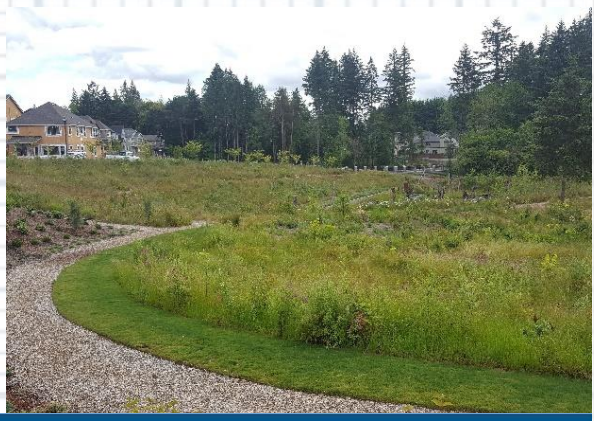

DESIGN AND CONSTRUCTION STANDARDS

FOR SANITARY SEWER AND SURFACE WATER MANAGEMENT

DECEMBER 2019

Clean Water Services

BEFORE THE BOARD OF DIRECTORS OF CLEAN WATER SERVICES

In the Matter of Amending Clean Water Services Resolution and Order No. 19-5 to Update Pump Station Standards, Revise Engineering Details and Make Minor Corrections	RESOLUTION AND ORDER NO. 19-22

The above-entitled matter came before the Board of Directors of Clean Water Services (Board) at its regular meeting of November 12, 2019; and

It appearing to the Board that it did, on April 2, 2019, adopt Clean Water Services (District) Resolution and Order No. 19-5, which repealed Resolution and Order No. 17-5 and adopted revisions to the Design and Construction Standards (Standards) pertaining to the sanitary sewerage and storm and surface water management systems, including regulations for erosion control and protection of water quality sensitive areas, pursuant to Ordinance 27; and,

It appearing to the Board that provisions of R&O 19-5 are in need of amendment; and,

It appearing to the Board that it has conducted a public hearing regarding the adoption of these amendments in accordance with District Ordinance No 27, Section 8, and that public notice was given as required and interested persons were given an opportunity to appear and be heard; and

It appearing to the Board that the amendments are within the scope of District Ordinance No. 27 and are necessary to further the objectives of District Ordinance No. 27, which include: enhancement and maintenance of the water quality of the Tualatin River and its tributaries; compliance with state and federal permit and regulatory requirements; promotion of the health, safety and welfare of the community; and furtherance of the objectives and purposes of the Federal Water Pollution Control Act 33 USC§§1251-1387; and the Board being fully advised in the premises; now, therefore it is

RESOLVED AND ORDERED that the Clean Water Services Board of Directors does hereby amend R&O 19-5 as provided in Exhibit A attached hereto; and it is further

CLEAN WATER SERVICES
2550 S.W. Hillsboro Highway
Hillsboro, Oregon 97123-9379
Telephone (503) 681-3600 Fax (503) 681-3603

RESOLVED AND ORDERED that the Chief Executive Officer is hereby authorized and directed to take such steps as are necessary to finalize the Standards, including but not limited to correcting typographical errors, removing "Reader Notes," and removing underline and strike-outs to produce a final version that can be published and available to the public. These changes shall not affect the substance of the Standards; and it is further

RESOLVED AND ORDERED that these amendments shall take effect for all development and construction permit applications received on or after December 2, 2019, except as provided in R&O 19-5 and R&O 18-28 or unless specifically requested by applicants for development and construction permit with applications currently in process.

DATED this twelfth day of November, 2019.

CLEAN WATER SERVICES
By its Board of Directors

11/12/19
Chair Kathryn Harrington

Recording Secretary

	AYE	NAY	ABSENT
HARRINGTON	✓		
SCHOUTEN	✓		
TREECE	✓		
ROGERS	✓		
WILLEY	✓		

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BEFORE THE BOARD OF DIRECTORS OF CLEAN WATER SERVICES

In the Matter of Adopting Revisions to the Design and Construction Standards Pertaining to the Sanitary Sewerage and Storm and Surface Water Management Systems, Including Regulations for Erosion Control and Protection of Water Quality Sensitive Areas; Pursuant to Ordinance 27; Repealing Resolution and Order No. 17-5	RESOLUTION AND ORDER NO. CWS 19-5

The above-entitled matter came before the Board of Directors of Clean Water Services (Board) at its regular meeting of April 2, 2019; and

It appearing that this Board adopted Ordinance 27 pertaining to the use and operation of the sanitary sewerage system and the storm and surface water management system throughout urban Washington County; that this ordinance provides authority to adopt additional rules by resolution and order pertaining to design and construction of public sanitary sewerage and storm and surface water management facilities, erosion control, provision of permanent water quantity and quality control facilities, regulation of activities affecting discharges of stormwater and nonpoint sources of pollution for the protection of the Tualatin River, its tributaries and other waters of the state within the Clean Water Services (District) boundary, requirements for permits for connection to the sanitary and stormwater system and related matters; and

It appearing to the Board that the District is responsible for sanitary sewer service and storm and surface water management throughout urban Washington County pursuant to Oregon Revised Statutes (ORS) Chapter 451 and subject to the rules and orders of the state Department of Environmental Quality, that the District is a permittee on the National Pollutant Discharge Elimination System Permit (NPDES) Watershed-Based Waste Discharge Permit for all urban Washington County, and that the District has adopted master plans for sanitary sewer and management of storm and surface water throughout urban Washington County, as authorized by ORS Chapter 451; and

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It appearing to this Board that the District has entered into intergovernmental agreements with Washington County (County) and the cities within the District's boundaries primarily affected by the District's master plans to provide for an integrated system pursuant to the District's master plan for sanitary sewer and storm and surface water management, and that these agreements provided that the cities and County will observe the orders promulgated by the District; and

It appearing to the Board that the Board, on March 28, 2017, adopted District Resolution and Order No. 17-5, which repealed Resolution and Order No. 07-20 as amended by Resolution and Order No. 08-28 and Resolution and Order No. 09-25 and adopted revisions to the Design and Construction Standards pertaining to the sanitary sewerage and storm and surface water management systems, including regulations for erosion control and protection of water quality sensitive areas, pursuant to Ordinance 27; and

It appearing to the Board that the Board, on November 27, 2018, adopted District Resolution and Order No. 18-28 which adopted the Implementation Policy for future revisions to Clean Water Services Design and Construction Standards Pertaining to Runoff Treatment and Control; and

It appearing to the Board that the existing rules and regulations of the District contained in Resolution and Order No. 17-5 are in need of revision to maintain compliance with requirements in the District's NPDES permit to incorporate development standards to address hydromodification; and

It appearing to the Board that the revised Design and Construction Standards serve to reduce the adverse effects to water quality and quantity of any construction or site alteration and will further safeguard the public health and safety and the operations of the District's sanitary and storm and surface water systems, to aid the District in achieving compliance with the rules and requirements of the Oregon Department of Environmental Quality, to coordinate the District's planning and actions with the comprehensive plans of the cities and County as those entities comply with title 3 of Metro's Urban Growth Management Functional Plan, and to further efforts

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to improve the water quality of the Tualatin River and its tributaries; and

It appearing to the Board that the District has conducted an extensive outreach of public information regarding the development and adoption of these rules, including meeting with representatives of the cities within the District and with the County, and providing information and copies of the proposed rules to those entities and members of the public; and

It appearing to the Board that the revised Design and Construction Standards (Standards) are available on the District website and a copy of the proposed changes were made available at the Clerk's desk; and

It appearing to the Board that it has conducted a public hearing regarding the adoption of these Standards on March 26, 2019 in accordance with District Ordinance No. 27, Section 8 and that public notice was given as required and interested persons were given an opportunity to appear and be heard; and

It appearing to the Board that after receiving public testimony the Board continued the public hearing to April 2, 2019 and directed staff to make certain changes; and

It appearing to the Board that District posted the Standards with directed changes on the District website and gave a copy to the Clerk's desk on March 27, 2019; and

