

PART 01000 - RIGHT-OF-WAY DEVELOPMENT AND CONTROL**Section 01030 - Seeding****Description**

01030.00 Scope - This work consists of seeding and associated tasks to develop plant growth for erosion control, environmental mitigation, and roadside development.

01030.02 Definitions:

Certified Seed - A grass or legume seed named variety that has been reviewed and accepted into the Oregon Certified Seed program. Currently certified seed is individually sold in bags with a blue-colored Oregon Certification Tag, thus the name commonly used for such seed is "blue tag stock".

Establishment Period - A period when planting work has been performed and initially accepted, and there is a Contract requirement to care for the planted areas in some way until the period ends.

Native Plant (existing) - A variety of plant species that occurring in its natural habitat without direct or indirect human actions.

Noxious Weed - All weed designated by the Oregon State Weed Board as injurious to public health, agriculture, recreation, wildlife, or all public or private property. The Oregon Department of Agriculture (ODA) will be the authority in determination of noxious weed species.

Pure Live Seed (PLS) - The amount of living seed in the total quantity of seed when non-viable seed or non-seed material is excluded.

Riparian - Related to the bank, shore, or water-influenced areas of a watercourse or water body.

Sensitive Areas - Defined areas such as wetlands, natural water and riparian resources, special environmental zones, or where certain activities are restricted such as the use of chemicals.

Specified Weeds - All noxious weeds as defined above, and all plant species identified in the Special Provisions or on the plans as a species to be removed.

Waters of the State - See ORS 468B.005 for "Waters of the State" definition.

Weed - A plant that is undesirable where it is growing.

Weed Free - For these Specifications, "Weed Free" is defined as the following maximum amount of living weeds per square yard:

- Zero "Type A" or "Type T" Noxious Weeds
- One "Type B" Noxious Weed
- One of each non-noxious weed listed in the Special Provisions

The ODA Noxious Weed Policy and Classification System lists Type "A", "B", and "T" Noxious Weeds.

Weed Management Area (WMA) - A defined project area with Specified Weeds to remove, including areas where weeds begin growing because of project-associated ground disturbance. A WMA may be the entire project site or any portion, including material source and disposal sites as shown.

Materials

01030.11 Topsoil - Furnish topsoil meeting the requirements of 01040.14.

01030.12 Soil Conditioners, Amendments, and Bio-Amendments - Furnish soil modifiers meeting the requirements of 01040.15, 01040.16, and 01040.17.

01030.13 Seed - Furnish seed meeting the following requirements:

(a) Label - Deliver all seed in standard, sealed containers meeting the requirements of the Oregon Seed law. See ORS 633.520 and OAR 630-56 for specific labeling requirements.

- The kind and variety of each seed of 3% or more in a mixture, by weight. Be sure that seed mix labels include the words "mixture" or "mixed seed" when the seed is a mixture
- The country or state where the seed is grown
- The lot number or other lot identification
- The total percentage, by weight, of other crop seed
- The total percentage, by weight, of weed seed
- The total percentage, by weight, of inert matter
- Statement of "No Noxious (weed) Found"
- For each named seed:
 - Percentage of germination
 - Percentage of hard (non-living) seed, if more than 1%
 - Percent of PLS for each kind of seed
 - Percent and kind of other crop
 - Month and year of seed test
 - Net weight of contents
 - Name and address of seed labeler or seller

- Origin for each seed (state or foreign country)
- If seed inoculant is used, the claimed date that inoculant effectiveness ends
- For treated seeds (if any):
 - Statement that the seeds have been treated
 - Name of all chemical used in the treatment
 - Description process used in the treatment
 - Warning statement for all residual chemicals used
- Net weight of each container
- For seeds listed as native, date and location of collection of source (first generation) seed
- For native seeds specified to be collected for direct use on a project, label containers with the date and location of collection sites for each seed species

Alternate label requirements may be identified in the Special Provisions for certain native plant seeds.

In addition to the labeling requirements of the Oregon Seed Law, label all native seed containers with the date and location of where the original stock seed originated. Seed whose origin cannot be traced may not meet the definition of "native." For native seed collected for direct use on a Project, label containers with the date and field location of collection of each seed type.

(b) Quality - Furnish seed meeting the following requirements:

- The seed and labeling complies with Oregon Seed Law and Federal Seed Act.
- The seed has been tested within 18 months of the planting date.
- The seed is not sprouted, moldy, or showing evidence of having been wet or otherwise damaged.
- The seed is labeled as "Oregon Certified Seed" or the equivalent from another state when identified in the Special Provisions. Information about certified seed is available from County Extension Offices, Oregon State University, and the Oregon Department of Agriculture.

(c) Pure Live Seed - Obtain the amount of seed to apply by using the purity and germination percentages from the label on actual bag of seed to be used on the Project.

To calculate the amount of seed to be applied:

- Obtain the PLS factor by multiplying the seed label germination percentage times the seed label purity percentage
- Divide the specified PLS rate by the PLS factor

Example

A PLS seeding rate of 10 pounds per acre is specified. The seed label shows a purity of 80% and germination is 90%. After converting percentages to decimals, 0.80×0.90 equals a factor of 0.72. The specified PLS rate, 10 pounds per acre, divided by the factor of 0.72 equals 13.88. About 14 pounds per acre of total seed needs to be applied in order to meet a PLS seeding rate of 10 pounds per acre. For a seed mix, make this calculation for every seed to obtain the total amount to be applied.

(d) Inspection - Each lot of seed is subject to inspection upon delivery to the Project. Seed that is not labeled or that does not conform to the Specifications will be rejected and replaced at no additional cost to the City.

(e) Mixes - Furnish seed mixes that meet the labeling, quality and inspection requirements stated above. Submit any other proposed seed or seed mixes for consideration and receive written approval before seeding work begins. Replace rejected seed before planting.

(f) Types of Seed Mixes - Seed mixes, quantities, standards, and other information will be included in the Special Provisions for each type of seed mix.

The following are the functional categories of seed mixes that may be included on projects (a category may have multiple functions on a project site):

- **Temporary Seeding** - To provide short-term control of soil erosion until permanent seeding is performed or all potential for erosion is removed.
- **Permanent Seeding** - The final seeding or only seeding performed for erosion control.
- **Lawn Seeding** - Seeding for areas where finished turf appearance is desired.
- **Wildflower Seeding** - Seeding to develop growth of wildflowers. The seed mix will typically contain grass or other plant seed to provide erosion control.
- **Plant Seeding** - Seeding which typically includes more than just grass species, such as seeds of woody or herbaceous plants.
- **Water Quality Seeding** - For use in water quality facilities such as swales or settling basins.
- **Wetland Seeding** - To vegetate existing or constructed wetlands with native plant species.
- **Native Plant Seeding** - Seeding to restore native vegetation.

(g) Availability - Provide a list of seed sources for all specified seeds within 60 calendar days after execution of the Contract. Verify that all specified seed has been located and will be available for use on the Project.

01030.14 Fertilizer - Furnish standard, commercial grade fertilizer meeting the following requirements:

(a) **General** - Deliver fertilizers in separate or mixture containers that have the percentage of total nitrogen, available phosphoric acid, and water-soluble potash (NPK) in the amounts specified. Label each container with a quality compliance certificate that includes the container weight, the percentage of each ingredient, and the source of each component in the mixture. Ensure that each container is labeled with a Quality Compliance Certificate that meets the applicable requirements of Section 00165.

Furnish fertilizer according to State and Federal regulations. Fertilizer is subject to testing by the State Department of Agriculture.

(b) **Type of Fertilizer** - Provide the following fertilizer:

(1) **West of the Cascades** - Furnish 22-16-8 inorganic fertilizer, analyzing 22% nitrogen, 16% phosphoric acid, 8% soluble potash, and including a minimum of 2% sulfur. Furnish fertilizer containing not less than 50% available water-insoluble, controlled-release nitrogen derived from one of the following sources:

- Urea formaldehyde (Nitroform)
- Isobutylidene Diurea (IBDU)
- Polymer coated urea (no sulfur)

(2) **Near Water** - For application within 50 feet of open water, furnish 22-2-11 low-phosphorus fertilizer, analyzing 22% nitrogen, 2% phosphorus, and 11% potassium which releases slowly over an 8 to 9 month period. Furnish fertilizer containing a minimum of 60% available water-insoluble, controlled-release nitrogen derived from one of the three sources stated above. Furnish phosphorus and potassium that is coated to allow a minimum of 95% controlled-release.

01030.15 Mulch - Furnish mulch materials free of all weed or plant seeds containing no substances detrimental to plant life. The kind of mulch material(s) acceptable for use will be shown on the plans listed in the Special Provisions, or will be as approved.

Furnish mulch for seeding according to the following:

Furnish straw mulch for all roadside erosion control seeding except hydromulch may be used under the following conditions:

- Spring planting between March 1 and May 15
- Slopes are steeper than IV to 1.5H and longer than 16 feet
- Residential or commercial sites with low erosion potential such as sidewalk, median, or parking lot planter strips

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Projects that have variable slopes may include straw mulch and hydromulch when approved.

(a) Hydromulch from Cellulose, Wood, or Straw Fiber - Furnish cellulose fiber produced from virgin wood, straw, or paper fiber product from the CPL.

Furnish wood or straw mulch processed so the fibers remain uniformly suspended under agitation in water and the fibers have moisture-absorption and percolation properties.

Ship hydromulch in packages of uniform weight, plus or minus 5%, that are labeled with the manufacturer's name and air-dry weight.

(b) Straw - Unless otherwise specified, furnish straw mulch for non-hydroseeding applications from bentgrass, bluegrass, fescue or ryegrass singly or in combination. Cereal grain straw from barley, oat or wheat may be allowed upon approval of the City. Provide straw that is not moldy, caked, decayed or of otherwise low quality. Submit certification from the supplier that the straw is free of noxious weed seeds or plant parts. Acceptable documentation is any one of the following:

- The straw source is an "Oregon Certified Seed" field.
- The straw is certified by a recognized program accepted by the Oregon Department of Agriculture as being weed free.
- Seed lab test results of seed harvested from the straw meet minimum Oregon Certified Seed quality for weed seed content.

(c) Tracer - For hydromulch application, include enough green dye so applied mulch is easily visible.

01030.16 Tackifier - Furnish a commercial quality tackifier containing no agent toxic to plant life. Furnish tackifier of either a liquid stabilizing emulsion or a dry powder tackifier meeting the following requirements:

(a) Liquid Stabilizer Emulsion - Tackifier with a base material of liquid, polyvinyl acetate polymers, using emulsion resins and containing not less than 55% total solids by weight. Furnish tackifier containing no polyacrylates or polyvinyl acrylics. The emulsion shall, when diluted with water and upon drying, allow exchange of air and moisture to the seeds and have an effective life of 1 year or more.

(b) Dry Powder Tackifier - Tackifier base consisting of one or more active hydrocolloids from natural plant sources, which hydrates in water and blends with other slurry materials, and upon application and drying tacks the slurry particles to the soil surface, and exhibits no growth or germination inhibiting factors. Provide stabilizing emulsion in a dry powder form that may be re-emulsifiable, and consisting of a processed organic adhesive derivative of one of the following:

- Gumbinder derived from guar (*Cyamopsis tetragonoloba*)
- Gumbinder derived from plantain (*Plantago insularis*)

01030.17 Pesticides - Submit proposed pesticides and receive approval before using. Submit a copy of the manufacturer's federal registered label and, if requested, a Material Safety Data Sheet. The City reserves the right to restrict chemicals from being used on Sensitive Areas.

Labor

01030.30 General:

(a) Weed Control Coordinator - Submit certification at the preconstruction conference that the weed control coordinator meets the following minimum requirements:

- Demonstrates ability to identify noxious and other weed species commonly seen in Oregon. Some examples of potentially acceptable credentials are at least one year conducting weed surveys in Oregon or Washington State or a degree in botany or horticulture from an accredited institution.
- Has successful weed control experience, with similar duties to those stated under typical duties below, on at least 3 construction or vegetation management projects. Two examples of acceptable certification are an Oregon Pesticide Consultant License or Oregon Landscape Contractor's License held in the individual's name.

Typical duties of the weed control coordinator include the following:

- Identify Specified Weeds.
- Prepare and update the Weed Control Work Plan (WCWP).
- Coordinate Contractor's weed removal work and records.
- Resolve weed control issues as the Contractor's representative.
- Determine when Specified Weed content exists in disposable materials and ensures the materials are disposed of at an approved off-site facility.

(b) Pesticide Applicator - Submit certification before application of pesticide work begins, that when chemical weed control is used, that each applicator possesses an Oregon Commercial Pesticide Applicator's License held in the individual's name. Submit a certification each time a new applicator begins application work on the Project.



Construction

01030.40 General - Notify the City not less than 24 hours in advance of seeding operations. Do not begin seeding until prepared slopes in an area have been approved for seeding. Do not perform seeding during windy weather or when the ground is frozen, excessively wet, or otherwise not tillable.

Do not disturb or damage existing desirable vegetation that is to be left in place. Do not disturb areas previously seeded and mulched, with the exception of disturbances caused by stage construction. If previously seeded areas are disturbed, rework and reseed as directed, at no additional cost to the City.

Remove all non-approved plants resulting from the seed mixes provided for the Project at no additional cost to the City, including erosion protection required during reseeding.

01030.41 Area Preparation - Refer to 01040.48 for area preparation for the following kinds of seeding:

- Temporary Seeding - Method E
- Permanent Seeding - Method D
- Wildflower Seeding - Method B
- Plant Seeding - Method B
- Water Quality Seeding - Method B
- Wetland Seeding - Method B
- Lawn Seeding - Method C
- Native Plant Seeding - Method B

01030.42 Weed Control - When the Contract Schedule of Items includes an item for "Weed Control", remove and prevent regrowth of Specified Weeds, weed plant parts, and weed seeds from areas within the Project limits.



Do not harm or disturb existing native or ornamental vegetation, unless directed to do so. Do not compact soil with heavy equipment in areas where soil will not be disturbed for roadway or other construction.

If a pesticide has been approved for use, apply according to Federal and State laws, including conditions and requirements of the Federally registered pesticide label.

(a) Weed Control Work Plan - Depending on project conditions such as location, sensitive environments, permit requirements, jurisdictional regulations, or other items, there may be limits on the use of chemicals or other weed control methods. Before submitting the initial WCWP, determine if there are restrictions or all potential for restrictions on weed control methods on project sites. At the preconstruction conference, submit a WCWP with the following:

- Name and contact information for the approved weed control coordinator.
- WMAs with existing Specified Weeds mapped on project plan sheets where possible.
- Botanical and common name of each species of weed to be removed.
- The proposed methods of weed removal and continuing control for each weed species listed.
- Schedule of weed control measures.
- Request to use wheeled or tracked construction equipment in sensitive areas.

If changes of the WCWP are necessary, resubmit a revised WCWP for approval before proceeding.

(b) Weed Control Inspections - Inspect the project for new growth of specified weeds at least monthly and apply weed control measures as appropriate. This requirement may be waived by the Engineer during the period that weeds are fully dormant. To ensure satisfactory weed removal, the last WMA inspection will occur at least 30 days after growing season has begun or as directed.

At a minimum, schedule weed control inspection with the City at the following times:

- After approval of WCWP and prior to beginning weed control within a WMA.
- Monthly.
- Upon request by the City to discuss non-compliant weed control work.
- After completing weed control at material sources and disposal sites.

(c) Remove and Control of Weeds - Remove and control weeds according to the following:

(1) All areas:

- At least 3 calendar days prior to beginning weed control activities, walk through each WMA with the Engineer and confirm the identity, location, type, and approximate number of Specified Weeds. Verify that control methods in the WCWP are acceptable as planned for each WMA before proceeding with weed control activities.
- Remove Specified Weeds and receive approval prior to beginning construction or equipment mobilization in that area. As much as practicable, ensure that weed seeds or reproducing plant parts such as vines, runners, or rhizomes don't remain or become dispersed during control activities.



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- As soon as practicable, place weeds and related materials in an approved container and transport to an approved offsite disposal facility according to applicable laws and regulations. During transport, ensure that materials are fully enclosed at all times to prevent escape.
- Keep a record of all weed material loads transported off the Project and submit documentation from the approved disposal facilities that a corresponding number of weed material loads were disposed of at that facility.
- Keep WMAs Weed Free including weeds not initially present in the walk through.

(2) Sensitive Areas:

- Unless otherwise approved in writing, use only hand or light mechanical weed control methods within 50 feet of Sensitive Areas. Hand methods include the use of hand tools. Light mechanical methods include the use of hand carried, motorized machinery.
- Inside Sensitive Areas, obtain approval before using wheeled or tracked construction equipment. Requests will be approved only when all vegetation in the area will be cleared, such as under new roadways or slopes.
- The Engineer will be the authority in the determination of Sensitive Areas.

(d) Weed Control Corrective Work - If corrective work for areas identified as deficient by the Engineer is not completed within a 15 calendar day period, the Engineer may suspend the work according to 00180.70. If the Contactor's weed control work is determined to be unsatisfactory, the City reserves the right to do the work at the Contractor's expense.

01030.43 Temporary and Permanent Seeding:

(a) Temporary Seeding - Temporarily seed disturbed soils and slopes that are not at finished grade and which will be exposed for two months or longer before being disturbed again. Provide fertilizer, mulch, water, and other amendments necessary to ensure establishment. Ensure that temporary seeding work achieves the coverage of live plants required by 01030.60 by the end of the next permanent seeding date stated in 01030.43(b). If this coverage is not achieved, or if the City determines that it is not effective in stabilizing the soil from erosion, stabilize the area with other temporary stabilization methods as described in 00280.42 at no additional cost to the City.

(b) Permanent Seeding - Perform this seeding during the permanent seeding dates shown below. If work done within the seeding dates does not provide coverage according to 01030.60, re-seed according to 01030.48 and as directed. The dates for permanent, wildflower, plant, water quality, wetland, lawn, and native plant seeding are as follows:

- **West of the Cascades** - March 1 through May 15 and September 1 through October 31. If new lawn areas are regularly watered, they can be seeded from March 1 through November 15.
- **Wetland (Statewide)** - September 1 through October 31 and March 1 through April 30.

Permanent seeding outside the these dates requires written authorization from the City. Approval to seed outside these dates will only be given when physical completion of Project work is imminent and environmental conditions are conducive to satisfactory growth. For permanent seeding done outside the seeding dates, ensure that the coverage of live plants required by 01030.60 is achieved no later than 3 weeks into the next permanent seeding period. If this coverage is not achieved, re-seed and refertilize areas of insufficient coverage according to the permanent seeding requirements, at no additional cost to the City.

01030.44 Fertilizer:

(a) **Inorganic** - Apply 22-16-8 or 22-10-5 at the rate of 400 pounds per acre.

(b) **Low-phosphorous** - Apply 22-2-11 polymer coated urea low-phosphorus fertilizer at the rate of 200 pounds per acre.

Use low-phosphorous fertilizer within 50 feet of water.

01030.45 Soil Testing - Test soil according to 01040.13.

01030.46 Topsoil and Wetland Topsoil - Construct topsoil according to 01040.43 or 01040.44 as appropriate.

01030.47 Soil Amendments and Bio-Amendments - Incorporate soil amendments and bio-amendments into the seeding operation according to 01040.45 and 01040.46, as appropriate.

01030.48 Application - The following application methods are acceptable for both temporary and permanent seeding:

(a) **Hydroseeding, Fertilizing, Hydromulching, and Tacking** - Apply seed, fertilizer, mulch, and tackifier as follows:

Use hydraulic equipment that continuously mixes and agitates the slurry and applies the mixture uniformly through a pressure-spray system providing a continuous, non-fluctuating delivery. Ensure the equipment and application method provides a uniform distribution of the slurry. Place seed, fertilizer, mulch, and tackifier in the hydroseeder tank no more than 30 minutes prior to application.

(1) **Hydroseeding operation** - Perform hydroseeding according to the following:

a. **One-step operation** - Apply materials in one step only for the following situations:

- When seeding in conjunction with erosion control matting. Apply seed, fertilizer, and tracer before installing matting.
- When treating small areas according to 01030.48(e). Double the amount of seed to compensate for seed suspended above soil by the mulch.

b. **Two-step operation** - Except for the one-step method situations in 01030.48(a)(1)(a), use the two-step method for all hydroseeding operations:

- **Step 1** - Apply seed, fertilizer, and tracer. The seed and fertilizer may be applied separately or together. If hydromulch is used as tracer, apply it at a rate of 500 pound per acre.
- **Step 2** - Apply mulch and tackifier. Hydromulch, if used as a tracer in Step 1, will be included as part of the specified hydromulch rate specified in 01030.48(a)(3)

(2) **Seed** - Thoroughly mix seeds when more than one kind is to be used.

(3) **Mulch** - Apply hydromulch at the following rates based on dry fiber weight:

a. **Slopes Flatter Than 1V:2H** - Apply cellulose fiber that includes a tackifier at a rate of 2,000 pounds per acre.

b. **Slopes 1V:2H or Steeper** - Apply cellulose fiber that includes a tackifier at a rate of 3,000 pounds per acre.

(4) **Tackifier for Cellulose Fiber Applications** - Use one of the following:

a. **Liquid Stabilizer Emulsions** - Dilute the emulsion with water at a rate of one part emulsion to 30 parts water. Apply the diluted mixture at a rate of 865 gallons per acre unless the manufacturer recommends a greater rate of application.

b. **Dry Powder Tackifier** - Apply at the following rates unless the manufacturer recommends a greater rate of application:



- **Slopes Flatter Than 1V:2H** - 60 pounds per acre mixed with hydromulch fibers at the rate specified.
- **Slopes of 1V:2H or Steeper** - 100 pounds per acre mixed with hydromulch fibers at the rate specified.

(b) Seeding, Fertilizing, Dry Mulching, and Tacking - Apply seed and fertilizer separately or together as the first step. Apply dry mulch as the second step. Tackify the mulch as the third step.

(1) Seed and Fertilizer - Apply seed and fertilizer at the specified rates. When fertilizer and seed are to be applied in dry condition, apply them separately. When applied from separate compartments, the application may be done in one operation. Apply seed and fertilizer by one of the following methods:

- a. Blower** - Blower equipment using air pressure and an adjustable spout that uniformly applies dry fertilizer and dry seed in separate and successive applications at constant measured rates.
- b. Helicopter** - Helicopter equipped with hoppers and adjustable disseminating mechanisms that separately and successively apply fertilizer and seed in uniform and prescribed quantities.
- c. Mechanical Spreaders** - Hand or machine operated mechanical spreaders that uniformly apply dry fertilizer and dry seed separately and successively in the prescribed quantities.
- d. Hydroseeding** - Uniformly apply at the rate specified. Add 500 pounds per acre of hydromulch fiber to the seed and fertilizer mixture to visibly aid uniform application at the Contractor's expense.

(2) Dry Mulch - Evenly apply straw mulch material according to these Specifications within 24 hours after seeding and fertilizing. In areas not accessible to heavy equipment or hose, mulch by hand or by other approved methods.

Place straw mulch approximately 2 inches deep, in loose condition, which requires roughly 2 1/2 tons per acre of dry mulch, depending on moisture content. Do not use straw mulch on slopes of 1V:1.5H or steeper.

(3) Tacking - Anchor mulch using one of the following methods:

- a. Dry Powder Tackifier** - Unless the manufacturer recommends a greater rate, apply dry powder tackifier at the rate of 80 pounds per acre mixed with 800 pounds per acre of hydromulch.
- b. Mechanical Crimping** - Mechanically incorporate the straw into the top 2 inches of the soil forming uniform erosion control surface cover.

c. Crimping Disc - A heavy disk with flat scalloped discs approximately 6 1/4 inch thick, having dull edges and spaced no more than 9 inches apart.

d. Sheep's-Foot Roller - Modified sheep's foot roller equipped with straight studs, made of approximately 3/4 inch steel plate, placed approximately 8 inches apart and staggered. Ensure that the studs are not less than 6 inches long, nor more than 6 inches wide, and are rounded to prevent withdrawing the straw from the soil. Use a roller with enough weight to incorporate the straw sufficiently into the soil providing a uniform surface cover.

(c) Drill Seeder - Apply seed and fertilizer with a grass seed drill that works fertilizer into the soil and places seed under about a 1/4 inch soil cover.

(d) Seeding Over Mulched Areas - If an area has been previously mulched for erosion control or temporary seed and mulch is present on the soil surface, double the pound rate for each seed type used. Apply seed and fertilizer hydraulically and add a green dye to the mixture to visibly aid uniform application. Upon approval, fertilizer and seed may only be applied after mulching if one of the following conditions apply:

- Mulch is punched into the soil by mechanized means.
- It is necessary to hold down mulch with netting or like material.
- The slope is 1V:1.5H or steeper and a slurry mixture would tend to run down the slope.
- Mulch is removed prior to seeding.

(e) Optional Temporary or Permanent Seeding - Upon approval, the following may be used to stabilize disturbed areas that are 1,500 square feet or less and totaling no more than 0.5 acre:

(1) Seed - Seed the disturbed area with the seed mix at the rate of 2 pounds per 1,000 square feet. Seed may be spread by mechanical spreader according to 01030.48 (b)(1)(c).

(2) Cover - Cover seeded areas with one of the following:

- Straw mulch at a rate of 100 pounds per 1,000 square feet. Spread the mulch uniformly and apply commercial tackifier or netting to hold in place.
- Bark mulch spread uniformly at an approximate depth of 1/2 inch. Use well-decomposed mulch for seed mulching.
- Suitable open-weave, biodegradable erosion control matting installed according to manufacturer's instructions.
- Hydromulch applied in one step according to 01030.48(a).

(3) Fertilizer - Fertilize according to 01030.44.

01030.49 Work Quality:

(a) Drift - Prevent drift and displacement of seed and fertilizer regardless of equipment and methods used. Use protective covering on structures and objects where coverage and stains would be objectionable and when tacking agents are used with mulch. Protect vehicles and people from drifting spray. If equipment and methods of application result in wasting material, make corrections to prevent waste.

(b) Displacement - Prevent seed, fertilizer, and mulch from falling or drifting onto areas occupied by rock base, rock shoulders, plant beds, or other areas where grass is detrimental. Remove material that falls on plants, roadways, gravel shoulders, structures, and other surfaces where material is not specified.

(c) Damage - Prevent damage to prepared areas and to completed fertilizer, seed, and mulch work. Replace all material that becomes displaced before acceptance of the work.

Maintenance

01030.60 General - Ensure that each seeded area has a uniform, healthy and weed-free stand of grass or other seeded plants growing at the end of the establishment period. The minimum living plant coverage standards for acceptance of seeding in a planted area are as follows:

- **Temporary Seeding** - 70% coverage of ground surface.
- **Permanent Seeding** - 90% coverage of ground surface.
- **Wildflower and Wetland Seeding** - 70% coverage of ground surface.
- **Water Quality and Lawn Seeding** - 100% of ground surface.
- **Woody or Other Plant Seeding** - See Special Provisions for minimum living plant coverage.

01030.61 Establishment Period - The seeding establishment period is as follows:

(a) Erosion Control Seeding - For temporary and permanent seeding done solely for erosion control, the establishment period begins upon acceptance of the initial seeding work and ends upon satisfactory plant growth and coverage of the seeded areas according to 01030.42 and 01030.60.

(b) All Other Seeding - Establishment periods for wildflower, plant, water quality, lawn, wetland, and permanent seeding begins upon acceptance of the initial seeding work and ends as follows:

- The seeding establishment period will end 45 days after the beginning of the establishment period, if the area was seeded during the seeding season and all establishment responsibilities have been met

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- If the original seeding construction is completed and accepted outside the permanent seeding dates, the establishment period will end 45 calendar days after any necessary reseeding is completed and accepted during the following seeding season

01030.62 Establishment Work:

(a) Erosion Control Seeding - Select and provide establishment work for erosion control seeding from 01030.62(b) necessary to provide performance described in 01030.60.

(b) All Other Seeding - Ensure the establishment of wildflower, lawn, plant, water quality, wetland, native plant, and permanent seeding by the following:

(1) Protection - Protect seeded areas from trespass and other hazards of damage. Use protective fences and signs at no additional cost to the City. Obtain approval of any protective methods used.

(2) Fertilizing and Watering - Apply fertilizer according to 01030.44. Apply water according to good horticultural practice under the prevailing conditions, as required to promote a healthy stand of plants. Obtain water at no additional cost to the City.

