility for provision of all materials required to establish and maintain benchmarks and control points, including batter boards, grade stakes, structure elevation stakes, and other items.

D. Having a skilled instrument person(s) available on short notice when necessary for laying out the work.

E. Preparation and maintenance of daily reports of activity on the work. Submission of reports containing key progress indicators and job conditions to Engineer.
   1. Major equipment and materials installed as part of the work.
   2. Major construction equipment utilized.
   3. Location of areas in which construction was performed.
   4. Materials and equipment received.
   5. Work performed, including field quality control measures and testing.
   6. Weather conditions.
   7. Safety.
   8. Delays encountered, amount of delay incurred, and the reasons for the delay.
   9. Instructions received from Engineer or Owner, if any.

F. Preparation and maintenance of professional-quality, accurate, well organized, legible notes of all measurements and calculations made while surveying and laying out the work.

G. Prior to backfilling operations, surveying - locating, and recording on a copy of Contract Documents - an accurate representation of buried work and Underground Facilities encountered.

H. Setting up and executing time-lapse photography of construction activities.

1.04 REFERENCE STANDARDS

A. FGDC-STD-007.1 - Geospatial Positioning Accuracy Standards - Part 1: Reporting Methodology; 1998.

B. FGDC-STD-007.2 - Geospatial Positioning Accuracy Standards - Part 2: Standards for Geodetic Networks; 1998.

C. FGDC-STD-007.4 - Geospatial Positioning Accuracy Standards - Part 4: Architecture, Engineering, Construction, and Facilities Measurement; 2002.

D. State Plane Coordinate System for the State in which the Project is located.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.06 QUALITY ASSURANCE

A. Land Surveyor's Qualifications: As established in Section 01 70 00 - Execution and Closeout Requirements.

B. Use adequate number of skilled and thoroughly-trained workers to perform the work of this section in a timely and comprehensive manner.

C. Minimum accuracy for required work is as follows:
   1. Grade: Horizontal Tolerance: Plus or minus 0.1 feet (30.5 mm), Vertical Tolerance: Plus or minus 0.1 feet (30.5 mm).
   2. Culverts and ditches: Horizontal Tolerance: Plus or minus 0.1 feet (30.5 mm), Vertical Tolerance: Plus or minus .05 feet (15.5 mm).
   3. Structures: Horizontal Tolerance: Plus or minus .01 feet (3 mm) (location), Vertical Tolerance: Plus or minus .01 feet (3 mm).

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify layout information shown on drawings in relation to property survey and existing benchmarks.

B. Notify Owner’s representative and Engineer of discrepancies immediately in writing before proceeding to lay out work.

C. Locate and protect existing benchmarks, base lines, and demarcations. Preserve permanent reference points during construction.

D. Existing Utilities and Equipment: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify existing conditions.

3.02 FIELD ENGINEERING

A. Maintain field office files, drawings, specifications, and record documents.

B. Coordinate field engineering services with Contractor's subcontractors, installers, and suppliers as appropriate.

C. Prepare layout and coordination drawings for construction operations.

D. Check and coordinate the work for conflicts and interferences, and immediately advise Engineer and Owner of all discrepancies of which Contractor is aware.

E. Cooperate as required with Engineer and Owner in observing the work and performing field inspections.

F. Review and coordinate work on a regular basis with shop drawings and Contractor's other submittals.

G. In general, match existing adjacent grades and maintain existing flow lines.

H. Check the location, line and grade of every major element as the work progresses. Notify the Engineer when deviations from required lines or grades exceed allowable tolerances. Include in such notifications a thorough explanation of the problem, and a proposed plan and schedule for remedying the deviation. Do not proceed with remedial work without Owner’s concurrence of the remediation plan.

I. Check all formwork, reinforcing, inserts, structural steel, bolts, sleeves, piping, other materials and equipment for compliance with shop drawings and Contract Documents requirements.

J. Check all bracing and shoring for structural integrity and compliance with designs prepared by the Contractor.

3.03 LAND SURVEYING

A. General: Follow standards for geospatial positioning accuracy.
   1. FGDC-STD-007.1 as amended by Authority Having Jurisdiction.
   2. FGDC-STD-007.2 as amended by Authority Having Jurisdiction.
   3. FGDC-STD-007.4 as amended by Authority Having Jurisdiction.

B. Coordinate survey data with the State Plane Coordinate System of the State in which the Project is located.

C. Contractor is responsible for the restoration of all property corners and control monuments damaged or destroyed by construction-related activities. Any disturbed monuments must be replaced at Contractor's expense by a surveyor licensed in the State in which the Project is located, and approved by the Engineer.
   1. Temporarily suspend work at such points and for such reasonable times as the Owner may require for resetting monuments. The Contractor will not be entitled to any additional compensation or extension of time.

3.04 BOUNDARY DEMARCATIONS

A. Wetlands: Protect demarcations and areas from disturbance as indicated on drawings.

B. Species Habitat: Protect demarcations and areas from disturbance as indicated on drawings.

C. Historic Archaeology: Protect demarcations and areas from disturbance as indicated on drawings.

D. Undisturbed: Protect demarcations and areas from disturbance as indicated on drawings.

3.05 CONSTRUCTION SURVEYING

A. General: Perform surveying as applicable to specific items necessary for proper execution of work.
   1. Alignment Staking: Provide alignment stakes at 50 foot (15.24 m) intervals on tangent, and at 25 foot (7.62 m) intervals on curves.
   2. Slope Staking: Provide slope staking at 50 foot (15.24 m) intervals on tangent, and at 25 foot (7.62 m) intervals on curves. Re-stake at every ten-foot difference in elevation.
   3. Structure: Stake out structures, including elevations, and check prior to and during construction.
   4. Pipelines: Stake out pipelines including elevations, and check prior to and during construction.
   5. Site Utilities: Stake out utility lines including elevations, and check prior to and during construction.
   6. Road: Stake out roadway elevations at 50 foot (15.24 m)50-foot intervals on tangent, and at 25 foot (7.62 m) intervals on curves.
   7. Cross-sections: Provide original, intermediate, and final staking as required, for site work and other locations as necessary for quantity surveys.
   8. Easement Staking: Provide easement staking at 50 foot (15.24 m) intervals on tangent, and at 25 foot (7.62 m) intervals on curves. If required by project conditions, provide wooden laths with flagging at 100 foot (30.48 m) intervals.

B. Surveying to Determine Quantities for Payment.
   1. For each application for progress payment, perform such surveys and computations necessary to determine quantities of work performed or placed. Perform surveys necessary for Engineer to determine final quantities of work in place.

C. Record Log: Maintain a log of layout control work. Record any deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used.

D. Use by the Engineer: The Engineer may at any time use line and grade points and markers established by the Contractor. The Contractor's surveys are a part of the work and may be checked by the Engineer at any time.

E. Accuracy:
   1. Establish Contractor's temporary survey references points for Contractors use to at least second-order accuracy (e.g., 1:10000). Set construction staking used as a guide for the work to at least third-order accuracy (e.g., 1:5000). Provide the absolute margin for error specified below on the basis established by such orders.
      a. Horizontal Accuracy of Easement Staking: Plus/minus 0.1 foot (30.5 mm).
      b. Accuracy of Other Staking: Plus/minus 0.04 foot (12.2 mm) horizontally and plus/minus 0.02 foot (6.1 mm) vertically.
      c. Include an error analysis sufficient to demonstrate required accuracy in survey calculations.
   2. Owner reserves the right to check the Contractor's survey, measurements, and calculations. The requirement for accuracy will not be waived, whether this right is exercised or not.

3.06 SUPPORT AND BRACING

A. General requirements: Design all support and bracing systems, if required. Provide for attachment to portions of the building structure capable of bearing the loads imposed. Design systems to not overstress the building structure.

3.07 RECORDS

A. Maintain at the Site a complete and accurate log of control and survey work as it progresses.
   1. Organize and record survey data in accordance with recognized professional surveying standards, Laws and Regulations, and prevailing standards of practice in the State in which the Project is located. Record Contractor's surveyor's original field notes, computations, and other surveying data in Contractor-furnished hard-bound field books. Contractor is solely responsible for completeness and accuracy of survey work, and completeness and accuracy of survey records, including field books. Survey records,(including field books) may be rejected by Owner due to failure to organize and maintain survey records in a manner that allows reasonable and independent verification of calculations, and/or allows identification of elevations, dimensions, and grades of the work.
   2. Illegible notes or data, and erasures on any page of field books, are unacceptable. Do not submit copied notes or data. Corrections by ruling or lining out errors will be unacceptable unless initialed by the surveyor. Violation of these requirements may require re-surveying the data questioned by Engineer.

END OF SECTION

WARRANTIES AND BONDS

PART 1 - GENERAL

1.01 SUBMITTAL REQUIREMENTS

A. Assemble warranties, bonds and services and maintenance contracts, executed by each of the respective manufacturers, suppliers, and subcontractors.

B. Review submittals to verify compliance with Contract Documents. Submit to Engineer for review and transmittal to Owner.

1.02 TIME OF SUBMITTALS

A. For equipment or component parts of equipment put into service during progress of construction submit within 10 days after acceptance.

B. Otherwise make submittals within ten days after Date of Substantial Completion, prior to final request for payment.

C. For items of work, where acceptance is delayed materially beyond the Date of Substantial Completion, provide updated submittal within ten days after acceptance, listing the date of acceptance as the start of the warranty period.

END OF SECTION

SUBSURFACE INVESTIGATION

PART 1 - GENERAL

1.01 SUMMARY

A. If procured by the owner, a Geotechnical Report was used in preparing the design and can be provided by the engineer.

B. The Geotechnical Report is not a conclusive indication of the soil conditions other than where the borings were taken.

C. The accuracy of the Geotechnical Report is not guaranteed in any respect by the Owner, and the Owner accepts no responsibility for interpretation of conclusions drawn therefrom.

D. The information contained in the Geotechnical Report is made available in order that the Contractor may have ready access to the same information available to the Owner as of this date.

E. Contractor is invited and encouraged to make his own interpretation and evaluation of the information and by starting work shall be assumed to have fully accepted responsibility for the subsurface conditions that may hereafter be encountered in performing the excavation work.

F. Contractor is to examine the project site and the record of investigation and make, to whatever extent they deem appropriate, his own investigation of existing subsurface conditions to determine the nature, kind and character of materials to be encountered.

G. Extra payment will not be authorized for work which should have been anticipated or could have been anticipated upon careful examination of the site, or upon soil investigation, or upon consideration of factors generally recognized as being inherent in excavation work of the nature indicated by the Contract Documents.

H. The Contractor shall advise Engineer of discovery of any unknown or undetermined items.

I. The Contractor shall make their own investigation into the location and size of existing site utilities whether represented on the drawings or not.

END OF SECTION

CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formwork for cast-in-place concrete, with shoring, bracing and anchorage.

B. Form stripping.

1.02 RELATED REQUIREMENTS

A. Section 03 20 00 - Concrete Reinforcing.

B. Section 03 30 00 - Cast-in-Place Concrete.

C. Section 31 23 16 - Excavation: Shoring and underpinning for excavation.

1.03 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment of forming work will be by the unit price method.

B. Formwork (Horizontal Structures): Measure by the square foot (meter). Includes form materials, placement, placing accessories, stripping.

1.04 REFERENCE STANDARDS

A. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).

B. ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).

C. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

1.05 SUBMITTALS

A. Product Data: Provide data on void form materials and installation requirements.

B. Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties.

C. Design Data: As required by authorities having jurisdiction.

1.06 QUALITY ASSURANCE

A. Perform work of this section in accordance with Highways standards of the State of TX.

B. Maintain one copy of each installation standard on site throughout the duration of concrete work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver prefabricated forms and installation instructions in manufacturer's packaging.

B. Store prefabricated forms off ground in ventilated and protected manner to prevent deterioration from moisture.

C. Protect plastic foam products from damage and exposure to sunlight.

PART 2 PRODUCTS

2.01 FORMWORK - GENERAL

A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.

B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.

C. Chamfer outside corners of beams, joists, columns, and walls.

D. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.

E. Comply with Highways standards of the State of TX.

2.02 WOOD FORM MATERIALS

A. Form Materials: At the discretion of the Contractor.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 EARTH FORMS

A. Earth forms are not permitted.

3.03 ERECTION - FORMWORK

A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI SPEC-301.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

C. Install stay in place mesh steel formwork in accordance with manufacturer's recommendations.

D. Align joints and make watertight. Keep form joints to a minimum.

E. Coordinate this section with other sections of work that require attachment of components to formwork.

3.04 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

3.05 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.

3.06 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI SPEC-117, unless otherwise indicated.

3.07 FIELD QUALITY CONTROL

A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

3.08 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

END OF SECTION

CONCRETE REINFORCING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Reinforcing steel for cast-in-place concrete.

B. Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS

A. Section 03 10 00 - Concrete Forming and Accessories.

B. Section 03 30 00 - Cast-in-Place Concrete.

1.03 PRICE AND PAYMENT PROCEDURES

A. Bar Reinforcement: By the ton (metric ton). Includes reinforcement, placement, and accessories.

B. Welded Wire Reinforcement: By the square foot (square m). Includes welded wire reinforcement, placement, and accessories.

1.04 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ACI MNL-66 - ACI Detailing Manual; 2020.

C. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

D. ASTM A184/A184M - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement; 2024.

E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2025.

F. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019 (Reapproved 2025).

G. ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement; 2024.

H. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2025.

I. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2024.

J. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement; 2024.

K. ASTM A1035/A1035M - Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement; 2023a.

L. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.

M. CRSI (P1) - Placing Reinforcing Bars, 10th Edition; 2019.

1.05 SUBMITTALS

A. Shop Drawings: Comply with requirements of ACI MNL-66 Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.

1. Prepare shop drawings under seal of a Professional Structural Engineer experienced in design of work of this type and licensed in the State in which the Project is located.

B. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.

C. Reports: Submit certified copies of mill test report of reinforcement materials analysis.

1.06 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI SPEC-301.
   1. Maintain one copy of each document on project site.

PART 2 PRODUCTS

2.01 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa).
   1. Plain billet-steel bars.
   2. Unfinished.

B. Reinforcing Steel: ASTM A706/A706M, deformed low-alloy steel bars.
   1. Unfinished.

C. Reinforcing Steel: Deformed bars, ASTM A996/A996M Grade 40 (280), Type A.

D. Reinforcing Steel: Plain or deformed bars; ASTM A1035/A1035M, Grade 100 (100,000 psi) (690 MPa), Type CL.

E. Reinforcing Steel Mat: ASTM A704/A704M, using ASTM A615/A615M, Grade 40 (40,000 psi) (280 MPa) steel bars or rods, unfinished.

F. Stirrup Steel: ASTM A1064/A1064M steel wire, unfinished.

G. Steel Welded Wire Reinforcement (WWR): Galvanized, deformed type; ASTM A1064/A1064M.
   1. Form: Flat Sheets.
   2. WWR Style: 4 x 8-W6 x W10 (102 x 203-MW39 x MW65).

H. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch (1.29 mm).
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide stainless steel components for placement within 1-1/2 inches (38 mm) of weathering surfaces.

2.02 RE-BAR SPLICING:

A. Dowel Bar Splicer with Dowel-Ins: Mechanical devices for splicing reinforcing bars.
   1. Comply with ACI CODE-318 steel reinforcing design strength requirements for splices in tension and compression.

B. Grout: Cementitious, non-metallic, non-shrink grout for use with manufacturer's grout sleeve reinforcing bar coupler system.

2.03 FABRICATION

PART 3 EXECUTION

3.01 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.

B. Accommodate placement of formed openings.

C. Comply with applicable code for concrete cover over reinforcement.

3.02 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Section 01 40 00 - Quality Requirements, will inspect installed reinforcement for compliance with contract documents before concrete placement.

END OF SECTION

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete formwork.

B. Floors and slabs on grade.

C. Concrete reinforcement.

D. Joint devices associated with concrete work.

E. Miscellaneous concrete elements, including equipment pads, flagpole bases, thrust blocks, and manholes.

F. Concrete curing.

1.02 RELATED REQUIREMENTS

A. Section 03 10 00 - Concrete Forming and Accessories: Forms and accessories for formwork.

B. Section 03 20 00 - Concrete Reinforcing.

C. Section 07 92 00 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

D. Section 32 13 13 - Concrete Paving: Sidewalks, curbs and gutters.

1.03 PRICE AND PAYMENT PROCEDURES

A. Cast-in-place concrete work will be paid for by the unit price method.

B. Concrete - Slab-on-Fill or Slab-on-Grade: Includes formwork as specified in Section 03 10 00, reinforcement as specified in Section 03 20 00, concrete, placement accessories, consolidating and leveling, troweling, and curing. Measurement by:
   1. Cubic yard (meter).

C. Concrete - Miscellaneous Locations: Includes formwork as specified in Section 03 10 00, reinforcement as specified in Section 03 20 00, concrete, placement accessories, consolidating, and curing. Measurement by:
   1. Cubic yard (meter).

D. Concrete - Grouting: Includes preparation of substrate, grout, placement, consolidating, troweling, and curing. Measurement by the cubic yard (meter).

E. Construction Joint Devices: Includes component, accessories, and installation. Measurement by the linear foot (meter).

1.04 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.

C. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).

D. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.

E. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.

F. ACI PRC-308 - Guide to External Curing of Concrete; 2016.

G. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).

H. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

I. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2025.

J. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.

K. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.

L. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2024.

M. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2025.

N. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

O. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

P. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2024a.

Q. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2024.

R. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2025.

S. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2023.

T. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2024.

U. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2025a.

V. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2025.

W. ASTM C845/C845M - Standard Specification for Expansive Hydraulic Cement; 2024.

X. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.

Y. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types); 2023.

Z. COE CRD-C 48 - Handbook for Concrete and Cement Standard Test Method for Water Permeability of Concrete; 1992.

AA. COE CRD-C 513 - Handbook for Concrete and Cement Corps of Engineers Specifications for Rubber Waterstops; 1974.

BB. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair; 2013.

1.05 SUBMITTALS

A. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.

B. Mix Design: Submit proposed concrete mix design.
   1. Indicate proposed mix design complies with expansive component manufacturer's written recommendations.

C. Test Reports: Submit report for each test or series of tests specified.

D. Sustainable Design Submittal: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete cast in place, mix design(s) used showing the quantity of portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used.

E. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.
   1. Maintain one copy of each document on site.

B. Follow recommendations of ACI PRC-305 when concreting during hot weather.

C. Follow recommendations of ACI PRC-306 when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK

A. Comply with requirements of Section 03 10 00.

B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
   1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
   2. Earth Cuts: Do not use earth cuts as forms for vertical surfaces. Natural rock formations that maintain a stable vertical edge may be used as side forms.
   3. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
   4. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches (38 mm) of concrete surface.

2.02 REINFORCEMENT MATERIALS

A. Comply with requirements of Section 03 20 00.

B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa).
   1. Type: Deformed billet-steel bars.
   2. Finish: Unfinished, unless otherwise indicated.

C. Steel Welded Wire Reinforcement (WWR): Galvanized, plain type, ASTM A1064/A1064M.
   1. Form: Coiled Rolls.
   2. WWR Style: 4 x 8-W6 x W10 (102 x 203-MW39 x MW65).

D. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch (1.29 mm).
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches (38 mm) of weathering surfaces.
   4. Coupler Systems: Mechanical devices for splicing reinforcing bars; capable of developing full steel reinforcing design strength in tension and compression.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type II - Moderate Portland type.
   1. Acquire cement for entire project from same source.

B. Blended, Expansive Hydraulic Cement: ASTM C845/C845M, Type K.

C. Fine and Coarse Aggregates: ASTM C33/C33M.
   1. Acquire aggregates for entire project from same source.

D. Lightweight Aggregate: ASTM C330/C330M.

E. Fly Ash: ASTM C618, Class C or F.

F. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.04 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

B. Air Entrainment Admixture: ASTM C260/C260M.

2.05 BONDING AND JOINTING PRODUCTS

A. Slab Isolation Joint Filler: 1/2-inch (13 mm) thick, height equal to slab thickness, with removable top section forming 1/2-inch (13 mm) deep sealant pocket after removal.

B. Slab Contraction Joint Device: Preformed linear strip intended for pressing into wet concrete to provide straight route for shrinkage cracking.

C. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6 inches (150 mm) on center; ribbed steel stakes for setting.

D. Dowel Sleeves: Plastic sleeve for smooth, round, steel load-transfer dowels.

2.06 CURING MATERIALS

A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.

B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.

C. Curing Agent, Water-Cure Equivalent Type: Clear, water-based, non-film-forming, liquid-water cure replacement agent.
   1. Comply with ASTM C309 standards for water retention.
   2. Compressive Strength of Treated Concrete: Equal to or greater than strength after 14-day water cure when tested in accordance with ASTM C39/C39M.
   3. VOC Content: Zero.

D. Curing Compound, Non-Dissipating: Liquid, membrane-forming, clear, nonyellowing acrylic; complying with ASTM C309.

E. Curing and Sealing Compound, Low Gloss: Liquid, membrane-forming, clear, non-yellowing acrylic; complying with ASTM C1315 Type 1 Class A.

2.07 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI PRC-211.1 recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI SPEC-301.

C. Admixtures: Add acceptable admixtures as recommended in ACI PRC-211.1 and at rates recommended or required by manufacturer.

D. Normal Weight Concrete:
   1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 4,000 pounds per square inch (27.6 MPa) unless otherwise indicated in the design drawings.
   2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
   3. Water-Cement Ratio: Maximum 40 percent by weight.
   4. Total Air Content: 4 percent, determined in accordance with ASTM C173/C173M.
   5. Maximum Slump: 4 inches (100 mm).
   6. Maximum Aggregate Size: 5/8 inch (16 mm).