It appearing to this Board that after considering written and oral testimony it is appropriate to adopt the Standards and that such Standards are within the scope of District Ordinance No. 27 and are necessary to further the objectives of District Ordinance No. 27, which include: enhancement and maintenance of the water quality of the Tualatin River and its tributaries; compliance with state and federal permit and regulatory requirements; promotion of the health, safety, and welfare of the community; and furtherance of the objectives and purposes of the Federal Water Pollution Control Act 33 USC§§1251-1387; and the Board being fully advised in the premises; now, therefore it is

RESOLVED AND ORDERED that the Standards are hereby adopted; and it is further

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RESOLVED AND ORDERED that the District or its designee shall review all development plans and site assessments required by these Standards and specify in a certification letter to the city or county responsible for land use review of the proposed development what conditions must be met by the application in order for the District or its designee to issue a stormwater connection permit pursuant to District Ordinance No. 27 and these Standards; and it is further

RESOLVED AND ORDERED that final stormwater connection permits shall be issued by the District or its designee upon confirmation that the development approved through the land use review or through other development permit process is consistent with the conditions required in the certification letter or revisions thereto; and it is further

RESOLVED AND ORDERED that administration of the Standards may be delegated to individual cities and to the counties as the District's designees only pursuant to intergovernmental agreements that specifically provide for such delegation; and it is further

RESOLVED AND ORDERED that the Chief Executive Officer is hereby authorized and directed to take such steps as are necessary to finalize the Standards, including but not limited to correcting typographical and formatting errors, removing "Reader Notes," and removing underline and strike-outs to produce a final version that can be published and available to the public. These changes shall not affect the substance of the Standards; and it is further

RESOLVED AND ORDERED that Resolution and Order No. 17-5 is hereby repealed, provided however that all permits issued, enforcement and other actions taken pursuant to said Resolution and Order prior to the effective date of this resolution or after the effective date of this resolution pursuant to Resolution and Order No. 18-28 shall remain in full force and effect or be able to be issued and enforced; and it is further

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RESOLVED AND ORDERED that this Resolution and Order shall take effect on April 22, 2019 for all development and permit applications pursuant to Resolution and Order 18-28, unless specifically requested by applicants for development and construction permits with applications currently in process. More specifically:

- New land use and building permit applications accepted by the land use authority on or after April 22, 2019 must be accompanied by a Clean Water Services Service Provider Letter dated on or after April 22, 2019 or one dated before April 22, 2019 which specifically references compliance with this Resolution and Order.
- Modifications to Service Provider Letters for land use or building permit applications that were accepted by the land use authority before April 22, 2019 will be reviewed and processed for compliance with the rules under which the Service Provider Letter was originally issued.

DATED this 2nd day of April, 2019.

CLEAN WATER SERVICES
By its Board of Directors

	AYE	NAY	ABSENT
HARRINGTON	✓		
SCHOUTEN	✓		
TREECE	✓		
ROGERS	✓		
WILLEY	✓		

Kathy Hyatt 04/02/19
Chair

Barbara Hejtmanek
Recording Secretary

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Chapter 1

GENERAL REQUIREMENTS AND ADMINISTRATIVE PROVISIONS

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Chapter 1

GENERAL REQUIREMENTS AND ADMINISTRATIVE PROVISIONS

1.01 Purpose

The purpose of these Standards is to outline design requirements for sanitary sewer, storm sewer, and surface water management. The provisions of this Chapter are intended to prevent or reduce adverse impacts to the drainage system and water resources of the Tualatin River Basin. In combination with other state, federal, and local laws and ordinances, these requirements are intended to protect the beneficial uses of waters within the Tualatin River Basin and within the District. These standards are designed to protect public health, safety, and the general welfare, and to comply with Federal law, including meeting the requirements of the District's NPDES Watershed-Based Waste Discharge Permit (Permit) and other regulations relating to surface water quality and quantity.

In addition, these standards are intended to ensure the long-term viability of the sanitary sewer, storm sewer, and surface water management system and avoid unnecessary and excessive maintenance and replacement costs.

1.02 Applicability

1.02.1 Application of These Regulations

Except as provided otherwise in a specific section of these rules, these standards and regulations shall apply to all territory within the District. A city within the District may adopt more restrictive standards within the scope of this Resolution and Order, but may not adopt less restrictive standards.

1.02.2 Application of This Chapter

The requirements and administrative provisions of this Chapter shall apply to the construction of all components of the public sanitary sewer and storm and surface water systems. Additionally, all requirements and provisions of this Chapter except Sections 1.07.1, Plan Submittal Requirements and 1.08.2, Easements shall apply to the construction of any building sewer or side sewer within the District boundaries.

1.03 Definitions

As used in this Resolution and Order, the words or abbreviations set forth below shall have the indicated meanings unless the context requires otherwise. The definitions set forth in Ordinance 27, as amended, shall also apply.

1.03.1 AASHTO

American Association of State Highway and Transportation Officials

1.03.2 ANSI

American National Standard Institute

1.03.3 Approved by District or City

The phrase "Approved by District or City" is intended to allow the District or City to interpret the provisions in question in a manner consistent with the purposes stated in Section 1.01 and other applicable laws and standards of the District, and to preserve the safe and reliable operation of the public sanitary sewer and storm and surface water systems. The phrase "as approved by District or City" shall allow a City to make the interpretation. Where the context provides for approval by the District or City of an alternative or a waiver to the standards provided in this Resolution and Order, the term shall mean approval of an alternative method, material, or design which, based on an engineering judgment, meets the purpose of the standard, for the specific application and as provided in Section 1.06.

1.03.4 ASTM

American Society of Testing and Materials

1.03.5 AWWA

American Water Works Association

1.03.6 BMP

Best Management Practice

1.03.7 Break in Slope

The transition point where a valley or river bank slope flattens and represents an historic geologic terrace of a stream or river. The point at which the grade extending from a break in slope, away from the stream or river, is less than 25%. Break in slope is also commonly referred to as top of ravine in steeply sloped headwater environments. Break in slope does not include minor surface anomalies that result from localized landslide slumps or site grading.

1.03.8 Building Sewer

That portion of the private sanitary or storm sewer extending from a point five

feet outside the established line of the building or structure (including any structural projection except eaves) to the public right of way or boundary of a conveyance easement dedicated to the District or City.

1.03.9 Capital Improvement Plan

The Capital Improvement Plan adopted by the Clean Water Services Board of Directors, and any updates of the plan.

1.03.10 Construction Permit Agreement

An agreement signed by the owner containing all assurances deemed necessary by the District that all public improvements will be constructed in accordance with these standards and the approved project plans.

1.03.11 Contractor

The person designated by the District, City, or Owner to do the work in question.

1.03.12 Conveyance System

The conveyance system consists of the surface water conveyance system and the sanitary sewer system. The surface water conveyance system includes all portions of the surface water system, either natural or man-made, that transport storm and surface water runoff. The purpose of the surface water conveyance system is to drain surface water from properties so as to provide protection to property and the environment. The sanitary sewer system includes all interceptor and main sewer pipe lines, force mains, pump stations, manholes and related facilities.

1.03.13 Culvert

A surface water drainage pipe crossing a road, driveway, or pathway which has no attached structures.

1.03.14 Designee

The entity designated by the District to conduct alternatives analysis activities, per District/City Inter-Governmental Agreement (IGA), and/or co-implementer status on the National Pollution Discharge Elimination System (NPDES) Permit.

