SECTION 32 12 16

ASPHALT PAVING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Cold milling of existing hot-mix asphalt pavement.

2. Hot-mix asphalt patching.

3. Hot-mix asphalt paving.

4. Hot-mix asphalt paving overlay.

5. Asphalt surface treatments.

6. Pavement-marking paint.

7. Traffic-calming devices.

8. Imprinted asphalt.

B. Related Sections:

1. Division 02 Section "Selective Site Demolition" for demolition, removal, and recycling of existing asphalt pavements, and for geotextiles that are not embedded within courses of asphalt paving.

2. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.

3. Division 32 Section "Concrete Paving" for joint sealants and fillers at paving terminations.

1.02 DEFINITION

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

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Samples: For each paving fabric, 12 by 12 inches minimum.

D. Qualification Data: For qualified manufacturer and Installer.

E. Material Certificates: For each paving material, from manufacturer.

F. Material Test Reports: For each paving material.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by the City of Vancouver or WSDOT.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Section 5-04 the Standard Specifications for Road, Bridge, and Municipal Construction by WSDOT, 2018 edition.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

D. Pre-installation:

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.

b. Review condition of subgrade and preparatory work.

c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.05 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.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F.

2. Tack Coat: Minimum surface temperature of 60 deg F.

3. Slurry Coat: Comply with weather limitations in ASTM D 3910.

4. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.

5. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 55 deg for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.01 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D 1073 sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

2.02 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a, PG 64-22

B. Asphalt Cement: ASTM D 946

C. Prime Coat: ASTM D 2027, medium-curing cutback asphalt, MC-250.

D. Prime Coat: Asphalt emulsion prime coat complying with Washington DOT requirements.

E. Tack Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

F. Fog Seal: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

G. Water: Potable.

H. Undersealing Asphalt: ASTM D 3141, pumping consistency.

2.03 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Sand: ASTM D 1073, Grade Nos. 2 or 3.

C. Paving Geotextile: AASHTO M 288, nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

D. Joint Sealant: ASTM D 6690, hot-applied, single-component, polymer-modified bituminous sealant.

E. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N, colors complying with FS TT-P-1952. All pavement markings (directional arrows, crosswalks, stop bars, ADA markings, and other items that are private) shall be thermoplastic applications.

1. Color:
    a. White: Federal Standard 595, color number 37875
    b. Yellow: Federal Standard 595, color number 33538
    c. Red: Federal Standard 595, color 31350
    d. Blue: Federal Standard 595, color number 35180

F. Glass Beads: AASHTO M 247, Type 1.

G. Wheel Stops, Concrete: Precast, air-entrained concrete, 2500-psi minimum compressive strength, dimensions per details within plans. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.

H. Wheel Stops, Recycled Rubber: Solid, integrally colored, 96 percent recycled HDPE or commingled postconsumer and postindustrial recycled plastic; UV stabilized; 4 inches high by 6

inches wide by lengths as indicated. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.

2. Adhesive: As recommended by wheel-stop manufacturer for application to asphalt pavement.

2.04 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

2. Crushed Surfacing Top Course meeting the requirements of WSDOT Standard Specification Section 9-03.9(3).

3. Crushed Surfacing Base Course meeting the requirements of WSDOT Standard Specification Section 9-03.9(3).

B. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types."

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

2. Provide mixes complying with composition, grading, and tolerance requirements in ASTM D 3515.

C. Emulsified-Asphalt Slurry: ASTM D 3910.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.

2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.

3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by the Owner's Representative, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

3.02 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of 3".

2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.

3. Control rate of milling to prevent tearing of existing asphalt course.

4. Repair or replace curbs, manholes, and other construction damaged during cold milling.

5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.

6. Transport milled hot-mix asphalt to asphalt recycling facility.

7. Keep milled pavement surface free of loose material and dust.

3.03 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.

2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

E. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.04 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.

2. Protect primed substrate from damage until ready to receive paving.

D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.05 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.

2. Place hot-mix asphalt surface course in single lift.

3. Spread mix at minimum temperature of 250 deg F.

4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.

5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.06 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.

2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.

3. Offset transverse joints, in successive courses, a minimum of 24 inches.

4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time.

5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.

6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.07 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Alignment: Bevel edges while asphalt is still hot; compact thoroughly.

G. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

H. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

I. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

PAVEMENT MARKING

J. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

K. Allow paving to age for 30 days before starting pavement marking.

L. Sweep and clean surface to eliminate loose material and dust.

M. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal.

3.08 WHEEL STOPS

A. Install wheel stops in bed of adhesive as recommended by manufacturer.

B. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.09 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.

2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.

b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.10 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow milled materials to accumulate on-site.

END OF SECTION 32 12 16

SECTION 32 13 13

CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes exterior cast-in-place concrete, including reinforcement, concrete materials, mix design, placement procedures, and finishes for the following:
   A. Concrete surface (4 IN.)
   B. Concrete curbs

B. Related Sections include the following:
   A. Division 31 Section "Earth Moving" for subgrade preparation, grading and base course.
   B. Drawings and Sections 8-14 of the WSDOT 2018 Standard Specifications for Road, Bridge, and Municipal Construction, Amendments and Special Provisions for pervious cement concrete sidewalks.

1.2 DEFINITIONS

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

1.3 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixtures: For each concrete mix indicated, submit mix design with substantiating test data in conformance with UBC Section 1905, a minimum of two weeks prior to scheduled pour.

C. Aggregates: Normal-weight aggregates used in concrete mix where exposed aggregate finish is specified.

D. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

E. Field quality-control test reports.

F. Minutes of pre-installation conference.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94 requirements for production facilities and equipment.
   A. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

C. Standard Specifications: Perform site concrete Work in compliance with the latest edition of the "Standard Specifications for Road, Bridge and Municipal Construction" prepared by Washington State Department of Transportation (WSDOT) and American Public Works Association (APWA), Washington State Chapter. Comply with the more stringent of the WSDOT Sections of Division 5, 6, and 9 or the ASTM Standards listed below.

D. Concrete Testing Service: Owner will engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

E. Mockups: Cast mockups of full-size sections of concrete pavement to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.
   A. Build mockups in the location and of the size indicated or, if not indicated, as directed by Owner's Representative.
   B. Notify Owner's Representative seven days in advance of dates and times when mockups will be constructed.
   C. Obtain approval of mockups from Owner's Representative before starting construction.
   D. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
   E. Demolish and remove approved mockups from the site when directed by Owner's Representative.
   F. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Formwork Observation: Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed. Notify Owner's Representative 48 hours minimum prior to placing concrete that formwork is in place and ready for observation. Do not proceed with concrete placement prior to obtaining Owner's Representative's approval that formwork meets the lines and grades intended on the Drawings. Concrete placed without the Owner's Representative's approval of formwork shall be removed and replaced at no additional cost to the Owner.

1.5 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities. Provide barricades, cones and signs required for driveway closures

and detours. See Section 1-10 of the WSDOT 2018 Standard Specifications for Road, Bridge, and Municipal Construction, Amendments and Special Provisions for additional requirements.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces. Provide appropriate form liner material to shape the reveal patterns indicated on the Drawings.

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 and Tie Bars: ASTM A 615/A 615M, Grade 60; deformed.

B. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

C. Plain Steel Wire: ASTM A 82, as drawn.

D. Deformed-Steel Wire: ASTM A 496.

E. 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" from steel wire, plastic, or precast concrete of greater compressive strength than concrete.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use one of the following cementitious materials, of the same type, brand, and source throughout the Project:
   A. Portland Cement: ASTM C 150, Type I or II or I/II, gray. Supplement with the following:
      a. Fly Ash: ASTM C 618, Class C or F.
      b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 4M coarse aggregate, uniformly graded. Provide aggregates from a single source.
   A. Maximum Coarse-Aggregate Size: Not exceeding 1 inch nominal.

B. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement, when tested in accordance with ASTM C 1260.
C. Aggregate Sizes: 3/4 to 1 inch nominal.
D. Aggregate Sizes: 1/2 to 3/4 inch nominal.
E. Aggregate Sizes: 3/8 to 5/8 inch nominal.

C. Water: ASTM C 94.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
A. Water-Reducing Admixture: ASTM C 494, Type A.
B. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

2.4 RELATED MATERIALS

A. Expansion Joint Filler Strips: ASTM D 3575, 1/2-inch closed-cell polyurethane foam backing, with removable joint cap, Sonneborn Sonolastic Expansion Joint Filler, or approved equal.

B. Joint Primer: ASTM C 920, Type S, Grade P, Class 25. Solvent based primer for preparing concrete surfaces for adhesion to sealant. Sonneborn Sonolastic Primer 733, or approved equal.

C. Joint Sealant: ASTM C 920, Type S, Grade P, Class 25. Non-priming, single-component, polyurethane sealant, Sonneborn Sonolastic SL1, or approved equal. Color to be selected by Owner's Representative from Sonneborn's Rainbow of Colors palette.

D. Backer Rod: Non-gassing, reticulated closed-cell polyethylene rod designed for use with cold-applied joint sealants where joint depth exceeds manufacturer's recommended depth for joint sealant. Comply with ASTM C 1330, Type C. Size as required for joint design. Sonneborn Sonolastic Closed-Cell Backer Rod, or approved equal.

E. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

F. Curing Compounds for Non-Colored Cement Concrete: Clear, ASTM C 309, non- staining.

2.5 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
A. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:
   A. Compressive Strength (28 Days): 3000 psi.
   B. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
   C. Slump Limit: 4 to 4-1/2 inches without Water-Reducing Admixtures; 5 inches with Water-Reducing Admixtures.
      a. Slump Limit for Concrete Containing High-Range Water-Reducing Admixture: When a high-range water-reducing admixture is used, the maximum limit may be increased an additional 2 inches.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 4 to 6 percent.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
   A. Use water-reducing admixture and/or high-range, water-reducing admixture in concrete, as required, for placement and workability.
   B. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements as follows:
   A. Fly Ash or Pozzolans: 25 percent.
   B. Ground Granulated Blast-Furnace Slag: 50 percent.
   C. Combined Fly Ash or Pozzolans, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or Pozzolans not exceeding 25 percent.

2.6 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Furnish batch certificates for each batch discharged and used in the Work.
   A. When air temperature is between 85 and 90 degrees Fahrenheit reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 degrees Fahrenheit, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Comply with requirements and measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
   A. For concrete mixes of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
   B. For concrete mixes larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.

C. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proceed with concrete placement operations only after nonconforming conditions have been corrected.

3.2 PREPARATION

A. Proof-roll prepared base course 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 base course surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Formwork: Design, construct, erect, shore, brace, and maintain formwork according to ACI 301.

B. 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.

C. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 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 bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 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 1/2-hour unless pavement terminates at isolation joints.
   A. Continue steel reinforcement across construction joints, unless otherwise indicated.
   B. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
   C. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys where concrete pavements abut job-built concrete curbs, unless otherwise indicated on the Drawings. Embed keys at least 1-1/2 inches into concrete.
   D. Doweled Expansion Joints: Install dowel bars and support assemblies at expansion joints in concrete paving indicated as "Vehicular Concrete Paving" on the Drawings. Lubricate, asphalt-coat, or provide PVC sleeve on one-half of dowel length to prevent concrete bonding to one side of joint.
   E. Doweled Joints: Install dowel bars where new concrete paving meets existing concrete paving. Drill and epoxy one-half of bar into existing paving. Lubricate, asphalt-coat, or provide PVC sleeve on the half of dowel length embedded in new concrete to prevent concrete bonding to that side of joint.