E. Structural Lightweight Concrete:
   1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 3,000 pounds per square inch (20.7 MPa) unless otherwise indicated in the design drawings.

2. Maximum Slump: 4 inches (100 mm).
3. Maximum Aggregate Size: 5/8 inch (16 mm).

2.08 MIXING

A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.
   1. Colored Concrete: Add pigments in strict accordance with manufacturer's instructions to achieve consistent color from batch to batch.

B. Transit Mixers: Comply with ASTM C94/C94M.

C. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Formwork: Comply with requirements of ACI SPEC-301. Design and fabricate forms to support all applied loads until concrete is cured and for easy removal without damage to concrete.

B. Verify that forms are clean and free of rust before applying release agent.

C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

D. Prepare existing concrete surfaces to be repaired according to ICRI 310.2R.

E. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.

F. Where new concrete with integral waterproofing is to be bonded to previously placed concrete, prepare surfaces to be treated in accordance with waterproofing manufacturer's instructions. Saturate cold joint surface with clean water, and remove excess water before application of coat of waterproofing admixture slurry. Apply slurry coat uniformly with semi-stiff bristle brush at rate recommended by waterproofing manufacturer.

G. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

3.03 PLACING CONCRETE

A. Place concrete in accordance with ACI PRC-304.

B. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

C. Ensure reinforcement, inserts, and formed construction joint devices will not be disturbed during concrete placement.

D. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

3.04 SLAB JOINTING

A. Locate joints as indicated on drawings.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.

D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch (5 mm) thick blade and cut at least 1 inch (25 mm) deep but not less than one quarter (1/4) the depth of the slab.

E. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

3.05 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

3.06 CURING AND PROTECTION

A. Comply with requirements of ACI PRC-308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than seven days.
   2. High early strength concrete: Not less than four days.

C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.

3.07 FIELD QUALITY CONTROL

A. Provide free access to concrete operations at project site and cooperate with appointed firm.

B. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

C. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

D. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards (76 cu m) or less of each class of concrete placed.

E. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

F. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.08 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Engineer and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

3.09 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION

MASONRY MORTARING AND GROUTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Mortar for masonry.

B. Grout for masonry.

1.02 RELATED REQUIREMENTS

A. Section 33 05 61 - Concrete Manholes: Installation of mortar and grout.

1.03 REFERENCE STANDARDS

A. ASTM C91/C91M - Standard Specification for Masonry Cement; 2025.

B. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2025.

C. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.

D. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

E. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry; 2025.

F. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry; 2019a.

G. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2020.

H. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

1.04 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

1.05 PRECONSTRUCTION TESTING

A. Grout Mixes: Test grout batches in accordance with ASTM C1019 procedures.

1. Test results will be used to establish optimum grout proportions and establish quality control values for construction testing.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.07 FIELD CONDITIONS

A. Maintain materials and surrounding air temperature to minimum 40 degrees F (5 degrees C) prior to, during, and 48 hours after completion of masonry work.

B. Maintain materials and surrounding air temperature to maximum 90 degrees F (32 degrees C) prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.01 MORTAR AND GROUT APPLICATIONS

A. At Contractor's option, mortar and grout may be field-mixed from packaged dry materials, made from factory premixed dry materials with addition of water only, or ready-mixed.

B. Grout Mix Designs:

1. Engineered Masonry: 3,000 psi (21 MPa) strength at 28 days; 8-10 inches (200-250 mm) slump; provide premixed type in accordance with ASTM C 94/C 94M.

2.02 MATERIALS

A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
   1. Color: Standard gray.

B. Portland Cement: ASTM C150/C150M.
   1. Type: Type I - Normal; ASTM C150/C150M.
   2. Color: Standard gray.

C. Grout Aggregate: ASTM C404.

D. Water: Clean and potable.

E. Bonding Agent: Latex type.

2.03 MORTAR MIXING

A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.

B. Maintain sand uniformly damp immediately before the mixing process.

C. Do not use anti-freeze compounds to lower the freezing point of mortar.

D. If water is lost by evaporation, re-temper only within two hours of mixing.

2.04 GROUT MIXING

A. Mix grout in accordance with ASTM C94/C94M.

B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.

C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.

PART 3 EXECUTION

3.01 PREPARATION

A. Apply bonding agent to existing concrete surfaces.

B. Plug clean-out holes for grouted masonry with brick masonry units. Brace masonry to resist wet grout pressure.

3.02 INSTALLATION

A. Install mortar and grout to requirements of section(s) in which masonry is specified.

B. Work grout into masonry cores and cavities to eliminate voids.

C. Do not install grout in lifts greater than 16 inches (400 mm) without consolidating grout by rodding.

D. Do not displace reinforcement while placing grout.

E. Remove excess mortar from grout spaces.

3.03 GROUTING

A. Use either high-lift or low-lift grouting techniques, at Contractor's option, subject to other limitations of Contract Documents.

B. Low-Lift Grouting:
   1. Limit height of pours to 12 inches (300 mm).
   2. Limit height of masonry to 16 inches (400 mm) above each pour.
   3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
   4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.

C. High-Lift Grouting:

1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
2. Place grout for spanning elements in single, continuous pour.

END OF SECTION

PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stair railings and guardrails.

B. Free-standing railings at steps.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Placement of anchors in concrete.

B. Section 09 91 13 - Exterior Painting: Paint finish.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

E. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2024.

F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

G. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
2. Include the design engineer's seal and signature on each sheet of shop drawings.

C. Designer's Qualification Statement.

D. Fabricator's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.

B. Comply with ASTM E985.

C. Allow for expansion and contraction of members and building movement without damage to connections or members.

D. Dimensions: See drawings for configurations and heights.

E. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.

F. Provide slip-on non-weld mechanical fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

G. Welded and Brazed Joints: Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
1. Ease exposed edges to a small uniform radius.

2.02 STEEL RAILING SYSTEM

A. Steel Tube: ASTM A500/A500M Grade B cold-formed structural tubing.

B. Steel Pipe: ASTM A53/A53M Grade B Schedule 80, black finish.

C. Non-Weld Mechanical Fittings: Slip-on, galvanized malleable iron castings, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.

D. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

E. Exposed Fasteners: No exposed bolts or screws.

2.03 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:
1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

C. Apply one coat of bituminous paint to concealed aluminum surfaces that will be in contact with cementitious or dissimilar materials.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Install railings in compliance with ADA Standards for accessible design at applicable locations.

D. Anchor railings securely to structure.

E. Field weld anchors as indicated on drawings. Touch-up welds with primer. Grind welds smooth.

F. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION

SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Clearing and grubbing.

B. Selective removal and trimming.

C. Earth stripping and stockpiling.

D. Repair and restoration.

E. Debris removal.

1.02 RELATED REQUIREMENTS

A. Section 02 41 00 - Demolition: Removal of built elements and utilities.

B. Section 31 10 00.10 - Tree Protection

C. Section 31 23 23 - Fill: Material for filling holes, pits, and excavations generated as result of removal operations.

D. Section 01 57 13 - Temporary Erosion and Sediment Control

1.03 PRICE AND PAYMENT PROCEDURES

A. Unit Prices:

1. Basis of Measurement for Clearing and Grubbing and Earth Stripping and Stockpiling: By sq yard (sq meter).
2. Basis of Measurement for Selective Removal and Trimming and Restoration of Damaged Vegetation: Per unit.

1.04 REFERENCE STANDARDS

A. Project Geotechnical Report

B. Storm Water Pollution Prevention Plan

C. ANSI A300 Part 1 - American National Standard for Tree Care Operations - Tree, Shrub, and Other Woody Plant Management - Standard Practices (Pruning); 2017.

D. ANSI A300 Part 5 - American National Standard for Tree Care Operations – Tree, Shrub and Other Woody Plant Maintenance Standard Practices (Management of Trees and Shrubs During Site Planning, Site Development, and Construction); 2019.

E. ANSI A300 Part 6 - Tree, Shrub, and Other Woody Plant Management--Standard Practices (Planting and Transplanting); 2012 (Reapproved 2018).

F. ANSI Z133 - American National Standard for Arboricultural Operations - Safety Requirements; 2017.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene prework meeting one week prior to start of work of this section; require attendance by affected personnel.

B. Coordinate pre-construction meeting with local jurisdictional authority.

C. Sequencing: Ensure utility disconnections are in orderly and expeditious manner.

1.06 QUALITY ASSURANCE

A. Clearing Firm Qualifications: Company specializing in performing work of type specified and with at least three years of experience.

B. Trimming or Pruning Qualifications: Tree Care Industry Association (TCIA) Certified Treecare Safety Professional.

1.07 FIELD CONDITIONS

A. Ambient Conditions: Terminate work during hazardous environmental conditions according to 29 CFR 1910.266.

B. Existing Conditions: See site and utility survey, geotechnical report, hazardous material survey, existing conditions survey, and site drawing.

C. Temporary Erosion and Sediment Control: Comply with other requirements specified in Section 01 57 13 - Temporary Erosion and Sediment Control.

PART 2 PRODUCTS

2.01 MATERIALS

A. Sedimentation Barrier: See Section 01 57 13 - Temporary Erosion and Sediment Control.

B. Tree Wound Compound: Application capable of sealing vegetation wounds and grafts.

PART 3 EXECUTION

3.01 EXAMINATION

A. Locate property boundaries and benchmarks and protect monumentation.

B. Identify potential runoff areas.

C. Construction Fencing: Make sure construction fencing is installed and maintained.

D. Erosion and Sediment: Make sure SWPPP Best Management Practices are implemented and maintained.

E. Identify potential dust sources.

F. Identify preexisting debris, junk, and trash on-site.

3.02 PREPARATION

A. Coordinate work with utility companies; notify before starting work and comply with local requirements; obtain required permits.

B. Contact Texas Excavation Safety System at 811 and have all utilities field located. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Protect existing structures and other elements that are to remain.

E. Protect existing vegetation to remain from damage and monitor according to ANSI A300 Part 5.
   1. Photograph vegetation with documentation indicating data, time, weather, and brief description of health condition.

F. Install sedimentation barriers according to Section 01 57 13 - Temporary Erosion and Sediment Control.

G. Protect benchmarks, survey control points, and existing structures from damage or displacement.

H. Develop dust remediation controls and methods. Do not use water if that results in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

I. Remove preexisting debris, junk, and trash on-site.

J. Contractor is responsible for complying with State and local requirements related to permitting, storm water control, statutory notification periods, keeping roadways clear of debris, and dust control during operations.

K. Any existing water wells and septic systems found on the site shall be abandoned or removed as required by the Health Department. The Contractor shall obtain permits for such work from the Health Department.

3.03 CLEARING AND GRUBBING

A. Clearing: Cut trees, stumps, shrubs, downed timber, and other vegetation for removal within identified area as indicated on drawings according to 29 CFR 1910.266. Follow recommendations of ANSI Z133 and best local practices for species involved.

B. Clear site after relocating vegetation in accordance with ANSI A300 Part 6.

C. Do not remove or damage vegetation beyond limits indicated on drawings.
   1. Building Perimeter: 20 feet (12 m) outside.
   2. Paving: 10 feet (3.1 m) each side of surface walkways, patios, surface parking, and utility lines less than 12 inches (305 mm) in diameter.
   3. Minor Utility Trenches: 10 feet (3.1 m) each side of utility lines less than 12 inches (305 mm) in diameter.
   4. Roadways and Main Utility Trenches: 15 feet (4.6 m) each side.
   5. Pervious Paving: 15 feet (4.6 m) outside perimeter.

D. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum subsoil disturbance.

E. Grubbing: Remove stumps, roots, buried timber, and other vegetation minimum depth 12 inches (30 cm) from ground. Remove rocks minimum depth 6 inches (15 cm) from ground.

3.04 SELECTIVE REMOVAL AND TRIMMING

A. Selective Removal: Individual tree and shrub identified for removal as indicated on drawings according to 29 CFR 1910.266.
   1. Includes trees, stumps, shrubs, downed timber, and other vegetation identified for removal as indicated on drawings.
   2. Fell trees away from vegetation identified to remain.
   3. Pull stumps, remove roots, buried timber, and other vegetation identified for removal 12 inches (30 cm), minimum depth, from ground. Remove rocks 6 inches (15 cm), minimum depth, from ground.
   4. Cut stump neatly and close to ground.
   5. Fill holes left by removal of stumps and roots, using suitable fill material, with top surface neat in appearance and matching existing grade.

B. Selective Trimming: Individual limbs and branches cut back according to ANSI A300 Part 1 identified for removal as indicated on drawings. Follow recommendations of ANSI Z133 and best local practices for species involved.

3.05 EARTH STRIPPING AND STOCKPILING

A. Stripping:
   1. Remove topsoil within identified area:
      a. 4 inches (10 cm) deep.
      b. According to soil report.
   2. Remove topsoil within identified area as indicated on drawings.

B. Stockpiling:
   1. Place topsoil in identified areasif indicated for reuse:
      a. Pile depth not to exceed 8 feet (2.5 m).
      b. Protect piles from erosion.
   2. Place rock in identified areasif indicated for reuse.

3.06 REMOVED VEGETATION PROCESSING

A. Do not burn, bury, landfill, or leave on-site.

B. Trees: Sell if marketable.

C. Sod: Reuse on-site if possible; otherwise dispose of off-site.

D. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; give preference to on-site uses.

3.07 REPAIR AND RESTORATION

A. Remaining Existing Facilities, Utilities, and Site Features: If damaged due to this work, repair or replace to original condition.

B. Vegetation: Replace damaged or destroyed vegetation identified to remain as indicated on drawings at no cost to Owner:
   1. Outside removal limits.
   2. Inside protection limits.

C. Apply tree wound compound according to manufacturer's recommendations.

3.08 DEBRIS REMOVAL

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and windblown debris from public and private lands.

D. Remove paving, curbs, and other surface improvements as indicated on the Design drawings.

E. Remove abandoned utilities unless otherwise noted to remain. Indicate removal termination point for underground utilities on Record Documents.

3.09 CLEANING

A. Remove unused stockpiled subsoil. Grade stockpile area to prevent standing water.

B. Do not burn or bury materials on site.

C. Leave site clean and ready to receive work.

END OF SECTION

TREE PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Protection of Existing Trees.

1.02 RELATED REQUIREMENTS

A. Section 02 41 00 - Demolition

B. Section 31 10 00 - Site Clearing

C. Section 31 22 00 - Grading

1.03 PRICE AND PAYMENT PROCEDURES

A. Tree Protection Fence: By the linear foot. Includes chain link or plastic mesh fence, posts, tie wire, and installation.

1.04 REFERENCE STANDARDS

A. ANSI A300-2008 Pruning.

B. Local Municipal Code.

1.05 QUALITY ASSURANCE

A. Employ certified arborist or landscape architect to supervise or perform tree protection work as required.

PART 2 PRODUCTS

2.01 MATERIALS

A. Tree Protection Fence: 4 feet high galvanized chain link.
   1. Posts: 1-1/2 inch at 6 feet on center, 2 feet deep.
   2. Tension Wire: Not less than 12 gauge at top and 6 inches above existing grade.

B. Tree Protection Fence: 4 feet high heavy gauge orange plastic mesh with 2" openings.
   1. Posts: "T" posts at 6 feet on center, 2 feet deep.

PART 3 EXECUTION

3.01 TREE PROTECTION FENCE

A. Install at Root Protection Zone of all existing trees to be protected per local jurisdictional requirements; otherwise, as shown on drawing.

B. Root Protection Zone as defined by the local jurisdiction; otherwise, shall be located 1 foot radius from trunk for every 1 inch diameter of trunk at 4 feet from ground. The diameter of a multi-trunk tree is calculated as the sum of the largest trunk plus half of the sum of additional trunks at 4.5 feet from ground.

C. Fence may be located a minimum of half of the root protection radius if approved by the regulatory authority, Engineer, or Owner.

D. Fence Location Detail: See detail as shown on drawings.

3.02 TREE PROTECTION REQUIREMENTS

A. Install tree protection fence prior to any clearing, excavation, or grading and maintain in good repair for the duration of all construction work unless otherwise directed**.**

B. No construction operations are allowed within the Root Protection Zone.

C. Root Protection Zone shall be sustained in a natural state and shall be free from vehicular or mechanical traffic; no fill, equipment, liquids, or construction debris shall be placed inside the protective barrier.

D. Root Protection Zone shall be covered with 6" of mulch to reduce moisture stress.

E. The proposed finished grade and elevation of land within the Root Protection Zone of any trees to be preserved shall not be raised or lowered more than 3 inches. Welling and retaining methods are allowed outside the Root Protection Zone.

F. Root Protection Zone shall remain pervious, i.e. ground cover or turf at completion of landscape design.

G. No roots may be cut closer than 6 feet from the base of any tree. Roots cut within the Root Protection Zone will only be allowed on one side of the tree. Any roots that need to be cut within the Root Protection Zone will be cut using a saw-type trencher, and all cut roots will be painted.

H. All trees impacted by construction shall be fertilized with an organic tree fertilizer prior to construction and again at the end of construction. The area within the protective fencing shall be mulched with about 6 inches of mulch. Water barrels shall be placed within the Root Protection Zone to irrigate these trees if necessary.

I. No trash or warming fires shall be placed within 50 feet of any tree.

J. No pedestrian traffic shall occur within dripline of any tree.

3.03 DAMAGE TO PROTECTED TREES

A. Trim trees and shrubs when doing so will prevent removal or damage. Trimmed or damaged trees shall be treated or repaired under supervision of a certified arborist or landscape architect.

B. Any damage done to existing tree crowns or root systems shall be repaired immediately under supervision of a certified arborist. All wounds to oaks shall be painted with pruning paint within 20 minutes after damage. Roots exposed during construction operations will be cut cleanly. Cut surfaces shall be painted and topsoil and mulch placed over exposed root area immediately.

C. Branch Pruning Detail: See detail as shown on drawings.

D. Contractor shall compensate owner for damage to existing trees designated to remain in the amount of $200 per caliper inch measured 4 feet from ground. This amount will be deducted from final payment.

END OF SECTION

GRADING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rough grading.

B. Fine grading.

1.02 RELATED REQUIREMENTS

A. Section 31 10 00 - Site Clearing.

B. Section 31 23 16 - Excavation.

C. Section 31 23 16.26 - Rock Removal.

D. Section 31 23 23 - Fill.

1.03 PRICE AND PAYMENT PROCEDURES

A. Unit Prices:
   1. Basis of Measurement for Rough Grading: By square yard (yard).
   2. Basis of Measurement for Fine Grading: By square yard (yard).

1.04 REFERENCE STANDARDS

A. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2017 (Reapproved 2025).

1.05 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.06 QUALITY ASSURANCE

A. Perform in accordance with State of TX, Highway Department standards.

1.07 FIELD CONDITIONS

A. Ambient Conditions: Terminate work during hazardous environmental conditions in accordance with 29 CFR 1910.266.

B. Existing Conditions: See site and utility survey, geotechnical report, hazardous material survey, existing conditions survey, and site drawing.

PART 2 PRODUCTS

2.01 MATERIALS

A. Gravel: Excavated on-site.
   1. Graded according to ASTM D2487 Group Symbol GW, GP, or SP.

B. Other Fill Materials: See Section 31 23 23.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify survey bench mark and intended elevations for grading areas are as indicated.

B. Verify the absence of standing or ponding water.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Stake and flag locations of known utilities.

C. Locate, identify, and protect above- and below-grade utilities to remain.

D. Notify utility company to remove and relocate utilities.

E. Provide temporary means and methods to remove standing or ponding water from areas prior to grading.

F. Protect site features to remain, including but not limited to bench marks, survey control points, and fences.

G. Remove topsoil in accordance with Section 31 10 00.

H. Excavate materials in accordance with Section 31 23 16.

I. Remove rock in accordance with Section 31 23 16.26.

J. Fill and backfill in accordance with Section 31 23 23.

3.03 ROUGH GRADING

A. Excavate and fill subgrade material to elevations indicated on plans.

B. Horizontally bench existing slopes greater than 1:4.

C. Replace displaced subgrade in accordance with Section 31 23 23.

D. Remove and replace unsuitable materials as specified fill.

E. See Section 31 23 16 for stockpiling procedures.

3.04 FINE GRADING

A. Scrape and spread subgrade material uniformly smooth and without disruptions.

B. Slopes: Transition smoothly to adjacent areas.

C. See Section 31 23 23 and the Geotechnical Report for final compaction.

3.05 TOLERANCES

A. Top Surface: Plus or minus 1/2 inch (13 mm).

3.06 CLEANING

A. Remove unused stockpiled subsoil. Grade stockpile area to prevent standing water.

B. Leave site clean and raked, ready to receive work.

END OF SECTION

EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and protection.

B. Dewatering.

C. Excavation.

D. Excavation repairs.

1.02 RELATED REQUIREMENTS

A. Project Geotechnical Report

B. Section 02 41 00 - Demolition.

C. Section 31 10 00 - Site Clearing.

D. Section 31 22 00 - Grading.

E. Section 31 23 16.13 - Trenching.

F. Section 31 23 16.26 - Rock Removal.

G. Section 31 23 19 - Dewatering.

H. Section 31 23 23 - Fill.

1.03 PRICE AND PAYMENT PROCEDURES

A. Unit Prices:

1. Basis of Measurement for Unclassified Excavation: By cubic yard (cubic meter).
2. Basis of Measurement for Excavation Classified as Earth: By cubic yard (cubic meter).

1.04 REFERENCE STANDARDS

A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: Independent firm specializing in materials testing.