1.03.15 Development

a. All human-induced changes to improved or unimproved real property, including:
    1. Construction of structures requiring a building permit if such structures increase or modify the impervious surface footprint on the real property;
    2. Land division, including subdivisions, lot line adjustments, expedited land partitions and minor land partitions. "Land Division" does not include plats for the sole purpose of converting existing buildings to condominiums;
    3. Drilling;
    4. Site alterations resulting from surface mining or dredging;
    5. Grading that would require an erosion control permit;
    6. Construction of earthen berms;
    7. Paving and roadway construction;
    8. Excavating that would require an erosion control permit;
    9. Clearing when it results in the removal of trees or native vegetation that would require a permit from the City/County or notification to the Oregon Department of Forestry;
    10. Redevelopment; and
    11. Construction of utility infrastructure.

b. The following activities are not included in the definition of development:

    1. Farming activities when conducted in accordance with accepted farming practices as defined in ORS 30.930 or under the Tualatin River Subbasin Agricultural Water Quality Management Area Plan.
    2. Construction on lots in subdivisions meeting the criteria of ORS 92.040(2).
    3. Any development activity for which land use approvals have been issued pursuant to a land use application submitted to a land use authority on or before February 4, 2000 and deemed complete by the land use authority on or before March 15, 2000. Renewals or modifications of such land use approvals shall be required to conform to these regulations.
    4. When not proposed in conjunction with other development, measures to repair, maintain, or remove existing structures, facilities, roadways, driveways, accessory uses, or other impervious surfaces, provided such measures are consistent with District/City/County regulations, and do not encroach further into the Vegetated Corridor or Sensitive Area.
    5. Interior modifications and vertical additions (additional stories) that do not modify the existing structure footprint or increase the building footprint impervious area of the site, provided such

modifications or additions are consistent with District/City/County regulations and do not encroach further into the Vegetated Corridor or Sensitive Area.

6. Measures to replace within the existing footprint a structure(s) lost due to a catastrophic event such as fire, provided that such measures are consistent with District/ City/County regulations. Structures that are partly or wholly within a FEMA designated 100-year floodplain that are damaged beyond more than 50% of the value or proposed to be improved by more than 50% of their value, must be elevated or flood-proofed consistent with the National Flood Insurance Program participation requirements.

1.03.16 Development Class

One of the project conditions determining the Hydromodification Approach, based on the land use at the project site. There are two Development Classes: Developed Area and Expansion Area. For the purposes of these standards, Developed Areas are those areas that were added to the Metro Urban Growth Boundary prior to 2002, and Expansion Areas are areas added to the Metro Urban Growth Boundary after 2002 that remain largely undeveloped.

1.03.17 District or CWS

"District" or "CWS" means Clean Water Services and includes any representative or employee of the District authorized to act in its behalf.

1.03.18 District or City

a. When the term "District or City" is used in this Resolution and Order, either the District or a City, including its authorized representatives, may perform a task or duty specified within this Resolution and Order, provided that, a City may perform such task or duty only when:

   1. There is an intergovernmental agreement in effect between the District and City assigning such authority to the City, and
   2. The City action is within the boundary of that City, and
   3. The action is subject to the terms of such agreement and to the provisions of this Resolution and Order.

b. Where the term "District or City" is used, the District shall retain the ability to carry out a task or duty.

1.03.19 Drainage Ditch

a. Drainage ditches include:

1. Roadside ditches that carry only stormwater runoff from the adjacent road which may be mixed with unconcentrated flow from adjacent lots;
2. Constructed channels designed as part of the stormwater infrastructure and drain directly from stormwater facilities or storm pipe systems; and
3. Agricultural or other manmade ditches that divert water away from the natural stream for the purpose of irrigation or livestock watering.

b. Drainage ditches do not include historically altered streams or channels that convey surface water flows.

1.03.20 Easement or Right-of-Way

A right of use on real property of another, entitling the District or City to construct, own and maintain a public sanitary sewer, pump station, storm system, and related facilities on, under and through the subject real property.

1.03.21 Edge of Sensitive Area

The Edge of Sensitive Area is defined based on the type of sensitive area as detailed below:

a. The top of the channel bank;

b. The two-year 24 hour design storm elevation for the Tualatin River;

c. The delineated boundary of the wetland, per DSL / Corps procedures for wetland delineation;

d. The outside edge of spring emergence (measured as the area of saturation, hydric soil conditions, or channel formation, whichever is greatest);

e. The average high water mark for lakes, ponds, and in-stream impoundments;

f. For streams draining 10 or more acres where no defined channel exists, and where there are no other sensitive areas such as wetlands, the edge of the sensitive area shall be the centerline of the natural drainage swale.

1.03.22 Engineer

The person, firm, corporation, partnership, or association duly registered by the State of Oregon providing engineering work on a project or construction

covered by this Resolution and Order. If the person providing the engineering for the project is a District or City employee, then "engineer" expressly includes such employee.

1.03.23 Enhancement

Modification of a Sensitive Area or Vegetated Corridor to improve its ecological functions and values, improve its ability to protect the water resources, and improve surface water quality.

1.03.24 Erosion

The movement of soil particles resulting from the flow or pressure from water, or wind, or from tracking by vehicles or foot traffic.

1.03.25 Floodplain

The land area identified and designated by the United States Army Corps of Engineers, the Oregon Division of State Lands, FEMA, or Washington County that has been or may be covered temporarily by water as a result of a storm event of identified frequency.

1.03.26 Floodway

The portion of a watercourse required for the passage or conveyance of a given storm event as identified and designated by the District pursuant to this Resolution and Order. The floodway shall include the channel of the watercourse and the adjacent floodplain that must be reserved in an unobstructed condition in order to discharge the base flood without increasing flood levels by more than one foot.

1.03.27 Floodway Fringe

The area of the flood plain lying outside the floodway which does not contribute appreciably to the passage of flood water but serves as a retention area.

1.03.28 Frontage Length

A linear measure of the length of the development front, which is directly adjacent to the vegetated corridor.

1.03.29 General Processing Fee

A fee established in the District's Rates and Charges Resolution and Order.

1.03.30 Governmental Unit

Governmental Unit includes:

a. The federal government and any of its departments, agencies, boards or commissions;

b. The government of the State of Oregon and any of its departments, agencies, boards or commissions;

c. Any city within the District's service district boundaries;

d. The cities of Portland and Lake Oswego;

e. Washington County;

f. Any school district;

g. Any municipal or public corporation or special district, as defined by ORS Chapter 198, which is created for the administration of public affairs, supported by public funds and governed by managers which derive their authority from a federal, state, or local governing body; and

h. Any intergovernmental agency, department, council, or like entity created under ORS Chapter 190.

1.03.31 Hazardous Material(s)

"Hazardous material(s)" or "hazardous substance(s)" means any element or compound that, when it enters in or upon the water, presents an imminent and substantial danger to the public health or welfare or the environment, including but not limited to fish, animals, vegetation or any part of the natural habitat in which they are found. "Hazardous material or substance" includes but is not limited to a substance designated under 33 U.S.C. §1321 (b)(2)(A), any element, compound, mixture, solution or substance designated under 42 U.S.C. §9602, any hazardous waste having characteristics identified under or listed under 42 U.S.C. §6921, any toxic pollutant listed under 33 U.S.C. §1317 (a), any imminently hazardous chemical substance or mixture with respect to which the Administrator of the United States Environmental Protection Agency has taken action under 15 U.S.C. §2606, and any residue classified as a hazardous waste pursuant to ORS 466.020(3).

1.03.32 Hydromodification

Alteration of runoff volumes, rates, and timing resulting from increased impervious surface. This typically occurs with conversion of land uses from non-urban to urban, or within urban land uses, with a change in development density or type.

1.03.33 Hydromodification Approach

An engineered or natural feature designed or protected to provide stormwater management and offset impacts to natural resources from the effects of hydromodification.

1.03.34 ICEA

Insulated Cable Engineers' Association

1.03.35 Impervious Surface

Pavement, maintained gravel areas, structures, public and private roadways, roofs, and other hard surfaces which are not specifically designed to allow water to infiltrate.

1.03.36 Infill Exemption

An allowance for Fee-In-Lieu forprojects where drainage from the project site is relatively small compared to the drainage basin of the receiving stream, the basin for the receiving stream is mostly developed, and the Risk Level is low or moderate as described in these Standards.

1.03.37 Inspector/District Inspector

The person designated by the District or City to inspect the work.