C. Expansion Joints: Form expansion/isolation joints of preformed joint-filler strips abutting catch basins, manholes, inlets, light pole bases, structures, walks, other fixed objects, and where indicated on the Drawings.
   A. Doweled Expansion Joints: Install dowel bars and support assemblies at joints where indicated on the Drawings. Lubricate, asphalt coat, or provide PVC sleeve on one-half of dowel length to prevent concrete bonding to one side of joint.
   B. Locate expansion joints at intervals of 20 feet maximum, unless otherwise indicated on the Drawings.
   C. Extend joint fillers full width and depth of joint.
   D. Terminate joint filler flush with top of paving for joint fillers having removable joint cap.
   E. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

F. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
G. Allow concrete to cure minimum of 28 days.
H. Remove joint filler cap; clean and prime concrete surfaces to receive sealant per manufacturer's recommendations; and fill void with sealant to match concrete color.
I. If joint filler depth from top of paving exceeds 3/8 inch, install backer rod prior to installing joint sealant. Backer rod to be 25 percent wider than joint width. Sealant depth to be 1/2 width of joint, not to exceed 3/8 inch, whichever is smaller. Install backer rod and sealant per manufacturer's recommendations
J. Protect sealant from pedestrian traffic until cured.
K. Clean excess sealant from paved surfaces.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated on the Drawings. Construct contraction joints for a depth equal to at least 1/4 of the concrete thickness, at intervals of 10 feet maximum, unless otherwise indicated on the Drawings, and as follows:
A. Score Joints: Form score joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of score joints after applying surface finishes. Eliminate groover marks on concrete surfaces.

E. Edging: Tool exposed edges of ramps, sidewalks, walkways and joints in concrete after initial floating with an edging tool to a 1/2-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from base course surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten base course to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery, at Project site, or during placement.

F. Do not add water to fresh concrete after testing.

G. 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.

H. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   A. 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.

I. Place concrete pavement in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
   A. Remove and replace concrete that has been placed for more than 15 minutes without being covered by top layer, or use bonding agent if approved by Owner's Representative.

J. Screed pavement surfaces with a straightedge and strike off. 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.

K. When adjoining concrete pavements are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

L. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   A. When air temperature has fallen to or is expected to fall below 40 degrees Fahrenheit, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees Fahrenheit and not more than 80 degrees Fahrenheit at point of placement.
   B. Do not use frozen materials or materials containing ice or snow.
   C. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.

M. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
   A. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   B. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
   C. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 CONCRETE FINISHING

A. Float Finish Concrete Pads: Begin the second floating operation when bleed-water sheen has disappeared and the 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.

A. 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.

3.8 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 as follows:

A. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.

b. Continuous water-fog spray.

c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

B. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3.9 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 for driveways, roadways, ramps, sidewalks, walkways, and as follows:

A. Elevation: 1/4 inch.

B. Thickness: Plus 3/8 inch, minus 1/4 inch.
C. Surface: Gap below 10-foot long, unleveled straightedge not to exceed 1/4 inch.
D. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
E. Vertical Alignment of Tie Bars: 1/4 inch.
F. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
G. Joint Spacing: 3 inches.
H. Contraction Joint Depth: Plus 1/4 inch, no minus.
I. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
   A. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.
      a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   B. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
   C. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
   D. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 degrees Fahrenheit and below and when 80 degrees Fahrenheit and above, and one test for each composite sample.
   E. Compression Test Specimens: ASTM C 31; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
   F. Compressive-Strength Tests: ASTM C 39; test 1 specimen at 7 days and 2 specimens at 28 days.
      a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Owner’s Representative, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design

compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7-day and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Owner's Representative but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Owner's Representative.

G. Remove and replace concrete where test results indicate that it does not comply with specified requirements at no additional cost to the Owner.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements at no additional cost to the Owner.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete that is broken, damaged, or defective or that does not comply with requirements in this Section at no additional cost to the Owner.

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 concrete areas with portland cement concrete bonded 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.

3.12 CLEANING

A. Remove all excess material, debris, and equipment from site upon completion of work in this Section. Keep work area clean and in an orderly condition during the course of the Work.

B. Do not dispose of waste concrete or wash out materials on the site unless otherwise directed by the Owner's Representative. Areas to be paved may be acceptable for concrete truck wash areas only as approved by the Owner's Representative.

PART 4.0 MEASUREMENT

A. CONC. SURFACE (4 IN) shall be measured per square yard.

B. CONC. CURB shall be measured per linear foot.

PART 5.0 PAYMENT

A. Payment will be made in accordance with WSDOT Standard Specifications Section 1-04.1, for each of the following bid items that are included in the proposal:

B.

a. "CONC. SURFACE (__ IN.)", per square yard.
The unit Contract price per square yard for "CONC. SURFACE (__ IN)" shall be full payment for all labor, tools, equipment, and materials required for the installation and all other work described in this Section.

b. "CONC. CURB", per linear foot
The unit Contract price per linear foot for "CONC. CURB" shall be full payment for all labor, tools, equipment, and materials required for the installation of all other work described in this Section.

END OF SECTION 32 13 13

SECTION 32 31 13

CHAIN LINK FENCING AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the work necessary to install new fences and gates.

B. The type of steel fences and gates include the following:
1. Galvanized steel systems.

C. Related Sections include the following:
1. Division 31 Section "Grading" for excavation and subgrade preparation.
2. Division 03 Section "Cast-in-Place Concrete" for concrete footings.

1.2 QUALITY ASSURANCE

A. Standards of manufacture: Comply with the standards of the Chain Link Fence Manufacturer's Institute for "Galvanized Steel Chain Link Fence Fabric" and as herein specified.

B. Provide each type of steel fence and gates as a complete unit produced by a single manufacturer, including necessary erection accessories, fittings and fasteners.

1.3 SUBMITTALS

A. Submit within 15 days after contract award, two 2 copies to manufacturer's technical data and installation instructions for steel fences and gates to the Owner’s Representative.

B. Product Certificates: Signed by manufacturer of chain link fences and gates that products furnished comply with requirements.

1.4 DAMAGES

A. Any structures or facilities damaged due to Work of this Project shall be restored equal or better to their original condition at Contractor's expense and to the satisfaction of owner and Owner’s Representative at no additional cost to the Owner.

1.5 EXISTING UTILITIES

A. Locate and identify, with visible marking, existing underground utilities in the areas of work. If utilities are to remain in place, provide adequate means of protection during excavation operations.

B. If uncharted piping or other utilities are encountered during excavation, consult the utility owner immediately for directions. Cooperate with the owner and public and private utility companies in keeping their respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility owner. The cost of repairing charted utilities shall be paid by the Contractor at no additional cost to the Owner.

C. Do not interrupt existing utilities service facilities occupied and used by the Owner or others, except when permitted in writing by the Owner's Representative and then only after acceptable temporary utility services have been provided.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS

A. Pipe sizes indicated are commercial pipe sizes. Tube sizes indicated are nominal outside dimension.

B. Finish for framework and appurtenances: Provide the following finishes for steel framework and appurtenances.
   1. Galvanized finish with not less than minimum weight of zinc per square foot, complying with the following:
      a. Pipe: ASTM A120 (1.8 oz. zinc psf)
      b. Hardware and Accessories: ASTM A153 (zinc weight per Table I).

C. Height: Top of chain link fence shall be 4' as indicated on Drawings. Bottom shall be 2 inches above adjacent grade.

2.2 FABRIC

A. Provide chain link fabric:
   1. Standard Fence:
      a. 2-inch mesh, No. 9 gauge, top and bottom selvages knuckled.
      b. Top and bottom rails at all fence heights.
   2. Backstop:
      a. 2-inch mesh, No. 9 gauge.
      b. Top and bottom selvages knuckled.
      c. Top and bottom rails at all levels.

B. Fabric and wire finishes: Color black, zinc and powder coated, not less than 1.2 oz. zinc per square foot, complying with ASTM A392, Type II, Class 1; or aluminum coated, not less than 0.4 oz. aluminum per square foot, complying with ASTM A491, Type I, Class 1.

2.3 POSTS, RAILS AND BRACES

A. End, corner and pull posts: Provide end, corner and pull posts of the minimum sizes and weights as follows: (salvaged post may be used if they comply with the following):
1. Less than 6-foot fabric height:
2. 2.375 inch O.D. Schedule 40 pipe weighing 3.65 lbs. per linear foot.
3. Backstop:
   4.00-inch O.D. Schedule 40 pipe.

B. Line posts: Provide line posts of the minimum sizes and weights as follows. Space posts 10 feet O.C. maximum.
1. Less than 6-foot fabric height:
2. 1.875 inch O.D. Schedule 40 pipe weighing 2.72 lbs. per linear foot.
3. Backstop:
4. 4.00-inch O.D. Schedule 40 pipe; minimum 10′-0″ on center. Evenly space between end, corner, and pull posts, when length is less than 20′-0″ feet.

C. Top rail: Provide top rails of the following:
1. Less than 6-foot fabric height:
2. 1.660-inch O. D. pipe weighing 2.27 lbs. per linear feet.
3. Backstop:
4. 1.875 inch O.D. Schedule 40 pipe weighing 2.72 lbs. per linear foot.
5. Provide in manufacturer's longest lengths, minimum 18 feet long, with expansion type couplings, approximately 6 inches long for each joint. Provide means for attaching the top rail securely to each gate, corner pull and end post.

D. Post brace assembly: Provide bracing assemblies at end, gate posts, and at both sides of corner and pull posts, with the horizontal brace located at mid-height of the fabric. Use 1.660-inch O. D. pipe weighing 2.27 lbs. per linear feet for horizontal brace and .375-inch diameter rod with turnbuckle for diagonal truss.

E. Canopy support truss assembly (backstop): Galvanized steel truss rod assembly consisting of minimum ½″ (12.7mm) diameter truss rod with malleable or pressed steel turnbuckle.

F. Tension wire: Provide tension wire consisting of galvanized 7-gauge coiled spring wire on all fences.

G. Post tops: pressed steel, wrought iron, or malleable iron, designed as a weathertight closure cap (for tubular posts). Provide one cap for each post. Provide caps with openings to permit through passage of top rail.

H. Stretcher bars: one-piece lengths equal to full height of fabric with a minimum cross-section of 3/16 inch by 3/4 inch. Provide 1 stretcher bar for each gate and end post, and 2 for each corner and pull post, except where fabric is integrally woven into the post.

I. Stretcher bar bands: steel, wrought iron, or malleable iron, spaced not over 15 inch O.C. to secure stretcher bars to end, corner, pull and gate posts. Bands may also be used with special fittings for securing rails to end, corner, pull and gate posts.

J. Brace and tension bands (backstop): 3/8" (9.52 mm) thick by 1" (25 mm) galvanized steel bands.

2.4 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Wire ties: for tying fabric to line posts, use 9-gauge aluminum wire ties. Space 12 inches O.C. For tying fabric to rails and braces, use 9-gauge aluminum wire ties spaced 24 inches O.C. For tying fabric to tension wire, use 11-gauge hog rings spaced 24 inches O.C. Finish off ties to match fabric finish. Manufacturer's standard procedure will be accepted if of equal strength and durability.

B. Concrete: Provide concrete consisting of portland cement ASTM C-150, aggregates ASTM C-33, and clean water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 2500 PSI using at least 4 sacks of cement per cubic yard, 1-1/2-inch maximum size aggregate, maximum 3-inch slump, and 2 percent to 4 percent entrained air.

PART 3 - EXECUTION

3.1 INSPECTION

A. Installer must examine the conditions under which the fence is to be installed and notify the Owner's Representative in writing of the conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.2 INSTALLATION

A. General: Do not begin fence installation and erection before the final grading is completed with finish elevations established, unless otherwise permitted by Owner's Representative.

B. Excavation: Drill holes of diameters and spacings per the manufacturer's recommendations at location shown on the Drawings, for post footings in firm, undisturbed, or compact soil. Spread soil from excavations uniformly adjacent to the fence line or adjacent areas of the site as directed.

C. Setting Posts:
1. Remove loose and foreign materials from sides and bottoms of holes and moisten soil prior to placing concrete. Check grading for elevation of top of footings.
2. Install footing reinforcement as shown on Structural Drawings.
3. Center and align posts in holes 3 inches above bottom of excavation.