1.06 FIELD CONDITIONS

A. Ambient Conditions: Do not perform excavation during periods of heavy rain as directed by Engineer.

B. Existing Conditions: See site and utility survey, geotechnical report, hazardous material survey, existing conditions survey, and site drawing.

C. Utility Location: Notify Call Before You Dig (811) before excavation to request approximate underground utility marking.

D. Stormwater: Comply with requirements, see Section 01 57 13 - Temporary Erosion and Sediment Control.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify survey bench mark elevations are as indicated on drawings.

B. Survey existing adjacent structures and exterior improvements to establish exact elevations at fixed points for bench marking.

C. Assess adjacent structures and exterior improvements to establish existing conditions. Notify Engineer of existing cracks, sags, or other damages prior to starting work.

D. Verify prevailing groundwater level is as indicated on drawings.

3.02 PREPARATION

A. See Section 31 10 00 for site clearing and topsoil removal.

B. Identify required lines, levels, contours, and datum locations.

C. Protect survey bench marks, control points, and monuments from excavating equipment and vehicular traffic.

D. Protect existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Protect plants and other features to remain.

F. Locate and identify known utilities to remain and protect from damage.

G. Notify utility company to remove and relocate utilities.

3.03 SUPPORT AND PROTECTION

A. Excavation Safety: Comply with OSHA's Excavation Standard, 29 CFR 1926, Subpart P.

B. Permanently leave in place excavation support and protection systems used as formwork or within 10 feet (3.03 m) of existing foundations unless otherwise noted on drawings.

3.04 DEWATERING

A. Prevent surface water and groundwater from entering excavations and surrounding areas.

B. Dispose of water without causing surface erosion, sediment buildup, or endangering public health or property.

C. See Section 31 23 19 for additional dewatering requirements.

3.05 EXCAVATION

A. Grade top perimeter of excavation to prevent surface water collection.

B. General Excavation:
   1. Excavate to indicated contours, elevations, and grades.
   2. Unclassified Excavation: Excavate material as indicated on drawings.
   3. Classified Excavation: Classify excavated material as rock and earth.
      a. Earth Excavation: Excavate material as indicated on drawings.
      b. Rock Excavation: See Section 31 23 16.26.

C. Excavation for Exterior Improvements:
   1. Excavate to subgrade; do not disturb subsoils.
   2. Compact subgrade as indicated on the Geotechnical Report.

D. Excavation to accommodate foundations, underground tanks, and underground utilities.
   1. Excavate to specified elevations.
   2. Over-excavate to safely install, adjust, and remove forms, bracing, or supports necessary for installation of work.
   3. Hand trim excavations. Remove loose matter.

E. See Section 31 23 16.13 for trenching.

F. Notify Engineer of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.

G. Do not interfere with 45-degree bearing splay of foundations.

3.06 EXCAVATION REPAIRS

A. Notify Engineer of over-excavations.

B. Correct areas over-excavated with native compacted soil.

C. See Section 31 23 23 for additional requirements.

3.07 FIELD QUALITY CONTROL

A. Resurvey existing adjacent structure and exterior improvement bench marks. Notify Engineer of changes in elevations, positions, or slopes.

B. Notify Engineer of additional cracks, sags, or other damages to adjacent structures or exterior improvements occurring during work.

3.08 CLEANING

A. Stockpile excavated material for re-use in area designated on-site; see Section 31 22 00.

B. Remove excavated material unsuitable for re-use from site.

C. Remove excess excavated material from site.

3.09 PROTECTION

A. Divert surface water away from excavations.

B. Keep excavations free of standing water.

C. Maintain stability of banks and loose soils; prevent from falling into excavations.

D. Maintain excavations in satisfactory, undisturbed condition.

E. Protect bottom of excavations from freezing.

END OF SECTION

TRENCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Trench excavation.

B. Utility bedding and cover.

C. Backfill and compaction.

D. Dewatering.

1.02 RELATED REQUIREMENTS

A. Section 31 05 19 - Geosynthetics for Earthwork.

B. Section 31 10 00 - Site Clearing.

C. Section 31 22 00 - Grading.

D. Section 31 23 16 - Excavation.

E. Section 31 23 16.26 - Rock Removal.

F. Section 31 23 19 - Dewatering.

G. Section 31 23 23 - Fill.

1.03 PRICE AND PAYMENT PROCEDURES

A. Unit Prices:

1. Basis of Measurement for Trenching: By linear foot (linear meter).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate trenching with utility installation.

1.05 SUBMITTALS

A. Samples: 10 lb (4.5 kg) sample of each type of fill; submit in air-tight containers to testing laboratory.

B. Source Quality Control Submittals: Submit name of imported materials source.

1. Results of gradation tests on proposed and actual materials used.

C. Field Quality Control Submittals:

1. Results of compaction density tests.

D. Manufacturer's qualification statement.

E. Installer's qualification statement.

F. Testing agency's qualification statement.

G. Compaction Density Test Reports.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with minimum 3 years of experience.

B. Installer Qualifications: Company specializing in performing work of type specified, with minimum 3 years of experience.

C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

D. Documents at Project Site: Maintain at project site one copy of manufacturer's instructions, erection drawings, and shop drawings.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver fill to project site in advance of need.

B. When fill materials need on-site storage, locate stockpiles where indicated on drawings.

1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
2. Prevent contamination.
3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. General Fill: Comprised of sand and gravel; free of shale, clay, friable materials, and debris.
   1. Fill Type General: Complying with State of TX Highway Department standard.
   2. Fill Type General: Subsoil excavated on-site.
      a. Free of lumps larger than 3 inches (75 mm), rocks larger than 2 inches (50 mm), and debris.
      b. Complying with ASTM D2487 Group Symbol CL.

B. Granular Fill: Pit-run washed stone; free of shale, clay, friable materials, and debris.
   1. Fill Type Aggregate: Coarse aggregate, complying with State of TX Highway Department standard.

C. Crushed Stone: Crusher-run, mineral aggregate, free of silt, clay, loam, friable or soluble materials, and organic matter.
   1. Type Aggregate: Complying with State of TX Highway Department standard.
   2. Grade in accordance with ASTM D2487 Group Symbol GM.

D. Filter Fabric: Geotextile, capable of material separation.
   1. Geotextile: Nonbiodegradable, woven.
   2. Geotextile: See Section 31 05 19.

E. Sand: Natural river or bank, washed free of silt, clay, loam, friable or soluble materials, and organic matter.
   1. Type Sand: Complying with State of TX Highway Department standard.
   2. Grade in accordance with ASTM D2487 Group Symbol SW.
   3. Sand Equivalent: In accordance with ASTM D2419.

F. Concrete: Ready mix.
   1. Ready for placement in accordance with ASTM C94/C94M.

G. Flowable Fill: Controlled low-strength material in accordance with ASTM D6103/D6103M.

H. General Fill: Subsoil excavated on-site.

I. Structural Fill: Subsoil excavated on-site.

J. Granular Fill - Gravel: Pit run washed stone; free of shale, clay, friable material and debris.
   1. Graded in accordance with ASTM C136/C136M.

K. Granular Fill - Pea Gravel: Natural stone; washed, free of clay, shale, organic matter.
   1. Graded in accordance with ASTM C136/C136M.

L. Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.
   1. Graded in accordance with ASTM C136/C136M.

2.02 ACCESSORIES

A. Underground Warning Tape: Suitable for direct burial.
   1. Bright-colored, continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mils, 0.004 inch (0.10 mm) thick.

B. Buried Detection Wire: Copper, single strand, continuously insulated, 12 AWG, suitable for direct burial.

2.03 SOURCE QUALITY CONTROL

A. Test fill materials in accordance with specified standard before delivery to site.

B. Nonconforming Materials: Change and retest.

C. Provide materials of each type from same source or as directed by Engineer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify survey benchmarks and intended elevations for work are as indicated on drawings.

B. Verify prevailing groundwater level is as indicated on drawings.

C. Perform assessment of adjacent structures and exterior improvements to establish existing conditions. Notify Engineer of existing cracks, sags, or other damages prior to starting work.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. See Section 31 10 00 for site clearing and topsoil removal.

C. Protect survey benchmarks, control points, and monuments from excavating equipment and vehicular traffic.

D. Protect existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Protect plants and other features to remain.

F. Locate and identify existing utilities to remain as indicated on drawings and protect from damage.

G. Notify utility company to remove and relocate utilities as indicated on drawings.

3.03 SUPPORT AND PROTECTION

A. Excavation Safety: Provide Trench Safety Protection. Comply with OSHA's Excavation Standard, 29 CFR 1926, Subpart P.

B. Contractor is responsible for providing trench box, sheeting, shoring and bracing, as required to maintain stability of excavation. Design of sheeting, shoring and bracing is by the Contractor based on soil profiles per the geotechnical report.

C. Abandon support and protection systems used as formwork or within 10 feet (3.03 m) of existing foundations, unless otherwise noted on drawings.
   1. Remove top 4 feet (1.22 m) below grade.

3.04 DEWATERING

A. Prevent surface water and groundwater from entering excavations and surrounding areas.

B. Dispose of water without causing surface erosion, sediment buildup, or endangering public health or property.

C. See Section 31 23 19 for additional dewatering requirements.

3.05 TRENCH EXCAVATION

A. Grade top perimeter of excavation to prevent surface water collection.

B. Notify Engineer of unexpected subsurface conditions and discontinue affected work in area until notified to resume.

C. General: Cut trenches neat and clean.
   1. Slope banks of excavations deeper than 4 feet (1.2 m) to angle of repose or less until shored.
   2. Do not interfere with 45-degree bearing splay of foundations.
   3. Cut trenches wide enough to allow inspection of installed utilities.
   4. Hand trim excavations and remove loose matter.
   5. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
   6. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd (0.25 cu m) measured by volume.

7. See Section 31 23 16.26 for rock removal.

D. Utility Preparation: Rake trench bottom to uniform grade.
   1. Remove unsuitable subgrade and backfill.
   2. Compact subgrade to density equal to or greater than subsequent fill material requirements.

E. Maintain trenches and prevent loose soil or rocks from entering.

F. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

G. Slope banks of excavations deeper than 4 feet (1.2 meters) to angle of repose or less until shored.

H. Do not interfere with 45 degree bearing splay of foundations.

I. Cut trenches wide enough to allow inspection of installed utilities.

J. Hand trim excavations. Remove loose matter.

K. Remove excavated material that is unsuitable for re-use from site.

L. Remove excess excavated material from site.

M. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Engineer. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

N. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot (305 mm) into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Engineer.

3.06 UTILITY BEDDING AND COVER

A. Maintain trenches and prevent loose soil or rocks from entering.

B. Crushed Stone: Compact to 95 percent of maximum dry density.
   1. Bedding: Fill to subgrade elevation; rake smooth.
   2. Cover: Completely cover utility.

C. Sand: Compact in maximum 8-inch (200 mm) lifts to 95 percent of maximum dry density.
   1. Bedding: Fill to subgrade elevation; rake smooth.

D. Filter Fabric: Position geosynthetic smooth and wrinkle-free on prepared surface; unroll or unfold carefully; avoid stretching.
   1. Wrap around crushed stone and utility assembly; overlap seams.
   2. See Section 31 05 19 for additional requirements.

E. Concrete: Place in accordance with ACI PRC-304.

F. Inspect utility for damage from falling rock. Repair or replace damaged utility.

3.07 FLOWABLE FILL

A. Completely cover utilities in accordance with NRMCA CLSM.
   1. Fill trench to indicated elevation.

3.08 PREPARATION FOR UTILITY PLACEMENT

A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.09 BACKFILL AND COMPACTION

A. Backfill to contours and elevations indicated on drawings using unfrozen materials.

B. Fill to subgrade elevations unless otherwise indicated on drawings.

C. Employ placement method that does not disturb or damage other work.

D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen, or spongy subgrade surfaces.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. General Fill: Place and compact materials in equal continuous layers not exceeding 8 inches (200 mm) compacted depth.

G. Granular Fill: Place and compact material in equal continuous layers not exceeding 6 inches (150 mm) compacted depth.

H. Slope grade away from building minimum 2 inches in 10 feet (50 mm in 3 m), unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

I. Correct areas that are over-excavated.
   1. Thrust-Bearing Surfaces: Fill with concrete.
   2. Other areas: Use general fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.

J. Compaction Density Unless Otherwise Specified or Indicated:
   1. Under paving, slabs-on-grade, and similar construction: 97 percent of maximum dry density.
   2. At Other Locations: 95 percent of maximum dry density.

K. Reshape and re-compact fills subjected to vehicular traffic.

L. Underground Warning Tape:
   1. Install 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe if required by the owner.

M. Buried Detection Wire: Install 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe, if required by the owner.

3.10 BEDDING AND FILL AT SPECIFIC LOCATIONS

A. Utility Piping, Conduits, and Duct Bank:

B. At Pipe Culverts:

C. Over Subdrainage Piping at Foundation Perimeter:

D. At French Drains:

3.11 TOLERANCES

A. Maximum Variation from Top Surface of General Backfilling: Plus or minus 1 inch (25 mm) from required elevations.

B. Maximum Variation from Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch (25 mm) from required elevations.

3.12 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for general requirements for field inspection and testing.

B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, or ASTM D6938.

C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 modified proctor, AASHTO T 180, or ASTM D698 standard proctor.

D. Nonconforming Work: For failed tests, remove work, replace, and retest.

E. Frequency of Tests: As directed by the Geotechnical Engineer.

3.13 CLEANING

A. Stockpile excavated material re-used in area designated on-site; see Section 31 22 00.

B. Remove excavated material that is not required or unsuitable for re-use from site.

C. Remove excess excavated material from site.

3.14 PROTECTION

A. Divert surface water away from excavations.

B. Keep excavations free of standing water.

C. Maintain stability of banks and loose soils; prevent from falling into excavations.

D. Maintain excavations in neat and square, undisturbed condition.

END OF SECTION

TRENCH EXCAVATION PROTECTION

PART I - GENERAL

1.01 SECTION INCLUDES:

A. Trench Excavation Protection required for the construction of all trench excavation protection systems to be utilized in the project and including all additional excavation and backfill necessitated by the protection and backfill necessitated by the protection system.

1.02 MEASUREMENT AND PAYMENT

A. Trench Excavation Protection is to be included in the cost of installation of trenched underground utilities.

1.03 RELATED SECTIONS

A. Trench Excavation Protection shall be accomplished as required by the provisions of Part 1926, Subpart P - Excavations, Trenching, and Shoring of the Occupational Safety and Health Administration Standards and Interpretations.

B. A copy of the Document is available for review at the office of the Engineer. It shall be construed that this document is included in this Project Manual and shall apply to every Section as if written in full therein.

PART 2 - PRODUCTS -- NOT USED

PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS

A. Trench Excavation Protection shall be accomplished as required by the provisions of, Part 1926, Subpart P - Excavations, Trenching, and Shoring of the Occupational Safety and Health Administration Standards and Interpretations.

END OF SECTION

FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Filling, backfilling, and compacting for building volume below grade, footings, slabs-on-grade, paving, and site structures.

B. Backfilling and compacting for utilities outside the building to utility main connections.

C. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

D. Lightweight concrete fill.

1.02 RELATED REQUIREMENTS

A. Geotechnical report; bore hole locations and findings of subsurface materials.

B. Section 01 57 13 - Temporary Erosion and Sediment Control: Slope protection and erosion control.

C. Section 31 05 19 - Geosynthetics for Earthwork.

D. Section 31 10 00 - Site Clearing.

E. Section 31 22 00 - Grading: Site grading.

F. Section 31 23 16 - Excavation: Removal and handling of soil to be re-used.

G. Section 31 23 16.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.

H. Section 31 23 16.26 - Rock Removal: Removal of rock during excavating.

I. Section 31 37 00 - Riprap.

J. Section 32 11 20 - Subbase and Aggregate Base Courses.

K. Section 33 41 00 - Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.

1.03 PRICE AND PAYMENT PROCEDURES

A. General Fill:
   1. Measurement Method: By the cubic yard (cubic meter).
   2. Includes: Excavating existing soil, stockpiling, scarifying substrate surface, placing where required, compacting, and dewatering.

B. Structural Fill:
   1. Measurement Method: By the cubic yard (cubic meter).
   2. Includes: Excavating existing soil, stockpiling, scarifying substrate surface, placing where required, compacting, and dewatering.

C. Granular Fill:
   1. Measurement Method: By the cubic yard (cubic meter).
   2. Includes: Excavating existing material, stockpiling, scarifying substrate surface, placing where required, compacting, and dewatering.

D. Aggregates:
   1. Measurement Method: By the cubic yard (cubic meter).
   2. Includes: Excavating existing material, stockpiling, scarifying substrate surface, placing where required, compacting, and dewatering.

E. Lightweight Concrete Fill:
   1. Measure completed lightweight concrete fill work in place. Do not count wasted material towards total.
   2. Measurement Method: By the cubic yard (cubic meter).

3. Includes: Excavating existing material, supplying lightweight concrete fill, scarifying substrate surface, placing lightweight concrete fill where required, compacting other fill adjacent to lightweight concrete, and dewatering.

1.04 DEFINITIONS

A. Finish Grade Elevations: Indicated on drawings.

B. Subgrade Elevations: 4 inches (100 mm) below finish grade elevations indicated on drawings, unless otherwise indicated.

1.05 REFERENCE STANDARDS

A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil–Aggregate Subbase, Base, and Surface Courses; 2017 (Reapproved 2021).

B. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop; 2025.

C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2025.

D. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

E. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.

F. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012 (Reapproved 2021).

G. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2024.

H. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)); 2012 (Reapproved 2021).

I. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2015.

J. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2017 (Reapproved 2025).

K. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2017, with Editorial Revision (2018).

L. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2023.

1.06 SUBMITTALS

A. Product Data for Manufactured Fill.

B. Soil Samples: 10 pounds (4.5 kg) sample of each type of fill; submit in air-tight containers to testing laboratory.

C. Materials Sources: Submit name of imported materials source.

D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

E. Compaction Density Test Reports.

F. Lightweight Concrete Test Reports.

G. Manufacturer's Instructions.

H. Testing Agency Qualification Statement.

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

B. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. When necessary, store materials on site in advance of need.

B. When fill materials need to be stored on site, locate stockpiles where designated.
   1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
   2. Prevent contamination.
   3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. General Fill: Complying with State of TX Highway Department standard.

B. General Fill: Subsoil excavated on-site.
   1. Graded.
   2. Free of lumps larger than 3 inches (75 mm), rocks larger than 2 inches (50 mm), and debris.
   3. Complying with ASTM D2487 Group Symbol CL.

C. Structural Fill: Complying with State of TX Highway Department standard.

D. Structural Fill: Subsoil excavated on-site.
   1. Graded.
   2. Free of lumps larger than 3 inches (75 mm), rocks larger than 2 inches (50 mm), and debris.
   3. Complying with ASTM D2487 Group Symbol CL.

E. Concrete for Fill: Lean concrete, compressive strength of 2,500 psi.

F. Granular Fill: Coarse aggregate, complying with State of TX Highway Department standard.

G. Granular Fill - Gravel : Pit run washed stone; free of shale, clay, friable material and debris.
   1. Graded in accordance with ASTM D2487 Group Symbol GW.

H. Granular Fill - Pea Gravel: Natural stone; washed, free of clay, shale, organic matter.
   1. Grade in accordance with ASTM D2487 Group Symbol GM.

I. Sand: Complying with State of TX Highway Department standard.

J. Sand: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter.
   1. Grade in accordance with ASTM D2487 Group Symbol SW.

K. Engineered Fill - Lightweight Concrete:
   1. Materials:
      a. Cement: ASTM C150/C150M.
      b. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.
      c. Expansion Material: Manufacturer's recommended expansion material.
      d. Mix Design: By manufacturer.

2.02 ACCESSORIES

A. Geotextile: See Section 31 05 19.

2.03 SOURCE QUALITY CONTROL

A. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.

B. If tests indicate materials do not meet specified requirements, change material and retest.

C. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the Work are as indicated.

B. Identify required lines, levels, contours, and datum locations.

C. See Section 31 22 00 for additional requirements.

D. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.

E. Verify structural ability of unsupported walls to support imposed loads by the fill.

F. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.

G. Verify areas to be filled are not compromised with surface or ground water.

3.02 PREPARATION

A. Scarify and proof roll subgrade surface to a depth of 6 inches (150 mm) to identify soft spots.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

A. Place fill in compacted lifts in accordance to the Geotechnical Report

B. Fill to contours and elevations indicated using unfrozen materials.

C. Fill up to subgrade elevations unless otherwise indicated.

D. Employ a placement method that does not disturb or damage other work.

E. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

F. Maintain optimum moisture content of fill materials to attain required compaction density.

G. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches (150 mm) compacted depth.

H. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches (200 mm) compacted depth.

I. Slope grade away from building minimum 2 inches in 10 feet (50 mm in 3 m), unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

J. Correct areas that are over-excavated.
   1. Load-bearing foundation surfaces: Use structural fill, flush to required elevation, compacted to 97 percent of maximum dry density.
   2. Other areas: Use general fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.

K. Compaction Density Unless Otherwise Specified or Indicated in the Geotechnical Report:
   1. Under paving, slabs-on-grade, and similar construction: 97 percent of maximum dry density.
   2. At other locations: 95 percent of maximum dry density.

