

SECTION 32 01 16 ASPHALT OVERLAY

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Section specifies the requirements for scarifying, grinding, sweeping and repair of existing asphalt concrete pavement to establish a base course and provide a new asphalt surface course to the lines, grades and elevations as determined from the drawings and in accordance with these specifications.

1.2 APPLICABLE PUBLICATIONS

The following publications of the latest issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

- A. Texas Department of Transportation 2004 Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges (TxDOT).
 - 1. Item 247 - Flexible Base
 - 2. Item 300 - Asphalts, Oils and Emulsions
 - 3. Item 302 – Aggregates for Surface Treatments
 - 4. Item 310 – Prime Coat
 - 5. Item 320 – Equipment for Asphalt Concrete Pavement
 - 6. Item 340 – Dense Graded Hot Mix Asphalt
 - 7. Item 292 – Asphalt Treatment (Plant Mix)
- B. American Society for Testing and Materials Standards (ASTM)
 - 1. D 698 - Moisture Density Relations of Soil Using 5.5 Pound Rammer and 12 Inch Drop.
 - 2. D 8-02 – Standard Terminology Relating to Materials for Road Pavements
- C. Texas Department of Transportation Test Procedures
 - 1. TEX 207-F – Determining Density of Compacted Bituminous Mixtures
 - 2. TEX 227-F – Theoretical Maximum Specific Gravity of Bituminous Mixtures
 - 3. TEX 227-F – Theoretical Maximum Specific Gravity of Bituminous Mixtures

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 11 00 Clearing and Grubbing
- B. Section 31 22 13 Site Grading

- C. Section 31 25 13 Erosion and Sedimentation Control
- D. Section 32 17 23.13 Painted Pavement Markings
- E. Section 32 17 23.33 Thermoplastic Pavement Markings

1.4 DEFINITIONS

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
- B. Material Certificates: For each paving material, signed by manufacturers.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Manufacturer shall be a paving-mix manufacturer registered with and approved by authorities having jurisdiction or if none exists, the DOT of the state in which Project is located.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:
 - 1. Prime and Tack Coats: Minimum surface temperature of 60 deg F.
 - 2. Slurry Coat: Comply with weather limitations of ASTM D 3910.
 - 3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
 - 4. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 ASPHALTIC MATERIALS

- A. Asphaltic material shall conform to the applicable requirements of TxDOT Item 300.
 - 1. Asphalt cement shall be AC-20.
 - 2. Prime coat shall be MC-250 or as directed by the Engineer.
 - 3. Tack coat shall be CSS-1, CSS-1h, RS-1, or CRS-1 as directed by the Engineer

2.2 MINERAL AGGREGATES

- A. The coarse aggregate, fine aggregate, and mineral filler shall conform to the requirements of TxDOT Item 340 article 340.2.A.1 Course Aggregate, 340.2.A.3 Fine Aggregate and 340.2.B Mineral Filler

2.3 ADDITIONAL BASE MATERIAL

- A. Additional Crushed Limestone required per section 3.3.B below shall conform to the following requirements:
 - 1. Table 1 in TxDOT Item 247.2.A Aggregate for Grade 2 when constructing roadways and Grade 3 when constructing parking lots.
 - 2. Test results: Maximum Liquid Limit = 40; Maximum Plasticity Index = 12
 - 3. Materials must be Crushed stone produced and graded from oversize quarried aggregate that originates from a single, naturally occurring source. Do not use gravel or multiple sources.

2.4 SURFACE COURSE AGGREGATE

- A. Surface course aggregate material shall be composed of clean, tough and durable particles of gravel, crushed gravel or crushed stone meeting the sieve analysis requirements of TxDOT Item 302 "Type D"

2.5 EQUIPMENT

- A. All equipment necessary to perform the work within the scope of this Section shall conform to requirements of Item 320, TxDOT.

2.6 WATER

- A. Water used for mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable matter or other substances injurious to the finished product.
- B. Water sources other than the local municipal domestic water supply must be approved by the Owner.
 - 1. If onsite reclaimed water sources are used, tanks and apprentices must be clearly marked with the words "non-potable" water.

PART 3 - EXECUTION

3.1 GENERAL

- A. The equipment to be provided for the recycling and stabilization of the material specified herein shall include but not be limited to the following:
- B. Recycling Unit: The recycling unit shall be a self propelled unit consisting of a variable speed rotor equipped with a minimum of 100 removable cutting teeth. The rotor shall have a minimum cutting width of 72 inches and a minimum cutting depth of 9 inches.

- C. Compaction Equipment: The compaction equipment used to compact the stabilized material shall consist of approved rollers including pneumatic, steel wheel, and vibratory sheepsfoot of sufficient compactive effort to attain the required density requirements.
- D. Water Placement Equipment: The equipment used to add water to the mixed material shall include spray bars or other distribution devices which will insure even distribution of water across the surface of the mixture. The equipment shall have adequate capacity to distribute the water during one application.

3.2 EROSION PROTECTION

- A. There shall be at all times adequate protection to newly graded areas to prevent soil erosion as provided in Section 31 25 13 Erosion and Sedimentation Control.
- B. Soil erosion that occurs prior to acceptance of the work shall be repaired at no expense to the Owner.

3.3 CONSTRUCTION METHOD

- A. Prior to the start of the milling/mixing operations the pavement surface shall be cleaned of any loose materials and any and all vegetation. This shall be accomplished by blading and sweeping.
- B. All asphalt and base material where specified shall be removed and relocated to a stockpile area. Additional base material consisting of crushed limestone per section 2.2 above as required shall be added to the stockpiled mix. The limestone material shall be thoroughly mixed with the stockpiled material to a uniform gradation throughout the mixture.
- C. The completely mixed composite base material shall then be relocated to its original location after the subgrade has been lime stabilized per Section 31 32 13.19 "Lime Stabilization." Water shall be added during this operation until the optimum moisture content has been reached. The water shall be introduced into the mixture and shall be uniformly mixed throughout the material.
- D. The base material shall be compacted as described in TxDOT ITEM 247 Flexible Base per article 247.4.C Compaction using Density Controls.
- E. Degree of finish:
 - 1. The surface of the completed pavement will be checked longitudinally and transversely for smoothness with a 10 foot straightedge.
 - 2. The surface shall not vary more than 1/4" in 16 feet. Correct by loosening, adding or removing material, reshaping and recompacting in accordance with part C above.
- F. Base course shall be allowed to cure until the moisture content is at least 2 percentage points below optimum before applying the next successive course or prime coat.
- G. Contractor shall take special care in working in the area of underground electrical conduit for parking lot lights.

3.4 ASPHALTIC STABILIZED BASE

- A. Before any material is placed, the subgrade and subgrade material shall be approved by the Owner. Subgrade fill material shall conform to the specifications for select fill as outlined in Site Grading Section 31 22 13, Article *2.2.A.2,* prepared and placed to the lines and grades shown on the plans. This does not preclude using site soils if they can be made to meet these specifications. Subgrade must be compacted to 95% of standard density in accordance with Section 31 22 13 before placing any base material. Where required by these specifications or as shown on the plans, the subgrade shall be stabilized with lime or cement.
- B. Asphaltic stabilized base course shall be stockpiled, stored, proportioned, mixed and applied in accordance with Article 340.4 Item 340, TxDOT.
- C. A tack coat of 0.05 to 0.15 gallons per square yard of surface shall be applied on each layer of the black base course and allowed to cure before placing the succeeding course.
- D. The asphaltic stabilized base material shall be spread and shaped to a thickness and cross section that will provide the required thickness and section after compaction.
- E. Compacting and finishing shall be accomplished as follows:
 - 1. The mix shall be compacted immediately after placing.
 - 2. Initial rolling with a steel-wheeled tandem roller, steel three-wheeled roller, or a pneumatic-tired roller shall follow the paver as close as possible.
 - 3. Intermediate rolling with a pneumatic-tired roller shall follow the paver as close as possible.
 - 4. Final rolling shall eliminate marks from previous rolling.
 - 5. Initial, Intermediate and Final rolling pattern input can be obtained from Testing Laboratory in order to meet compaction and density requirements stated below.
 - 6. In areas too small for the roller, a vibrating plate compactor or a hand tamper shall be used to achieve thorough compaction.
 - 7. Compaction with Density Control shall meet requirements stated in TxDOT Item 292.4.E
 - 8. Target density will be determined by taking the average density of five laboratory-prepared specimens collected at random from trucks delivering the mixture to the job site. A bulk sample must be taken at least every 300 tons or at a minimum of 1 per day.
 - 8. Samples will be tested in accordance with TEX 207-F, TEX 222-F and TEX 227-F and test results shall be reported the same day the tests are made.
- F. Degree of finish:
 - 1. The surface of the completed pavement will be checked longitudinally and transversely for smoothness with a 10 foot straightedge.
 - 2. The surface shall not vary more than 1/8" in 10 feet.

- G. Base course shall be allowed to cure for a minimum of 72 hours prior to asphalt surfacing.

3.5 ASPHALT SURFACE COURSE

- A. Asphalt surface course shall be applied in accordance with Article 340.4, Item 340, TxDOT.
- B. Prior to the application of the prime coat, the prepared base shall be cleaned of all foreign or objectionable matter with power blowers, power brooms, or hand brooms as required.
- C. Prime coat shall be applied to the base at a rate ranging from 0.2 to 0.5 gallons per square yard of surface.
- D. Prime coat shall be applied in accordance with Item 310, TXDOT.
 - 1. Material shall be as specified in paragraph *2.1 ASPHALTIC MATERIALS*.
 - 2. Application temperature 100 degrees F.
- E. A tack coat of 0.05 to 0.15 gallons per square yard of surface shall be applied on each layer of the surface course and allowed to cure before placing the succeeding course.
- F. Compacting and finishing shall be accomplished as follows:
 - 1. The mix shall be compacted immediately after placing.
 - 2. Initial rolling with a steel-wheeled tandem roller, steel three-wheeled roller, or a pneumatic-tired roller shall follow the paver as close as possible.
 - 3. Intermediate rolling with a pneumatic-tired roller shall follow the paver as close as possible.
 - 4. Final rolling shall eliminate marks from previous rolling.
 - 5. In areas too small for the roller, a vibrating plate compactor or a hand tamper shall be used to achieve thorough compaction.
 - 6. Compaction with Air Void Control shall meet requirements stated in TxDOT Item 340.4.H
 - 7. Target density will be determined by taking the average density of five laboratory-prepared specimens collected at random from trucks delivering the mixture to the job site. A bulk sample must be taken at least every 300 tons or at a minimum of 1 per day.
 - 8. Samples will be tested in accordance with TEX 207-F, TEX 222-F and TEX 227-F and test results shall be reported the same day the tests are made
 - 9. The surface of the completed pavement will be checked longitudinally and transversely for smoothness with a 10 foot straightedge.
 - 10. The surface shall not vary more than 1/8" in 10 feet.

3.6 TESTING AND INSPECTION

- A. Contractor shall notify Owner's testing **laboratory 24 hours** in advance of beginning any earth work operations and coordinate testing schedules to meet these specifications.
- B. Base Course testing
 - 1. Maximum density tests per ASTM D 698-07e1 shall be taken on all fill materials at a rate of one test for every 100 cubic yards of fill.
 - 2. Field density tests per ASTM D 1556-07 shall be taken on all fill material at a rate of one test for every 100 cubic yards of fill.
 - 3. All imported fill material shall be approved prior to importing.
 - 4. Contractor shall provide certifications from the Owner approved testing laboratory that the specified quantity of cement has been provided.
 - 5. Payment of any and all pay requests will not be made until specified tests are submitted to the Owner.
- C. Surface Course Testing
 - 1. Samples will be tested in accordance with TEX 207-F, TEX 222-F and TEX 227-F and test results shall be reported the same day the tests are made

3.7 DUST ABATEMENT

- A. The Contractor shall comply with applicable Federal, State, and local laws and regulations concerning the prevention and control of dust pollution.
- B. During the performance of the work required by these specifications or any operations appurtenant thereto, whether on right-of-way provided by the Owner or elsewhere, the Contractor shall furnish all the labor, equipment, materials, and means required, and shall carry out proper and efficient measures wherever and as often as necessary to reduce the dust nuisance, and to prevent dust which has originated from his operations from damaging crops, orchards, cultivated fields, and dwellings, or causing a nuisance to persons. The Contractor will be held liable for any damage resulting from dust originating from his operations under these specifications.
- C. Dust Control shall be accomplished by one of the following methods:
 - 1. Whenever ordered by the Owner, the Contractor shall furnish and distribute over the traveled road surfaces, which have not yet been fully restored, an application of Calcium Chloride. The material used shall be Regular Flake Calcium Chloride having a minimum chemical content of Calcium Chloride of 77%. Unless otherwise specified or ordered by the Owner, rate of application shall be three (3) pounds per square yard of surface covered.
 - 2. Whenever ordered by the Owner, the Contractor shall apply on traveled road surfaces "Bituminous Surface Treatment" in accordance with the current Texas Standard Specifications for Construction of Highways, Streets and Bridges.

- D. The cost of sprinkling or of other methods of reducing formation of dust shall be included in the prices bid in the schedule for other items of work.

END OF SECTION

SECTION 32 01 16.72 – ASPHALT PAVEMENT RECYCLING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Section pertains to the recycling of the existing site pavement base and wearing surface materials, mixing of cement with these materials, adding moisture to this mixture and compacting these materials to form a pavement base in accordance with these specifications.
- B. The work performed hereunder shall include the furnishing of all labor, materials, equipment and incidentals necessary to thoroughly mill, grind and mix the existing flexible base material and asphalt wearing surface to a uniform gradation. Additional flexible base material of the type specified may be required to obtain the desired thickness.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Drawings and general provisions of the Contract, including A-procurement and Contracting Requirements, Division 00 and Division 01 apply to this section.
- B. Section 31 32 13.19 Lime Stabilization
- C. Section 31 32 13.26 Lime Fly Ash or Fly-Ash Stabilization
- D. Section 31 32 13.16 Cement Stabilization
- E. Section 31 25 13 Erosion and Sedimentation Control
- F. Section 32 12 16 Asphalt Concrete Paving
- G. Section 32 13 13 Concrete Paving

1.3 PERMITS

- A. Prior to commencement of work, the Contractor shall be responsible for obtaining, at his own expense, all construction permits necessary to complete the project according to the plans and specifications.

1.4 APPLICABLE PUBLICATIONS

- A. The following specifications of the latest issue listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent required by the references thereto.
 - 1. Texas Department of Transportation (TxDOT), 2004 Standard Specifications for Construction of Highways, Streets and Bridges (TxDOT).
 - a. Item 247 Flexible Base
 - 2. American Society for Testing and Materials (ASTM).
 - a. D 698-07e1 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Efforts (12,400 ft-lbf/ft³ (600kN-m/m²)).

- b. D 1556-07 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.

1.5 DEFINITIONS

- A. Subgrade: The uppermost surface of an excavation, including excavation for trenches, or the top surface of a fill or backfill immediately below base course, pavement, or topsoil materials.
- B. Backfill: Soil material or controlled low-strength material used to fill an excavation.
- C. Base Course: The layer placed between the subgrade and surface pavement in a paving system.
- D. Geotechnical Engineer: Person or company contracted by the owner and/or through the architect to provide testing and onsite Geotechnical services during the construction schedule.

1.6 QUALITY ASSURANCE

- A. Testing of materials and installed work
 - 1. Materials and installed work require testing to show that the specifications for the materials and work have been met. The Owner may, at his expense, take random tests on materials and installed work. The Contractor shall allow free access to material stockpiles and facilities at all times. In fill areas each lift must be tested and approved before proceeding on the next lift. Contractor shall give 24 hour notice when testing is required. Tests, not specifically indicated to be done at Owner's expense including the retesting of rejected materials and installed work, shall be done at the Contractor's expense.
 - 2. The Contractor shall provide testing to verify that the specified density for the stabilized base material. The Contractor must also submit tests agreed to by the Contractor, Owner, Engineer and Contractor's testing lab, verifying that the specified amount of cement (minimum 6% by weight) has been added to the base material, and that a 7-day unconfined compressive strength of 300 psi has been achieved.

1.7 PROJECT/SITE CONDITIONS

- A. Protection of existing utilities and adjacent work
 - 1. Prior to earthwork operations, existing utilities, facilities and permanent objects to remain shall be located and adequately protected. When working near public and private utility company lines Contractor shall contact the local utility coordinating committee or the utility company involved to locate their lines.
 - 2. If unknown and uncharted utilities are encountered during excavation, promptly notify Owner and the governing utility company when determinable and wait for instructions.
 - 3. If it is ascertained by Owner that such utility line has been abandoned, properly cap line at a depth approved by Owner or remove line as directed.

4. If such unknown utilities are encountered and work is continued without contacting the Owner for instructions, and damage is caused to said utilities, Contractor shall repair, at his own expense, such damage to the satisfaction of the Owner and the Utility Company.
- B. Upon completion of the grinding, milling and mixing operation, the material shall be stabilized by the incorporation of Portland Cement at a minimum of 6% by weight to achieve a 7-day unconfined compressive strength of 300 psi.

PART 2 - MATERIALS

2.1 WATER

- A. Water used for mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable matter or other substances injurious to the finished product.
- B. Water sources other than the local municipal domestic water supply must be approved by the Owner.
 1. If onsite reclaimed water sources are used, tanks and apprentices must be clearly marked with the words "non-potable" water.

2.2 CRUSHED LIMESTONE

- A. Additional Crushed Limestone required per section 3.3.B below shall conform to the following requirements:
 1. Table 1 in TxDOT Item 247.2.A Aggregate for Grade 2 when constructing roadways and Grade 3 when constructing parking lots.
 2. Test results: Maximum Liquid Limit = 40; Maximum Plasticity Index = 12
 3. Materials must be Crushed stone produced and graded from oversize quarried aggregate that originates from a single, naturally occurring source. Do not use gravel or multiple sources.

PART 3 - EXECUTION

3.1 GENERAL

- A. The equipment to be provided for the recycling and stabilization of the material specified herein shall include but not be limited to the following:
- B. Recycling Unit: The recycling unit shall be a self propelled unit consisting of a variable speed rotor equipped with a minimum of 100 removable cutting teeth. The rotor shall have a minimum cutting width of 72 inches and a minimum cutting depth of 9 inches.
- C. Compaction Equipment: The compaction equipment used to compact the stabilized material shall consist of approved rollers including pneumatic, steel wheel, and vibratory sheepsfoot of sufficient compactive effort to attain the required density requirements.
- D. Water Placement Equipment: The equipment used to add water to the mixed material shall include spray bars or other distribution devices which will insure even distribution of water

across the surface of the mixture. The equipment shall have adequate capacity to distribute the water during one application.

3.2 EROSION PROTECTION

- A. There shall be at all times adequate protection to newly graded areas to prevent soil erosion as provided in Section 31 25 13, Erosion and Sedimentation Control.
- B. Soil erosion that occurs prior to acceptance of the work shall be repaired at no expense to the Owner.