4. Place concrete around posts in a continuous pour and vibrate or tamp for consolidation. Check each post for vertical and top alignment and hold in position during placement and finishing operations.
5. Finish tops of footings at proper elevation and match adjacent paving finish. Slope to direct water away from posts. Extend footings for gate posts to the underside of bottom hinge. Set stops, sleeves and other accessories into concrete as required.
6. Keep exposed concrete surfaces moist for at least 7 days after placement, or cure with membrane curing materials or other acceptable curing methods.

D. Concrete strength: allow concrete to attain at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than 7 days after placement, before rails, tension wires, barbed wire or fabric is installed. Do not stretch and tension fabric and wires and do not hang gates until the concrete has attained its full design strength.

E. Top rails: Run rail continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by fencing manufacturer.

F. Brace assemblies: Provide braces so posts are plumb when diagonal rod is under proper tension.

G. Tension wire: Provide tension wires by attaching to the fabric and tying to each post with not less than 9-gauge aluminum wire with hog rings.

H. Fabric: leave 2 inches between finish grade and bottom selvage. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains intension after pulling force is released. Repair damaged castings in the shop or during field erection by recoating with manufacturer's recommended repair compound, applied per manufacturer’s directions.

I. Stretcher bars: Thread through or clamp to fabric 4 inches O.C. and secure to posts with metal bands spaced 15 inches O.C.

J. Tie wires: Provide U-shaped wire, conforming to diameter of pipe to which attached clasping pipe and fabric firmly with ends twisted at least 2 full turns. Bend ends of wire to minimize hazard to persons or clothing.

K. Fasteners: Provide nuts for tension band and hardware bolts on side of fence opposite fabric side.

3.3 CLEAN-UP

A. All excess material shall be removed from site.

B. Clean excess dirt and concrete from all surfaces.

3.4 INSPECTION AND ACCEPTANCE

A. When the project is completed, the Owner's Representative will make an inspection to determine acceptability.

B. Where inspected work does not comply with the requirements, replace rejected work until reinspected by the Owner's Representative and found to be acceptable at no additional cost to the Owner.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT AND PAYMENT

A. When not listed in the Bid proposal, all "Chain Link Fencing" costs will be considered incidental work for which no separate payment will be made.

B. When listed in the Bid Proposal, payment for work specified under this section to be made at the units and prices named in the Proposal, complete and satisfactory to the Owner's Representative.

C. Payment indicated shall include complete compensation for all labor, equipment, materials and incidentals required or the completion of the work. No additional compensation to be allowed.

END OF SECTION 32 31 13

SECTION 32 84 00
IRRIGATION DESIGN-BUILD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Piping.
2. Manual valves.
3. Specialty valves
4. Control-valve boxes
5. Sprinklers
6. Controllers
7. Other materials

1.2 DEFINITIONS

A. Mainline: Piping downstream from irrigation point of connection to valves. Piping is under constant pressure.

B. Lateral Line: Piping downstream from control valves to sprinklers, outlets, and drain valves. Piping is not under constant pressure.

C. The following are industry abbreviations for plastic materials:

1. PE: Polyethylene plastic.
2. PP: Polypropylene plastic.
3. PVC: Polyvinyl chloride plastic.
4. TFE: Tetrafluoroethylene plastic.

1.3 PERFORMANCE REQUIREMENTS

A. Modify existing irrigation system to accommodate new site improvements and plantings. Design and install system that ensures adequate coverage to maintain plant establishment and continued health of both proposed and existing plant material.

1.4 SUBMITTALS

A. Materials List: Within 30 days after award of Contract, and before any irrigation system materials are delivered to the job site, submit to the Owner's Representative a complete list of all irrigation system materials proposed to be furnished and installed. Submit catalog data,

including manufacturer's name and catalog number, model number, specifications, brochures, or other data giving complete information about each item.

B. Shop Drawings: Submit design-build irrigation plan for approval by Owner's Representative prior to construction. Show the following information on the drawings:
   1. New irrigation system piping connection to existing main line.
   2. Subsurface irrigation pipes.
   3. Location of sleeves under pavement, plant and landscaping features, and site structures.
   4. Schedule of equipment to be used.
   5. Verify condition of controller and controller size and number of stations available for newly added valves.
   6. If new controller is required, coordinate 120 volt service to controller location and provide power connection for controller.

C. The following minimum design criteria shall be met:
   1. Design irrigation system to comply with the irrigation product and performance requirements of these specifications.
   2. Velocity in pipes not to exceed 5 feet per second.
   3. Irrigation system shall be capable of irrigating the entire site between 10:00 P.M. and 6:00 A.M.
   4. All irrigation equipment, excluding pipes shall be obtained from one local (Western Washington) supplier, unless otherwise approved. All drip irrigation, zone valve and control system shall be provided by a single manufacturer. Manufacturers: Rain Bird, Toro, or Hunter or approved.
   5. The irrigation system shall be gravity drainable and have drain valves to facilitate gravity drainage.

D. During construction, show in red line on a print of the drawings, all changes from the irrigation system design. Make available for inspection.

E. Delivery, Storage and Handling:
   1. Delivery: Deliver materials in manufacturer's original, unopened, undamaged packaging with identification labels intact, or alternative, secure packaging provided by distributor.
   2. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

F. After completion of construction, submit neat and legible As-Built drawings as 'Record Drawings'. Dimension and note all underground work vertically and horizontally. Measure from a permanent structure for location after burial.

G. Qualification Data: For qualified Installer.

H. Zoning Chart: Show each irrigation zone and its control valve.

I. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.

J. Field quality-control reports.

K. Operation and Maintenance Data: For sprinklers, controllers and automatic control valves to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers that include a certified irrigation designer qualified by The Irrigation Association.

B. 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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

B. Store materials in areas designated by the Owner.

C. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

D. Use all means necessary to protect irrigation system materials from damage, theft and vandalism before, during, and after installation.

E. In the event of damage, immediately make all repairs and replacements necessary to the satisfaction of the Owner's Representative, and at no additional cost to the Owner.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner’s Representative no fewer than two days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Owner’s Representative written permission.

1.8 WARRANTY

A. Warranty work and materials in writing for one year from the date of final acceptance, against defective workmanship and materials. All failures in workmanship or materials will be repaired at no additional cost to the Owner immediately after notification by the Owner’s Representative.

B. Contractor shall be responsible for maintaining system and protecting it from all damage until date of Final Acceptance at no additional cost to Owner. This shall include damage caused by vandalism or adverse weather conditions.

1.9 ONE-YEAR CORRECTION PERIOD

A. Repair any settling of backfilled trenches occurring during the one-year correction period at no additional cost to Owner. Include complete restoration of all damaged planting, pavement, and or other improvements of any kind.

1.10 SYSTEM COVERAGE

A. The system shall provide full coverage, less plant interference, on all planting areas. It is anticipated that Contractor will exercise professional judgment in location, height, slope of sprinkler heads without measurably changing the system design.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

B. Galvanized-Steel Pipe: ASTM A 53/A 53M, Standard Weight, Type E, Grade B.

1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless-steel pipe with threaded ends.
2. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
3. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface, and female threaded ends.
4. Cast-Iron Flanges: ASME B16.1, Class 125.

C. PVC Pipe, General:

1. Material used in the manufacture of the pipe shall be domestically produced rigid PVC 1120 compound, Type I Grade I, with Cell Classification of 12454 as defined in ASTM D-1784.
2. Pipe shall continuously bear the National Sanitation Foundation seal of approval for potable water usage and comply with the following requirements for product marking ASTM D-2241, D-1785 and D-2665 as applicable. Markings shall include: manufacturers name; nominal pipe size; outside diameter system; material designation code; applicable Standard thermoplastic pipe Dimension Ratio designation code (SDR number) or pipe schedule, and corresponding pressure rating in psi for water at 73 degrees Fahrenheit.
3. Belled-end pipe shall have tapered sockets to create an interference-type fit, which meet or exceed the dimensional requirements and the minimum socket length for pressure-type sockets as defined in ASTM D-2672.
4. Pipe sizes 1/2 inch and 1-1/4 inch are not allowed.

D. PVC Mainline: ASTM D-1785, Schedule 40.

E. PVC Lateral Line, Pressure-Rated Pipe: ASTM D-2241, SDR 21, 200 psi minimum.

F. PVC Nipples and Fittings:

1. PVC Socket Fittings, Schedule 40: ASTM D-2466; and Schedule 80: ASTM D 2467.
2. PVC Pipe Nipples: ASTM D-1785, PVC 1120 compound, Schedule 80.
3. PVC Threaded Fittings, Schedule 80: ASTM D-2464.

G. PE Drip Tubing with In-line Pressure Compensating Emitters:

1. Tubing shall be of nominal sized one-half inch low-density, ultra-violet-resistant, linear polyethylene tubing with internal pressure-compensating, self-cleaning, integral emitters at a specified interval. The tubing shall be brown in color and shall conform to an outside diameter (O.D.) of 0.63 inch and an inside (I.D.) diameter of 0.54 inch. The low volume tubing shall be capable of a discharge rate of .61 gallons per hour (GPH) and between operating pressures of 8.5 to 60 psi for each individual emitter.
2. The individual self-cleaning, pressure-compensating emitters shall be co-extruded to the inside of the tubing wall. The emitters are constructed of three individual pieces.
3. Emitter spacing shall be available in the following on-center intervals: 12, 16 or 24 inches.
4. Approved Manufacturer: Rain Bird, Hunter, Toro or equal.

H. PE Tubing Fittings:

1. All insert barbed fittings shall be constructed of molded, ultra-violet-resistant, brown colored plastic having a nominal inside dimension (I.D.) of 0.54 inch. Each fitting shall have a minimum of two ridges or barbs per outlet. All fittings shall be of same manufacturer as drip tubing and shall be available in one of the following end configurations:
    a. Barbed insert fittings
    b. Male pipe threads (MPT) with barbed insert fittings; or
    c. Female pipe threads (FPT) with barbed insert fittings.

I. Sleeves: PVC pipe under all paving, sized to accommodate required sizes and numbers of pipes and wires, 6-inch minimum diameter, in no case less than twice the diameter of the pipe being sleeved.

1. Schedule 40 PVC, ASTM D-1785 or Plastic Sewer Pipe ASTM D-3034, SDR-35, PVC conforming to ASTM D-1784, N.S.F. approved pipe.

2.2 JOINING MATERIALS

A. Pipe Solvent Cement:

1. PVC Solvent Cement ASTM D-2564.
2. I.P.S. 705 for pipe sizes up to 2-inch diameter.
3. I.P.S. 711 cement with P70 primer for pipe sizes 2-1/2 inches and larger.

B. PVC Primer:

1. ASTM F-656, I.P.S. P-70.

C. PVC Cleaner:

1. SCAQMD 1168, Low V.O.C, I.P.S. C-65

D. Field assembled Swing Joints:

1. For Rotors and Quick Couplers: Schedule 40 PVC fittings and Schedule 80 PVC nipples as shown on the drawings. Size to match inlet size of rotor head or quick coupler. Use is acceptable for all flows.

E. Pre-fabricated Swing Joint Assemblies:

1. Class 315 PVC construction with leak-proof "O-ring" seals. Size to match inlet size of pop-up rotor head or quick coupler. Use for flows greater than 4 gpm. Length as required. Lasco triple swing joint or equal.
2. Flexible PE swing pipe flexible riser assembly: Minimum 18-inch length polyethylene piping with black Marlex spiral barb fittings. Use for flows under 4 gpm. RainBird swing assemblies or equal.

2.3 MANUAL VALVES

A. Isolation Valve: Full port ball valve with threaded ends, minimum 400 PSI CWP rating, forged brass and cast bronze bodies and end pieces RPTFE seats and seals, blow-out proof stem design, chrome-plated brass ball, with stainless steel handle, 'Apollo' 77 Series or equal. Size same as pipe on which it is installed.

B. Drain Valves (Mainline Drain Valves): bronze, angle-pattern, globe valve with screw-in bonnet, integral seat, 200 PSI CWP rating, conforming to MSS SP-80: 'Milwaukee' 504 or equal, 2 inch minimum.