L. Reshape and re-compact fills subjected to vehicular traffic.

M. Maintain temporary means and methods, as required, to remove all water while fill is being placed as required, or until directed by the Engineer. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.04 ENGINEERED FILL - LIGHTWEIGHT CONCRETE

A. Install lightweight concrete fill according to manufacturer's written instructions.

B. Use batching, mixing, and placing equipment approved by the manufacturer.

C. Prevent segregation of material.

D. Tolerance: Finished surface within 2 inches (50 mm) of elevation indicated on drawings.

3.05 FILL AT SPECIFIC LOCATIONS

A. Comply with the Geotechnical Report. If not otherwise indicated in the Geotechnical Report use general fill.

B. Structural Fill at buildings:
   1. Use structural fill.
   2. Fill up to subgrade elevations.
   3. Maximum depth per lift: 6 inches (150 mm), compacted.
   4. Compact to minimum 97 percent of maximum dry density.

C. Over Subdrainage Piping at Foundation Perimeter:
   1. Drainage fill and geotextile: Section 31 05 19.
   2. Cover drainage fill with general fill.
   3. Fill up to subgrade elevation.
   4. Compact to 95 percent of maximum dry density.

D. Over Buried Utility Piping, Conduits, and Duct Bank in Trenches:
   1. Bedding: Use granular fill.
   2. Cover with general fill.
   3. Fill up to subgrade elevation.
   4. Compact in maximum 8 inch (200 mm) lifts to 95 percent of maximum dry density.

E. At Landscape Areas:
   1. Use general fill.
   2. Fill up to 4 inches (100 mm) below finish grade elevations.
   3. Fill up to subgrade elevations.
   4. Compact to 95 percent of maximum dry density.

F. At French Drains:
   1. Use granular fill.
   2. Compact to 95 percent of maximum dry density.

3.06 TOLERANCES

A. Top Surface of General Filling: Plus or minus 1 inch (25 mm) from required elevations.

B. Top Surface of Filling Under Paved Areas: Plus or minus 1/2 inch (12 mm) from required elevations.

3.07 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.

B. Soil Fill Materials:
   1. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, or ASTM D6938.
   2. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor"), ASTM D1557 ("modified Proctor"), or AASHTO T 180.
   3. If tests indicate work does not meet specified requirements, remove work, replace and retest.
   4. Frequency of Tests: As recommended by the Geotechnical Engineer.
   5. Proof roll compacted fill at surfaces that will be under slabs-on-grade, pavers, and paving.

C. Engineered Fill - Lightweight Concrete:

1. Testing: Provide third-party testing of samples in accordance with ASTM C796/C796M except do not oven-dry load-test specimens.

3.08 CLEANING

A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

EROSION AND SEDIMENTATION CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Permanent erosion and sediment control.

1.02 RELATED REQUIREMENTS

A. Section 31 05 19 - Geosynthetics for Earthwork: Geotextiles, geogrids, fabrics, reinforcement mats, and other synthetic materials for erosion control.

B. Section 31 23 23 - Fill: Filling and compaction.

C. Section 31 37 00 - Riprap: Stabilization using riprap.

D. Section 32 11 23 - Aggregate Base Courses: Aggregate base course.

1.03 PRICE AND PAYMENT PROCEDURES

A. Topsoil:
   1. Basis of Measurement: By the cubic yard (meter).
   2. Basis of Payment: Includes topsoil, placing topsoil.

B. Grassed Areas:
   1. Basis of Measurement: By the square yard (meter).
   2. Basis of Payment: Includes preparation of subsoil, placing topsoil, seeding, watering and maintenance to specified time limit.

1.04 REFERENCE STANDARDS

A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil–Aggregate Subbase, Base, and Surface Courses; 2017 (Reapproved 2021).

B. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2017, with Editorial Revision (2018).

C. ASTM D8298/D8298M - Standard Test Method for Determination of Erosion Control Products (ECP) Performance in Protecting Slopes from Continuous Rainfall-Induced Erosion Using a Tilted Bed Slope; 2020.

D. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.

E. FHWA FLP-94-005 - Best Management Practices for Erosion and Sediment Control; 1995.

1.05 SUBMITTALS

A. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

B. Maintenance Instructions: Provide instructions covering inspection and maintenance for preventive measures that must remain after Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with requirements of EPA (NPDES) for erosion and sedimentation control, as specified by the NPDES, and in compliance with requirements of Construction General Permit (CGP).

B. Comply with requirements of State of TX TPDES.

C. Comply with requirements of the local jurisdiction for erosion and sedimentation control.

D. Best Management Practices Standard: FHWA FLP-94-005.

2.02 MATERIALS

A. High Performance - Flexible Growth Medium (HP-FGM):
   1. Physical Properties:

a. Water Holding Capacity: Greater than or equal to 1,700 percent when tested in accordance with ASTM D7367.
b. Material Color: Green.
c. Cure Time: Zero to 2 hours.
d. Functional Longevity: Less than or equal to 18 months when tested in accordance with ASTM D5338.
e. Cover Factor: Less than or equal to 0.01 when tested in accordance with ASTM D8298/D8298M.
f. Application Rate: 3,500 lb per acre (3900 kg per hectare).
g. Seed Germination and Vegetation Enhancement: Greater than or equal to 100 percent when tested in accordance with ASTM D7322/D7322M.

B. Bonded Fiber Matrix (BFM):
1. Physical Properties:
a. Water Holding Capacity: Greater than or equal to 1,200 percent when tested in accordance with ASTM D7367.
b. Material Color: Green.
c. Cure Time: 4 to 24 hours.
d. Functional Longevity: Observed, less than or equal to 6 months.
e. Cover Factor: Less than or equal to 0.05 when tested in accordance with ASTM D8298/D8298M.
f. Application Rate: 3,500 lb per acre (3900 kg per hectare).

C. Engineered Fiber Matrix (EFM):
1. Physical Properties:
a. Water Holding Capacity: Greater than or equal to 1,400 percent when tested in accordance with ASTM D7367.
b. Material Color: Green.
c. Cure Time: 4 to 24 hours.
d. Functional Longevity: Less than or equal to 12 months when tested in accordance with ASTM D5338.
e. Cover Factor: Less than or equal to 0.05 when tested in accordance with ASTM D8298/D8298M.
f. Application Rate: 3,500 lb per acre (3900 kg per hectare).

2.03 ACCESSORY MATERIALS

A. Fill Material: Soil, concrete, granular fill, sand, crushed stone, or waste materials used to raise an existing grade, acceptable to authorities having jurisdiction, and in compliance with specified performance requirements. See Section 31 23 23.

B. Geotextiles: Permeable, synthetic fabric used to stabilize loose soil and prevent erosion. See Section 31 05 19.

C. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.

D. Grass Seed for Permanent Cover: Mixture of grass seeds compatible with soil composition in the locality of the work.

E. Sod for Permanent Cover: Cultivated grass sod, type as indicated; with strong fibrous root system, free of stones, burned or bare spots.

F. Plants for Permanent Cover: Specie and sizes identified in plant schedule, grown in climatic conditions similar to those in locality of the work.

G. Crushed Stone and Gravel: See Section 32 11 23 for aggregate.

H. Riprap: Limestone type; broken stone; solid and nonfriable; 6-inch (150 mm) minimum size, 12-inch (300 mm) maximum size. See Section 31 37 00.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

B. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish documentation required to obtain applicable permits.
   1. Obtain and pay for permits and provide security required by authority having jurisdiction.
   2. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.

C. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.

3.03 FIELD QUALITY CONTROL

A. Testing is not required if recent tests are available for imported topsoil. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.

3.04 INSTALLATION

A. Hydroseeding: Apply seeded slurry with a hydraulic seeder at a rate of 300 lbs per acre (136 kg per hectare) evenly in two intersecting directions.

B. Do not seed areas in excess of that which can be mulched on same day.

C. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches (100 mm) of soil.

D. Following germination, immediately reseed areas without germinated seeds that are larger than 36 inches (900 mm).

3.05 PROTECTION

A. Cover seeded slopes where grade is 6 inches per foot (150 mm per m) or greater with geotextile fabric. Roll fabric onto slopes without stretching or pulling.

B. Lay fabric smoothly on surface, bury top end of each section in 6-inch (150 mm) deep excavated topsoil trench. Provide 12-inch (300 mm) overlap of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil.

C. Secure outside edges and overlaps at 36-inch (900 mm) intervals with stakes.

D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches (150 mm).

3.06 MAINTENANCE

A. Maintain seeded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.

B. Immediately reseed areas that show bare spots.

C. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches (13 mm) or more rainfall at the project site, and daily during prolonged rainfall.

D. Repair deficiencies immediately.

E. Place sediment in appropriate locations on site; do not remove from site.

3.07 CLEAN UP

A. Clean out sediment control structures that are to remain as permanent measures.

END OF SECTION

LIME SOIL STABILIZATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavating, treatment, and placement of lime treated subsoil mix.

1.02 RELATED REQUIREMENTS

A. Section 31 23 16 - Excavation: General site and building excavation.

B. Section 31 23 16.13 - Trenching: Backfilling of utility trenches.

C. Section 31 23 16.26 - Rock Removal.

D. Section 31 23 23 - Fill: General site and building backfilling.

E. Section 31 23 23 - Fill: Soil and aggregate materials.

1.03 PRICE AND PAYMENT PROCEDURES

A. Measurement Method: By the square yard (square meter) of lime/subsoil mix, based on a lime/soil mix ratio determined by the geotchnical engineer. Includes supplying ingredient materials, scarifying substrate surface, mixing and placing where required, compacting and curing.

1.04 REFERENCE STANDARDS

A. AASHTO M 216 - Standard Specification for Quicklime and Hydrated Lime for Soil Stabilization; 2022.

B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012 (Reapproved 2021).

C. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2024.

D. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)); 2012 (Reapproved 2021).

E. NLA Bull 326 - Lime-Treated Soil Construction Manual: Lime Stabilization & Lime Modification; 2004.

1.05 SUBMITTALS

A. Submit mix design and materials mix ratio that will achieve specified requirements.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with State of TX Highways standards.

1.07 FIELD CONDITIONS

A. Do not install mixed materials in wind in excess of 10 mph (16 k/h) or when temperature is below 40 degrees F (5 degrees C).

PART 2 PRODUCTS

2.01 MIX MATERIALS

A. Subsoil: General fill specified in Section 31 23 23.

B. Lime: AASHTO M 216 hydrated lime.

2.02 EQUIPMENT

A. Equipment: Capable of excavating subsoil, mixing and placing materials, wetting, consolidation, and compaction of material.

2.03 LIME/SOIL MIX

A. Mix subsoil, lime, sand and aggregate in accordance with Geotechnical Report. Quantity of lime is not to exceed 10 percent of dry mixed materials by volume.

B. Carefully add water to the mix to achieve a consistent mixture without lumping yet not create a wet plastic consistency.

C. Obtain approval of the mixby the Geotechnical Engineer before proceeding with placement.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not place fill over frozen or spongy subgrade surfaces.

3.02 EXCAVATION

A. Protect adjacent structures from damage by this work.

B. Excavate subsoil to depth indicated.

C. Proof roll subgrade to identify soft areas; excavate those areas.

D. Do not excavate within normal 45 degree bearing splay of any foundation.

E. Notify Geotechnical Engineer of unexpected subsurface conditions. Discontinue affected Work in area until notified to resume work.

F. Stockpile excavated material in area designated on site; remove excess material not being reused from site.

3.03 SOIL TREATMENT AND BACKFILLING

A. Site mix subsoil, backfill and compact. Blend treated subsoil mix to achieve mix formulation and required stabilization.

B. Place mix material in continuous layers not exceeding 12 inches (300 mm) depth.

C. Maintain optimum moisture content of mix materials to attain required stabilization.

D. Do not exceed 60 minutes in placing adjacent mixed material.

E. Commence compaction of mix no later than 60 minutes after placement.

F. Compact to 95 percent of maximum density determined in accordance with ASTM D698; test in-place density in accordance with ASTM D1556/D1556M.

G. Slope grade away from building minimum 2 inches in 10 ft (150 mm in 3 m), unless noted otherwise.

H. Shape to required line, grade, and cross section.

I. Make grade changes gradual. Blend slope into level areas.

J. At end of day, terminate completed Work by forming a straight and vertical construction joint.

K. Replace damaged fill with new mix to full depth of original mix.

L. Remove surplus mix materials from site.

3.04 TOLERANCES

A. Top Surface of Fill: Plus or minus one inch (25 mm) from required elevations.

3.05 FIELD QUALITY CONTROL

A. Compression test and analysis of hardened fill material will be performed in accordance with ASTM D698.

B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.

END OF SECTION

RIPRAP

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General riprap.

B. Nonmachined riprap.

C. Riprap bedding.

D. Geotextile filter fabric.

1.02 RELATED REQUIREMENTS

A. Section 31 05 19 - Geosynthetics for Earthwork.

B. Section 31 23 16 - Excavation.

C. Section 31 23 23 - Fill.

1.03 PRICE AND PAYMENT PROCEDURES

A. Unit Prices:
   1. See Section 01 22 00 - Unit Prices for additional requirements.
   2. Basis of Measurement for Riprap: By square yard (meter) of riprap lift areas, of riprap blocks. Includes supply and placing riprap mix in sacks, moist-cured.
   3. Basis of Payment for Riprap: Include purchase, delivery, and installation.

1.04 REFERENCE STANDARDS

A. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 2022.

B. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a (Reapproved 2023).

C. ASTM D4833/D4833M - Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products; 2007 (Reapproved 2020).

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data:
   1. Manufacturer's data for weight, bag type, and approximate dimensions.
   2. Manufacturer's data on each geosynthetic product used, including physical properties and seaming materials.

PART 2 PRODUCTS

2.01 GENERAL RIPRAP

A. Riprap: Limestone type; broken stone; solid and nonfriable; 6 inch (150 mm) minimum, 12 inch (300 mm) maximum.

2.02 NONMACHINED RIPRAP

A. Solid and nonfriable; broken stone; limestone type.

B. Mean Particle Size: 6 inches (152 mm):
   1. Percent Smaller by Weight:
      a. 12 inch (305 mm): 70 to 100 percent.
      b. 9 inch (230 mm): 50 to 70 percent.
      c. 6 inch (152 mm): 35 to 50 percent.
      d. 2 inch (51 mm): 2 to 10 percent.

2.03 GEOTEXTILE FILTER FABRIC

A. See Section 31 05 19.

B. Woven polyester material, capable of passing surface water and providing material separation.
   1. Grab Strength: 300 pound (1.3 kN) minimum, when tested in accordance with ASTM D4632/D4632M.
   2. Puncture Strength: 450 pound (2.0 kN) minimum, when tested in accordance with ASTM D4833/D4833M.
   3. Permittivity: 0.12 per second minimum, when tested in accordance with ASTM D4491/D4491M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify survey benchmarks and intended elevations for work are as indicated on plans.

B. Identify required lines, levels, contours, and datum locations.

C. Verify riprap areas are uncompromised with surface or groundwater.

D. Do not place riprap over frozen or spongy subgrade surfaces.

3.02 PREPARATION

A. Grade riprap areas to indicated elevations, allowing for riprap thickness. Remove organic materials and compact.

B. See Section 31 23 23 for subgrade fill.

C. See Section 31 23 16 for excavation.

3.03 PLACEMENT

A. Perform work in accordance with State of TX Highway standard.

B. Place in full course lifts starting at slope base and working uphill.

C. Installed Thickness: 12 inches (300 mm), average.

3.04 BEDDING OR SUBSTRATE CONTACT INSTALLATION

A. Geotextile Filter Fabric Placement:
   1. See Section 31 05 19.
   2. Install in accordance with manufacturer's recommendations.
   3. Place over substrate in direction of water flow.
   4. Edges:
      a. Overlapped 2 feet (610 mm), minimum.
      b. Field sewn at 80 percent fabric strength, minimum.
   5. Secure fabric to prevent movement.
   6. Repair or replace fabric damaged during installation.

B. Riprap Bedding Placement:
   1. See Section 31 23 23.
   2. Spread uniformly to 12-inch (31 cm) depth.
   3. Smooth surface and remove mounds, dips, and windrows.
   4. Place bedding in manner to prevent damage to geotextile. Repair damages created by bedding placement.

C. Nonmachine Riprap Placement:
   1. Place in full course lifts starting at slope base and working uphill.
   2. Place with homogeneous sizing; interlock larger stones and fill with smaller ones.
   3. Prevent clusters of smaller stones.
   4. Lay flat stones on edges.
   5. Installed Thickness: 12 inches (300 mm), average.
   6. Place riprap without causing bedding disturbances. Correct bedding complying with drawings.

3.05 GEOTEXTILE OR BEDDING CONTACT INSTALLATION

A. Geotextile Filter Fabric Placement:
   1. See Section 31 05 19.
   2. Install in accordance with manufacturer's recommendations.
   3. Place over substrate in direction of water flow.
   4. Edges:
      a. Overlapped 2 feet (610 mm), minimum.
      b. Field sewn at 80 percent fabric strength, minimum.
   5. Secure fabric to prevent movement.
   6. Place geotextile in manner to prevent disruptions to bedding. Correct disruptions created by geotextile placement.
   7. Repair or replace fabric damaged during installation.

END OF SECTION

SUBBASE AND AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Subbase course.

B. Geosynthetic reinforcement.

C. Aggregate base course.

1.02 RELATED REQUIREMENTS

A. Project Geotechnical Report

B. Section 31 05 19 - Geosynthetics for Earthwork.

C. Section 31 22 00 - Grading.

D. Section 31 23 16.13 - Trenching.

E. Section 31 23 23 - Fill.

F. Section 32 13 13 - Concrete Paving.

G. Section 32 16 23 - Sidewalks.

1.03 PRICE AND PAYMENT PROCEDURES

A. Unit Prices:

1. Basis of Measurement for Subbase Course: By cubic yard (cubic meter).
2. Basis of Measurement for Geosynthetic Reinforcement: By square foot (square meter).
3. Basis of Measurement for Aggregate Base Course: By cubic yard (cubic meter).

1.04 REFERENCE STANDARDS

A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil–Aggregate Subbase, Base, and Surface Courses; 2017 (Reapproved 2021).

B. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop; 2025.

C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2025.

D. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012 (Reapproved 2021).

E. ASTM D1241 - Standard Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses; 2015.

F. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2024.

G. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)); 2012 (Reapproved 2021).

H. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2015.

I. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2017 (Reapproved 2025).

J. ASTM D3665 - Standard Practice for Random Sampling of Construction Materials; 2024.

K. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2017, with Editorial Revision (2018).

L. ASTM D5397 - Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test; 2020.

M. ASTM D6693/D6693M - Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes; 2020.

N. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2023.

1.05 SUBMITTALS

A. Product Data: Geogrid indicating tensile strength.

B. Test Reports:
   1. Aggregate Composition: Results of laboratory tests on proposed and actual materials used.
   2. Compaction Density: Results of laboratory tests on compacted course.

C. Manufacturer's Instructions: Indicate geosynthetic installation procedure.

D. Source Quality Control Submittals: Submit name of imported materials source.

E. Field Quality Control Submittals: Submit compaction density testing results.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience.

B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

C. Documents at Project Site: Maintain at project site one copy of manufacturer's instructions.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver geosynthetic to project site wrapped in protective covering, maintain prior to use.

B. Aggregate Storage: Prevent material intermixing, contamination, and deterioration.

PART 2 PRODUCTS

2.01 MATERIALS

A. Subbase Course: As indicated in the Geotechnical Report

B. Geosynthetic:
   1. Geotextile: See Section 31 05 19.
   2. Geotextile: Nonbiodegradable, woven.

C. Aggregate Base Course: As indicated in the Geotechnical Report and Design Drawings.
   1. If not otherwise indicated, then: Type A, Grade 1 or 2, Item 247:Comply with State of TX Highway Department standard.

2.02 SOURCE QUALITY CONTROL

A. If tests indicate materials do not meet specified requirements, change material and retest.

B. Provide materials of each type from same source throughout the Work.

C. For aggregate materials using classification complying with ASTM D2487, provide testing before delivery to site.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the work are as indicated.

B. Verify substrate has been inspected, and gradients and elevations are correct and dry.

3.02 PREPARATION

A. Prepare the site as indicated in the Geotechnical Report.

B. If not otherwise indicated then, proof roll subgrade to identify soft spots.

C. Correct irregularities in subgrade gradient and elevation by scarifying, reshaping, and recompacting.

D. Moisture condition subgrade by scarifying a minimum of 6 inches and recompacting to a minimum 95% of the maximum density, +-3%, determined by TxDOT Compaction Test, TxDOT Tex-114-E.

E. Do not place aggregate on soft, muddy, or frozen surfaces.

F. Grade excavated and filled substrate; see Section 31 22 00.

G. Backfill and compact trench excavations; see Section 31 23 16.13.

H. Backfill and compact subgrade fill; see Section 31 23 23.

I. Verify subgrade has been inspected, gradients and elevations are correct.

3.03 PLACEMENT

A. Under Bituminous Concrete Paving:
   1. Subbase Compacted Thickness: According to design drawings and Geotechnical Report.
   2. If required, install geosynthetic reinforcement on substrate in accordance with manufacturer's instructions.
   3. Aggregate Base Compacted Thickness: According to design drawings and Geotechnical Report; otherwise, a maximum of 8 inches.
   4. Compaction as indicated in the Geotechnical Report; otherwise, to 95 percent of maximum dry density in accordance with ASTM D 1557 at a moisture content ranging from -2 to +3 percent of the optimum moisture content..

B. Under Portland Cement Concrete Paving:
   1. Subbase Compacted Thickness: According to design drawings and Geotechnical Report.
   2. If required, install geosynthetic reinforcement on substrate in accordance with manufacturer's instructions.
   3. Aggregate Base Compacted Thickness: According to design drawings and Geotechnical Report; otherwise, a maximum of 8 inches.
   4. Compaction as indicated in the Geotechnical Report; otherwise, to 95 percent of maximum dry density in accordance with ASTM D 1557 at a moisture content ranging from -2 to +3 percent of the optimum moisture content.