1.03.38 Intermittent Streams and Springs

Streams and springs that consistently do not have year-round water or saturated soil within their channel or swale in a year with wet to average precipitation patterns. Intermittent flow must occur with some degree of regularity and must be in a definite direction. Section 3.14.3 provides the methodology for determining intermittent status.

1.03.39 Lateral

That portion of the private sanitary or storm sewer extending from a point five feet outside the established line of the building or structure (including any structural projection except eaves) to the public sanitary sewer or storm

system main, including the fittings or connection to the mainline. The lateral includes both the "building sewer" and the "side sewer."

1.03.40 LIDA

Low Impact Development Approaches (LIDA) mitigate the impacts of increased runoff and stormwater pollution using a set of planning, design, construction techniques and stormwater management approaches that promote the use of natural systems for infiltration, evapotranspiration and reuse of rainwater. LIDA can occur at a wide range of landscape scales (i.e., regional, neighborhood and site) and include, but are not limited to, green roofs, porous pavement, and vegetated stormwater management approaches.

1.03.41 Linear Development Project

Linear development projects include but are not limited to roads, trails, paths, and utility lines where development is taking place within a right-of-way or an easement on a parcel that is not owned or controlled by the applicant. Linear development projects also include linear projects such as trails where the project is occurring on only a small part of a large parcel owned by the applicant.

1.03.42 Local Program

The portion of the sanitary sewerage system, or storm and surface water system, program of construction, operation, maintenance, and regulation within the District's service area which may be performed by the District or by a City, County, or by intergovernmental agreement.

1.03.43 Mitigation

The reduction of adverse effects of a proposed project by considering, in the following order:

a. Avoid the impact altogether by not taking a certain action or parts of an action;

b. Minimize impacts by limiting the degree or magnitude of the action and its implementation;

c. Rectify the impact by repairing, rehabilitating or restoring the affected environment;

d. Reduce or eliminate the impact over time by preservation and maintenance operations during the life of the action by monitoring and taking appropriate corrective measures; and

e. Compensate for the impact by replacing or providing comparable sensitive areas or vegetated corridors.

1.03.44 Modify or Modification (as related to impervious surface)

The removal of an impervious surface that exposes gravels, aggregates or soil followed by the placement of impervious or pervious surfaces when not a repair, maintenance activity, or associated with the placement of underground utilities.

1.03.45 NEMA

National Electrical Manufacturers Association

1.03.46 "Or Equal," "Or Approved Equal," "Or Equivalent"

These terms indicate that the "equal" product is the same or better than the product or standard named or prescribed in function, performance, reliability, quality, and general configuration.

Determination of the quality in reference to the project design requirements will be made by the District. Contractor shall not use such "equal" products without prior written approval of the District.

1.03.47 ORS

Oregon Revised Statutes

1.03.48 Outfall

A point where collected and concentrated surface and stormwater runoff is discharged.

1.03.49 Owner or Property Owner

The person who is the legal record owner of the real property, or where there is a recorded land sale contract, the purchaser thereunder.

1.03.50 Path

A developed route primarily for use by pedestrians and non-motorized vehicles.

1.03.51 Perennial Streams and Springs

Streams and springs that have year-round water or saturated soil within the channel in a year with wet to average precipitation patterns. A stream will be considered perennial unless determined to be intermittent using one of the criteria outlined in Section 3.14.3.

1.03.52 Person

Any individual, firm, partnership, joint venture, association, social, fraternal, educational, religious or charitable organization, fraternity, sorority, joint stock company, corporation, estate, trust, business trust, receiver, trustee, syndicate, municipal corporation, district or political subdivision or any legal entity whatsoever.

1.03.53 Plans

The drawings and designs that specify construction details as prepared by the Engineer.

1.03.54 Point of Discharge

Location where stormwater runoff from a project site discharges to the Receiving Reach. This may be a direct discharge to the Receiving Reach on-site or a discharge through conveyances systems, such as pipes and roadside ditches, to an off-site Receiving Reach.

1.03.55 Post Construction Erosion Control

Re-establishing groundcover or landscaping prior to the removal of temporary erosion control measures.

1.03.56 Pre-Development

A Project Site's surface condition prior to the proposed development.

1.03.57 Property or Project or Site

The subject real property on which development or permitted activity takes or is proposed to take place. For activity occurring on property other than that which the applicant owns or controls, the property or the site shall mean the land within limits of the permanent and temporary construction easements or right-of-way.

1.03.58 Project Size Category

One of the project conditions used to determine the Hydromodification Approach for a project site that is based on the amount of impervious surface within the project site. There are three Project Size Categories: Small, Medium, and Large.

1.03.59 Public Sanitary Sewer(s) and Storm and Surface Water System

The sanitary sewer and storm and surface water collection systems, within easements or right-of-way dedicated to the public or District/City, which are operated and under the jurisdiction of and maintained by the District and/or City.

1.03.60 Redevelopment

Redevelopment includes only those activities that alter existing improved impervious surfaces on the subject property. Redevelopment does not include the addition of impervious surfaces to areas that were previously pervious. Redevelopment includes but is not limited to: the expansion of or change to an existing building footprint or structure, provided such expansion only impacts already impervious surfaces; reconfiguration of existing roadways, driveways, or parking lots; and land disturbing activities related to structural or impervious surface modifications.

1.03.61 Receiving Reach

Used to determine Hydromodification Risk Level for a project, the stream reach extending from the Point of Discharge to one quarter mile downstream.

1.03.62 Replacement Area

The mitigation area required to compensate for an encroachment into the Vegetated Corridor or Sensitive Area.

1.03.63 Risk Level

One of the recieving reach conditions used to determin the Hydromodification Approach for a development, based on the likely risk of physical or biological degradation of the stream corridor. There are three Hydromodification Risk Levels: High, Moderate, and Low.

1.03.64 Roadways

Roadways include the driving surface, the structural embankment of the road surface, and associated drainage ditches. Roadways may or may not correspond to the road right-of-way.

1.03.65 Sensitive Area

a. Includes:

1. Existing and created wetlands;

2. Rivers, streams, and springs, whether flow is perennial or intermittent; or

3. Natural lakes, ponds, and in-stream impoundments.

b. Does not include:

1. Stormwater infrastructure;

2. A Vegetated Corridor (a buffer) adjacent to the Sensitive Area;

3. An off-stream recreational lake, wastewater treatment lagoon, fire pond or reservoir; or

4. Drainage Ditches.

1.03.66 Side Sewer

That portion of the private sanitary sewer or storm system extending from the public sanitary sewer or storm system main to the edge of the public right-of-way or boundary of a conveyance easement dedicated to the District or City.

1.03.67 Spring

The point at which groundwater emerges and forms a channel or swale.

1.03.68 Stream

A surface concentration of flow in a channel or swale in which a flow of water occurs either perennially or intermittently.

1.03.69 Stormwater

Stormwater is water that runs off only from impervious surfaces during rain events.

1.03.70 Stormwater Infrastructure

Any structure, feature, or drainage ditch that is designed, constructed, and maintained to collect and filter, convey, retain, or detain stormwater runoff during and after a storm event for the purpose of water quality improvement

or quantity management. It includes, but is not limited to, features such as constructed wetlands, water quality swales, landscaped retention areas, and detention ponds that are maintained as stormwater quality or quantity control facilities.

1.03.71 Surface Water

Water that drains from the landscape via overland flow or ground water resurgence. Surface water flows can and often do include stormwater runoff.

1.03.72 This Resolution and Order

"This Resolution and Order," "These Standards and Regulations" and similar terms mean this entire Resolution and Order adopted by the CWS Board of Directors, this Exhibit A, Chapters 1-10 and Appendices A and B.

1.03.73 UL

Underwriters Laboratories, Inc.

1.03.74 User

The person responsible for discharge of stormwater or wastewater into the public system, as further defined in Ordinance 27.

1.03.75 Vegetated Corridor

A corridor adjacent to a Sensitive Area that is preserved and maintained to protect the water quality functions of the Sensitive Area.