C. Quick Coupling Valve: RainBird 44-LRC 1 inch with corresponding key and swivel hose ell.

2.4 SPECIALITY VALVES

A. Remote Control Valves: Glass-filled nylon reinforced plastic glove valve, normally closed, slow-closing, one-piece solenoid, with pressure regulating module, flow control, and self-cleaning screen for dirty water applications.

2.5 CONTROL-VALVE BOXES

A. Valve Boxes and Vaults: HDPE plastic boxes. 'Carson Brooks', 'Armor' or equal, with locking top and 6-inch extensions to facilitate required depth of installation where applicable. Lids shall be green color unless otherwise noted.

1. Electric valves shall be installed in standard boxes.
2. Electric drip system valves shall be installed in jumbo boxes.

3. Air relief valves shall be installed in standard boxes.
4. Quick couplers shall be installed in 8-inch round valve boxes.
5. Drain and gate valves shall be installed in 5-1/4 inches round adjustable valve boxes.
6. Grounding rods shall be installed in 8-inch round valve boxes with black covers.
7. Flow meters shall be installed in standard valve boxes.

B. Valve Box and Vault Accessories

1. Drain Rock: 3/4 inch to l/4 inch clean and washed pea gravel, no fines.
2. Filter Fabric: Woven or non-woven geotextile for use in separating drain rock from subgrade in valve box and vault installations while providing adequate drainage.
3. Brick or Concrete Block Supports: (2)-4-inch by 8-inch by 4-inch bricks or (1) 8-inch by 8-inch by 4-inch concrete paver at each corner of valve box.

2.6 SPRINKLERS

A. Approved manufacturers: Rain Bird, Hunter, Toro, or equal.

2.7 CONTROLLERS

A. Control System

1. Requirement For: If all new irrigation modifications can be made to existing zones, and if capability for all additional zones is available on the existing controller, then a new control system will not be required.
2. The control system assembly consists of a completely pre-assembled control system that is tested for operation and is housed within a cabinet. The components are pre-wired in the cabinet, which is to be mounted on a vertical surface. The only connections required are primary power, proper grounding, valve station wiring, and flow sensing. All conduits and wire runs are to be provided and installed by the Contractor.
3. Grounding Rods/Lightning Arrestor: Per manufacturer's recommendations.
4. Ground testing and verification of electrical continuity of control wires shall be completed and reported after the installation.
5. Controller Stations for Automatic Control Valves:
   a. Provide one controller station for each irrigation zone.
   b. Each station is variable from approximately 0 to 120 minutes. Include switch for manual or automatic operation of each station.
6. Timing Device: Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate 2 or more times daily.
7. Manual or Semiautomatic Operation: Allows this mode without disturbing preset automatic operation.
8. Nickel-Cadmium Battery and Trickle Charger: Automatically powers timing device during power outages.
9. Surge Protection: Metal-oxide-varistor type on each station and primary power.

10. Controller Transformer: 24-V secondary, with primary fuse, Omit grounding rod for wall mount controllers, interior and exterior.
11. Ground testing and verification of electrical continuity of control wire shall be completed and reported after the installation.

B. Electrical Control Wire and Accessories:

1. Single-strand copper, UL approved for direct burial, AWG-UF type, sized per manufacturer's recommendations, No. 14-gauge minimum.
2. Use red wire for each control valve and white for common. Reserve yellow for spare wires, and blue for tracer wires.
3. Control Wire Connectors: 3M/ DBY and DBR connectors, or equal.
4. Communication cable (for flow sensor): Paige Electric Cable Model No. PE-89.
5. Communication Cable Splice and Cap: Preformed Line Products "Super Serviseal" closure with Poly-Bee sealant. Model #8006039.
6. Electrical Conduit and Fittings: High-impact Schedule 40 PVC C-2000 compound, UL approved, gray color, size as required. Solvent-weld fittings.

2.08 OTHER MATERIAL

A. Identification Markers:

1. Detectable Warning Tape: Minimum 3-inch wide, 5 mils thick inert plastic tape with continuous layer of aluminum foil encased in the plastic. Tape identification shall match the utility being marked on all mainline. 'Terra Tape' Detectable, or equal.

PART 3 - EXECUTION

3.01 EARTHWORK

A. Prior to all work of this Section, carefully examine the installed work of all other trades and verify that all such work is complete to the point where the installation may properly commence.

B. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

C. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.

D. Keep trenches free of pipe-damaging rocks and debris.

E. Trench to be 12 inches wide minimum and wide enough to allow all pipes to lie side by side with 6-inch minimum separation between pipes.

F. Provide minimum cover over top of underground piping according to the following:

1. Irrigation Main Piping: Minimum depth of 24 inches below finished grade, or not less than 18 inches below average local frost depth, whichever is deeper.

2. Lateral Piping: 18 inches.
3. Drain Piping: 18 inches.
4. Sleeves: 24 inches under paving, 36 inches under roads.

3.02 PIPING INSTALLATION

A. Layout to follow as closely as practicable the design as shown on the Shop Drawings. Use field marking paint to stake out mainline routing and locations of all proposed equipment, for acceptance by Owner's Representative, prior to trenching.

B. Systems shall meet minimum p0ressure at last head in each zone a shown on approved Shop Drawings. Notify Owner's Representative immediately if any modifications of piping layout will be required to accomplish this. Do not proceed until layout has been verified in the field with Owner's Representative.

C. Follow pipe layout plan making modifications as necessary to avoid trenching through roots of existing trees or other obstructions. Take care in protection all existing tree root zones.

D. Do not use solvent cement on threaded joints. Wrap joints with minimum three wraps of Teflon tape.

E. Ensure that the inside of the pipe remains absolutely clean. Pipe ends shall be protected and not left open. Remove all foreign matter and dirt from inside of pipe before lowering into trench.

F. Lay pipe in accordance with standard practices, on solid foundation, uniformly sloped, substantially supported at all locations. "Snake" pipe slightly from side to side in trench to allow for expansion and contraction. Keep pipe markings visible.

G. PVC pipe joints to be solvent welded except as indicated on the Drawings. Cut pipes square, deburr, wipe from surface all saw chips, dust, dirt, moisture and all foreign matter which may contaminate the cemented joint. Clean pipe with pipe cleaner to remove dirt, oil and grease. Apply primer and solvent cement. Make joints in accordance with manufacturer's recommendations.

H. For 90-degree turns in mainline pipe, install two 45-degree fittings.

I. For non-standard angles and bends, install double fittings to avoid stressing the pipe or fittings.

J. Underground lines shall have a minimum horizontal and vertical clearance of 12 inches from other utility lines. For lines crossing at angles from 45 degrees to 90 degrees with each other, maintain 6-inch vertical clearance. No line shall be installed parallel to and directly over another line.

K. Provide 6 inches' clearance between pipes. Do not stack pipe unless accepted by Owner's Representative to avoid tree roots.

L. Do no solvent welding of pipe when raining or when temperature is below 40 degrees Fahrenheit.

M. No fittings are to be closer than 6 inches apart.

N. Obtain tight, inseparable joints. Allow 24-hour curing before testing.

3.03 DRAIN VALVE INSTALLATION

A. Install manual drain valves at low points along mainline to ensure complete drainage of all mainlines.

B. Pipe drain valves into approved drainage structures. Install drain piping with minimum of 18 inches of cover to top of pipe.

C. Drain Pockets: Where no drainage structures exist, excavate 1 cubic yard of soil material at discharge to drain valves. Backfill with drainage backfill to 12 inches below grade. Wrap drainage backfill with drainage fabric and backfill remainder with amended topsoil.

3.05 CONTROL WIRING

A. Install per manufacturer's instructions with minimum 24-inch expansion loop at each controller.

B. All wire splicing to be made waterproof by using U.L. approved wire connectors and sealant. Follow manufacturer's instructions for installation.

C. All wire splicing shall occur only at the valve or at the controller.

D. Lay wire in trenches adjacent to mainline or lateral lines for maximum protection. Place wires 18 inches below grade in electrical conduit where there are no pipes in the trench.

E. Control wires to each solenoid from controller shall have a colored jacket, and common neutral wires shall have a white jacket.

F. All valve wiring back to controller to be identified and labeled with self-adhesive labels manufactured for this purpose prior to installation of the controller and remote control valves.

G. Control wires sharing the same controller shall all be the same color.

H. Provide different color pilot wires for each controller installed on the Project.

I. Where there is more than one controller, common wires shall be white with a colored stripe to match the pilot wire color with which it is circuited.

J. Bundle and tape wires together at 10-foot intervals.

K. Provide 24 inches' expansion loops at least every 100 feet in runs of more than 100 feet in length, at changes in direction along the mainline, and at entrance and exits to all sleeves under

paving. Provide 24-inch expansion coils at connection to control valves. Provide expansion loops in neat 1-inch diameter coils.

L. Master Valve Control Wires shall be orange and white dedicated common wire for the master valve only, and with a yellow wire as a spare.

M. Flow Sensor Cable: Install communication cable from flow sensor to central control unit as recommended by manufacturer. Provide a minimum of 36 inches of slack communication wiring in the flow sensor valve box and in the base of the controller pedestals and cabinets. Splices between flow sensor and controller pedestal are not allowed.

3.06 CONTROLLERS (IF REQUIRED):

A. Install per manufacturer's directions, coordinate location with Owner's Representative.

B. Provide conduits for all wiring entering cabinet and enclosure.

C. Follow manufacturer's instructions for wire hook-ups.

D. Verify organization of zones with the Owner's Representative. Otherwise, follow the zone numbering as shown on Drawings.

E. Provide electrical storm protection as specified by the manufacturer to protect each controller.

3.07 VALVES:

A. Install plumb to grade in a neat and uniform pattern as per manufacturer's directions, and as shown on Drawings.

B. Thoroughly flush supply lines before installing irrigation control valves.

C. Provide threaded unions at each end of automatic control valve.

D. Follow manufacturer's instructions and adjust pressure regulating module to achieve optimum operating pressure for each zone.

3.09 FLUSHING:

A. Flush lines with water for a minimum of 5 minutes each zone prior to installation of irrigation heads.

B. Cap risers immediately after flushing.

3.10 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Where there is more than one controller on the Project, install engraved plastic-laminate equipment nameplates and signs on each automatic controller.

B. Install valve identification tags on each automatic control valve per manufacturer's recommendations.

C. Install control wire numbering labels on each control wire to correspond with the valve station number at both ends of the control wires. Label spare and trace wires.

D. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tape over underground piping, during backfilling of trenches.

3.11 TRACE WIRE:

A. Place one strand of trace wire for all mainlines, and leave end at point of connection location. Tape wire to top of mainline at no less than 36-inch intervals. All locator wire shall be spliced together with water-tight splice connectors.

B. Run a 12-inch loop of trace wire into each remote control valve box for ease of detection.

3.12 PRESSURE TESTING

A. Notify the Owner's Representative five days before pressure testing.

B. Backfill trenches sufficiently to ensure the stability of pipe, leaving joints exposed.

C. Mainline and lateral lines may be tested at different times to allow isolation of either

D. Supply certified pressure gauge and force pump during tests.

E. Mainline Testing:

1. Thoroughly flush piping before testing. Cap all fittings on mainline fill with water.
2. Test mainlines to control valves at 100 psi for 1 hour. If pressure loss occurs, inspect the entire system, make water-tight, and retest until no pressure loss occurs for the testing period.
3. Pressure test must show no pressure loss for the specified period and be accepted by the Owner's Representative before backfill of trenches will be allowed.

F. Drip Tubing Testing:

1. Before backfilling, maintain 45 psi pressure for 15 minutes before and during inspection by Owner's Representative.
2. Installation may not lose pressure or experience breaks at barbed fittings during test period.
3. Detect and repair leaks and re-test system until accepted by Owner's Representative.