3.3 CONSTRUCTION METHOD

- A. Prior to the start of the milling/mixing operations the pavement surface shall be cleaned of any loose materials and any and all vegetation. This shall be accomplished by blading and sweeping.
- B. All asphalt and base material where specified shall be removed and relocated to a stockpile area. Additional base material consisting of crushed limestone per section 2.2 above as required shall be added to the stockpiled mix. The limestone material shall be thoroughly mixed with the stockpiled material to a uniform gradation throughout the mixture.
- C. The completely mixed composite base material shall then be relocated to its original location after the subgrade has been lime stabilized per Section 31 32 13.19 "Lime Stabilization." Water shall be added during this operation until the optimum moisture content has been reached. The water shall be introduced into the mixture and shall be uniformly mixed throughout the material.
- D. The base material shall be compacted as described in TxDOT ITEM 247 Flexible Base per article 247.4.C Compaction using Density Controls.
- E. Degree of finish:
 - 1. The surface of the completed pavement will be checked longitudinally and transversely for smoothness with a 10 foot straightedge.
 - 2. The surface shall not vary more than 1/4" in 16 feet. Correct by loosening, adding or removing material, reshaping and recompacting in accordance with part C above.
- F. Base course shall be allowed to cure until the moisture content is at least 2 percentage points below optimum before applying the next successive course or prime coat.
- G. Contractor shall take special care in working in the area of underground electrical conduit for parking lot lights.

3.4 TESTING AND INSPECTION

- A. Contractor shall notify Owner's testing laboratory 24 hours in advance of beginning any earth work operations and coordinate testing schedules to meet these specifications.
- B. All imported fill material shall be approved prior to importing.

- C. Contractor shall provide certifications from the Owner approved testing laboratory that the specified quantity of cement has been provided.
- D. Payment of any and all pay requests will not be made until specified tests are submitted to the Owner.

3.5 DUST ABATEMENT

- A. The Contractor shall comply with applicable Federal, State, and local laws and regulations concerning the prevention and control of dust pollution.
- B. During the performance of the work required by these specifications or any operations appurtenant thereto, whether on right-of-way provided by the Owner or elsewhere, the Contractor shall furnish all the labor, equipment, materials, and means required, and shall carry out proper and efficient measures wherever and as often as necessary to reduce the dust nuisance, and to prevent dust which has originated from his operations from damaging crops, orchards, cultivated fields, and dwellings, or causing a nuisance to persons. The Contractor will be held liable for any damage resulting from dust originating from his operations under these specifications.
- C. Dust Control shall be accomplished by one of the following methods:
 - 1. Whenever ordered by the Owner, the Contractor shall furnish and distribute over the traveled road surfaces, which have not yet been fully restored, an application of Calcium Chloride. The material used shall be Regular Flake Calcium Chloride having a minimum chemical content of Calcium Chloride of 77%. Unless otherwise specified or ordered by the Owner, rate of application shall be three (3) pounds per square yard of surface covered.
 - 2. Whenever ordered by the Owner, the Contractor shall apply on traveled road surfaces "Bituminous Surface Treatment" in accordance with the current Texas Standard Specifications for Construction of Highways, Streets and Bridges.
- D. The cost of sprinkling or of other methods of reducing formation of dust shall be included in the prices bid in the schedule for other items of work.

END OF SECTION

SECTION 320190.13

LANDSCAPE MAINTENANCE FOR 90 DAYS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for 90 day landscape maintenance for the following:

1. Watering trees and grass.
2. Monitoring adjustment and minor repair of the landscape irrigation system.
3. Mowing, edging and trimming of lawn areas.
4. Monitoring, fertilizing, weeding, and cultivating of lawn areas.
5. Pruning and trimming of plant material.
6. Weed, cultivating and cleaning of planting beds.
7. Application of fertilizers, insecticides, and herbicides.
8. General site clean up; removal of trash and products of maintenance.
9. Replacement of trees, shrubs, groundcovers, sod and hydromulch.
10. Sediment removal from bayou high water.
11. Extra services as needed.

B. Related Sections

1. Turfs and Grasses - Section 329200
2. Trees, Shrubs, and Ground Covers - Section 329313
3. Planting Irrigation Systems – Section 328400

1.2 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- E. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.3 EXTRA SERVICES

- A. All services not covered under this contract shall be considered "extra services" and will be charged for separately according to the nature of the item of work. The consent and authorization of the Owner or their authorized representative must be obtained prior to the performance or installation of such "extra services" items and prior to purchase of any chargeable materials.
- B. Plant replacements as a result of flood damage.

1.4 MAINTENANCE REQUIREMENTS

- A. Begin maintenance after each plant and lawn portion is installed.
- B. Maintenance period shall begin upon inspection and approval at Substantial Completion by phase and shall be for ninety (90) days.
- C. Sprinkler Irrigation System: Maintenance of the sprinkler irrigation system shall consist of monitoring and adjustment of the duration and frequency of the watering schedule, adjustment of heads for coverage and elevation, repair of leaks in both mains and lateral lines and all other work required to establish a complete working sprinkler irrigation system.
- D. Trees, Shrubs, Groundcovers and Vines: Maintenance of new planting shall consist of watering, cultivating, weeding, mulching, re-staking, tightening and repairing of guys, resetting plants to proper grades or upright position, restoration of the planting saucer, and furnishing and applying such sprays and invigorants as are necessary to keep the plantings free of insects and disease and in thriving condition.
- E. Lawns: Maintenance of new lawns shall consist of mowing, edging, raking, watering, weeding, fertilizing, and repair of all erosion, reseeding and resodding as necessary, to establish a uniform stand of the specified grasses.

1.5 PROTECTION

- A. Protect planting areas and lawns at all times against damage of all kinds for duration of maintenance period. Maintenance includes temporary protection fences, barriers and signs as required for protection. If any plants become damaged or injured, because sufficient protection was not provided, treat or replace as directed by Owner at no additional cost to Owner.

1.6 NEGLECT AND VANDALISM

- A. Turf, shrubs, trees or plants that are damaged or killed due to contractors operations, negligence or chemicals shall be replaced at no expense to the Owner. If plant damage or death is caused by conditions beyond the contractor's control, replacement shall be at the Owner's expense.

- B. Sprinklers or structures that are damaged due to the contractor's operations must be replaced by the contractor promptly. Likewise, damage to the irrigation system by others shall be corrected immediately by the contractor, at the Owner's expense.
- C. All man made water damage, resulting from Contractor's neglect shall be corrected at Contractor's expense.
- D. All damage to or thefts of landscaping and irrigation installations not caused or allowed by the contractor shall be corrected by the contractor at the Owner's expense upon receipt of written authorization to proceed.

1.7 EMERGENCIES

- A. Answer emergency or complaint calls regarding conditions in landscaped areas regarding fallen trees or branches or shrubs or trees that obstruct the trail or other pavement within 1 hour and correct the problem or place warning signs and advise the Owner of the need for major work to be performed within 4 hours of the initial contact.
- B. Answer emergency calls regarding the landscape irrigation system failure or need of repair.

1.8 FINAL ACCEPTANCE

- A. Work under this Section will be accepted by Owner's representative upon satisfactory completion of all work, including maintenance, but exclusive of the required guaranteed sprinkler irrigation obligations, replacement of plant materials and lawns under the Warranty Period. Upon Final Acceptance, the Owner will assume responsibility for maintenance of the work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fertilizers, soil amendments, equipment, or other materials required for installed items shall match those already in use.
- B. Samples of all materials not specified under other Sections of these Specifications shall be submitted for review by Owner's representative prior to use.

PART 3 - EXECUTION

3.1 REQUIRED EQUIPMENT

- A. Employ the necessary maintenance equipment.

3.2 WATERING

- A. It shall be the responsibility of the Contractor to assure that the correct watering of plant materials is being accomplished through the following irrigation services:
1. Regular deep watering to all new trees until there are definite signs that the trees have established themselves and new growth is apparent. Deep watering shall be accomplished with hoses and water truck equipment.
 2. Frequent watering to the lawn areas to insure against drying. This may be accomplished as above, by hand watering or portable sprinklers.

3.3 LANDSCAPE IRRIGATION SYSTEM

- A. Monitor and program the automatic controlling devices to provide optimum moisture levels in all planted areas.
1. Irrigation cycles shall be set to take place prior to sunrise (usually 4:00 - 5:00 am) unless otherwise instructed by the Owner, except during visits of grounds maintenance personnel; during such visits the irrigation system may be operated as desired by those personnel.
 2. If there is more than one irrigation controller, do not program to water during the same time period as over-draft of water meters will result. Set controllers so that one finishes watering cycle before next starts watering cycle. During periods of high rainfall, set controllers to "dry mode" until irrigation is needed. Do not switch controller to "off", as this will stop time clock.
 3. Complete sprinkler system servicing shall be performed as required to maintain sprinklers in correct operating condition, including all required labor. Operation of sprinklers shall be monitored on a bi-monthly basis to assure proper cover and operation.
 4. Adjust sprinklers to avoid damage to windows and buildings. Make repairs and alterations to the sprinkling system and water lines. All sprinklers repairs such as cleaning of heads or breaks caused by the Contractor shall be the Contractor's responsibility.
 5. Perform minor additions, subtractions and/or adjustments to irrigation equipment (i.e., addition of spray head or riser extension) as may be required in order to conform to the irrigation requirements herein specified. Such additions, subtractions and/or realignments to irrigation system equipment shall not materially reduce the extent or value of the irrigation system equipment, and shall be accomplished after securing approval of the Owner.
 6. Supplemental irrigation beyond that which can be provided by the irrigation system shall be provided by the grounds maintenance firm as required in order to assure optimum moisture levels.
 7. Sediment removal from project site as a result of bayou tide rising and receding by use of project stand pipes.

3.4 MAINTENANCE OF TURF AREAS

- A. Mowing lawn/grass areas shall be accomplished with sharp, properly adjusted mowers of the correct size for the various areas.
- B. Mowing frequency shall be as per the Landscape Maintenance Program. Blade heights shall be set according to the following schedule:
 - 2 Inches Initial Mowing
 - 2-1/2 Inches April - November
- C. In the event of a prolonged rainy period and a surge of leaf growth is anticipated, the mower height may be re-adjusted to prevent "scalping" or skinning of lawn on preceding cuts.
- D. Lawn shall be edged evenly at all walks, headers and other structures as per Landscape Maintenance Program.
- E. Until the establishment of the turf, the Contractor will be responsible for replacing soils that have eroded onto the paved areas. Residual soils on paving will be removed and if not mingled with objectionable materials, may be re-used in eroded areas.
- F. Immediately upon observing any lawn grass spreading into shrub or groundcover areas, the Contractor shall initiate a program of mechanical removal and maintain this program throughout the maintenance period.
- G. Any lawn grass appearing in paved areas shall receive an application of soil sterilant according to manufacturer's direction. The sterilant shall be approved and will not be detrimental structurally to paved areas.
- H. Special effort shall be given to the control of fire ants infesting the site. After control is accomplished, the ant mounds shall be lowered and tamped to the existing grade.
- I. Removal of debris from the site unrelated to horticultural maintenance (paper, bottles, cans, "Pirate" signs, etc.) shall be the responsibility of the maintenance Contractor and limited to areas designated.

3.5 MAINTENANCE OF TREES, SHRUBS, AND GROUNDCOVERS

- A. Contractor shall adjust and tighten as required all tree staking and guying. Removal as directed by Owner's Representative.
- B. Contractor shall deep water all new trees until there are definite signs the trees have established themselves and are pushing out new growth.
- C. Watering basins shall be removed by Contractor after the trees have established themselves or as directed by Owner's representative. Basins are normally removed one year from time of planting.

- D. Contractor shall be continuously alert for signs of insect presence or damage or the presence or damage from plant fungi. Upon locating such evidence, the Contractor shall report it to the Owner's representative and take action as directed.

3.6 MAINTENANCE FREQUENCY SCHEDULE

- A. Mowing, Edging, Trimming, Litter Cleanup, and Watering Monitoring: Four visits per month for 12 months.
- B. Top-dress Fertilizer: Thirty days after seeding and/or sodding.
- C. Mulching, Weeding, Weed Control, and Guying Adjustment: As required each visit.
- D. Reseeding: As required upon notice.
- E. Tree and Plant Replacement: As required each visit.
- F. Trash and Debris Removal: Collect all trash and debris at each visit and dispose of off-site.

END OF SECTION 320190.13

SECTION 320190.16

LANDSCAPE MAINTENANCE FOR TWELVE MONTHS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for twelve month landscape maintenance for the following:
1. Watering trees and grass.
 2. Monitoring adjustment and minor repair of the landscape irrigation system.
 3. Mowing, edging and trimming of lawn areas.
 4. Monitoring, fertilizing, weeding, and cultivating of lawn areas.
 5. Pruning and trimming of plant material.
 6. Weed, cultivating and cleaning of planting beds.
 7. Application of fertilizers, insecticides, and herbicides.
 8. General site clean up; removal of trash and products of maintenance.
 9. Replacement of trees, shrubs, groundcovers, sod and hydromulch.
 10. Sediment removal from bayou high water.
 11. Extra services as needed.
- B. Related Sections
1. Planting Irrigation Systems – Section 328400
 2. Turfs and Grasses - Section 329200
 3. Trees, Shrubs, and Ground Covers - Section 329313

1.2 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- E. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.
- F. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.3 EXTRA SERVICES

- A. All services not covered under this contract shall be considered "extra services" and will be charged for separately according to the nature of the item of work. The consent and authorization of the Owner or their authorized representative must be obtained prior to the performance or installation of such "extra services" items and prior to purchase of any chargeable materials.
- B. Plant replacements as a result of flood damage.

1.4 MAINTENANCE REQUIREMENTS

- A. Begin maintenance after each plant and lawn portion is installed.
- B. Maintenance period shall begin upon inspection and approval at Substantial Completion by phase and shall be for twelve (12) months.
- C. Sprinkler Irrigation System: Maintenance of the sprinkler irrigation system shall consist of monitoring and adjustment of the duration and frequency of the watering schedule, adjustment of heads for coverage and elevation, repair of leaks in both mains and lateral lines and all other work required to establish a complete working sprinkler irrigation system.
- D. Trees, Shrubs, Groundcovers and Vines: Maintenance of new planting shall consist of watering, cultivating, weeding, mulching, re-staking, tightening and repairing of guys, resetting plants to proper grades or upright position, restoration of the planting saucer, and furnishing and applying such sprays and invigorants as are necessary to keep the plantings free of insects and disease and in thriving condition.
- E. Lawns: Maintenance of new lawns shall consist of mowing, edging, raking, watering, weeding, fertilizing, and repair of all erosion reseeding, resodding, necessary to establish a uniform stand of the specified grasses.

1.5 PROTECTION

- A. Protect planting areas and lawns at all times against damage of all kinds for duration of maintenance period. Maintenance includes temporary protection fences, barriers and signs as required for protection. If any plants become damaged or injured, because sufficient protection was not provided, treat or replace as directed by Owner at no additional cost to Owner.

1.6 NEGLECT AND VANDALISM

- A. Turf, shrubs, trees or plants that are damaged or killed due to contractors operations, negligence or chemicals shall be replaced at no expense to the Owner. If plant damage or death is caused by conditions beyond the contractor's control, replacement shall be at the Owner's expense.

- B. Sprinklers or structures that are damaged due to the contractor's operations must be replaced by the contractor promptly. Likewise, damage to the irrigation system by others shall be corrected immediately by the contractor, at the Owner's expense.
- C. All man made water damage, resulting from Contractor's neglect shall be corrected at Contractor's expense.
- D. All damage to or thefts of landscaping and irrigation installations not caused or allowed by the contractor shall be corrected by the contractor at the Owner's expense upon receipt of written authorization to proceed.

1.7 EMERGENCIES

- A. Answer emergency or complaint calls regarding conditions in landscaped areas regarding fallen trees or branches or shrubs or trees that obstruct the trail or other pavement within 1 hour and correct the problem or place warning signs and advise the Owner of the need for major work to be performed within 4 hours of the initial contact.
- B. Answer emergency calls regarding the landscape irrigation system failure or need of repair.

1.8 FINAL ACCEPTANCE

- A. Work under this Section will be accepted by Owner's representative upon satisfactory completion of all work, including maintenance, but exclusive of the required guaranteed sprinkler irrigation obligations, replacement of plant materials and lawns under the Warranty Period. Upon Final Acceptance, the Owner will assume responsibility for maintenance of the work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fertilizers, soil amendments, equipment, or other materials required for installed items shall match those already in use.
- B. Samples of all materials not specified under other Sections of these Specifications shall be submitted for review by Owner's representative prior to use.

PART 3 - EXECUTION

3.1 REQUIRED EQUIPMENT

- A. Employ the necessary maintenance equipment.

3.2 WATERING

- A. It shall be the responsibility of the Contractor to assure that the correct watering of plant materials is being accomplished through the following irrigation services:
1. Regular deep watering to all new trees until there are definite signs that the trees have established themselves and new growth is apparent. Deep watering shall be accomplished with hoses and water truck equipment.
 2. Frequent watering to the lawn areas to insure against drying. This may be accomplished as above, by hand watering or portable sprinklers.

3.3 LANDSCAPE IRRIGATION SYSTEM

- A. Monitor and program the automatic controlling devices to provide optimum moisture levels in all planted areas.
1. Irrigation cycles shall be set to take place prior to sunrise (usually 4:00 - 5:00 am) unless otherwise instructed by the Owner, except during visits of grounds maintenance personnel; during such visits the irrigation system may be operated as desired by those personnel.
 2. If there is more than one irrigation controller, do not program to water during the same time period as over-draft of water meters will result. Set controllers so that one finishes watering cycle before next starts watering cycle. During periods of high rainfall, set controllers to "dry mode" until irrigation is needed. Do not switch controller to "off", as this will stop time clock.
 3. Complete sprinkler system servicing shall be performed as required to maintain sprinklers in correct operating condition, including all required labor. Operation of sprinklers shall be monitored on a bi-monthly basis to assure proper cover and operation.
 4. Adjust sprinklers to avoid damage to windows and buildings. Make repairs and alterations to the sprinkling system and water lines. All sprinklers repairs such as cleaning of heads or breaks caused by the Contractor shall be the Contractor's responsibility.
 5. Perform minor additions, subtractions and/or adjustments to irrigation equipment (i.e., addition of spray head or riser extension) as may be required in order to conform to the irrigation requirements herein specified. Such additions, subtractions and/or realignments to irrigation system equipment shall not materially reduce the extent or value of the irrigation system equipment, and shall be accomplished after securing approval of the Owner.
 6. Supplemental irrigation beyond that which can be provided by the irrigation system shall be provided by the grounds maintenance firm as required in order to assure optimum moisture levels.
 7. Sediment removal from project site as a result of bayou tide rising and receding by use of project stand pipes.

3.4 MAINTENANCE OF TURF AREAS

- A. Mowing lawn/grass areas shall be accomplished with sharp, properly adjusted mowers of the correct size for the various areas.
- B. Mowing frequency shall be as per the Landscape Maintenance Program. Blade heights shall be set according to the following schedule:
 - 2 Inches Initial Mowing
 - 2-1/2 Inches April - November
- C. In the event of a prolonged rainy period and a surge of leaf growth is anticipated, the mower height may be re-adjusted to prevent "scalping" or skinning of lawn on preceding cuts.
- D. Lawn shall be edged evenly at all walks, headers and other structures as per Landscape Maintenance Program.
- E. Until the establishment of the turf, the Contractor will be responsible for replacing soils that have eroded onto the paved areas. Residual soils on paving will be removed and if not mingled with objectionable materials, may be re-used in eroded areas.
- F. Immediately upon observing any lawn grass spreading into shrub or groundcover areas, the Contractor shall initiate a program of mechanical removal and maintain this program throughout the maintenance period.
- G. Any lawn grass appearing in paved areas shall receive an application of soil sterilant according to manufacturer's direction. The sterilant shall be approved and will not be detrimental structurally to paved areas.
- H. Special effort shall be given to the control of fire ants infesting the site. After control is accomplished, the ant mounds shall be lowered and tamped to the existing grade.
- I. Removal of debris from the site unrelated to horticultural maintenance (paper, bottles, cans, "Pirate" signs, etc.) shall be the responsibility of the maintenance Contractor and limited to areas designated.