C. Under Unit Pavers:
   1. Subbase Compacted Thickness: According to design drawings.
   2. Install geosynthetic reinforcement on substrate in accordance with manufacturers instructions.
   3. Aggregate Base Compacted Thickness: According to design drawings.
   4. Compact to 95 percent of maximum dry density.

D. Place course in maximum 8 inch (203 mm) layers and roller compact to specified density.

E. Level and contour surfaces to elevations and gradients indicated.

F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.04 TOLERANCES

A. Variation From Design Elevation: Within 1/4 inch (6.4 mm).

B. Flatness: Maximum variation of 1/4 inch (6.4 mm) measured with 10 foot (3 m) straight edge.

C. Scheduled Compacted Thickness: Within 1/4 inch (6.4 mm).

3.05 FIELD QUALITY CONTROL

A. Subbase Compaction Density Testing: In accordance with ASTM D1556/D1556M, ASTM D2167, or ASTM D6938.

B. Aggregate Base Compaction Density Testing: In accordance with ASTM D1556/D1556M, ASTM D2167, or ASTM D6938.

C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with AASHTO T 180, ASTM D698 ("standard Proctor"), or ASTM D1557 ("modified Proctor").

D. Frequency of Tests: In accordance with ASTM D3665.

E. Remove, replace, and retest work that does not meet specified requirements.

F. Proof roll compacted aggregate at surfaces going underneath flexible paving.

3.06 CLEANING

A. Stockpile unused materials neat and compact.

B. Remove unused materials and grade areas to prevent standing surface water.

END OF SECTION

ASPHALT PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aggregate base course.

B. Single course bituminous concrete paving.

C. Double course bituminous concrete paving.

D. Surface sealer.

1.02 RELATED REQUIREMENTS

A. Project Geotechnical Report

B. Section 31 22 00 - Grading: Preparation of site for paving and base.

C. Section 31 23 23 - Fill: Compacted subgrade for paving.

D. Section 32 11 20 - Subbase and Aggregate Base Courses.

E. Section 32 17 13 - Parking Bumpers: Concrete bumpers.

F. Section 32 17 23 - Pavement Markings.

G. Section 33 05 61 - Concrete Manholes: Manholes, including frames; gutter drainage grilles, covers, and frames for placement by this section.

1.03 PRICE AND PAYMENT PROCEDURES

A. Asphalt Pavement Mix (Base Course): By the ton (metric ton). Includes preparing base, tack coating surfaces, placing, compacting and rolling, testing. Includes mix design, supplying to site, testing.

B. Asphalt Pavement Mix (Binder Course): By the ton (metric ton). Includes preparing base, tack coating surfaces, placing, compacting and rolling, testing. Includes mix design, supplying to site, testing.

C. Asphalt Pavement Mix (Wearing Course): By the ton (metric ton). Includes preparing base, tack coating surfaces, placing, compacting and rolling, testing. Includes mix design, supplying to site, testing.

D. Seal Coat: By the square yard (meter). Includes preparing surfaces and applying.

1.04 REFERENCE STANDARDS

A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil–Aggregate Subbase, Base, and Surface Courses; 2017 (Reapproved 2021).

B. AI MS-2 - Asphalt Mix Design Methods; 2015.

C. AI MS-19 - Basic Asphalt Emulsion Manual; 2008.

D. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2025.

E. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction; 2009a.

F. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2017 (Reapproved 2025).

G. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2017, with Editorial Revision (2018).

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with State of TX Highways standard.

B. Mixing Plant: Complying with State of TX Highways standard.

C. Obtain materials from same source throughout.

1.06 FIELD CONDITIONS

A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F (4 degrees C), or surface is wet or frozen.

B. Place bitumen mixture when temperature is not more than 15 F degrees (8 C degrees) below bitumen supplier's bill of lading and not more than maximum specified temperature.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with applicable code for paving work on public property.

2.02 MATERIALS

A. Asphalt Cement: ASTM D946.

B. Aggregate for Base Course: In accordance with State of TX Highways standards.

C. Aggregate for Binder Course: In accordance with State of TX Highways standards.

D. Aggregate for Wearing Course: In accordance with State of TX Highways standards.

E. Fine Aggregate: In accordance with State of TX Highways standards.

F. Tack Coat: Homogeneous, medium curing, liquid asphalt.

2.03 ASPHALT PAVING MIXES AND MIX DESIGN

A. Use dry material to avoid foaming. Mix uniformly.

B. Asphalt Base Course: 3.0 to 6 percent of asphalt cement by weight in mixture in accordance with AI MS-2.

C. Asphalt Binder Course: 4.5 to 6 percent of asphalt cement by weight in mixture in accordance with AI MS-2.

D. Asphalt Wearing Course: 5 to 7 percent of asphalt cement by weight in mixture in accordance with AI MS-2.

E. Submit proposed mix design of each class of mix for review prior to beginning of work.

2.04 SOURCE QUALITY CONTROL

A. Test mix design and samples in accordance with AI MS-2.

PART 3 EXECUTION

3.01 EXAMINATION

A. Proof roll the base coarse and remove and replace any soft materials.

B. Verify that compacted subgrade is dry and ready to support paving and imposed loads.

C. Verify gradients and elevations of base are correct.

D. Verify manhole frames, clean outs, and other utility access covers are installed in correct position and elevation.

3.02 AGGREGATE BASE COURSE

A. Place and compact aggregate base course.

B. See Section 32 11 20.

3.03 PREPARATION - PRIMER

A. Apply primer in accordance with manufacturer's instructions.

B. Apply primer on aggregate base or subbase at uniform rate of 1/3 gal/sq yd (1.5 L/sq m).

C. Use clean sand to blot excess primer.

3.04 PREPARATION - TACK COAT

A. Apply tack coat in accordance with manufacturer's instructions.

B. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 1/3 gal/sq yd (1.5 L/sq m).

C. Coat surfaces of manhole and catch basin frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.05 PLACING ASPHALT PAVEMENT - SINGLE COURSE

A. Install Work in accordance with State of TX Highways standards.

B. Place asphalt within 24 hours of applying primer or tack coat.

C. Install gutter drainage grilles and frames in correct position and elevation.

D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

E. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.06 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

A. Place asphalt binder course within 24 hours of applying primer or tack coat.

B. Place asphalt wearing course within two hours of placing and compacting binder course.

C. Install gutter drainage grilles and frames in correct position and elevation.

D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

E. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.07 SEAL COAT

A. Apply seal coat to asphalt surface course in accordance with AI MS-19.

3.08 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch (6 mm) measured with 10 foot (3 m) straight edge.

B. Compacted Thickness: Within 1/4 inch (6 mm) of specified or indicated thickness.

C. Variation from True Elevation: Within 1/4 inch (6 mm).

3.09 FIELD QUALITY CONTROL

A. Provide field inspection and testing. Take samples and perform tests in accordance with AI MS-2.

3.10 PROTECTION

A. Immediately after placement, protect pavement from mechanical injury for 2 days or until surface temperature is less than 140 degrees F (60 degrees C).

3.11 SCHEDULE

A. Pavement at Parking Areas: In accordance with the Geotechnical Report and design drawings; otherwise, two courses; binder course of 2-1/2 inch (63 mm) compacted thickness and wearing course of 1-1/2 inch compacted thickness..

END OF SECTION

CONCRETE CURBS AND GUTTERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Concrete curbs and gutters.

1.02 RELATED SECTIONS

A. Section 31 23 23 - Fill.

B. Section 32 11 20- Subbase and Aggregate Base Courses.

C. Section 32 13 13 - Concrete Paving

1.03 PRICE AND PAYMENT PROCEDURES

A. Concrete Curbs and Gutters: By the linear foot. Includes trenching, steel reinforcement, concrete curb installation, and cleaning.

1.04 REFERENCES

A. ASTM D 1190, Concrete Joint Sealer Hot Poured Elastic Type.

B. ASTM D 994-71 (R1977), Preformed Expansion Joint Filler For Concrete (Bituminous Type).

C. ASTM D 1751-73 (R1978) Preformed Expansion Joint Fillers for concrete Paving Structural Construction.

D. TxDOT, Item 529. "Concrete Curb, Gutter and Combined Curb and Gutter".

1.05 SUBMITTALS

A. Samples: Submit for review samples, applicable manufacturer's product data, test reports and material certifications.

B. Shop Drawings:
   1. Detailed Reinforcing Steel Layout.
   2. Detailed Construction And Control Joint Layout.

1.06 QUALITY ASSURANCE

A. The testing laboratory shall sample and test concrete in accordance with Section 32 13 13 - Concrete Paving.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Unless otherwise specified in this Section, all concrete and concrete materials shall conform to TxDOT, Item 529, "Concrete Curb, Gutter and Combined Curb and Gutter".

B. Bituminous Joint Filler: Bituminous type conforming to ASTM D 994 or D 1751 unless otherwise indicated on drawings.
   1. Reinforcing steel shall be ASTM A 615 grade 60, deformed and conform to the provisions of TxDOT Standard Specifications, Item No. 529, "Concrete Curb, Gutter and Combined Curb and Gutter".
   2. All reinforcing steel to be new billet steel.

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

A. Preparation of the subgrade including compaction shall be completed two feet (2') beyond the limits of the work:
   1. Where the subgrade is constructed by excavation of existing grade, the top six inches (6") of the subgrade shall be compacted to at least 95 percent of maximum density as determined by TxDOT TEX-113-E at a moisture content between optimum and optimum +4 percent unless otherwise indicated.
   2. The subgrade shall be brought to the final lines and grades utilizing select backfill.

3. Pit Run Sand or Granular Embedment:
    a. Pit run sand or granular embedment shall be provided as shown on drawings.
    b. The material shall be as specified in Section 31 23 23 and compacted as specified.

3.02 FORM CONSTRUCTION

A. Forms shall be in conformance with TxDOT Standard Specification, Item 529, "Concrete Curb, Gutter and Combined Curb and Gutter".

B. Set forms to line and grade. Install forms over full length of curbs, gutters and sidewalks.

3.03 REINFORCEMENT

A. Locate, place, and support reinforcement as specified in TxDOT Standard Specifications, Item 529, "Concrete Curb, Gutter and Combined Curb and Gutter" unless otherwise shown on drawings.

3.04 CONCRETE PLACEMENT

A. General: Comply with the requirements of TxDOT Standard Specifications, Item 529, "Concrete Curb, Gutter and Combined Curb and Gutter".

B. Machine Formed/Hand Formed:
    1. Automatic curb and gutter machine may be used in lieu of hand formed methods for forming and placing.
    2. Concrete shall have properties as previously specified, except that maximum slump shall be 2-1/2 inches (2 1/2") and air content shall be two percent (2%).
    3. Machine forming shall produce curbs, gutters and sidewalks to the required cross-section, lines, and grades, finish and jointing, as specified for conventionally formed concrete.
    4. Unacceptable work will be removed and replaced at Contractor's expense.

3.05 JOINTS

A. General:
    1. Construct expansion, contraction, and construction joints with faces perpendicular to surface of the curb, gutter and sidewalk.
    2. Construct transverse joints at right angles to the work centerline and as shown.

B. Control Joints:
    1. Provide these joints at ten feet (10') on centers for curbs and gutters.

C. Construction Joints
    1. Place joints at locations where placement operations are stopped for a period of more than 1/2 hour, except where such pours terminate at expansion joints.

D. Expansion Joints
    1. Provide 1/2 inch expansion joint filler where work abuts structures; at returns; and at 50-foot spacing for straight runs.
    2. Where gutter and sidewalk are not poured monolithically, provide expansion joints where each abuts the other.
    3. Place top of expansion joint filler not less than 1/2 inch or more than one inch (1") below concrete surface.
    4. Apply joint sealer on top of expansion joint material flush with concrete surface, and in accordance with manufacturer's instructions.

3.06 CONCRETE FINISHING

A. Smooth the exposed surface by screeding and floating.

B. Work edges of gutter and sidewalks, back top edge of curb, and transverse joints; and round to 1/4-inch radius.

C. Complete surface finishing by drawing a fine-hair broom across surface, perpendicular to line of traffic unless alternative finish is indicated on drawings.

3.07 CURING

A. Protect and cure finished concrete curbs, gutters and sidewalks, complying with applicable requirements of TxDOT Standard Specifications, Item 529, "Concrete Curb, Gutter and Combined Curb and Gutter".

3.08 REPAIR AND CLEANING

A. Broken or defective curb, gutters and sidewalks shall be repaired or replaced as directed by the Engineer at the Contractor's expense.

B. Sweep work and wash free of stains, discolorations, dirt or other foreign material.

END OF SECTION

SIDEWALKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete sidewalks.

B. Concrete wheelchair ramps.

1.02 RELATED REQUIREMENTS

A. Section 32 11 20 - Subbase and Aggregate Base Courses.

B. Section 32 13 13 - Concrete Paving.

C. Section 32 17 23 - Pavement Markings.

1.03 PRICE AND PAYMENT PROCEDURES

A. Provide concrete sidewalk paving by the unit price method.

B. Concrete for Sidewalks: Measurement by the square yard (sq m). Includes mix design, supplying to site, preparing base, placing, floating, finishing and verification.

C. Concrete for Wheelchair Ramps: Measurement by each. Includes mix design, supplying to site, preparing base, placing, floating, finishing and verification.

1.04 REFERENCE STANDARDS

A. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.

B. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.

C. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.

D. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.

F. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.

G. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2025.

1.05 SUBMITTALS

A. Product Data:
   1. Concrete: Provide data on admixtures.
   2. Paver: Provide data on joint filler.

B. Design Data: Indicate pavement thickness, design strength, reinforcement, and typical details.

C. Weather Data: Records during placement of asphalt or concrete, including date, location of placement, quantity, and air temperature.

1.06 FIELD CONDITIONS

A. Follow recommendations of ACI PRC-305 and ACI PRC-306 when concreting during hot and cold weather, respectively.

PART 2 PRODUCTS

2.01 CONCRETE SIDEWALKS AND WHEELCHAIR RAMPS

A. Gravel Subbase: Thickness as indicated on drawings.

B. Concrete Forms: Wood.

C. Concrete Materials: Comply with ASTM C94/C94M.

D. Aggregate: Pit Run, washed, 3/8 inch (1 cm) stone; free of shale, clay, friable material and debris.

E. Reinforcement:

1. Steel Welded Wire Reinforcement: ASTM A1064/A1064M, plain type, flat sheets, unfinished, 6" x 6" - W2.9 x W2.9 to be installed at the midpoint.
2. Steel rebar #3 bars @ 18" O.C.each way installed at midpoint.

F. Joint Filler: Preformed expansion, with a thickness of 1/2 inch (13 mm).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify gradients and elevations of the subgrade are correct as shown on drawings. Where poor subgrade material is encountered, remove and replace with suitable material.

B. Verify compacted subgrade is acceptable, ready to support imposed loads and paving, and ready to receive work.

3.02 SUBBASE PREPARATION

A. Maintain minimum 2" subgrade in a smooth, compacted condition with required section and established grade until concrete is placed.

B. See Section 32 11 20 for aggregate subbase.

3.03 CONCRETE SIDEWALK AND WHEELCHAIR RAMP INSTALLATION

A. Mixing:
1. Proportioning Normal Weight Concrete: Comply with ACI PRC-211.1 recommendations.

B. Forming:
1. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
2. Sidewalk Forms: Place and secure forms to location, dimension, profile, and gradient shown on drawings. Height equal to the full depth of the finished sidewalk.
3. Form sidewalk at maximum 2% cross-slope.
4. Wheelchair Ramps: Place and secure forms to location, dimension, profile, and gradient shown on drawings. Comply with ADA Standards.

C. Reinforcement:
1. Place wire-mesh or rebar reinforcement mid-height of forms.

D. Placement:
1. Place concrete in a single lift.
2. Consolidate concrete by tamping and spading.
3. Install work in accordance with local jurisdiction..

E. Joints:
1. Spacing: Provide control joints every 5 feet (1.5 m).
2. Spacing: Provide expansion joint every 50 feet (15.25 m)
3. Provide keyed joints as indicated.
4. Filler height equal to the full depth of the finished concrete.

F. Finishing:
1. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge, 1/4 inch radius (6 mm radius).
2. Wheelchair Ramps: Broomed perpendicular to slope.

G. Record weather information for placement.

3.04 TOLERANCES

A. Surface Flatness: 1/4 inch (6 mm), maximum, measured with 10 foot (3 m) straight edge.

B. Variation from True Position: 1/4 inch (6 mm), maximum.

C. Compacted Thickness: Within 1/4 inch (6 mm) of specified or indicated thickness.

D. Max sidewalk cross slope: 2%.

E. Maximum sidewalk longitudinal slope without ramps: less than 5 %.

3.05 PROTECTION

A. Immediately after placement, protect sidewalk from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Do not permit pedestrian traffic over sidewalk for 7 days minimum after finishing.

END OF SECTION

PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Painted pavement markings.

B. Raised pavement markings.

C. Plastic pavement markings.

1.02 RELATED REQUIREMENTS

A. Section 32 12 16 - Asphalt Paving.

B. Section 32 13 13 - Concrete Paving.

C. Section 32 16 23 - Sidewalks.

1.03 PRICE AND PAYMENT PROCEDURES

A. Unit Prices:

1. Basis of Measurement for Linear Painted or Plastic Pavement Markings: By linear foot (linear meter).
2. Basis of Measurement for Painted or Plastic Pavement Markings Symbols or Text: Per unit.
3. Basis of Measurement for Raised Pavement Markings: Per unit.

1.04 REFERENCE STANDARDS

A. AASHTO M 237 - Standard Specification for Epoxy Resin Adhesives for Bonding Traffic Markers to Hardened Portland Cement and Asphalt Concrete; 2005 (Reapproved 2019).

B. AASHTO M 247 - Standard Specification for Glass Beads Used in Pavement Markings; 2013 (Reapproved 2018).

C. AASHTO M 249 - Standard Specification for White and Yellow Reflective Thermoplastic Striping Material (Solid Form); 2012 (Reapproved 2020).

D. AASHTO MP 24 - Standard Specification for Waterborne White and Yellow Traffic Paints; 2015 (Reapproved 2020).

E. ASTM D4505 - Standard Specification for Preformed Retroreflective Pavement Marking Tape for Extended Service Life; 2012 (Reapproved 2017).

F. ASTM E303 - Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester; 2022.

G. DMS 8220 - Hot Applied Thermoplastic

H. DMS 8200 - Traffic Paint

I. DMS 8290 - Glass Traffic Beads

J. FHWA MUTCD - Manual on Uniform Traffic Control Devices; 2023.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work of this section with adjoining work.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by affected installers.

1.06 SUBMITTALS

A. Shop Drawings: Indicate survey control points and pavement markings.

B. Shop Drawings: Indicate traffic management plan with barricades, cones, and temporary markings.

C. Product Data: Manufacturer's data sheets on each product to be used.

D. Manufacturer's Instructions:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver paint in containers of at least 5 gallons (18 L) accompanied by batch certificate.

B. Deliver glass beads in containers suitable for handling and strong enough to prevent loss during shipment, accompanied by batch certificate.

C. Store products in manufacturer's unopened packaging until ready for installation.

D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.09 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F (10 degrees C) or more than 95 degrees F (35 degrees C).

1.10 SEQUENCING

A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of markings.

PART 2 PRODUCTS

2.01 PAINTED PAVEMENT MARKINGS

A. Comply with State of TX Highway Department standards.

B. Comply with FHWA MUTCD.

C. Painted Pavement Markings: As indicated on drawings.
   1. Marking Paint: In accordance with AASHTO MP 24.
      a. Parking Lots: Yellow unless otherwise indicated on the design drawings.
      b. Symbols and Text: White.
      c. Wheelchair Symbols: Provide blue and white.
   2. Reflective Glass Beads: Type 1, in accordance with AASHTO M 247.
   3. Obliterating Paint: Type I, in accordance with AASHTO MP 24.
      a. Bituminous Pavement: Black.
      b. Concrete Pavement: Gray.

2.02 RAISED PAVEMENT MARKINGS

A. Comply with State of TX Highway Department standards.

B. Comply with FHWA MUTCD.

C. Surface Reflectors: Bidirectional, visible to approaching traffic; capable of withstanding pavement-rated loading.
   1. Housing: Plastic, yellow.
   2. Lens: Prismatic, acrylic, yellow.
   3. Dimensions: 4 inches by 4 inches (102 mm by 102 mm).
   4. Mounting Adhesive: Type I, in accordance with AASHTO M 237.
   5. Pavement Projection: 1/2 inch (12 mm).

D. Delineator Posts: All-direction visibility, reboundable.

1. Upright:
    a. Material: Polypropylene.
    b. Height: 24 inches (610 mm).
    c. Width: 3 inches (76 mm).
    d. Color: Yellow.
    e. Reflective Bands: Two bands.
    f. Shape: Round.
2. Base:
    a. Material: Acrylonitrile butadiene styrene.
    b. Mounting Holes: 1/4 inch (6 mm).
3. Mounting Hardware: Stainless steel.
4. Mounting Adhesive: Type I, in accordance with AASHTO M 237.