3.13 BACKFILLING

A. Delay backfilling until piping is pressure tested and accepted.

B. Place clean sand or approved backfill 3 inches below and 6 inches above all pipe. Fill the rest of the trench with approved material, free of rocks and debris capable of damaging pipe. Compact to adjacent soil density in 6 inch lifts.

C. Stones larger than 1-inch diameter are not allowed in backfill material.

D. Place metallic locating tape in all mainline trenches in accordance with manufacturer's instructions.

E. Fill mainline with water at approximately 25 psi during backfilling operations.

3.14 IRRIGATION HEADS

A. Install sprinkler heads as necessary to acieve head to head coverage.

B. Provide freedom of movement at all swing and swivel joints.

C. Adjust and set for optimum performance as shown on Drawings.

D. Locate heads adjacent to planters, mowstrips, walks, pavement, and curbs with a 2-inch minimum and 3-inch maximum clearance between head and hard surface.

E. Locate no head closer than 6 inches from building foundation.

3.15 DRIP TUBING

A. Delay installation of drip tubing until PVC supply line and header piping is pressure tested accepted, and backfilling of amended top soils is complete.

B. Drip Tubing Layout: Verify existing field dimensions of the area to be irrigated with the irrigation plans for accuracy. Begin emitter tubing layout 4 inches away from both hard surfaces; (i.e., concrete sidewalks, curbs, asphalt), and/or undefined edges; (i.e., shovel-cut headers). Mark tubing intervals on the ground with flags, paint, or some other markings that can be maintained throughout the installation.

C. Installation Drip System:

1. Tree and Shrub Areas: Layout tubing with 12" spacing at locations indicated on Drawings. Minor adjustment to the spacing may occur because of plant placement.
2. Connect drip tubing to rigid PVC supply line and exhaust headers.
3. Trenching: Hand or mechanically trench to the tubing to depth indicated on the Drawings or in these specifications and backfill flush with finish grade. Remove all rock 1-inch and larger when excavating and remove from site. Do not backfill trenches with rock that will come in direct contact with tubing or rigid PVC piping.

4. Flush the lines to clear the tubing of dirt and debris. Install line flushing valve, air release valve and test for leaks. Repair leaks and retest.
5. Compact backfill by hand to a minimum of 80% relative compaction. Maintain adequate soil levels as needed to achieve the required compaction requirement.
6. Following the tubing installation and backfill, installation of groundcover may occur. Exercise caution in digging to plant groundcover, avoiding cutting or puncturing emitter tubing.

D. Drip Tubing Depth: Install at grade unless otherwise specified. Cover with an additional 2 inch of bark mulch as indicated.
1. Drip tubing can be installed with the water outlets facing upward or downward. Offset the water outlets to form a triangular pattern throughout the tubing layout. In irregular areas, some water outlets may end up too close to fixed improvements and may have to be capped off with an emitter plug ring.

E. Barbed Fittings: Connect drip tubing to barbed fittings by pushing on and over both barbs until the tubing has seated against another piece of tubing or has butted against another portion of the barbed fitting.

F. Flush Valve:
1. Install flush valves below grade at the lowest elevations within each zone Depending on the site conditions and tubing layout, more than one flush valve may be required. Install per manufacturer’s recommendations. Place the valve within a round valve box with a locking cover and a 1 cu-ft gravel sump as noted in Drawings.

3.16 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Any irrigation product will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.17 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.

3.18 CLEANING

A. Revise this article to suit Project. Flush dirt and debris from piping before installing sprinklers and other devices.

3.19 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain automatic control valves and controllers.

3.20 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized Weathermatic service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing. Representative to verify that all controller-related components are properly assembled and ready for use.

B. Backflow Preventer Testing: All backflow preventers shall be tested and certified for proper operation prior to being placed in operation.

1. Original copies of the certification shall be submitted to the Owner.
2. Backflow preventers shall be labeled with plastic laminated field history tag showing date and tester information.

3.21 STARTUP SERVICE

A. Verify that controllers and all associated components are installed and connected according to the Contract Documents and are functioning properly.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.

C. Complete startup checks according to manufacturer's written instructions.

3.22 CLEANUP

A. Remove debris from project site upon completion or sooner, if directed.

3.23 FINAL INSPECTION

A. Thoroughly flush, clean, adjust, and balance the entire irrigation system for complete coverage and efficient operation. Set heads to avoid over-spray on walks. Upon 5 days' written notice, demonstrate the entire system to the Owner's Representative, proving that all valves and controls are properly operating and that the installed system is workable, clean, and efficient.

B. Contractor to deliver to the Owner the items scheduled for submittal at the time of the final inspection for irrigation.

3.24 WARRANTY

A. Full and complete head to head irrigation coverage without overthrow onto roadways, sidewalks, or buildings is required.

B. The warranty period relating to all products, materials, and workmanship will begin on the date of final acceptance of the work and extend for the period of one year.

C. The Contractor must repair or replace all defective materials and workmanship during the warranty period. The conditions of the warranty apply to all replacement material and repair work from the date such materials are installed or repair work done.

3.25 ADDITIONAL REQUIREMENTS

A. Provide Owner's Maintenance Personnel with system familiarization and 8 hours minimum of instruction in maintenance and operation of each piece of equipment installed.

B. Repair settling trenches. Include complete restoration of plantings, mulch, grades, pavements or other improvements.

C. Fall Winterizing Visit: Return to the job site at the beginning of the first winter season to perform a general inspection of the system, test all valves, lines, sprinkler heads, vacuum breakers, repair all leaks and faulty work, check operation of the system, adjust spray patterns for full coverage, drain system, show maintenance staff location of all drain valves and blow out points and restore all areas where trenches have settled.

D. Spring Start-Up Visit: Return in spring after the first winter season for system check and if necessary, restore system for spring and summer operation. Explain system and operation methods to maintenance staff. Restore all areas where trenches have settled.

END OF SECTION 32 84 00

SECTION 32 91 13

SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish labor, material and equipment required for soil preparation of areas to be planted, and finish grades as shown on the Drawings and as specified herein.

B. Coordinate work with installation of other site work including earthwork, irrigation, seeding, and planting.

C. Section Includes planting soils specified by composition of the mixes.

D. Related Requirements:
1. Division 31 Section "Earth Moving" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
2. Section 313000 “Site Clearing” for topsoil stripping and stockpiling.
3. Section 329200 “Turf and Grasses “for placing soil for turf and grasses.
4. Section 329300 “Plants” For placing planting soil for plantings.

1.2 ALLOWANCES

A. Preconstruction and field quality-control testing are part of testing and inspecting allowance.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or un-amended soil as indicated.

B. CEC: Cation exchange capacity.

C. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

D. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

E. Imported Soil: Soil that is transported to Project site for use

F. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

G. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

H. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

I. Soil Conditioner: Soil conditioners are for modifying soil structure and improving soil aeration characteristics, as distinguished from plant food, mulch, and soil organism amendments. Provide soil conditioners free of noxious weeds, living plants and rhizomes, and substances detrimental to plant growth, and pest organisms. Soil conditioners proposed for use are subject to testing at any time or place the owner deems appropriate.

J. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

K. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

1.4 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.5 SUBMITTALS

A. Product Data. Include Material Safety Data Sheets (MSDS) where applicable: For the following:

1. Fertilizers, including application rates.
2. Soil Amendments.
3. Herbicides.

B. Samples for Verification: For the following:

1. 1/2 cubic foot of each imported topsoil. Furnish one sample from each site from which soil is to be furnished.

C. Qualification Data: For testing agencies.

D. Material Test Reports:

1. Soil Compaction Test: Provide results of soil compaction tests minimum of 7 days prior to planting and seeding.

E. Delivery Slips: Provide delivery slips as proof of shipment of specified materials.

1.6 QUALITY ASSURANCE

A. Soil Compaction Testing: Furnish soil compaction standard tests per ASTM 698. Request inspection and allow observation by Owner's Representative of prepared soils before planting.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil.
   1. Notify Owner's Representative seven days in advance of the dates and times when laboratory samples will be taken.

B. Preconstruction Soil Analyses: For each un-amended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
   1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.8 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by Contractor in presence of Owner's Representative under the direction of the testing agency.
   1. Number and Location of Sample: Minimum of five representative soil samples as directed by Owner's Representative for each soil to be used or amended for landscaping purpose.
   2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
   3. Division of Samples: Spilt each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
   4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.9 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article,

B. Physical Testing:
   1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis – Part 1-Physical and Mineralogical Methods":
      a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
      b. Hydrometer Method: Reports percentages of sand, silt, and clay.

2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis – Part 1- Physical and Mineralogical Methods."
3. Water Retention: According to SSSA's "Methods of Soil Analysis – Part 1-Physcial and Mineralogical Methods."
4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis – Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D 698 (Standard Proctor).

C. Chemical Testing:
1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis – Part 3- Chemical Methods."
2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis – Part 1-Physical and Mineralogical Methods."
3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium and vanadium. If RCRA metals are present, include recommendations for corrective action.
4. Phytotoxicity: Test for plant-available concentrations of phytotoxic mineral including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.

D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol, including the following:
1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity of alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm.
14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis – Part 3-Chemical Methods."

F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable

plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and micronutrients.

1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000sq. ft. for 6-inch depth of soil.
2. Soil Reactions: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity of buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil

1.10 SITE CONDITIONS

A. Topsoil placement and soil preparation shall not take place during periods where saturated soil or surface water is present in work areas.

B. Work shall not take place when temperature is less than 32 degrees Fahrenheit, or when frozen soil exists on site.

1.11 COORDINATION

A. Coordinate soil preparation with Division 2 Section "Earthwork" such that topsoil, soil amendments and fertilizers are incorporated into ground fill areas in specified lifts to specified depths below finish grade for both planting areas and lawn areas. Topsoils shall be amended per paragraph 1.6.

B. Coordinate work with installation of other site work, including irrigation, seeding, and planting.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Package Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - GENERAL

2.1 MATERIALS

A. Regional Materials: Imported soil, manufactured planting soil and soil amendments and fertilizers shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles for Project site.

2.2 PLANTING SOILS SPECIFIED BY COMPOSITION

A. General: Soil amendments, fertilizers, and rates of application specified in the article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

B. Planting Soil for lawn areas, shrub areas, and planting backfill in native topsoil. Existing, on-site surface soil, with the duff layer, if any, retained and stockpiled on-site; modified to produce viable planting soil. Blend existing, on-site surface soil with the following soil amendments and fertilizers in the following quantities to produce planting soil: Ration of Loose Compost to Soil: 1:4 by volume.
   1. Ratio of Coarse Sand to Soil: 1:4 by volume
   2. Weight of Lime: Apply lime as recommended by soil test results
   3. Weight of Sulfur: Apply sulfur as recommended by soil test results.
   4. Weight of Agricultural Gypsum: Apply agricultural gypsum as recommended by soil test results.
   5. Weight of Superphosphate: Apply superphosphate as recommended by soil test results.
   6. Weight of Slow-Release Fertilizer: Apply fertilizer as recommended by soil test results

2.3 INGORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
   1. Class T, with a minimum of 99 percent passing through a No.8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
   2. Class: O, with a minimum of 95 percent through a No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
   3. Form: Provide lime in form of ground dolomitic limestone.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Perlite: Horticultural perlite, soil amendment grade.

E. Screened pumice: Naturally occurring volcanic pumice mined from 200 miles from project site. 90 percent of screened pumice shall pass ¼" screen.

F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground 90 percent passing through a No. 5 sieve.

G. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33/M

2.4 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows.
   1. Feedstock: Yard debris or certified compost from municipal composting facility.
   2. Reaction: Ph OF 6 – 8.5
   3. Soluble-Salt Concentration: Less than 5 Ds/M.
   4. Moisture Content: 35 to 60 percent by weight.
   5. Organic-Matter Content: 35 minimum percent of dry weight.
   6. Particle Size: Minimum of 98 percent passing through a ½-inch sieve.