3.5 MAINTENANCE OF TREES, SHRUBS, AND GROUNDCOVERS

- A. Contractor shall adjust and tighten as required all tree staking and guying. Removal as directed by Owner's Representative.
- B. Contractor shall deep water all new trees until there are definite signs the trees have established themselves and are pushing out new growth.
- C. Watering basins shall be removed by Contractor after the trees have established themselves or as directed by Owner's representative. Basins are normally removed one year from time of planting.

- D. Contractor shall be continuously alert for signs of insect presence or damage or the presence or damage from plant fungi. Upon locating such evidence, the Contractor shall report it to the Owner's representative and take action as directed.

3.6 MAINTENANCE FREQUENCY SCHEDULE

- A. Mowing, Edging, Trimming, Litter Cleanup, and Watering Monitoring: Four visits per month for 12 months.
- B. Top-dress Fertilizer: Thirty days after seeding and/or sodding.
- C. Mulching, Weeding, Weed Control, and Guying Adjustment: As required each visit.
- D. Reseeding: As required upon notice.
- E. Tree and Plant Replacement: As required each visit.
- F. Trash and Debris Removal: Collect all trash and debris at each visit and dispose of off-site.

END OF SECTION 320190.16

SECTION 32 12 16 ASPHALT CONCRETE PAVING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Section specifies the requirements for placing a hot laid plant mix asphalt surface course upon either an asphalt stabilized base course or a crushed limestone base course, all upon a previously prepared subgrade to the lines, grades and elevations as determined from the drawings and in accordance with these specifications.

1.2 APPLICABLE PUBLICATIONS

The following publications of the latest issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

- A. Texas Department of Transportation 2004 Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges (TxDOT).
 - 1. Item 247 - Flexible Base
 - 2. Item 300 - Asphalts, Oils and Emulsions
 - 3. Item 302 – Aggregates for Surface Treatments
 - 4. Item 310 – Prime Coat
 - 5. Item 320 – Equipment for Asphalt Concrete Pavement
 - 6. Item 340 – Dense Graded Hot Mix Asphalt
 - 7. Item 292 – Asphalt Treatment (Plant Mix)
- B. American Society for Testing and Materials Standards (ASTM)
 - 1. D 698 - Moisture Density Relations of Soil Using 5.5 Pound Rammer and 12 Inch Drop.
 - 2. D 8-02 – Standard Terminology Relating to Materials for Road Pavements
- C. Texas Department of Transportation Test Procedures
 - 1. TEX 207-F – Determining Density of Compacted Bituminous Mixtures
 - 2. TEX 227-F – Theoretical Maximum Specific Gravity of Bituminous Mixtures
 - 3. TEX 227-F – Theoretical Maximum Specific Gravity of Bituminous Mixtures

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 32 17 23.13 Painted Pavement Markings

- B. Section 32 17 23.33 Thermoplastic Pavement Markings
- C. Section 31 22 13 Site Grading
- D. Section 31 11 00 Clearing and Grubbing

1.4 DEFINITIONS

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
- B. Material Certificates: For each paving material, signed by manufacturers.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
- B. Manufacturer shall be a paving-mix manufacturer registered with and approved by authorities having jurisdiction or if none exists, the DOT of the state in which Project is located.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:
 - 1. Prime and Tack Coats: Minimum surface temperature of 60 deg F .
 - 2. Slurry Coat: Comply with weather limitations of ASTM D 3910.
 - 3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
- B. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 ASPHALTIC MATERIALS

- A. Asphaltic material shall conform with the applicable requirements of TxDOT Item 300.
 - 1. Asphalt cement shall be AC-20.
 - 2. Prime coat shall be MC-250 or as directed by the Engineer.
 - 3. Tack coat shall be CSS-1, CSS-1h, RS-1, or CRS-1 as directed by the Engineer

2.2 MINERAL AGGREGATES

- A. The coarse aggregate, fine aggregate, and mineral filler shall conform to the requirements of TxDOT Item 340 article 340.2.A.1 Course Aggregate, 340.2.A.3 Fine Aggregate and 340.2.B Mineral Filler

2.3 BASE MATERIAL

- A. Acceptable base materials are as follows:
 - B. Crushed limestone conforming to the following requirements:
 - 1. Sieve analysis: TYPE "A", TxDOT Item 247, Grade 2 (roadways) and Grade 3 (parking lots).
 - 2. Test results
 - Maximum Liquid Limit 40
 - Maximum Plasticity Index 12
 - B. Crushed concrete conforming to the following requirements:
 - 1. Sieve analysis: TYPE "D", TxDOT Item 247, Grade 2, (roadways) and Grade 3 (parking lots).
 - 2. Test results
 - Maximum Liquid Limit 40
 - Maximum Plasticity Index 12

- 2.4 SURFACE COURSE AGGREGATE Surface course aggregate material shall be composed of clean, tough and durable particles of gravel, crushed gravel or crushed stone meeting the sieve analysis requirements of TxDOT Item 302 "Type D"

2.5 EQUIPMENT

- A. All equipment necessary to perform the work within the scope of this Section shall conform to requirements of Item 320, TxDOT.

PART 3 - EXECUTION

3.1 FLEXIBLE BASE

- A. Before any material is placed, the subgrade and subgrade material shall be approved by the Owner. Subgrade fill material shall conform to the specifications for select fill as outlined in Site Grading Section 31 22 13, Article *2.2.A.2,* prepared and placed to the lines and grades shown on the plans. This does not preclude using site soils if they can be made to meet these specifications. Subgrade must be compacted to 95% of standard density in accordance with Section 31 22 13 before placing any base material. Where required by these specifications or as shown on the plans, the subgrade shall be stabilized with lime or cement.
- B. Material as described in 2.3 A or B shall be spread and shaped to a thickness and cross section that will provide the required thickness and section after compaction.

- C. The base material shall be compacted as described in TxDOT ITEM 247 Flexible Base per article 247.4.C Compaction using Density Controls.
- D. Degree of finish:
 - 1. The surface of the completed pavement will be checked longitudinally and transversely for smoothness with a 10 foot straightedge.
 - 2. The surface shall not vary more than 1/4" in 16 feet. Correct by loosening, adding or removing material, reshaping and recompacting in accordance with part C above.
- E. Base course shall be allowed to cure until the moisture content is at least 2 percentage points below optimum before applying the next successive course or prime coat.

3.2 ASPHALTIC STABILIZED BASE

- A. Before any material is placed, the subgrade and subgrade material shall be approved by the Owner. Subgrade fill material shall conform to the specifications for select fill as outlined in Site Grading Section 31 22 13, Article *2.2.A.2,* prepared and placed to the lines and grades shown on the plans. This does not preclude using site soils if they can be made to meet these specifications. Subgrade must be compacted to 95% of standard density in accordance with Section 31 22 13 before placing any base material. Where required by these specifications or as shown on the plans, the subgrade shall be stabilized with lime or cement.
- B. Asphaltic stabilized base course shall be stockpiled, stored, proportioned, mixed and applied in accordance with Article 340.4 Item 340, TxDOT.
- C. A tack coat of 0.05 to 0.15 gallons per square yard of surface shall be applied on each layer of the black base course and allowed to cure before placing the succeeding course.
- D. The asphaltic stabilized base material shall be spread and shaped to a thickness and cross section that will provide the required thickness and section after compaction.
- E. Compacting and finishing shall be accomplished as follows:
 - 1. The mix shall be compacted immediately after placing.
 - 2. Initial rolling with a steel-wheeled tandem roller, steel three-wheeled roller, or a pneumatic-tired roller shall follow the paver as close as possible.
 - 3. Intermediate rolling with a pneumatic-tired roller shall follow the paver as close as possible.
 - 4. Final rolling shall eliminate marks from previous rolling.
 - 5. Initial, Intermediate and Final rolling pattern input can be obtained from Testing Laboratory in order to meet compaction and density requirements stated below.
 - 6. In areas too small for the roller, a vibrating plate compactor or a hand tamper shall be used to achieve thorough compaction.

7. Compaction with Density Control shall meet requirements stated in TxDOT Item 292.4.E
 8. Target density will be determined by taking the average density of five laboratory-prepared specimens collected at random from trucks delivering the mixture to the job site. A bulk sample must be taken at least every 300 tons or at a minimum of 1 per day.
 8. Samples will be tested in accordance with TEX 207-F, TEX 222-F and TEX 227-F and test results shall be reported the same day the tests are made.
- F. Degree of finish:
1. The surface of the completed pavement will be checked longitudinally and transversely for smoothness with a 10 foot straightedge.
 2. The surface shall not vary more than 1/8" in 10 feet.
- G. Base course shall be allowed to cure for a minimum of 72 hours prior to asphalt surfacing.

3.3 ASPHALT SURFACE COURSE

- A. Asphalt surface course shall be applied in accordance with Article 340.4, Item 340, TxDOT.
- B. Prior to the application of the prime coat, the prepared base shall be cleaned of all foreign or objectionable matter with power blowers, power brooms, or hand brooms as required.
- C. Prime coat shall be applied to the base at a rate ranging from 0.2 to 0.5 gallons per square yard of surface.
- D. Prime coat shall be applied in accordance with Item 310, TXDOT.
1. Material shall be as specified in paragraph *2.1 ASPHALTIC MATERIALS*.
 2. Application temperature 100 degrees F.
- E. A tack coat of 0.05 to 0.15 gallons per square yard of surface shall be applied on each layer of the surface course and allowed to cure before placing the succeeding course.
- F. Compacting and finishing shall be accomplished as follows:
1. The mix shall be compacted immediately after placing.
 2. Initial rolling with a steel-wheeled tandem roller, steel three-wheeled roller, or a pneumatic-tired roller shall follow the paver as close as possible.
 3. Intermediate rolling with a pneumatic-tired roller shall follow the paver as close as possible.
 4. Final rolling shall eliminate marks from previous rolling.

5. In areas too small for the roller, a vibrating plate compactor or a hand tamper shall be used to achieve thorough compaction.
6. Compaction with Air Void Control shall meet requirements stated in TxDOT Item 340.4.H
7. Target density will be determined by taking the average density of five laboratory-prepared specimens collected at random from trucks delivering the mixture to the job site. A bulk sample must be taken at least every 300 tons or at a minimum of 1 per day.
8. Samples will be tested in accordance with TEX 207-F, TEX 222-F and TEX 227-F and test results shall be reported the same day the tests are made
9. The surface of the completed pavement will be checked longitudinally and transversely for smoothness with a 10 foot straightedge.
10. The surface shall not vary more than 1/8" in 10 feet.

END OF SECTION

SECTION 32 12 36 ASPHALT SLURRY SEAL COAT

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Section specifies the requirements for placing an asphalt slurry seal coat upon an existing asphalt pavement surface for maintenance purposes as determined from the drawings and in accordance with these specifications.

1.2 APPLICABLE PUBLICATIONS

The following publications of the latest issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

- A. Texas Department of Transportation 2004 Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges (TxDOT).
 - 1. Item 300 - Asphalts, Oils and Emulsions
 - 2. Item 302 - Aggregates for Surface Treatments
 - 3. Item 316 - Surface Treatments
 - 4. Item 320 – Equipment for Asphalt Concrete Pavement
- B. American Society for Testing and Materials Standards (ASTM)
 - 1. D 8-02 – Standard Terminology Relating to Materials for Road Pavements
 - 2. D 698 - Moisture Density Relations of Soil Using 5.5 Pound Rammer and 12 Inch Drop.
- C. Texas Department of Transportation Test Procedures
 - 1. TEX 207-F – Determining Density of Compacted Bituminous Mixtures
 - 2. TEX 227-F – Theoretical Maximum Specific Gravity of Bituminous Mixtures

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 32 17 23.13 Painted Pavement Markings
- B. Section 32 17 23.33 Thermoplastic Pavement Markings
- B. Section 32 12 16 Asphaltic Concrete Paving
- C. Section 32 22 13 Site Grading
- D. Section 31 11 00 Clearing and Grubbing

1.4 DEFINITIONS

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
- B. Material Certificates: For each paving material, signed by manufacturers.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Manufacturer shall be a paving-mix manufacturer registered with and approved by authorities having jurisdiction or if none exist, the DOT of the state in which Project is located.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:
 - 1. Prime and Tack Coats: Minimum surface temperature of 60 deg F.
 - 2. Slurry Seal Coat: Comply with weather limitations of ASTM D 3910.

PART 2 - PRODUCTS

2.1 ASPHALTIC MATERIALS

- A. Asphaltic material shall conform to the applicable requirements of Item 300, TXDOT. Asphalt Emulsion shall be AC-5.

2.2 MINERAL AGGREGATE

- A. The aggregate and mineral filler shall be a graded sand mixture conforming to the following:

U.S. Standard Sieve Size	Total Percent Passing
No. 8	100
No. 16	65-90
No. 30	40-60
No. 50	25-42
No. 100	15-30
No. 200	10-20

2.3 SEAL COAT MIXTURE

- A. The seal coat mixture shall be mixed in the following proportions based upon a 220 pound aggregate mixture. A larger mix may be made using the proper proportions.

Material	Weight (lbs)
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Aggregate including mineral filler	220
Asphalt emulsion	33-66
Water, including water present in the emulsion and aggregate	22-33 (as required for proper consistency)

2.4 EQUIPMENT

- A. All equipment necessary to perform the work within the scope of this Section shall conform to requirements of TxDOT Item 316, Article 316.3.

2.5 WATER

- A. Water used for mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable matter or other substances injurious to the finished product.
- B. Water sources other than the local municipal domestic water supply must be approved by the Owner.
 - 1. If onsite reclaimed water sources are used, tanks and apprenices must be clearly marked with the words "non-potable" water.

PART 3 - EXECUTION

3.1 GENERAL

- A. Asphalt Surface Course shall be applied to existing asphaltic surface in accordance with TxDOT Item 316 Article 316.4.
- B. Samples will be tested in accordance with TEX 207-F and TEX 227-F and test results shall be reported the same day the tests are made.

3.2 SURFACE PREPARATION

- A. Potholes and other structural failure of the surface shall be repaired prior to placing the seal coat.
- B. The surface shall be swept clean of all debris, dirt, loose gravel and other loose articles. If necessary, the surface can be washed, but the surface must be dry before the seal coat is applied.

3.2 SLURRY SEAL COAT APPLICATION

- A. Mix asphalt emulsion, water, mineral filler and aggregate in a mixer.
- B. Apply mixture in an average thickness of 1/16th to 1/8th inches. The mixture should form a creamy-textured mixture which, when spread, will flow in a wave approximately two (2) feet ahead of the strike-off squeegee.

- C. Allow mixture to cure for 48 hours.
- D. Apply a second seal coat in the same manner as the first coat and allow the second coat to cure for 48 hours.
- E. Test surface at the end of the second curing process to insure surface is dry and not tacky. Apply paint for striping and open for traffic after paint has dried.

END OF SECTION

SECTION 321313

CONCRETE PAVING FOR PEDESTRIAN AREAS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
 - 1. Walkways.
 - 2. Courtyards.
 - 3. Plazas.
 - 4. Pedestrian Ramps.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete pavement mixture.
- C. Related Sections:
 - 1. Section 07 92 00 "Joint Sealants" for expansion joints within pedestrian pavements

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A-185, fabricated from as-drawn steel wire into flat sheets.
- B. Deformed-Steel Welded Wire Reinforcement: ASTM A-497, flat sheet.
- C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

- D. Plain Steel Wire: ASTM A 82, as drawn.
- E. Deformed-Steel Wire: ASTM A-496.
- F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice."

2.2 CONCRETE MATERIALS

- A. Cementitious Material: Use[**one of**] the following Cementitious materials, of the same type, brand, and source throughout the Project:
 - 1. Portland Cement: ASTM C 150, Type gray.
 - a. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 - 2. Blended Hydraulic Cement: ASTM C 595.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate, uniformly graded. Provide aggregates from a single source.
- C. Water: ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: ASTM C 494/C 494M, of type suitable for application, certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

2.3 FIBER REINFORCEMENT

- A. Synthetic Fiber: Polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.

2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

- E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.

2.5 RELATED MATERIALS

- A. Alternate 1: Expansion and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Alternate 2: One-component polyurethane self-leveling sealant, conforming to ASTM C920, Type S, Grade P, Class 25, Use T or M, in the upper ½" depth of the joint, over the joint filler material.
- C. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

2.6 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, with the following properties:
 - 1. Compressive Strength (28 Days): 3000 psi.
 - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement 0.50.
 - 3. Slump Limit: 4 inches, plus or minus 1 inch.
 - 4. Air Content 5-1/2 percent plus or minus 1.5 percent.
- B. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd.
- C. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions.

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Proof-roll prepared sub-base surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.4 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness. If applicable, match jointing of existing adjacent concrete pavement.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 3/16-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

- A. Moisten sub-base to provide a uniform dampened condition at time concrete is placed.
- B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

- C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- D. Screed pavement surfaces with a straightedge and strike off.
- E. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.6 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
 - 2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
 - 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
- C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on pavement surface according to manufacturer's written instructions.
 - 1. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
 - 2. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.

3.7 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.

- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these methods.

3.8 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
 - 1. Elevation: 1/4 inch.
 - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 - 3. Surface: Gap below 10-foot long, unlevelled straightedge not to exceed 1/4 inch.
 - 4. Joint Spacing: 3 inches.
 - 5. Contraction Joint Depth: Plus 1/4 inch, no minus.
 - 6. Joint Width: Plus 1/8 inch, no minus.

3.9 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.
- B. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement.
- C. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321313.13

EXPOSED AGGREGATE CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
 - 1. Walkways.
 - 2. Courtyards.
 - 3. Plazas.

1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash, and other pozzolans, ground granulated blast-furnace slag.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete pavement mixture. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Samples: 10-lb. sample of exposed aggregate. Information from aggregate supplier indicating source, type, color, and gradation of aggregate shall accompany sample.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Experienced installer who has completed pavement work similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications:
 - 1. Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 2. Manufacturer certified in according to the National Ready Mix Concrete Association's Plant Certification Program.

- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated as documented according to ADTM E 548.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.
- E. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
- F. Mockups: Cast mockups of full-size sections of concrete pavement to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.
 - 1. Build a 4' x 4' mockup on site. If location not indicated, as directed by Owner's representative.
 - 2. Notify Owner's representative seven days in advance of dates and times when mockups will be constructed.
 - 3. Obtain approval from Owner's representative before starting mockup construction.
 - 4. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
 - 5. Demolish and remove approved mockups from the site when directed by Owner's representative.
- G. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section, "Project Meetings".
 - 1. Before submitting design mixes, review concrete pavement mix design and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with concrete pavement to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixes.
 - c. Ready-mix concrete producer.
 - d. Concrete subcontractor.

1.5 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

- A. Form Materials: Plywood, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth, exposed surfaces.