(3) Weed Control - Remove Specified Weeds prior to plants going to seed and keep WMAs and seeded areas "Weed Free" throughout the establishment period.

(4) Mowing - Mowing is required for lawn seeding and water quality seeding. Do the first mowing of grass when soil is firm enough to prevent rutting and grass is about 3 inches tall. After mowing, leave grass that is approximately 2 inches tall. At each subsequent mowing, leave about 1 1/2 inches of growth. After the second mowing, grass clippings may be left in place upon written approval. The approval may be granted if:

- Mowing is done with a mulching blade.
- There are no weed seeds in the mulch.
- Mulch is not detrimental to the growth of grass.

(5) Repair and Restore - Repair and restore soil grades and re-seed any damaged, settled, or unproductive areas to the specified conditions of this Section at no additional cost to the City.

Finishing and Clean Up

01030.70 Cleanup - Remove weeds, trash, debris, stones, and all other extraneous matter from seeded areas as directed and dispose of according to 00290.20.

01030.71 Waste Disposal - Protective coverings used on structures and all waste materials associated with seeding, fertilizing, mulching, and associated activities become the property of the Contractor at the point of origin. Dispose of these waste materials according to 00290.20.

Measurement

01030.80 Measurement - The quantities of seeding and associated work performed under this Section will be measured according to the following:

- **Unit Basis** - Unit basis items will be measured by actual count.
- **Area Basis** - Area basis items will be measured on the ground surface.

Payment

01030.90 Payment - The accepted quantities of seeding and associated work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Weed Control	Acre
(b) Seeding Mobilization	Each
(c) Temporary Seeding, _____	Acre
(d) Permanent Seeding, _____	Acre
(e) Wetland Seeding, _____	Acre
(f) Water Quality Seeding, _____	Acre
(g) Plant Seeding, _____,	Acre
(h) Native Plant Seeding _____	Acre
(i) Wildflower Seeding, _____	Acre
(j) Lawn Seeding	Acre or Square Yard
(k) Fertilizing	Acre
(l) Mulching	Acre

Item (a) includes all work associated with the WCWP.

Item (b) includes all labor and transportation of materials and equipment, each time the Contractor mobilizes as required for all hydraulically or airborne applied seeding, fertilizing, and mulching.

Items (c) through (j) include preparing the seed bed, soil preparation, seeding, fertilizing, mulching, applying tacking agent, and all establishment work.

When temporary seeding, applied according to 01030.43(a), is later accepted as permanent seeding according to 01030.43(b), payment will be made only one time under the permanent seeding pay item. No separate payment will be made for the initial seeding.

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Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for:

- mobilization for application by blowers, mechanical spreaders, or hand spreading
- inspections or maintenance
- seeding mobilization if it is not included in the Contract Schedule of Items

The amount paid for permanent seeding items will be as follows:

- At completion of seeding 70%
- At completion of the establishment period 30%



Section 01040 - Planting

Description

01040.00 Scope - This work consists of planting and associated work as shown or directed.

01040.02 Definitions:

Arborist - A specialist in the care and maintenance of trees.

Caliper - The diameter of a tree measured at a point 6 inches above the ground. If the measurement is over 4 inches, a new measurement is taken at a point 12 inches above the ground.

Certified Arborist - An Arborist certified by the International Society of Arboriculture (ISA).

Consulting Arborist - An Arborist registered with the American Society of Consulting Arborists (ASCA).

Dripline - The area directly under the branch and leaf canopy of trees and large shrubs. This area typically contains the most important of a plant's roots and is sometimes used as an approximate guide to estimate a root protection zone.

Licensed Nursery - Commercial nursery licensed by the Oregon Department of Agriculture to operate as a grower, dealer or agent, or to transport or store nursery stock grown or held for sale.

| **Native Plant (existing)** - See 01030.02 for native plant definition.

| **Noxious Weed** - See 01030.02 for noxious weed definition.

Ornamental Plant - A desirable plant species that is not native, or a plant propagated in such a way that it does not carry genetic characteristics of the species that are native to the area where it is planted.

| **Permanent Wilting Point** - The level of soil wetness at which a plant wilts and can no longer recover its sustainable turgidity when placed in a saturated atmosphere for 12 hours.

| **Plant Establishment Period** - A period of time, that is part of the planting work, that ensures satisfactory growth and establishment of plants.

Root Protection Zone - A generally circular area around an existing plant to be protected from disturbance or compaction by the use of temporary fencing or other means. The zone as actually staked may exceed the current root area to allow for future growth of the plant. Root Protection Zones will be shown on the plans or staked before construction activities begin.

| **Weed** - See 01030.02 for weed definition.

01040.03 General - Ensure that work meets the following requirements:

(a) Existing Vegetation - Do not disturb existing desirable vegetation that is to remain or is designated for protection, unless approved by the City prior to construction.

(b) Pesticide Applicators License and Chemical Registration - Furnish evidence to the City that each applicator is licensed for the specific class of chemical being applied. Also, furnish evidence that any chemical is registered for the proposed use by the Oregon Department of Agriculture according to ORS Chapters 452, 561, 570, and 634.

(c) Weather Conditions - Planting work will not be allowed during the following conditions, unless otherwise approved:

- **Cold weather** - When air or ground temperatures are expected to be below 32 °F.
- **Hot weather** - When air or ground temperatures are expected to be above 88 °F.
- **Wet weather** - When the ground reaches saturation, except as approved when planting wetland plants.
- **Windy weather** - When wind velocity exceeds 25 mph.

(d) Work Performed During Unacceptable Conditions - If any work occurs during unacceptable weather conditions, the Contractor may be required to provide the following services at no additional cost to the City:

(1) Expert Consultation - Consultation with a certified Arborist (for trees) or other expert as approved (for other plants) to determine what plant care measures are required to maintain the plants installed during the unacceptable weather conditions in a healthy and vigorous condition.

(2) Replacement - Replacement of all work performed during unacceptable weather conditions.

(3) Watering and Maintenance - Watering and maintenance of all plant materials installed during the unacceptable weather conditions and responsibility for all extra costs incurred.

01040.04 Coordination - Coordinate the following elements with the City prior to construction:

(a) Planting Work Plan (PWP) - Within 90 calendar days of award of the Contract, submit a PWP for approval. Include or describe the proposed methods for the following:

- Work progress schedule according to 00180.41
- Material submittals according to 01040.10
- Contract Growing Plan according to 01040.19(g)
- Topsoil or Wetland Topsoil approvals according to 01040.14
- Plant installation and establishment
- Weed Control Work Plan (WCWP) according to 01030.42(a)
- Emergency contact person, including the name, telephone and pager numbers, and voice mail or email address information

The following are included as part of the PWP, but are required only before the related planting work begins:

- Soil Fertility Test and Soil Amendment Report according to 01040.13
- Soil Testing and Soil Bio-amendment Report according to 01040.13

Proceed according to the approved PWP once written approval is received from the City. If any part of the PWP become unworkable at any time during construction, notify the City, then submit a revised plan. Do not proceed with the planting work until approved by the City.

(b) Notice for Inspections - Notify the City a minimum of 24 hours prior to each required inspection.

(c) Site Conditions - Ensure that the area is properly prepared prior to the start of the planting operation.

(d) Utility Locate - Coordinate all existing utility locations according to Section 00150.

(e) Utility Use - Provide required water and electricity for planting and plant establishment at no additional cost to the City unless an approved City source is available.

(f) Verification - Verify actual ground dimensions prior to construction. Notify the City of any discrepancies before beginning work.

Materials

01040.10 General - Submit a list of Project materials for approval according to 01040.04(a) before arranging for procurement of any materials. For materials not approved, submit a list of alternate materials for approval. Materials installed without approval will be subject to removal and replacement with acceptable material at no additional cost to the City.

Substitute materials may be allowed if proof of equivalent quality, suitable product specifications, manufacturer's literature and other detailed information is furnished to the City according to 00140.70.

01040.12 Product Delivery, Storage, and Handling - Deliver manufactured products in original, unopened containers, each bearing the manufacturer's guaranteed analysis, name, trade name, and conformance with governing regulations and laws. Protect products against damage or dehydration. Remove unacceptable products as soon as possible from the Project site. If required or requested, provide any manufacturer's literature to the City.

01040.13 Soil Testing - Furnish the following kinds of soil testing and reports:

(a) Soil Fertility Test and Soil Amendment Report - Prior to planting, furnish a soil fertility analysis of existing soils performed by a certified testing lab. Prior to planting, adjust soil amendment and fertilizer applications as recommended by the soil amendment report and as approved by the City.

(1) Sampling - Take 5 samples per hectare of each soil type. Mix the 5 samples into one test sample for each soil type. Furnish soil fertility test results that provide information on available nutrient content and fertility status of the soil. Conduct sampling procedures according to the Oregon State University Extension Service handout EC 628, "How to Take a Soil Sample... and Why".

(2) Testing - The test may be performed by any qualified soils testing laboratory. A list of qualified soils testing laboratories is available from the Oregon State University Extension Service. Include testing for levels of acidity (pH), salinity, nitrates, ammonium, phosphates, potassium, calcium, magnesium, and any other tests necessary to determine appropriate fertilization and amendment needs for the type of plants being planted.

(3) Soil Amendment Report - Provide a report from the testing laboratory summarizing sampling locations and procedures with printed results, and which makes recommendations for fertilizers and soil amendments to effectively develop productive soil.

(b) Testing and Soil Bio-Amendment Report - Have soils tested prior to planting by an approved soil ecology lab. Provide information on soil foodweb structure and function, and include total and active bacterial biomass, total and active fungal biomass, protozoan numbers, nematodes, microarthropods, and mycorrhizal colonization. Adjust the kind and amount of soil conditioners, soil amendments, soil bio-amendments, and fertilizers (if any) as recommended by the soil bio-amendment report, and as approved by the City prior to construction.

(1) Sampling - Take 5 samples per acre of each soil type. Mix the 5 samples into one test sample for each soil type. Conduct sampling according to the standard procedures for soil organism assessment as recommended by the soil ecology lab.

(2) Testing - Perform the following soil ecology tests and furnish soil meeting these minimum soil organism biomass requirements:

Test	Minimum Requirements
Percent active bacterial and fungal biomass	between 5% and 25% activity
Total bacterial biomass	6×10^8 per gram of dry soil
Total fungal biomass	100 µg for grasslands 200 µg for shrubs or perennials 300 µg for forested areas
Protozoa.....	5000 per gram of soil
Beneficial nematodes.....	20 per gram of soil (No root-feeding nematodes)

Determine if anaerobic or compacted conditions are present, based on the assessment of total bacterial biomass, percent bacterial activity, and protozoan biomass.

If the soil contains biomass numbers lower than these levels, apply amendments and inoculates according to the soil ecology lab recommendations in the soil bio-amendment report in 01040.13(b)(3).

(3) Soil Bio-amendment Report - Provide a report summarizing sampling locations and procedures. Include the soil ecology lab report of the soil organism assessment and the recommendations for:

- Inoculation of missing organisms groups to the soil
- Amendment with food resources for organism groups with too low of a biomass
- Reduction of undesirable groups, or groups with the biomass too high for the optimal growth of the desired plants
- Any adjustments to the bio-amendments required for the types of plants being planted

01040.14 Topsoil - Furnish topsoil containing no substance detrimental to the growth of plants and that is free of plants designated by the Oregon Department of Agriculture as Type "A" or Type "B" weeds. Unsuitable topsoil, or topsoil placed by the Contractor without approval in areas to be planted, may be required to be replaced at no additional cost to the City.

20 days before furnishing any type of topsoil, do the following:

- Give the City notice of intent to use the source
- Provide access to the source for City inspection
- Provide one 20 pound representative soil sample of each topsoil type for testing of particle size range and organic matter by the City, unless otherwise specified
- Obtain approval of the source before excavation of topsoil begins

(a) Selected Topsoil - Furnish native topsoil from the required excavations according to 00330.10 or from other City-controlled lands. The general limits of topsoil materials will be indicated on the plans. The City will make the final determination of the areas where the most suitable materials exist. Furnish topsoil that is the fertile part of a soil profile commonly referred to as the "A" horizon, typically ranging in depth from 3 inches to 12 inches. Do not take material for topsoil from a depth greater than 12 inches below existing ground, unless approved.

Select only sources that are well-drained and, before stripping, have a healthy crop of vegetative growth. Remove and dispose of all heavy grass or other vegetation before taking materials from the source.

(b) Imported Topsoil - Furnish imported topsoil from non-City controlled lands that, when tested according to AASHTO T 88, conforms to the following limits:

Standard Sieve Analysis

Particle Size Range	Percent Retained (by Weight)
Larger than 2"	0
2" - 3/4"	0 - 5
3/4" - No. 4	0 - 20
No. 4 or less	0 - 100

Of the fraction passing the No. 4 sieve, excluding organic material, furnish topsoil that conforms to the following limits:

Hydrometer Analysis

Particle Size Range	Percent (by Weight)
No. 4 - No. 200	5 - 70 (Retained)
No. 200 - 2 µm	20 - 80 (Retained)
Less than 2 µm	5 - 30 (Passing)

In addition, furnish topsoil that analyzes at least 2% organic matter according to ASTM D 2974.

(c) Wetland topsoil - Furnish a native, naturally hydric wetland topsoil consisting of silts, clays, and organic matter in combination that is free from substances detrimental to plant growth, such as noxious weeds, undesirable plant roots, refuse, sticks, or lumps. Provide wetland topsoil that is from a wetland with an existing, well established, healthy growth of the desired wetland plants. Obtain approval of the source before excavation of wetland topsoil begins.

Excavate, at a minimum, the top 24 inch depth of existing wetland soils using standard construction equipment.

(d) Stormwater Facility Topsoil - Furnish imported topsoil for vegetated stormwater facilities conforming to the following:

(1) Standard Blend for Public and Private Facilities - Use this blend for all vegetated stormwater management facilities, except those in the right-of-way where compaction from foot traffic is a concern as specified in Section 01040.14(d)(2) "Infiltration Blend for the Right-of-Way".

a. General Composition - The material shall be any blend of loamy soil, sand, and compost that is 30-40% compost (by volume) and meets the other criteria in this specification.

b. Analysis Requirements for the Blended Material:

1. Particle Gradation - A particle gradation analysis of the blended material, including compost, shall be conducted in conformance with ASTM C117/C136 (AASHTO T11/T27). The analysis shall include the following sieve sizes: 1 inch, 3/8 inch, #4, #10, #20, #40, #60, #100, #200. The gradation of the blend shall meet the following gradation criteria.

Sieve Size	Percent Passing
1 inch	100
# 4	75 -100
# 10	40-100
# 40	15-50
# 100	5-25
# 200	5-15

The blend shall have a Coefficient of Uniformity (D60/D10) equal to or greater than 6 to ensure it is well graded (has a broad range of particle sizes). The coefficient is the ratio of two particle diameters on a grain-size distribution curve; it is the particle diameter at 60% passing divided by the particle diameter at 10% passing.

2. Acidity - The pH (Power of Hydrogen) of the blended material shall be tested and be between 6 to 8.

c. General Requirements for the Blended Material:

1. The material shall be loose and friable.
2. It shall be well mixed and homogenous.
3. It shall be free of wood pieces, plastic, and other foreign matter.
4. It shall have no visible free water.

d. Compost - The compost shall be derived from plant material and provided by a member of the US Composting Council Seal of Testing Assurance (STA) program. See www.compostingcouncil.org for a list of local providers.

The compost shall be the result of the biological degradation and transformation of plant-derived materials under conditions designed to promote aerobic decomposition. The material shall be well composted, free of viable weed seeds, and stable with regard to oxygen consumption and carbon dioxide generation. The compost shall have no visible free water and produce no dust when handled. It shall meet the following criteria, as reported by the US Composting Council STA Compost Technical Data Sheet provided by the vendor.

- 100% of the material must pass through a 1/2 inch screen.
- The pH of the material shall be between 6 and 8.
- Manufactured inert material (plastic, concrete, ceramics, metal, etc.) shall be less than 1.0% by weight.
- The organic matter content shall be between 30 and 70% (dry weight basis).
- Soluble salt content shall be less than 6.0 mmhos/cm.
- Maturity Indicator shall be greater than 80% for Germination and Vigor.
- Stability shall be 'Stable' to 'Very Stable'.
- Carbon/Nitrogen (C/N) ratio shall be less than 25:1.
- Trace metals test result = "Pass."

e. Submittals - At least 14 working days in advance of construction, submit the following:

1. Documentation for the two analyses described in section 01040.14(d)(1)(b) of this specification (particle gradation with calculated coefficient of uniformity; and pH) shall be performed by an accredited laboratory with certification maintained current. The date of the analyses shall be no more than 90 calendar days prior to the date of the submittal. The report shall include the following information:
 - Name and address of the laboratory.
 - Phone contact and e-mail address for the laboratory.
 - Test data, including the date and name of the test procedure.

2. A compost technical data sheet from the compost vendor. The analysis and report must conform to the sampling and reporting requirements of the US Composting Council Seal of Testing Assurance (STA) program. The analysis shall be performed and reported by an approved independent STA program laboratory and be no more than 90 calendar days prior to the date of the submittal.

3. Two 5-gallon buckets of the blended material.

4. A description of the location, equipment, and method proposed to mix the material.

f. **Stormwater Facility Topsoil Installation** - See 01040.43(c).

(2) **Infiltration Blend for the Right-of-Way** - Use this blend for facilities in the right-of-way where compaction from foot traffic is a concern. Approval is required.

a. **General Composition** - The material shall be a mix of sand and compost, blended by volume consisting of 60-70% sand and 30-40% compost (by volume).

b. **Analysis Requirements** - The requirements are the same as those specified in section 01040.14(d)(1)b for the "Standard Blend for Public and Private Facilities." The single difference is the particle gradation criteria, which are as follows.

Sieve Size	Percent Passing
1 inch	100
# 4	60-100
# 10	40-100
# 40	15-50
# 100	5-20
# 200	1-5

c. **General Requirements for the Blended Material** - See 01040.14(d)(1)c.

d. **Compost** - See 01040.14(d)(1)d.

e. **Submittals** - See 01040.14(d)(1)e.

f. **Stormwater Facility Topsoil Installation** - See 01040.43(e).



01040.15 Soil Conditioners - Soil conditioners are for modifying soil structure and improving soil aeration characteristics, as distinguished from plant foods, mulch, and soil organism amendments. Furnish soil conditioners free of noxious weeds, living plants and rhizomes, and substances detrimental to plant life. Submit a 15 pound sample for approval by the City prior to construction. Provide soil conditioners that are free of weed seeds, excessive salts, chemicals detrimental to plant growth, and pest organisms. Soil conditioners proposed for use are subject to testing at any time or place the City deems appropriate.

Furnish one or more of the following soil conditioners:

(a) Mushroom Compost - The used bedding material from commercial mushroom production.

(b) Composted Yard Debris - Commercially manufactured material, made from dead plant material such as grass clippings, weeds, green and dead dry leaves, garden and vegetable material, and ground branches of trees and shrubs. Furnish a product that is composted under controlled aerobic decomposition, with the internal temperature reaching 135 °F for 15 days, without exceeding 155 °F. Ensure that it contains a maximum of 10% bacteria and 10% fungus. Additional certification may be required in areas having a certification program.

(c) Peat Moss - Horticultural grade, natural peat moss in air-dry condition, free from woody substances, in bales or bags labeled for content and volume. Only peat moss used in combination with one of the above composts is acceptable.

01040.16 Soil Amendments - Soil amendments are intended to improve soil nutrition. Furnish soil amendments that are free of materials detrimental to plant life. Furnish manufacturer or supplier quality compliance certification according to 00165.35. Ensure that material testing methods meet the requirements of the Oregon Department of Agriculture appropriate to that material. Obtain approval for use before beginning work. Soil amendments may include the following:

- Lime
- Dolomite Lime
- Gypsum
- Rock, Diammonia, or other Phosphate
- Calcium or Potassium Nitrate
- Iron Sulfate

01040.17 Soil Bio-amendments - Soil bio-amendments are intended to increase beneficial soil organism numbers or soil organic nutrient content. Furnish bio-amendment products or materials that are free of substances or lifeforms detrimental to plant life and receive approval prior to use on the Project. Furnish manufacturer or supplier quality compliance certification according to 00165.35. Ensure that material testing methods meet the requirements of the Oregon Department of Agriculture appropriate to that material. The following are typical soil bio-amendments that may be identified in the soil bio-amendment report:

(a) Bacterial Food Amendments:

- Simple sugars such as brown sugar, brown syrups, or molasses
- Plant extracts of Yucca or Nettle, usually containing sap of the plant comprised of a combination of simple sugars, proteins, and carbohydrates
- Fulvic acids
- Yeast, including baker's yeast, brewer's yeast, and champagne yeast
- Kelp meal
- Rock dust

(b) Fungal Food Amendments:

- Cellulose
- Lignin
- Humic acids - brown to dark brown products (black is not acceptable)

(c) Protozoa Food Amendments:

- Bacteria
- Hay infusions - A method of growing protozoa for soil inoculation by using hay in water

(d) Nematode Food Resources - Nematodes come as four types: bacterial-feeders, fungal-feeders, root-feeders and predatory nematodes. Predatory nematodes eat other nematodes, while the name of the other groups indicate what organisms they eat.

The primary source of material containing a wide diversity of beneficial nematodes is good compost. Provide certification that the compost contains beneficial nematodes and does not contain root-feeding or other detrimental nematodes.

(e) Mycorrhizal Inoculates - Commercially produced ectomycorrhizal and endomycorrhizal fungi that improve plant root absorption of soil nutrients.

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(f) **Microbes** - Commercially produced product designed to enhance microbiological activity in the soil by the addition of beneficial and essential microbes. Commercial products may also contain vitamins, amino acids, plant growth hormones, micronutrients, and plant stress relievers.

(g) **Earthworms** - Common earthworms that are either "Red Wigglers" or "Night Crawlers" delivered in peat moss or other damp medium.

01040.18 Fertilizer - The soil amendment and bio-amendment reports will recommend fertilizer types and application rates. When identified in the report furnish commercial fertilizer meeting the requirements of 01030.14 and the following:

(a) **Organic** - Organic fertilizer 5-4-3, analyzing 5% nitrogen, 4% available phosphoric acid, and 3% soluble potash.

(b) **Plant Bags and Tablets** - Plant bags or tablets containing 20-10-5, or approved equal, may be used instead of granular fertilizer in pit planting.

Furnish plant bags or tablets that are controlled-release with a minimum 1 year release period. Chemical formulation, rates and use will be approved by the City.

01040.19 Plants:

(a) **Nomenclature** - Botanical identification and nomenclature of plant materials shall be according to the most current edition of "Hortus Third", by Bailey. The City may authorize use of other references such as the "Sunset Western Garden Book", the "Flora of the Pacific Northwest", by Hitchcock, or the "Manual of California Plants", by Jepson.

Furnish plants that conform to the applicable requirements of the current issue of the "American Standard for Nursery Stock", published by the American Association of Nurserymen. When a conflict exists between this publication and the Specifications, the Specifications will prevail.

(b) **Quality** - Provide plants that are healthy, first-class representatives of their species or variety, free from disease and insect pests, with top growth that is well developed and free of disfiguring knots, sun scalds, bark abrasions, wind or frost injury or any other objectionable features.

Furnish plants that are acclimated to the specific project environmental site conditions prior to planting. Store all container-grown and balled and burlapped (B & B) plant materials acquired for fall planting a minimum of 3 months before planting, at a location north of the 42nd Latitude (Oregon - California border).

Furnish plants that possess top growth and root systems typical to their variety. Provide trees with central leaders that have a symmetrical, well-branched, straight trunk. Trees with a damaged or missing leader, multiple leaders or Y-crotches will be rejected, as will sheared conifer trees.

Protect plants at all times during handling, shipping, storage and planting against such detrimental effects as windburn, extreme weather conditions and drying of roots, root balls and foliage.

(c) Certification - Furnish a State inspection certificate and shipping certificate for each load or lot of plant material that includes the following information:

- Date of shipment
- Name of nursery where grown
- Name of plants (Including all names as specified in the Contract)
- Number of plants
- Grade or classification of plants (Verifying conformance with the Specifications)
- Size (Including height, spread, runner length, caliper and other measurements as required)
- Identify at least one plant (botanical and common name) within each group of like species
- Identify one plant (botanical and common name) within each different size category

(d) Inspection - Plants will be subject to inspection by the City, at any time and place. The City will make no plant material inspection at the source, except as it may elect. Notify the City of each delivery of plants to the Project site no less than 24 hours ahead of delivery. Do no planting until the plants have been inspected and approved for use. Any planting done without prior approval of the plants will be considered in violation of these Specifications.

The presence of noxious weeds in the soil accompanying plants or at the nursery source will be cause for rejection of any or all plants from that source.

(e) Availability - Furnish a list of nursery sources for all specified plants within 90 calendar days after execution of the Contract. Verify, by this list, that all specified plant material has been located and will be available for use on the Project. If applicable, see 01040.19(g) for alternate requirements.

(f) Plant Substitution - No substitution of plant materials will be allowed unless written evidence is submitted that a specified plant or material cannot be obtained and has been unobtainable since the execution of the Contract. If substitution is allowed, it will be by written approval from the City for the nearest acceptable variety, size and grade. Make any request for substitution in writing to the City with ample time for approval without delaying the work.

(g) Contract Grown Plant Materials - When required by the Special Provisions, include a contract growing agreement between the Contractor and a nursery supplier in order to ensure plant availability or suitability.

If a contract growing agreement is part of the Project, submit a Contract Growing Plan that describes plant material size at delivery, growth environment, name and location of nursery, and the source for each plant (native seed, indigenous cuttings, or commercially grown). Submit this required information as part of the PWP outlined in 01040.04.

(h) Definition of Plants and Descriptive Terms - The following definitions describe the distinctive habit and characteristics of the most common plant materials:

(1) Conifer Trees - Trees with needle or scale-like leaves that maintain live-leaf foliage throughout the year, and that usually bear seed from a woody cone.

(2) Deciduous Trees - Trees with leaves that are shed at the end of the growing season, and which remain leafless throughout dormancy.

(3) Transplanted Specimen Plants - Unique or large plants typically used in low numbers on projects. See the plans for specimen type, size, and location. Deliver trees to the site that are dormant and with buds that have not yet swelled. Furnish plants that have an unbroken root ball sufficient to sustain continued growth. Ensure that the root ball size conforms to the current edition of the "American Standard for Nursery Stock". Provide plants with no broken limbs or bark abrasions, and cleanly cut off any frayed roots or damaged limbs. Deliver trees that are balled and burlapped, boxed or moved by commercial tree spade.

(4) Balled and Burlapped (B & B) Plants - Plants excavated with soil around the root system whose root ball is wrapped for shipping and handling. B & B materials are generally trees or shrubs, such as evergreens, that require a large ball of earth to sustain them after the transplant. Furnish plants that are balled and burlapped in conformance with the latest edition of the "American Standard for Nursery Stock", including minimum size of root balls.

Furnish plants with root balls securely wrapped in burlap or similar mesh fabrics not harmful to plants, and bound with removable twine or wire. Provide root balls that are firm, intact and held solidly together by a fibrous root system consisting of only the earth in which the plant was growing. "Made" balls will be rejected.

(5) Collected Plants - Plant material that is harvested from existing on- or off-site plant populations. Furnish collected plants that conform to all appropriate quality, grade and class requirements of the current issue of the "American Standard for Nursery Stock".

(6) Container Grown Plants - Plants that are grown and delivered in containers which possess well-formed top growth and whose root growth is typical to the variety.

Furnish plants that are resident in their delivery containers long enough to have established new fibrous roots, have a root mass that will retain its shape, and hold 90% (visual estimate) of the root ball material when removed from their containers. Some root growth should be visible along the outer edges of the container. Root-bound container grown plants and "made" container plants will be rejected.

(7) Seedling Trees - Plants that are grown from seed in a nursery and brought to the site in a bare root condition. Provide seedlings labeled with age and certification (class number) which shows the number of seasons grown in a nursery seedbed, followed by the number of seasons grown in a transplant bed. Furnish seedling trees that are a minimum 2 years old.

Furnish seedling trees that are Oregon Department of Forestry "zoned" (grown) within approximately 500 vertical feet of the Project site elevation. Submit seedling zone information for the proposed plants to the City prior to construction.