2.03 PLASTIC PAVEMENT MARKINGS

A. Comply with State of TX Highway Department standards.

B. Comply with FHWA MUTCD.

C. Plastic Pavement Markings: Preformed, uniform, smooth edges.
1. Marking Tape: Vinyl, with retroreflective beads, in accordance with ASTM D4505.
    a. Class: Class 1, in accordance with ASTM D4505.
    b. Color: As indicated on the design drawings, otherwise Yellow.
    c. Retroreflectivity: Retroreflectivity II, in accordance with ASTM D4505.
    d. Skid Resistance: Level B, in accordance with ASTM E303.
    e. Thickness: 60 mils, 0.06 inch (1.5 mm).
    f. Width: 4 inches (102 mm).
    g. Primer: As recommended by manufacturer.
2. Thermoplastic Markings: Alkyd, in accordance with AASHTO M 249.
    a. Color: As indicated on the design drawings, otherwise Yellow.
    b. Reflective Glass Beads: Type 1, in accordance with AASHTO M 247.
    c. Existing-Pavement Primer: Asphalt, thermosetting adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Identify existing markings for removal.

B. Verification of Conditions: Verify that pavement is dry and ready for installation.

C. Notify Engineer of unsatisfactory conditions before proceeding.

3.02 PREPARATION

A. Establish survey control points for locating and dimensioning of markings.

B. Place barricades, warning signs, and flags as necessary to alert approaching traffic per the traffic control plan.

C. Clean surfaces prior to installation.
1. Remove dust, dirt, and other debris.
2. Remove rubber deposits, existing paint markings, and other coatings.

D. Apply paint stencils by type and color at necessary intervals.

3.03 INSTALLATION

A. General:
1. Position pavement markings as indicated on drawings.
2. Field location adjustments require approval of Engineer.
3. Allow traffic movement without hindrance.

B. Painted Pavement Markings:
1. Apply in accordance with manufacturer's instructions.

2. Apply in accordance with State of TX Highway Department standards.
3. Apply in accordance with FHWA MUTCD standards.
4. Obliterating Paint: Apply as necessary to cover existing markings completely.
5. Marking Paint: Apply uniformly, with sharp edges.
    a. Applications: Two coat.
    b. Wet Film Thickness: 0.015 inch (0.4 mm), minimum.
    c. Stencils: Lay flat against pavement, align with striping, remove after application.
    d. Glass Beads: Apply directly to paint, 10 second lag time, 6 lbs/gal (720 g/L) of paint, uniform thickness and coverage.
    e. Length Tolerance: Plus or minus 3 inches (75 mm).
    f. Width Tolerance: Plus or minus 1/8 inch (3 mm).

C. Raised Pavement Markings:
1. Install in accordance with manufacturer's instructions in manner necessary to maintain manufacturer's warranty.
2. Install in accordance with State of TX Highway Department standards.
3. Install in accordance with FHWA MUTCD standards.
4. Surface Reflectors:
    a. Cut pavement and remove depth equal to height of reflector.
    b. Partially fill area with road marker epoxy adhesive.
    c. Press reflector into adhesive and apply pressure.
5. Delineator Posts:
    a. Base: Drill anchor holes into pavement. Place anchor sleeves into anchor holes flush with pavement surface. Screw anchor bolts through base holes into anchor sleeves.
        1) Apply mounting adhesive to base underside before anchoring.
    b. Upright: Attach post to base before anchoring in place.

D. Plastic Pavement Markings:
1. Install in accordance with manufacturer's instructions in manner necessary to maintain manufacturer's warranty.
2. Install in accordance with State of TX Highway Department standards.
3. Install in accordance with FHWA MUTCD standards.
4. Marking Tape: Place tape on pavement smooth and without wrinkles. 1/4 inch (6 mm) maximum gap between adjacent pieces. Immediately apply uniform pressure until firmly adhered.
    a. Apply primer to pavement at a rate of 1 oz/sq ft (3 L/sq m) and allow to set for 10 minutes prior to taping.
5. Thermoplastic Markings: Preheat pavement surface to 275 degrees F (135 degrees C). Place markings on pavement smooth and without wrinkles. 1/4 inch (6 mm) maximum gap between adjacent markings. Uniformly heat markings between 400 degrees F (204 degrees C) to 440 degrees F (227 degrees C). Do not overheat, scorch, or disperse embedded glass beads.
    a. Apply primer according to manufacturer's recommendations.

E. Apply Markings:
1. Using widths and colors and locations shown on the design drawings.
2. In proper alignment and without abrupt deviation.
3. Free of blisters.
4. Apply in unform cross-section with uniform density, width, and thickness.
5. Ends that are reasonably square and clean.
6. If required, with retroreflectorized drop on glass beads.

3.04 TOLERANCES

A. Maximum Variation From True Position: 1 inches (25 mm).

B. Maximum Offset From True Alignment: 1 inches (25 mm).

3.05 FIELD QUALITY CONTROL

A. Perform field inspection for deviations from true alignment or material irregularities.

B. If inspections indicate work does not meet specified requirements, rework and reinspect at no cost to Owner.

C. Allow the pavement marking to set at least the minimum time recommended by manufacturer.

3.06 CLOSEOUT ACTIVITIES

A. Temporary Markings: Remove without damaging surfaces.

3.07 PROTECTION

A. Prevent approaching traffic from crossing newly applied pavement markings.

B. Replace damaged or removed markings at no additional cost to Owner.

C. Preserve survey control points until pavement marking acceptance.

END OF SECTION

STEEL GUARDRAIL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Steel guardrail and wood posts.

B. Excavating for post bases.

1.02 PRICE AND PAYMENT PROCEDURES

A. Guardrail:
   1. Basis of Measurement: By the linear foot (meter).
   2. Basis of Payment: Includes rail, accessories, end closures, finished.

B. Intermediate Posts:
   1. Basis of Measurement: By the unit.
   2. Basis of Payment: Includes excavating, sleeving through concrete, posts, backfilling and compacting at posts.

C. Terminal Anchor Posts:
   1. Basis of Measurement: By the unit.
   2. Basis of Payment: Includes excavating, sleeving through concrete, posts, anchors and anchor footings, backfilling and compacting at posts.

1.03 REFERENCE STANDARDS

A. AASHTO M 180 - Standard Specification for Steel Components for Highway Guardrail; 2025.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

E. ASTM A428/A428M - Standard Test Method for Weight [Mass] of Coating on Aluminum-Coated Iron or Steel Articles; 2021.

F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

H. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2025.

I. AWPA U1 - Use Category System: User Specification for Treated Wood; 2025.

1.04 SUBMITTALS

A. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, anchorage, and schedule of components.

B. Product Data: Provide data on rail, posts, accessories, hardware and structural capabilities of rail section.

C. Manufacturer's Installation Instructions: Indicate installation requirements.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with detail shown on the design plans or applicable code for rail height or location restrictions.

2.02 MATERIALS

A. Guardrail Beam: AASHTO M 180 Class A Type I; W profile; rolled steel sections, die punched bolt holes for site assembly and attachment to posts, formed steel curved terminating sections.

B. Steel Posts: ASTM A501/A501M hot-formed tubing.

C. Wood Posts: Softwood timber, pressure preservative treated to AWPA U1 using creosote preservatives, 8 by 8 inch (200 by 200 mm) nominal size.

2.03 ACCESSORIES

A. Concrete: Ready-mixed, complying with ASTM C94/C94M; normal Portland cement; 2,500 psi (17 MPa) strength at 28 days, 3 inch (75 mm) slump; 3/8 inch (10 mm) nominal sized aggregate.

B. Hardware: Steel, bolts, nuts and washers to suit rail profile.

2.04 FINISHES

A. Components: Galvanized in accordance with ASTM A123/A123M.

B. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install rails and posts and accessories in accordance with manufacturer's instructions.

B. Set top of rail at height indicated in the design detail.

C. Space posts at intervals not exceeding 10 feet (3 m).

D. Set posts plumb, in concrete footings.
   1. Top of Footing: 2 inches (50 mm) above finish grade.
   2. Footing Depth: As indicated.
   3. Slope top of concrete for water run-off.

E. Drive posts plumb to correct elevations.

F. Attach rails securely to posts with anchoring hardware.

3.02 TOLERANCES

A. Posts - Maximum Variation From Plumb: 1/2 inch (12 mm).

B. Rail - Maximum Offset From True Position: 1 inch (25 mm).

C. Rail - Maximum Variation From True Height: 1/2 inch (12 mm).

D. Components shall not infringe adjacent property lines.

END OF SECTION

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Posts, rails, and frames.

B. Barbed wire.

C. Concrete.

D. Manual gates with related hardware.

E. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete anchorage for posts.

1.03 PRICE AND PAYMENT PROCEDURES

A. Provide the work under the unit price method.

1. Fencing: Measurement and payment by the linear foot (linear meter), to the fence height specified, based on the specified post spacing. Includes posts, rails, tension wire, fabric, accessories, attachments.
2. Post Footings: Measurement and payment by each unit of footing, to the depth specified. Includes excavation, concrete placed, finishing.
3. Gates: Measurement and payment by square foot (by square meter). Includes frame posts, fabric, accessories, and hardware.

1.04 REFERENCE STANDARDS

A. ASTM A121 - Standard Specification for Metallic-Coated Carbon Steel Barbed Wire; 2022.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

D. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a (Reapproved 2022).

E. ASTM A491 - Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric; 2011 (Reapproved 2022).

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025.

G. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2025.

H. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2023.

I. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and Other Polymer-Coated Steel Chain Link Fence Fabric; 2017 (Reapproved 2022).

J. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2018 (Reapproved 2022).

K. ASTM F1665 - Standard Specification for Poly(Vinyl Chloride) (PVC) and Other Conforming Organic Polymer-Coated Steel Barbed Wire Used with Chain-Link Fence; 2008 (Reapproved 2022).

L. CLFMI CLF-FIG0111 - Field Inspection Guide; 2014.

M. CLFMI CLF-SFR0111 - Security Fencing Recommendations; 2014.

N. FS RR-F-191/1D - Fencing, Wire and Post Metal (Chain-Link Fence Fabric); 1990.

O. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.05 SUBMITTALS

A. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.

B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components. See CLFMI CLF-SFR0111 for planning and design recommendations.

C. Manufacturer's Installation Instructions: Indicate installation requirements, post foundation anchor bolt templates,and gate hardware.

D. Manufacturer's Qualification Statement.

E. Fence Installer Qualification Statement.

F. Field Inspection Records: Provide installation inspection records that include post settings, framework, fabric, barbed wire, fittings and accessories, gates, and workmanship.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of experience.

B. Fence Installer: Company with demonstrated successful experience installing similar projects and products, with not less than three years of experience.

1.07 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Line Posts: 1.9 inch (48 mm) diameter.

B. Corner and Terminal Posts: 2.38 inch (60 mm) diameter.

C. Gate Posts: 3-1/2 inch (89 mm) diameter.

D. Bottom Rail: 1.66 inch (42 mm) diameter, plain end, sleeve coupled.

E. Gate Frame: 1.66 inch (42 mm) diameter for welded fabrication.

F. Fabric: 2 inch (51 mm) diamond mesh interwoven wire, 6 gauge, 0.1920 inch (4.9 mm) thick, top selvage knuckle end closed, bottom selvage twisted tight.

G. Tension Wire: 6 gauge, 0.1920 inch (4.9 mm) thick steel, single strand.

H. Tie Wire: Aluminum alloy steel wire.

2.02 MATERIALS

A. Posts, Rails, and Frames:
   1. Formed from hot-dipped galvanized steel sheet, ASTM A653/A653M, HSLAS, Grade 50, with G90 (Z275) zinc coating.
   2. Line Posts: Type I round in accordance with FS RR-F-191/1D.
   3. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round in accordance with FS RR-F-191/1D.

B. Barbed Wire:
   1. Zinc-coated steel, complying with ASTM A121 Type Z Coating Class 1; 2 strands of 0.099 inch (2.51 mm) diameter wire, with 2-pointed barbs at 4 inches (102 mm) on center.

C. Concrete:
   1. Type specified in Section 03 30 00.

2.03 MANUAL GATES AND RELATED HARDWARE

A. Hardware for Single Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches (1,525 mm) high, 3 for taller gates; fork latch with gravity drop and padlock hasp; keeper to hold gate in fully open position.

B. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches (1,525 mm) high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position.

C. Hinges: Finished to match fence components.
   1. Brackets: Round.
   2. Mounting: Center.
   3. Closing: Manual.

D. Latches: Finished to match fence components.
   1. Brackets: Round.
   2. Locking: Mechanical.

E. Cantilever Gates:
   1. Length: 20 feet (6.1 m).
   2. Height: 60 inches (1525 mm).
   3. Weight Rating: 1,000 lb (454 kg).
   4. Shaft: 1-inch (25.4 mm) diameter.
   5. Roller: Polymer casting, secured to shaft with nylon locknut.
   6. Mounting to Round Fence Post: U-bolts.
   7. Material: Aluminum.
   8. Finish: Galvanized.

2.04 ACCESSORIES

A. Caps: Aluminum alloy; sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.

C. Extension Arms: Cast steel galvanized, to accommodate 3 strands of barbed wire, single arm, vertical.

2.05 FINISHES

A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 ounces per square foot (530 g/sq m).

B. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.

C. Accessories: Same finish as framing.

D. Color(s): Determined by the owner.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Verify that areas are clear of obstructions or debris.

3.02 PREPARATION

A. Removal: Obstructions or debris.

B. Ground Preparation:
   1. Verify Grading is complete.

3.03 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

B. Set intermediate posts plumb , in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.

C. Line Post Footing Depth Below Finish Grade: ASTM F567.

D. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F567.

E. Brace each gate and corner post to adjacent line post with horizontal center brace rail. Install brace rail one bay from end and gate posts.

F. Provide top rail through line post tops and splice with 6 inch (150 mm) long rail sleeves.

G. Install center brace rail on corner gate leaves.

H. Install bottom tension wire stretched taut between terminal posts.

I. Install support arms sloped inward and attach barbed wire; tension and secure.

J. Do not attach the hinged side of gate to building wall; provide gate posts.

K. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

L. Peen all bolts upon installation.

M. Install operator in accordance with manufacturer's instructions and in accordance with NFPA 70.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm).

B. Maximum Offset From True Position: 1 inch (25 mm).

C. Do not infringe on adjacent property lines.

3.05 FIELD QUALITY CONTROL

A. Layout: Verify that fence installation markings are accurate to design, paying attention to gate locations, underground utilities, and property lines.

B. Post Settings: Randomly inspect three locations against design for:
   1. Hole diameter.
   2. Hole depth.
   3. Hole spacing.

C. Fence Height: Randomly measure fence height at three locations or at areas that appear out of compliance with design.

D. Barbed Wire: Randomly inspect three locations against design for:
   1. Spacing of barb wire.

E. Gates: Inspect for level, plumb, and alignment.

F. Workmanship: Verify neat installation free of defects. See CLFMI CLF-FIG0111 for field inspection guidance.

3.06 CLEANING

A. Leave immediate work area neat at end of each work day.

B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.

C. Clean fence with mild household detergent and clean water rinse well.

D. Remove mortar from exposed posts and other fencing material using a 10 percent solution of muriatic acid followed immediately by several rinses with clean water.

E. Touch up scratched surfaces using materials recommended by manufacturer. Match touched-up paint color to factory-applied finish.

END OF SECTION

DISINFECTION OF WATER UTILITY PIPING SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Disinfection of site domestic water lines and site fire water lines specified in Section 33 14 16.

B. Testing and reporting results.

1.02 RELATED REQUIREMENTS

A. Section 33 14 16 - Site Water Utility Distribution Piping.

1.03 PRICE AND PAYMENT PROCEDURES

A. Disinfection: By the linear foot (meter). Includes preparing, disinfecting, testing, and reporting.

1.04 REFERENCE STANDARDS

A. AWWA B300 - Hypochlorites; 2024.

B. AWWA B301 - Liquid Chlorine; 2024.

C. AWWA B302 - Ammonium Sulfate; 2023.

D. AWWA B303 - Sodium Chlorite; 2024.

E. AWWA C651 - Disinfecting Water Mains; 2023.

1.05 SUBMITTALS

A. Test Reports: Indicate results comparative to specified requirements.

B. Certificate: From authority having jurisdiction indicating approval of water system.

C. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.

D. Disinfection report:
   1. Type and form of disinfectant used.
   2. Date and time of disinfectant injection start and time of completion.
   3. Test locations.
   4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
   5. Date and time of flushing start and completion.
   6. Disinfectant residual after flushing in ppm for each outlet tested.

E. Bacteriological report:
   1. Date issued, project name, and testing laboratory name, address, and telephone number.
   2. Time and date of water sample collection.
   3. Name of person collecting samples.
   4. Test locations.
   5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
   6. Coliform bacteria test results for each outlet tested.
   7. Certification that water complies, or fails to comply, with bacterial standards of the local jurisdiction.

1.06 QUALITY ASSURANCE

A. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this Section with minimum three years experience.

B. Testing Firm: Company specializing in testing potable water systems, certified by governing authorities of the State in which the Project is located.

C. Submit bacteriologist's signature and authority associated with testing.

PART 2 PRODUCTS

2.01 DISINFECTION CHEMICALS

A. Chemicals: AWWA B300 Hypochlorite, AWWA B301 Liquid Chlorine, AWWA B302 Ammonium Sulfate, and AWWA B303 Sodium Chlorite.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping system has been cleaned, inspected, and pressure tested.

B. Schedule disinfecting activity to coordinate with start-up, testing, adjusting and balancing, demonstration procedures, including related systems.

3.02 DISINFECTION

A. Use method prescribed by the applicable state or local codes, or health authority or water purveyor having jurisdiction, or in the absence of any of these follow AWWA C651.

B. Provide and attach equipment required to perform the work.

C. Inject treatment disinfectant into piping system.

D. Maintain disinfectant in system for 24 hours.

E. Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water.

F. Replace permanent system devices removed for disinfection.

G. Pressure test system to 180 psi (1241 kPa). Repair leaks and re-test.

3.03 FIELD QUALITY CONTROL

A. Test samples in accordance with AWWA C651.

END OF SECTION

SITE CONCRETE ENCASEMENT, CRADLES, SADDLES AND COLLARS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. All work required to install and complete all concrete encasements, cradles, saddles and collars.

1.02 RELATED REQUIREMENTS

A. Section {\id\#1000003} - {\t\#1000003}

B. Section 31 23 16 - Excavation

C. Section 31 23 16.13 - Trenching

D. Section 33 05 61 - Concrete Manholes

E. Section 33 31 13 - Site Sanitary Sewerage Gravity Piping

1.03 PRICE AND PAYMENT PROCEDURES

A. Encasement, Cradles, Saddles, and Collars: By the cubic yard. Includes formwork, concrete, placement accessories, consolidating and curing.

1.04 REFERENCES

A. Texas Department of Transportation Standard Specification, Item 420 – Concrete for Structures.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer’s data on manufactured products showing compliance with specified requirements.

B. Manufacturer’s Installation Instructions: Indicate installation procedures and interface required with adjacent construction for concrete accessories.

1.06 QUALITY ASSURANCE

A. The testing laboratory shall sample and test concrete in accordance with geotechnical report unless otherwise indicated.

PART 2 PRODUCTS

2.01 MATERIALS

A. Concrete: Shall conform to Class B in accordance with Item 420, "Concrete for Structures", TxDOT Standard Specifications.

B. Reinforcement: If required, shall be Grade 60, deformed bars, new billet steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Concrete Encasement
   1. The trench shall be excavated and fine graded to a depth conforming with details and sections shown on the plans.
   2. The pipe shall be securely tied down to prevent flotation and supported by precast concrete blocks of the same strength as the concrete for encasement.
   3. Encasement shall then be placed to a depth and width conforming with details and sections shown on the plans.

B. Concrete Cradles
   1. The trench shall be prepared and the pipe supported in the same manner as described in this Section.
   2. Concrete cradles shall be constructed in accordance with details and sections shown on the plans.

C. Concrete Saddles

1. Pipe to receive concrete saddle shall be backfilled in accordance with Section 31 2316.13 – Trenching to the spring line.
2. Concrete placed to a depth and width conforming with details and sections shown on the plans.

D. Concrete Collars
1. Concrete collars shall be constructed in accordance with details and sections shown on the plans.

3.02 CLEANING

A. Properly dispose of all debris, trash containers, residue, remnants and scraps which result from the work of this Section.

END OF SECTION

SITE CASTINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Castings shall include labor, materials, equipment and incidentals to construct manhole frames and covers, catch basin inlet frames and grates, trench drain frames and grates, and area drains.

B. Castings include metal items which are not a part of the miscellaneous metal fabrications or metal systems in other sections of these specifications.

1.02 RELATED SECTIONS

A. Section 33 05 61 - Concrete Manholes

1.03 SUBMITTALS

A. Shop Drawings:
   1. Submit Shop Drawings to the Engineer for the fabrication and erection of all casting assemblies. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items.
   2. Include setting drawings for location and installation of castings and anchorage devices.
   3. Copies of manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions.

1.04 QUALITY ASSURANCE

A. Shop Assembly
   1. Preassemble items in the shop to the greatest extent possible, so to minimize field splicing and assembly of units at the site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

PART 2 PRODUCTS

2.01 MANHOLE FRAMES AND COVERS

A. Drainage Manholes
   1. Material:
      a. Cast iron conforming to ASTM A 48, Class 30A.
   2. Size:
      a. As shown on the Drawings.
   3. Construction:
      a. Heavy duty suitable for HS-20 loading, with bearing surfaces between frames and covers machined, fitted together, and match marked to prevent rocking.

B. Sanitary Sewer Manholes
   1. Material:
      a. Cast iron conforming to ASTM A 48, Class 30.
   2. Size:
      a. As shown on the Drawings.
   3. Construction:
      a. Heavy duty suitable for HS-20 loading, with bearing surfaces between frames and covers machined, fitted together, and match marked to prevent rocking.
   4. Product and Manufacturer:
      a. Manhole frames and covers shall be as shown on the Plans, or as manufactured by an approved vendor authorized by the local jurisdictional authority.