1. Use flexible or curved forms for curves of a radius 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- B. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615 M, Grade 60 (Grade 420). Cut bars true to length with ends square and free of burrs.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
 1. 1/2 inch steel bars 15 inch center.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:
 1. Concrete for exposed aggregate paving shall be Portland Cement ASTM C150, Type I, Gray as required to match color of concrete used on standard [Insert Option Here] sidewalks.
- B. Exposed Aggregate: Exposed hard, sound, durable, and free of all deleterious materials and staining qualities. Provide aggregates from a single source.
 1. Store select seeding aggregates off the ground and protected from moisture.
 2. Aggregate shall match color, size, and gradation of the aggregate used in the exposed aggregate sidewalks and pavement existing in the immediate vicinity of the Project.
 3. Approved Suppliers:
 - a. The Ground Up, Houston, Texas – Pea Gravel
 - b. San Jacinto Stone, Houston, Texas – Pea Gravel
 4. Water: Potable.

2.4 CURING MATERIALS

- A. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- B. Water: Potable.

2.5 RELATED MATERIALS

- A. Board Filler: #1 treated #1 Southern Yellow Pine.
 - 1. Board filler shall be free of defects which will impair their usefulness as expansion joint fillers.
- B. Joint Sealing Material: Pavement joint sealing material shall meet the requirements and specifications of TxDOT item 360.2 (8).
- C. Acid: Acid for acid wash shall be 5-10 percent solution of muriatic acid. Acid solution shall be tested on aggregate to ensure that aggregate does not dissolve or discolor.
- D. Sealer: Methyl methacrylate acrylic resin suitable for sealing of exposed aggregate horizontal concrete surfaces. Sealer shall be subject to approval.

2.6 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, with the following properties:
 - 1. Exposed Aggregate Surface: Concrete to receive an exposed aggregate surface shall contain a minimum of 560 lb. of ASTM C 150 Type II Portland cement per cubic yard of concrete.
 - 2. Compressive Strength (28 Days): 3000 psi.
 - 3. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.53.
 - 4. Slump Limit: 4 inches, plus or minus 1 inch.
 - 5. Air Content: 6 percent plus or minus 1 percent.
 - 6. Aggregates used in base mix shall not be limestone.
 - 7. Aggregate size shall be a minimum of 3/8 inch and a maximum of 3/4 inch.
- B. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd..
- C. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions.

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Proof-roll prepared sub-base surface to check for unstable areas and verify need for additional compaction. Proceed with pavement only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.
- B. Remove loose material from compacted sub-base surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

3.4 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
 - 1. When joining existing pavement, place transverse joints to align with previously placed joints unless otherwise indicated.
- C. Install dowel bars and support assemblies at joints where indicated.

- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool. Repeat grooving of contraction joints after applying surface finishes to a 1/4-inch (6 mm) radius. Eliminate grooving marks on concrete surfaces.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete form-work installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from sub-base surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten sub-base to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- D. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery, at Project site, or during placement.
- F. Deposit and spread concrete in a continuous between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- H. Screed pavement surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading dry-shake surface treatments.

3.6 FINISHES

- A. Seeded Exposed Aggregate Finish: Immediately after floating, broadcast a single layer of aggregate uniformly onto the pavement surface. Tamp seeded aggregate into plastic concrete, and float to entirely embed aggregate with mortar cover of 1/16 inch.
1. Prior to the concrete placing operation, all select seeding aggregate shall be thoroughly washed so that it is free of all dust, dirt, and clay particles. The aggregate shall be in a damp condition but without free surface water at the time of seeding application. There shall be sufficient select aggregate on hand to complete the seeding once it has commenced.
 2. The seeding operation shall start immediately after the placement of concrete as described above. The select aggregate shall be carefully and uniformly seeded by suitable means so that the entire surface is completely covered with one layer of stone. Stacked stones and flat and slivery particles shall be removed at this time. The aggregate shall be embedded by suitable means. Care shall be taken to not over-embed and deform the surface. Under no circumstances shall areas lacking sufficient mortar be filled with small quantities of the base concrete mix.
 3. Without dislodging aggregate, remove excess mortar by lightly brushing surface with a stiff, nylon bristle broom.
 4. Fine-spray surface with water and brush. Repeat water flushing and brushing cycle until cement film is removed from aggregate surfaces to depth required.
 5. Work shall be planned so that the concrete placing and aggregate seeding procedures are coordinated with the capabilities of the washing and brushing crew.

3.7 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection and ACI 305 R for hot-weather protection during curing.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these methods.

3.8 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unlevelled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch (6 mm).
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: The contractor shall engage a qualified independent testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement.
 1. Compressive-strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cubic yards, but less than 25 cubic yards plus one set for each additional 50 cubic yards.
 2. One specimen shall be tested at 7 days and two specimens at 28 days. One specimen shall be retained in reserve for later testing if required.
- B. Test results shall be reported in writing to Owner's representative, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain:
 1. Project identification name and number.
 2. Date of concrete batch in pavement.
 3. Design compressive strength at 28 days.
 4. Concrete mix proportions and materials.
 5. Compressive breaking strength.
 6. Type of break for both 7 and 28 day tests.

3.10 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.
- B. Drill test cores where directed by Owner's representative when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313.13

SECTION 32 13 14 - CONCRETE PAVEMENT FOR VEHICULAR AREAS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Section specifies the requirements for forming and placing reinforced concrete curbs and vehicular pavement to the lines and grades shown on the drawings and constructed as specified herein.

1.2 APPLICABLE PUBLICATIONS

The following specifications and standards of the latest issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

- A. Texas Department of Transportation 2004 Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges (TxDOT).
 - 1. Item 360 - Concrete Pavement
 - 2. Item 421 – Hydraulic Cement Concrete
- B. American Society for Testing and Materials Standards (ASTM):
 - 1. D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction
 - 2. A 653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
 - 3. C 309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - 4. A 615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 5. C 94 – Standard Specification for Ready-Mixed Concrete
 - 6. C 31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - 7. C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - 8. A 185 – Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
 - 9. D 698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
 - 10. D 994 – Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Typed)

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 22 13 Site Grading
- B. Section 31 32 13.16 Cement Stabilization
- C. Section 31 32 13.19 Lime Stabilization
- D. Section 31 32 13.26 Lime-Fly Ash or Fly Ash Stabilization
- E. Section 32 17 23.13 Painted Pavement Markings
- F. Section 32 17 23.33 Thermoplastic Pavement Markings

1.4 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. ***[DESCRIBE ANY OTHER PROJECT CONDITIONS AND/OR CONSTRAINTS THAT THE CONTRACTOR NEEDS TO BE AWARE OF]**

1.5 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. If there is an exposed aggregate finish the following sample shall be submitted .
Samples: **10-lb (4.5-kg)** sample of exposed aggregate.
- D. Material Test Reports: From a qualified testing laboratory indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
- E. Material Certificates: Signed by manufacturers certifying that each of the following materials which are part of this project, complies with requirements:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Admixtures.
 - 4. Curing compounds.
 - 5. Applied finish materials.
 - 6. Bonding agent or epoxy adhesive.

7. Joint fillers.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.

PART 2 - PRODUCTS

2.1 CONCRETE

- A. Cement, aggregates, admixtures, and water shall conform to the specifications of TXDOT, Item 421. Preparation of concrete mix shall be in accordance with article 360.4 of TxDOT, Item 360
- B. Maximum size of aggregate 1-1/2 inches.
- C. Slump shall range from 2 to 5 inches.
- D. Air entrainment concrete mixture shall have an air content by volume of 4.5 percent plus or minus 1.5%.
- E. Concrete shall be mixed in accordance with TxDOT, Item 421.
- F. Ready mixed concrete conforming to ASTM C 94 may be used.
- G. The concrete mix shall be designed by a commercial testing laboratory, and submitted for approval.

2.2 REINFORCEMENT

- A. Reinforcing steel shall meet the specifications of ASTM A615, Grade 60. Bars shall be deformed billet steel free of defects.

2.3 BOARD FILLER

- A. Filler board of selected stock. Use wood of density and type as follows:
1. Clear, all-heart cypress weighing no more than 40 pounds per cubic foot, after being oven dried to constant weight.
 2. Clear, all-heart redwood weighing no more than 30 pounds per cubic foot, after being oven dried to constant weight.
- B. Board filler shall be free of defects which will impair their usefulness as expansion joint fillers.

2.4 PREFORMED BITUMINOUS EXPANSION BOARD

- A. Preformed bituminous expansion boards shall meet the specifications for ASTM D 994 and D 1751.

2.5 JOINT SEALING MATERIAL

- A. Curb and Pavement joint sealing material shall meet the requirements and specifications of TxDOT Items 360.2F and 360.4D.
- B. Sidewalk joint sealing materials shall be GC-9 synthacalk sealant as manufactured by Pecora or approved equal.

2.6 DEFORMED CONTRACTION JOINT METAL STRIPS

- A. Deformed contraction joint metal strips shall be 28 ga. steel, galvanized 1.25 oz. per square foot or heavier and meet the specifications of ASTM A 653.

2.7 CURING COMPOUND

- A. Curing compound shall conform to the specifications of ASTM C 309, Type 1 or Type 2, white pigmented.

2.8 LOAD TRANSMISSION DEVICES FOR EXPANSION AND CONTRACTION JOINTS

- A. Load Transmission devices shall be as detailed on plans and conform to the properties specified in ASTM A615, Grade 60 steel.

2.9 STEEL DOWEL BARS

- A. Steel dowel bars and steel reinforcement shall be deformed or smooth bars conform in properties to ASTM A 615 Grade 40. Unless otherwise shown on the plans all reinforcing steel shall be deformed bars, all dowel bars at joints shall be smooth bars, and all curb dowels shall be deformed bars.
- B. Greenstreak two component speed dowel system can be used at construction joints pending engineer approval. Product submittal required for approval.
- C. Greenstreak two component speed load system can be used at expansion joints pending engineer approval. Product submittal required for approval.

PART 3 - EXECUTION

3.1 GENERAL

- A. The curb and sidewalk pavement shall be constructed to the lines and grades shown on the drawings.

3.2 PAVEMENT

- A. Preparation of Subgrade
 - 1. The subgrade shall be a previously prepared subgrade, stabilized if required, compacted to a minimum of 95% standard density ASTM D-698, and graded to the required section and grades shown on the drawings and as specified.
 - 2. Rolling and sprinkling shall be performed to maintain the specified moisture content of the subgrade as necessary prior to placing the concrete curbs.

3. Refer to Section 32 22 13 Site Grading for applicable specifications for materials and placement.
- B. Placing and Removing Forms
1. Forms shall be of wood or metal, properly treated to insure concrete does not adhere to the forms, straight, clean, free from warp or defect, and of sufficient depth.
 2. The forms shall be so placed that when placed each form section will be firmly in contact for its whole length and base width and exactly at the established grade.
 3. Any subgrade under the forms below established grade shall be corrected using suitable material, placed, sprinkled, and rolled.
 4. Forms shall be securely staked and tightly jointed and keyed to prevent displacement.
 5. Sufficient stability of forms to support equipment operated thereon and to withstand its vibration without springing shall be required.
 6. Forms shall remain in place not less than 24 hours after concrete is placed.
- C. Joints in Concrete Pavement
1. Shall be constructed in the pavement slab at locations and according to details as shown on the drawings. Stakes, braces, brackets or other devices shall be used as necessary to keep the entire joint assembly in true vertical and horizontal position.
 2. When prefabricated plastic strips are used to form joints, they shall be placed after the concrete surface has been leveled and before the finishing is completed. The strips shall be of a type specifically manufactured for the purpose of forming joints in concrete pavement and to the dimensions as required to form the specified joints. The strips shall be removed after the concrete has set per the manufacturer's recommendations. Any blemishes caused by the removal of the strips shall be repaired immediately using approved methods.
- D. Tie Bars and Load Transmission Devices shall be accurately placed and held securely (parallel to pavement surface and perpendicular to joint) during placing and finishing of pavement.
- E. Expansion Joints shall be constructed with board filler and sealed at top. Board filler must be perpendicular to plane of concrete slab. Alignment of joint shall not vary more than 1/4 inch in 10 feet.
- F. Reinforcing Steel shall be accurately placed as shown on drawings and secured in place. Each bar intersection shall be tied. All bars shall be supported on steel or plastic bar chairs. Laps shall be a minimum of ten (10) inches and tied. Wire fabric may not be used in vehicular pavement.
- G. Concrete Placing and Finishing
1. Concrete not placed as herein prescribed within 90 minutes after mixing shall be rejected.

2. Concrete shall not be placed when temperature is below 40 degrees F and falling, but may be placed when the temperature is above 35 degrees F and rising, the temperature being taken in the shade and away from artificial heat.
3. Concrete shall not be placed before the time of sunrise, and shall not be placed later than will permit the finishing of the pavement during sufficient natural light.
4. Concrete shall be consolidated by a mechanical vibrator to remove all voids. Special care shall be exercised in placing and spading concrete against forms and at all joints to prevent the forming of honeycombs and voids and to prevent displacement of steel reinforcement and load transmission devices.
5. The concrete shall be struck off with an approved strike-off screed to such elevation that when consolidated and finished, the surface of pavement shall conform to the required section and grade. In no case shall the maximum ordinate from a 10 foot straight edge to the pavement be greater than 1/8 inch.
6. The strike template shall be moved forward with a combined transverse and longitudinal motion in the direction the work is progressing, maintaining the template in contact with the forms, and maintaining a slight excess of material in front of the cutting edge.
7. After completion of a strike-off, consolidation and transverse screeding, a hand-operated longitudinal float shall be operated to test and level the surface to the required grade.
8. Workmen shall operate the float from approved bridges riding on the forms and spanning the pavement. The longitudinal float shall be held in contact with the surface and parallel to the center line, and operated with short longitudinal strokes while being passed from one side of the pavement to the other. If contact with the pavement is not made at all points, additional concrete shall be placed if required, and screeded, and the float shall be used to produce a satisfactory surface. After a section has been smoothed so that the float maintains contact with the surface at all points in being passed from one side to the other, the bridges may be moved forward half the length of the float, and the operations repeated.
9. After completion of the straightedge testing, a pass with a burlap drag shall be made as soon as construction operations permit and before the water sheen has disappeared from the surface. This shall be followed by as many passes of the drag as required to produce the desired surface texture.
10. After completion of dragging and about the time the concrete becomes hard, the edge of the slab and joints shall be left smooth and true to line.

H. Curing

1. Concrete pavement shall be cured by protecting it against excessive loss of moisture for a period of not less than 72 hours from the beginning of curing operation.
2. Immediately after finishing operations have been completed, the entire surface of the newly laid concrete shall be covered and cured in accordance with the requirements of "Membrane Curing", TxDOT Item 360.4I.

3. Special care should be exercised to keep spraying curing compound out of pavement joints.

3.3 CURBS

A. Dowelled on Curb

1. After curing the concrete pavement, doweled on curbs, using secure forms shall be constructed to the size shown on the plans.
2. Dowels may be placed in the pavement slab before the concrete has set, or placed in drilled holes using epoxy adhesive to secure the bars in place.
3. Pavement joints shall extend through the curbs. Expansion joint material shall be the same thickness, type and quality as specified for the pavement.
4. When sawed joints are provided, the placement of curb shall be delayed until all transverse joints are sawed.
5. Weakened plane joints shall be formed by inserting an asphaltic board strip cut to conform to the shape of the curb.
6. All joints should be tool finished after sufficient curing of the concrete.
7. The concrete, reinforcement and curing of the curbs shall conform to the requirements specified for the concrete pavement.
8. In finishing the curbs, a thin coating of mortar shall be worked into the exposed face of the curb in order to obtain a brush finish free of all blemishes and form or tool marks.
9. Curbs shall have a straightness tolerance of 1/8 inch in 10 feet, measured longitudinally along the back and face of the curb.
10. The top of the curb shall not vary vertically in height more than 1/8" when measured up from the concrete pavement.

B. Monolithic Curbs and Curb and Gutter

1. Monolithic curb and curb and gutter shall conform to the specifications for doweled on curb and the details shown on the plans.
2. Monolithic curb and curb and gutter shall be constructed after final grading of the subgrade and before placement of the base material.
3. These curbs shall be cured for at least 72 hours and shall be properly backfilled behind the curb by hand tamping to 95% standard proctor density ASTM D 698 before placing the base material.

3.4 APPLICATION OF JOINT SEALING COMPOUND

- A. Joints shall be thoroughly cleaned of loose scale, dirt, dust and curing compound. When necessary, existing joint material shall be removed to the depth as shown on the plans.

- B. Joints shall be filled to the full depth of the joint opening. Pouring shall be done in a neat and workman like manner to give satisfactory results. Sufficient joint sealer shall be poured into the joints so that upon the completion of the work the surface of sealer within the joint shall be 1/4" above top of the pavement surface.

3.5 TESTS

A. Concrete Test Specimens

1. Test cylinders for compressive strength shall be taken and cured in accordance with ASTM C 31 and tested in accordance with ASTM C 39.
2. At least 3 cylinders shall be made for each day for each 100 c.y. of concrete or fraction thereof, placed.
3. Laboratory technician will prepare concrete test cylinders.

B. Testing of Concrete Surface

1. After finishing is complete and while the concrete is still workable, the surface shall be tested for trueness with an approved 10' steel straightedge.
2. The straightedge shall be operated from the side of the pavement placed parallel to the pavement center line and passed across the slab to reveal any high spots or depressions.
3. The straightedge shall be advanced along the pavement in successive stages of not more than 1/2 its length. A tolerance of 1/8" in 10' must be met.
4. Any correction of the surface required shall be accomplished by adding concrete if required and by operating the longitudinal float over the area.
5. The surface test with the straightedge shall then be repeated.

3.6 OPENING PAVEMENT TO TRAFFIC

- A. The pavement shall be closed to all traffic, including vehicles of the Contractor, until the concrete is at least 7 days old or has attained a minimum average of 3000 psi compressive strength.
- B. Any damage to the pavement prior to acceptance by the Owner shall be repaired by the Contractor at no extra cost to the Owner.
- C. This does not relieve the Contractor from the normal liabilities and maintenance responsibilities, implied or otherwise, for the pavement or other items.

END OF SECTION

SECTION 32 17 23.13 – PAINTED PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Section pertains to the application of pavement marking as indicated on the drawings and as specified herein.

1.2 APPLICABLE PUBLICATIONS

- A. Harris County Public Infrastructure Department Engineering Division Specifications for Roads and Bridges within Harris County, Texas, published April 1988 latest revision February 2011.
- B. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 1 Specifications apply to this section.

1.3 SUBMITTALS (NOT USED)

1.4 PROJECT CONDITIONS

- A. The Contractor shall provide adequate public protection at all times, by erecting fences, barricades, and etc., as necessary.
- B. All work shall be in accordance with the Texas Manual on Uniform Traffic Control Devices latest edition.
- C. Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F (4 deg C) for oil-based materials, 50 deg F (10 deg C) for water-based materials, and not exceeding 95 deg F (35 deg C).

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Materials shall consist of paint and glass beads. Paint for stripping shall conform to Harris County Engineering Specifications Item 676 latest edition 2003. Glass reflective beads for traffic paint shall conform to Harris County Engineering Specification Item 662 latest edition 2011.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Owner.
- B. Allow paving to age for 30 days before starting pavement marking.
- C. The pavement surface to receive the striping shall be thoroughly cleaned of all dirt, organic growth, oil, grease, or other materials that will prevent adhesion of the paint to the roadway surface.
- D. Paints shall be applied by brush, spray, or flow methods to clean and dry surfaces with surface temperature 50 F or above.
 - 1. Paint shall have net film thickness of 0.015 inches with a uniform cross section. Minimum thickness of 0.010 inches measured in the dry condition prior to adding any glass reflective spheres.
 - 2. Paint shall be applied no sooner than 14 days after seal coat has been applied.
 - 3. Paint shall be applied in one (1) coat.
 - 4. Paint shall be applied as shown on drawings.
 - 5. Glass spheres or reflectorized granules shall be applied, before the paint sets or dries, evenly at a rate of 6 pounds of glass spheres or 1.7 pounds of reflectorized granules per gallon of paint.