(8) Bare-root Plants - Small deciduous plant material that is excavated for transplant with exposed roots. Furnish only bare-root plant materials that have dormant buds at the time of planting. Take great care to protect bare-root plants against dehydration and sunburn.

(9) Plant Cuttings - Living, freshly cut branches from certain woody shrub or tree species that readily propagate when embedded in damp soil. Furnish plant cuttings of regionally native species and dimensions as shown on the plans. Obtain written approval of the cutting stock sources before taking any cuttings and furnish a brief, written description of the cutting site(s) and the date and time the cuttings were taken to the City. Take cuttings in such a manner so as to leave no long-term damage to the source population. If willow species are called for, select the local native shrub variety.

(10) Fascine - Bound, cylindrical bundles of live plant cuttings that are placed in shallow trenches, partially covered with soil, and staked in place, typically used to stabilize stream banks against erosion. Furnish only fascines of regionally native materials having the dimensions shown on the plans.

(11) Brush Mattress - A combination of plant cuttings and fascines installed to cover and protect stream banks and shorelines. Brush mattress dimensions and any material requirements will be shown on the plans.

(12) Tubeling Plants - Plants grown in containers that encourage deep root growth.

(13) Vines - Plants with growth primarily along stems, often having climbing characteristics, and typically attaching to walls by tendrils or other means.

(14) Groundcovers - Low growing or spreading plants.

(15) Wetland Plants - Plants that meet the definition of hydrophyte, which is any macrophyte that grows in water, or on a substrate, that is at least periodically deficient in oxygen as a result of excessive water content.

(16) Bulbs - For the purposes of this section, these will typically include the forms known as bulbs, corms, culms, plantlets, rhizomes, runners, small offsets, stolons and tubers. These plants will be collectively referred to as "Bulbs". The appropriate propagule (plant part that can be separated and used to grow another plant) will vary depending on the plant species.

(17) Sod Lawn - Grass sod grown on agricultural land that is commercially cultivated specifically for turf sod. Furnish sod that is free of weeds, diseases, harmful nematodes and insects. Provide sod that is mature, not less than 10 months old, and machine cut to a uniform thickness of 5/8 inch or more, excluding top growth and thatch. Broken pieces and torn or uneven ends will not be accepted. Plant sod within 36 hours of harvest.

01040.20 Mulch - Furnish plant bed mulch materials free of noxious weed seeds or plants and which contain no substance detrimental to plant life. Mulches are subject to inspection at any time and place at the discretion of the City. The following are some types of materials that fall under the category of "mulch", and may be used on projects:

(a) Bark Mulch - Ground, shredded or broken particles from the bark of fir, pine or hemlock trees which is free of non-bark debris, harmful bacteria, disease spores, pests and substances toxic to plant growth. Provide mulch that is the standard trade size known as "medium fine mulch".

(b) Cinder Mulch - Crushed lava cinders, screened to an approximate size between 3/16 inch to 5/8 inch. Furnish cinders free of fines and other non-cinder material.

(c) Straw Mulch - Provide straw mulch according to 01030.15.

(d) Environmental Zone Grass Straw Mulch - If shown in the Special Provisions, use grass straw mulch from native species. Submit documentation showing seed lab test for species type and certify that no Type "A" or "B" weed seeds are present in the straw.

(e) Rock Mulch - Round 3/8" - No. 4 pea gravel or round 2" - 3/8" rock. Provide material that is free of fines and other non-gravel material. Rock colors may vary.

(f) Wood Chip Mulch - Mulch that is chipped from cleared site vegetation. Ensure that chipped material is free of any noxious weeds or invasive vegetation. Allowable size range or other qualities may be listed in the Special Provisions.

01040.21 Herbicides - The use of herbicide chemicals will be permitted only upon approval of the City. Select and apply chemical herbicides according to all applicable Federal, State and local laws, as well as the Weed Control Plan requirements of the PWP outlined in 01040.04. The following are standard herbicide functional categories:

(a) **Soil Sterilant** - Chemical herbicide that is used to kill all new emergent vegetation, often including seeds or other plant parts.

(b) **Pre-emergent** - Chemical herbicide that is used to stop the germination of seeds before they grow above the soil level.

(c) **Post-emergent** - Chemical herbicide that is used to selectively or non-selectively kill vegetation after germination and emergence above ground.

01040.22 Water- When required by the Special Provisions, furnish the following:

(a) **Pressure Moisture Stress (PMS) Instrument** - A pressure chamber instrument capable of applying up to 40 Bars or 600 psi to a small leaf or shoot in order to determine its water potential. Instrument is to include all accessories necessary to perform a plant moisture stress test.

(b) **Timed-Release Water** - Containerized moisture retention chemical in the form of a solid gel that is delivered in biodegradable cartons. Typical ingredients are 97.85% water, 2% cellulose and 0.15% aluminum sulfate.

(c) **Moisture Retention Chemicals** - Granular chemical that are typically cross-linked potassium based polyacrylate or polyacrylamide copolymers. Provide commercial quality product from the CPL.

01040.23 Miscellaneous Items - Furnish miscellaneous items meeting the following requirements or provide commercial-quality products from the CPL. Obtain approval from the City prior to use.

(a) **Anti-transpirant** - Apply liquid anti-transpirant spray to all appropriate deliverable plant materials, prior to transport.

(b) **Boulders** - Furnish boulders of indigenous materials, with source, dimensions, and other characteristics as shown.

(c) **Browsing Protectors** - Flexible, semi-rigid plastic or metal mesh, brown or light green in color, with stake supports.

(d) **Game Repellent** - A commercial nontoxic spray that makes vegetation unpalatable for animal forage.

(e) **Root Barrier** - A root barrier designed to contain and control root intrusion into unwanted areas.

01040.40

(f) Tree Grates - Tree grates complete with frames, all required attachment hardware, and at least one issue of any specialty key or tool that is required to open or move the item for maintenance.

(g) Tree Stakes and Ties - Rough sawn tree stakes of 1 1/2 inch x 1 1/2 inch douglas fir or pine, construction grade or better. Use stakes 6 foot long for trees less than 8 feet tall, and stakes 8 foot long for trees 8 feet or taller. Stain all tree stakes with an approved, dark green penetrating oil stain. Provide tree trunk protection of guying material of either a commercially available tree tie or a section of garden hose. Furnish tree guying material of a commercial product manufactured for this use, such as plastic chain, or stainless steel woven-wire with clamp fasteners. Size the guying material appropriate to the size of the tree and the wind factors of the area.

(h) Trunk Wrap - Typically manufactured of waterproof, crinkled paper and is designed to protect tree trunks against sunscald, loss of moisture and insect attack.

(i) Weed Control Geotextile - Weed control geotextile is typically manufactured of permeable, fibrous synthetic material and is generally for use under material such as mulch or gravel.

(j) Woody Course Debris - Logs or root-wads salvaged from on-site deciduous tree clearing and grubbing activity.

Construction

01040.40 General - Planting areas and plant locations shown on the plans are approximate unless shown with dimensions. Be responsible for layout and staking for plant placement, subject to approval by the City before planting. The City will make only field measurements necessary to calculate and verify quantities for payment.

Adjust tree locations to avoid possible conflicts with vehicle recovery clear zones, utilities, structures, miscellaneous appurtenances, and signing, as directed. In mowable grass areas, locate trees at least 10 feet from the edge of plant beds, other trees, fences, and ditch bottoms, unless otherwise specified.

01040.41 Planting Season - Perform all plant installation work from September 1 to May 15, unless otherwise specified. Container-grown materials located within irrigated areas may be planted at other times, depending upon written City approval.

Do not place lawn sod before March 15 or after September 30 without written City approval.

01040.43 Topsoil:

(a) Excavation - Prevent fouling of suitable material with subsoil or other detrimental matter. Form stockpiled soil into windrows at least 6 feet high, not to exceed 13 feet high, to maintain and preserve soil organism vitality.

(b) Subsoil Preparation - Grade and finish areas that are to receive topsoil, allowing for the specified amounts of topsoil. Scarify or till subsoil that is not loose and friable to a depth of 6 inches and obtain approval from the City before placing topsoil.

(c) Hauling and Spreading - Haul and spread material without compacting the topsoil or areas where it is placed. Protect from damage any surrounding objects, pavement, structures and areas that must be traveled, crossed or mounted by equipment.

Smoothly spread the topsoil over the specified areas to the thickness, grades, and slopes shown or directed. Avoid wasting topsoil and do not place material during wet conditions. Do not work saturated soils in any manner. Material placed contrary to City instructions or in undesignated places will not be paid for and removal may be required at the discretion of the City.

(d) Finishing and Cleaning Up - Finish areas covered with topsoil to proper grade, contour and cross section. Cultivate all topsoil not in a loose and friable condition to a depth of at least 4 inches. Bring the surface to a condition ready for planting operations.

(e) Stormwater Facility Topsoil Installation:

(1) Protection of the Topsoil - The material shall be protected from all sources of contamination, including weed seeds, while at the supplier, in conveyance, and at the project site.

(2) Placement of the Topsoil - The material shall be placed in loose lifts, not to exceed 8 inches each and each lift shall be compacted with a water-filled landscape roller. The material shall not otherwise be mechanically compacted.

(3) Timing of Plant Installation - Weather permitting and as approved, plants shall be installed as soon as possible after placing and grading the topsoil in order to minimize erosion and further compaction.

(4) Erosion Control - Temporary erosion control measures are required until permanent stabilization measures are functional.

(5) Protection of the Installed Topsoil - In all cases, the installed material must be protected from foot or equipment traffic and surface water runoff. Temporary fencing or walkways should be installed as needed to keep workers, pedestrians, and equipment out of the area. Under no circumstances should materials and equipment be stored on top of the installation area.

(6) Wet and Winter Conditions - Placement of the topsoil will not be allowed when the ground is frozen or saturated or when the weather is too wet as determined by the Owners Representative.

01040.44 Select Wetland Topsoil:

(a) Excavation - Stage construction so that excavated soils may be moved directly to the wetland mitigation location. If that is not possible, stockpile the material for not more than 28 days. Water stockpiled material twice weekly and keep moist until used. Form stockpiled soil into windrows at least 6 feet high, not to exceed 13 feet high, to maintain and preserve soil organism vitality.

(b) Subsoil Preparation - Excavate or grade areas to receive selected wetland topsoil as shown and finish as smooth as practicable through one pass of standard construction equipment. Have subsoil preparation inspected and approved by the City prior to spreading the selected wetland topsoil.

(c) Hauling and Spreading - Transport select wetland topsoil to the site by any means which meets all applicable regulations related to hauling potentially wet or moist materials. Spread the topsoil to a depth of 6 inches minimum to 24 inches maximum, or to meet the finished elevations as indicated. Make as smooth as practicable without excessive soil compaction. After spreading, have the area inspected and approved by the City prior to planting.

01040.45 Soil Amendments - Incorporate soil amendments into the topsoil when required by the soil fertility test and soil amendment report. The application rate will be verified by checking settings on the spreading or application equipment.

01040.46 Soil Bio-Amendments - Incorporate the following soil bio-amendments into the topsoil of areas to be planted, according to the recommendations of the soil bio-amendment report, the supplier, or the following:

- Bacterial Food Amendments
- Fungal Food Amendments
- Protozoa Food Amendments
- Nematode Food Amendments
- Microbes and Biostimulants
- Earthworms - Add 9 worms per cubic yard of topsoil (this roughly equates to 3 worms per surface) 10 square feet of topsoil at 12 inches depth.
- Mycorrhizal inoculation - Incorporate into the planting hole quantities of mycorrhizia sufficient to correct the soil for the type of plants or grasses being grown.
- Mycorrhizal Inoculation (Injection) - Provide pre-measured packets containing live endo-mycorrhizal and ecto-mycorrhizal fungi.
- Mycorrhizal Inoculation (Root Dip) - Apply root dip material containing live endo- and ecto-mycorrhizal fungi.

The application rate will be verified by visual inspection of application rates. A one-time application should be adequate, as long as pesticides, fertilizers or other toxic materials are not used at the same time. If it becomes necessary to apply pesticides that have non-target organism effects, or to apply fertilizer at rates greater than 13 pounds per acre, re-inoculate the organisms about one month after the pesticide or fertilizer was applied.

01040.47 Fertilizers - Incorporate fertilizer based upon recommendations of the soil amendment and soil bio-amendment reports or, with City approval, at the type and rate as follows:

Plant Bags/Tablets

Plant	Rate	Size
Tree	3 per tree	3/4 ounce
Shrub	2 per shrub	3/4 ounce
Vine/Ground Cover	1 per plant	3/16 ounce

Granular Fertilizer Rate

- 1 pound per tree per application
- 1/2 pound per shrub per application
- 1/8 pound per vine/ground cover per application

Evenly space planting bags or tablets around plants after planting pits are 2/3 filled with backfill. Mix granular fertilizer into the upper 1/2 of plant backfill.

The application rate will be verified by visual inspection. Furnish manufacturer or supplier quality compliance certification according to 00165.35. Ensure that material testing methods meet the requirements of the Oregon Department of Agriculture appropriate to that material.

Do not allow the fertilizer application to conflict with the soil bio-amendments. In case of questions, provide the soil bio-amendment supplier's written recommendations to the City.

01040.48 Planting Area Preparation - All planting areas are to be Weed Free before planting or seeding operations begin. Identify, kill, and remove plants according to 01030.62(b)(3).

Prepare planting areas according to the following methods, or as otherwise specified:

(a) Method "A" (Cultivated Planting Areas, Non-lawn) - Cultivate plant beds to a depth of 2 inches. Thoroughly mix 2 inches of soil conditioners into the top 12 inches of plant beds. In addition, add soil amendments, soil bio-amendments and fertilizers, as shown or specified, according to the soil amendment and soil bio-amendment reports recommendations, into the top 12 inches of topsoil.



Finish grades by raking to a grade tolerance of plus or minus 1 inch, with a smooth and firm condition, and an even grade that is free of undulations or low areas that could create standing water. Match existing grades at the perimeter. Finish to the proposed grades shown or specified.

On slopes that the City determines are too steep to cultivate, plants may be planted in individual planting holes prepared using method "B".

(b) Method "B" (Non-Cultivated Planting Areas) - Spray existing weeds and non-desirable vegetation with herbicide to kill all top growth and roots in areas not requiring cultivation. Use herbicides that have limited residual toxicity to permit safe planting as required under the Contract. Do not spray or otherwise harm plants to be saved. After inspection and approval, remove the dead top growth of plant material within 2 inches of the surface and dispose of according to Section 00320. Replace plants to be saved that are damaged by herbicide application at no additional cost to the City.

Add any soil conditioners, soil amendments, soil bio-amendments or fertilizers with the backfill at each plant pit or to the seeding operation.

Finish wetland mitigation planting areas to specified finish elevations, blending to existing ground smoothly, as required and directed. Except for projects that are less than one year in duration and unless otherwise approved, review the seasonal hydrology of the area to be planted for one full winter season (November 15 to February 28) prior to planting any wetland plants. Adjust plant types and planting locations as required or directed, based on the review of site hydrology.

When planting seedling plants, completely scalp vegetation from a 12 inch diameter area around each planting hole. Clear all debris such as wood and rocks from the planting spots, provided debris is not deeper than 12 inches. When debris is deeper, move the planting location. Use herbicides around seedlings only upon written approval of the City.

(c) Method "C" (Sod Lawn and Seeded Lawn Areas) - Cultivate existing ground to a depth of 6 inches, achieving a loose and friable condition suitable for fine grading. Remove all vegetation, rocks larger than 2 inch diameter, clods, roots, sticks, debris, and other matter detrimental to the growth of sod.

Uniformly spread soil conditioners, soil amendments, soil bio-amendments, and fertilizer evenly over the area and thoroughly rototill into the soil to a depth of 4 inches. Apply at rates recommended by soil testing, or as follows:

Material	Rate (per 100 square yards)
Soil conditioner	1/2 cubic yard
Fertilizer	10 pounds
Lime (Western Oregon Only)	40 pounds

Fine-grade and roll planting areas with a water-filled roller to provide a fine-textured, smooth, firm surface, free of undulations, irregularities or low areas that could create standing water. Grade areas receiving sod to within 1/2 inch of the designed grades, and 1 inch below adjacent walks, curbs and pavement. Since sod thickness varies, adjust initial grades so the final sod soil level is slightly below adjacent hard surface grades. Ensure that final sod grade does not create a pedestrian tripping hazard.

Furnish the City with sod mixture information and a quality compliance certificate from the sod grower, certifying sod compliance with mixture requirements, according to 01040.10.

Prior to completion of any sodding and seeding, re-grade ruts, footprints, washouts, or any other irregularities, and re-seed or re-sod repaired areas as originally specified.

(d) Method "D" (Rough Areas Seeded for Revegetation or Erosion Control) - Remove any matter detrimental or toxic to the growth of plants, including weeds, clods, rocks or debris. On slopes 1V:3H or flatter, remove all debris larger than 2 inches in any dimension. On cut slopes 1V:1.5H or flatter, roughen the surface with furrows parallel with slope contours and loosen the soil to a depth between 3 inches and 6 inches.

(e) Method "E" (Temporary Seeding Areas) - If grading is required or directed, make equipment passes at right angles to the slope in order to form seed-holding tracks in the soil.

01040.49 General Planting - Plant trees, shrubs, groundcover, vines, and bulbs using the following practices:

- Inspect plants after arrival at the Project and before planting. Do not install plant materials until each required inspection by the City is complete. Replace plants not meeting the requirement of the Specifications with plants as specified or otherwise directed, at no additional cost to the City. Initial approval of plant materials for planting by the City will not constitute final acceptance.
- Protect all plants during shipping, handling, storage, and planting from windburn or exposure to harmful weather conditions, and root or root ball drying.
- When excavating planting holes, stockpile excavated topsoil separately from subsoil. Do not include alkali soil, subsoil, gravel, debris or rocks in the topsoil. Dispose of any substandard excavated materials in a manner not harmful to plants or planting work. Scarify planting pit sides and bottoms to eliminate glazed surfaces. Dispose of excess soil in a manner that is not harmful to plants or planting work.
- Do not plant in standing water unless approved by the City. If standing water is present within a plant pit, notify the City prior to planting to determine what corrective measures are required. Perform corrective measures on an Extra Work basis according to Section 00196.

- Excavate tree plant pits a minimum of twice the diameter of the plant root ball or 2 feet greater than the ball, whichever is larger. Dig shrub plant pits a minimum of one foot greater than diameter of root ball. Dig pits to the same depth as the root ball, root mass or container. Spread root systems of bare root plants and plant stock as necessary to keep plants from being root bound.
- Cleanly cut off broken or frayed roots of bare-root plants before planting. Spread out roots in their natural position within the pit and trim only damaged roots as approved by the City. Remove all labels, tags and attachment materials from the plants before final inspection.
- Set upright growing plants straight and plumb, and prostrate growing plants level to the ground surface. Set all plants so that, after settlement, they are at the same level as when growing in the nursery or container.
- Place the backfill then add soil amendments, soil bio-amendments, and fertilizers as recommended by the soil amendment and bio-amendment reports. Moisten backfill completely after placing to eliminate air pockets and minimize settlement of the backfill. Form a shallow 2 inch high water-holding saucer in the soil around the plant unless directed otherwise.
- Balled and burlapped plants may be placed with the root ball wrapping removed or, if all materials are untreated and fully biodegradable, left in place. If the root ball wrapping (burlap) is left around the plant, completely remove all tie wire, string or twine and fold down the burlap from the top half of the root ball.
- Perform any required pruning using good horticultural practice appropriate to the type of plant. Prune to remove all dead, damaged, crossed or rubbing twigs and branches, and to compensate for loss of roots during planting. Make cuts close to the parent stem, but not flush or through the bark "knob" at the branch joint. Do not prune terminal ends of tree leaders without approval of the City.
- Apply bark or wood chip mulch of the type and depth as shown. Correct any contamination of new mulch due to the Contractor's operations at no additional cost to the City. Feather mulch into plant material trunks, stems, canes or root collars, and leave 1 inch below the top of junction and valve boxes, curbs and pavement edges. Any mulch placed to a thickness greater than specified will be at no additional cost to the City.
- Do not disturb protected existing vegetation unless approved by the City prior to construction.
- Dig pits of street streets that have hard surfaces around them so the crown of the rootball will be 3 inches below the finish surface of the surrounding grade.
- Water deciduous trees 1 1/2 inches or larger, conifer trees over 4 feet in height, and all shrubs at a minimum frequency identified in the Special Provisions.

01040.50 Special Planting Requirements:

(a) Transplanted Specimen Plants - Use the following methods for transplanting specimen plants, unless otherwise specified:

(1) Mechanical Digging - Use a "Vermeer" type of tree spade or approved equal. Move only during the season that the tree is dormant. Treat deciduous plants with anti-transpirant prior to excavation. Confirm with the City that the size of the spade is appropriate to the size and type of tree prior to beginning work. Dig the receiving hole prior to digging the tree to be transplanted. Take care not to damage the tree bark. Refill the original hole after transplanting. Do not move Oregon White Oak (*Quercus garryana*) by this method.

(2) Hand Digging - Before digging, obtain approval from the City for the size of container or root ball to be used for each plant. Begin digging at a diameter greater than the expected size of the root ball and remove dirt toward the plant until the surface roots show. When completely dug, secure the root ball with burlap and twine, wire basket or in a wooden box. Take special care to dig deep enough so that the taproot is not cut until it is smaller than 3/8 inch. Take care not to damage the tree bark. Refill the original hole and compact the soil after transplanting.

Install perforated plastic drainpipe as shown. Add fertilizer, soil amendments or bio-amendments to backfill topsoil mixture. Stake or guy the tree as specified.

Provide one application of anti-transpirant before transplanting, and one application of Vitamin B1 growth hormone after planting to each specimen plant according to the manufacturer's recommendations.

Perform all replanting of specimen plants according to 01040.41 and 01040.42.

(b) Staking and Guying Trees - Stake and guy planted trees as shown or directed.

(c) Seedling Trees - Plant seedling trees using one of the following three methods:

- Planting hoe capable of opening a vertical hole broken out on 3 sides, with a minimum blade length of 12 inches and width of 3 inches
- Planting shovel capable of opening a vertical hole broken out on 3 sides and at least 10 inches deep
- Normal bare-root planting method

No pre-staking of planting locations will be required. The City will be present as planting begins and will approve the spacing, planting method, and areas to be planted before work can begin. Vary plant spacing in order to allow seedlings to be planted in suitable soil. During the planting process, remove one tree at a time from the planting bag or other container to prevent drying of roots.

Place the roots of each seedling in the ground so that they assume a natural arrangement and do not twist, angle, bunch together or turn up at the ends. Plant seedlings so that the root collar is at or above the ground plane by no more than 1/2 inch. During planting, tamp soil around the roots in the lower half of the hole. Then fill the hole to the surrounding soil level and firmly pack so that no air pockets remain around the roots.

Ensure that seedlings do not pull loose with a tug strong enough to detach a small group of needles or small branch ends as applicable. Place a stake at the edge of each planting pit and install browsing protection and browsing repellent.

(d) Tubeling Plants - Place the tubeling into the planting pit without breaking the root mass. Set the top of the root collar 1/2 inch above finish grade, and gently tamp soil around the plant to compact the backfill. Place a stake at the edge of the plant pit and attach a browsing protector around each plant.

(e) Collected Plants - After plants become dormant, excavate collected plants by hand, protecting the root mass against drying, freezing or breaking. If possible, plant all collected stock the same day as gathered, or transport to a local nursery for temporary storage until final planting.

If immediate planting is not possible, place collected plants in heavy paper or plastic with slightly damp peat moss or sterile potting soil. Store dormant plants at 32 °F to 37 °F until planting. Examine stored material frequently for signs of stress or disease and correct storage conditions as necessary. Plant collected plants before dormant bud development.

(f) Bulbs - Plant dormant bulbs at a depth of 1 inch to 2 inches or to the grade they grew naturally. Compact the soil firmly around the bulbs to prevent float-out and ensure good establishment. Dig holes large enough to naturally space bulbs within the planting area.

(g) Plant Cuttings - Collect and plant the cuttings while in winter dormancy, generally between October and March. Notify the City if conflicts exist with permit requirements. Store all cut material in ventilated plastic containers that allow free flow of water. Protect root systems from excessive drying at all times. Do not store plants in airtight containers.

Plant stock within 4 hours of harvest. If plants are a willow species, plant in the riparian zone on that portion of the slope where the plant stem ends will be in contact with year-round moist soil as determined by the City. Make planting holes by forcing a steel bar or similar tool into the ground about 12 inches deep. Place the cuttings into the holes and tamp soil firmly around the stems, leaving a minimum of 6 inches showing. Vary these dimensions as required for larger plant cuttings.

01040.51 Planting Wetland Plants - When planting wetland plants, do not use soil amendments, mulch, or fertilizer. Plant rhizomes, tubers and plugs within the upper 2 inches to 3 inches in exposed muddy or moist soils. When the water depth reaches or exceeds 1 inch notify the City of the potential need for adjustment to the planting.

01040.52 Placing Sod Lawn - Place sod only after approval of the City. Immediately before placing sod, water the soil bed to prevent drying of grass roots. Lay the first sod row in a straight line, then place subsequent rows parallel to and tightly against each other, staggering lateral joints. Do not stretch or overlap the sod. Tightly butt all joints. Do not use sod segments containing less than 2 square feet of surface area.

After placement, diagonally roll and thoroughly water the sod. Apply a second application of fertilizer (22-16-8) at the rate of 10 pounds per 100 square yards and thoroughly water.

01040.53 Mulch - Apply mulch according to the following:

(a) Ornamental Plant Bed Areas - Submit a 15 pound sample of bark mulch to the City for visual inspection and approval. The approved sample will be the standard of acceptability for all mulch used on the Project.

Apply bark mulch after beds are made free of weeds and debris, the surface is brought to a smooth finished grade, and all planting work, except for vines and groundcovers, is complete. Uniformly bark mulch planted areas to a nominal depth of 2 inches with bark mulch. Apply bark mulch so that it presents a smooth and even appearance as approved by the City. Raking may be required.

Keep bark mulch off plants, structures, roadways, shoulders, walks, and lawns. Uncover all plants covered by mulch material as soon as possible and leave the site in a neat, clean and finished appearance. When planting vines or groundcover, rake bark mulch away from planting pits so that the bark is not contaminated. After planting, evenly spread excess soil and rake bark mulch back into place.

Replace bark mulch that is displaced or blown away, and correct to the specified depth any bark mulch placed to a greater than specified depth, at no additional cost to the City.

Spread rock or cinder mulch to a depth of 2 inches after planting trees and shrubs.

(b) Non-Ornamental Plant Bed Areas - Apply mulch according to one of the following methods:

(1) Straw Mulch - Spread grass straw mulch to a nominal 2 inch depth and tackify, after planting of tubeling plants and seeding as required.

(2) Wood Chips - Spread wood chips to a nominal depth of 2 inches. Add 15 pounds of Ammonium Nitrate/1000SF to neutralize nitrogen loss.



01040.54 Water - Water all plants at intervals as required to maintain and promote healthy growth. Avoid excessive watering of shrub bed areas that may leach herbicide and damage adjacent lawns or desirable or protected vegetation. Repair all lawn vegetation damage at no additional cost to the City.

(a) Pressure Moisture Stress Sensor - When a pressure moisture stress sensor is specified, the City will test a 1% to 5% representative sample to ensure that the moisture stress level is below 20 bars of pressure and inform the Contractor if any material exceeds this limit. Any plant material found to have greater than 25 bars of pressure will be considered to be under extreme moisture stress. Provide sufficient water within 24 hours to bring the plant into normal range. The City will retest to determine the new representative pressure. Plant material that have 30 bars or greater will be considered to have reached its permanent wilting point. Replace all such material during the next planting period. Testing will occur at mid-day at the following times until the end of the establishment period(s):

- After plant delivery, during temporary storage, and before planting
- At 1 month intervals throughout the summer season, up to the first fall rain or snow
- At weekly intervals during extremely hot or dry summer periods
- Any time the City believes the plant material may be under stress

(b) Timed-Release Water - Apply timed-release water containers when specified. Cut the bottom from the carton, dig a hole next to the plant and place so the contents touches the root ball or root area approximately 4 inches beneath finish grade, or according to the manufacturer's directions. Fill soil back around the carton to hold it firmly in place. Apply 1 carton for seedlings and tubelings, 2 cartons for No. 1 containers, and 4 cartons for larger plant material.