1.03.76 Visible or Measurable Erosion

Visible or measurable erosion includes but is not limited to:

a. Deposits of mud, dirt, sediment or similar material exceeding one-half cubic foot in volume on public or private streets, adjacent property, or into the storm and surface water system, either by direct deposit, dropping, discharge, or as a result of the action of erosion.

b. Evidence of concentrated flows of water over bare soils; turbid or sediment laden flows; or evidence of on site erosion such as rivulets on bare soil slopes, where the flow of water is not filtered or captured on the site using the techniques in Chapter 6.

c. Earth slides, mudflows, earth sloughing, or other earth movement, which leaves the property.

1.03.77 Water Quality or Quantity Approach

An engineered or natural feature designed or protected to provide stormwater management. Approaches consist of water quality and quantity facilities, natural systems and other low impact development approaches.

1.03.78 Water Quality Sensitive Area, or Sensitive Area

See "Sensitive Area" definition.

1.03.79 Watercourse

A watercourse is a:

a. channel

b. creek

c. stream

d. river

e. swale, or

f. storm drain pipe in which a flow of water occurs either perennially or intermittently.

1.03.80 Wetlands

Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Categories of wetlands include:

a. Created Wetlands
Those wetlands developed in an area previously identified as a non wetland to replace, or mitigate wetland destruction or displacement. A created wetland shall be regulated and managed the same as an existing wetland.

b. Constructed Wetlands
Those wetlands developed as a stormwater facility, subject to change and maintenance as such. These areas must be clearly defined or separated from existing or created wetlands. Constructed wetlands shall be regulated as created wetlands only if they serve as wetland mitigation.

c. Jurisdictional Wetlands
Jurisdictional wetlands as determined by the Division of State Lands (DSL) or the US Army Corps of Engineers (COE).

d. Isolated Wetlands
Wetlands not connected to streams or other surface water bodies.

1.03.81 Work

All labor necessary to produce the construction required by the approved construction plans, and all materials and equipment incorporated to complete construction.

1.04 Prohibited Activities

In addition to the restrictions of Ordinance 27, Section 3.B, the following activities are prohibited, except as expressly allowed or approved by District / City/ County permit:

a. The discharge, placement, deposit, dumping or otherwise contributing a solid or liquid material into the public storm and surface water system, either directly or indirectly, which may obstruct flow or otherwise interfere with the operation or function of a public storm and surface water facility. This shall include but is not limited to placing of soil or rock without an approved fill permit, or the dumping of debris, yard waste, rubbish, trash, or other waste material.

b. The operation of a motor vehicle on native ground in a Sensitive Area or Vegetated Corridor.

c. The removal of native vegetation in a Sensitive Area or Vegetated Corridor.

d. The interruption of a natural water source to a Sensitive Area.

e. The removal of non-native invasive vegetation from a Sensitive Area, Vegetated Corridor, or Stormwater facility other than with an integrated vegetation management approach.

f. The use of pesticides on property, including easements, owned by a city, county or other political subdivision, including the District, unless the use is permitted by property owner, or in the case of District easements, the District.

1.05 Enforcement

Failure to comply with any provision of these Standards or with a permit issued under these rules shall be deemed a violation of this ordinance and subject to enforcement action pursuant to applicable District and City Ordinances and Resolutions and Orders, including all implementing rules and regulations.

1.06 Alternate Methods

Alternate methods or materials not explicitly approved in these Standards will be considered for approval on the basis of the intent, objectives, and applications set forth in this Resolution and Order and other District rules and regulations. Any alternative shall meet or exceed the minimum requirements set forth in these Standards. Those seeking such approvals shall make application in writing. Approval of any major or significant deviation or waiver from these Standards, as determined by the District, will be in written form.

The written application is to include the manufacturer's specifications, testing results, design drawings, calculations, maintenance and operation requirements, and other pertinent information. Request for approval of alternatives or waiver of a standard may be submitted with initial or subsequent plan submittals and shall include a written report with all pertinent information necessary to review, evaluate and approve the request. All requests will be reviewed and evaluated on a case-by-case basis.

1.07 Provisions Within Cities Operating the Local Program

1.07.1 Plan Submittal Requirements

Construction plans for any proposed public sanitary or storm system or water quality or quantity facility to be located within a City operating a local program shall be prepared by an Engineer registered in Oregon and submitted to the appropriate City for review. The City shall submit one set of construction plans to CWS for review and approval. If the proposed public sanitary/storm system connects to a CWS-maintained system, the City shall submit two sets of plans to the District. (Plans can be submitted to CWS in electronic format). CWS shall review the plans to ensure conformance to these construction standards and return one set to the City. The City shall incorporate CWS's comments into the final approval of the construction plans.

1.07.2 Inspection

Except as provided within intergovernmental agreements, the inspection of sanitary and storm sewer systems and water quality and quantity facilities within a City which operates a local program is the responsibility of that City. The City shall ensure compliance with these construction standards. The District may inspect such facilities at its discretion in addition to the City inspection.

1.08 Other Provisions

1.08.1 Responsibilities of Property Owner

In addition to all requirements placed upon the Owner herein, whenever any

requirement or obligation is imposed upon the Engineer, the Contractor or any other individual employed or supplied by the Owner in this Resolution and Order, such requirement or obligation is also expressly imposed upon the Owner of the property. The Owner's indemnification, contained in Section 1.08.4 below, expressly includes indemnification for any failure on the part of the Engineer, the Contractor or any other employee to comply with this Resolution and Order.

All costs associated with the sanitary sewer or storm system construction, vegetated corridors, and erosion control pursuant to a Construction Permit Agreement including, but not limited to, repairs of defective work, shall be borne by the Property Owner.

1.08.2 Easements

Facilities which are part of the publicly owned sanitary and surface water management system shall require an easement or dedication. The publicly owned facilities shall include sanitary sewers, pump stations, storm sewer systems, and water quality or quantity facilities serving more than one property. Facilities shall also include sensitive areas and associated vegetated corridors and created and constructed wetlands. Access easements are required to all public water quality and quantity facilities that include outlet control structures and to manholes where required by the District or City. The Owner shall provide the District or City with the documents necessary to grant such easements.

1.08.3 Right of Entry to Work

Representatives of the District and any federal, state, or local agencies having jurisdiction over any sanitary or storm and surface water work site, shall have right of entry to any and all portions of the work at reasonable times, and the Contractor shall cooperate in all respects with such agencies and shall provide proper facilities for access and inspection.

1.08.4 Indemnification

The Owner and other parties to a construction permit agreement shall indemnify and hold harmless the District and/or City, its officers and employees from and against all claims, demands, penalties, damages, losses, expenses, including attorneys' fees, and causes of action of any kind or character, including the cost of defense thereof, arising or alleged to have arisen in favor of any person on account of personal injury, death or damage to property arising out of or resulting from or alleged to have arisen out of or resulted from, in whole or in part, any act or omission of the Owner, its Engineer, its Contractor, its Safety Manager or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable.

1.08.5 Guarantee

The Owner shall furnish high quality equipment, supplies, and materials, and perform the work in accordance with these specifications. Any failure or omission of any District or City inspector to reject any defective equipment, supplies, materials, or work shall not be construed as an acceptance thereof nor release the Owner from his obligations hereunder. Upon notification of any deficiency by District or City, the Owner shall properly reconstruct or replace any defective equipment, supplies, materials, or work at its own expense at any time upon discovery of the defect during the period of construction and for the full guarantee period following acceptance of the work and indemnify District and City from any claims resulting therefrom. The Owner shall guarantee all materials and equipment furnished and work performed for a minimum period of one year from the date of formal written acceptance by the District or City. The Owner further warrants and guarantees for a minimum period of one year from the date of final acceptance of the system that the completed system is free from all defects due to faulty materials or workmanship and the Owner shall promptly make such corrections as may be necessary by reason of such defects including the repairs of any damage to other parts of the system resulting from such defects.