2.02 CATCH BASIN INLET FRAMES AND GRATES

A. Catch Basin Inlets
   1. Material:

a. Ductile iron conforming to ASTM A 536.
2. Size:
a. As shown on the Drawings.
3. Construction:
a. Heavy duty suitable for HS-20 loading, with machine bearing surfaces.
b. Inlet covers shall be bolted down.

2.03 TRENCH DRAIN FRAMES AND GRATES

A. Trench Drain Frames and Grates
1. Material:
a. Ductile iron conforming to ASTM A536.
2. Size:
a. As shown on the Drawings.
3. Construction:
a. Heavy duty suitable for HS-20 loading, with machine bearing surfaces.
b. Trench grate covers shall be secured.

B. Trench Drain: As shown on the Plans, or as manufactured by an approved vendor authorized by the local jurisdictional authority.

2.04 AREA DRAINS

A. Area Drains
1. Material:
a. Ductile iron conforming to ASTM A536.
2. Size:
a. As shown on the Drawings.
3. Construction:
a. Heavy duty suitable for HS-20 loading, with machine bearing surfaces.

2.05 DESIGN AND FABRICATION

A. Design all frames, covers, and grates to prevent rocking and rattling under traffic.

B. Fabricate castings true to pattern so that component parts fit together.

2.06 FINISH

A. Shall be in accordance with manufacturer's recommendation, unless shown or specified otherwise.

PART 3 EXECUTION

3.01 INSTALLATION

A. Follow manufacturer's printed instructions and Shop Drawings.

B. Set castings accurately to required locations, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Brace temporarily or anchor temporarily in formwork.

C. Area and planting drains shall be installed in accordance with the manufacturer's recommendations.

END OF SECTION

CONCRETE MANHOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Precast concrete manholes.

B. Concrete masonry unit manholes.

C. Cast-in-place concrete manholes.

D. Cast-in-place concrete base pad.

E. Polymer concrete manhole inserts.

F. Grade adjustments.

G. Frames and covers.

1.02 RELATED REQUIREMENTS

A. Section 31 23 16 - Excavation.

B. Section 31 23 23 - Fill.

C. Section 33 31 13 - Site Sanitary Sewerage Gravity Piping.

D. Section 33 42 11 - Stormwater Gravity Piping.

E. Section 33 42 30 - Stormwater Drains.

F. Section 33 46 00 - Stormwater Management.

1.03 PRICE AND PAYMENT PROCEDURES

A. Unit Prices: Concrete Manholes

1. Basis of Measurement: By the unit for a nominal depth of 10 feet (3 m).
2. Basis of Payment: Includes excavation, hand trimming, bedding and backfilling, base pad, frame and grate, accessories.

1.04 REFERENCE STANDARDS

A. AASHTO HB - Standard Specifications for Highway Bridges; 2005, with Errata.

B. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).

C. ACI PRC-440.1 - Guide for the Design and Construction of Structural Concrete Reinforced with Fiber-Reinforced Polymer Bars; 2015.

D. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

E. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.

F. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.

G. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2025.

H. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

I. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2024.

J. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2025a.

K. ASTM C478/C478M - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections; 2020.

L. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2024.

M. ASTM C923/C923M - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals; 2020.

N. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants; 2009 (Reapproved 2019).

O. ASTM D6783 - Standard Specification for Polymer Concrete Pipe; 2005a (Reapproved 2017).

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Installation of concrete manholes with piping and other structures.
   1. See Section 33 31 13 for site sanitary sewerage gravity piping.
   2. See Section 33 42 11 for stormwater gravity piping.
   3. See Section 33 42 30 for stormwater drains.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by affected installers.

C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.06 SUBMITTALS

A. Product Data: Provide manhole covers, component construction,structural rating, features, configuration, and dimensions.

B. Shop Drawings: Indicate manhole locations, elevations, piping sizes and elevations of penetrations.

C. Manufacturer's Installation Instructions: Indicate special procedures for assembly.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Field Quality Control Submittals: Document results of field quality control testing.

F. Project Record Documents:
   1. Record invert elevations of concrete manholes.
   2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of experience.

1.08 FIELD CONDITIONS

A. Maintain materials and surrounding air temperature to minimum 50 degrees F (10 degrees C) prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.01 CONCRETE MANHOLES

A. Weight Rating: HS20 according to AASHTO HB.

B. Precast Concrete Manholes: Comply with ASTM C478/C478M, reinforced.
   1. Wall Thickness: 6 inches (152 mm).
   2. Base Thickness: 12 inches (305 mm).
   3. Cone Thickness: 6 inches (152 mm).
   4. Lid Thickness: 10 inches (254 mm).
   5. Reinforcement: Formed steel wire, galvanized finish, wire diameter as indicated on drawings.
   6. Joint Sealant: Comply with ASTM C990.

C. Cast-In-Place Concrete Manholes: Comply with ASTM C94/C94M, reinforced.
   1. Wall Thickness: 6 inches (152 mm).

D. Cast-In-Place Concrete Base Pads: Comply with ASTM C94/C94M, reinforced.
   1. Thickness: 12 inches (305 mm).
   2. Reinforcement: Formed steel wire, galvanized finish, wire diameter as indicated on drawings.
   3. Width: Match outside catch basin diameter.

4. Length: Match outside catch basin diameter.

E. Cast-In-Place Concrete Materials:
1. Cement: ASTM C150/C150M, Type II.
2. Sand: ASTM C33/C33M, fine aggregate.
3. Crushed Gravel: ASTM C33/C33M, coarse aggregate.
4. Reinforcement: Formed steel wire, galvanized finish, wire diameter as indicated on drawings.
5. Water: Potable.
6. Admixtures, General: Chemical type complying with ASTM C494/C494M, wet mix only.
7. Air-Entraining Admixture: In accordance with ASTM C260/C260M, wet mix only.
8. Form Materials: Wood, profiled to suit conditions.

F. Polymer Concrete Manhole Inserts: Comply with ASTM D6783, reinforced.
1. Wall Thickness: 7 inches (178 mm).
2. Base Thickness: 6 inches (152 mm).
3. Cone Thickness: 5 inches (127 mm).
4. Lid Thickness: 10 inches (254 mm).
5. Reinforcement: Fiber-reinforced polymer bars, in accordance with ACI PRC-440.1.
6. Joint Sealant: Comply with ASTM C990.

G. Polymer Mortar: Provided by the manufacturer.

H. Grade Adjustments:
1. Adjustment Ring: Concrete, 6 inches (152 mm) wide, diameter matching frame dimensions, in accordance with ASTM C478/C478M.

I. Mortar Mixing:
1. Thoroughly mix mortar ingredients in accordance with ASTM C270 and in quantities needed for immediate use.
2. Maintain sand uniformly damp immediately before the mixing process.
3. Do not use antifreeze compounds to lower the freezing point of mortar.

J. Frame and Cover: Cast iron construction, ASTM A48/A48M Class 30B, machined flat bearing surface; hinged; sealing gasket.

2.02 ACCESSORIES

A. Steps: If required, formed galvanized steel rungs; 3/4 inch (19 mm) diameter. Formed integral with manhole sections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify items provided by other sections of work are properly sized and located.

B. Verify that built-in items are in proper location, and ready for roughing into Work.

C. Verify excavation for manholes is correct.

3.02 PREPARATION

A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

3.03 EXCAVATION AND FILL

A. Hand trim excavation for accurate placement to indicated elevations.

B. Backfill with cover fill, tamp in place and compact, then complete backfilling.

C. See Section 31 23 16 for additional excavation requirements.

D. See Section 31 23 23 for additional fill requirements.

3.04 INSTALLATION

A. Establish elevations and pipe inverts for inlets and outlets as indicated in drawings.

B. Precast Concrete Manholes:
   1. Place base section plumb and level.
   2. Install joint sealant uniformly around section lip.
   3. Overlay additional sections on joint sealant.
   4. Install cone or lid plumb and level on joint sealant.

C. Cast-In-Place Concrete Base Pad:
   1. Form bottom of excavation walls clean and smooth to correct limits.
   2. Install reinforcement in maximum lengths. Offset end laps in both directions. Splice laps with tie wire.
   3. Place concrete in accordance with ACI PRC-304.
   4. Float base pad top surface level.

D. Cast-In-Place Concrete Manholes:
   1. Form catch basin on concrete base pad plumb and level.
   2. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
   3. Install reinforcement in maximum lengths. Offset end laps in both directions. Splice laps with tie wire.
   4. Place concrete in accordance with ACI PRC-304.
   5. Float catch basin top surface level.

E. Polymer Concrete Manhole Inserts: Install according to manufacturer's instructions.
   1. Protect manhole from foreign material entrance.

F. Grade Adjustments:
   1. Lay concrete ring on mortar bed, plumb and level. Top with mortar, plumb and level.
   2. Place adjacent materials tight, and smooth following design grades.

G. Frames and Covers:
   1. Place frame plumb and level.
   2. Mount frame on mortar bed at indicated elevation.
   3. Mount frame on expanded polypropylene ring according to manufacturer's instructions.
   4. Place grate in frame securely.

3.05 FIELD QUALITY CONTROL

A. Perform field inspection for pipe invert elevations.

B. If inspections indicate work does not meet specified requirements, adjust work and reinspect at no cost to Owner.

END OF SECTION

SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water pipe for site conveyance lines.

B. Pipe valves.

C. Fire hydrants.

D. Backflow preventers - reduced pressure principle assemblies.

E. Backflow preventers - double check-valve assemblies.

1.02 RELATED REQUIREMENTS

A. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.

B. Section 33 01 10.58 - Disinfection of Water Utility Piping Systems: Disinfection of site service utility water piping.

1.03 PRICE AND PAYMENT PROCEDURES

A. Pipe: By the linear foot (linear meter). Includes hand trimming excavation, pipe and fittings, bedding, concrete thrust restraints, connection to building service piping, and to municipal utility water source.

B. Fittings: By the ton. Includes tees and bends.

C. Valves: By the unit. Includes valve, fittings and accessories.

D. Hydrant: By the unit. Includes hand trimming excavation, gravel sump, hydrant, valve, connection, and accessories.

1.04 REFERENCE STANDARDS

A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.

B. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2021.

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.

E. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies; 2021.

F. ASSE 1015 - Performance Requirements for Double Check Backflow Prevention Assemblies; 2021.

G. ASSE 1047 - Performance Requirements for Reduced Pressure Detector Backflow Prevention Assemblies; 2021.

H. ASSE 1048 - Performance Requirements for Double Check Detector Backflow Prevention Assemblies; 2021e.

I. ASSE 1060 - Performance Requirements for Outdoor Enclosures for Fluid Conveying Components; 2017 (Reaffirmed 2025).

J. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

K. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.

L. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.

M. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.

N. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2024.

O. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2024.

P. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020 (Reapproved 2024).

Q. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals; 2019 (Reapproved 2025).

R. ASTM F1267 - Standard Specification for Metal, Expanded, Steel; 2018 (Reapproved 2023).

S. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.

T. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.

U. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.

V. AWWA C115/A21.15 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges; 2020.

W. AWWA C200 - Steel Water Pipe, 6 in. (150 mm) and Larger; 2023.

X. AWWA C205 - Cement–Mortar Protective Lining and Coating for Steel Water Pipe—4 in. (100 mm) and Larger—Shop Applied; 2024.

Y. AWWA C206 - Field Welding of Steel Water Pipe; 2023.

Z. AWWA C207 - Steel Pipe Flanges for Waterworks Service, Sizes 4 in. through 144 in. (100 mm through 3600 mm); 2023.

AA. AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings; 2022.

BB. AWWA C209 - Hand-Applied Tape Coatings for Steel Water Pipe and Fittings; 2025.

CC. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service; 2019.

DD. AWWA C502 - Dry-Barrel Fire Hydrants; 2024.

EE. AWWA C504 - Rubber-Seated Butterfly Valves; 2023.

FF. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 48-In. (50-mm Through 1,200-mm) NPS; 2025.

GG. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; 2023.

HH. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances; 2023.

II. AWWA C602 - Cement-Mortar Lining of Water Pipelines in Place - 4 In. (100 mm) and Larger; 2023.

JJ. AWWA C606 - Grooved and Shouldered Joints; 2022.

KK. AWWA C800 - Underground Service Line Valves and Fittings; 2021.

LL. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 60 In. (100 mm through 1500 mm); 2022.

MM. AWWA C901 - Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, 3/4 In. (19 mm) Through 3 In. (76 mm), for Water Service; 2025.

NN. AWWA C904 - Cross-Linked Polyethylene (PEX) Pressure Tubing, ½ In. (13 mm) Through 3 In. (76 mm), for Water Service; 2016.

OO. AWWA M11 - Steel Pipe - A Guide for Design and Installation; 2017, with Addendum (2019).

PP. NSF 61 - Drinking Water System Components - Health Effects; 2024.

QQ. UL 246 - Hydrants for Fire-Protection Service; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.06 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.07 QUALITY ASSURANCE

A. Perform Work in accordance with municipality and utility provider requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers with labeling in place.

B. Protect crosslinked polyethylene tubing from direct and indirect UV exposure.

PART 2 PRODUCTS

2.01 WATER PIPE

A. Comply with material requirements of the local jurisdiction.

B. Steel Pipe: Welded or Seamless complying with AWWA C200.
   1. Fittings: AWWA C208.
      a. Construct of same material as pipe with standard tube turns or segmentally welded sections to accommodate the type of couplings or joints provided.
      b. Thickness Rating: Comply with not less than specified pipe thickness and calculated pipe pressure rating.
      c. Mechanically or manually wrap, line, and coat all fittings with same protective materials and applications used for pipe.
   2. Joints:
      a. Welded: Provide electrodes complying with AWWA C206.
      b. Sleeve Type Mechanical Coupled:
         1) Designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections and provide for confinement and compression of gaskets.
         2) Coupling Assembly:
            (a) One steel middle ring, flared or beveled at each end, providing a gasket seat and two steel or malleable iron follower rings, providing for confinement and compression of the gaskets.
            (b) Provide middle ring and follower rings consisting of true, circular sections, free from irregularities, flat spots, and surface defects.
            (c) Two resilient and tapered rubber gaskets, designed for resistance to set after installation.
            (d) Bolts and nuts to draw the follower rings toward each other to compress the gaskets.
         3) Bolts: Track head complying with ASTM A307 Grade A, with nuts complying with ASTM A563/A563M Grade A.
         4) Coupling Strength: Not less than adjoining pipeline.
      c. Flanged:
         1) Steel Flanges: AWWA C207, Class D.
         2) Bolts, Nuts, and Rubber Gaskets: AWWA C207.
         3) Asbestos gaskets not allowed.
      d. Insulating Joints:
         1) Provide flanged type with insulating gasket, bolt sleeves, and washers to prevent metal-to-metal contact with adjacent piping.

2) Gaskets: Dielectric type, full face, as recommended in Appendix to AWWA C115/A21.15.
3) Bolts and Nuts: As recommended in Appendix to AWWA C115/A21.15.

C. Ductile Iron Pipe: AWWA C151/A21.51:
1. Fittings: Ductile iron, standard thickness.
2. Joints: AWWA C111/A21.11, Styrene butadiene rubber (SBR) or vulcanized SBR gasket with rods.
3. Jackets: AWWA C105/A21.5 polyethylene jacket.

D. Copper Tubing: ASTM B88, Type K, Annealed:
1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
2. Joints: Compression connection or AWS A5.8M/A5.8, BCuP silver braze.

E. PVC Pipe: ASTM D1785 Schedule 80.
1. Fittings: ASTM D2466, PVC.
2. Joints: ASTM D2855, solvent weld.

F. PVC Pipe: AWWA C900 Class 165:
1. Fittings: AWWA C111/A21.11, Schedule 40 per ASTM D2466 or schedule 80 per ASTM D2467.
2. Joints: ASTM D3139 compression gasket ring.

G. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Water Service" in large letters.

2.02 VALVES

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Gate Valves Up To 3 Inches (75 mm):
1. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, compression ends, with control rod, valve key, and extension box.

C. Gate Valves 3 Inches (75 mm) and Over:
1. AWWA C500, iron body, bronze trim, non-rising stem with square nut, single wedge, flanged ends, control rod, valve key, and extension box.

D. Ball Valves Up To 2 Inches (50 mm):
1. Brass body, Teflon coated brass ball, rubber seats and stem seals, Tee stem pre-drilled for control rod, AWWA inlet end, compression outlet, with control rod, valve key, and extension box.

E. Swing Check Valves From 2 Inches to 24 Inches (50 mm to 600 mm):
1. AWWA C508, iron body, bronze trim, 45 degree swing disc, renewable disc and seat, flanged ends.

F. Butterfly Valves From 2 Inches to 24 Inches (50 mm to 600 mm):
1. AWWA C504, iron body, bronze disc, resilient replaceable seat, water or lug ends, infinite position lever handle.

2.03 HYDRANTS

A. Hydrants: Type as required by utility company.

B. Hydrant Extensions: Fabricate in multiples of 6 inches (150 mm) with rod and coupling to increase barrel length.

C. Hose and Streamer Connection: Match sizes with utility company, two hose nozzles , one pumper nozzle.

D. Pressure Rating: According to utility company.

E. Finish: Primer and two coats of enamel in color required by utility company.

2.04 BACKFLOW PREVENTERS - REDUCED PRESSURE PRINCIPLE ASSEMBLIES

A. Reduced Pressure Backflow Preventer Assemblies up to 2 Inches NPS (50 mm DN):
   1. ASSE 1013; NSF 61; bronze body; two independently operating, spring-loaded check valves with stainless steel springs; differential pressure relief valve located between check valves; integral test fittings.
   2. Size: 3/4- to 2-inch NPS (20 to 50 mm DN) assembly with full port ball valves.
   3. Maximum Working Parameters: 175 psi (1207 kPa) at 180 degrees F (82.2 degrees C).
   4. Accessories: Provide Y-strainer, outdoor-mounted protective enclosure, and test cocks.

B. Reduced Pressure Backflow Preventer Assemblies 2-1/2 Inches NPS (65 mm DN) and Larger:
   1. ASSE 1013; NSF 61; epoxy-coated cast iron body; two independently operating, spring-loaded check valves with stainless steel springs; differential pressure relief valve located between check valves; integral test fittings.
   2. Size: 2-1/2- to 10-inch NPS (65 to 250 mm DN) assembly with flanged OS&Y gate valves.
   3. Maximum Working Parameters: 175 psi (1207 kPa) at 140 degrees F (60 degrees C).
   4. Accessories: Provide Y-strainer, outdoor-mounted protective enclosure, and test cocks.

C. Reduced Pressure Backflow Detector Assembly:
   1. ASSE 1047; NSF 61; epoxy-coated cast iron body; metered bypass; two independently operating, spring-loaded check valves with stainless steel springs; differential pressure relief valve located between check valves; integral test fittings.
   2. Size: 2-1/2- to 10-inch NPS (65 to 250 mm DN) assembly with flanged OS&Y gate valves.
   3. Maximum Working Parameters: 175 psi (1207 kPa) at 140 degrees F (60 degrees C).
   4. Accessories: Provide Y-strainer, outdoor-mounted protective enclosure, and test cocks.

2.05 BACKFLOW PREVENTERS - DOUBLE CHECK-VALVE ASSEMBLIES

A. Double Check-Valve Assemblies up to 2 Inches NPS (50 mm DN):
   1. ASSE 1015; NSF 61; bronze body; two independently operating, spring-loaded check valves with stainless steel springs; integral test fittings.
   2. Size: 3/4- to 2-inch NPS (20 to 50 mm DN) assembly with full port ball valves.
   3. Maximum Working Parameters: 175 psi (1207 kPa) at 180 degrees F (82.2 degrees C).
   4. Accessories: Provide Y-strainer, test cocks, and pit-mounted protective enclosure.

B. Double Check-Valve Assemblies 2-1/2 Inches NPS (65 mm DN) and Larger:
   1. ASSE 1015; NSF 61; epoxy-coated cast iron body; two independently operating, spring-loaded check valves with stainless steel springs; integral test fittings.
   2. Size: 2-1/2- to 10-inch NPS (65 to 250 mm DN) assembly with flanged OS&Y gate valves.
   3. Maximum Working Parameters: 175 psi (1207 kPa) at 140 degrees F (60 degrees C).
   4. Accessories: Provide Y-strainer, test cocks, and pit-mounted protective enclosure.

C. Double Check-Detector Assemblies:
   1. ASSE 1048; NSF 61; epoxy-coated cast iron body; metered bypass, two independently operating, spring-loaded check valves with stainless steel springs; integral test fittings.
   2. Size: 2-1/2- to 10-inch NPS (65 to 250 mm DN) assembly with flanged OS&Y gate valves.
   3. Maximum Working Parameters: 175 psi (1207 kPa) at 140 degrees F (60 degrees C).
   4. Accessories: Provide Y-strainer, test cocks, and pit-mounted protective enclosure.

2.06 BEDDING AND COVER MATERIALS

A. Bedding: As specified in Section 31 23 16.13.

B. Cover: As specified in Section 31 23 16.13.

2.07 ACCESSORIES

A. Meter: Per local jurisdictional requirements and size indicated on the design drawings.

B. Casing Spacer: Stainless steel spacer designed to maintain pipe casing integrity.

C. Outdoor Backflow Enclosures:
   1. Vandal and Damage Resistant, Caged:

a. Description: Expanded metal enclosure to protect aboveground piping, specialties, and equipment from vandalism and damage.
b. Construction:
1) Side and Top Panels: ASTM F1267, expanded metal, rigid construction throughout entire assembly, powder-coated finish.
2) Provide locking device and devices for attachment of enclosure to base.
3) Precast Concrete Base:
(a) Overall size to extend base 6 inches (150 mm) beyond perimeter of enclosure.
(b) Minimum Thickness: 4 inches (100 mm).
(c) Provide piping openings.