Water deciduous trees 1 1/2 inches or larger and conifer trees over 4 feet in height as follows:

Time	Frequency	Gallons/Tree (Minimum)
May - June	weekly	15
July - August	weekly	20
September - October	weekly	15

Water shrubs as follows:

Time	Frequency	Gallons/Shrub
May - June	weekly	5 - 10
July - August	weekly	15 - 20
September - October	weekly	10 - 15

(c) Moisture Retention Chemicals - Utilize moisture retention chemicals according to the manufacturer's recommendation, depending upon specific application.

01040.55 Miscellaneous Items - Place or install miscellaneous items as follows:

(a) Boulders - Place boulders in locations as shown. Do not scar or break boulders with equipment. Ensure that 1/3 to 1/2 of each rock is buried beneath finish grade. Verify all rock placement with the City prior to installation.

(b) Tree Grates - Install grates, frames, and appurtenances as shown and according to the manufacturer's recommendations. Place frames flush at sidewalks and place guards plumb according to the manufactures recommendations.

(c) Weed Control Geotextile - Place weed control geotextile at finish soil grade when planting is complete but before mulch placement begins. Place weed control geotextile with a minimum 4 inch overlap between rolls, turned under edges, and attached to the ground as recommended by the manufacturer.

(d) Woody Course Debris - Place woody course debris within the stream channel, facing upstream at approximately 45° from the stream bank, or as shown or as directed. Anchor woody course debris to the stream channel bottom as shown.

(e) Anti-transpirant - Apply anti-transpirant according to the manufacturer's directions to all exposed foliage surfaces immediately before materials are delivered to the Project, or as otherwise specified. Provide certification of compliance.

(f) Game Repellent - Apply a game repellent to all exposed foliage surfaces immediately after materials are planted, or as otherwise specified. Re-apply to each plant every 120 days, or according to the manufacturer's printed instructions, until the end of the plant establishment period.

(g) Browsing Protectors - Install browsing protectors according to the manufacturer's recommendations.

(h) Root Barrier - Install root barrier according to the manufacturer's recommendation.

(i) Tree Stakes and Ties - Place tree stakes parallel with the prevailing winds and drive vertically into the ground at least 12 inches below the planting hole depth, or as shown. Do not drive stakes through the rootball.

(j) Trunk Wraps - Wrap tree trunks with the specified wrap, covering all exposed trunk between finish ground and the first whorl of tree branches.

01040.56 Cleanup During Construction - Maintain the Project in a neat, orderly condition. Remove unsightly construction materials at the end of each working shift. Clean all pavement surfaces of mud, debris, or other materials that may, in the opinion of the City, cause problems. If material is not removed, the City reserves the right to have the cleanup work performed and deduct the value of this work from the monies otherwise due the Contractor.

Plant Establishment

01040.70 General - The Contractor is responsible for the survival of all plant material until the end of a plant establishment period of 1 calendar year. The plant establishment period work will begin when all the original planting is completed. The original planting is considered complete when all the plant material has been planted to the satisfaction of the City.

Establishment period work includes removing all plants that have reached their permanent wilting point, are dead, dying, or which do not meet Specifications, and replacing them with healthy plants. All plants in place after this replacement will be recognized as the "original planting" and will be subject to the establishment specifications. Repair, restore, and replace all plantings that have been damaged by vehicles, vandalized and stolen according to 00170.80.

01040.71 Plant Care and Success Criteria - During establishment, maintain plants in a vigorous growing condition by regularly:

- Watering, and fertilizing sufficiently to promote growth
- Weeding, cultivating, pruning, and repairing
- Adjusting tree stakes and guys
- Controlling weeds before they seed according to 01040.48
- Controlling pests and noxious weeds before the reproductive cycle
- Removing dead or non-vigorous plants
- Replacing missing plants
- Re-mulching of plant bed areas

The determination of a successful plant establishment period will be made at periodic plant establishment inspections. A successful planting establishment for each inspection is defined as follows:

- All plants are surviving and have vigorous growth.
- Plants are free of insects and disease.
- Plants show signs of continuing health.
- Plants have not reached permanent wilting point.

At the discretion of the City, certain types of regularly spaced plantings such as groundcovers may be measured using an area sampling method. To determine the rate of survival, set out (delineate) representative plots measuring 100 square feet at the completion of the original planting at random locations in each general planting area. The representative plots will be mutually agreed upon between the Contractor and the City. Mark the plot corners with permanent markers such as re-bar, including date and identification. Delineate a minimum of 3 plots per acre of new planting area.

The use of representative plots is intended to simplify the measurement of planting establishment work. If work within the representative plots does not accurately reflect the condition of the entire planting area(s), the City reserves the right to reject all establishment work.

01040.72 Periodic Inspections - During each establishment period, the City will make three inspections jointly with the Contractor at the following times:

- Spring, early May
- Summer, mid July
- Fall, late September

Depending on when the establishment period begins, one of the above inspections will be the final inspection.

During each plant establishment inspection, the City may determine, based upon the specified success criteria, that supplemental corrective work is required. If so, the City will provide the Contractor with a written notice of required corrective work sent by hand-delivery or mail.

01040.73 Corrective Work - Complete all corrective work within 15 calendar days after written notification is received by the Contractor, except for such work as plant replacement during the appropriate planting season, unless otherwise specified. The 15 day requirement excludes those days the City determines to be impractical for working.

When the corrective work has been re-inspected and is completed to the satisfaction of the City, the appropriate proportional payment due the Contractor will be made.

The Contractor will be allowed to replace plants outside the Planting Season to perform corrective work after each periodic inspection

Provide plant replacements of the same variety, size and quality as specified for the original plants, unless otherwise approved.

Notify the City when the corrective work complete. When the corrective work has been re-inspected and is completed to the satisfaction of the City, the appropriate partial payment due the Contractor will be made.

01040.75

If the Contractor does not perform the corrective work within the 15 day period after written notification, excluding those days the City determines to be impractical for working, the City may have the corrective work done by others and deduct the entire cost of the corrective work from monies due or to become due the Contractor under the Contract.

01040.75 Weed Control - Provide weed control according to 01030.42.

01040.77 Plant Establishment (Ornamental Areas) - In addition to these plant establishment requirements, perform the following:

(a) Watering, Fertilizing, and Mulching - Water all plants at the required intervals using the installed permanent or temporary irrigation systems, or such means as has been established for the Project. Avoid excessive watering of shrub areas adjacent to lawns that may leach herbicide and damage the lawn. Repair damaged lawns at no additional cost to the City.

If specified for the original planting, re-fertilize plants to promote vigorous growth.

Maintain the plant bed mulch at a 2 inch depth during establishment, unless otherwise specified. Rake to a smooth and even finish grade.

Remove all timed-release water cartons that have not bio-degraded by the end of the establishment period.

Water all plants during establishment as shown in 01040.54.

(b) Trimming and Pruning - Prune in order to enhance the natural growth of plants, eliminate dead growth and crossing branches, maintain growth within available space, minimize overgrowth onto walks and walls, and minimize tree canopy damage from winds.

Prune during the dormant season unless otherwise specified. Remove and dispose of all dead and critically damaged plant material to maintain the overall appearance of the Project.

(c) Transplanted Specimen Plants - Care for transplanted specimen plants immediately after the planting work is completed. Water, fertilize, and protect specimen plants against disease and infestation as required to ensure the plants remain healthy and vigorous. Final acceptance of transplanted specimen plants will depend on plant health and condition.

(d) Seeded Lawn and Sod - Mow, cut and fertilize turf as required to maintain a healthy and vigorous condition. A schedule of feeding, mowing, and general treatment, including thatching and aeration will be listed in the Special Provisions. If directed in the Special Provisions, final acceptance of sod lawn areas may be 45 days, depending on its health and condition. Keep sod mowed to a height between 1 1/2 to 2 inches.

Do not perform the first mowing until the sod is firmly rooted and secure in place. Remove no more than 1/3 of the grass leaf during initial or subsequent cuttings.

01040.78 Plant Establishment (Mitigation or Other Non-Ornamental Areas):

(a) **Watering and Mulching** - Water all plants as necessary to promote and maintain growth using temporary irrigation methods. Keep planted areas raked to a smooth and even finish grade. Maintain mulch within plant saucers at a 2 inch depth, unless otherwise specified.

(b) **Weeding** - Perform weed control activities according to 01030.42.

(c) **Soil Testing and Corrective Soil Amendments** - If specified for the original planting, have a soil test performed by a soil ecology lab between the second and third periodic inspection. Present the recommendations to the City at the third inspection. Apply the amendments as recommended by the soil test report and as directed by the City.

01040.79 Final Inspection - After plant replacement work and any other required work has been completed, the City will make a final inspection. Ensure that all plant materials, planting beds and other facilities are according to the Specifications as a prerequisite for acceptance.

Measurement

01040.80 Measurement - The quantities of plantings and associated work performed under this Section will be measured according to the following:

(a) **Soil Testing** - Soil testing will be measured on the unit basis for each test that is completed and accepted. Soil testing includes the required sampling, testing, analyses, and reports for one or more of the following:

- Soil particle size range test
- Soil fertility test and soil amendment report (including chemical analysis, acidity, salinity)
- Soil ecology analysis and soil bio-amendment report

(b) **Topsoil and Wetland Topsoil** - Topsoil and wetland topsoil will be measured on the volume basis in the hauling vehicle or in containers delivered to the Project site.

Topsoil taken from the required excavations according to 00330.10 will be measured according to 00330.82.

(c) **Soil Conditioners** - Soil conditioners will be measured on the volume basis in the hauling vehicle or in containers delivered to the Project site.

(d) **Plant Materials** - Plant materials will be measured according to one of the following:

- **Unit Basis** - Under this method, plant materials will be measured on a unit basis.
- **Average Area Method** - This method may be used when a plant bed area is greater than or equal to 3,000 square yards and will be measured as follows:
 - The total plant bed area will be measured along the ground surface by the foot and calculated to the nearest square yard and will be measured as follows:
 - 1% to 5% of the plant bed area will be selected and staked as 30 square yard representative plots
 - All the plants in each staked representative plot will be counted. Unless otherwise approved, if the number of plants in a plot exceeds the number of required plants of the representative plot, the number of required plants will be used to represent the plot.
 - Based on the results of the plant count, the average number of plants per plot will be calculated
 - The quantities of each item will be based on the calculated average number of plants per plot multiplied by the number of plots in the total plant bed area.

(e) **Sod Lawn** - Sod lawn will be measured on an area basis on the ground surface and calculated to the nearest square yard.

(f) **Mulches** - Mulch will be measured on the volume basis in the hauling vehicle.

(g) **Miscellaneous** - Miscellaneous items will be measured as follows:

- **Tree Grates** - Tree grates will be measured on a unit basis. One grate includes two half grates, frame, hardware, tree guards and appurtenances.
- **Woody Course Debris** - Woody course debris will be measure on a unit basis.
- **Boulders** - Boulders will be measured on a unit basis on the weight basis.
- **Root Barrier** - Root barrier will be measured on the length basis.
- **Weed Control Geotextile** - Weed control geotextile will be measured on the area basis on the ground surface and calculated to the nearest square foot.

If not listed in the Schedule of Items, these items are considered Incidental to planting and no separate measurement will be made.

Payment

01040.90 Payment - The accepted qualities of plantings and associated work performed under this Section will be paid for according to the following:

(a) Soil Testing - Soil tests will be paid for at the Contract unit price, per each, for the item "Soil Testing".

Payment includes mobilization, soil sampling, testing, analyses, and preparation of the soil amendment and bio-amendment reports.

(b) Topsoil and Wetland Topsoil - Topsoil not taken from required excavations, will be paid for at the Contract unit price, per cubic yard, for the item "Topsoil".

Wetland topsoil, taken from either the Project excavations or imported from other sites, will be paid for at the Contract unit price, per cubic yard, for the item "Wetland Topsoil".

Topsoil taken from required excavation according to 00330.10 will be paid for according to 00330.94.

No payment will be made for topsoil or wetland topsoil that is placed in non-designated areas or which is contrary to the City's instructions.

(c) Soil Conditioners - Soil conditioners will be paid for at the Contract unit price, per cubic yard, for the item "Soil Conditioner".

(d) Plant Materials - Plants will be paid for at the Contract unit price per each, for the appropriate items listed in the Schedule of Items. Plant materials will be listed by caliper size, size of container, or other size, or condition shown.

Transplanted plants will be paid for at the Contract unit price, per each, for the item "Transplanted Specimen Plants".

Partial payments for plant materials will be made as follows:

At the time of the original planting.....	30%
After the first plant establishment inspection.....	10%
After the second plant establishment inspection.....	10%
After the third plant establishment inspection.....	10%
At completion of the establishment period.....	40%

Partial payments made throughout the establishment period will be made for all surviving and replaced plants.

Upon completion of the establishment period, full payment will be made for all surviving and replaced plants, except for corrective work performed by other according to 1040.73. The City will pay the Contract unit price only once for the specified quantity, whether or not plants are replaced.



01040.90

If the Contractor requests partial payment for plant materials on hand, payment will be made according to 00195.60.

(e) Sod Lawn - The accepted quantities of sod lawn will be paid for at the Contract unit price, per square yard, for the item "Sod Lawn".

(f) Mulch - The accepted quantities of mulch will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Bark Mulch	Cubic Yard
(b) Cinder Mulch	Cubic Yard
(c) Wood Chip Mulch	Cubic Yard
(d) Grass Straw Mulch	Cubic Yard
(e) Rock Mulch.....	Ton

(g) Miscellaneous - The accepted quantities of miscellaneous items will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Tree Grates	Each
(b) Woody Course Debris	Each
(c) Boulders	Each or Ton
(d) Root Barrier	Foot
(e) Weed Control Geotextile	Square Foot

Payment will be payment in full for furnishing and placing the materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be paid for:

- soil amendments
- lime, gypsum, or trace minerals
- soil bio-amendments
- fertilizer
- herbicides
- anti-transpirants
- game repellent
- browsing protectors
- pesticides
- trunk wraps
- tree stakes and ties
- water

- timed-released water
- pressure moisture stress sensors
- mulch materials required as part of replacement planting
- corrective work during the plant establishment period



Section 01050 - Fences

Description

01050.00 Scope - This work consists of constructing:

- Fences, gates, and gateways of barbed wire, woven wire fabric, chain link fabric, or combinations, to the lines and grades shown or directed
- Protective fences, on and off structure as shown or directed

All dimensions shown on the plans are horizontal and vertical measurement. Actual quantities required for the installation may be greater depending on the slope of the terrain.

01050.01 Definitions:

(a) Fences - Fence, gates, gateways, and appurtenances, regardless of kinds and types.

(b) Gates - Swinging units to provide an opening in the fence line.

(1) Single Gate - A unit of 16 feet or less.

(2) Double Gate - Two single gate units used together for an opening of more than 16 feet.

(c) Gateway - Supported fence wire or fabric stretched between gate posts and fastened by bars, wire hinges and locking devices.

(d) Panel - That portion of fence between adjacent posts.

(e) Run - As used in this specification, run is defined as follows:

- **Fences, gates, and gateways** - The length of fence between end posts, intermediate end posts, corner posts, and gate posts.
- **Bridge protective fence** - A section of fence 150 feet or less in length.

Materials

01050.10 Materials - Furnish materials meeting the following requirements:

Bar Reinforcement	02510.10
Barbed Wire	03010.10
Chain Link Fabric	03010.30
Commercial Grade Concrete	00440
Fence Gates	03010.60
Fence Grounding	03010.50(e) and (f)
Fence Posts, Braces, and Appurtenances ..	02110.30, 03010.50
Guardrail Elements	02820.10
Pickets	03010.31

Protective Fence Materials, On and Off Structures.....03010.75
 Vinyl Clad Fabric.....03010.40
 Woven Wire Fabric 03010.20

Construction

01050.40 General - Construct the several kinds and types of fences including the assembly and erection of all component parts and materials complete in place at the locations shown or directed. Confine activities and operations to the area immediately adjacent to the right-of-way line and within the highway right-of-way. Arrange for permits required from adjacent property owners to perform the work.

Restrain animals to lands on which they are confined using temporary fences or other adequate means. Provide adequate temporary fences or other protection around excavations to prevent animals or unauthorized persons from entering. Schedule the installation of fencing or provide temporary fencing or other adequate means to prevent animals from entering the Project right-of-way, easements or adjoining properties.

At bridges, animal passes and culverts, if shown or directed, connect the new fence to the structure in a manner that permits free passage of animals under or through the structure.

01050.41 Lines, Grades and Preparation Work - Unless otherwise directed, set fences so the fence fabric and wires are on right-of-way lines or City property lines, with posts set on City property. If directed, center concrete footings and fence posts 1 foot from the right-of-way or property line on City property.

Clear, grub and prepare the fence line area. Remove all shrubs, brush, snags, down timber, float rock, and other obstacles, including trees up to 6 inches in diameter which interfere with fence construction. If directed, preserve trees and geographic features on fence lines by varying the fence alignment to miss them.

Fill or excavate ground surface irregularities which interfere with maintaining specified clearance above ground surface of the bottom wire of the fence. Limit the width as necessary to provide a clear way for the fence.

Excavate for concrete footings to reasonably neat lines, but not less than the specified dimensions in soil, or not less than 18 inches deep in rock. Prevent disturbance of original ground at the sides and bottom of the excavation.

Clear and grade gate openings to permit the gate to swing in a horizontal plane according to 01050.48.

Dispose of materials removed under these provisions, including excess excavation, in a satisfactory manner.



01050.42

01050.42 Optional Posts - Use steel or wood posts in barbed, or barbed and woven wire fence construction according to one of the following options, and once an option has been selected, use that option throughout the Project:

Option 1: Steel posts entirely in all types of fence.

Option 2: Treated wood posts entirely in:

- Type 1 fence
- Type 1-5W fence
- Type 2 fence
- Median fence on median areas exceeding 16 feet in width

Option 3: Steel line post in combination with treated wood end posts, intermediate end posts, corner posts and gate posts in:

- Type 1 fence
- Type 1-5W fence
- Type 2 fence
- Median fence on median areas exceeding 16 feet in width

01050.43 Installing Posts and Braces:

(a) General - Set all metal end posts, intermediate end posts, corner posts, gate posts, chain link fence posts in concrete footings. Set all other posts firmly in the ground or in concrete footings as the Contractor elects.

Set posts to the depths shown. Reasonable variation in depths will be allowed and posts may be appropriately shortened or left slightly high, as approved by the Engineer, to:

- Avoid unnecessary penetration or excavation in rock or other unusually firm material
- Obtain desired grades along the fence

Set all posts vertical, except on curved alignment set posts slightly off vertical, as directed, to offset the pull of the fence fabric and wires.

(1) Driven Posts - Posts which are set by driving shall be free of damage when set. Remove and replace any driven posts which are split, twisted or bent, or have badly misshapen tops.

(2) Dug Holes - Where rock is encountered, set the posts to depths of not less than 18 inches and backfill with fine granular material. Do not exceed the post height shown by more than 3 inches.

When posts are set in dug holes, backfill in 6 inch layers with each layer separately and thoroughly tamped and compacted.

(3) Concrete Footings - Dimensions of footings shall not be less than shown and shall fill the excavated areas. Place the concrete with contact against firm soil at the sides and bottom and tamp around the posts and brace ends after the posts and braces have been brought to and firmly held in proper position. Strike off, slope or crown and smooth the surface of the concrete at the ground level to shed water. Allow to cure for at least 5 calendar days before subjecting the posts and braces to strain.

(b) End Posts - Set end posts:

- At the beginning and end of new fence construction that is not terminating at gate posts
- At the end of the intersecting line of existing fences just outside the line of the new fence

(c) Intermediate End Posts - Set intermediate end posts in the line of the new fence:

- At each summit and at each valley in the grade of the fence where the algebraic difference in the grades of adjoining panels of fence exceeds 30%
- At other points located along the new fence line to break the fence construction into approximately equal runs not exceeding the applicable lengths of runs shown

(d) Corner Posts - Set corner posts as follows:

(1) Barbed and Woven Wire Fences - At angle of deflection exceeding 5° for fences with steel line posts or 15° for fences with wood line posts. Changes in line where the angle of deflection does not exceed the above limitations will be considered alignment angles. The adjacent line posts at alignment angles shall be made fast to the angle post by means of diagonal tension wires.

(2) Chain Link Fences - At angle points in fence alignment where the alignment of adjoining panels of fence changes direction by 20° or more.

(e) Gate Posts - Set gate posts at the beginning or end of runs of fence to provide openings for gates or gateways.

(f) Line Posts - Set line posts along the line of fence, between end, intermediate end, corner, and gate posts, and at the spacings shown. Line posts may be set at spacings not exceeding 25% greater than specified or at closer spacings if approved. Set a line post in the new fence line at a point in alignment with each intersecting fence line approximately 1 foot from the end post of the intersecting fence line.

It is intended that the actual number of line posts will average to the number required for normal spacing.

01050.44

(g) Braces - Construct braces before placing of fence fabric and wires on the posts.

(1) Metal Braces - Provide corner posts and intermediate end posts with two braces, one each direction from the post in the main fence lines. Provide end posts and gate posts with one brace in the line of the fence as shown.

Attach metal braces to the metal end, intermediate end, corner and gate posts and set in concrete footings.

(2) Wood Braces - Assemble and construct treated wood braces in conjunction with treated wood end posts, intermediate end posts, corner posts and gate posts to form units as shown. Fasten the wire brace guys to posts with three staples in each post. By means of a wood lever, twist together the four strands of wire between the posts until the entire assembly is taut and firm. Leave the lever in place. Drive the staples to provide contact with the wires without indentation of the posts.

01050.44 Barbed and Woven Wire Fence:

(a) Placing Fabric and Wire - Place fabric and wire on the face of the post which is away from the highway or as shown. On curved alignment, place the fabric and wire on the face of the post against which the normal pull of the fabric and wire will be exerted.

Attach fence fabric and barbed wire to each post according to recognized standard practice for fence construction and as shown or directed.

(b) Splicing Fabric and Wire - Splices of fabric and splices of separate lines of wire between posts will be allowed provided that not more than two fabric or separate wire splices, spaced at least 50 feet apart, occur in any one run of fence. Use wrap or telephone-type splices for the longitudinal woven wire and barbed wire with each end wrapped around the other wire for not less than 6 complete turns.

(c) Stretching Fabric - Stretch the barbed wire and woven wire fabric. Use care in stretching woven wire fabric, so the pull is evenly distributed over the longitudinal wires and not more than 1/2 of the original depth of the tension curves is removed.

(d) Fastening Fabric and Wire:

(1) At End, Intermediate End, Corner, and Gate Posts - Terminate the fence fabric and barbed wire at each end, intermediate end, corner, and gate post in the new fence line. Wrap each line of barbed wire and each longitudinal wire of the fence fabric around the post and then itself with at least four turns.

(2) At Line Posts - Fasten woven wire fabric to the post at top and bottom and at intermediate points not exceeding 12 inches apart. Fasten each line of barbed wire to each line post. Use approved wire ties or clamps to fasten the wires to metal posts. Drive staples, for use with wood posts, crosswise with the grain of the wood and pointed slightly downward. Drive the staples just short of actual contact with the wires to permit free longitudinal movement of those wires and to prevent damage to the protective coating.

(3) At Intersection of New and Existing Fence - Where existing fences intersect the new fence, cut the existing fence materials, or splice basically in-kind new materials as necessary, and fasten each longitudinal wire of the fabric and each line of barbed wire to the new end post according to 01050.44(d)(1).

(e) Swinging Panels at Waterway Crossings - At waterway crossings subject to floating debris, if directed, construct wood framed swinging panels of fence fabric, barbed wire or combinations. Attach the panels to the lower wire(s) of the fence to provide fenced closure of the waterway so there will be no unfenced side or bottom openings exceeding 6 inches when the waterway is at its lightest flow or is dry.

(f) Additional Panels at Depressions - If depressions in the ground surface leave unfenced openings greater than 12 inches in height beneath the bottom line of the fence, provide additional panels of fence fabric, barbed wire, or combinations between line posts, as approved, across the opening so no side or bottom openings exceeds 6 inches. If the bottom line of the fence leaves an unfenced opening beneath it of 12 inches or less, pull the fabric and wires down between posts and anchor with pins or posts driven at least 18 inches into the ground so there will be no bottom opening at any point along the fence greater than 6 inches in height.

(g) Stay Wires and Final Adjustments - Free the fabric and barbed wire in final position from warp and sag with stay wires placed approximately vertical to the grade of the fence. Appearance shall reflect first-class work. Retighten brace guys and leave the lever restrained against the fence fabric or fence wires.

01050.45 Chain Link Fence:

(a) Concrete Footings - Construct concrete footings according to 01050.43(a-3).

(b) Chain Link Fence Rails and Tension Wires - Place longitudinal rails and longitudinal tension wires along the line of chain link fence, except at gates.

(1) Rails - Attach rails to end, gate and corner posts by clamps and sockets, and thread through loop caps on the end of line posts. Provide expansion sleeves or couplings at spacings not exceeding 200 feet in longitudinal top and bottom rails.

01050.46

(2) Tension Wire - Attach tension wire to end, gate and corner posts by bands and clamps. Either thread the top tension wire through line post loop caps or hold in open slots in a manner to limit vertical movement. Tie or attach the bottom tension wire to the bottom of line posts by ties or clamps in a manner that prevents vertical movement. Provide tension wires with one turnbuckle or one ratchet take-up in each run of fence.

(c) Chain Link Fence Fabric and Wire - Assemble and install chain link fence fabric and wire according to 01050.44 and the following:

(1) Splicing Fabric - Use spiral pickets of specified chain link fabric material for fabric splices. Use wrap or telephone-type splices for tension wire and barbed wire with each end wrapped around the other wire for not less than 6 complete turns.

(2) Fastening Fabric - Fasten fabric to end, gate and corner posts and to gate frames as shown. Attach fabric to line posts with wire ties at top and bottom and at intermediate spacings not exceeding 18 inches. Fasten fabric to top and bottom rails and to longitudinal tension wires with metal bands or tie wires spaced as shown, but in no case greater than 24 inches apart.

(3) Screening Pickets - If shown, insert the screening pickets vertically in each diamond.

01050.46 Protective Fence for Bridges - If welding of special connections for protective fence is required, pre-qualification of welders will not be required and inspection of welding will be visual.

01050.47 Fence Grounding:

(a) General - Except for bridge protective fence, provide at least one "ground" for each run of fence and place at any post within the run according to 00960.50(b). Fence grounding for bridge protective fence is not required.

Fasten each line of barbed wire, alternate longitudinal wires of fence fabric, and the rails and tension wire of chain link fences to the ground wire by clamps. Clamp the ground wires to the grounding rods.

(b) At Electrical Lines - Ground the fence directly below the point of crossing at each location where an electric transmission, distribution or secondary line crosses over the fence.

Ground the fence at each end or gate post or at intervals not to exceed 500 feet when an electric transmission, distribution or secondary line runs parallel or nearly parallel to and within 100 feet of the fence.

01050.48 Gate Installation:

(a) **Metal Gates** - Install metal gates and fittings between gate posts previously set as specified. Firmly attach the fittings to the posts and gates. Hinge each single gate in a manner which will prevent removal of the gate without tools. Set the gate in an approximately horizontal plane to swing freely inward and outward, and so it can be fastened securely in its latch holder, or in the case of double gates, in its latch holder and gate stops. Set double gates on their respective hinge pintles to provide a common horizontal plane in which each single gate swings.

Gates shall swing open at least of 90° in each direction.

(b) **Gateways** - Construct gateways of the same material as the fence and as shown. Construct wire splices according to 01050.44(b). Provide a taut and well-aligned closure of the opening, capable of being readily opened and closed by hand.

01050.49 Removing and Rebuilding Fence - Remove and rebuild existing fences as shown or directed. Construct fences to approximately the same condition as the original fence. Salvage the materials in existing fences to be removed and rebuilt and incorporate in the rebuilt fences. Replace fence materials damaged beyond reuse at no additional cost to the City. Firmly reset posts to the staked alignment. Post spacing and the number of wires to be strung and stapled to the posts shall be the same as the original fence. Furnish and use new staples or clips to fasten the wires to the posts.