1.08.6 Traffic Maintenance and Safety

The Contractor shall comply with all rules and regulations of the City, County, or State authorities regarding the closures of public streets or highways to use of public traffic. No public road shall be closed to the public except by express permission of the public agency responsible for the road. The Contractor shall conduct its operations so as to ensure the least possible obstruction to traffic and normal commercial pursuits. The Contractor may be required to submit a traffic control plan to the appropriate jurisdiction for review and approval prior to beginning construction.

1.08.7 Protection of Property

The Contractor shall protect stored materials, cultivated trees and crops, and other items located adjacent to the proposed construction limits. Property Owners affected by the construction shall be notified at least 48 hours in advance of the time construction begins. During construction, no person shall be without vehicular access to their residence or place of business for a period exceeding eight hours, unless the Contractor has made special arrangements in writing with the affected person.

1.08.8 Safety Requirements

The Owner and Contractor are responsible for the safety of the work and of all persons and property coming into contact with the work. The Contractor shall

conduct the work in such a manner as to comply with all requirements of Occupational Safety and Health Administration, the Oregon Safe Employment Act and any other agency having authority over such matters. The Contractor shall minimize the possibility of accident or injury to workers and the general public. The Contractor shall conduct the work to provide all reasonable safeguards so as to protect public and private property. If the District or City inspector observes a violation of safety practices, the District or City inspector will inform the Contractor of the inspector's observation. The Contractor shall then immediately correct the violation. If the Contractor does not do so, the District or City shall notify the appropriate agency having jurisdiction. If, in the opinion of the District or City inspector, the safety violation is of a nature to present imminent danger to Contractor's workers or the general public, the District or City inspector may cause the construction work to stop until the safety violation is corrected. The District and City inspector's role is not one of supervision or safety management, but is one of overview only. Nothing contained in this section or elsewhere in this Resolution and Order shall be interpreted to obligate the District or City to act in any situation nor to shift the Owner's responsibility for safety compliance to the District or City. No responsibility for the safety or the work or for construction means, methods, techniques, sequences or procedures shall attach to the District or City by virtue of its action or inaction under this section.

1.08.9 Compliance with Applicable Laws

The Contractor shall keep fully informed of all local ordinances, as well as state and federal laws, which in any manner affect the work herein specified. The Contractor shall at all times comply with said ordinances, laws, and regulations, and protect and indemnify the District and/or City and its officers and agents against any claim or liability arising from or based on the violation of any such laws, ordinances, or regulations. All permits, licenses, and inspection fees necessary for execution and completion of the work shall be secured by the Owner or Contractor, except where specifically provided by the District or City.

1.08.10 Interference with Public Sanitary Sewer or Storm System Prohibited

No person shall block, obstruct or interfere with any portion of the public sanitary sewer or storm system without approval of the District or City. This prohibition includes, but is not limited to, the obstruction of the flows from and to any point within the public sanitary sewer or storm system.

1.08.11 Inspection Warrants

The District or a City may apply to a court of competent jurisdiction for an inspection warrant pursuant to this section. The District or City may apply for such warrants whenever the District or City has requested of the property

owner or his/her apparent agent access to any premises to ascertain information necessary to carry out the provisions of this Resolution and Order and such request has been denied. Information necessary to carry out these provisions shall include, but not be limited to, verification of Owner supplied data. An inspection warrant issued pursuant to this section is an order authorizing an inspection or investigation to be conducted at a designated place or property for the purpose of obtaining the above described information.

1.08.12 Professional Engineering Submittals

The District requires strict compliance with ORS 672 for Professional Engineers.

When required by this Resolution and Order all engineering plans, reports, calculations, and other technical submittals shall be prepared, sealed, and signed by a Professional Engineer currently registered in the State of Oregon. It is the Engineer's responsibility to become familiar with, and comply with all design and construction Standards as contained within this Resolution and Order and to review any proposed changes with the District prior to design, permit approval, or construction. District approval of engineered plans and other submittals does not in any way relieve the Engineer of responsibility to meet all requirements of the District or obligation to protect the life, health, safety, and property of the public. Except where alternative methods, materials or designs have been approved by the District under Section 1.06, the Engineer shall be required to revise or supplement the design if the District determines that the full requirements of these Standards have not been met.

Chapter 2

ADMINISTRATIVE PROCEDURES

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Chapter 2

ADMINISTRATIVE PROCEDURES

2.01 General

2.01.1 Application of Chapter

a. Except as defined in subsections (b) and (c) below, the requirements and administrative provisions of this Chapter apply to the construction of any and all components of the public sanitary sewer and storm systems, and to all activities with the potential to cause erosion or create or modify impervious surfaces, within the unincorporated area of the District, and within the following Cities: Banks, Durham, Gaston, King City, and North Plains, and within any other City which formally adopts these requirements.

b. The following requirements shall apply to all areas within the District:

1. Section 2.02 – Pre-Development Site Certification and Assessment

2. Erosion Control
The requirements for Erosion Control Permits and NPDES 1200-C and 1200-CN Permits as stated in Sections 2.03.4 and 2.03.5 respectively

3. Section 2.04.1 and 2.04.2 (d)-(n) – Plan Submittal Minimum Requirements and Initial Plan Submittal Requirements

4. Section 2.05 - Requirements for Plan Approval for Single Family Existing Lots of Record.

5. Section 2.08.2 – Private Stormwater Facilities Agreement

6. Sections 2.11 and 2.12 - Maintenance Assurance and Maintenance Period Inspection and Completion

7. Administrative Provisions
Sections 2.13.5, District Maps/Plans Not Guaranteed, and Section 2.13.6, Technical Guidance Documents, apply throughout the District.

c. Requirements related to stormwater and vegetated corridors shall not apply to projects within the City of Gaston.

2.01.2 Fees

The District and Cities shall collect fees to defray the costs of reviewing plans, issuing permits, and performing inspections of projects permitted under these rules. The fees are identified in the District's Rates and Charges Resolution and Order and, where appropriate, City ordinances.

2.02 Pre-Development Site Certification and Assessment

a. Site Certification Required
Prior to undertaking any development or completing a land use application to the land use authority for development, as defined in Chapter 1, the Owner or the Owner's authorized agent shall submit a site certification, and if required, a natural resource assessment, for the Water Quality Sensitive Areas and Vegetated Corridors on or adjacent to the development site, to the District for review and concurrence in accordance with the requirements of Chapter 3, or receive a determination from the District that a Site Certification is not necessary.

b. Expiration of Site Certification
District Site Certification is valid for two years from the date of approval, or until the project's current land use approval expires, unless substantial construction has started and is continuing. After two years, if land use application has not been completed, or a Site Development Permit has not been issued or if substantial construction is not continuing, the plans must be resubmitted to the District for review and approval, and the District shall require an updated natural resource assessment to document current conditions of the Sensitive Area and Vegetated Corridor.

2.03 Construction Permits

2.03.1 Site Development Permit

No person shall undertake the construction of, or modification to, any public sanitary sewer or stormwater infrastructure or other development governed by these rules without first obtaining a Site Development Permit from the District, with the exception of development on single family and duplex existing lots of record as outlined in Section 2.03.2.

The Site Development Permit will not be issued until the Owner or its authorized agent has satisfied the following requirements:

a. Submitted easements as required in Section 2.06;

b. Submitted required performance assurances as required in section 2.07;

c. Executed and submitted a Construction Permit Agreement and Private Stormwater Facilities Agreement as required in Section 2.08;

d. Paid all required fees including plan review and inspection fees, erosion control fees, and systems development charges; and

e. Gained approval of site development plans as required in Section 2.04.