END OF SECTION

SECTION 32 17 23.33 – THERMOPLASTIC PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This item includes white thermoplastic pavement markings for crosswalks, stop lines, lane lines, and other types of traffic controls.

1.2 RELATED WORK SPECIFIED ELSEWARE

- A. Section 32 12 16 Asphalt Concrete Paving
- B. Section 32 13 13 Concrete Paving
- C. Section 32 01 16 Asphalt Overlay
- C. Section 32 12 36 Asphalt Slurry Seal Coat

1.3 REFERENCES

- A. ASTM E 28 - Standard Test Methods for Softening Point of Resins Derived from Naval Stores by Ring-and-Ball Apparatus.
- B. ASTM G 152 - Standard Practice for Operating Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials.
- C. ASTM G 153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials.
- D. TxDOT Tex-822-B - Determining Refraction Index of Glass Beads.
- E. TxDOT Tex-826-B - Water Absorption Test of Beads.
- F. TxDOT Tex-839-B - Determining Color in Reflective Material.
- G. TxDOT Tex-851-B - Evaluating the Abrasion Resistance of Pavement Marking Material.

1.4 SUBMITTALS

- A. Product Data: Submit Manufacturer's literature indicating product specifications and instructions for handling, installation, and curing. Include performance test data sheets for each product.
- B. Submit material supplier's certification of compliance with specifications.
- C. Chemical Analysis: Submit infrared analysis of Type B resins for each manufacturer used.

PART 2 - P R O D U C T S

2.1 MATERIAL REQUIREMENTS

- A. General Requirements: Thermoplastic pavement marking material Type B for use on either asphaltic or Portland cement concrete surfaces. Clearly mark each container to indicate color, weight, type of material, and lot or batch number (consider lot or batch as each individual mix or blend that produces finished product ready for use). Package material in either suitable corrugated containers or thermal degradable plastic bags to avoid sticking during shipment or storage.
- B. Thermoplastic markings shall not be slippery when wet, nor exhibit tacky, exposed surface. Cold ductility of material shall permit normal road surface expansion and contraction without chipping or cracking. Markings shall retain their original color, dimensions, and placement under normal traffic conditions at road surface temperatures of 158 F and below.
- C. Prime and filler pigments shall pass U.S. Standard sieve No. 230 (0.0024 inch opening) when washed free of resins by solvent washing, and meet following specific requirements for each pigment.
 - 1. Prime Pigments: White pigment shall be Rutile Titanium Dioxide.
 - 2. Filler Pigment: Filler pigment shall be calcium carbonate, 95% purity.
- D. Binder
 - 1. Type B - Alkyd: Use binder consisting of mixture of resins, at least one of which is solid at room temperature, and high boiling point plasticizers. At least one-third of binder compositions shall be a maleic-modified glyceryl ester 012 Rosin and shall be no less than 8% by weight of entire material formulation.
- F. Glass Traffic Beads: the total silica used in formulation shall be in form of glass traffic beads meeting the following requirements:
 - 1. Manufacture. Use glass traffic beads having the following characteristics:
 - a. Manufactured from glass;
 - b. Spherical in shape;
 - c. Free of sharp angular particles;
 - d. Free of particles showing milkiness, surface scoring, or surface scratching;
 - e. Water white in color.
 - 2. Contaminants. Use glass traffic beads having the following characteristics:
 - a. Containing less than 1/4 of 1% moisture by weight;
 - b. Free of trash, dirt, etc;
 - c. Showing no evidence of objectionable static electricity when flowing through regular traffic-bead dispenser.
 - 3. Gradation:

- a. Sieve Analysis. Glass traffic beads shall meet following gradation requirements:

Openings U.S. Standard Sieves Percent Passing
No. 20 95 - 100
No. 30 80 - 95
No. 50 15 - 35
No. 100 0 - 4
 - b. Irregular Particles: Glass traffic beads, retained on screen used to determine gradation requirements, shall not contain more than 30% (by weight) irregular particles.
4. Index of Refraction: Glass traffic beads, when tested by TxDOT Tex-822-B, using liquid immersion method at 25 C (77 F) shall show index of refraction within range of 1.50 to 1.53.
 5. Wetting. Use glass traffic beads capable of being readily wet with water when tested in accordance with TxDOT Tex-826-B.
 6. Stability. Use glass traffic beads showing no tendency toward decomposition, surface etching, change in retro reflective characteristics, or change in color after:
 - a. One hour exposure to concentrated hydrochloric acid at 25 C (77 F);
 - b. Twenty-four-hour exposure to weak alkali;
 - c. One hundred hours of Weather-O-Meter exposure, in accordance with ASTM G 152 and ASTM G 153.

2.2 FINISHED PRODUCT REQUIREMENTS

- A. Physical Characteristics. Finished thermoplastic pavement markings material shall be free flowing granular material, unless otherwise shown on Drawings. Material shall remain in free flowing state in storage at temperatures of 100 F or less. Materials shall be readily sprayed through nozzles commonly used on thermoplastic spray equipment at temperatures between 205 and 218 C (401 to 425 F).
- B. Toxicity. At temperatures up to and including 230 C (446 F), materials shall not give off fumes which are toxic and otherwise injurious to persons, animals, or property.
- C. Material shall not break down or deteriorate when held at 205 C (401 F) for 4 hours.
- D. Temperature versus viscosity characteristics of material in plastic state shall remain constant throughout up to four reheatings at 205 C (401 F) and from batch to batch.
- E. Material shall not be adversely altered by contact with sodium chloride, calcium chloride, or other similar chemicals on, or used on, roadway surface; by contact with oil content of pavement materials, or by contact from oil dropping from traffic.
- F. Softening Point. After heating thermoplastic materials for two hours at 204 C (400 F) Type B Alkyd material shall have softening point greater than 90 C (194 F) when tested in accordance with ASTM E 28-58T - Ball and Ring Method.

- G. Color. CIE chromaticity coordinates of materials, when determined in accordance with TxDOT Tex-839-B, shall fall within area having following corner points and shall meet following luminosity requirements.

CIE CHROMATICITY COORDINATE CORNER POINTS

Color	Point 1		Point 2		Point 3		Point 4		Luminosity
	X	Y	X	Y	X	Y	X	Y	
White	0.290	0.315	0.310	0.295	0.350	0.340	0.330	0.360	Min 65

Material shall meet above specified color requirements, before and after 70 hours of exposure in Weather-O-Meter (Atlas, Sunshine Type) fitted with 18 - 102 (18 minutes of sunshine and rain and 102 minutes of sunshine) cyclic gear. Prepare panels for testing with material as supplied.

- H. Abrasion. Thermoplastic pavement marking materials shall have loss between 4.0 and 12.0 grams when tested for abrasion in accordance with TxDOT Tex-851-B. Test according to steps 1 through 8 of procedure utilizing following test parameters:

Test distance: 5 inches
 Blast pressure: 40 psi
 Sample angle: 10 degrees and 122 gram blast media
 Blast Media: 1200 grams

- I. Uniformity. Manufacture material so that, when sampled in accordance with TxDOT Manual of Testing Procedures, 100-gram sample will be representative of batch or lot of material.
- J. When applied 1/8 inch thick, setting time shall not exceed characteristic straight-line curve, lower limit of which is four minutes at 59 F road surface temperatures, and upper limit of which is ten minutes at 90 F road surface temperature. Both temperatures are to be measured at maximum relative humidity of 90%.

2.3 FORMULAE

- A. Type B - Alkyd Thermoplastic Marking:

Pounds
Binder 18 - 23
Titanium Dioxide 12 - 15
Calcium Carbonate 20 - 42
Glass Traffic Beads 30 - 45
TOTAL 100

PART 3 EXECUTION

3.1 GENERAL

- A. Spray apply pavement marking or extrude hot to pavement surface unless application method is specified on Drawings.

- B. Provide continuous mixing and agitation of material. Provide clean, square, marking ends. Do not use pans, aprons, or similar appliances which dye overruns.
- C. Provide thermometer capable of measuring temperature of pavement marking material.
- D. Use automatic bead dispenser attached to pavement marking equipment in manner that beads are dispensed uniformly and almost instantly upon marking as marking is being applied to road surface. Rate of application shall be sufficient to achieve retro-directive reflective characteristics specified. Provide automatic cut-off control for bead dispenser, synchronized with cut-off of pavement marking equipment.
- E. Place markings in accordance with approved traffic control plan so that minimal interruption to traffic flow is achieved. Protect newly-installed pavement markings from damage by traffic.
- F. Apply pavement markings onto clean, dry pavement having road surface temperature above 60 F for Portland cement concrete surface and above 50 F for asphaltic surface. When pavement marking application is by spray and operations cease for five or more minutes, flush spray head by spraying pavement marking material into pan or similar container until material is proper temperature for application.
- G. Use markings that are completely reflectorized internally and externally.
- H. Use crew experienced in work of installing pavement markings and supply all equipment and materials necessary for placement of pavement markings.
- I. Apply material within temperature limits recommended by manufacturer.
- J. Prior to placement of thermoplastic material, properly prepare pavement with primer.

3.2 LAYOUT

- A. Place pavement markings in proper alignment with guidelines established on roadway. Do not deviate from alignment established greater than two inches. Do not deviate in alignment of marking being placed greater than one inch per 200 feet of marking and do not deviate abruptly.
- B. Place additional markings required to achieve alignment specified throughout both straight and horizontally curved sections of roadway. Additional markings placed on roadway for alignment purposes shall be temporary in nature and shall not establish permanent marking on roadway. Materials used for alignment markings and equipment used to place markings shall be approved by Engineer.

3.3 SURFACE PREPARATION

- A. Clean pavement by sandblasting and prepare in accordance with recommendations of thermoplastic material manufacturer and to satisfaction of Engineer, prior to placement of markings. Surface scarification can be used with prior approval of Engineer.
- B. Use cleaning methods approved by Engineer that completely remove contaminants, loose materials, and conditions deleterious to proper adhesion. Do not clean Portland cement concrete surfaces by grinding.

- C. Prepare Portland cement concrete surfaces further after cleaning by completely sealing with epoxy or methyl methacrylate sealer, as recommended by thermoplastic material manufacturer. Place sealer sufficiently in advance of thermoplastic to allow release of all solvents.
- D. Prime asphaltic surfaces with sealer, as recommended by thermoplastic material manufacturer based on surface conditions. Include adhesive or adhesion promoter when asphaltic surfaces exhibit polished aggregate.

3.4 INSTALLATION

- A. Install in widths of 4, 6, 8, or 12 inches, or shaped otherwise as shown on Drawings. Tolerances in width shall not exceed 1/8 inch. Tolerance shall not exceed 1/4 inch in case of undulation in pavement.
- B. Material shall not prohibit adhesion of other thermoplastic markings if, at some future time, new markings are placed over existing materials.
- C. Maintain uniform thickness of each pavement marking. Minimum thickness of markings, as measured above plane formed by pavement surface, shall not be less than 1/8 inch (125 mils), unless shown otherwise on Drawings. Maximum thickness shall be 3/16 inch. Supply device, approved by Engineer, to measure thickness of applied extruded markings.

3.5 TESTING

- A. Maintain uniform cross section, density, quality, and thickness for markings. Markings shall be uniform throughout their thickness. Use applied markings that are 95% free of holes and voids, and free of blisters for minimum of 60 days after application.

END OF SECTION

SECTION 328400

LANDSCAPE IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Piping.
 - 2. Manual valves.
 - 3. Automatic control valves.
 - 4. Automatic drain valves.
 - 5. Sprinklers.
 - 6. Quick couplers.
 - 7. Controllers.
 - 8. Boxes for automatic control valves.

1.2 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Intent of Drawings: Sprinkler lines shown on the Drawings are diagrammatic. Locations of all sprinkler heads, valves, piping, wiring, etc. shall be established by the Contractor at the time of construction. Spacing of sprinkler heads and quick coupling valves are shown on the Drawings and shall be exceeded only with the permission of the Owner's authorized representative.
- C. Keep all areas of work clean, neat, and orderly at all times. Keep paved areas clean during installation operations.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For irrigation systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- D. Zoning Chart: Show each irrigation zone and its control valve.
- E. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
- F. Field quality-control reports.
- G. Operation and maintenance data for the following:
 - 1. Irrigation controller.
 - 2. Valves and gate valves.
 - 3. Pipe and fittings.
 - 4. Valve boxes.
 - 5. Quick coupling valves.
 - 6. Low voltage wire and connections.
- H. Record Irrigation Drawings:
 - 1. Furnish Record Drawings of complete irrigation system in accordance with the General and Special Conditions.
 - 2. Procure full size set of Contract Drawings from Landscape Architect.
 - a. Construction Drawings shall be on-site at all times while irrigation system is under construction.
 - b. Make daily record of all work installed each day.
 - c. Actual location of valves and quick couplers and all irrigation and drainage piping shall be shown on prints by dimensions from easily identifiable permanent features, such as buildings, curbs, fences, walks, or property lines.
 - d. Drawings shall show approved substitutions of material. Include material, manufacturer's name, and catalogue number.
 - e. Drawings shall be to scale and all indications shall be easily understandable, legible, and neat.

1.4 QUALITY ASSURANCE

- A. Requirement of Regulatory Agencies:
 - 1. All work and materials shall be in full accordance with the latest rules and regulations of safety orders of Division of Industrial Safety; the Uniform Plumbing Code and other applicable laws or regulations, including the City of Houston.
 - 2. Nothing in Drawing is to be construed to permit work not conforming to these codes. Should the Contract Documents be at variance with the aforementioned rules and regulations, notify Landscape Architect and get instructions before proceeding with the work.
- B. Testing:
 - 1. Preliminary review of completed installation will be made by the Landscape Architect prior to backfilling trenches and during hydrostatic testing.

2. Final review shall be made in conjunction with the final review, shrubs, and tree planting.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 FINAL ACCEPTANCE

- A. Work under this Section will be accepted by Landscape Architect upon satisfactory completion of all work. Upon final acceptance, Owner will assume responsibility for maintenance of the work. Said assumption does not relieve Contractor of obligations under Warranty.

1.6 WARRANTY

- A. In addition to the manufacturer's guarantees or warranties, all work shall be warranted for one year from the date of Final Acceptance against defects, material, equipment and workmanship by the Contractor. Warranty shall also cover repair of damage to any part of the premises resulting from leaks or other defect in materials, equipment, and workmanship to the satisfaction of the Owner.
- B. Contractor shall not be held responsible for failures due to neglect by the Owner, vandalism, etc., during the Warranty or Guarantee period. Report such conditions to the Landscape Architect in writing.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials throughout the system shall be as specified and noted on the Drawings, new and in perfect condition.
- B. Gate Valves: Three inches in size and under, 125 pound bronze construction, non-rising stem type, sized to line. NIBCO #T113 or approved equal.
- C. Sleeves: Control wire and water line sleeves shall be PVC 1120-1220, Schedule 40 pipe.
- D. Water Meters: Per City of Houston
- E. Backflow Preventer:
 1. Pressure type: Manufacturer: Febco
 2. Double check: Manufacturer: Febco
 3. Use Pressure Type when the required elevation of the BFP is 3'-0" or less above finish grade.
 4. Use Double Check Valve when the required elevation for a Pressure Type BFP is greater than 3'-0" above finish grade.

5. Protect Backflow preventer from vandalism with a lockable wire mesh cage.
Manufacturer: Backflow Protection; Model: "Ultimate Tuff Cage"
- F. Irrigation Controllers: Manufacturer: Base-line. Model 3200. Remote Control Valves:
Manufacturer: Rainbird – Model: PEB with Baseline decoders.
- G. Control Wiring: Solid copper, UL approved for direct burial in ground. Minimum gage#14 UF
(#12 UF for runs over 1,000 LF). Common ground wire shall be white.
- H. Valve Boxes: Injection molded of polymers and fibrous inorganic temperature resistant
components. Box shall provide adequate clearance to operate and service valve. Box and lid
shall be Green.
 1. Acceptable Manufacturers: Amtek, Christy, Carson, or approved equal.
 2. Valve boxes for remote control valves shall be rectangular, approximately 10-inch x 14-
inch inside dimensions by 15 inches deep. Boxes shall be black with lockable lids and
have painted on lid with 1-inch high white letters "RC".
 3. B. Valve boxes for gate valves and quick couplers, shall be round, approximately 9-inch
inside diameter by 10-inch deep. Boxes shall be black with lockable lids and have
painted on lid with 1-inch high white letters "QC".
- I. Quick Couplers:
 1. Valve and keys as specified on Drawings.
 2. Furnish two valve keys fitted with 3/4-inch swivel hose ells.
- J. Sprinkler Heads:
 1. Rotors: Hunter PGP
 2. Spray Heads: Rainbird MPR
- K. Conduit: All conduits for low voltage irrigation control wires shall be 2-inch Schedule 40 PVC.
Control wiring may be placed in common sleeve with lateral or main lines under paving when
sleeves are larger than 4-inches. Use galvanized steel pipe only under public roads or for high
voltage power conductors.

2.2 PIPING

- A. Piping on pressure side of irrigation control valves:
 1. Two and one-half inch diameter and smaller – ASTM D 1785, PVC 1120-1220 compound,
Schedule 40.
- B. Piping on non-pressure side of irrigation control valves:
 1. Two inch to three-quarter inch – ASTM D 1785, PVC 1120-1220, Class 200.
 2. One-half inch and smaller – ASTM D 1785, PVC 1120-1220, Class 315.

- C. Identification: Continuously and permanently marked with manufacturer's name or trademark, size, schedule and type of pipe, working pressure at 73 degrees F., and National Sanitation Foundation (NSF) approval.

2.3 FITTINGS

- A. Fittings for Solvent- Welded Pipe:
 - 1. Schedule 40, polyvinyl chloride, standard weight, as manufactured by "Sloane", "Lasco", or approved equal, to meet ASTM D-2466-73 and D-2467-73.
 - 2. Threaded PVC nipples - Schedule 80 PVC.
- B. Fittings for Polyethylene Pipe:
 - 1. Polyallomer as manufactured by "Flintkote" or approved equal.
 - 2. Compression type of CPVC as manufactured by "Pepco".
- C. Fittings for Swing Joints:
 - 1. Supply three (3) Schedule 40 "Marlex" elbows.
 - 2. Threaded PVC Nipples - Schedule 80 PVC.

2.4 PIPING JOINING MATERIALS

- A. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- B. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Site Verification of Conditions:
 - 1. Contractor shall be acquainted with all site conditions. Should utilities or other work not shown on the plans be found during excavations, Contractor shall promptly notify Landscape Architect for instructions as to further action. Failure to do so will make Contractor liable for any and all damage arising from operations subsequent to discover of such utilities not shown on plans.
 - 2. Contractor shall take necessary precautions to protect site conditions. Should damage be incurred Contractor shall repair damage to its original condition or furnish and install equal replacement.