Measurement

01050.80 Measurement - The quantities of fences, protective fences, gates, and associated items performed under this Section will be measured according to the following:

(a) **Barbed and Woven Wire Fence and Gateways** - Barbed wire fence, woven wire fence, and barbed and woven wire fence will be measured on the length basis. Gateways will be considered as fence of the type which adjoins them, and will be measured as a continuing part of that type of fence. Measurement will be from center to center of posts, measured along the line and grade of each separate continuous run of fence as constructed, exclusive of gates. Where existing fences are extended to intersect the new fence, the length of extension, from point of joining to the center of the new end post, will be measured and included for payment, if similar in design or type to a Pay Item; otherwise this work will be paid for according to 00140.60.

(b) **Metal Gates for Barbed and Woven Wire Fence** - Metal gates for barbed and woven wire fence will be measured on a unit basis per each by actual count of each size of single gate and of each size of double gate, respectively. The size designation of gates for barbed wire and woven wire fence gates will be by width. The width will be the width of opening the gate is to fit.

(c) **Chain Link Fence** - Chain link fence will be measured on the length basis of each type of fence. Measurement will be from center to center of posts, measured along the line and grade of each separate continuous run of fence as constructed, exclusive of gates.

(d) **Metal Gates for Chain Link Fence** - Chain link fence metal gates will be measured on a unit basis of each size of single gate and of each size of double gate, respectively. The size designation of chain link fence gates will be by width and height. The width will be the width of opening the gate is to fit.

(e) **Protective Fence for Bridges** - Bridge protective fence will be measured on the length basis.

Measurement will be between beginning and ending locations as shown.

(f) **Removing and Rebuilding Fence** - Removing and rebuilding existing fence will be measured on the length basis, including gates. Measurement will be from center to center.

Payment

01050.90 Payment - The accepted quantities of fences, protective fences, gates, and associated items performed under this Section will be paid for according to the following.

(a) **Barbed and Woven Wire Fence** - Barbed and woven wire fence and gates will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Type ____ Fence	Foot
(b) ____ Foot Single Gates	Each
(c) ____ Foot Double Gates	Each

In item (a) the type of fence will be inserted in the blank.

In items (b) and (c) the width of the gate opening will be inserted in the blank.

(b) **Chain Link Fence** - Chain link fence and gates will be paid for at the Contact unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) ____ Chain Link Fence	Foot
(b) ____ Chain Link Fence with ____	Foot
(c) ____ Foot x ____ Inch Chain Link Single Gates	Each
(d) ____ Foot x ____ Inch Chain Link Double Gates	Each

In item (a) the type of fence will be inserted in the blank.

In item (b) the type of fence will be inserted in the first blank and the type of material or pickets used for screening will be inserted in the second blank.

In items (c) and (d) the width of the gate opening will be inserted in the first blank and the height of gate be inserted in as the second blank.

(c) Protective Fence for Bridges - Bridge protective fence will be paid for at the Contact unit price, per foot, for the item " ____ Foot Type ____ Protective Fence".

The height of the fence will be inserted in the first blank. The type of fence will be inserted in the second blank.

(d) Removing and Rebuilding Fence - Removing and rebuilding fence will be paid for at the Contact unit price per foot for the item "Removing and Rebuilding Fence".

New material necessary to complete the rebuilding of fence will be included in payment made for the removing and rebuilding fence item.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Payment for materials, equipment, and labor involved in constructing panels of fence additional to normal fence construction at waterways and at ground surface depressions, according to 01050.44(e) and 01050.44(f), will be paid for according to Section 00196.



Section 01070 - Mailbox Supports

Description

01070.00 Scope - This work consists of removing and maintaining mailboxes and supports at temporary locations during construction, and installing mailboxes and newspaper boxes affected by construction on new or existing supports at permanent locations as shown or directed.

Materials

01070.10 Reinforcement - Furnish reinforcement for concrete collars meeting the requirements of Section 00530.

01070.11 Concrete - Furnish concrete for concrete collars meeting the requirements of Section 00440.

01070.12 Tube Support Frame - Furnish tube support frames meeting either of the following requirements:

- Requirements of ASTM A 500, Grade B, and galvanized according to AASHTO M 111 ASTM A 123
- Tensile requirements of ASTM A 53, Grade B, and galvanized with a minimum 0.9 ounce per square foot coating, as tested according to ASTM A 90, on the exterior surface followed by a chromate conversion coating and a cross link polyurethane acrylic coating. A zinc base corrosive resistant interior coating shall also be applied.

01070.13 Mounting Brackets and Hardware - Furnish mailbox mounting brackets, angles, adapter plates, and hardware as shown and galvanize according to ASTM A 153. Furnish mounting brackets for newspaper boxes as shown on the standard drawings.

01070.14 Post Mounting Socket - Furnish Flush V-Wing Post Mounting Socket manufactured by Foresight Industries of Cheyenne, Wyoming, or an approved equal.

Construction

01070.40 General - Protect and maintain mailboxes and supports at locations accessible to the delivery agent and as convenient as possible for the public being served. This may require removing and relocating the mailboxes and supports more than once to maintain service. When roadway construction is completed, install the mailboxes and newspaper boxes on new supports in their permanent locations as shown or directed.

Repair damaged galvanized surfaces, such as the cut end of the tube support frame or drilled holes, according to 02420.10(d), except add 1 1/2 ounces of leafing aluminum powder to each quart of high zinc dust content paint.

Install mounting brackets of the proper size to fit each existing mailbox.

If multiple supports are furnished for fewer than 5 mailboxes, install on the support Size 1 mounting brackets for the empty spaces.

If property owners want to keep the original mailbox support, place the support on the owner's property adjacent to the work. Otherwise, dispose of the original mailbox support according to 00290.20.

Measurement

01070.80 Measurement - The quantities of mailbox supports and concrete collars will be measured on the unit basis of each kind of mailbox support and the number of concrete collars, regardless of size, installed in permanent locations.

01070.81 Existing Supports - The quantities of mailboxes and supports removed, maintained and reinstalled will be measured on the unit basis of each kind of mailbox support, regardless of type, installed in permanent locations.

Payment

01070.90 Payment - The accepted quantities of mailbox supports and collars will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Single Mailbox Supports	Each
(b) Multiple Mailbox Supports	Each
(c) Mailbox Concrete Collars	Each
(d) Remove and Reinstall Mailbox Supports	Each

Payment for item (d) includes installing existing supports to be reused in temporary locations before installing in the permanent location.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for:

- removing existing mailbox supports
- providing temporary installations
- installing new supports in permanent locations
- installing owner-furnished mailboxes and newspaper boxes



Section 01090 - Gravel Beds and Blankets

Description

01090.00 Scope - This work consists of preparing areas for gravel beds and gravel blankets, and furnishing and placing soil sterilant, weed control geotextile, and gravel bed aggregates or gravel blanket aggregates at locations shown or directed.

Materials

01090.10 Soil Sterilant - Furnish products with current legal labels listing active ingredients, which may include simazine, diuron, bromacil, suffometuron-methyl or from the CPL. Submit a sample of the proposed soil sterilant's registered label to the Engineer for approval before using.

01090.11 Weed Control Geotextile - Furnish the following weed control geotextiles:

- "Weed-Chek Landscape Mat"
- 3 ounce, UV stabilized, non-woven, polypropylene fabric
- 3.75 ounce, UV stabilized, needle-punched, polypropylene fabric
- Weed control geotextile from the CPL

01090.12 Aggregates - Provide clean, uncrushed, nearly round rock for gravel beds and gravel blankets meeting the following gradation requirements:

Sieve Size	Gravel Bed	Gravel Blanket
	3/4" - 1/2"	1 1/2" - 1/2"
Percent Passing (by Weight)		
2"		100
1 1/2"		80 - 100
1"	100	0 - 15
3/4"	80 - 100	—
1/2"	0 - 10	0 - 5

The Engineer may accept aggregates by visual inspection.

Construction

01090.40 General - Prepare gravel bed and gravel blanket areas, and furnish and place soil sterilant, geotextile, and aggregates as follows:

(a) Excavation - Excavate and shape the areas for gravel beds and gravel blankets as shown or directed and according to Section 00330.

(b) Soil Sterilant - Furnish and place the approved soil sterilant at a rate of application recommended by the Manufacturer. During use of soil sterilant strictly adhere to label cautions, especially those concerning existing plants or waterways in the immediate area.

(c) **Geotextile** - After the area has been treated with soil sterilant, place the weed control geotextile over the prepared ground surface according to 00350.41(a). Extend or lap the geotextile as follows:

- **Gravel Beds** - Extend the geotextile approximately 2 inches up the sides of the bed and overlap at least 12 inches.
- **Gravel Blankets** - Lap the ends of the sheets 18 inches and the sides 12 inches.
- **Aggregates** - Place aggregate cover as follows:
 - **Gravel Beds** - Cover the geotextile with gravel bed aggregates to the depth specified then level and roll with a water-filled landscape roller for a minimum of 2 complete coverages.
 - **Gravel Blankets** - Cover the geotextile with gravel blanket aggregates to the depth specified or directed.

Measurement

01090.80 Measurement - The quantities of gravel beds will be measured on the volume basis.

The quantities of gravel blankets will be measured on the area basis by surface measurement of the material in place limited to the established neat lines and grades.

Payment

01090.90 Payment - The accepted quantities of gravel beds and gravel blankets will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Gravel Beds	Cubic Yard
(b) Gravel Blanket	Square Yard

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for excavation, or weed control geotextiles.



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PART 01100 - WATER SUPPLY SYSTEMS**Section 01120 - Irrigation Systems****Description**

01120.00 Scope - This work consists of installing irrigation systems and associated equipment at locations shown or specified and as directed.

01120.01 Qualifications - In order to install certain kinds of equipment or systems, manufacturer's certifications may be required, if described in the Special Provisions.

Materials

01120.10 General - Furnish only commercial quality materials and equipment. All items proposed for use will be subject to testing to ensure compliance with the Specifications. Provide materials of the same function that are of the same type and the same manufacturer.

Submit a list of proposed materials for approval as soon as practicable after Award and before arranging for procurement of any materials, especially those materials or products not shown or specified. If any initially proposed materials are not approved, submit substitutes for approval. Any materials installed without approval will be subject to removal and replacement with acceptable material at the Contractor's expense.

Materials may be designated by trade name or by manufacturer's catalogue information as shown or specified. The use of a substitute material may be permitted if a written request for substitution and proof of equivalent quality and suitability are furnished. Make any request for substitution with ample time for approval without delaying the work.

When alternate equipment, such as sprinkler heads, is proposed for use with hydraulic characteristics differing from that originally shown, the following will be required:

- A redrafted, legible plan that shows the redesigned layout, location, or sizes of every affected system element as required for proper operation as originally designed. Furnish a plan showing every relevant system element, site feature, and plan element that was shown on the original plan. A plan made by marking up the original plan will not be accepted.

- A hydraulic calculation table for the alternate equipment. At a minimum, show a complete calculation for one average sprinkler zone (section) and a complete calculation for the "worst case" sprinkler zone (i.e., the section that is farthest from the point of connection (POC.), is the largest, or otherwise presents the most challenging hydraulics). Starting from the POC, show the calculation with a step-down method with flow and loss at each piece of equipment and length of pipe run between equipment. Show the new total water required for each zone and the total for all zones to ensure that maximums for meter size, pipe sizes, and watering times will not be exceeded.
- Where any controller run-time change will be required, submit a separate page showing the total timing per controller required for each section, to show that timing changes will still allow all zones to be run within a reasonable time period.
- A cost page showing the Contractor's actual discount cost from the supplier(s), comparing the original plan costs versus the proposed equipment costs for each type of item, such as pipe by size, where there is a change required. Show the line total of each type of item and the grand total for the proposed change.

01120.11 Pipe, Tubing and Fittings - Furnish galvanized iron or steel, PVC, or polyethylene pipe as shown or specified that meets the following requirements:

(a) Galvanized Pipe and Fittings - Furnish pipe of standard weight, hot-dip galvanized iron or steel, standard threaded, coupled, and that meets the requirements of ASTM A 53/A 53M. Non-standard threaded fittings will be rejected.

(b) Polyvinyl Chloride Pipe and Fittings - Furnish PVC pipe and fittings of PVC compound Type 1, Grade 1, conforming to ASTM D 2241 and certified approved by the National Sanitation Foundation. Provide pipe and fittings free from defects caused by poor materials, low quality of work, or rough handling. Dimensional and quick burst tests of pipe and fittings may be required after arrival at the job site before materials will be accepted.

Furnish pipe and fittings as follows:

Used for	Class or Schedule
Caps.....	Schedule 80 PVC
Direct bury pipe, not in sleeves, placed under road beds or other paved areas	Schedule 40 PVC
Irrigation sleeves	Schedule 40 PVC
Main and lateral lines	Schedule 40 PVC

Furnish PVC threaded pipe of PVC 1120, Schedule 80 material conforming to ASTM D 1785.

Provide PVC solvent-weld pipe of PVC 1120 materials having a 200 psi minimum pressure rating with SDR 21 walls that conform to ASTM D 2241.

Furnish PVC pipe fittings conforming to ASTM D 2466, Type I, Grades 1 or 2.

Pipe may be belled on one end with the dimensions of the tapered bell conforming to ASTM D 2672.

Install PVC pipe with walls heavier than SDR 21 when shown or specified.

(c) Non-Potable Colored Coded Pipe - Wherever non-potable, reclaimed or reuse water is used, furnish PVC pipe that is tinted purple and imprinted with the warning "Caution: Reclaimed Water - Do Not Drink". Provide pipe meeting the same AWWA and ASTM specifications as the potable water pipe sizes on which they are based.

(d) Polyethylene Pipe - Furnish polyethylene pipe of Class 80, SDR 15, medium density, meeting the requirements of ASTM D 2239, conforming to U.S. Commercial Standard CS-255, and approved by the National Sanitation Foundation (NSF).

(1) Micro Tubing and Fittings - Where drip emitters are not required, furnish a blank type and provide any connections necessary. Provide tubing consisting of nominal-sized linear, low-density, minimum 1/4 inch outside diameter (OD) polyethylene.

(2) Low Volume (Drip) Tubing - Furnish drip tubing manufactured from specially formulated, chemical-resistant, low to medium density, virgin polyethylene or polybutylene which is selected for excellent weatherability and stress cracking resistance, and is designed specifically for use in drip irrigation systems. Provide drip tubing having a minimum wall thickness of 0.044 inch.

01120.12 Automatic Controllers - Provide Underwriter's Laboratories (UL) approved controller(s) as shown or specified. Furnish each outdoor controller with either a pedestal or wall mount brackets when appropriate. Provide and install the controller in a weatherproof and vandal-proof cabinet of corrosion-resistant metal. Furnish the controller housing or cabinet with hasp and lock or locking device. Provide locks or locking devices that are master-keyed and include three sets of keys for the locks. If the irrigation system serves both lawns and planting beds, furnish a controller that has a dual programming capability. Provide controllers that are compatible with and capable of operating the irrigation system as constructed.

The following are definitions of some controller-associated equipment:

Central Controller - A computer system programmable to receive data from and provide commands to multiple irrigation systems remotely located from the central system location.

Flow Sensor - The hardware located in a pipeline that senses water flow and sends resulting data by electronic pulses to the pulse output transmitter.

Pulse Decoder - A microprocessor-based device designed to read electrical pulses originating at the flow sensor (or other type of monitoring device) and send the data to a central control system for analysis and action. When reading water flow data, the pulse decoder may also be referred to as a flow monitor.

Pulse Output Transmitter - A device that reads electronic pulses from the flow sensor and sends data to the pulse-decoding device.

Rain Sensor - A sensor able to interrupt the power from the irrigation controller to the valves when the rainfall exceeds a pre-selected amount. Furnish rain sensors that are compatible with the system controller and are fully adjustable.

Satellite Controller - A satellite controller similar to a normal stand-alone controller and able to operate as one, but designed to be operated by a central controller located off-site.

Soil Moisture Sensor - A sensor that interrupts programmed irrigation cycles until the soil moisture reaches a predetermined condition at the sensor's probe location.

Weather Station - A field station that collects and stores various weather data for access and use by a central control system in modifying an irrigation program for weather conditions. Typical data collected over a time period are wind speed, wind direction, relative humidity, rainfall, solar radiation and air temperature.

01120.13 Quick-Coupling Equipment - Furnish quick coupling equipment with a body of cast leaded semi-red brass alloy No. C84400 conforming to ASTM B 584, and a service rating not less than 125 psi for non-shock cold water. Provide couplers having standard male pipe threads at the top and standard female pipe threads at the base. Ensure that the valve is designed to open only upon inserting a coupler key and close completely after removing the key, with absolutely no leakage of water between the coupler and valve body. Provide valve bodies to receive couplers that are designed with double worm slots to allow smooth opening and closing action with a minimum of effort. Ensure that slots notched at the base will hold the coupler firmly in the open position. Furnish couplers of one piece construction with steel reinforced side handles attached, a locking top and of the same material as the valve body. The coupler shall have stainless steel double guide lugs to fit the worm slots. Furnish two couplers and two hose swivels for operation of the valves, and two keys for the locking caps if quick-coupling valves are required. For non-potable water systems, furnish a color-coded, purple tinted cap that bears the printed warning "Caution: Reclaimed Water - Do Not Drink".

01120.14 Hose Bibs - Furnish bronze or brass hose bibs, with angle-type thread to accommodate a 3/4 inch hose connection, and with a key- operated design that prevents operation by wrench or pliers.

01120.15 Cross-Connection Control Devices - Cross-connection control devices will be shown on the plans. Furnish and install cross-connection control devices meeting the requirements of the Oregon Health Division and the local water authority.

01120.16 Water Meter - Water meter procurement, installation, and associated costs will be the responsibility of the City. Be responsible for coordinating water meter needs in a timely fashion with the City.

01120.17 Valves:

(a) Gate Valves - Furnish gate valves of heavy-duty bronze conforming to the requirements of ASTM B 62. Provide valves of the same size as the pipes on which they are placed and install with union or flange connections. Service rating (for non-shock cold water) shall be 150 psi. Valves shall be of the double disk, taper seat type, with rising stem, union bonnet and hand wheel or suitable cross wheel for standard key operation. The valves shall have the manufacturer's name, type of valve, and size clearly cast on them.

(b) Drain Valves - Furnish bronze or brass drain valves, 1 inch or 3/4 inch in size, manual angle globe type, with rising stem, hex brass union, removable bonnet and stem, and adjustable packing gland. Ensure that valves are designed for underground installation with a suitable cross wheel operable with a standard key. The valves shall have a service rating of not less than 150 psi non-shock cold water. Furnish three standard operating keys.

(c) Check Valves - Furnish heavy duty bronze or steel check valves which function by means of a hinged disc suspended from the body, and which is able to close of its own mass. Furnish valves that are of the same size as the pipes on which they are placed, unless otherwise specified, and with union or flanged connections. Provide valves that are rated for non-shock cold water service of not less than 150 psi. The valves shall have the manufacturer's name, valve type, and size cast on them.

(d) Pressure-Reducing Valves - Furnish pressure-reducing valves with a minimum of 150 psi working pressure and an adjustable outlet range of 20 to 70 psi, rated for non-shock cold water service up to 175 psi. The valves shall be factory set as shown or specified.

(e) Isolation Valve - Furnish isolation valves as shown on the plans or Special Provisions. If no isolation valve is shown, furnish ball valves as shown below.

(f) Ball Valves - Furnish bronzed-bodied ball valves conforming to ASTM B 62 and with a hard, chrome plated ball conforming to ASTM B 124/B 124M. The valve shall be non-shock cold water service-rated at not less than 400 psi. Plastic valves will not be accepted.

(g) Air Relief Valve - The air relief valve automatically relieves air pressure to break an air vacuum in the pipe section where it is located. Install air relief valves at the exact high point of each pipe section where relief is needed. (Note - air relief valves are not associated with backflow prevention).

(h) Control Valves:

(1) Manual Control Valves - Furnish manual valves of bronze or brass, angle type, with hex brass union, and with a service rating not less than 150 psi non-shock cold water. Provide valves for underground installation designed with a cross wheel suitable for operation with a standard key. Furnish three suitable operating keys per irrigation system. Furnish valves that have removable bonnet and stem assembly, with adjustable packing gland housing for the long acme-threaded stem to ensure full opening and closing. Provide valves with discs that are full floating with replaceable seat washers.

(2) Automatic Control Valves - Furnish automatic control valves of a normally closed design, operated by an electric solenoid of the required rating, but not more than 6.5 W and operating on 24 V AC power. Ensure that solenoids directly attached to the valve bonnets or bodies have completely internal control parts. Provide bodies that are not less than 150 psi if brass or bronze and not less than 125 psi if plastic, with a manual control bleed cock to operate the valve without electric current. Ensure that the closing speed is not less than 5 seconds and the opening speed is not less than 3 seconds. Both shall be at a constant rate of opening and closing so the water flow is completely stopped when the valve is either manually or electrically closed. Provide valves having manual shutoff stems with cross handles that will adjust the valve from fully closed to wide open with the valve automatically operable in the adjusted position.

(3) Automatic Control Valves with Pressure Regulator - Furnish valves of the same manufacture as the automatic control valves, capable of reducing the inlet pressure to a constant lower pressure regardless of supply fluctuations, and which are fully adjustable.

01120.18 Valve Boxes and Protective Sleeves - Provide automatic control valves, flow control valves, pressure reducing valves, backflow preventers, filters and other serviceable fixtures with valve boxes that are extendable to obtain the depth required. Furnish boxes constructed of thermoplastic, with locking lids, green in color, and of the type shown or specified. Include a protective sleeve and cap with all manual drain valves and manual control valves.

01120.19 Electrical Wire and Splices - Unless otherwise specified, furnish electrical wiring used as a hot wire for each zone between the automatic controller and automatic valves of copper, minimum size AWG No. 14, and red in color. Furnish common wire that is a minimum AWG No.12 and white in color. Furnish type USE that is chemically cross-linked Polyethylene or Thermoplastic. Furnish Type UF that is color-coded or marked with number identification.

Make low voltage splices with one of the following:

- Furnish a kit containing a "T" shaped open cell with a centering device and a plastic bag of urethane and hardener, which is mixed at the time of installation. The resin used with the "T" shaped centering device shall be a quick curing, flexible compound with a set up time of about 4 minutes at 70 °F. Acceptable kits are "3-M DBY", "RainBird Snap-Tite", "Pen-tite PVC Socket and Sealing Plus" or approved equal.
- Heat-shrinkable insulating tubing manufactured for use in irrigation electrical systems. Furnish heat-shrink tubing of a mastic-lined, heavy-wall, polyolefin cable sleeve.

Provide and install an extra wire with all wiring runs that is the same gauge, but of a different color than the hot wire and common wire. The extra wire will be reserved for future use or modifications to the system.

01120.20 Communication Cable - Furnish communication wire in central satellite control systems that is 18 gauge polyethylene (PE) 89, minimum 6 pair, or approved equal. Provide sufficient pairs to connect all decoding, sensing and monitoring devices to the Central Control Unit.

01120.21 Detectable Wire and Marking Tape - Provide a detectable wire at the elevation of all main and lateral lines using continuous #14 gauge, single strand locator wire that is blue in color. Provide marking tape above all main and lateral lines consisting of inert polyethylene plastic that is impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. Furnish color-coded tape with the type of line buried below and the word "Caution" imprinted continuously over its entire length in permanent black ink. Provide tape of the width recommended by the manufacturer for the depth of installation used.

Construction

01120.40 General - The irrigation plans are a schematic design and may require adjustment. Do not install the sprinkler system as shown if it is evident that obstructions, grade differences, or differences in area dimensions create conditions different than anticipated in the design. Bring all such obstructions or differences to the attention of the Engineer. In the event this notification is not performed before construction begins on a part of the system where discrepancies exist, any revisions necessary to make the system operate as designed will be the Contractor's responsibility.

(a) Plumbing - Install all parts of the irrigation system according to the Oregon Plumbing Code and State and local laws. Make water service connections as shown and specified. Conform to the requirements of the jurisdictional water authority. Ensure that water velocities in PVC pipe do not exceed 5 feet per second, unless approved in writing by the City. Bring any velocities exceeding 5 feet per second created by pipe sizes shown on the plans to the attention of the City before beginning construction. Correct excess velocities existing after construction, or caused by changes from the plans, at the Contractor's expense, unless a written agreement has been made authorizing otherwise.

(1) Double Check Valve Assembly (DCVA) - Install, inspect, and test the DCVA according to applicable regulations of the Oregon Health Division and the local water authority. Furnish test records on forms approved by the Oregon Health Division. Furnish forms filled out by a State-licensed Backflow Device Tester documenting that the DCVA is in good operating condition before any flushing and testing of downstream water lines. During the life of the Contract, test the DCVA annually or more often if successive inspections indicate repeated failure. Repair or replace the DCVA whenever it is found to be defective.

(2) Reduced-Pressure Backflow Device (RPBD) - Install, inspect, and test the RPBD according to the applicable portions of the Oregon Plumbing Code and applicable regulations of the Oregon Health Division and the local water authority. Apply the same specific testing requirements as stated for the DCVA above.

(b) Electrical Service - Install electrical service according to 00960.49, the National Electrical Code, and all State and local laws. Power sources will be as shown or as directed. Be responsible for coordination and installation of electrical service. Furnish and install meter bases at the power source conforming to the requirements of the power supplier. Give the power supplier's representative notice before making any installation. Provide a separate, dedicated circuit for the controller.

01120.41 Layout of Irrigation System - Stake the irrigation system, following the schematic design on the plans, before construction begins. With prior approval, make alterations and changes in the layout to conform to ground conditions and to obtain adequate coverage of water. Call before you dig. Comply with the requirements of 00150.50.

01120.42 Excavation - Excavate trenches no wider than necessary to lay the pipe or install the equipment. Keep the top 6 inches of topsoil, if applicable, separate from subsoil and replace this topsoil as the top layer when backfilling. Provide smooth trench bottoms of sand or other material, free from rocks and unsuitable material. Excavate trenches in rock or other unsuitable material at least 6 inches below the required depth and backfill with sand or other suitable material free from rocks.

Exercise care when excavating near existing trees. Where roots are 2 inches and greater in diameter, except in the direct path of the pipe, hand excavate and tunnel the pipe trench. When large roots are exposed, wrap them with heavy burlap for protection and to prevent excessive drying. When digging trenches by machine adjacent to trees having roots 2 inches and less in diameter, hand trim the sides of the trench, making a clean cut of the roots. Treat all cut and trimmed roots 1/2 inch or larger in diameter with an approved tree wound dressing. Backfill trenches having exposed tree roots within 24 hours unless protected by continuously moist burlap or canvas.

Place detectable marking tape in the trench directly above, parallel to, and along the entire length of all nonmetallic water pipes and all nonmetallic and aluminum conduits installed under existing or planned pavement. Use tape widths recommended by the manufacturer for the burial depth.

Pipe installation using a "pipe puller" may be approved if there is adequate topsoil depth and the topsoil is free of rock. Obtain the Engineer's approval before using a pipe puller. Include any resultant changes in material or design with the request for use of this method.

If unforeseen bedrock is encountered during excavation that prevents the pipe from being buried at the specified depth, immediately bring it to the attention of the Engineer.

01120.43 Piping - Backfill all pipe between the top of the pipe and finished grade with a minimum of 18 inches of fill according to 01120.49. Where possible, place mains and laterals or section piping in the same trench. Separate all pipes by at least 2 inches. Place all pipe lines a minimum of 3 feet from the edge of concrete sidewalks, curbs, guardrail, fences, traffic barriers or walls unless otherwise approved.

Place marking tape above all pressurized mainline, according to the manufacturer's instructions.

Place all live mains to be constructed under existing pavement in sleeves jacked under the pavement, unless otherwise shown. Place all PVC pipe installed under pavement in pipe sleeves of Schedule 40 PVC, unless steel sleeving is shown or specified. Furnish pipe caps of Schedule 80 PVC. Install sleeves 2 feet below subgrade when passing under roadways. Extend sleeves 2 feet beyond the edge of gravel, edge of sidewalk or back of curbs. Mark sleeves with a 2 foot piece of #4 rebar driven flush with the ground or other adjacent surface. Place PVC caps over both ends of sleeves but do not glue. Solvent-weld sleeve sections. Pipe bedding and backfill shall conform to Section 00405. Extend the sleeve a minimum of 12 inches beyond the edge of pavement. Perform all jacking operations according to an approved jacking plan. If obstacles are encountered during required jacking, notify the Engineer, who may authorize corrective measures according to 00140.60. Provide for complete drainage of all pipe lines with manual drain valves installed at section low points. Drain valves may not be shown on the plans.