2.03.2 Development Permits for Single Family Existing Lots of Record

a. Development on single family and duplex existing lots of record does not require a Site Development Permit, where construction of public sanitary sewer or stormwater infrastructure is not proposed. District will permit development through applicable connection and inspection permits.

b. District plan review is required when a Site Assessment is required in accordance with Chapter 3 or a water quantity or quality approach is required in accordance with Chapter 4. The applicable permits will not be issued until the Owner or its authorized agent has satisfied the following requirements:

1. Submitted easements as required in Section 2.06;

2. Executed and submitted a Private Stormwater Facilities Agreement as required in Section 2.08;

3. Paid all required fees including plan review and inspection fees, erosion control fees, and systems development charges;

4. Gained approval of plans as required in Section 2.05.

2.03.3 Erosion Control Only Permit, Prior to Site Development Permit

a. Criteria for Issuance
Erosion Control Only permits may be issued on all or a portion of the site in advance of the Site Development Permit when application for an Erosion Control Permit is made separately from application for a Site Development Permit. The District/City shall make the determination, at its sole discretion, as to whether an Erosion Control Only permit may be issued, based on its evaluation of the following factors:

1. A preliminary site development plan shall have been submitted separately and have undergone initial review by the District or City for compliance with this Resolution and Order. The site development plan shall be of sufficient detail to determine that no major revisions are required that may substantially affect grading, pipe alignments, water quality or quantity approaches, sensitive areas or vegetated corridor requirements.

2. All other agency (i.e., COE, DSL, DEQ) permits must have been issued for the portion of the site or development for which the Erosion Control Only permit is being requested and a copy of these permits shall be provided to the District.

3. The timing of the request is appropriate based on the following factors:
   A) A significant amount of grading can be performed prior to site development approval;
   B) A reasonable expectation exists that site development permits will be issued near the time grading is complete so that the site does not remain open during the wet weather season; and
   C) An early grading approval will not increase the risk of erosion from the site.

b. Submittal Requirements
The application for an Erosion Control Only permit shall include the following:

1. Four sets of folded plans, on 24" x 36" sheets, shall be submitted to the District or City for review. This plan set shall only include the title sheet, grading and Erosion Prevention and Sediment Control Plan, and related sheets. The plan shall be clearly marked for Erosion Control Only and shall be separate from the development plan submittal. With District or City concurrence, some or all documents in a submittal may be submitted in an electronic format approved by the reviewing jurisdiction.
2. The grading and Erosion Prevention and Sediment Control Plan shall show the methods and interim facilities to be constructed or used concurrently and to be operated during construction to control erosion. The grading and Erosion Prevention and Sediment Control Plan shall meet the requirements of Section 2.04.2 (k) and the provisions of Chapter 6.

2.03.4 Erosion Control Permits

a. Erosion Control Permit Required
Except as noted in Section 2.03.4 (d), no person shall cause any change to improved or unimproved real property that causes, will cause, or is likely to cause a temporary or permanent increase in the rate of soil erosion from the site without first obtaining a permit from the District or City and paying prescribed fees. Such changes to land shall include, but are not limited to, grading, excavating, filling, working of land, logging or stripping of soil or vegetation from land.

Erosion Control Permits are issued in conjunction with other permits or issued as a stand-alone permits as outlined in (1) – (3) below:

1. Except as provided in Section 2.03.3, when Site Development Permits are required the Erosion Control Permits are issued in conjunction and included with Site Development Permits and do not need to be obtained separately.

2. When Connection Permits are required separate from the Site Development Permit, Erosion Control Permits are issued in conjunction and included with Connection Permits and do not need to be obtained separately.

3. When construction, grading, excavating, filling, or clearing of land does not require a Site Development Permit or Connection Permit, Erosion Control Permits must be obtained separately.

b. Coordination with Other Agencies
No jurisdiction shall issue a permit for construction, land development, grading, excavating, filling, or clearing of land without first verifying in writing that the District or City has issued an Erosion Control Permit covering such work, or the District or City has determined that no permit is required.

c. Erosion Control Permits Required on Public Projects
No public agency or body shall undertake any public works project without first obtaining an Erosion Control Permit covering such work, or receiving a determination from the District or City that no permit is required.

d. Erosion Control Permit Not Required
No Erosion Control Permit from the District or City is required for the following:

1. For work of a minor nature where the work on the site involves disturbing less than 500 square feet of land surface.

2. Permits and approvals for land division, interior improvements to an existing structure, and other approvals for which there is no physical disturbance to the surface of the land.

3. Activities within the boundary of CWS that constitute accepted farming practices as defined in ORS 30.930 and 215.203.

4. Pavement maintenance including overlays where the pavement area is not expanded beyond the existing pavement boundaries and

minor pavement patch work involving less than 500 square feet of area.

e. Erosion Prohibited in All Cases
In all cases the Property Owner, together with any person or persons, including but not limited to the Contractor or the Engineer who causes such erosion, shall be responsible for compliance with Section 6.02.1 and for obtaining a permit at District or City discretion.

2.03.5 NPDES 1200-C and 1200-CN General Permits

Through an agreement with the Department of Environmental Quality (DEQ), the District acts as DEQ's agent in receiving applications for registration for coverage by the 1200-C and 1200-CN General Permits (1200-C Program) for the control of stormwater associated with construction activities where required by DEQ. Persons who develop within the District boundary and who would be required to obtain a DEQ 1200-C or 1200 CN permit shall submit the required 1200-C or 1200-CN forms and fees, as applicable, to the District or City prior to obtaining the Site Development permit. The District reviews the permit application for compliance and inclusion in the DEQ General Permit program.

2.04 Requirements for Site Development Plan Approval

2.04.1 Plan Submittal Minimum Requirements

a. The Owner or the Owner's authorized agent shall submit to the District or City for review and approval plans prepared by an Engineer registered in Oregon for the construction or modification of any public sanitary or storm system, stormwater facility, Erosion Control Permit, or other facility covered by these rules.

b. The following plan submittal requirements are the minimum required to satisfy the District's standards, unless specifically waived in writing by the District. Cities may require additional information.

2.04.2 Initial Plan Submittal Requirements

No submittal shall be considered complete until the following information is received and all the requirements of this section are met as determined by the District or City.

a. Plan Check Application Fee, if applicable.

b. Land Use Authority Conditions of Approval.

c. Three sets of folded plans on 24" X 36" sheets, or as otherwise approved by the District, and two copies of associated documents such as drainage reports. Individual plan sets that exceed 20 pages may be rolled and stapled. With District or City concurrence, some or all documents in a submittal can be submitted in an electronic format approved by the reviewing jurisdiction.

d. The following information shall be included on the first plan sheet:

1. Vicinity map sufficient in scope to locate the proposed development.
2. The proposed name of the development, the name and address of the Owner and developer, the name and address of the engineer, and the land use authority case file number, on the lower right-hand quarter of the sheet.
3. A description that includes township, range, quarter section and tax lot numbers of the areas impacted by the development.
4. The total square footage of new and existing impervious areas within the project area. This calculation shall be separated into the square footage:
   A) Within Public Right-of-Way;
   B) Within Private Right-of-Way;
   C) On Private Property;
   D) Building(s) footprint (commercial properties only); and
   E) Onsite drives, parking, walks, etc. (commercial properties only).
5. Index of plan sheets.
6. A site map showing the limits of the proposed development including the area of the overall site size and limits of ground disturbance. For multi-phase projects, the site map shall show the limits of each phase.
7. Corps and/or DSL permit application number (if permit is required), and the project or permit application number(s) for any other federal, state or local entity, or wetland delineation. Copies of the permit applications shall be included with the submittal. A Site Development Permit shall not be issued until CWS or City has received confirmation of the permit conditions from the permitting authority and reviewed the plans to determine if any changes are necessary as a result of the permit conditions.

e. Clear, readable plan and profile views of all proposed sanitary sewer lines, storm sewer and surface water systems, shall be provided. The plan and profile drawings shall meet the requirements outlined in 2.04.2(e) (1)-(15), or as otherwise approved by the District. If the design Engineer anticipates that any of the requirements will not be met due to the configuration of the proposed development, the design Engineer is advised to meet with

District staff to gain approval for the deviation prior to submittal.