3.2 LAYOUT

- A. Consideration will not be given to design changes until after award of contract.
- B. Lay out work as closely to that shown on the Contract Drawings as possible. Contract Drawings are diagrammatic in nature. Adjust layout as necessary to accommodate actual site conditions. Locate pipe and valves shown under paving in adjacent planting area.
- C. Full and complete coverage is required. Contractor shall make minor adjustments to layout as required to assure full and complete coverage. When such adjustments require exceeding radius limitations shown on irrigation legend, contact Landscape Architect for direction.
- D. Substitutions for smaller pipe sizes will be not be accepted.

3.3 EARTHWORK

- A. Perform excavation as required for installation of work included under this Section, including shoring of earth banks if necessary. Restore all surfaces, existing underground installations, etc., damaged or cut as a result of excavations, to their original condition.
- B. Should utilities not shown on the plans be found during excavation, promptly notify Landscape Architect for instructions as to further action. Failure to do so will make Contractor liable for any and subsequent discovery of such utilities. Indicate such utility crossings on the Record Drawings promptly.
- C. Dig trenches wide enough to allow a minimum of 4-inches between parallel pipe lines. Trenches shall be of sufficient depth of proved minimum cover from finish grade as follows:
 - 1. Over pipe on pressure side of irrigation control valve, control wires and quick coupling valves: 18 inches.
 - 2. Over pipe on non-pressure side of irrigation control valve: 12 inches.
- D. Trenching within the drip-line of existing trees shall not employ the use of mechanical trenching devices. Hand dig without severing roots which exceed 1-1/2" in diameter. Notify the Landscape Architect immediately if site conditions prohibit such action.

3.4 PIPING INSTALLATION

- A. General:
 - 1. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
 - 2. Clean all pipes and fittings of dirt and moisture before assembly.
 - 3. Install piping free of sags and bends.
 - 4. Install groups of pipes parallel to each other, spaced to permit valve servicing.
 - 5. Install fittings for changes in direction and branch connections.

6. Install unions adjacent to valves and to final connections to other components with NPS 2 (DN 50) or smaller pipe connection.
 7. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 (DN 65) or larger pipe connection.
 8. Install expansion loops in control-valve boxes for plastic piping.
 9. Lay piping on solid sub-base, uniformly sloped without humps or depressions.
 10. Install ductile-iron piping according to AWWA C600.
 11. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.
- B. Solvent-Welded Joints for PVC Pipes:
1. Use solvents and methods by pipe manufacturer
 2. Cure joint a minimum of one hour before applying any external stress on the piping and at least twenty four (24) hours before placing the joint under water pressure.
- C. Threaded Joints for Plastic Pipes:
1. Use Teflon tape on the threaded PVC fittings except where Marlex fittings are used.
 2. Use strap-type friction wrench only. Do not use metal-jawed wrench.
 3. When connection is plastic to metal, male adaptors shall be used. The male adaptor shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be Teflon tape or approved equal.
- D. Joints for Polyethylene Pipes:
1. Double-clamp all connections 1-1/4-inch diameter and greater.
 2. Make all connections between polyethylene pipes and metal valves or pipes with threaded fittings using male adaptors.
- E. Laying of Pipe:
1. Pipes shall be bedded in at least 2-inches of finely divided material with no rocks or clods over 1-inch diameter to provide a uniform bearing.
 2. Pipe shall be snaked from side to side of trench bottom to allow for expansion and contraction. One additional foot per 100 feet of pipe is the minimum allowance for snaking.
 3. PVC Pipe shall not be laid when there is water in the trench.
 4. Install plastic pipe in a manner to provide for expansion and contraction as recommended by the manufacturer.
 5. Cut plastic pipe with PVC pipe cutters or hacksaw to ensure a square cut. Remove burrs at cut ends prior to installation to ensure that a smooth unobstructed flow will be obtained.
 6. All plastic to plastic joints shall be solvent-weld joints or slip seal joints. Only solvent recommended by the pipe manufacturer shall be used. Install plastic pipe and fittings as outlined and instructed by pipe manufacturer. It shall be the Contractor's responsibility to make arrangements with the pipe manufacturer for any field assistance that may be necessary. Contractor shall assume full responsibility for the correct installation.

3.5 EQUIPMENT INSTALLATION

- A. Gate Valves: Group valves together and locate in planted areas where possible. Box shall be flush with finish grade.
- B. Irrigation Control Valves: Install control valves in valve boxes where shown and group together where practical. Place no closer than 12-inches to walk edges, buildings, and walls. Valve boxes shall be flush with finish grade.
- C. SPRINKLER HEADS:
 - 1. Place all rotary pop-up sprinkler heads in lawn areas on swing joints as Detailed on Drawings with top of heads 1-Inch above finish grade. Place part-circle rotary pop-up sprinkler heads 8-inches from edge of and flush with top of adjacent walks, header boards, curbs, mowing bands, or paved areas at time of installation. Install rotary sprinklers on a swing joint assembly as detailed.
 - 2. Install spray heads and bubbler heads on a swing joint assembly as detailed on the Drawings.
- D. Quick Coupling Valves: Install quick coupling valves on a swing joint assembly as detailed on the Drawings.
- E. Automatic Controller:
 - 1. Install per local code and manufacturer's latest printed instructions.
 - 2. Connect remote control valves to controller in clockwise sequence to correspond with station setting beginning with Stations 1, 2, 3, etc.
 - 3. Affix controller name (i.e. "Controller A") on inside of controller cabinet door with letters minimum of 1-inch high.
 - 4. Affix a non-fading copy of irrigation diagram to cabinet door below controller name. Seal irrigation diagram between two sheets of 20 mil (minimum) plastic.
 - 5. Irrigation diagram shall be a reduced copy of the as-built drawing and shall show clearly all valves operated by the controller, showing station number, valve size, and type of planting irrigated.
- F. Control Wiring:
 - 1. Install control wires with sprinkler mains and laterals in common trenches wherever possible. Lay to the side of pipe line. Provide looped slack at valves and snake wires in trench to allow for contraction of wires. Tie wires in bundles at ten (10') foot intervals.
 - 2. Crimp and seal control wire splices at remote control valves with specified splicing materials. Line splices will be allowed only on runs of more than 500 feet. Line splices to be Scotchlok and sealed with Scotchkote sealer.
 - 3. Install a minimum of one (1) extra control wire to the control valve located the greatest distance from the controller in both directions and label each end blank or as shown on drawings.
- G. Closing of Pipe and Flushing of Lines:

1. Cap or plug all openings as soon as lines have been installed to prevent entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.
2. Thoroughly flush out all water lines before installing heads, valves and other hydrants.
3. Test as specified.
4. Upon completion of testing, complete assembly and adjust sprinkler heads for proper distribution.
5. All sprinkler heads and quick coupling valves shall be set perpendicular to finished grades unless otherwise designated on the Drawings, or otherwise specified. Sprinkler heads adjacent to existing walls, curbs and other paved areas, shall be set to grade. Sprinkler heads which are to be installed in lawn areas where the turf has not yet been established shall be set 1-inch above the proposed finish grade. Heads installed in this manner will be lowered to grade when the turf is sufficiently established to allow walking on it without appreciable destruction. Such lowering of heads shall be done by Contractor as part of the original contract with no additional cost to the Owner.

3.6 BACKFILL AND COMPACTING:

- A. After system is operating and required tests and inspections have been made, backfill excavations and trenches with clean soil free of debris.
- B. Backfill for all trenches, regardless of the type of pipe covered, shall be compacted to minimum 95 percent density under pavements, and 85 percent under planted areas.
- C. Compact trenches in areas to be planted by thoroughly flooding backfill. Jetting process may be used in those areas.
- D. Dress off all areas to finish grades.

3.7 GUARANTEE

- A. The Contractor shall warrant all materials and workmanship for one (1) year from final acceptance.

3.8 CLEAN UP

- A. Clean up and remove all debris from the entire work area prior to Final Acceptance to satisfaction of Landscape Architect.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Perform hydrostatic tests when welded PVC joints have cured per manufacturer's instructions.

1. Pressurized Mains:
 - a. Completely install mains, gate valves, and control valves. Do not install laterals.
 - b. Fill all lines with water.
 - c. Pressurize the main with air to 70 psi. Monitor gauge for pressure loss for four (4) hours. Maximum allowable loss over four (4) hour period - 3 psi.
 - d. Leave lines and fittings exposed throughout testing period.
 - e. Leaks resulting from tests shall be repaired and tests repeated until the system passes.
 - f. Test all gate valves for leakage.
2. Non-Pressure Laterals:
 - a. Test piping after laterals and risers are installed and system is fully operational.
 - b. Leave trenches open to detect possible leaks.
- C. Submit written requests for inspections to the Landscape Architect at least forty eight (48) hours prior to anticipated inspection date.
- D. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 1. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Any irrigation product will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.10 ADJUSTING

- A. Adjust settings of controllers.
- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
- C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch above, finish grade.

END OF SECTION 328400

SECTION 329113

SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Components of planting mediums.
 2. Testing and certification of components.
 3. Mixing of planting mediums.
 4. Transporting of mediums.
 5. Soil and soil amendments products including all imported landscape soil as required to make-up deficiencies in quantity of stockpiled native topsoil available on site.

1.2 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.
- D. Topsoil: Soil with organic content suitable for sustaining the growth of a soil stabilizing groundcover such as turf. Topsoil is spread over prepared subgrade.
1. Stockpiled Native Topsoil: Topsoil stripped from the site prior to rough grading work to be spread and amended as specified (When available). No onsite soil may be used as topsoil unless approved by Landscape Architect. Soil cut from non organic layers will not be considered for use as topsoil.
 2. Imported Landscape Topsoil: Off-site topsoil imported and stockpiled to be spread and amended as specified.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, furnish manufacturer's literature, certifications, sources, samples, and laboratory analytical data.
1. Organic amendments.
 2. Topsoil.

3. Sand.
4. Mulch.
5. Plant bed mix.
6. Fertilizer.
7. Soil amendments.
8. Pre-emergent herbicide.

1.4 QUALITY ASSURANCE

- A. Testing: Soil testing laboratory shall be approved by Owner. Soils laboratory shall be capable of providing all tests outlined in this section and shall provide recommendations and rates of applications per 1000 sq. ft. for soil amendments, soil chemistry, and soil placement.
1. All costs for testing shall be paid for by Contractor.
 2. Materials to be Tested:
 - a. Stockpiled Native topsoil - 3 samples minimum from at least 3 different locations within the stockpile.
 - b. Imported Landscape soils - 3 samples minimum from at least 3 different locations within the stockpile.
 3. Agricultural Test Reports: Stockpiled Native Topsoil, Imported Landscape Soils, and Subgrade Soil shall be tested as follows:
 - a. Fertility (as expressed in measures of pH, salinity, nitrates, ammonium, phosphate, potassium, calcium, and magnesium).
 - b. Agricultural Suitability (sodium absorption ratio, sodium acetate and extractable calcium).
 - c. Particle Size: Classify the soil by USDA standards including particle size and organic content notations. Lab reports to conform to material specification description for sieve sizes.
 - d. Heavy metals (cadmium, lead, arsenic, aluminum).
 - e. Soils lab may require additional tests due to field conditions.
 4. Fertility Considerations: In the event of nutrient inadequacies, provisions shall be made to add required materials in soils to overcome inadequacies prior to planting.
 5. Imported Landscape Topsoil: Test for herbicide contamination.
 6. Certificates: Certify strict compliance with accepted soil mixes and amendments, including rate of application.

PART 2 - PRODUCTS

2.1 NATIVE LANDSCAPE TOPSOIL

- A. Stockpiled Native Topsoil

1. Quantity: Approximate quantity of stockpiled native topsoil will not be known until demolition and rough grading have been completed under Civil Work.
2. Stockpiling: Stockpile stripped topsoil onsite.
3. Composition: Fertile, friable, well-drained soil, of uniform quality, free of stones over 1-inch diameter, sticks, oils, chemicals, plaster, concrete and other deleterious materials.
4. Analysis: Obtain an agricultural suitability analysis of the proposed topsoil from an accepted, accredited Testing Agency at Contractor's cost.
5. Test Results: Request Testing Agency to send one (1) copy of test results directly to Landscape Architect and one (1) copy to the Owner. Imported topsoil shall be amended per soils analysis report.

2.2 IMPORTED TOPSOIL

A. Grading:

Sieve Size	Percent Passing Sieve
25.4 mm (1")	95-100
9.5 mm (3/8")	85-100
53 Micron (270 mesh)	10-30

B. Chemistry - Suitability Considerations:

1. Salinity: Saturation Extract Conductivity (ECe x 103 @ 25 degrees C.) less than 4.0.
2. Sodium: Sodium Absorption Ratio (SAR) less than 9.0.
3. Boron: Saturation Extract Concentration less than 1.0 PPM.
4. Reaction: pH of Saturated Paste: 6.0- 7.5.

C. Pests: The population of any single species of plant pathogenic nematode shall be fewer than 500 per pint of soil.

D. Fertility Considerations: Soil to contain sufficient quantities of available nitrogen, phosphorus, potassium, calcium, and magnesium to support normal plant growth. In the event of nutrient inadequacies, provisions shall be made to add required materials to overcome inadequacies prior to planting.

E. Source of above shall be approved and conformity of material shall be laboratory verified for each 100 cubic yards of material delivered to the site.

F. Composition: Fertile, friable, well drained soil, of uniform quality, free of stones over 1 in. diameter, sticks, oils, chemicals, plaster, concrete and other deleterious materials.

2.3 PINE BARK MULCH

A. Finely ground decomposed pine bark.

- B. White wood or filler material is not allowed.
- C. Submit sample for approval.

2.4 SAND

- A. Grading: Clean bank sand free of deleterious materials and clumps larger than 1 inch in diameter.
- B. Planting Bed Mix/Tree Backfill: Sharp sand.

2.5 CHEMICAL ADDITIVES

- A. The following soil components listed shall be applied at rates shown as determined by soil tests. Till additives into existing soil for all grassed areas.
 - 1. Gypsum: Agricultural grade product containing 80 percent minimum calcium sulphate. Apply at a rate of 6lbs./1000 sq. ft.
 - 2. Boil Sulphur: Agricultural grade sulphur containing a minimum of 96 percent sulphur. Apply at a rate of .2 lbs./1000 sq. ft.
 - 3. Apply the following micronutrients at the rates shown:
 - a. Zinc: .05 ounces/1000 sq. ft.
 - b. Manganese: .05 ounces/1000 sq. ft.
 - c. Copper: .05 ounces/1000 sq. ft.

2.6 PLANTING MEDIA

- A. Thoroughly mix planting media in the following proportions:
 - 1 part sharp sand
 - 1 part topsoil
 - 1 part pine bark mulch
- B. The ratio of mix components may be altered during Contract period to meet site conditions found different in various Project areas.
 - 1. Chemical additives – determined by soil tests.
 - 2. Maintain pH at 6.5 to 7.5.

PART 3 - EXECUTION

3.1 SOIL MOISTURE CONTENT

- A. Do not work soil when the following conditions occur:
 - 1. Moisture content is so great that excessive compaction will occur.
 - 2. When it is so dry that dust will form in air or where clods will not break readily.
 - 3. When it is frozen.
- B. Apply water if necessary to bring soil to optimum moisture content for tilling and planting.

3.2 CLEARING AND CULTIVATION

- A. Clearing: Clear all planting areas of stones 1-1/2 in. diameter and larger, weeds, debris and other extraneous materials prior to soil preparation work.
- B. Cultivation of Subgrade:
 - 1. Verification:
 - a. Verify that subgrades for installation of stockpiled native topsoil and imported landscape soil have been established under rough grading and have been approved by the landscape architect. Do not spread landscape soil prior to acceptance of subgrade work.
 - b. Depth: Verify that subgrades are 4-inch minimum below finished grades, + 1 inch. Report all variations.
 - 2. Cultivation: Rip or cultivate rough grade in all lawn and planting areas to a depth of 4 inches immediately prior to spreading stockpiled native topsoil or imported landscape soil.

3.3 SPREADING, DEPTH, AND AMENDING OF IMPORTED LANDSCAPE SOIL

- A. Sequence: Existing soil subgrade cultivation and amending to be approved prior to spreading stockpiled native topsoil or imported landscape soils.
- B. Install stockpiled topsoil in low areas to bring the rough grade to within plus or minus 1 foot.
- C. Place in lifts of 3 inches maximum where necessary.

3.4 MIXING

- A. Till soil amendments into existing soil for grassed areas with the use of mechanical tiller to a depth of 4 inches.
- B. Mix soil base, amendments, and chemical additives by mechanical means. Do not mix additives with excavated material at the plant pit site.
- C. Mechanical means should thoroughly mix all amendments with soil or soil-less base.
- D. Soil and sand bases shall be completely pulverized and free of lumps or aggregated material. Moisture content of base materials shall not be such that chemical granular or pelletized additives become dissolved before thorough mixing.
- E. Mix media in quantities of not less than 50 cubic yards or mix total quantity required if less than 100 cubic yards. Contractor shall be responsible for continuity between batches.
- F. The Contractor shall keep in storage, at his own expense, sufficient quantities of mix to repair any settling or to adjust grades throughout the warranty period.

3.5 FIELD QUALITY CONTROL

- A. Landscape Architect reserves the right to take and have a Soils Testing Laboratory analyze soil samples at the site.
- B. Immediately remove rejected materials from site. Replacements are subject to all specified requirements.
- C. Contractor shall bear final responsibility for proper surface drainage of planted areas. Any discrepancy in the Drawings or Specifications, obstructions on the site, or prior work done by another party, which Contractor feels precludes establishing proper drainage shall be brought to the attention of Landscape Architect in writing for correction or relief of said responsibility.

END OF SECTION 329113

SECTION 329119

LANDSCAPE GRADING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes prevention of excessive weed growth in lawns.
- B. Related Sections:
 - 1. Section 328400 – Planting Irrigation.
 - 2. Section 329113 – Soil Preparation.
 - 3. Section 329200 – Turf and Grasses.

1.2 DEFINITIONS

- A. Finished Grading: Placing and grading of additional soil that may be required to bring the grade to the required grades for lawns, shrubbery, and groundcover beds.
- B. Additional Fill Materials: Topsoil as specified herein unless otherwise specified.

1.3 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-preparation operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
 - 3. Minimize use of heavy machinery where practicable.

1.4 QUALITY ASSURANCE

- A. Qualifications: Work shall be performed by personnel trained and experienced in the work and shall be done under the direct supervision of a superintendent on Contractor's staff.
- B. Workmanship: Perform work in conformance with recognized acceptable practices. Where job requirements require deviation from those practices, obtain approval from Landscape Architect before processing.

1.5 EXISTING CONDITIONS

- A. Protection of Existing Utilities:
 - 1. Existence and location of underground items are not guaranteed. Investigate and field verify before starting work. Excavation and backfill in the vicinity of existing items of work shall be carried out with extreme caution.
 - 2. Contractor shall be held responsible for any damage and for maintenance and protection of existing utilities.
 - 3. Indicate on record drawings where there is conflict between field conditions and drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Topsoil: Topsoil shall be free from herbicides and insecticides which might adversely affect subsequent growth of turf or plantings, or which might otherwise contain materials toxic to humans and pets.
- B. Sand: Required product shall be "Bank Sand". Submit sample for approval. Sand is not permitted for fine grading purposes if depth exceeds 3/4 inches to achieve finished grade.