01120.44 Pipe Jointing:

(a) General - During construction, plug or cap pipe ends to prevent entry of dirt, rocks and other debris.

(b) Galvanized Steel Pipe - Ensure that galvanized steel pipe has clean cut, well fitted standard pipe threads. Ream all pipe to its full diameter and remove burrs before assembly. Construct threaded joints using either a non-hardening, non-seizing multipurpose sealant, Teflon tape, or paste as recommended by the pipe manufacturer. Make all threaded joints tight with wrenches, without using handle extensions. Clean and remake joints that leak with new material. Use of caulking or thread cement to make joints tight will not be permitted.

(c) **PVC Pipe** - Handle and install PVC pipe, couplings and fittings according to the manufacturer's recommendations. Chamfer the outside of the PVC pipe to a minimum of 1/16 inch at approximately 22°. Join pipe and fittings by solvent welding. Use only solvents that penetrate the surface of both pipe and fitting with a result of complete fusion at the joint. Use solvent and cement only as recommended by the pipe manufacturer. On plastic to metal connections, work the metal connection first. Use a non-hardening compound on threaded connections. Thread connections between metal and plastic using only female threaded PVC adapters with threaded Schedule 80 PVC nipples.

(d) **Polyethylene Pipe** - Install polyethylene pipe and fittings according to the manufacturer's recommendations. Cut the ends of the polyethylene pipe square and insert the fitting to its full depth. Use stainless steel clamps for insert fittings.

01120.45 Installation:

(a) **Sprinkler Heads** - Position turf heads and other pop-up heads between 1/2 inch and 1 inch above finish grade, measured from the top of the sprinkler. Place sprinklers as close as practical to walks, curbs, pavement and lawn edges, but leave enough space to allow height adjustment. Do not place heads on risers in areas with any potential for pedestrian traffic, unless otherwise shown. Use swing riser assemblies that allow positioning for correct sprinkler height.

(b) **Drip Emitters** - Install emitters directly above the root mass of the plant being watered, according to the plans or the manufacturer's recommendations.

(c) **Low Volume Drip Tubing** - Install drip irrigation tubing according to the plans or the manufacturer's recommendations.

(d) **Controllers** - Install controllers according to the manufacturer's recommendations and as shown. Receive approval of the location before installing. Since the controller will need to be accessed frequently, install it at a height, position, and location that allow ease of access.

(e) **Valve Boxes and Quick Couplers** - Position the tops of valve boxes, capped sleeves, and quick coupler valves between 1/2 inch and 1 inch above finish grade or mulch.

(f) **Valves** - Install valves so that access for maintenance is maintained.

(g) **Central Control Equipment** - If shown or specified, install the following equipment according to the manufacturer's recommendations:

- Rain sensors
- Soil moisture sensors
- Flow meters
- Central control system with satellite controllers
- Weather stations

01120.46 Low Voltage Electrical Installation - Use direct burial wiring between the automatic controller and automatic valves. The wiring may share a common neutral. When more than one automatic controller is required, provide a separate common neutral for each controller and the automatic valves it controls. Run separate control conductors from the automatic controller to each valve. Provide and install an extra wire according to 01120.40.

Install wire adjacent to or beneath the irrigation pipe. Use plastic tape or nylon tie-wraps to bundle wires together at 10 foot intervals. Snake the wire from side to side in the trench to provide slack in the wire run. When it is necessary to run wire separate from the irrigation pipe, bundle and place the wire under detectable marking tape. Splices will be permitted only at junction boxes, valve boxes, pole bases, or control equipment. Leave a minimum of 2 feet of excess conductor at all splices, terminals and control valves to facilitate inspection and future splicing.

01120.47 Flushing and Testing:

(a) General - Provide gauges used in the testing of water pressures that are certified correct by an independent testing laboratory immediately before use on the Project. Retest gauges when directed. Test automatic controllers by actual operation for a period of 2 weeks under normal operating conditions. Should adjustments be required, adjust according to the manufacturer's direction and test until operation is accepted as satisfactory.

(b) Sprinkler Head Flushing - Flush all sprinkler heads as recommended by the manufacturer.

(c) Sprinkler Head Testing - Test for leaks in heads and connections and correct as required.

(d) Main Line Flushing - To remove debris that may have entered the line during construction, flush main supply lines twice with the supply valve fully open. Flush first before placing valves and again after placing valves and before pressure testing.

(e) Main Line Testing - Purge all main supply lines of air and test with static water pressure of at least 150 psi for 60 minutes without introduction of additional service or pumping pressure. Test with one pressure gauge installed on the line where directed. Install an additional pressure gauge at the pump when directed. Lines showing loss of pressure exceeding 5 psi at the end of the specified test period will be rejected. Correct rejected installations and retest for leaks.

(f) Lateral Line Flushing - Flush all lateral lines once with the supply valve fully open prior to placement of sprinkler heads, emitters and drain valves. Flush long enough to remove any debris that enters the lateral lines during construction.

(g) Lateral Line Testing - Purge all lateral lines of air and test under operating line pressures with risers capped and drain valves closed. Maintain operating line pressures for 30 minutes through open valves and pressure regulating devices. Lines showing leaks when visually inspected at the end of the specified test periods will be rejected. Correct and retest lateral line installations that have been rejected.

(h) Lateral Line Alternate Test Method - When conditions prevent effective visual inspection of lateral lines, the Engineer may require that the lines be tested by use of pressure gauges. In that event, maintain the static water pressure equal to the operating line pressure in the lines for 30 minutes, with valves closed and without introduction of additional service pressure. Lateral lines showing loss of pressure exceeding 5 psi at the end of the specified test period will be rejected. Correct and retest lateral line installations that have been rejected.

(i) Testing of Micro Tubing - Micro tubing will be tested by visual inspection while operating and before burial. Tubing that has obvious leaks or that doesn't operate as designed will be rejected. To fully test micro tubing, a water collection procedure recommended by the manufacturer may be required. Correct all faults before retesting.

01120.48 Adjusting System - Before final inspection, adjust and balance all sprinklers to provide adequate and uniform coverage. Balance spray patterns by adjusting individual sprinkler heads with the adjustment screws or by replacing nozzles to produce a uniform pattern. Unless otherwise specified, water spray will not be permitted on pavement, walks or structures.

01120.49 Backfill - Do not start backfill until all piping has been inspected, tested and approved. Complete backfilling as soon as possible after approval. Ensure that backfill material placed within 6 inches of the pipe is free of rocks or other unsuitable material that might cut or otherwise damage the pipe. Backfill from the bottom of the trench to approximately 6 inches above the pipe with continuous compaction in a manner that will not damage the pipe or wiring, and proceed evenly on both sides of the pipe. Thoroughly compact the remainder of the backfill without using heavy equipment within 18 inches of any pipe. Ensure that the top 6 inches of the backfill is topsoil material or, if suitable, is the first 6 inches of material removed in the excavation.

Pipe bedding material conforming to 00405.12 may be authorized in quantities determined by the Engineer. When authorized to proceed, fill the bottom 2 inches of the trench with approved bedding before laying pipe. After the pipe is in position, add enough bedding material to bring the backfill height to 2 inches above the pipe. Continue backfilling as usual.

If sufficient suitable backfill material is not available from trench excavation or other sources on the Project, notify the Engineer. Provide an estimate of imported backfill required, if possible. Unless otherwise shown or specified, imported pipe bedding material will be authorized according to 00140.60.

Maintenance

01120.60 System Operation - Repair, flush and test all main and lateral lines that sustain a break or disruption of service. Upon restoration of the water service, bring the affected lines up to operating pressure. After pressurizing, conduct a thorough inspection of all sprinkler heads, emitters, and other fittings, located downstream of the break or disruption of service, and repair. This inspection is required to ensure that the entire irrigation system is operating properly.

Completely install and test the irrigation system, and make it automatically operable before planting in a unit area except where otherwise shown, specified, or approved. Be fully responsible for all maintenance, repair, testing, inspection and automatic operation of the entire system until all work is complete and approved.

This responsibility includes, but is not limited to, draining the system before winter and reactivating the system in the spring and at other times as directed.

Be responsible for having annual inspections and tests performed on all cross connection control devices as required by the State Health Division.

In the spring, when the drip irrigation system is in full operation, make a full inspection of all emitters. This involves visual inspection of each emitter under operating conditions. Make all adjustments, flushing or replacements to the system at this time to ensure the proper operation of all emitters.

01120.61 Drip Line Warranty - The warranty of 00170.85(b) applies to drip tubing installed under this Section. Provide a written warranty from the manufacturer against defects in manufacturing, rot, electrolytic corrosion, and stress cracking for at least 5 years from the time of installation.

Finishing and Cleaning Up

01120.70 As-Built Plans and System Orientation - Upon completion of the work, submit corrected working drawings, schematic circuit diagrams, or other drawings necessary for the Engineer to prepare corrected plans showing the work as constructed. Provide drawings of sizes conforming to 00150.35(m). Prepare and present a training and orientation session covering the operation, adjustment and maintenance of the irrigation system. Review corrected drawings and explain all features. At this session, provide the Engineer with parts lists and service manuals for all equipment. Notify the Engineer in writing 2 weeks before the proposed date of the training and orientation session. The date and time of the session will be mutually agreed to.

01120.80

Measurement

01120.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

01120.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract lump sum amount for the item "Irrigation System".

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and Incidentals necessary to complete the work as specified.

No separate or additional payment will be made for excavation, backfill, electrical service and system orientation.



Section 01140 – Potable Water Pipe and Fittings

Description

01140.00 Scope - This work consists of constructing potable water pipe and fittings. Install pipe in the materials, sizes and lengths and at the locations shown or as directed to the lines and grades established. Furnish and construct joints, fittings, accessories and appurtenances as necessary, for complete installation of the potable water system.

Materials

01140.10 Materials - Furnish materials meeting the following requirements:

Bolted, sleeve-type couplings for plain end pipe	02475.60
Commercial grade concrete in thrust blocks	00440
CLSM	00442
Concrete Cylinder Pipe	02470.36
Detectable marking tape or wire	02470.60
Ductile iron pipe fittings	02475.20
Ductile iron pipe	02470.20
Polyethylene encasement	02470.50
Reinforcement	00530
Restrained joints	02475.50
Steel pipe - 6 inches and larger	02470.30
Steel pipe fittings - 6 inches and larger	02475.30
Steel pipe fittings - under 6 inches	02475.35

01140.11 Handling Pipe and Fittings:

(a) General - Handle pipe and fittings so as to prevent damage to the pipe, fitting, lining, or coating. Load and unload pipe and fittings using hoists and slings so as to avoid shock or damage, and under no circumstances allow them to be dropped, skidded, or rolled against other pipe or fittings. If any part of the coating or lining is damaged, repair in an approved manner. Damaged pipe and fittings will be rejected. Immediately separate all damaged pipe and fittings and remove from the job site.

(b) Thread Protection - Protect threaded pipe ends with couplings or other means until installed. Inspect the pipe and fittings and notify the City of any defects.

(c) Storage and Delivery - Pipe shall be delivered with protective covering on pipe ends to prevent entry of dirt, groundwater, or other foreign material. Store pipe on cradles and maintain protective covering during storage.



01140.12

(d) Bracing - For concrete cylinder pipe and steel pipe, furnish pipe and fittings with temporary bracing inside as shown or as recommended by the manufacturer. Bracing shall be installed as soon as practicable after cement mortar lining is applied. Maintain bracing in place until the pipe zone backfill has been placed and compacted. Prevent damage to the pipe when removing bracing. Pipe end shall be sealed by the manufacturer to keep moisture in and prevent cracking of lining material.

(e) Placement - Keep the pipe or pipe joint free of dirt or other foreign material during handling and laying operations.

01140.12 Cutting Pipe:

(a) General - The minimum length of cut pipe used for adjustments, proper spacing of valves, tees or special fittings shall be no less than 2 feet.

(b) Cutting Operation - Cut pipe with abrasive saws or by special pipe cutters. Square all pipe ends with the longitudinal axis of the pipe. Ream and otherwise smooth the cut ends so that good connections can be made. Cut threads cleanly. Flame cutting of ductile iron pipe will not be allowed. Inspect trimmed pieces to ensure cement lining was not damaged during the cutting process per manufacturer recommendations.

Construction

01140.40 Trench Work - Excavate trench, install bedding, pipe zone material, backfill, and dispose of excavated material according to Section 00405 and the following:

(a) Dewatering Trenches - Remove water encountered in the trench during pipe laying operations and maintain the trench until the ends of the pipe are sealed and provision is made to prevent floating of the pipe. Do not allow trench water or other deleterious or foreign materials to enter the pipe at any time. Pipe shall not be installed in standing water.

(b) Bedding and Pipe Zone - For the purpose of these Specifications, all potable water pipes are considered flexible pipes. Use bedding and pipe zone material for flexible pipes as described in 00405.12 and 00405.13 and as shown.

(c) Work in Contaminated Soils - Contract Work in Contaminated Soils or Suspected Contaminated Soils, cleanup and treatment of the contaminated soils must be done in accordance with DEQ regulations and requires special training and certification from DEQ. If unexpected contaminated soils are encountered, comply with 00291.45.

(d) Installation in Paved Areas - If pipe is installed within paved areas to be preserved, perform the installation according to Sections 00405 and 00495.

(e) Scheduling - Schedule work so that pipe trench is backfilled daily.

01140.41 Pipe Installation:

(a) **General** - Lay pipe to the lines and grades shown and established.

(b) **Ductile Iron Pipe** - Install ductile iron pipe according to AWWA C600 and the manufacturer's recommendations.

(1) **Depth of Cover** – Depth of cover shall be from the finish grade to the top of the pipe. Where no pipe grade elevations are shown, install pipe with at least 36 inches of cover for pipe 8 inches in diameter and smaller; install pipe with at least 42 inches of cover for pipe 12 inches in diameter; install pipe with a minimum of 48 inches of cover for pipe 16 inches in diameter and larger. Do not backfill pipe unless approved.

(2) **Curves and Deflections** - Lay long radius curves, either horizontal or vertical, with standard pipe by deflecting the joints. If the pipe is shown curved in the plans and no special fittings are shown, assume that curves may be achieved by deflecting the joints with standard lengths of pipe. Do not exceed 80% of the manufacturer's printed recommendations for the amount of deflection at each joint when the pipe is laid on a horizontal or vertical curve.

(3) **Pipe Laying Procedure** - When ductile iron pipe is laid on a curve, join the pipe and fittings in a straight alignment and then deflect it to the curved alignment. Pipe shall not hug trench wall. Make trenches wider on curves for this purpose.

(4) **Layout** - Pipe may be strung along the street a maximum distance of 300 lineal feet or enough pipe for one day of installation, whichever is less. Do not block driveways or otherwise interfere with the use of private property. Distribute the pipe so that no hazard will be presented to occupants of the adjoining property, or pedestrian and vehicular traffic. Ensure all pipe, fittings and construction materials are secured from movement while staged.

(5) **Fittings** – Do not use cast plain-end fittings. Fabricated ductile iron spools are permitted.

(c) Steel Pipe and Concrete Cylinder Pipe:

(1) **Installation** - Install steel pipe and concrete cylinder pipe according to the manufacturer's recommendations. Install steel pipe and concrete cylinder pipe on curves according to 01140.41(b)(3).

(2) **Steel Welds** - Steel welds shall conform to the requirements of AWWA C206. For 36 inch nominal diameter and larger pipe, lap joints shall be full fillet double welded. The City shall perform weld inspection that may include a certified welding inspector (CWI).

(d) **Compliance with OAR 333** – Install new water lines and appurtenances in compliance with OAR 333 regulations governing the horizontal and vertical separations between water and sewer facilities.

(1) Variance - If variance is proposed, submit written proposal for review and approval by the Portland Water Bureau. Include the reason for the variance, type of material and condition of the sewer line, location of the water and sewer facilities, horizontal and vertical skin-to-skin clearances and the corrective measures proposed. Each variance will be considered on a case-by-case basis.

(2) Review Time - Allow a minimum of 5 working days review and response to each proposal.

(e) Restraint – All joints within the designated restrained joint area shown or as directed, shall be restrained. Additional restrained ductile iron pipe and fittings may be required to resolve conflicts with utilities and obstructions, or for changes in alignment, change in location of appurtenances, or change in testing locations or change in connection locations.

(f) Utility Crossings – Install Schedule 80 PVC pipe or 40 mil reinforced geomembrane for encasement of waterlines where the new waterline crosses any cathodically protected utility lines for 20 feet of length, 10 feet on each side of the crossing. See Section 01180 for additional requirements.

(g) Pipe Cleanup – As pipe-laying progresses, keep the pipe interior clean and free of all debris. Completely clean the interior of the pipe, including fittings and appurtenances, and remove any sand, dirt, mortar splatter, and any other debris before testing and disinfecting the system.

01140.42 Jointing Pipe:

(a) General - Clean all parts of the pipe ends, couplings, fittings, and appurtenances to remove oil, grit, or other foreign matter from the joint. Keep the joint from contacting the ground. When assembling gasketed joints, apply an ANSI/NSF Standard 61, Drinking Water System Components – Health Effects, or equivalent (NSF 61) approved lubricant as specified by the pipe manufacturer. Maintain cover on pipe ends until installation. Mark pipe not furnished with a depth mark before joint assembly. Plug, cap, or otherwise close the last section of pipe installed with a watertight plug. Coating of field joints shall be applied after all welding operations are complete and inspected. Refer to Section 01180 for additional requirements.

(b) Steel Pipe: 6 Inches and Larger Joint Protection:

(1) Inside Joints – Install cement mortar in joints as specified by AWWA C205 – Field Joints. Apply the lining after the pipe is installed, backfilled, compacted and interior surfaces have been cleaned. Cement mortar lining must be NSF 61 approved and as recommended by the pipe manufacturer.

(2) Outside Joints:

a. Tape Coating - Apply a hot or cold applied coal tar tape coating in accordance with AWWA C203 or AWWA C209 respectively. The cold applied coal tar tape can be used only if the Contractor furnishes an affidavit of compliance with AWWA C209 and the tape meets the materials specifications with a minimum width of 4 inches and a total wrapping thickness of not less than 80 mils.

b. Mortar Coating - Clean the exposed metal at the exterior space and fill the annular space with a Portland cement grout. Grout shall be one part cement to one and one half parts fine sand with sufficient water to form a mixture the consistency of thick cream. Wrap the joint with a strip of clean woven fabric and band around the pipe at each side of the joint. The fabric shall be woven to allow the escape of air and excess water, but prevent escape of mortar. The fabric shall be no less than 80 mil thickness. Grout the joint full through a space in the woven fabric slightly to one side of the top. Rod the grout with a beaded wire or chain as it is poured into the joint. Immediately after completing the exterior joint, place approved pipe zone backfill material over and around the joint to prevent rapid drying per pipe manufacturer's recommendations. Commercially approved diapers with integral banding may be used.

(c) Concrete Cylinder Pipe Joint Protection:

(1) Inside Joints - After the trench backfill has been placed and compacted, dampen the inside joint space with clean water or a neat cement slurry and fill by compacting into the joint an NSF 61 approved Portland cement grout. Grout shall be one part cement to not more than two parts fine sand with sufficient clean water to form a stiff mix. Finish the surface to a dense troweled surface free of projections or depressions and flush with the inside pipe surface. Do not put the pipeline into service until the mortar has cured per the manufacturer's recommendations.

(2) Outside Joints - Clean the exposed metal at the exterior space and fill the annular space with a Portland cement grout. Grout shall be one part cement to one and one half parts fine sand with sufficient water to form a mixture the consistency of thick cream. Wrap the joint with a strip of clean woven fabric and band around the pipe at each side of the joint. The fabric shall be woven to allow the escape of air and excess water, but prevent escape of mortar. The fabric shall be no less than 80 mil thickness. Grout the joint full through a space in the woven fabric slightly to one side of the top. Rod the grout with a beaded wire or chain as it is poured into the joint. Immediately after completing the exterior joint, place approved pipe zone backfill material over and around the joint to prevent rapid drying per pipe manufacturer's recommendations. Commercially approved diapers with integral banding may be used.

01140.43 Polyethylene Encasement - Furnish and install according to 01180.18 and 01180.46 as shown or directed.

01140.44

01140.44 Concrete Thrust Blocks - Place concrete thrust blocks when shown or directed, at bends, tees, dead ends, and crosses. Wrap pipe or fittings with 8 mils thickness polyethylene encasement before pouring concrete. Cast concrete thrust blocks in place against solid, undisturbed earth at the sides and bottom of the trench excavation. Shape the blocks so as not to obstruct access to the joints of the pipe or fittings. At no time allow fly ash or calcium containing cementation materials to come into contact with the ductile iron or ferrous materials.

01140.45 Detectable Marking Tape or Wire:

(a) **Installation** - Install detectable marking tape or wire over all nonmetallic water lines, including service connections. Place the tape or wire approximately 1 foot above the top of the pipe for its full length. Tracer wire shall be blue 18 gauge minimum. Splices are allowed with an approved kit only. Detection tape shall have printed along length "water" or "water line".

(b) **Accessibility** - Make ends of tape or wire accessible in water meter boxes, valve boxes or casings, or outside the foundation of buildings where the pipe enters the building. Provide detectable marking tape or wire access at locations less than 1,000 feet apart or as shown.

01140.46 Connections to Existing Mains:

(a) **Service Connections and Main Tie-ins** - The City will make the service connections and the main tie-ins to the existing water system, unless otherwise specified or directed.

(b) **Valve Operation** - Do not operate any valves on the existing water system. Coordinate with the Engineer to make all necessary arrangements for notification and temporary services prior to disrupting any existing services.

01140.47 Maintaining Service:

(a) **Coordination** - Where existing services are to be transferred from old to new mains, plan and coordinate the work with that of the City so that service will be resumed with the least possible inconvenience to the public. City will review potential disruptions of service on a case by case basis.

(b) **Connection Work by Contractor** - Verify line and grade on all key connection points. Do not operate the system once it has been connected without written pre-approval.

(c) **Connection Work by the City** - The City will make connections of the new pipe at such locations as the City may elect to supply customers with water, after the affected section of pipe has passed hydrostatic and bacteriological tests. The installation of any such connections by the City shall not be construed as an acceptance by the City of any part of the work required under the contract.

01140.48 Backfilling - After the pipe is installed and inspected, backfill the trench according to Section 00405 and as shown.

01140.49 Out-of-Service Water Mains - Submit abandonment plan identifying locations and limits of work, CLSM mix design, method of installation of CLSM and CLSM volumes for each pipe section. Drain out-of-service potable water mains and install plug or cap on opposing pipe ends or as directed. Remove valve boxes, risers, and meter boxes. Remove out-of-service pipes as shown or approved in writing. For mains 12 inches and larger that are not removed, install tapped caps with vent/grout/standpipe piping and fill pipe with CLSM. Vent/grout/standpipe piping shall allow water and air to be expelled from the pipe and verification that pipe section is completely filled. CLSM shall attain a 28-day compressive strength of 100 to 150 psi. CLSM shall be pumped or gravity fed into one end of the out-of-service pipe section. After CLSM filling is complete, cut and remove vent/grout/standpipe piping.

Testing

01140.50 Filling and Flushing:

(a) Pipe Filling - Fill pipes slowly with potable water at a maximum velocity of one foot per second in the main while venting all air. Take all required precautions to prevent entrapping air in the pipes. Refer to 00170.02 and 00405.49 for batch discharge permit.

(b) Pipe Flush - Flush sections of pipe to be tested and disinfected to remove any solids or contaminated material that may have become lodged in the pipe during manufacture, delivery or construction. Flushing shall not exceed the allowances listed in the discharge permit from the applicable regulatory authority.

(c) Disposal of Treated Water - Dispose of treated water flushed from mains. Neutralize the waste water for protection of aquatic life in the receiving water before disposal into any natural drainage channel. Dispose of disinfecting solution to the satisfaction of the Engineer and the applicable agencies. If approved, disposal may be made to any available sanitary sewer provided the rate of disposal will not overload the sewer. Refer to the applicable discharge permit for maximum flow rates.

01140.51 Hydrostatic Testing:

(a) General - Test all water mains and appurtenances under a hydrostatic pressure equal to 1 1/2 times the working pressure, but at least 150 psi, measured at the highest point of the test section. High pressure systems will require higher test pressures. Furnish all labor, materials and equipment necessary for performing the test. City will furnish a calibrated pressure gauge for hydrostatic testing. Refer to Section 01180 to coordinate hydrostatic testing with corrosion protection testing.

(1) Backfill - Do not begin hydrostatic test until backfill has been placed, compacted and passed required testing and the thrust blocks have reached 75% of the design strength. Where permanent blocking is not required, furnish and install temporary blocking and remove it after testing.

(2) Pre-Test Preparation - Furnish all labor, materials, and equipment such as but not limited to air tanks, fittings, pumps, hoses, valves, and meters, necessary to fill and test the line except for the calibrated pressure gauges to be furnished by the City. Fill the mains with water and allow to stand under 75% test pressure for at least 12 hours to allow the escape of air and to allow the lining of the pipe to absorb water. The City will furnish the water to fill the pipeline at no cost to the Contractor for flushing and testing the water pipeline on water projects only. Transportation of the water from the source to the site shall be the Contractor's responsibility. A hydrant permit and an approved backflow prevention device are required for water main testing.

(3) Test Time - Test by pumping the main up to the required pressure for at least 2 hours. Continuously maintain pressure within 5 psi of that required. During the test, observe the section being tested to detect any visible leakage. Use a clean container to hold water for pumping up pressure on the main being tested. Sterilize this makeup water by adding chlorine to a concentration of 25 mg/L.

(4) Measure Quantity - The City will determine the quantity of water required to maintain and restore the required pressure at the end of the test period.

(5) Loss Formula - The maximum allowable hourly leakage rate calculation is as follows:

$$L = \frac{SD (P)^{1/2} \times 128}{148,000}$$

In the above formula:

L = Allowable leakage in ounces per hour
 S = Length of pipe tested, in feet
 D = Nominal diameter of pipe, in inches
 P = Test pressure during the leakage test in psi

The test lasts for 2 hours and each hour's loss stands on its own and will not be averaged. This formula is not applicable to HDPE or PVC pipe.

(6) Pressure Loss - There shall be no appreciable or abrupt loss in pressure during the test period.

(7) Leakage - Correct any visible leakage regardless of the allowable leakage specified above. After correcting the leak, restart the test for 2 hours.

(8) Use of Hydrant Valves - Make all tests with the hydrant auxiliary gate valves open and pressure against the hydrant valve. After the pipe test has been completed, test each gate valve in turn by closing it and relieving the pressure beyond. This test of the gate valve will be acceptable if there is no immediate loss of pressure on the gauge when the pressure beyond the valve is relieved. Verify that the pressure differential across the valve does not exceed the rated working pressure of the valve.

(9) Test Section Length - Limit section to be tested to 1,200 feet, unless otherwise shown or approved. The City may require that the first installed section of pipe, not less than 1,200 feet in length, be tested. Do not continue pipe laying more than an additional 1,200 feet until the first section has been tested successfully.

(10) Test Equipment Readiness - Prior to calling out the City to witness the pressure test, set up all equipment completely ready for operation and successfully perform the test to ensure that the pipe is in a satisfactory condition.

(11) Defective Materials or Workmanship - Replace defective materials or workmanship discovered during hydrostatic testing. Whenever it is necessary to replace defective material or correct the workmanship, repeat the hydrostatic test until a satisfactory test is obtained. Repairs shall be at the Contractor's expense.

(b) Air Testing – Air testing on steel pipe for full double welded lap and double welded butt strap joints shall conform to the requirements of AWWA C206 and as modified:

(1) Tap Installation - Provide a 1/4 inch IPT tap into the welded joint. Apply a static air pressure of 100 psi minimum into the joint for a minimum of 10 minutes.

(2) Welds - While the joint is under pressure, coat welds, inside and out, with a soapy water solution.

(3) Leakage - If bubbling or leakage is visible, repair or replace the defective joint and repeat the test.