2.5 FERTILIZERS

A. Superphosphate: Commercial, phosphate, mixture, soluble; a minimum of 20 percent available phosphoric acid.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
   1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition.
   1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports form a qualified agency.

D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

2.6 MISCELLANEOUS PRODUCTS

A. Post-Emergent Herbicide: "Round-Up" by Monsanto or equal.

B. Contact Herbicide for controlling Nut Sedges: Mirage by Monsanto.

PART 3 - EXECUTION

3.1 EXAMINATION OF SITE CONDITIONS

A. Examine for site conditions that will adversely affect execution, permanence, quality of work, and survival of plant material and grasses.

B. Verify that subgrades and slopes of lawn and planting areas are acceptable to Owner's Representative prior to commencing work of this Section.

C. Should the Contractor find any discrepancies between the Drawings and the physical conditions, inform the Owner's Representative immediately for clarification.

D. Begin Work required under this Section only after conditions are satisfactory.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, and existing lawns and exterior plants from damage caused by soil preparation operations.

B. Prepare soils at a time when moisture conditions will permit proper cultivation.

C. Remove stones over 1-inch diameter, sticks, roots, mortar, concrete, rubbish, debris, and all materials harmful to plant life, and legally dispose of them off Owner's property.

D. Remove or spray as required to eradicate noxious weed growth and roots.

1. Achieve complete removal or kill of all weeds within all areas receiving new plantings and lawn areas.
2. In planting beds, kill achieved by working soil is permissible for annual non-noxious broad-leaf type weeds.
3. Apply post-emergent herbicide over all areas of weed or grass growth within landscaped area to eradicate weed growth and roots. Apply in two applications at manufacturer's maximum recommended rate, as follows:

    a. First application: Apply 7 days prior to performing soil preparation.
    b. Second application (to kill new vegetation): Apply after soil preparation has been completed and minimum of 48 hours prior to planting.
    c. Observe manufacturer's recommended period prior to working in treated areas.
4. Apply contact herbicide directly onto foliage of nutsedges. In areas of established turf grasses infested with nutsedge, apply herbicide by wicking. Do not spray.

E. Locate and securely mark or flag irrigation sprinkler heads, area drains, catch basins, clean outs, manholes, valve boxes, and other site improvements not extending above finish grade.

F. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, in accordance with Division 2 Section "Erosion and Sedimentation Control."

3.3 SOIL PREPARATION FOR PLANTING AREAS

A. This article pertains to those shrub bed areas indicated as "Shrub and Groundcover Planting Areas" on the Drawings where mass plantings of trees, shrubs and ground cover plants are scheduled.

B. Prepare subgrades: cross-rip subgrades to depth of 6 inches prior to placing topsoil required to meet finish grades. See Division 2 Section "Earthwork" for excavation and preparation of subgrades.

C. Place topsoil and fertilizers per 1,000 square feet and rototill thoroughly to a depth of 8 inches, allowing for compaction and natural settlement.

D. Water lightly and allow planting mix to settle. Add additional material at mixture indicated in paragraph above to bring soil level to grades shown on the Drawings with allowance at pavement edges for mulch placement. Provide compaction to 85 percent relative density or as indicated in Division 2 Section "Earthwork."

E. Meet lines, grades and elevations shown, after light rolling and natural settlement. Fine grade shrub and ground cover areas to smooth even surface with loose, uniformly fine texture. Rake and drag shrub and ground cover areas to remove ridges and fill depressions to obtain firmness and finish grades preparatory to receiving planting.

F. Remove stones over 1/2-inch in any dimension and sticks, roots, rubbish and other extraneous matter.

3.4 SOIL PREPARATION FOR SEEDED LAWNS

A. This article pertains to new lawns and grasses as shown on Drawings.

B. Prepare subgrades by removing rock and other construction material. Cross-rip subgrades to depth of 6 inches prior to placing topsoil. See Division 2 Section "Earthwork" for excavation and preparation of subgrades.

C. Place topsoil and fertilizers per 1,000 square feet and rototill thoroughly to a depth of 8 inches. Rototill thoroughly to a depth of 8 inches Place sufficient topsoil allowing for compaction and natural settlement.

D. Leveling Rolling: Drag with flexible tine harrow (or approved equipment) to remove ridges and fill depressions, as required to meet finish grades. Roll areas (minimum roller weight 10 pounds per square inch) in two opposing directions.

E. Repeat rolling procedures and drag lightly to establish a smooth uniform compacted surface free of rocks and other extraneous matter. Provide compaction to 85 percent relative density or as indicated in Division 2 Section "Earthwork."

F. Water lightly and allow planting mix to settle. Add additional material at mixture indicated in paragraph above to bring soil level to grades shown on the Drawings with allowance at pavement edges. Provide compaction to 85 percent relative density or as indicated in Division 2 Section "Earthwork."

G. Meet lines, grades and elevations shown, after light rolling and natural settlement. Fine grade lawn areas to smooth even surface with loose, uniformly fine texture. Rake and drag lawn areas to remove ridges and fill depressions to obtain firmness and finish grades preparatory to receiving lawn planting.

H. Remove stones over 1/2-inch in any dimension and sticks, roots, rubbish and other extraneous matter.

I. Finish Grading: Grade lawn areas to smooth, even surface with a loose uniformly fine texture. Finish grade of soil shall be flush with adjacent pavement. Limit preparation to areas which will be planted promptly after preparation.

J. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.

K. Restore seedbed areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

3.5 SOIL PREPARATION FOR PLANTING PITS OF TREES

A. This article pertains to tree planting when occurring on an individual basis.
   1. Backfill Mix: Prepared backfill mix and place in planting pits as specified in Division 32 Section "Plants."
   2. Grade smooth to elevations shown.

3.6 FINE GRADING

A. Finish grade after full settlement including mulch, shall be 1 inch below tops of curbs, walks, or existing grades in shrub areas and flush in lawn areas.

B. Slope all areas to prevent puddling and drain surface water toward catch basins, drains, curbs, or off-site as shown on Drawings.

C. Soil in all areas shall be thoroughly settled, with a smooth surface free of humps and hollows, and shall be firm enough to resist undesirable impressions when stepped upon.

D. Use levels, screens, drags, or any other equipment necessary to establish and verify grades and surfaces.

E. Finish grade lawn and planting areas to smooth, even surface with loose, uniformly fine texture.

F. Roll, rake, and drag lawn areas, remove ridges and fill depressions with topsoil mix to obtain firmness and finish grades as indicated.

G. Notify Owner's Representative 36 hours in advance to review fine grading of lawn and planting areas. Finish grades shall be prepared to the satisfaction of the Owner's Representative prior to planting.

H. See Division 32 Section "Plants," for mulch placement.

3.7 CLEAN-UP

A. Clean up excess materials and debris from project site upon completion of work or sooner if directed by the Owner's Representative.

B. Leave in neat and tidy condition daily.

3.8 DISPOSAL

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 32 91 13

SECTION 32 92 00

TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Seeding.
2. Hydroseeding.

B. Related Sections:

1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling.
2. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.
3. Division 32 Section “Soil Preparation”
4. Division 32 Section "Plants" for border edgings.
5. Division 33 Section "Subdrainage" for subsurface drainage.

1.2 DEFINITIONS

A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

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. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

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

I. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Submit within 30 days from Award of Contract the following:

1. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
2. Vendor’s proof of order for seed mix specified. Deliver the seed bag tags to Owner's Representative.
3. Fertilizers: Submit manufacturer’s guaranteed analysis.
4. Mulch: Submit samples and vendor's product certificates for top dressing mulch and hydroseed mulch.
5. Certification of each seed mixture for sod, identifying source, including name and telephone number of supplier.
6. Submit copy of herbicide applicator's Commercial Applicator's License to Owner’s Representative before application of herbicides (includes pesticides). Submit a copy of the application record to the Owner’s Representative immediately after each herbicide or pesticide application.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Seed: Deliver seed in original sealed, labeled, and undamaged containers.

B. 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.

1.6 PROJECT CONDITIONS

A. Coordinate work with installation of other site work including irrigation and planting.

B. Verify site conditions that will not adversely affect execution. Verify that soil preparation has been completed and irrigation systems have been installed.

C. Owner's representative shall determine areas beyond those shown on Drawings disturbed by construction that are to be prepared and seeded at no additional cost to the Owner.

D. Observe the conditions under which Work is to be performed, and notify the Owner's Representative of unsatisfactory conditions. When conditions detrimental to lawn growth are encountered, such as rubble, rock fill or adverse drainage conditions, notify the Owner's Representative before planting or adding soil amendments. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Owner's Representative. Should any conditions not mentioned on the Drawings be found to exist, notify the Owner's Representative immediately.

E. Environmental Requirements: Do not place, spread, or roll fill materials during unfavorable weather conditions. When work is interrupted by adverse weather conditions, do not resume fill operations until moisture content and density of fill are satisfactory.

F. Protection of subgrade: Do not allow equipment to pump or rut subgrade, stripped areas, footing excavations or other areas prepared for the Project. Protect subgrades, fills and excavation areas from surface waters flowing into the work areas.

G. Season: Seeding shall take place in normal weather and temperatures that are appropriate and typical for such work between April 1st and October 15th. Seeding on other dates or during adverse conditions is at the risk of the Contractor. Do not sow seed when weather conditions are unfavorable, such as during drought, heavy rain or high winds.

1.7 PROTECTION

A. Provide adequate measures to protect workers and passers-by the site. Execute all work in an orderly and careful manner with due consideration for any and all surrounding areas, plantings, or structures which are to remain. Protect all adjacent property and improvements from work damage, and replace any portions damaged.

B. Any structures or facilities damaged due to Work of this Section shall be restored equal or better to their original condition at Contractor's expense and to the satisfaction of the Owner's Representative at no additional cost to the Owner.

1.8 WARRANTY

A. Guarantee seeded lawns and grasses in writing for a period of 1 year, or to the end of one full growing season after date of Final Acceptance, whichever is longer. Maintain and protect seeded lawns and grasses from damage until date of Final Acceptance. This shall include damage caused by vandalism or adverse weather conditions.

B. Remove and replace seeded lawns and grasses found to be dead, having low germination or growth rates, or in unhealthy condition during and at the end of warranty period. All replacement work shall be made within 14 days after receiving notification by the Owner's Representative, weather permitting. Provide new seeded lawns and grasses which comply with the Drawings and specifications, at no additional cost to the Owner. Guarantee replacement seeded lawns and grasses for 1 year from the date of seeding as specified above.

C. In the event the Contractor does not make repairs accordingly, the Owner without further notice may provide materials and labor to make such repairs at the expense of the Contractor at no additional cost to the Owner.

1.9 MAINTENANCE

A. Lawn Maintenance

1. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but not for less than the following periods

    a. Seeded Lawns: 60 days from date of substantial completion of lawn areas.
    b. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.

2. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting and other operations. Roll, re-grade and replant bard or eroded areas and re-mulch to produce a uniformly smooth lawn.

    a. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch. Anchor as required to prevent displacement.

3. Watering: Provide and maintain piping, hoses and lawn watering equipment to convey water from sources and to keep lawn uniformly moist to a depth of 2 inches.

a. Schedule watering to prevent wilting, puddling, erosion and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
b. Water lawn at a minimum rate of 1 inch per week.

4. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 40% of grass height. Remove no more than 40% of grass-blade growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowing to maintain the following grass height:

   a. Mow grass 2 inches high.

5. Lawn Post fertilization: Apply fertilizer after initial mowing and when grass is dry.

   a. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. to lawn area.