2.2 EQUIPMENT

- A. Machinery: Machinery shall be approved by Owner. Contractor shall provide equipment and machinery sufficient for proper execution of Work.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE PROTECTION

- A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

3.3 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Landscape Architect not less than two weeks in advance of proposed utility interruptions to allow conformance with Utility Department Outage Notification protocol.

3.4 FINISH GRADING

- A. In areas to receive lawns, till, disc, or otherwise scarify soil removing all clods, stones, and related material one inch or larger. Place and spread any additional material that may be required.
- B. Landscape areas shall have 2% minimum slope for good drainage. Contractor shall be responsible for minor adjustments to finished subgrade if deemed required by Landscape Architect.
- C. Hand rake surface, removing all clods and undesirable material greater than one-half inch from ground surface. Fill all low spots and cut irregularities to the acceptance of the Landscape Architect.
- D. Finish all swales and additional swales that may be required to drain areas where there are existing plant materials during finished grading operations.
- E. Prepare to immediately begin grassing operations of the completed and accepted finish grade to prevent excessive weed growth in lawn areas.

3.5 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
 - 1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 329119

SECTION 329202

SODDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sodding.

1.2 REFERENCES

- A. Hortus III – 1976 Edition, Bailey Hortorium, Cornell University.
- B. Guideline Specifications to Turfgrass Sodding – 1995 Edition, By Turfgrass Producers International

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- C. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.
- E. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Certification of grass sod.
 1. Certification of each seed mixture for turfgrass sod.
- C. Product certificates.

- D. Planting Schedule: Indicating anticipated planting dates for each type of planting.

1.5 QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.
- B. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory.
 - 1. Report suitability of topsoil for lawn growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Sod: Harvest, deliver, store, and handle sod according to requirements in TPI's "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in its "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

1.7 PROJECT CONDITIONS

- A. Do not install lawns during rainy or freezing weather, or when soil is frozen.

1.8 TIMING OF INSTALLATION

- A. Sod:
 - 1. Immediately after finish grading is accepted.
 - 2. Allow sufficient time for sod to knit together and meet requirements for preliminary review.

1.9 WARRANTY

- A. Time Period: Warrant that lawns are in healthy and flourishing condition of vigorous active growth one year from date of Final Acceptance.
- B. Appearance During Warranty: Lawns shall be free of dead or dying patches, and all areas shall show foliage of a normal density, size and color.
- C. Delays: Delays caused by the Contractor in completing planting operations which extend the planting into more than one planting season shall extend the Warranty Period correspondingly.

- D. Exceptions: Contractor shall not be held responsible for failures due to neglect by Owner, vandalism, or Acts of God during Warranty Period. Report such conditions in writing.

1.10 MAINTENANCE SERVICE

- A. Initial Lawn Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
 - 1. Seeded Lawns: 60 days from date of planting completion.
 - a. When initial maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.
 - 2. Sodded Lawns: 30 days from date of planting completion.

PART 2 - PRODUCTS

2.1 LAWN SOD

- A. One year old nursery-grown sod that is certified Common Bermuda.
- B. Dense, healthy, field-grown on fumigated soil with the grass having been mowed at 1-inch height before lifting from field.
- C. Dark green in color, free of thatch, free from diseases, weeds and harmful insects.
- D. Reasonably free of objectionable grassy and broad leaf weeds. Sod shall be considered weed free if no more than ten (10) such weeds are found per 100 sq. ft. of sod.
- E. Sod shall be rejected if found to contain the following weeds:
 - 1. Quackgrass.
 - 2. Johnson grass.
 - 3. Poison ivy.
 - 4. Nimbleweed.
 - 5. Thistle.
 - 6. Bindweed.

7. Bentgrass.
 8. Perennial sorrel.
 9. Bromegrass.
- F. All sod to be cut 1-1/2 inches deep. Rhizome development should be apparent.

2.2 GENERAL ACCESSORIES

- A. Water: Potable water as furnished by Owner.
- B. Pre-plant Fertilizer: See Soil Preparation - Section 329113
- C. Top-Dress Fertilizer: 16-6-8 (N-P-K)
- D. Herbicides: Do not use herbicides which persist in the ground longer than 30 days.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 1. Grades: Verify that grades are within 1-inch plus or minus the required finished grades. Verify that all soil preparation has been completed and approved. Report all variations in writing.
 2. Stones, Weeds, Debris: Verify that all areas to receive lawns and grasses are clear of stones larger than 1-1/2 inch in diameter, weeds, debris, and other extraneous materials.

3.2 PREPARATION

- A. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- B. Before planting, restore areas if eroded or otherwise disturbed after finish grading.

3.3 SODDING

- A. Sod Bed Preparation:
 1. Rolling: Roll amended soil with 200 pound water-ballast roller.

2. **Moistening Soil Surface:** After all unevenness in the soil surface has been corrected, lightly moisten the soil immediately prior to laying the sod.
3. **Timing:** Sod immediately thereafter, provided the sod bed has remained in friable condition.

B. Sodding Operations :

1. **Big roll sod** shall be installed by tractors with proper flotation tires or by an approved big roll sod installation machine. Care should be taken to roll out sod at a proper speed so that no humping or tearing of sod occurs. Sod will be manually pulled together by stiff rakes to insure no gaps remain in the seams. Joints should be staggered. Damaged or problem areas shall be cut out and replaced in a professional manner.
2. **Starter Strip:**
 - a. Lay first row of sod in a straight line, with subsequent rows parallel to and tightly against each other.
 - b. Stagger lateral joints.
 - c. Do not stretch or overlap sod.
 - d. Butt all joints tightly to eliminate all voids.
3. **Cutting:** Use a sharp knife to cut sod to fit curves, surface components of the irrigation system or other items.
4. **Tamping and Rolling:** Thoroughly tamp and roll sod to make contact with sod bed. Roll each entire section of completed sod.
5. **Watering:** Thoroughly water sod immediately after installation to wet the underside of the new sod pad and the soil immediately below to a depth of 6 inches. Maintain constant moisture for 2 weeks or until sod is fully rooted.
6. **Top-Dress Fertilizer:** Apply at the rate of (6) to (8) pounds per 1,000 square feet at 25 days and at 50 days after sodding.

3.4 LAWN MAINTENANCE

- A. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, re-grade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth lawn. Provide materials and installation the same as those used in the original installation.

- B. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowing.

3.5 SATISFACTORY LAWNS

- A. Satisfactory Sodded Lawn: At end of maintenance period, a healthy, well-rooted, even-colored, viable lawn has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

3.6 FIELD QUALITY CONTROL

- A. Tests: Samples of materials may be taken and tested for conformity to specifications at any time.
- B. Rejected Materials: Remove rejected materials immediately from site at Contractor's expense. Pay cost of testing of materials not meeting specified requirements.

3.7 CLEANING

- A. Erosion: Immediately restore eroded areas. Keep all adjacent paved surfaces clear of dirt, mud, stains, and organic debris.

END OF SECTION 329200

SECTION 32 92 13 - HYDROMULCH SEEDING

PART 1 GENERAL

1.1 SCOPE

- A. Refer to the Drawings, Schedules and Details for type and locations of work required herein. Furnish all labor, materials, equipment and supervision for the installation of items included within these specifications. Such work includes, but is not limited to the following:
 - 1. Furnishing and applying hydromulch seeding including all materials and equipment required for the specified method of lawn installation.
 - 2. Site cleanup.
 - 3. Maintenance and guarantee.

1.2 APPLICABLE PUBLICATIONS

- A. The following publications of the latest issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by references thereto:
 - 1. Texas Department of Transportation 2004 Standard Specifications for construction of Highways, Street and Bridges (TxDOT).
 - a. Item 162 - Sodding for Erosion Control
 - b. Item 164 - Seeding for Erosion Control

1.3 RELATED WORK

- A. Section 31 22 13 - Site Grading.
- B. Section 31 25 13 - Erosion and Sedimentation Control
- C. Section 32 92 00 Turf and Grasses

1.4 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. Perform Work in accordance with all applicable laws, codes, and regulations required by authorities having jurisdiction over such work and provide for all inspections and permits required by Federal, State, and local authorities in furnishing, transporting, and installing materials.

1.5 SUBMITTALS

- A. Samples:
 - 1. The Owner reserves the right to request samples of materials for conformity to specifications at any time. Contractor shall furnish samples upon request. Rejected

materials shall be immediately removed from the site at Contractor's expense. Cost of replacement of materials not meeting the specifications shall be paid by Contractor.

2. Typical requests from the owner may include copies of manufacturers' literature, certifications, or laboratory analytical data for the following items:
 - a. Fibre Mulch.
 - b. Tank Mix Fertilizer.
 - c. Top Dress Fertilizer.

1.6 SCHEDULE

- A. Submit a proposed work schedule to the Owner for approval at least fifteen (15) days prior to start of work under this Section. After approval, no modification shall be made to this schedule without written authorization by the Owner.
- B. In general, the work shall proceed as rapidly as the site becomes available, consistent with normal seasonal limitations for planting work.

1.7 PRODUCT DELIVERY, HANDLING AND STORAGE

- A. Furnish standard products in manufacturer's standard containers bearing original labels showing quantity, analysis and name of manufacturer.
- B. Submit written requests for inspections to the Engineer at least seven (7) days prior to anticipated inspection date.

PART 2 - MATERIALS

2.1 SEED

- A. All seed used shall be labeled in accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act in effect on the date of Invitation for Bids. All seed shall be furnished in sealed standard containers unless exception is granted in writing by the Engineer. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable. The minimum percentage by weight or pure live seed in each lot of seed shall be as follows and seed shall be planted at the rate per acre indicated under pure live seed required per acre.

<u>Kind of Seed</u>	<u>Minimum % Pure Live Seed Required</u>	<u>Pounds Pure Live Seed Required Per Acre</u>
Bermuda Grass	85	7
K.R. Bluestem	85	1
Bahiagrass (Pensacola)	85	9

Note: % Pure Live Seed = (% Purity) X (% Germination)

- B. Weed seed shall not exceed ten (10%) of weight of the total of pure live seed and other material in the mixture. Johnson grass, nut grass, or other noxious weed seed will not be allowed.
- C. Source - Quality Control

1. Seed: The Contractor must follow the Federal Seed Act with respect to interstate commerce and transportation. Each lot of seed may be re-sampled and retested in accordance with latest Rules and Regulations under the Federal Seed Act at the discretion of the Owner. The seed retests will be conducted by a testing laboratory allowed by the State of Texas Department of Agriculture Seed Control Office. Material found to be below specified content levels will be at the contractor's responsibility to correct by removing and replanting and/or additional plantings.

2.2 FERTILIZER FOR TANK MIX

- A. Shall be 13-13-13 grade, pelleted, uniform on composition, free-flowing, and suitable for application with approved equipment. The fertilizer shall be delivered to the site in bags or other convenient containers, each fully labeled, conforming to the applicable state fertilizer laws, and bearing the name or trademark and warrant of the producer.

2.3 WOOD CELLULOSE FIBER MULCH

- A. Wood Cellulose fiber mulch, for use with the hydraulic application of grass seed and fertilizer, shall consist of specially prepared wood cellulose fiber. It shall be processed in such a manner that it will not contain germination or growth inhibiting factors. It shall be dyed a green color to allow visual metering of its application. The wood cellulose fibers shall have the property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil, the fibers shall form a blotter-like groundcover which readily absorbs water and allows infiltration to the underlying soil. Weight specifications from suppliers for all applications shall refer only to air dry weight of the fiber, a standard equivalent to eighteen (18%) percent moisture. The mulch material shall be supplied in packages having a gross weight not in excess of 100 pounds and be marked by the manufacturer to show the dry weight content. Suppliers shall be prepared to certify that laboratory and field testing of their product has been accomplished and that meets all of the foregoing requirements.

2.4 WATER

- A. Water used for mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable matter or other substances injurious to the finished product.
- B. Water sources other than the local municipal domestic water supply must be approved by the Owner.
 1. If onsite reclaimed water sources are used, tanks and appertices must be clearly marked with the words "non-potable" water.

2.5 SLURRY MIX COMPONENTS PER ACRE

- A. Wood Cellulose Fiber Mulch = 2,000 pounds
- B. Grass Seed = (as specified)
- C. Fertilizer (13-13-13) = 800 pounds

2.6 TOP DRESS FERTILIZER

- A. (Delayed Application) Complete fertilizer, fifty (50%) percent of the nitrogen to be derived from natural organic sources or urea-form. Available phosphoric acid shall be from superphosphate, bond, or tankage. Potash shall be derived from muriate of potash containing sixty (60%) percent potash:
 - 1. 16% Nitrogen
 - 2. 6% Phosphoric Acid
 - 3. 8% Potash

PART 3 - EXECUTION

3.1 HYDROMULCH SEEDING ON PREPARED FINISHED GRADE

- A. Bed Preparation: Immediately after the finished grade has been approved, begin hydroseeding operation to reduce excessive weed growth.
- B. Special Mulching Equipment and Procedures: Hydraulic equipment used for the application of fertilizer, seed, and slurry of prepared wood fiber mulch shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend, and homogeneously mix a slurry containing up to forty (40) pounds of fiber plus a combined total of seventy (70) pounds of fertilizer solids for each one hundred (100) gallons of water. The slurry distribution lines shall be large enough to prevent stoppage. The discharge line shall be equipped with a set of hydraulic spray nozzles which provide even distribution of the slurry on the slopes to be seeded. The slurry tank shall have a minimum capacity of eight hundred (800) gallons and shall be mounted on a traveling unit which may be either self-propelled or drawn with a separate unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded so as to provide uniform distribution without waste. The Engineer may authorize equipment with smaller tank capacity provided that the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform coat.
- C. Mixing: Care shall be taken that the slurry preparation should be accomplished per the material supplier's recommendations and the equipment manufacturer's written operations manual. Spraying shall commence immediately when the slurry is mixed and the tank is full. The operator shall spray the area with a uniform, visible coat by using the green color of the wood pulp as a guide.
- D. Application:
 - 1. Contractor shall obtain approval of hydromulch area preparation from the Engineer prior to application.
 - 2. Operators of hydromulching equipment shall be thoroughly experienced in this type of application. Apply specified slurry mix in a motion to form a uniform mat at specified rate.
 - 3. Keep hydromulch within areas designated and keep from contact with other plant material.
 - 4. Slurry mixture which has not been applied within four (4) hours of mixing shall not be used and shall be removed from the site.

5. After application, the Contractor shall not operate any equipment over the covered area.
6. Immediately after application, thoroughly wash off any plant material, planting areas, or paved areas not intended to receive slurry mix. Keep all paved and planting areas clean during maintenance operations.
7. Refer also to the maintenance portion of this section.
8. All areas designed on drawings shall be covered uniformly with specified materials using hydromulching processes. If surfaces remain uncovered within the designated area, the Contractor shall seed with required grasses or ground cover materials those areas missed by the hydromulch application. Method used to seed these missed surfaces shall be an alternate seeding operation approved by the Architect/Engineer/Owner's Representative and shall be accomplished at no additional cost to the Owner.

3.2 CLEAN UP

- A. Keep all areas of work clean, neat, and orderly at all times. Keep all paved areas clean during installation operations. Clean up and removal all deleterious materials and debris from the entire work area prior to Final Acceptance to the satisfaction of Engineer.

3.3 INSPECTIONS

- A. Make written request for inspection prior to seeding and after areas have been seeded.
- B. Submit requests for inspections to Engineer at least two (2) days prior to the anticipated inspection date.

3.4 MAINTENANCE BY THE CONTRACTOR

- *A. The Contractor shall begin maintenance after each plant is installed and continue until Final Acceptance. ***[OR]**
- *A. The Contractor's Maintenance Period shall begin upon inspection and approval at Substantial Completion and shall be for the period of 60 days.
- B. The Contractor's maintenance of new planting shall consist of watering, weeding, repair of all erosion and reseeding and resodding as necessary to establish a uniform stand of the specified grasses. Contractor shall guarantee growth and coverage of hydromulch planting under this Contract to the effect that a minimum of ninety five (95%) percent of the area planted will be covered with specified planting after sixty (60) days with no bare spots greater than ten (10) square feet. Any sod panels that are dead or dying shall be replaced.
- C. The Contractor shall be responsible for one (1) mowing in the event that the time between seeding or sodding and Final Acceptance exceeds thirty (30) days.
- D. Contractor shall make a second application of specified hydromulch planting to bare areas not meeting specified coverage as determined by the Engineer. Such replanting to be performed within sixty (60) days of initial application and immediately upon notification by Engineer to replant.

- E. Apply top dress fertilizer (16-6-8) at the rate of ten (10) pounds per 1,000 square feet at no less than nor more than twenty five (25) days after seeding unless approved in writing by the Owner.

3.5 FINAL ACCEPTANCE

- A. Work under this Section will be accepted by Engineer upon satisfactory completion of all work, but exclusive of re-application under the Guarantee Period. Final Acceptance of lawn establishment shall be as follows:
- B. For Seed: Ninety Five (95%) percent uniform coverage of grass in excess of one (1") inch height. No bare spots of greater than two (2) square feet will be accepted.
- C. The Engineer and/or Owner shall interpret the above. Upon Final Acceptance, the Owner will assume the responsibility for maintenance of the work.

END OF SECTION

SECTION 329313

TREES, SHRUBS, AND GROUNDCOVER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Trees.
 - 2. Shrubs.
 - 3. Ground cover.

1.2 REFERENCES

- A. "Grades and Standards", latest edition, Texas Association of Nurserymen Specifications, Austin, Texas 78704.
- B. "American Standard for Nursery Stock", American National Standards Institute, Incorporated, (ANSI Z 60).
- C. "Standardized Plant Names", 1942 Edition, American Joint Committee on Horticultural Nomenclature

1.3 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- E. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.
- F. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated provide requested copies of manufacturers literature, samples, certifications, and laboratory analytical data:
 - 1. Trees, shrubs, and groundcovers – Samples and/or photographs.
 - 2. Mulch – manufacturer’s literature and sample.
 - 3. Tree and shrub planting fertilizer – certification or laboratory analytical data.
 - 4. Tree paint – manufacturer’s literature.
- B. Product certificates.
- C. Planting Schedule: Indicating anticipated planting dates for exterior plants.
- D. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of exterior plants during a calendar year.

1.5 QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.
- B. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory.
 - 1. Report suitability of topsoil for plant growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
- C. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."
- D. Source - Quality Control:
 - 1. Plants shall be subject to inspection and approval by Landscape Architect at place of growth and upon delivery for conformity to specifications. Such approval shall not impair the right of inspection and rejection during progress of the Work. Submit written request for inspection of plant material at place of growth to Landscape Architect. Written request shall state the place of growth and quantity of plants to be inspected. Landscape Architect reserves right to refuse inspection at this time if a sufficient quantity of plants is not available for inspection. All plant material shall be tagged by the Landscape Architect at the nursery.
 - 2. All plants inspected at the nursery by the Landscape Architect shall be tagged with serialized self-locking tags. Trees delivered to the site without these tags or with broken tags shall be sufficient reason for rejection.
 - 3. Substitutions of plant materials will not be permitted unless authorized in writing by Landscape Architect. If proof is submitted that any plant specified is not obtainable, a proposal will be considered for use of the nearest equivalent size or variety with corresponding adjustment of Contract Price. Such proof shall be substantiated and submitted in writing to Landscape Architect at least thirty (30) days prior to start of

Work under this Section. These provisions shall not relieve Contractor of the responsibility of obtaining specified materials in advance if special growing conditions or other arrangements must be made in order to supply specified materials.