01140.52 Disinfecting - Disinfect all new mains according to the following:

(a) General - After passing the hydrostatic testing, disinfect the new water mains according to the procedure outlined in 01140.52(d). Allow a minimum of 5 days for testing and disinfection.

(b) Temporary Sample Points - For temporary service and air release sample points, temporary 2 inch construction, test and flushing/sample risers, sample stations are required at 1200 foot maximum intervals and on all side branches, or as directed. Hydrants may not be used as temporary sample points.

(c) **Dechlorination** - All water having chlorine residual shall be dechlorinated and disposed of in a manner which meets the DEQ standards and is accordance with 01140.50(d). No chlorinated water shall be discharged into a storm drainage system or stream prior to approved dechlorination treatment.

(d) **Chlorination Procedure** -Chlorinate all new mains according to the following:

(1) **Isolate Main** - Ensure that the main is completely isolated (physical separation or closed valve) from the system before proceeding with the disinfection process. Approved backflow protection is required if the source water for flushing or disinfection is the active distribution system. Do not test against a closed isolation valve on a live system.

(2) **Valve Position** - All non-isolation valves on the new main, fire hydrants and branches shall be in the fully open position.

(3) **Pipe Flush** - Flush new main, branches and services thoroughly with potable water to remove any sediment and debris. The minimum flushing velocity for this step is 2.5 feet per second (per AWWA Standard C651) unless conditions of the batch discharge permit make this flushing velocity unattainable.

(4) **Chlorine Amount** - Calculate the amount of liquid sodium hypochlorite necessary to achieve the minimum residual required by DHS regulations, 25 ppm. In order to ensure that this is achieved; use a target residual of 50 ppm unless otherwise directed. Maximum residual is 75 ppm unless otherwise directed. Any sodium hypochlorite used for the disinfection process must be NSF 60 certified and conform to AWWA B300.

(5) **Chlorine Application** - Maintain a steady flow rate while injecting the main with chlorinated water. Flow (bleed) a blow-off, standpipe, or hydrant at the high point(s) to allow air to escape and ensure that all interior pipe surfaces are wetted.

(6) **Chlorine Residual** - Measure chlorine residual with the high-range chlorine test kit at a point near to the injection point while filling the main. Adjust the dose rate as necessary to maintain the target dose rate.

(7) **Residual Measurements** - Once the main is completely filled with super-chlorinated water, measure the chlorine residual a minimum of once every 1200 feet of main and once for each main branch, or 2 inch service or as directed. The measured chlorine residual shall be at least 25 ppm and not greater than 75 ppm. If any chlorine residual measurement is less than 25 ppm or greater than 75 ppm, repeat steps (3) through (6).

(8) **Retention Time** - Wait 24 hours. The City will measure another set of chlorine residuals with the high-range chlorine test kit. The measured chlorine residuals shall be at least 10 ppm. If the chlorine residual is less than 10 ppm, repeat steps (3) through (7). If chlorine residual is 10 ppm or higher, proceed to the next step.

(9) Refill and Flush -Thoroughly flush the main, branches, and services with potable water until the chlorine residual in the main is approximately the same as the source water (approximately 2 ppm). There is no minimum flushing velocity for this step.

(e) Bacterial Testing - After completing the chlorination procedure test the main according to the following:

(1) Bacterial Sampling - DHS rules and the AWWA standards referenced therein require that a main pass 2 successive sets of bacteriological tests (the successive sets of samples shall not be collected on the same day). Two consecutive negative (passing) test results are required. Allow 24 hours for the test results for each sample.

(2) Sampling Locations - The City will take one bacteriological sample from the end of the main and on each branch. For long runs of main, at least 1 sample will be taken for every 1200 feet of new main and as directed.

(3) Sample Testing - The City will test the sample set for coliform bacteria and publish the test results within 24 hours.

(4) Evaluating the Test Results - If all test results of the sample set are negative (passing) repeat steps (2) through (4). When 2 consecutive sample sets test negative for coliform bacteria, the bacterial testing is complete. If 1 or more of the sample set tests positive for coliforms (fails), repeat steps (2) through (4) after correcting the cause of the failure and as directed by the Engineer

(5) Completion of Bacterial Testing - Upon completion of bacterial testing notify the City in writing that the testing is complete and the main is ready for tie-in.

(6) Multiple Positive (Failing) Test Results - If sample sets continue to test positive for coliforms, the Engineer will determine how to proceed, up to and including repeating the chlorination procedure or rejecting the pipe.

Measurement

01140.80 Pipe:

(a) Unrestrained Pipe - The quantities of the various kinds of pipe will be measured by the foot. Measurement will be horizontal measurement along the top of the trench with no deduction for fittings, valves, and couplings.

01140.81

(b) Restrained Pipe - The quantities of the various kinds of pipe will be measured by the foot. Measurement will be horizontal measurement along the top of the trench with no deduction for fittings, valves, and couplings. Measurement will only include the quantities of restrained pipe shown. No measurement will be made of additional restrained pipe installed for Contractor convenience.

(c) Sanitary Sewer Crossings - Pay length for sanitary sewer replacement or encasement when listed as separate pay items will be measured on a foot basis along the horizontal centerline of the finished trench.

01140.81 Couplings - Flex couplings and insulated flex couplings will be measured on a unit basis by size. All other couplings will not be measured.

01140.82 Additional Ductile Iron Pipe and Fittings - Measurement for additional ductile iron pipe and fittings added to resolve conflicts with utilities and obstructions will be made per the restrained ductile iron pipe pay item and Sections 00195, 00196 and 00197.

Payment

01140.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) _____ inch Ductile Iron Pipe.....	Foot
(b) _____ inch Ductile Iron Pipe Restrained	Foot
(c) _____ inch Concrete Cylinder Pipe	Foot
(d) _____ inch Concrete Cylinder Pip Restrained.....	Foot
(e) _____ inch Steel Pipe	Foot
(f) _____ inch Steel Pipe Restrained	Foot
(g) _____ inch Sanitary Sewer Crossing	Foot
(h) _____ inch Flex Couplings	Each
(i) _____ inch Insulated Flex Couplings.....	Each

The Contract unit price for the appropriate pay items reflects plan requirements or the Contractor's choice from the applicable options listed on the Pipe Data Sheets (if provided in the plans).

In items (a) through (i) the nominal diameter of pipe or coupling will be inserted in the blank.

Payment will be payment in full for furnishing and placing materials, and for furnishing all equipment, labor and incidentals necessary to complete the work as specified.

Trench work will be paid for according to Section 00405.

Trench resurfacing will be paid for according to Section 00495.

| Tunneling, jacking or boring will be paid for according to Section 00406.

| No separate or additional payment will be made for:

- concrete thrust blocks
- | • detectable marking tape and wire
- flushing, hydrostatic testing and disinfection
- | • geomembrane of water line and appurtenances
- | • polyethylene encasement of water line and appurtenances
- temporary blocking and restraint
- abandoning out-of-service pipes
- temporary blow offs
- test sampling points
- | • all couplings, other than flex couplings and insulated flex couplings



Section 01150 - Potable Water Valves

Description

01150.00 Scope - This work consists of furnishing and installing valves in potable water systems at the locations shown or at other locations as directed.

Materials

01150.10 Materials - Furnish materials meeting the following requirements:

Backflow prevention devices.....	02480.70
Ball valves.....	02480.23
Blowoff assemblies.....	02480.71
Butterfly valves.....	02480.22
Combination air release/air vacuum valves.....	02480.60
Commercial grade concrete in precast concrete blocks.....	00440
Commercial grade concrete in thrust blocking.....	00440
Gate valves.....	02480.20
Hydraulic cushion check valves.....	02480.40(c)
Hydraulically operated valves.....	02480.50
Polyvinyl Chloride (PVC) Pipe.....	02410.70
Power-actuating devices.....	02480.24
Spring-loaded plug or disc check valves.....	02480.40(b)
Swing check valves.....	02480.40(a)
Tapping sleeve and valve assemblies.....	02480.30
Valve boxes.....	02480.25
Valve operator extensions.....	02480.26

01150.11 Handling:

(a) Damage Prevention - Handle valves so as to prevent damage to the valve, lining or coating. Load and unload valves using hoists and slings so as to avoid shock or damage, and under no circumstances allow them to be dropped or skidded. Damaged valves will be rejected. If damage is confined to the coating or lining, replace or propose a repair method to be approved. Immediately remove damaged valves from the site.



(b) City-Furnished Materials - Arrange with the Engineer to obtain City-furnished valve boxes a minimum of 2 working days in advance, with pickup times between 9 a.m. and 3 p.m. Monday through Friday at the City's Interstate Yard. No pick up will be allowed on weekends and City observed holidays. Confirm order approval with Engineer prior to pick up.

(c) Materials Return - Return all unused and surplus City-furnished materials to the City's Interstate Yard no later than 3 working days prior to final inspection. Make arrangements with Engineer for material return time and date. The City will not accept the returned materials if they are not clean and in the same good condition as originally supplied. Cost for unacceptable returned materials will be deducted from the final payment.

01150.12 Connecting Ends - Furnish valves with connecting ends as shown and as required for connection to pipe and fittings furnished.

Construction

01150.40 Valves:

(a) **General** - Install valves according to the plans and the manufacturer's recommendations. Install valves in a manner that prevents any injury or damage to any part of the valve. Join to the pipe as set forth in Section 01140 and AWWA Standards for the type of connecting ends furnished. Thoroughly clean and prepare joints prior to installation. Where full face gaskets of a flanged type are used, no trimming of material will be allowed.

(b) **Valve and Valve Box Installation** - Set valves and valve boxes plumb. Operating nut on butterfly valves shall face the nearest curb, if applicable. Center the valve boxes over the operating nut of the valve. Place PVC riser and valve box over the valve or valve operator so that the valve box does not transmit shock or stress to the valve. Valve boxes installed in gravel or native landscaping shall be set in a circular concrete pad 18 inches in diameter, 6 inches minimum in depth. Do not bury or block access to any valve.

(c) **Valve Operator Extensions** - Install a valve operator extension with rock guard on any valve where the valve nut operator is installed more than 4 feet below finish grade. Extensions shall be hot dip galvanized after fabrication. Extension operator nuts shall be 2 feet from finish grade.

(d) **Backfilling** - Carefully tamp backfill around the valve box to a distance of 3 feet on all sides or to the undisturbed face of the trench, whichever is closer. Backfill around valves shall be in accordance with Section 00405. Set the CIV box cover flush with the roadbed or finish paved surface. Prior to substantial completion, all valve box covers and PVC risers shall be cleaned and free of all debris.

(e) **Large Valve Installation** - For all valves 16 inch and larger, place precast concrete block or valve pad concrete on undisturbed earth in the trench bottom. Construct valve pads with reinforcing steel to elevations and dimensions shown. Allow a minimum of 5 days curing time before placing the valve on the pad.

01150.41 Combination Air Release/Air Vacuum Valves - Install combination air release/air vacuum valves as shown. Slope all piping to permit escape of any entrapped air. Perform trenching and backfilling according to 01170.40 and Section 00405.

01150.42 Blowoff Assemblies - Construct blowoff assemblies as shown.

Testing

01150.50 Valve Operation Testing - After installation and hydrostatic testing, operate valves from full open to full closed to make sure valves do not bind during operation. Correct any malfunction in the operation of the valves. Verify and record the number of turns to 1/4 turn and direction from full open to full closed and submit documentation for the City's records prior to completing final project as-constructed drawings. Leave all valves open after testing is complete.

01150.51 Hydrostatic Testing - Subject valves to hydrostatic testing according to 01140.51. Correct any defects in design, materials or workmanship to the satisfaction of the Engineer.

01150.52 Disinfecting - Disinfect valves according to 01140.52.

Measurement

01150.80 Measurement - The quantities of valves will be measured on the unit basis.

01150.81 Blowoff Assemblies - Blowoff assemblies will be measured on the unit basis.

Payment

01150.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) _____ inch Gate Valve, MJ	Each
(b) _____ inch Butterfly Valve, MJ.....	Each
(c) _____ inch Combination Air Release/Air Vacuum Valve	Each
(d) _____ inch Air Release	Each
(e) _____ inch Blowoff Assembly	Each

In items (a) through (e) the size of the valve or assembly will be inserted in the blank.

Item (e) includes main line tee or tapping sleeve, gate valve, fittings, ductile iron pipe or copper pipe, joint restraint, testing and cleanup and surface restoration.

Payment will be payment in full for furnishing and placing the materials, and for furnishing all equipment, labor and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for earthwork not covered under other pay items, jointing, blocking of valves, protective coatings, valve boxes, valve operator extensions, valve pads, PVC riser and hydrostatic testing.

01150.91 Incidental - Payment for 6 inch gate valves used for hydrants shall be incidental to the fire hydrant assembly specified in 01160.91. Payment for 2 inch valves for 2-inch service lines are also incidental to the 2 inch service specified in Section 01170.

01150.92 City Furnished Materials - No separate or additional payment will be made for obtaining, installing, interim and final adjustments to match final grade and returning unused City-furnished CIV boxes and covers.



Section 01154 - Precast Concrete Vaults and Appurtenances

Description

01154.00 Scope -This work consists of furnishing and installing precast concrete vaults for meters, control valves, and other water system appurtenances at the locations shown or at other locations directed.

Materials

01154.10 Materials- Furnish materials meeting the following requirements:

Base Aggregate	02630
Potable Water Fitting Materials	02475
Potable Water Pipe Materials.....	02470
Potable Water Service Connection Materials, 2 Inch & Smaller.....	02490
Potable Water Valve Material.....	02480
Precast Concrete Vaults	02484

Construction

01154.40 Precast Concrete Vault - Install the vault plumb, free from movement and firmly set in place in location shown or as directed. Vault shall be installed watertight.

01154.41 Structural Backfill:

(a) Bedding - Place the vault on a minimum 6 inch thick layer of Class B backfill placed and compacted according to 00405.46. Place and level fill material to reduce the occurrence of voids between the vault and the backfill.

(b) Sidewall Backfill - Place 1" - 0 or 3/4" - 0 aggregate along each wall of the vault and compact to 95% Standard Proctor.

01154.42 Pipe, Fittings and Appurtenances - Install pipe, fittings, valves and appurtenances as shown.

01154.43 Pipe Penetrations - Core drill penetrations of piping, valve boxes and electrical conduits. Verify location of holes prior to core drilling. All core drills shall be water tight once piping is complete.

01154.44 Paint, Sealers and Coatings - Apply paint and sealant as shown. All vaults shall be coated with Co-Ma-Seal or approved equal according to manufacturer's recommendations.

01154.45 Ladder and Ladder Extension - Ensure that ladder is securely fastened to concrete vault wall. Ladder installation shall conform to all safety requirements of the Oregon Occupational Safety and Health Code, Stairways and Ladders. Ladder installation shall provide a minimum 3 feet extension and a maximum of 4 feet extension above finish grade.

01154.46 Finishing and Cleanup - Prevent entrance of dirt, grout, and other materials into drainage piping. Clean out rock, debris, and asphalt from around CIVs, access hatch and sump.

Testing

01154.51 Hydrostatic Testing - Hydrostatically test and flush all piping through the vault according to Section 01140.

Measurement

01154.52 Disinfecting - Disinfect according to and in conjunction with 01140.

Payment

01154.90 Unit Basis - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following item:

Pay Item	Unit of Measurement
___ Inch, ___Type Vault and Assembly.....	Each

In the item above, the following will be inserted in the blanks:

- The size of the vault and assembly in inches will be inserted with a separate pay item for each size.
- The dimension type of the vault and assembly will be inserted in the second blank.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for valves, appurtenances, earthwork, and acceptance testing.



Section 01160 - Hydrants and Appurtenances

Description

01160.00 Scope - This work consists of furnishing and installing dry-barrel fire hydrants and appurtenances in potable water systems at the locations shown or at other locations as directed.

Materials

01160.10 Materials - Furnish materials meeting the following requirements:

Auxiliary gate valves	02480.20
Concrete hydrant pad	00440
End connections	02485.20
Fire hydrants	02485.10
Guard posts	02485.70
Hydrant dimensions	02485.30
Hydrant extensions	02485.40
Traffic flange	02485.50
Valve boxes	02480.25
Valve operator extensions	02480.26

01160.11 Handling of Hydrants:

(a) Loading and Unloading - Handle hydrants so as to prevent damage to the hydrant, lining or coating. Load and unload hydrants using hoists and slings so as to avoid shock or damage, and under no circumstances allow them to be dropped, skidded or rolled against other hydrants. Damaged hydrants will be rejected. If damage is confined to the coating or lining, it may be repaired in an approved manner. Immediately place all damaged hydrants apart from the undamaged and remove the damaged hydrants from the site as soon as possible. Damaged hydrants shall be marked with a tag or a steel crayon until removed.

(b) End Caps - Provide factory-applied end cap on pipe connection end. Maintain end cap through shipping, storage and handling to prevent damage and prevent dirt and moisture from entering the hydrant.

(c) Delivery Inspection - Inspect hydrants upon delivery in the field to ensure proper working order.



Construction

01160.40 Setting Hydrants:

(a) Hydrant Installation - Install hydrant assemblies as shown and in conformance with applicable provisions of Section 01140. Set hydrants plumb with nozzles parallel, or at right angles to the curb, with the pumper nozzle facing the curb. Set the traffic flange (breakaway flange) at least 2 inches but not more than 6 inches above the finish grade. Measure from the back of the hydrant flange at the lowest bolt elevation. Provide a minimum 6 foot unobstructed working area extending from the hydrant center out on both sides, and a minimum 3.5 feet unobstructed working area extending behind from the hydrant center, around all hydrants including proximity to any permanent structures including guard posts, signs, guy wires, buildings, and other vertical objects. Maintain a 4 foot skin-to-skin clearance between all hydrants and poles supporting or conducting electrical power. In curbed locations, set hydrant back from street as shown.

(b) Drainage Gravel - Place drainage gravel around the pier block and bottom of hydrant to 6 inches above the hydrant drain opening.

(c) Drain Rock Cover - Place textile fabric to cover drain rock prior to placement of backfill. Setting shall allow the hydrant barrel to drain into drainage gravel at base of hydrant.

(d) Touchup Painting - After installation and testing is complete, paint the exposed portion of the hydrant with a minimum of one coat of the type and color coating as directed. Paint hydrants according to Section 02485.

(e) Out-of-Service Hydrants - To indicate that a fire hydrant is not operational, secure with reflective tape a yellow or orange plastic bag over the entire hydrant assembly or an approved out-of-service cover. The Contractor may also use an out-of-service ring in addition to the bag or cover in case of removal of the cover. Maintain the plastic bag or cover until the waterline is accepted or the water line has been connected to the live water system.

01160.41 Hydrant Laterals - Install hydrant laterals, consisting of 6 inch ductile iron pipe, from the auxiliary gate valve at the main to the hydrant, according to Section 01140 and as shown.

01160.42 Hydrant Restraints - Fully restrain all hydrant laterals with mechanical restraint from the main to the hydrant assembly as shown.

01160.43 Auxiliary Gate Valves and Valve Boxes - Install auxiliary gate valves and valve boxes according to Section 01150.

01160.44 Hydrant Guard Posts - Construct hydrant guard posts at the locations shown. Excavate holes 16 inches in diameter for hydrant guard posts to a depth of 36 inches. Install hydrant guard posts plumb, and center in the holes. Backfill the holes and fill the hydrant guard posts with Commercial grade concrete. Paint the exposed portion of each guard post with one coat of the type and color coating as directed.

01160.45

01160.45 Hydrant Extensions - Install hydrant extensions where required. Set the traffic flanges a minimum of 2 inches above finish grade and a maximum of 6 inches above finish grade from back of flange at lowest bolt elevation.

01160.46 Hydrant Pads - Hydrants shall have a 3 feet x 3 feet x 6 inches, 4,000 psi concrete pad installed after the hydrant has been set to grade as shown. Center hydrant pad on hydrant. Set hydrant pad flush with surrounding surfaces or as directed. Hydrant pads may be adjusted to reach the back of curb if the hydrant pad is no less than one foot in any one direction.

Testing

01160.50 General - After installation, operate hydrants from full open to full closed to make sure they do not bind during operation. Correct any malfunction in the operation of the hydrants.

01160.51 Hydrostatic Testing - Subject hydrants to hydrostatic testing in accordance with 01140.51.

01160.52 Disinfecting - Disinfect hydrants according to 01140.52.

Measurement

01160.80 Measurement - The quantities of work performed under this Section will be measured on the unit basis.

Payment

01160.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items.

Pay Item	Unit of Measurement
(a) Hydrant Assemblies.....	Each

Payment will be payment in full for furnishing and placing all materials, equipment, labor, and incidentals necessary to complete the work as specified and as shown.



No separate or additional payment will be made for:

- hydrant extension for grade adjustment
- restraint on hydrant run and the main run for the hydrant tee and hydrant run
- excavation, bedding and backfill
- valve operator extension
- hydrant guard posts
- out of service cover
- painting
- compaction
- testing
- surface restoration and clean up
- PVC riser for CIV box and cover

01160.91 City Furnished Materials - No separate or additional payment will be made for obtaining, installing, interim and final adjustments to match final grade and returning unused City-furnished CIV boxes and covers.



Section 01170 - Potable Water Service Connections, 2 Inches and Smaller

Description

01170.00 Scope - This work consists of furnishing and installing service connections, 2 inches in diameter and smaller, from the main to the water meter, and furnishing and installing sampling stations. The water meter will be furnished and installed by City unless specified otherwise in the Special Provisions or on the plans.

01170.02 Definitions:

Long Run - A long run service is a service connection that crosses the roadway centerline between the main and the meter box.

Short Run - A short run service is a service connection up to the meter box that lies on the same side of the roadway as the main.

Materials

01170.10 Materials - Furnish materials meeting the following requirements:

Brass and bronze pipe nipples.....	02490.40(d)
Brass and bronze service fittings	02490.40(c)
Copper pipe	02490.40(a)
Corporation stops.....	02490.30
Meter boxes	02490.70
Meter setters	02490.50
Saddles	02490.20
Sampling stations.....	02490.80

01170.11 PVC Sleeves - PVC sleeves shall meet the requirements of AWWA C900

01170.12 Steel Casings - Steel casings shall meet the requirements of AWWA C200 for sizes 6 inch and larger.

Construction

01170.40 Service Lines:

(a) General - All copper service lines shall be installed continuous, without joints or splices, complete from the new water main (insulating corporation stop) to the new meter location, install all facilities to the new meter location. Install service pipelines perpendicular to the main, unless shown otherwise. Install service runs parallel to existing services with a perpendicular distance of 2 feet minimum to 5 feet maximum from existing services and a minimum perpendicular distance of 18 inches from property line.



(b) Excavation Depth - Construct the depth of trench for service connection piping to provide a minimum of 30 inches of cover over the top of the pipe from finish grade or street profile. Do not damage the main in any way during the installation of the service. Excavate and backfill for service connections according to Section 00405. Where no meter is to be installed, place angled meter stop at 18 inches from face of curb with 12 inches to the springline in an approved box.

(c) Fittings and Appurtenances - Install necessary service saddles, valves, valve boxes, tubing, pipes, bends, fittings, and couplings necessary to complete service line installations.

(d) Corrosion Protection - Install cathodic protection items when required including dielectric insulating corporation stops, dielectric insulating joints, tape wrap, and grounding rod.

(e) Pipe Tools - Cut service pipes using tools specifically designed to leave a smooth, even and square end on the pipe. Ream cut ends to the full inside diameter of the pipe. Clean pipe ends to be connected using couplings that seal to the outside surface of the pipe to a sound, smooth finish before the couplings are installed. Adjust the meter box to the finished grade after the surface has been acceptably restored.

(f) Testing and Disinfection Preparation - Install temporary risers and appurtenances as required to facilitate testing and disinfection. Place a Valve Box and Cover (CIV) over the test riser after testing and disinfection.

(g) Service Line Connections - City will connect all service lines at the new meters or to existing service piping as shown.

(h) Casings or Sleeves - Install services through casings or sleeves as shown.

01170.41 Reconnecting Existing Services - When new service lines are not installed for existing services, City will connect all existing service lines to the new mains.

01170.42 Sampling Stations - Install sampling stations at the locations shown or as directed. Set at the depth shown or specified. Perform trenching and backfilling according to 01170.40.

01170.43 Service Taps:

(a) Installation Equipment - All direct service taps shall be made with a drilling and tapping machine intended for use on ductile iron pipe as manufactured by Mueller or approved equal. The drilling and tapping machine shall have alignment tool guides and a placement strap. Direct threaded taps shall engage a minimum of 4 full threads. Hand held equipment is not allowed. Coupons shall be removed from pipe.

01170.50

(b) Thread Tape - Direct service taps shall require the use of 2 layers of 3 mil tetrafluoroethylene (TFE) tape on the threads of the corporation stop. Liquid TFE will not be allowed. Direct taps for 1 inch services are allowed only on mains that are 6 inches in diameter or larger.

(c) Service Saddles - Service Saddles are required on water mains 4 inches in diameter and for all services taps larger than 1 inch. Double strap service saddles are required on all service taps larger than 1 inch.

(d) Swing Joint - Install swing joint on all 2 inch services.

Testing

01170.50 Testing - Testing shall be performed according to Section 01140.

Measurement

01170.80 Measurement - The quantities of service line installation will be measured on the unit basis by size for short runs and for long runs. Any service length greater than 20 feet will be measured on the length basis for the distance beyond 20 feet.

01170.81 Service Start - Services will begin at the centerline of the main for 1 inch and 2 inch copper services.

01170.82 Casing or Sleeve - Casings or sleeves for services will be measured on the length basis.

Payment

01170.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) ____ inch Service Line, Short Run.....	Each
(b) ____ inch Service Line, Long Run	Each
(c) ____ inch Service Line, Footage Exceeding 20 ft.....	Foot
(d) ____ inch PVC Sleeve	Foot
(e) ____ inch Steel Casing	Foot

In items (a) through (e), the size will be inserted in the blank.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for:

- excavation
- bedding and backfill
- piping
- service saddles
- fittings
- valve
- vaults
- meter boxes
- restrain
- tape wrap
- testing
- flushing
- disinfection
- cathodic protection
- complete restoration and cleanup

01170.91 City Furnished Materials - No separate or additional payment will be made for obtaining, installing, interim and final adjustments to match final grade and returning unused City-furnished CIV boxes and covers.



Section 01180 - Water System Piping Corrosion Control

Description

01180.00 Scope - This work consists of requirements for corrosion control materials and construction methods for the City water system piping. Provide the corrosion control system specified herein for transmission mains; for distribution mains and service lines proximate to foreign pipelines and to electric rail; for casing pipe; for pipe in vaults and above ground facilities; and for pipe on bridges. Impressed current corrosion protection systems are not covered.

01180.01 Abbreviations:

mdft - Mills Dry Film Thickness, referring to coating applications.

NACE - National Association of Corrosion Engineers.

01180.02 Definitions:

Casings and Sleeves - Protective pipe or geomembrane through which the main or service is run.

Distribution Mains - Piping systems designed to distribute water to services.

Exothermic Welding and Pin Brazing - A specialized process used for electrical connections to the exterior of pipe and fittings.

Pipe on Bridges - Pipe, fittings, and appurtenances above ground and exposed, generally attached to bridge structures.

Piping in Vaults and Facilities - Pipe, fittings, and appurtenances enclosed inside vaults, pump stations, or other buildings.

Services - The piping between the distribution main and the water meter.

Transmission Mains - Piping systems with minimal service connection, includes conduits, interties, supply mains, and pump mains.

01180.07 Submittals:

(a) **Products** - Provide submittals for all products referenced in this section.

(b) **Testing** - Submit written documentation of experience as a professional engineer regularly performing cathodic protection work or certification as a NACE Cathodic Protection Specialist for all personnel performing field testing.

(c) **Test reports** - Submit 3 copies of all field test reports.

Materials**01180.10 Exothermic Welds and Pin Brazing:**

(a) Weld Materials - Molds, cartridges, and all required materials for exothermic (copper) welding shall be as produced by "Cadweld", Erico Products, Inc., or approved equal. Provide molds and cartridges of a size and material as recommended in writing by the manufacturer. Molds for exothermic welding shall be graphite; ceramic molds are not acceptable.

(1) Ductile Iron Pipe - For connection to ductile iron pipe, use "Cadweld" XF-19 alloy weld metal or approved equal.