PART 2 - PRODUCTS

2.1 SEED

A. General: provide fresh, clean, new-crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America.

B. Finish Lawn-Hydro Seed Mix: Subject to compliance with requirements, provide the following proprietary seed mixes:

1. Finish Lawn Seed: Sunmark Seeds International, Inc. "Northwest Supreme Lawn Mix" or approved equal. Contact: 503-241-7333 or 888-214-7333
   Seed mix to consist of the following:

*Lolimum perenne var. Dasher 3**	Dasher 3 Perennial Ryegrass	35%
*Lolimum perenne var Cutter II**	Cutter II Perennial Ryegrass	35%
*Festuca rubra var. Garnet**	Garnet Creeping Red Fescue	15%
*Festuca rubra spp. Fallax var. Windward**	Windward Chewings Fescue	15%

2. Application rate: 8 pounds per 1000 square feet.

2.2 TOPSOIL

A. Topsoil: See Division 32 Section "Soil Preparation."

2.3 INORGANIC SOIL AMENDMENTS

A. Inorganic Soil Amendments: See Division 32 Section "Soil Preparation."

2.4 ORGANIC SOIL AMENDMENTS

A. See Division 32 Section "Soil Preparation."

2.5 HERBICIDES

A. Post-Emergent Herbicides: EPA registered and approved, of type recommended by manufacturer for selective weed eradication. "Round-Up," or approved equal.

2.6 FERTILIZER

A. Meet requirements of applicable State fertilizer laws. Fertilizers shall be uniform in composition, dry and free flowing. Deliver to the site in original unopened containers each bearing manufacturer's guaranteed analysis.

B. Composition and rate is referenced in Division 32 Section "Soil Preparation" for soil fertility requirements.

C. Commercial Fertilizer: provide slow release, granular fertilizer that is derived from natural organic and inorganic sources. For bidding purposes, assume a composition of 16 Nitrogen (N), 6 Phosphorous (P), 8 Potassium (K), 2 Iron (Fe), applied at a rate of 1 pound of actual Nitrogen per 1000 square feet. Adjust actual composition and rate based on results of soil analyses.

   a. Starter Fertilizer for manual seeding: PAR EX 14-19-19 with IBDU Starter Mix, as available from Wilbur-Ellis, Portland, Oregon, (503) 227-3525, or equal
   b. Starter Fertilizer for hydroseeding: PAR EX 18-16-16 with IBDU hydroseeders blend, as available from Wilbur-Ellis, Portland, Oregon, (503) 227-3525, or equal
   c. Maintenance Fertilizer: Woodburn Fertilizer 25-5-10 with 50 percent Slow Release, as available from Turf Care Products, (503) 620-0946, or equal.

2.7 MULCHES

A. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic; free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 2.8 to 6.8.

   1. Irrigated Lawns: Profile Products, LLC "Conwed Fibers 2000" or equal.

2. Non-Irrigated Lawns and Grasses: Interlocking crimped polyester fibers combined with wood fibers and crosslinked tackifier, Profile Products, LLC "Conwed Fibers Flexterra" or equal.

B. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.8 TEMPORARY BARRICADE MATERIALS

A. Agricultural metal stakes, minimum 42-inch exposed height.

B. Twine or wire.

C. Plastic flagging tape, 12-inch lengths.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 LAWN AREA PREPARATION

A. See Division 32 Section "Soil Preparation."

3.4 HERBICIDE APPLICATION

A. Spray herbicide as required to eradicate noxious weed growth.

1. Apply herbicide over all areas of weed or grass growth within landscaped area to eradicate weed growth. Apply in single application at manufacturer's maximum recommended rate, as follows:

a. Apply after soil preparation has been completed and approved by Owner's Representative.
b. Observe manufacturer's recommended period prior to working and seeding in treated areas.

3.5 SEEDING NEW LAWNS

A. Notify Owner's Representative for approval of seed bed prior to seeding.

B. Do not use wet seed or seed which is moldy or otherwise damaged in transit or storage.

3.6 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch with tackifier in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Areas with slope gradient less than 3 horizontal to 1 vertical: Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 2000 pounds per acre. weight, and seed component is deposited at not less than the specified seed-sowing rate.
2. Areas with slope gradient equal or greater than 3 horizontal to 1 vertical: Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 1000 pounds per acre. dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 2000 pounds per acre.

B. Keep hydromulch and seed out of planting beds and off walks, structures and areas not to be seeded. Clean up overspray of hydromulch onto these areas. Keep mulch and seed out of plant beds and other areas by mechanical means or selective herbicide if encroachment occurs. Clean up these areas to the satisfaction of the Owner's Representative.

3.7 LAWN MAINTENANCE

A. Maintain and establish lawn by watering, fertilizing, weeding, mowing, edging, trimming, replanting, and other operations necessary to establish a stand of grass to the satisfaction of the Owner's Representative. Roll, regrade, and replant bare or eroded areas and remulch to

produce a uniformly smooth lawn. Provide materials and installation the same as those used in the original installation.

1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.

B. Weed Eradication: Remove germinated lawn seed in planting areas without harming other plant material. Spray under and 6 inches outside of fences with "Roundup" to kill all grasses and weeds.

C. Duration: Maintenance of the seeded lawn shall commence after preliminary observation and approval of the seed bed by the Owner's Representative, and continue for a period of 60 calendar days minimum after written Notice of Substantial Completion of the Project and until Final Acceptance, whichever is later.

D. Establishment: If lawns are not established before the dormant period, maintain for a period of 60 calendar days minimum after the dormant period and until Final Acceptance. The dormant period is November 15th to March 1st.

E. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawn uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water lawn with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

F. Mowing: 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 mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. All grass clippings shall be collected and disposed of off-site in a legal manner. Schedule initial and subsequent mowings to maintain the following grass height:

1. Finish Lawn: Once growth has reached 4 inches, mow and cut no more than 1/3 total height of grass. Mow weekly thereafter to maintain a height of 2 inches. Maintain until Final Acceptance.

G. Lawn Postfertilization: Apply fertilizer after initial mowing and when grass is dry.

1. Fertilize lawns at end of 30 days with Maintenance Fertilizer at the rate of 1 pound per 1000 square feet. to lawn area.

2. Continue to fertilize lawns at 30 day intervals with maintenance fertilizer at a rate of 1 lb/1000 sf. to lawn area until final acceptance.

a. Adjust ration of N-P-K in maintenance fertilizer as required by season.

3.8 SATISFACTORY LAWNS

A. Lawn installations shall meet the following criteria as determined by the Owner's Representative:

1. Satisfactory Seeded Lawn: At end of maintenance period, a healthy, uniform, dense stand of grass has been established, free of weeds and surface irregularities, humps and depressions, with coverage exceeding 95 percent over any 10 sq. ft. and bare spots not exceeding 2 by 2 inches.
2. 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. Ensure that seed establishment occurs prior to October 15. Lawns that are not satisfactorily established at this time shall be sodded at no additional cost the Owner.

C. Where observed landscape work does not comply with the requirements, replace rejected work and use specified materials to reestablish lawns and continue maintenance until lawns are satisfactory.

3.9 CLEANUP AND PROTECTION

A. Promptly remove soil and debris, created by lawn work, from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from foot and vehicular traffic and to protect against trespassing and damage. Maintain fencing and barricades throughout initial maintenance period and remove after lawn is established.

C. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 32 92 00

SECTION 32 93 00

PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plants.
2. Mulches
3. Herbicide
4. Fertilizers
5. Tree stabilization.
6. Root Barriers
7. Planting Accessories

B. Related Sections:

1. Division 01 Section "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Division 31 Section "Site Clearing" for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.
3. Division 31 Section "Earth Moving" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
4. Division 32 Section "Turf and Grasses" for turf (lawn)
5. , hydroseeding, and erosion-control materials.
6. Division 32 Section “Soil Preparation” for areas to be planted.
7. Division 33 Section "Subdrainage" for below-grade drainage of landscaped areas, paved areas, and wall perimeters.

1.2 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than sizes indicated; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than sizes indicated.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Finish Grade: Elevation of finished surface of planting soil.

G. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

H. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

I. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

J. Planting Area: Areas to be planted.

K. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

M. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

N. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

O. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

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

Q. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, including soils.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project.

B. Samples for Verification: For each of the following:

1. Trees and Shrubs: Three samples of each variety and size delivered to the site for review. Maintain approved samples on-site as a standard for comparison.
2. Compost Mulch: 1-quart volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
3. Root Barrier: Width of panel by 18 inches.

C. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

D. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

E. Material Test Reports: For existing native surface topsoil and imported or manufactured topsoil.

F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

G. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Five years' experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."

3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

    a. Certified Landscape Technician - Exterior, with installation, maintenance, and irrigation specialty area(s), designated CLT-Exterior.
    b. Certified Landscape Technician - Interior, designated CLT-Interior.
    c. Certified Ornamental Landscape Professional, designated COLP.

5. Pesticide Applicator: State licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.

1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Architect. A minimum of **three** representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
3. Report suitability of tested soil for plant growth.

    a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
    b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

D. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

E. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread;

do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.

2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

F. Plant Material Observation: Owner's Representative may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Owner's Representative retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Owner's Representative of sources of planting materials seven days in advance of delivery to site.

G. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

D. Handle planting stock by root ball.

E. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.
2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of each service or utility.
2. Do not proceed with interruption of services or utilities without Construction Manager's written permission.

C. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: March 1 – May 15.
2. Fall Planting: September 1 – November 15

D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

E. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.7 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories 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 abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
b. Structural failures including plantings falling or blowing over.
c. Faulty performance of tree stabilization or tree grates.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods from Date of final acceptance:

a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.

3. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

1.8 MAINTENANCE SERVICE

A. Initial Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period: Until Substantial Completion

B. Initial Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period: Until Substantial Completion

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots will be rejected.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

C. 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.

D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.

E. If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.2 PLANTING SOIL MIXES

A. Refer to Division 32 Section “Soil Preparation.”

2.3 FERTILIZERS

A. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 5-gram, 10-gram, and/or 21-gram tablets.

2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.4 MULCHES

A. Bark Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs. It shall be commercially produced, medium-coarse, dark brown bark mulch. Bark shall be ground Fir or Hemlock bark, uniform color, free of weeds, seed, sawdust and splinters and shall not contain resin, tannin or other compounds detrimental to plant life. All material shall pass a 1-inch mesh screen.

B. Compost is a widely used bulk organic mulch and a recycled product. Because it is applied at much greater rates than fertilizer, compost has a significant cumulative effect on nutrient availability and may reduce or eliminate top-dressed fertilizing. Consider each plant's pH and soluble salt requirements and how they relate to the compost being used.

C. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5 decisiemens /m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Source Material: Recycled plant waste. Yard and garden waste, wood waste, agricultural crop residues, pre-consumer vegetable food waste or biosolids-based composts (when approved).

2.5 PESTICIDES

A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.6 TREE STAKING AND GUYING

A. Deciduous Tree Tie: Plastic chain-type, approximately 1-inch-wide by 1/8 inch thick.

B. Evergreen Tree Tie: 12 gauge galvanized wire with 1/2-inch rubber hose, black color, to protect tree trunk.

C. Stakes: (2) 2-inch x 2-inch x 8 feet Douglas Fir for deciduous trees; and (3) 2-inch x 2-inch x 36 inch Douglas Fir for coniferous trees.

D. Provide miscellaneous hardware, wire, and accessories as shown on the Drawings.

E. PVC Flags: 1/2 inch or 3/4-inch diameter x 18 inches long PVC pipe. Color: Yellow.

2.7 TREE WRAP

A. Corrugated or crepe paper, designed specifically to resist insect infestation and sun scald.

2.8 MISCELLANEOUS PRODUCTS

A. Root Barriers: Rigid interlocking polypropylene panels: Deep Root, Inc.; or equal.

1. Linear Root Barriers for trees along pavement edge: 18 inches deep by 10 feet long by 0.08-inch-thick polyethylene panel with integral root directing ribs and self-locking joiner strips. Model No. UB 18-2.

B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

C. Burlap: Non-synthetic, biodegradable.

D. Planter Drainage Gravel: 1-1/2 to 1/2 inches round washed river rock; no fines for non-percolating soil

E. Filter Fabric: Non-woven filter fabric to cover drain rock: Mirafi 140N as available from CSI, (360) 699-1426; Propex 4545 as available from A.C.F. West Inc., (503) 771-5115; or equal.