- E. Inspections: Make written request for inspection after planting operations have been completed. Such inspection is for the purpose of establishing the Maintenance Period.
- F. Submit written requests for inspections to the Landscape Architect at least seven (7) days prior to anticipated inspection date.
- G. Preinstallation Conference: Generally on site

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Submit plan for transporting plant material to site to Landscape Architect for approval. Plan should include:
 - 1. Date of pick-up at nursery or place of storage.
 - 2. Type of vehicle used for shipping.
 - 3. Method of protecting trees during transit.
 - 4. Dates in transit.
 - 5. Date of delivery to site.
 - 6. Projected date of installation.
 - 7. Means of storage, watering and shading used between delivery and planting.
- B. Landscape Architect suggests the following considerations for the Contractor to evaluate in product handling:
 - 1. During hot weather and when practical, the Contractor may be required to transport plant materials between sunset and sunrise if transported in an open trailer or unrefrigerated box.
 - 2. Dug material should be maintained and watered as required at the nursery to guarantee their vitality and health until shipping.
 - 3. Protect all trunks, stems, branches and root balls during tree tying, wrapping and loading operations from damage.
 - 4. Load balls or containers onto transport vehicle and secure in a manner that protects the structural integrity of the root balls.
 - 5. The Contractor shall be solely responsible for the safe transportation of plants to the site and their condition upon arrival. Trees damaged, dehydrated or abused during transit and storage will be rejected.
 - 6. Plant materials should not be stored on concrete or left exposed to the sun.
 - 7. Protect the balls and water regularly until planting. If trees are left in storage over the weekend or holiday, provide a means of periodical watering and inspecting root ball protection.
- C. Landscape Architect may inspect any phase of this operation and may reject any plant material improperly handled during any phase of this operation.

- D. Nothing in this Section shall be interpreted as relieving the Contractor of the responsibility of providing healthy, viable plants, nor shall it have any affect upon the terms of the warranty specified herein.
- E. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery and handling.
- F. Handle planting stock by root ball.
- G. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants and trees in shade, protect from weather and mechanical damage, and keep roots moist.

1.7 FINAL ACCEPTANCE

- A. Work under this Section will be accepted by Landscape Architect upon satisfactory completion of all work including maintenance, but exclusive of replacement of plant materials under the warranty period. Upon Final Acceptance, Owner will assume responsibility for maintenance of Work.

1.8 WARRANTY

- A. Special Warranty: Installer's standard form in which Installer agrees to repair or replace plantings that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, abuse by Owner, or incidents that are beyond Contractor's control.
 - b. Structural failures including plantings falling or blowing over.
 - 2. Warranty Periods from Date of Substantial Completion:
 - a. Trees and Shrubs: One year.
 - b. Ground Cover and Plants: Three months.

1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is

planted and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below.

1. Maintenance Period for Trees and Shrubs: 12 months from date of Substantial Completion.
2. Maintenance Period for Ground Covers and Plants: Three months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TREES, SHRUBS, VINES, AND GROUNDCOVER

- A. Plants shall be nursery grown in accordance with good horticultural practices under climatic conditions similar to those of project for at least two years unless specifically otherwise authorized by Landscape Architect in writing. Unless specifically noted otherwise, all plants shall be exceptionally heavy, symmetrical, tightly knit, so trained or favored in development and appearance as to be superior in form, number of branches, compactness and symmetry.
- B. Plants shall be sound, healthy and vigorous, well branched and densely foliated when in leaf. They shall be free of disease, insect pests, eggs, or larvae, and shall have healthy, well developed root systems. They shall be free from physical damage or adverse conditions that would prevent thriving growth.
- C. Plants shall be true to species and variety and shall conform to measurements specified except that plants larger than specified may be used if approved by Landscape Architect. Use of such plants shall not increase Contract price. If larger plants are approved, the ball of earth or container size shall be increased as specified under "Applicable Standards" and subject to the approval of the Landscape Architect.
- D. Plants shall be measured when branches are in their normal position. Height and spread dimensions specified refer to main body of plant and not branch tip to tip.
- E. Container stock, when specified, shall have grown in the containers in which delivered for at least six (6) months, but not over two (2) years. Samples must prove no root-bound conditions exist. No container plants that have cracked or broken balls of earth, when taken from container, shall be planted except upon special approval by Landscape Architect. Container stock shall not be pruned before delivery. Field grown plants recently transplanted into containers will not be accepted.
- F. Nursery grown B&B material (when allowable) shall be pruned and thinned at the place of growth immediately prior to digging as required for packaging and safe moving. Method of pruning shall be as approved in the field by the Landscape Architect. Do not remove self-locking tags during this pruning prior to delivery to site.

2.2 COMMERCIAL FERTILIZERS

- A. Shrub/Groundcover Fertilizers: Agri-Form 20-10-5, 21 gram tablets.
- B. Tree planting fertilizer: Davey Arbor Green Organic Liquid Soil injected at 115 PSI. Apply at mfg. recommended rates.
- C. Top-dress Fertilizer: Complete fertilizer, 50 percent of the nitrogen to be derived from organic sources or urea-form. Available phosphoric acid shall be from superphosphate, bone or tankage. Potash shall be derived from potassium sulfate containing 60 percent potash.

2.3 PRE-EMERGENCE WEED CONTROL

- A. In areas of Woody Ornamental Plants, Eptam or Eptam -5-G as manufactured by Greenlight Products Company, or approved equal.

2.4 STAKING MATERIALS

- A. Use staking materials necessary to meet requirements of specifications, subject to approval. Suggested materials:
 - 1. Tree Stakes: Green, Eight (8') feet long steel T-Post weighing 1.33 pounds per foot.
 - 2. Ties: Black rubber 3/4-inch hose with 3/16-inch wall thickness
 - 3. Tree Guying Material: #10 gage galvanized multi-strand cable.
 - 4. Cable Clamps: Size needed to hold two strands together.

2.5 MULCH

- A. Shredded Hardwood bark.

2.6 INSECTICIDE

- A. Ortho "Lindane Borer and Leaf Miner Spray" by Ortho, Consumer Products Division, Chevron Chemical Company, San Francisco, California 94119, or "Borer Killer" by Greenlight Company, San Antonio, Texas 78217.

2.7 WATERING TUBES

- A. Gray, perforated SDR PVC drainage pipe, 4 inches in diameter.

PART 3 - EXECUTION

3.1 LAYOUT AND EXCAVATION OF PLANTING AREAS:

- A. Layout plants in locations shown on Drawings. Use wire stakes color-coded for each specie of plant material. Stake location of each tree and major shrub and outline of shrub and groundcover beds.
- B. Landscape Architect will check location of plants in the field and shall adjust to exact position before planting begins.
- C. Subsoil shall not be worked when moisture content is so great that excessive compaction should occur, nor when it is so dry that clods will not break readily. Water shall be applied, if necessary, to bring soil to an optimum moisture content for tilling and planting.
- D. Excavate entire planting beds to a depth of 8 inches.

3.2 DRAINAGE, DETRIMENTAL SOILS, AND OBSTRUCTIONS:

- A. Test drainage of plant beds and pits by filling with water twice in succession. Conditions permitting the retention of water in planting beds for more than twenty four (24) hours or percolation of less than one inch per hour shall be brought to the attention of the Owner.
- B. Notify the Landscape Architect in writing of all soil or drainage conditions Contractor considers detrimental to growth of plant material.
- C. If rock, hardpan, underground construction work, tree roots or other obstructions are encountered in the excavation of plant pits and beds, alternate locations may be selected by Landscape Architect. Where locations cannot be changed, submit cost required to remove the obstructions to a depth of not less than 6 inches below the required pit or bed depth. Proceed with work after approval.

3.3 PREPARING PLANT MATERIALS FOR PLANTING:

- A. Canned stock shall be removed carefully after cans have been cut on two sides with approved cutter. Do not use spade to cut cans. Do not lift or handle container plants by tops, Stems, or trunks at any time.
- B. Do not bind or handle any plant with wire or rope at any time so as to damage bark or break branches. Lift and handle plants only from bottom of ball.

3.4 INSTALLATION OF BED PLANTED MATERIALS:

- A. Fill all shrub and groundcover beds with plant bed mix to finished grade (compacted).

- B. Excavate in planting mix for individual plant and install as required. Set plant plumb and brace rigidly in position until planting soil mix has been tamped solidly around the ball and roots.
- C. When plant pits have been backfilled approximately two-thirds (2/3) full, place Agriform tablets evenly distributed in plant pits according to the following schedule:
 - 1 gallon equivalent - 1 tablet
 - 5 gallon equivalent - 2 tablets
- D. Water thoroughly, saturating root ball, before installing remainder of the planting soil to top of pit, eliminating all air pockets. Top of root ball shall be 2 inches above finished grade.
- E. Smooth planting areas to conform to specified grades after full settlement has occurred. Contractor shall bear final responsibility for proper surface drainage of planted areas.
- F. Water all plants immediately again after planting.
- G. Apply pre-emergent weed control material over entire area to receive mulch.
- H. Mulch all shrub and groundcover beds as detailed on Drawings.

3.5 SURFACE DRAINAGE OF PLANTING AREAS

- A. Contractor shall bear final responsibility for proper surface drainage of planted areas. Any discrepancy in the Drawings or Specifications, obstructions on the site, or prior work done by another party which Contractor feels precludes establishing proper drainage, shall be brought to the attention of Landscape Architect in writing for correction or relief of said responsibility.

3.6 PRUNING

- A. Prune containerized plants only at time of planting and according to standard horticultural practice to preserve the natural character of the plant. Prune by removing entangled branching and by removing crotches. Avoid removing branch tips wherever possible. Pruning to be done under supervision of the Landscape Architect.
- B. Remove all dead wood, suckers, and broken or badly bruised branches. Use only clean, sharp tools.
- C. Paint cuts over 3/4- inch diameter with tree paint, covering all exposed, living tissue.

3.7 STAKING

- A. Contractor shall stake trees and shall be responsible for material remaining plumb and straight for all given conditions through the guarantee period. Tree support shall be done as outlined on the following tables.
- B. Staking shall be completed immediately after planting. Plants shall stand plumb after staking.
- C. Stake all trees in accordance with the following table:

Tree	No. of Stakes	Stake Size
30 Gal. and B&B	2	7 ft. T-Post
65 Gal. to 100 Gal.	3	8 ft. T-Post

- D. Machine moved trees do not require staking or guying.
- E. Locate first stake on prevailing windward side of tree and as close to the main trunk as is practical, avoiding root injury. Stakes shall be driven at least 18 inches into firm ground.
- F. Tie tree to stake using approved tree tie. Tie shall be located midway within tree crown or at a location approximately two-thirds (2/3) of the overall height of the tree. Locate tie just above major side branch in order to deter slippage of tie.
- G. Locate second stake opposite first. Secure with one tie opposite upper tie at first stake.
- H. Where used, stakes shall be equally spaced around the tree and placed equal distances from the trunk.
- I. Auxiliary stem stakes shipped with trees shall be removed after shipping.

3.8 CLEANING

- A. Clean all areas as required for complete and acceptable inspection.

3.9 INSPECTIONS:

- A. Make written request for inspection after planting operations are completed.
- B. Submit requests for inspections to the Owner at least two (2) days prior to anticipated inspection date.

3.10 PLANT MAINTENANCE

- A. Tree and Shrub Maintenance: Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- B. Ground Cover and Plant Maintenance: Maintain and establish plantings by watering, weeding, fertilizing, mulching, and other operations as required to establish healthy, viable plantings.
- C. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

END OF SECTION 329313

SECTION 329643

TREE TRANSPLANTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for transplanting trees.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualifications: Statement of qualifications including not less than five years experience in tree transplantation in the State of Texas.
- C. Samples of mineral mulch.
- D. Product certificates.
- E. Planting Schedule: Indicating anticipated planting dates for transplanting trees including:
 - 1. Time of year for transplanting.
 - 2. Transplanting methods.
 - 3. Follow-up care and maintenance.
- F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of exterior plants during a calendar year.

1.3 QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.
- B. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory.
 - 1. Report suitability of topsoil for plant growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
- C. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."
- D. Pre-installation Conference: Conduct conference at [Project site] <Insert location>.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not prune trees before delivery. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees in such a manner as to destroy their natural shape. Provide protective covering of trees during delivery. Do not drop during delivery and handling.
- B. Handle planting stock by root ball.
- C. Deliver trees after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior trees in shade, protect from weather and mechanical damage, and keep roots moist.

1.5 SEQUENCING AND SCHEDULING

- A. Proceed and coordinate work as the site becomes available, consistent with seasonal limitations for transplanting.
- B. Owner's representative will select and tag at the site, those plants to be transplanted to new locations.
- C. Transplant trees during cool weather. Avoid moving plants on very hot, dry, or windy days.

1.6 FINAL ACCEPTANCE

- A. Work under this Section will be accepted by Landscape Architect upon satisfactory completion of all work including maintenance, but exclusive of replacement of plant materials under warranty period. Upon Final Acceptance, Owner will assume responsibility of maintenance of the work.

1.7 WARRANTY

- A. Special Warranty: Installer's standard form in which Installer agrees to repair or replace plantings which fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, abuse by Owner, or incidents that are beyond Contractor's control.
 - b. Structural failures including plantings falling or blowing over.
 - 2. Any delay in completion of planting operations which extends planting into more than one planting season shall extend Warranty Period correspondingly.
 - 3. Warranty Periods from Date of Substantial Completion:

- a. Warrant that all trees planted under this Contract will be healthy and in flourishing condition of active growth one year from date of Final Acceptance.
- B. Replace, without cost to Owner, and as soon as weather conditions permit, all dead plants and all plants not in vigorous, thriving condition as determined by Owner during and at the end of Warranty Period. Plants shall be free of dead or dying branches and branch tips, and shall bear foliage of a normal density, size, and color. Replacements shall closely match adjacent specimens of the same species and shall be subject to all specified requirements.

1.8 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below.
 1. Maintenance Period for Trees and Shrubs: 12 months from date of planting completion.

PART 2 - PRODUCTS

2.1 TREE MATERIAL

- A. General: Furnish nursery-grown or field collected trees with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
- B. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- C. Provide balled and burlapped trees.

2.2 FERTILIZER

- A. Tree Planting Fertilizer: Davey Arborgreen Organic Liquid Soil or approved equal injected at 115 psi. Apply at manufacturer's recommended rates.

2.3 FERTILIZER INJECTOR

- A. Power injector capable of delivering 225 to 250 psi at nozzle.
- B. Hydraulic, agitated mixing tank.

- C. Nozzle point with three distribution orifices 120 degrees apart, capable of delivering fluid perpendicular to direction of shaft.
- D. Adjustable or permanent stop plate nozzle shaft to stop shaft at required depth.
- E. Ability to meter amount of material applied per injection.

2.4 INSECTICIDE

- A. Ortho "Lindane Borer and Leaf Miner Spray" or approved equal.

2.5 MULCHES

- A. Organic Mulch: Shredded hardwood, free of debris, deciduous leaves, and sticks. Bark chips shall not exceed 1-1/2 inch in size.

2.6 SAND

- A. The following requirements apply to sand:

Physical Properties - Grading

U.S. Sieve	Percent Passing
No. 4	100
No. 10	95-100
No. 18	90-100
No. 35	65-100
No. 140	0-20
No. 270	0-7

Chemistry

Range

Saturation Extract Conductivity (ECC)	Nil-3.0
Sodium Absorption Ratio (SAR)	Nil-6.0
Boron-ppm in saturation extract solution	Nil-1.0
Reaction (pH)	6.0-7.5
Available calcium-sodium acetate extractable-ppm dry weight	Nil-2000

2.7 EQUIPMENT

- A. Pruning Tools: Use only sharp, clean tools, sterilized prior to use.

- B. Transplanting Tools: Size of Vermeer Spade, if used is to be large enough to encompass fibrous feeder roots of each plant, consistent with standard nursery sizes for plant being relocated.
- C. Watering Tubes: Gray, perforated SDR PVC drainage pipe, four inches in diameter.
- D. Vehicles: Do not drive onto or operate a vehicle on jobsite carrying dirt or plant debris from another site. Wash all dirt and mud from tires prior to entering jobsite.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify with Owner all plants to be transplanted prior to beginning work.
- B. Stake plant layout for adjustment and approval prior to transplanting.
- C. Transplant all plantings as shown on Drawings. Proceed with transplanting operations based upon Owner accepted schedule and methods.
- D. Rootball Size: Minimum 10-inches in diameter per 1-inch tree caliper.
- E. Crown Pruning: Upon award of contract, prune trees back about 1/4th. Prune side branches only. Do not cut leaders.

3.2 MECHANICAL TRANSPLANTING OF TREES

- A. Use machinery in good condition with a minimum tolerance (max 2") between cutting blades. All blades shall be true to their designed shape and free of bends, which could interfere with their operation. Mount tree spade on a suitable stable machine capable of supporting the weight of all removed material and heavy enough to force the blades into the soil.
- B. Machine transplant trees in accordance with the following criteria:

Caliper	Minimum Machine Size	Manufacturer
Under 3"	44"	Vermeer, Davy, or approved equal
3"-5"	60"	Vermeer or approved equal
5"-8"	90"	Big John, Vermeer, or approved equal
8"-16"	12' Box	

- C. Do not excavate tree pits more than 24 hours prior to transplanting.
- D. Cut and remove all vines and underbrush from the trunk and branches of the tree to facilitate access by machine.

- E. Prune and thin the tree by removing interior branches and entangled limbs. Remove not less than 10 percent of all branching before digging but not more than 20 percent. Do not indiscriminately cut branch tips to achieve the above percentages.
- F. Use the same machine to dig receiving hole and to dig tree for transplanting.
- G. Reroute irrigation lines transplanting operation to maintain integrity of receiving hole.
- H. After tree is placed in hole, immediately fill all crevices with sand and water to fill all voids. Apply 4-inches of mulch.
- I. Provide periodic watering and misting of main foliage.
- J. Spray trunks with Lindane or Dursban for control of borers and wrap hardwoods to first branch.

3.3 DIGGING FOR BOX TRANSPLANTATION

- A. Trenching: Dig trench outside trench previously dug for root pruning.
- B. Do not damage new roots. Do not permit cracking of rootball or loss of soil.
 - 1. Protect rootball by completely wrapping with burlap per standard nursery practice.

3.4 POST PLANTING FERTILIZATION

- A. Apply fertilization 30-45 days after installation.
- B. Inject specified material with high pressure injector into soil at depth and diameter shown below:

Tree Caliper	Application Point	Depth	Radius	App. Rates per tree
Under 2"	3	4"-6"	16"-18"	1-1/2 Gal
2"-4"	3	4"-6"	18"-24"	2 Gal
4"-5"	4	4"-6"	2'-3'	2-1/2 Gal
5"-6"	5	4"-6"	3'-4'	3 Gal
Above 6"	3' o.c.	4"-6"	Dripline	5 Gal/100 sf of root area

3.5 TREE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.

- B. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character.
- C. Paint cuts over 3/4-inches in diameter with tree paint, covering all exposed, living tissue.

3.6 PLANT MAINTENANCE

- A. Tree and Shrub Maintenance: Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- B. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

3.7 FIELD QUALITY CONTROL

- A. Make written request for inspection after planting operations are complete.
- B. Submit requests for inspection to Owner at least two (2) days prior to anticipated inspection date.

3.8 CLEANING

- A. Clean all areas as required for complete and acceptable inspection.

END OF SECTION 329643