(2) Cast Iron Pipe - For connection to cast iron pipe, use "Cadweld" XF-19 alloy weld metal or approved equal.

(3) Steel Pipe - For connection to steel pipe, use "Cadweld" F-33 alloy weld metal alloy or approved equal.

(b) Terminals - All wires used with exothermic welds shall have formed sleeve terminals and shall be welded using the reduced weld size and special weld mold for formed terminals, as specified in writing by the manufacturer. The formed terminals may be factory fabricated or may be field formed using sleeves and a hammer die. Connections to mortar coated steel or concrete cylinder pipe shall be exothermically welded to a 1/2 inch diameter steel rod preinstalled on the pipe by the pipe manufacturer.

(c) Pin Brazing - Pins, studs, lugs and ferrules shall be as recommended in writing by the manufacturer for the wire size, pipe material, and pin braze machine settings.

(d) Weld Caps - Furnish weld caps of high-density plastic, 10 mils (minimum) thickness Handy Cap IP, as manufactured by Royston Laboratories, or approved equal. Provide caps that incorporate a dome for the weld, a tunnel to contain the lead wire from the weld connection, and a base plate to cover the prepared pipe surface. Weld caps shall be provided pre-filled with mastic/adhesive and have an integral primer for adhesion to the pipe or structure. Weld caps shall be sized for the exothermic or pin brazed connection.

01180.11 Galvanic Anodes - Supply galvanic anodes of the quantity, composition, dimensions, metal weight, and packaged backfill as shown or noted on the drawings. Provide magnesium anodes, nominal 20 inches long and nominal 30 pound bare metal weight. Magnesium anodes shall meet the requirements of ASTM B-843-M1C High Potential Magnesium Alloy and ASTM G97 with an open circuit potential of (-)1.7VDC to CSE and a current efficiency of 50%. The anodes shall be prepackaged in a permeable cloth bag containing the manufacturer's prescribed backfill and the packaged anode shall be a minimum of 2.5 times the bare anode weight. The anode lead wire shall be solid copper wire, AWG #12 or #10, with TW-, THHN-, or USE-type insulation, and the connection to the anode shall be silver soldered by the manufacturer and shall be of an un-spliced length specific to the application but not less than 15 feet.

01180.12 Test Stations and Coupons:

(a) Test stations - Flush-mounted test stations will be City-furnished CIV boxes and covers.

(b) Cathodic Protection Monitoring Coupons - Provide coupons, steel or ductile iron, to match the pipe material type. The coupon shall have 2 wires connected with a silver soldered potted connection, and with a minimum length of 10 feet. Provide MC Miller IR-Free coupons or approved equal. The coupon access drop tube shall be Schedule 40 PVC pipe, 2 inches in diameter.

01180.13 Wire - Wire for test stations and joint bonds larger than AWG #10 shall be single-conductor, stranded copper, with USE-type insulation. Wire AWG #10 or smaller shall be solid not stranded, with TW-, THHN-, or USE-type insulation. Provide the wire size as specified or shown.

01180.14 Split Bolts and Insulation for Split Bolt Connections - Provide bronze split bolts, sized for the wire to be joined; insulating putty, 3M Scotchfill or approved equal; and vinyl electrical tape, 3M Scotch Super 33 or approved equal.

01180.15 Ground Rods and Clamps - Provide hot-dipped galvanized ground rods, 5/8 inch diameter 8 foot length. Provide bronze clamps, and AWG #6 or #4 stranded copper wire with USE-type insulation for connections between rod and ground rod.

01180.16 Insulation for Dielectric Isolation:

(a) Insulating Flange Joints - Flange insulation shall include a full face insulating gasket, a full-length insulating sleeve for each bolt, and two insulating washers and two steel bearing washers for each flange bolt.

(1) Sleeves and Washers - Insulating sleeves and washers shall be Pyrox G-10. Both the insulating washers and the steel washers shall fit over the outside diameter of the sleeve and shall fit within the bolt facing of the flange.

(2) Gaskets - Gaskets shall be full faced, Styrene Butadiene Rubber (SBR), Nitrile (Buna-N), Neoprene, polytetrafluoroethylene (PTFE), or compressed vegetable fiber. Gaskets shall have adequate dielectric properties, 300V/mil minimum, and shall be suitable for the operating and test pressures of the pipe system.

(3) Joint Assembly - An insulating joint assembly shall consist of 2 flange by plain end or 2 flange by mechanical joint (FLG x PE or FLG x MJ) adapters, a full face insulating gasket, with full length insulating sleeves, 2 insulating washers, and 2 steel bearing washers for each flange bolt.

(b) Insulating Flexible Couplings - Flexible couplings size 12 inches in diameter or smaller shall be ductile iron and couplings larger than 12 inches in diameter shall be steel. All flexible couplings shall be fusion-bonded epoxy coated and furnished with high strength alloy bolts and nuts.

(1) Insulating Boots - Provide insulating flexible couplings with two insulating boots that cover and prevent contact between pipe ends. Insulating flexible couplings shall be Romac Industries, Inc. style IC501 or IC400 or approved equal.

(2) Reducing Couplings - Where couplings are for differing pipe sizes use reducing couplings. Transition couplings are not acceptable. Couplings shall be specially ordered and sized for an insulating boot on one side and thrust restraint on the other side.

(c) Insulating Copper Service Fittings - Fittings shall have insulators integral to the body of the fitting, as manufactured by Mueller Company or approved equal. The design of the fitting shall include a mechanical restriction to prevent the copper tube from passing through the insulation.

(d) Insulating Wall Seals - Wall seals shall consist of compression disks and pressure plates made of dielectric materials. Insulating wall seals shall be Model C Insulating Type as manufactured by Link Seal or approved equal.

01180.17 Casings and Sleeves:

(a) Casing Spacers and Casing End Seals - Casing spacers shall be constructed with fusion-bonded epoxy coated steel bands and reinforced insulating runners. If stainless steel bands are approved by the Owner, the bands shall be separated from the pipe with a manufacturer's elastomeric boot. Casing end seals shall be pull-on style with stainless steel clamps, custom sized for the OD of the casing and carrier pipe. Provide end seals, Type C, as manufactured by PSI or approved equal. Polyethylene encasement shall extend through the end seal and casing.

(b) Sleeve Slip-on and End Seals - Sleeves shall be ASTM D1785 Schedule 80 PVC pipe, 4 inch minimum pipe diameter.

01180.18

(1) Sleeve End Seals for DI Pipe- End seals for sleeved pipe shall be concentric elastomeric couplings PVC to DI with stainless steel clamps as manufactured by FERNCO, Inc. or approved equal. Couplings shall be sized to specific pipe type and size.

(2) Sleeve End Seals for Copper Service - End seals for sleeved copper services shall be pull on elastomeric molded pipe sleeve seals with stainless steel clamps. Provide pipe sleeves by Fernco, Inc. or approved equal. Step down from 4 inch to the required copper tube size with schedule 80 PVC reducers. Molded end seals shall be sized specific to the pipe type and size.

(3) Sleeve Wrapped - Furnish 40 mil PVC reinforced geo-membrane with 300V/mil dielectric strength and minimum 150 pound puncture resistance and 150 pound tensile strength.

01180.18 Polyethylene Encasement and Tape Wrap:

(a) Polyethylene Encasement for DI Pipe - Furnish 4 mil Type 2 high density cross laminated polyethylene film in accordance with AWWA C105 tube type encasement. Polyethylene sheet is not acceptable. Furnish polyethylene encasement from the same manufacturer that supplies the ductile iron pipe.

(b) Tape Wrap Coating for Casing - Provide tape wrap coating for casing pipes in accordance with AWWA C203, AWWA C209, AWWA C214, or AWWA C216. Provide tape system per manufacturer's requirements for repair and to cover holdbacks.

(c) Tape Wrap for Copper Tube - Provide a 20 mil minimum PVC tape wrap coating for copper services and insulating joints. Provide Scotchwrap 51 or approved equal.

(d) Tape Wrap Coating for Specials - When specified provide petrolatum wax tape system per AWWA C217 with an auxiliary thin film conforming stretch outlet wrap.

01180.19 Thin Film Coatings:

(a) Epoxy Coating for Buried Casing - Provide coating materials per AWWA C210, AWWA C213, except no coal tar epoxy will be allowed.

(b) Epoxy Repair - Provide 100% solids 2 component quick cure epoxy coating, NSF approved for potable water. Provide 3M Scotchkote 323 brush grade or approved equal.

(c) Epoxy Coatings for Pipe on Bridges - Provide epoxy primer and intermediate coats with an aliphatic polyurethane topcoat. Provide Pota-Pox epoxy primer and intermediate coats and an Endura-Shield polyurethane topcoat all by Tnemec or approved equal.

(d) Moisture Cured Urethane Coating for Pipe on Bridges - Provide a zinc and micaceous iron oxide moisture-cured urethane system. Provide an MC-Miozinc primer, an MC Miomastic intermediate coat, and a Ferrox A topcoat all by Wasser High Tech Coatings or approved equal.

(e) Thixotropic Mastic Coating - Provide a thixotropic mastic coating for field repair of existing coal-tar enamel that is not in contact with potable water. Provide Carboline Bitumastic 50 or approved equal.

(f) Leafing Aluminum Epoxy Coating - Provide a leafing aluminum epoxy mastic for marginally prepared surfaces. Provide Carbomastic 15 LO by Carboline or approved equal.

(g) Galvanizing - Galvanized items shall be per ASTM A123 & ASTM A153. Provide zinc base alloys for repair per ASTM A780. Hot stick method, zinc-rich paints are not acceptable.

(h) Silicate Concrete Coating - Provide a water based silicate sealer for waterproofing the exterior surface of new concrete vaults.

01180.20 Mortar, Grout, Grout Band - Mortar and grout shall be a chloride free Portland cement and sand mix with not less than 1 part cement to 3 parts sand or a proprietary cementitious chloride free mix approved in writing by the pipe manufacturer. The grout band shall physically contain the mortar/ grout and prevent moisture loss.

01180.21 Backfill - Backfill in the pipe zone shall be aggregate or sand. Controlled density fill (CDF) and controlled low strength material (CLSM) are not acceptable. For tape wrapped pipe and polyethylene encased pipe, backfill shall be Class C backfill produced from crushed gravel.

01180.22 Miscellaneous:

(a) Pipe Hangers - All pipe hangers shall be hot-dip galvanized after fabrication.

(b) Aluminum - Aluminum in contact with concrete or stainless steel shall be paint coated in areas of contact with a non-alkyd based paint suitable for contact with concrete.

(c) Stainless Steel - The exterior surface of stainless steel that is in contact with ductile iron shall be paint coated with a coal tar mastic or surface tolerant epoxy.

01180.23 Gravel - Use gravel conforming to 00405.14(c).

Construction

01180.40 Corrosion Protection:

(a) Transmission Mains - Transmission mains are piping systems with minimal service connections including conduits, interties, supply mains, and pump mains. Transmission mains shall be made electrically continuous with welded joints or joint bonds, shall be dielectrically isolated at all connections, and shall be dielectrically isolated into sections of 750 foot maximum length.

(1) Transmission mains crossing an electric rail track shall be cased under the track and for a minimum of 10 foot horizontal distance beyond the track slab.

(2) Test stations shall be provided at dielectric isolation joints, casings, where transmission mains cross cathodically protected foreign lines, and as shown.

(3) Transmission mains made of ductile iron pipe shall have polyethylene tube encasement and anodes. Steel transmission mains shall have tape wrap and anodes. Mortar-coated steel and concrete cylinder pipe (CCP) transmission mains shall have continuous mortar coating over all in-line valves, fittings, and special appurtenances, or when directed by Engineer, inline valves, fittings and special appurtenances shall be dielectrically coated and protected with anodes. All branch lines that are not mortar-coated shall be dielectrically isolated from the mortar coated main.

(b) Distribution Mains and Services:

(1) **Cathodically Protected Foreign Lines** - Distribution pipe and copper services crossing a cathodically protected foreign line shall be sleeved in PVC pipe or sleeved with a PVC geo-membrane wrap for a minimum of 10 feet from the centerline of the foreign line. Copper service pipe shall be tape-wrapped within the PVC pipe or geo-membrane wrap. Distribution pipe paralleling a cathodically protected foreign line shall be installed with a minimum of 5 feet skin-to-skin separation between pipes.

(2) **Electric Rail Systems** - Distribution pipe crossing an electric rail system shall be cased under the track and for a minimum of 10 feet beyond the track slab. Copper services crossing electric rail track shall be tape wrapped and sleeved in PVC pipe under the track and for a minimum of 10 feet beyond the track edge. Distribution pipe paralleling an electric rail shall be installed with a minimum of 10 feet horizontal separation between track slab and edge of the pipe. The pipe shall be made electrically continuous with joint bonds, shall be dielectrically isolated at all connections, and shall be dielectrically isolated into sections of 500 feet maximum length. In addition, the pipe shall have polyethylene encasement, anodes, and test stations.

(c) Casings - Casing pipe shall have welded joints, dielectric coating, and be protected with galvanic anodes. Casing pipe installed in an open trench shall have tape wrap coating, and casing pipe that is bored shall have epoxy coating with field-coated joints and all appurtenances shall be epoxy coated. Casing installations shall include dielectric spacers, end seals, anodes, and test stations.

(d) Piping in Vaults and Facilities - Piping in vaults and above ground facilities shall be painted with a leafing aluminum epoxy mastic. All pipe hangers and pipe supports shall be hot-dip galvanized.

(e) Pipe on Bridges - Pipe on bridges shall be painted with leafing aluminum epoxy mastic system, an epoxy/polyurethane coating system, or a moisture-cured urethane coating system. All pipe hangers and pipe supports shall be hot-dip galvanized.

01180.41 Exothermic Welding and Underground Electrical Connections:

(a) General - Unless otherwise specified, all electrical connections to the pipe shall be by exothermic welding or pin brazing. Properly cover exothermic or pin brazed welds with weld caps or in the case of mortar coated steel or Concrete Cylinder pipe (CCP), tape the exposed copper of weld and wire with vinyl electric tape then encase in mortar. Provide sufficient space between adjacent exothermic welds to install a full sized weld cap on each weld. Repair all damaged pipe coating in accordance with the manufacturer's recommendations. Prior to coating, test all exothermic or pin brazed welds by striking with a hammer in a manner approved by the professional engineer or specialist in cathodic protection.

(b) Pipe Joint Bonds - Provide pipe joint bonds to assure electrical continuity except where electrical isolation is specified. Connections to the pipe shall be by exothermic welding or by pin brazing. Bond wires shall be un-spliced wire with field connections made in the trench. Alternatively, "pig tails" can be pre-welded or pin brazed to the pipe then the pigtails spliced together in the trench with split bolt connectors. Joint bonds with lug terminals can be field connected to pin brazed threaded studs. To permit inspection of the welds and pin brazing and to prevent damage to the weld caps, apply all protective coating after the joint is in place and complete. Insulate the split bolt and all exposed copper wire by encapsulating with electrical insulation putty, Scotchfill® Insulating Putty or approved equal, molding the connection smooth, and then wrapping the connection at 50% overlap with vinyl electrical tape, Scotch Super 33 or approved equal.

(c) Joint Bond Configuration - There shall be a minimum of 2 parallel joint bond wires, AWG #2, at each pipe joint. Valves and fittings may be bypassed by bond wires, but the valve or fitting must be made electrically continuous with the pipeline by a single wire, AWG #2 or AWG #4 that connects directly to a pipe section or connects to a joint bond wire (header run) with a split bolt connection. An assembly of valve and fittings may have a single bond wire (tap) from each component piece split bolt connected to a header run (AWG #2) that connects at each end, directly to a pipe section by exothermic weld or by split-bolt connection to a joint bond wire.

(d) Wiring - All wiring is to be splice-free, except where splices are specified or shown or as approved. Coil or snake all buried wire with sufficient slack to prevent stress from backfill operations and earth settlement. All wire is to be buried a minimum of 30 inches below finish grade or installed in rigid conduit. All wire at test stations shall extend a minimum of 30 inches below finished grade or shall be installed in rigid conduit. Repair any damage to the wire insulation with self-adhering butyl rubber electrical tape, Scotch No. 130C or approved equal, and over wrap with vinyl electrical tape, Scotch No. 33 or approved equal. Spirally apply each layer at 50% overlap. This repair method is not applicable to repair of any wire in an impressed current system.

(e) Split Bolt Connections - Split bolt connections shall be limited to the connection of two wires. Three or more wires at one split bolt are not allowed. Connection of taps to header runs may be accomplished by stripping an appropriate length of insulation from the header without cutting the wire and connecting the tap at that point with a split bolt for each tap.

01180.42 Ground Rods - If the service is dielectrically isolated from the main, provide a ground rod, installed per National Electric Code, and connected to the customer side of the service.

01180.43 Galvanic Anode Installation:

(a) General - Unless specified otherwise, install anodes 5 feet below the pipe invert, positioned under the pipe or up to 3 feet perpendicular from the pipe edge. Do not place the anodes within 3 feet of a neighboring metallic structure. When anodes are distributed along the pipeline, alternate the perpendicular offset from one side of the pipe to the other.

(b) Location - Install the anode in clean, native backfill and not in the select bedding material. Locate anodes a minimum of 5 feet apart. Thoroughly soak the anode in water prior to installation. Compact the backfill to 95% of maximum density to 1 foot above the anode. Evenly distribute anodes along main and branch line installations. Anodes may be grouped at the ends of casings and short runs of pipe; maintain 5 foot minimum distance between anodes.

(c) Connection - The anode lead wire shall be exothermically welded to the pipe. Alternatively the anode shall be connected to a joint bonding wire by using a split-bolt connection. Distances between anodes are nominal lengths and anode connections shall be made at pipe joints. Unless otherwise specified, for ductile iron water mains and steel pipe and casings, provide anodes as shown.

01180.44 Test Station Installation - Locate test stations as follows:

(a) Isolation Joint Test Stations (TSIJ) - Provide a test station at all buried insulated flanges and insulating couplings, except insulated connections on copper services. Provide a test station at the dielectric isolation between mortar coated steel or CCP lines and dielectrically isolated branch lines, unless the Engineer elects to not install test stations at these locations. Insulating Joint Test stations shall have 2 AWG #8 wires welded to each side of the dielectric joint, 4 wires total.

(b) Casing Test Stations (TSC) - Provide one test station at each end of the casing. Casing Test Stations shall have 2 AWG #8 wires welded to the main and (2) AWG #8 wires welded to the casing, 4 wires total.

(c) Monitoring Test Stations (TSM) - Provide a monitoring test station with cathodic protection monitoring coupons where water mains cross cathodically protected foreign lines and where water mains cross electric rail tracks. Monitoring Test Stations shall have 2 AWG #8 wires welded to the main, and 2 cathodic protection monitoring coupons, each with 2 AWG #12 wires, 6 wires total.

(d) Combination Test Stations (TSC/IJ) - When 2 or more test stations on the same pipe are adjacent to each other (within 15 feet) they may be combined and the test wires run to a single flush mounted test station. A TSIJ near the end of a casing may be combined with the TSC into a single test station with 2 AWG #8 wires to the casing, 2 AWG #8 wires to the casing side of the dielectric joint and 2 AWG #8 wires to the far side of the dielectric joint, 6 wires total. A TSM can be included in the combined test station by providing 2 cathodic protection monitoring coupons without additional wires to the pipe or casing.

01180.45 Dielectric Isolation:

(a) General - Provide pipe isolation with insulating flange joints, or insulating flexible couplings. Insulating joints shall be separate assemblies and not incorporated into joints with valves or other appurtenances with the exception of branch lines connected to Mortar Coated Steel Pipe (MCSP) or Concrete Cylinder Pipe. Where a branch line connects to a flange integral with a section of MCSP or CCP, a separate assembly is not required. Copper services shall be isolated with meter stops designed with integral insulation. Use insulating wall seals at all concrete wall penetrations.

(b) Insulating joints - Mechanical joint assemblies of flange coupling adapters may be assembled above grade complete with attached test wires. Tape the flange edge of insulating joints with PVC tape to prevent particle bridging across the flange faces. Insulating flexible couplings shall have an insulating boot on each pipe end. Reducing insulating flexible couplings shall have a boot on one pipe end and restraining bolts on the other. Transition couplings are not acceptable. Use reducing couplings to accommodate differing pipe size. Joint restraint at flexible couplings shall only use hot-dip galvanized rod and nuts and shall be insulated from the non-cathodically protected side of a joint, or insulated from the mortar coated side of a joint, or insulated on one side of the joint if both sides are cathodically protected.

01180.46 Polyethylene Encasement Sleeve Wrapped and Tape Wrapped:

(a) Polyethylene Encasement Installation - Install polyethylene encasement, tube type, on all ductile iron pipe and appurtenances. Install one length of polyethylene tube encasement for each length of pipe in accordance with AWWA C105, Method A. Every 6 feet along the pipe, secure the polyethylene tube encasement with tape full circumference. The use of polyethylene sheets will not be allowed. Install 40 mil geo-membrane around mechanical joints and similar connections where the polyethylene can be punctured or ripped. Tape the ends and seams of the geo-membrane with PVC tape and then cover the pipe joint with the adjoining polyethylene encasement. Bedding and backfill around polyethylene or geo-membrane encased pipe shall be Class C backfill produced from crushed gravel.

(b) Sleeve Wrapped Installation - Install geo-membrane when crossing a cathodically protected foreign line where the pipe configuration does not allow for a PVC pipe sleeve.

(c) Tape Wrapped Coating for Casings - Apply tape wrapped coating on steel casing pipe in accordance with AWWA C203, AWWA C214, AWWA C216 for manufacturer applied tape wrap and AWWA C209 for minor field applications. For tape wrapped coating repairs and other coating holdback areas, apply repair tape system per manufacturer's requirements. Apply petrolatum wax tape per AWWA C217 with outer wrap only where directed.

(d) Tape Wrapped Coating for Copper Services - Provide 20 mil PVC tape wrap and apply at 50% overlap, 40 mil total. Wrap the copper tube, and all fittings including corporation and meter stop.

(e) Mortar Coated Steel (MCSP) and Concrete Cylinder Pipe (CCP) - Transmission mains shall have continuous mortar coating over all in-line valves, fittings, and other appurtenances, regardless of underlying coating, except when the application of a dielectric coating and installation of anodes at a valve, fitting or other appurtenance is allowed in lieu of mortar coating.

01180.47 Thin Film Coatings:

(a) Paint for Buried Casings, Casing Welds - Provide an epoxy coating per AWWA C210 and AWWA C213. Any angle iron, c-channels, lubricating or grout pipe, fins, or other appurtenances connected to the casing shall be epoxy coated on all sides. For field repairs, prepare the surface by power tool cleaning, SSPC-SP3, and repair with a 100% solids epoxy, one coat of 25 mil dry film thickness (mdft), or when permitted, coat the weld with a thixotropic coal tar mastic, one coat of 20 mdft.

(b) Paint Coating for Pipe in Vaults and Facilities - Coat all piping except fittings and specials that are factory coated with fusion-bonded epoxy. Prepare the surface by power tool cleaning, SSPC-SP3, or shop abrasive brush blasting, SSPC-SP7. Use a needle gun or abrasive blast to disrupt the asphaltic coating on ductile iron pipe and fittings, but it is not necessary to remove all asphaltic coating. All work in vaults and facilities shall be done with HEPA filter equipment. Do not coat bolt areas such as flanges or restrained joint holdback areas until connection is complete. Coat with a leafing aluminum epoxy mastic, Carboline Carbomastic 15 or approved equal, 2 coats minimum with 6 mdft per coat, 12 mdft total.

Steel pipe, fittings and specials, 16 inches diameter and larger, shall be shop coated, except for hold backs, prior to installation. Surface preparation shall be near white abrasive blast SSPC-SP10 and the coating shall be a leafing aluminum epoxy mastic, 2 coats 6 mdft per coat, 12 mdft total.

(c) Paint Coating for Pipe on Bridges - Shop blast and shop coat pipe except for hold back areas. Surface preparation and application of coatings shall be in accordance with manufacturer's written recommendations

(1) Ductile Iron (DI) Pipe - For ductile iron pipe prepare the surface by power tool cleaning, SSPC-SP3, or shop abrasive brush blasting, SSPC-SP7. Use a needle gun or abrasive blast to disrupt the asphaltic coating on DI pipe and fittings, but it is not necessary to remove all asphaltic coating. Do not coat bolt areas such as flanges or restrained joint holdback areas until connection is complete. Coat with a leafing aluminum epoxy mastic, Carboline Carbomastic 15 or approved equal, 2 coat minimum with 6 mdft per coat, 12 mdft total.

(2) Steel Pipe - For steel pipe prepare the surface by near white abrasive blasting SSPC-SP10. Coat with:

- a. leafing aluminum epoxy mastic, 6 mdft per coat 12 mdft total, or
- b. an epoxy coating system, 3 coats of 3-4 mdft per coat, 9-12 mdft total, or
- c. a moisture-cured urethane system at 3 mdft prime coat, 3 mdft intermediate coat, and 2 mdft topcoat, 8 mdft total.

(d) Galvanizing - Repair of galvanizing shall be per ASTM A780 using the zinc based alloys "hot stick" method. Zinc-rich paint is not permitted.

01180.48 Testing and Verification:

(a) Quality Assurance - The portion of the work that involves the installation and testing of the galvanic cathodic protection system shall be conducted by a professional engineer regularly performing cathodic protection work or by an individual who is registered or certified by the National Association of Corrosion Engineers (NACE) as a cathodic protection specialist. Submit verification of registration or certification for written approval prior to the start of the work.

(b) Field Verifications - The professional engineer or specialist in cathodic protection shall field verify the adequacy of the Contractor's personnel in handling and placing anodes, monitoring coupons, exothermic welding, installation of split bolt connectors, repair of coatings including weld caps, and measurements of dielectric isolation and bonding. The professional engineer or specialist in cathodic protection shall at the start of the work provide a list of qualified Contractor personnel and only these listed individuals shall perform such work for the Contractor.

(c) Testing During Construction - Test all isolation joints after installation and prior to backfilling.

(d) Continuity and Isolation Testing - Perform testing as follows:

(1) General - Test all sections of pipeline, appurtenances, services, hydrants, regulator vaults, and appurtenances that are cathodically protected and dielectrically isolated for electrical continuity and dielectric isolation after all Contractor connections have been made.

(2) Test Current Response - Measure the response of the pipe to the application of cathodic protection test current. If the application of the test current causes the pipe-to-soil potential to become more negative, electrical continuity of the pipeline, service runs, and appurtenances is indicated between that point and the point at which the test rectifier negative connection was made. The response of the potential shall be of a magnitude to demonstrate low resistance joint bonds. Electrical isolation across insulating fittings shall be indicated by the pipe-to-soil potential being more positive or only slightly negative in relation to the structure connected to the test rectifier.

(e) Lack of Continuity or Isolation - If electrical continuity or electrical isolation is not achieved, locate the deficiency and complete the necessary repairs. The engineer or specialist shall retest the system before final acceptance.

(f) Repairs - Make all repairs necessary to correct any deficiencies and repair any joint not passing the electrical continuity or isolation test at no cost to the City.

(g) Final System Testing - Final system testing shall be performed prior to the hydrostatic testing of each segment and prior to the substantial completion. Final testing shall be performed directly by the professional engineer or specialist in cathodic protection and witnessed by the City and shall include the following as a minimum:

(1) Test and Service Locations - Provide pipe-to-soil potential measurements for all test stations and for all service connections.

(2) Continuity and Isolation Measurements - Provide a report consisting of continuity and isolation measurements and other data for all cathodically protected sections of pipe, appurtenances, and for all service connections.

(3) Documentation - Provide 3 copies of a report documenting all testing and installation of cathodic protection system. The professional engineer shall stamp or the cathodic protection specialist shall sign the report. Include the specialist's NACE registration or certification number.

(h) Warranty - The 2 year warranty period specified in the Contract shall apply to the entire corrosion control system installed.

Measurement

01180.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Payment

01180.90 Lump Sum Basis - The accepted quantities of work performed under this Section will be paid for at the Contract lump sum amount for the item "Corrosion Control".

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

01180.91 Insulating Flex Couplings - When insulating flex couplings are required, payment will be according to Section 01140.

01180.92 City Furnished Materials - No separate or additional payment will be made for obtaining, installing, interim and final adjustments to match final grade and returning unused City-furnished CIV boxes and covers.