2. Insulated Enclosure without Heat Source:
a. Description: Insulated enclosure to protect aboveground piping, specialties, and equipment from vandalism, damage, and weather.
b. Comply with ASSE 1060, Class II.
c. Construction:
1) Enclosure Envelope: Insulated, reinforced fiberglass or aluminum.
2) Access doors with locking devices.
3) Anchors for attaching enclosure to concrete base.
4) Drain opening for enclosures with drain connection.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.

3.02 PREPARATION

A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare pipe connections to equipment with flanges or unions.

3.03 TRENCHING

A. See the sections on excavation and fill for additional requirements.

B. Hand trim excavation for accurate placement of pipe to elevations indicated.

C. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide 2 square feet (0.185 sq m) thrust restraint bearing on subsoil.

D. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.04 INSTALLATION - PIPE

A. Maintain separation of water main from sewer piping in accordance with local code.

B. Group piping with other site piping work whenever practical.

C. Establish elevations of buried piping to ensure not less than 4 feet (1.2 m) of cover.

D. Install pipe to indicated elevation to within tolerance of 5/8 inches (16 mm).

E. Install ductile iron piping and fittings to AWWA C600.

F. Route pipe in straight line.

G. Install pipe to allow for expansion and contraction without stressing pipe or joints.

H. Install access fittings to permit disinfection of water system performed under Section 33 01 10.58.

I. Slope water pipe and position drains at low points.

J. Install trace wire 6 inches (150 mm) above top of pipe; coordinate with Section 31 23 16.13.

3.05 INSTALLATION - STEEL PIPE

A. Make and assemble rubber-gasketed, bell-and-spigot joints in accordance with manufacturer's recommendations.

B. Make welded joints in accordance with AWWA C206 and install in accordance with AWWA M11, Chapter 12, Transportation, Installation, and Testing.

C. Assemble sleeve-type mechanical coupling joints in accordance with manufacturer's recommendations.

D. Make flanged joints water-tight without undue strain on other material and equipment, using right-sized bolts, and parallel to adjoining flanges.

E. Make grooved joints with equipment designed and produced by the manufacturer of grooved joint couplings and assemble in accordance with the coupling manufacturer's recommendations.

F. Make shouldered type joints with the specified coupling, connect with shouldered ends, and assemble in accordance with the couplings manufacturer's recommendations.

G. Make insulating joints with specified materials and assemble for flanged joints with bolts, with full size insulating sleeves for bolt holes, and no metal-to-metal contact with dissimilar metals after assembly.

H. After installation, line piping in-place with cement mortar in accordance with AWWA C602.

I. Finish joints on piping with cement-mortar lining in accordance with AWWA C205.

J. Maximum, allowable offsets for bell-and-spigot rubber-gasket joints, from a straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall be five degrees or less in accordance with manufacturer's recommendations.

K. Form short-radius curves and closures with short pipe lengths or specified, fabricated specials.

3.06 INSTALLATION - VALVES, HYDRANTS, BACKFLOW PREVENTERS

A. Set valves on solid bearing.

B. Center and plumb valve box over valve. Set box cover flush with finished grade.

C. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway in accordance with Section 21 11 00.

D. Set hydrants to grade, with nozzles at least 20 inches (500 mm) above ground in accordance with Section 21 11 00.

E. Locate control valve 24 inches (610 mm) away from hydrant.

F. Provide a drainage pit 36 inches (900 mm) square by 24 inches (600 mm) deep filled with 2 inches (50 mm) washed gravel. Encase elbow of hydrant in gravel to 6 inches (150 mm) above drain opening. Do not connect drain opening to sewer.

G. Paint hydrants per local code.

H. Install backflow preventers in accordance with requirements of local water utility and local authority having jurisdiction.

I. Support backflow preventer independently of surrounding pipe using pipe stanchions.

J. Outdoor Enclosures:
   1. Caged or Insulated without Heat Source:
      a. Install in accordance with manufacturer's recommendations.
      b. Anchor enclosure to flat, concrete base.
      c. Concrete Base Height: 2 inches (50 mm).
      d. Connect drain connection where required and route to suitable termination point.

3.07 SERVICE CONNECTIONS

A. Provide water service to utility company requirements with reduced pressure backflow preventer and water meter with bypass valves.

B. Provide sleeve in retaining wall for service main. Support with reinforced concrete bridge. Calk enlarged sleeve watertight.

C. Anchor service main to interior surface of foundation wall.

3.08 FIELD QUALITY CONTROL

A. Pressure test water piping to 180 pounds per square inch (1241 kPa).

B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

END OF SECTION

STORMWATER GRAVITY PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stormwater drainage piping.

B. Stormwater pipe accessories.

1.02 RELATED REQUIREMENTS

A. Section 31 23 16 - Excavation: Excavating of trenches.

B. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.

C. Section 31 23 23 - Fill: Bedding and backfilling.

D. Section 33 05 61 - Concrete Manholes.

E. Section 33 42 30 - Stormwater Drains.

F. Section 33 46 00 - Stormwater Management.

1.03 PRICE AND PAYMENT PROCEDURES

A. Pipe and Fittings:
   1. Basis of Measurement: By the linear foot (meter).
   2. Basis of Payment: Includes hand trimming excavation, bedding and backfilling, pipe and fittings, connection to building service piping and to outfall structure.

1.04 REFERENCE STANDARDS

A. AASHTO M 252 - Standard Specification for Corrugated Polyethylene Pipe, 75- to 250-mm (3- to 10-in.) Diameter; 2025.

B. AASHTO M 294 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter; 2025.

C. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe; 2020 (Reapproved 2025).

D. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; 2025.

E. ASTM C76M - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric); 2022a.

F. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2021.

G. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric); 2021.

H. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.

I. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2025.

J. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2021.

K. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2024, with Editorial Revision (2025).

L. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials; 2024.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of stormwater gravity piping with size, location and installation of stormwater drains according to Section 33 42 30.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.06 SUBMITTALS

A. Product Data: Provide data indicating pipe, pipe accessories.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.

D. Field Quality Control Submittals: Document results of field quality control testing.

E. Project Record Documents:
1. Record location of pipe runs, connections, and invert elevations.
2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 PRODUCTS

2.01 STORMWATER PIPE MATERIALS

A. Provide products that comply with applicable code(s).

B. Concrete Pipe: Reinforced, ASTM C76 (ASTM C76M), Class II with Wall type A; mesh reinforcement; inside nominal diameter of 18 inches (457 mm), bell and spigot end joints.

C. Reinforced Concrete Pipe Joint Device: ASTM C443 (ASTM C443M) rubber compression gasket joint.

D. Plastic Pipe: ASTM D1785, Schedule 80, Poly Vinyl Chloride (PVC) material; inside nominal diameter of 6 inches (150 mm), bell and spigot style solvent sealed joint end.

E. Plastic Pipe: ASTM D3350, High Density Polyethylene (HDPE) corrugated wall pipe with integrally formed smooth liner; inside nominal diameter of 6 inch (150 mm), meeting the requirements of AASHTO M 252, Type S, for diameters between 3 inches (75 mm) and 10 inches (250 mm) and AASHTO M 294, Type S, for diameters between 12 inches (300 mm) and 60 inches (1500 mm), water tight, bell and spigot joints with rubber gaskets, with pipe and fittings manufactured from virgin PE compounds with cell classification 3254420C.

F. Corrugated Steel Pipe: AASHTO M 36 Type I; nominal diameter of 12 inches (300 mm), rolled end joints; helical lock seam; coated inside and out with 0.050 inch (1.3 mm) thick bituminous coating.

G. Coupling Bands: Galvanized steel, 0.052 inches (1.3 mm) thick x 10 inches (250 mm) wide; connected with two neoprene "O" ring gaskets and two galvanized steel bolts.

2.02 PIPE ACCESSORIES

A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

B. Downspout Boots: Smooth interior without boxed corners or choke points; include integral lug slots and on-body cleanout and cover with neoprene gaskets.
1. Configuration: Angular.
2. Finish: Manufacturer's standard factory applied powder coat finish.
3. Color: Coordinate with the architect.
4. Accessories: Manufacturer's standard stainless steel fasteners, stainless steel building wall anchors, and rubber coupling.

2.03 BEDDING AND COVER MATERIALS

A. Bedding: As specified in .

B. Cover: As specified in Section 31 23 16.13.

PART 3 EXECUTION

3.01 TRENCHING

A. See Section 31 23 16.13 - Trenching for additional requirements.

B. Hand trim excavation for accurate placement of pipe to elevations indicated.

C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

D. Place bedding material as indicated in the design drawings.

3.02 INSTALLATION

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.

1. Plastic Pipe: Also comply with ASTM D2321.

C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch (3 mm) in 100 feet (30.5 m).

D. Connect to building storm drainage system, foundation drainage system, and utility/municipal system.

E. Make connections through walls through sleeved openings, where provided.

3.03 FIELD QUALITY CONTROL

A. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

3.04 PROTECTION

A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

STORMWATER CULVERTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe culvert, joints and accessories.

B. Bedding and slope protection at pipe end.

1.02 RELATED REQUIREMENTS

A. Section 31 23 16 - Excavation: Excavating of trenches.

B. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.

C. Section 31 23 23 - Fill: Bedding and backfilling.

D. Section 31 37 00 - Riprap.

1.03 PRICE AND PAYMENT PROCEDURES

A. Pipe Culvert: By the total linear foot (meter) invert length of pipe including tapered ends and the diameter in inches (mm). Includes hand trimming, excavating; removing soft subsoil, bedding fill, compacting; pipe, fittings and accessories assembled; repair of damaged coating.

B. Slope protection: By the unit.

1.04 REFERENCE STANDARDS

A. ASTM A929/A929M - Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe; 2024.

B. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; 2025.

C. ASTM C76M - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric); 2022a.

D. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2021.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work of this section.

1.06 SUBMITTALS

A. Product Data: Provide data on pipe, fittings and accessories.

B. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.

C. Accurately record actual locations of pipe runs, connections, and invert elevations.

D. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 PRODUCTS

2.01 CULVERT PIPE, GENERAL

A. Regulatory Requirements: Comply with applicable local code for materials and installation of the work of this section.

2.02 STEEL CULVERT PIPE

A. Corrugated Steel Pipe: Fabricated of ASTM A929/A929M galvanized steel sheet:
   1. rolled end joints.
   2. Helical lock seam.
   3. Coated inside and out with 0.050 inch (1.3 mm) thick bituminous coating.
   4. Shape: Circular, with nominal diameter of 12 inches.

B. Tapered Ends: Same material as pipe, machine cut, for joining to pipe end.

C. Coupling Bands: Galvanized steel, 0.052 inches (1.3 mm) thick x 10 inches (250 mm) wide; connected with two neoprene "O" ring gaskets and two galvanized steel bolts.

2.03 CONCRETE CULVERT PIPE

A. Concrete Pipe: Reinforced, ASTM C76 (ASTM C76M), Class III with Wall Type A; mesh reinforcement; bell and spigot end joints:
   1. Shape: Circular with a nominal diameter of 12 inches (Circular with a nominal diameter of 305 mm).

B. Reinforced Concrete Pipe Joint Device: ASTM C443 (ASTM C443M) rubber compression gasket joint.

2.04 BEDDING AND COVER MATERIALS

A. Bedding: As specified in Section 31 23 16.13.

B. Cover: As specified in Section 31 23 16.13.

2.05 ACCESSORIES

A. Fill at Pipe Ends: Riprap as specified in Section 31 37 00.

PART 3 EXECUTION

3.01 EXCAVATING

A. See Section 31 23 16.13 - Trenching for additional requirements.

B. Excavate culvert trench to 6 inches (150 mm) below pipe invert. Hand trim excavation for accurate placement of pipe to elevations indicated.

3.02 INSTALLATION - PIPE

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

B. Install pipe and accessories in accordance with manufacturer's instructions

C. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.

D. Shore pipe to required position; retain in place until after compaction of adjacent fills. Ensure pipe remains in correct position and to required slope.

E. Repair surface damage to pipe protective coating with two coats of compatible bituminous paint coating.

F. Install culvert end gratings.

3.03 PIPE ENDS

A. Place fill at pipe ends, at embankment slopes, at concrete aprons, to adjacent construction, and as indicated.

3.04 TOLERANCES

A. Lay pipe to alignment and slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch (3 mm) in 100 feet (30.5 m).

B. Maximum Variation From Intended Elevation of Culvert Invert: 1/8 inch (3 mm).

C. Maximum Offset of Pipe From True Alignment: 1/2 inch (6 mm).

D. Maximum Variation in Profile of Structure From Intended Position: 1 percent.

3.05 PROTECTION

A. Protect pipe and bedding from damage or displacement until backfilling operation is in progress.

END OF SECTION

STORMWATER DRAINS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Precast concrete catch basins.

B. Concrete masonry unit catch basins.

C. Cast-in-place concrete catch basins.

D. Cast-in-place concrete base pad.

E. Prefabricated drop inlets.

F. Prefabricated trench drains.

G. Frames and grates.

1.02 RELATED REQUIREMENTS

A. Section 31 23 16 - Excavation.

B. Section 31 23 23 - Fill.

C. Section 33 05 61 - Concrete Manholes.

D. Section 33 42 11 - Stormwater Gravity Piping.

E. Section 33 46 00 - Stormwater Management.

1.03 PRICE AND PAYMENT PROCEDURES

A. Catch Basins and Drop Inlets:
   1. Basis of Measurement: By the unit for a nominal depth of 6 feet (1.8 m).
   2. Basis of Payment: Includes excavation, hand trimming, bedding and backfilling, base pad, frame and grate, accessories.

B. Trench Drains:
   1. Basis of Measurement: By the linear foot (meter).
   2. Basis of Payment: Includes excavation, hand trimming, bedding and backfilling, frame and grate, accessories.

1.04 REFERENCE STANDARDS

A. AASHTO HB - Standard Specifications for Highway Bridges; 2005, with Errata.

B. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

C. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).

D. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.

E. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.

F. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

G. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

H. DIN 19580 - Drainage Channels for Vehicular and Pedestrian Areas - Durability, Mass Per Unit Area and Evaluation of Conformity; 2010.

I. DIN EN 1433 - Drainage Channels for Vehicular and Pedestrian Areas - Classification, Design and Testing Requirements, Marking and Evaluation of Conformity; 2005.

J. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.

K. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2025.

L. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

M. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2024.

N. ASTM C478/C478M - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections; 2020.

O. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2024.

P. ASTM C923/C923M - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals; 2020.

Q. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants; 2009 (Reapproved 2019).

R. ASTM G154 - Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials; 2023.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Installation of stormwater drains with piping and other structures.
   1. See Section 33 42 11 for stormwater gravity piping.
   2. See Section 33 05 61 for concrete manholes.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by affected installers.

C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.06 SUBMITTALS

A. Product Data: Weight rating for catch basins, drop inlets, trench drains, and frame and grates.

B. Shop Drawings: Indicate stack assembly, invert elevations, opening sizes, and pipe angles.

C. Manufacturer's Installation Instructions: Indicate special procedures for assembly.

D. Designer's qualification statement.

E. Manufacturer's qualification statement.

F. Installer's qualification statement.

G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

H. Field Quality Control Submittals: Document results of field quality control testing.

I. Project Record Documents:
   1. Record invert elevations of catch basins, drop inlets, and trench drains.
   2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.07 QUALITY ASSURANCE

A. Designer Qualifications: Perform design under direct supervision of a Professional Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of experience.

C. Installer Qualifications: Company specializing in installing work of the type specified in this section, and with at least three years of experience.

D. Documents at Project Site: Maintain one copy of manufacturer's instructions, assembly drawings, and shop drawings at the project site.

E. Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.
   1. Maintain one copy of each document on site.

F. Follow recommendations of ACI PRC-305 when concreting during hot weather.

G. Follow recommendations of ACI PRC-306 when concreting during cold weather.

PART 2 PRODUCTS

2.01 CATCH BASINS

A. Weight Rating: HS20 according to AASHTO HB.

B. Precast Concrete Catch Basins: Comply with ASTM C478/C478M, reinforced.
   1. Wall Thickness: 6 inches (152 mm) minimum.
   2. Base Thickness: 12 inches (305 mm).
   3. Cone Thickness: 6 inches (152 mm).
   4. Lid Thickness: 10 inches (254 mm).
   5. Reinforcement: Formed steel wire, galvanized finish, wire diameter as indicated on drawings.
   6. Joint Sealant: Comply with ASTM C990.

C. Cast-In-Place Concrete Catch Basins: Comply with ASTM C94/C94M, reinforced.
   1. Wall Thickness: 6 inches (152 mm) minimum.

D. Cast-In-Place Concrete Base Pads: Comply with ASTM C94/C94M, reinforced.
   1. Thickness: 12 inches (305 mm).
   2. Width: Match outside catch basin diameter.
   3. Length: Match outside catch basin diameter.

E. Grade Adjustments:
   1. Adjustment Ring: Concrete, 6 inches (152 mm) wide, diameter matching frame dimensions, in accordance with ASTM C478/C478M.

F. Frames and Grates: Steel, HS20 loaded, checkerboard pattern, minimum 1 by 1 inch (25 by 25 mm).

2.02 DROP INLETS

A. Weight Rating: HS20 according to AASHTO HB.

B. Prefabricated Drop Inlet: Polymer concrete, metal installation brackets.

C. Frames and Grates: Galvanized steel support, steel grate, checkerboard pattern, match drain opening size.

2.03 CATCH BASIN, TRENCH DRAIN, CLEANOUT, AND AREA DRAIN COMPONENTS

A. Lids and Drain Covers: As shown on the design drawings, unless otherwise indicated: Cast iron, hinged or bolted to cast iron frame.
   1. Catch Basin:
      a. Lid Design: Checkerboard grill.
      b. Nominal Lid and Frame Size: 12 by 12 inch (305 by 305 mm).
      c. Nominal Lid and Frame Size: 12 inches (305 mm) diameter.
   2. Cleanout:
      a. Lid Design: Checkerboard grill.
      b. Nominal Lid and Frame Size: 24 by 24 inch (610 by 610 mm).
      c. Nominal Lid and Frame Size: 26 inches (660 mm) diameter.
   3. Area Drain:
      a. Lid Design: Checkerboard grill.
      b. Nominal Lid and Frame Size: 12 by 12 inch (305 by 305 mm).
      c. Nominal Lid and Frame Size: 12 inches (305 mm) diameter.
   4. Trench Drain:
      a. Lid Design: Linear grill.
      b. Nominal Lid and Frame Size: 4 inches (102 mm) width.

2.04 PREFABRICATED TRENCH DRAINS

A. Prefabricated Trench Drain: Concrete or metal, metal installation brackets.
   1. Weight Rating: HS20 according to AASHTO HB.

2. Bottom: Sloped.
3. Ultraviolet Exposure: 10 years minimum, ASTM G154.
4. Frames and Grates: Galvanized steel support, steel grate, linear pattern, match drain opening size.

2.05 ACCESSORIES

A. Treatment System: Capable of removing debris, dissolved metals, gross solids, nutrients, suspended solids, and turbidity.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify items provided by other sections of work are properly sized and located.

B. Verify built-in items are in proper location and ready for roughing into work.

C. Verify excavation location and depth are correct.

3.02 EXCAVATION AND FILL

A. Hand trim excavation for accurate placement to indicated elevations.

B. Backfill with cover fill, tamp in place and compact, then complete backfilling.

C. See Section 31 23 16 for additional excavation requirements.

D. See Section 31 23 23 for additional fill requirements.

3.03 INSTALLATION

A. Establish elevations and pipe inverts for inlets and outlets as indicated in drawings.

B. Precast Concrete Catch Basins:
1. Place base section plumb and level.
2. Install joint sealant uniformly around section lip.
3. Overlay additional sections on joint sealant.
4. Install cone or lid plumb and level on joint sealant.

C. Cast-In-Place Concrete Base Pad:
1. Form bottom of excavation walls clean and smooth to correct limits.
2. Install reinforcement in maximum lengths. Offset end laps in both directions. Splice laps with tie wire.
3. Place concrete in accordance with ACI PRC-304.
4. Float base pad top surface level.

D. Cast-In-Place Concrete Catch Basins:
1. Form catch basin on excavation bottom plumb and level.
2. Form catch basin on concrete base pad plumb and level.
3. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
4. Install reinforcement in maximum lengths. Offset end laps in both directions. Splice laps with tie wire.
5. Place concrete in accordance with ACI PRC-304.
6. Float catch basin top surface level.

E. Prefabricated Drop Inlets, Trench Drains, or Slot Drains:
1. Place base section plumb and level.
2. Install according to manufacturer's instructions.
3. Secure installation brackets.
4. Protect drain from foreign material.

F. Grade Adjustments:
1. Lay concrete ring on mortar bed plumb and level. Top with mortar, plumb and level.
2. Place adjacent materials tight and smooth following design grades.

G. Frames and Grates:
   1. Place frame plumb and level.
   2. Mount frame on mortar bed at indicated elevation.
   3. Mount frame on prefabricated drop inlets or trench drains according to manufacturer's instructions.
   4. Place grate in frame securely.

3.04 FIELD QUALITY CONTROL

A. Perform field inspection for pipe invert elevations.

B. If inspections indicate work does not meet specified requirements, adjust work and reinspect at no cost to Owner.

END OF SECTION