F. Mycorrhizal Fungi: Provide “MycoApply Endo Plus” granular mycorrhizal inoculum. Available from: Mycorrhizal Applications, Inc., Grants Pass, OR (541) 476-3985, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint

thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.

2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Owner's Representative and replace with new planting soil.

3.2 PREPARATION

A. Verify finish grades are properly achieved and soil preparation has been completed in accordance with the specifications; start of Work denotes acceptance by the Contractor and Contractor assumes responsibility for final results.

B. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

C. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

D. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Owner's Representative's acceptance of layout before excavating or planting. Make minor adjustments as required.

E. Lay out plants at locations shown on Drawings or otherwise directed by Owner's Representative. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

F. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

G. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.3 SOIL PREPARATION

A. As specified in Division 2 Section "Soil Preparation".

3.4 HERBICIDE APPLICATION

A. Spray herbicide as required to eradicate noxious weed growth.

1. Apply herbicide over all areas of weed or grass growth within landscaped area to eradicate weed growth. Apply in single application at manufacturer's maximum recommended rate, as follows:

a. Apply after soil preparation has been completed and approved by Owner's Representative.
b. Observe manufacturer's recommended period prior to working and planting in treated areas.

3.5 EXCAVATION FOR TREES AND SHRUBS

A. Excavate planting holes, with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.

1. Planting hole needs to be 3 times width of root spread and 1 ½ times depth of root ball.

B. If non-percolating soils are encountered, fill excavations for trees and shrubs with water and allow to percolate out before planting. If plant holes do not drain: Auger drill holes 36 inches deep by 8 inches wide and fill with drainage backfill. Cover top with filter fabric. Notify Owner's Representative to observe prior to planting.

C. If conditions detrimental to plant growth are encountered, such as rubble fill, or obstructions, notify Owner's Representative and resolve before planting.

D. Scarify bottom and sides of hole with shovel to eliminate "glazed" surfaces.

E. Set plants on native soil where possible.

3.6 PLACING

A. Set top of root ball slightly higher than finish grade; deep planting not permitted. If hole for trees is too deep, fill hole with native soil only where applicable or prepared soil to correct levels.

B. Set plants plumb and faced for best appearance.

C. Remove wire baskets, burlap, fasteners from rootball completely if rootball will not be damaged. If damage is suspected, notify Owner's Representative for concurrence and remove tops and sides of baskets minimum. Use bolt cutters on wire if necessary to remove wire baskets. Bending back not acceptable. Remove all burlap and twine from planting pit.

D. Remove metal cans or plastic containers completely from rootball.

E. Neatly cut off broken, girdling, or frayed roots and any root growth growing in a circular manner conforming to its container.

3.7 BACKFILLING - General

A. Before mixing, clean topsoil of extraneous materials and other materials harmful or toxic to plant growth.

B. Prepare planting backfill soil mix prior to backfilling. Stockpile on site.

C. Planting backfill soil mix shall be as follows: 1/4 compost material, 1/4 amended topsoil and 1/2 soil excavated from planting pit.

1. For the following group of plant materials, include peat moss as part of the backfill mix: Azalea spp., Camellia spp., Kalmia spp., Pieris spp., Rhododendron spp.
2. The modified backfill mixture schedule for these plants shall be of the following ratio:

a. 1/4 compost material, 1/4 topsoil, 1/4 peat moss and 1/4 soil excavated from planting pit.

D. Backfill half of plant pit around rootball with backfill soil mix, carefully tamp soil around rootballs.

E. Provide slow-release fertilizer tablets during backfill at the following rates: Locate plant tablets 1 inch from roots and at mid-depth. Space evenly around the plant.

1-gallon shrub = 1 tablet
2-gallon shrub = 2 tablet
3-gallon shrub = 2 tablet
5-gallon shrub or tree = 3 tablets

F. Add 3 ounces mycorrhizal inoculum per caliper-inch to backfill around trees. Add 3 tablespoons mycorrhizal inoculum per gallon planting size. Add 1 teaspoon mycorrhizal inoculum per ground cover plant.

G. Complete backfilling, firming to surface grade.

H. Form watering basin from site topsoil as shown on Drawings.

I. Thoroughly hand water each plant and entire bed immediately after planting. Adjust rootball and soil as required if settlement of soil occurs.

J. Remove plant tags and ribbons.

3.8 PLANTING TREES AND SHRUBS

A. Set roots or rootball on layer of compacted planting soil backfill mix or native suitable topsoil from planting pit, plumb and in center of pit or trench with top of rootball at 1 inch above elevation of adjacent finished grade.

B. Place additional planting soil backfill mix around base and sides of ball and eliminate voids and air pockets. When backfill is approximately 2/3 complete, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill. Cut burlap from top of rootball and roll back to sides of planting hole; form watering basin; stake and guy immediately after planting.

C. After planting, apply top-dress fertilizer at the following rates:
   0-1-foot-tall shrub = 0.4 oz.
   1-2-foot-tall shrub = 0.8 oz.
   2-4-foot-tall shrub or tree = 1.75 oz.
   4-8-foot-tall shrub or tree = 4 oz.
   8+ feet = 4 oz. plus proportional amount per foot.

3.9 PLANTING GROUNDCOVER

A. Space plants as shown or scheduled on Drawings. Dig holes 3 times the width and 1-1/2 times the depth of the rootball. Plant with planting soil backfill mix. Work soil around roots to eliminate air pockets. Water thoroughly after planting.

B. After planting, apply top-dress fertilizer at the rate of 50 pounds per 1,000 square-feet, or apply 1 slow-release fertilizer tablet per plant during backfill.

3.10 LINEAR ROOT CONTROL BARRIERS

A. Provide at locations shown on the Drawings and as approved by the Owner's Representative. Excavate 18 inches deep trench along edge of proposed pavement. Install trench and barrier prior to pouring concrete or laying of pavers. Re-compact pavement subgrades and bases encountered during installation of root barriers. Cut any existing roots squarely according to standard horticultural practices and root barrier's recommendations.

B. Install panels vertically, with ribs on tree side of barrier, flush against paving, maximum 2 inches below top of paving, and 1/2 above finish grade. If panels cannot be installed immediately against paving formwork, backfill paving side of panel with 1-inch minus crushed rock to keep panel vertical and stabilized.

C. Provide minimum 10-foot length of connected panels, centered on tree trunk or existing root, as directed by Owner's Representative. Backfill tree side of barrier with existing soil. If existing roots have been cut, backfill tree side of barrier with planting backfill soil mix.

3.11 WRAPPING

A. Deciduous trees over 1-1/2-inch caliper when within five feet of pavement shall be wrapped promptly after planting to prevent sun scald, wrapping as approved by American Association of Nurserymen. Wrap spirally from ground line to the height of the first branch. Wrap in neat and snug manner and secure with tape similarly colored to tree wrap at bottom, top and in the middle. Wrap before staking or guying.

3.12 STAKING

A. Deciduous Trees 1-inch caliper and larger: Provide 2 stakes per tree 180 degrees from each other in the direction of prevailing winds. Drive plumb outside of rootball as shown on Drawings. Place tree ties around tree trunk, approximately 4 feet from ground level, one from each side.

B. Coniferous Trees 4 feet tall and larger: Provide 3 stakes evenly spaced around trunk of tree. Set stakes at a 60-degree angle to the trunk at 2/3 the height of the tree. Drive wooden stakes perpendicular to angle of tree ties. Place tree ties around tree trunk and secure to each stake and install PVC flags on each wire for visibility.

3.13 MULCH

A. Place mulch 2 inches deep in all planting beds. Rake smooth. Mulch shall be pulled away from crowns of shrubs, perennials and groundcover plants. Mulch shall be flush with adjacent curbs and paving. Taper mulch thickness from full 2 inches depth to 1 inch depth over a 12-inch horizontal run at paving edges so mulch will be flush with adjacent curbs and paving.

B. Tree Plantings in Lawns:

1. Deciduous Trees: Cut away and remove turf to establish a 3-foot radius circle from center of tree. Cut clean edge and fill with mulch.
2. Coniferous Trees: Cut away and remove turf to establish a circular ring 2 feet beyond the outside dimension of drip line of tree. Ring to be centered on tree minimum 3-foot radius. Cut clean edge and fill with mulch.
3. For trees in pavement cut outs, provide minimum 3 inches depth of mulch.

C. Ground Cover Plantings:

1. After fertilizing, mulch areas between groundcover plants; place minimum 2-inch thick specified mulch.

3.14 TREE, SHRUB, AND VINE PRUNING

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

B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.

C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.15 PLANTING IN PLANTERS

A. Place a layer of drainage gravel at least 4 inches thick in bottom of planter. Cover bottom with filter fabric and wrap filter fabric 6 inches up on all sides.

B. Fill planter with planting soil. Place soil in lightly compacted layers to an elevation of 1-1/2 inches below top of planter, allowing natural settlement.

3.16 MAINTENANCE

A. Begin plant maintenance immediately after planting and continue until Final Acceptance. Refer to Division 2 Section "Establishment Maintenance" for specific requirements**.**

B. Store maintenance materials and equipment where directed by Owner's Representative. Keep pavements clean and work areas in an orderly condition.

C. Maintain plants for an additional 90 days minimum after written notice of Substantial Completion of the Project and until Final Acceptance (whichever is later). If plants are not installed before the dormant period, November 15th to March 1st, maintain for a period of 90 days after the dormant period or until Final Acceptance, whichever is later.

1. Inspect plants at least once a week and perform maintenance promptly.
2. Maintain trees, shrubs and ground covers by watering, pruning, spraying, cultivating, and weeding as required for healthy growth.
3. Water when soil moisture is below optimum level for best plant growth.
4. Remove and replace impaired or dead plants promptly during specified planting season.
5. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required.
6. Eradicate all weeds, grass, and other undesired vegetation growth from planting areas. Remove dead weeds and dispose legally off-site. Remove all perennial weeds completely, including all underground parts.
7. Restore all soil settlement to original grade.

D. Fertilizing and Liming: Perform as recommended in the soil fertility analysis report provided by the Owner at substantial completion and as necessary to maintain cover crop in a healthy growing condition.

1. Fertilize trees, shrubs and ground cover once at the end of the Maintenance Period. Work the fertilizer thoroughly into the top 2 inches of soil.
2. In March, within the first growing season, fertilize all planting areas with 1 application of each of the maintenance fertilizers, at the rate of 7 pounds per 1,000 square feet of soil surface.

3.17 CLEAN-UP AND PROTECTION

A. During landscape work, keep pavements clean and work area in an orderly condition.

B. Sweep and wash paved surfaces to remove soil and soil stains.

C. Clean all mud and debris from catch basins, which is caused by Work of this Section.

D. Remove plant containers, trimmings, clippings, and all extraneous debris unearthed or resulting from any operations specified herein, from Project Site and dispose in a lawful manner.

E. Protect landscape work and materials from damage.

F. Maintain protection during installation and Maintenance Period.

G. Treat, repair or replace damaged Work as directed by Owner's Representative, at no additional cost to the Owner.

3.18 ACCEPTANCE

A. Substantial Completion:

1. Notify the Owner's Representative in writing of the completion of planting.
2. Within 10 days after notification of completion of Work, the Owner's Representative will inspect the Work in the presence of the Contractor and the Owner, and prepare a Notice of Substantial Completion, along with a list of items that require completion and correction (i.e., Punch List).
3. Notice of Substantial Completion constitutes the commencement of the Maintenance Period.

B. Final Acceptance:

1. The final inspection of all planting will be made by the Owner, Owner's Representative in the presence of the Contractor, following completion and correction of all items on the Punch List, and prior to the expiration of the Maintenance Period.
2. Before Final Acceptance will be granted, the site must be in the condition stipulated all correction items on the Punch List completed to the satisfaction of the Owner and Owner's Representative.

3. If Final Acceptance is not granted at the end of the Maintenance Period, continue maintaining plantings until Final Acceptance is granted, at no additional cost to the Owner.

3.19 DISPOSAL

A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 32 93 00