1. Sanitary sewer plan and profile information presented on separate sheets from the storm and surface water plan and profile information.
2. Plan and profile views displayed one over the other on the sheet.
3. Public and private lines and facilities clearly marked on both the plan and profile view.
4. Existing sanitary manholes labeled with the designated CWS or City number.
5. The distance from the nearest existing manhole where a new manhole structure is constructed over an existing line, or where a main line connection is made to a trunk line.
6. Existing and proposed utilities shown on the plan and profile views. The profile view shall show the utility crossings. Utilities other than sanitary and storm sewer shall be shown "ghosted".
7. A plan view scale no smaller than 1"= 50', and the profile view scale no smaller than 1"= 50' horizontal and 1"=10' vertical. Architectural scales shall not be used.
8. North arrow.
9. Type of backfill labeled on profile using CWS or City standard nomenclature.
10. All existing and proposed easements including the distance from the mainline to easement line.
11. Location of the low points of street grades and curb returns.
12. Drainage hazard areas and FEMA designated 100 year floodplains and floodways.
13. The stationing of each new main line section beginning at 0+00 or other even station (e.g., 1+00, 10+00, etc.) at the downstream terminus. In phased developments, previous stationing may be continued.
14. The edge of all Water Quality Sensitive Areas, as defined in Chapter 1.
15. The boundaries of the defined Vegetated Corridor.

f. The calculations for sizing of the sanitary system submitted in a separate document. This requirement may be waived by the District where the sanitary conveyance system is known to have adequate capacity for the proposed development.

g. If a water quantity or quality facility is required, a plan sheet(s) showing all the following information:

1. Profile of facility including inlet and outlet structures.
2. Cross section(s) of facility. Multiple cross sections may be required for facilities with walls or grade changes.

3. For water quantity facilities, detail of the outlet structure including orifice sizes and elevations. Standard details of structures to be included.
4. Access road design, including access to structures and bottom of facility.
5. If walls are used, wall construction details and notes identifying wall maintenance responsibility.
6. Fence and gate design and standard details.
7. Easement and tract boundaries around facility.
8. Planting and landscape design for the facility meeting the requirements of the Low Impact Development Approaches Handbook.

h. If vegetated corridor restoration is required in accordance with Chapter 3, a plan addressing the requirements shall be submitted which includes the following:

1. A plan view at no smaller than 1"=100' scale, showing the location, dimensions and the total square footage of the Vegetated Corridor;
2. Design information to meet the requirements of the Service Provider Letter; and
3. Planting Plans and Specifications meeting the requirements of Appendix A, Planting Requirements.
4. A Maintenance Schedule per Appendix A 2.6.e

i. Planting plans, tabular plant counts, and landscaping and maintenance instructions for sensitive areas and vegetated corridors shall be illustrated separately from those for water quality facilities.

j. Details for all ditch grading including cross sections, restoration, erosion control measures and channel protection.

k. An Erosion Prevention and Sediment Control Plan including at a minimum the items outlined in 2.04.2 (k) (1)-(3). If a 1200-C or 1200-CN permit is required, an erosion control plan set meeting the requirements of the 1200-C Program shall be submitted as outlined in Section 2.03.5.

1. If submitted independently of the full project plans, a cover sheet with the proposed name of the development, the name and address of the Owner and developer, the name and address of the Engineer, and the land use authority case file number.
2. The total acreage of the site and the total acreage of the proposed disturbed area.
3. Site features as identified below.

A) Existing site topography.
B) Adjacent off-site drainage patterns indicated by arrows.
C) Contours at 2-foot intervals. Where slopes exceed 15 percent, contours may be shown at 5-foot intervals.
D) North arrow.
E) Existing and proposed structures for the project site.
F) Existing and proposed access location for the project site.
G) Existing project boundaries, rights-of-way, easements, and jurisdictional boundaries clearly identified by note, symbol, or key.
H) Adjacent streets with street names and right-of-way boundaries.
I) Capacity and condition of existing drainage facilities, including roadside or other drainage ditches, that transport surface water onto, across, or from the project site.
J) Existing Sensitive Areas, Vegetated Corridors, and water quality and quantity facilities. For natural drainage features, show direction of flow, Drainage Hazard Areas, and the 100-year floodplain.
K) Clearing and grubbing limits.
L) Proposed ground contours.
M) For multi-phase projects, phasing of any erosion prevention and sediment control work clearly indicated on the plan.
N) Details of proposed erosion prevention and sediment control Best Management Practices (BMPs). When sedimentation ponds are proposed, at least one cross section detail shall be shown.
M) Supplemental Plan(s), if applicable, as described in Section 6.03.8.

l. If alternative methods, materials, or designs other than those included within this Resolution and Order are proposed, a written report shall be submitted which includes design drawings, calculations, maintenance and operation requirements, and other pertinent information necessary to review and evaluate the proposal.

m. A drainage report containing the information listed below. The District may waive some or all of these report requirements for single-family residential partition projects and projects where post-development impervious surfaces constitute less than 25% of the parcel. In order to apply for a waiver, the applicant must submit a written request to the District and the applicant or applicant's Engineer must participate in a pre-design meeting to discuss the proposed project and its stormwater impacts prior to initial plan submittal.

1. Maps showing the following information:
   A) Upstream basin flowing through the site with contours.
   B) Downstream basin to the point where analysis is required in the downstream analysis detailed in subsection (3) and (4) below, with contours.
   C) Site plan showing development layout with contours.
   D) Existing stormwater facilities on and adjacent to the site.
   E) Stormwater facilities proposed to be constructed by the project.

2. Calculations for:
   A) Sizing of water quality and quantity facilities.
   B) Sizing of conveyance system, including calculations showing portions of existing conveyance system that are not proposed to be altered have adequate capacity according to the criteria in these rules.

3. Review of Downstream Conveyance System:
   A) For each development constructing new impervious surface of greater than 5,280 square feet, or collecting and discharging greater than 5,280 square feet of impervious area, except for the construction of a detached single family dwelling or duplex, the design Engineer shall perform a capacity and condition analysis of existing downstream storm facilities and conveyance elements receiving flow from the proposed development.
   B) The analysis shall extend downstream to a point in the drainage system where the additional flow from the proposed development site constitutes 10 percent or less of the total tributary drainage flow.
   C) Where the additional flow from the proposed development drops to less than 10 percent of the total tributary drainage flow, then the analysis will continue for the lesser of:
      i. One-quarter (1/4) of a mile; or
      ii. Until the additional flow constitutes less than 5 percent of the total tributary drainage flow.
   D) When the downstream analysis does not continue for at least one-quarter (1/4) mile, the design engineer shall provide a stamped Certification of Investigation that states the design Engineer has visually investigated the downstream system for at least one-quarter (1/4) mile downstream and is aware of no observable downstream impacts to structures.

4. Hydromodification Assessment:
   A) For each development meeting the criteria of Section 4.03.2, the applicant must submit a Hydromodification Assessment. The design Engineer shall determine the Risk Level by either

using the District's Hydromodification Map or by performing a site-specific evaluation of the Receiving Reach.

B) The analysis shall follow the conveyance system to the Point of Discharge and extend downstream for ¼ mile from the Point of Discharge, which is the Receiving Reach.

C) The analysis may be truncated at the point that the resulting Risk Level is High, because the highest result is used to determine the representative of the Hydromodification Project Category, as described in Section 4.03.3.

5. Narrative, with tables where appropriate, describing:

A) How water quality, hydromodification, conveyance capacity, and LIDA requirements of these rules are met by the project.

B) Areas and flows used for design calculations in subsection (2) above with results of analysis clearly stated.

C) Results of downstream analysis.

n. For privately maintained stormwater management approaches or conveyance systems, a maintenance plan that clearly identifies maintenance activities and frequency in a form that can be easily provided to and understood by the people responsible for maintenance.

2.04.3 Timing for Plan Review

a. The District shall endeavor to perform a completion check of the initial plan submittal for compliance with Section 2.04.2 within three working days of receipt. Submittals which are not in substantial compliance with Section 2.04.2 will be returned without further review.

b. Upon acceptance of a complete plan submittal in compliance with Section 2.04.2, the District shall endeavor to approve, return for revision, or reject the plans within 15 working days of receipt. If plans are rejected, the reasons shall be indicated in writing.

c. The District shall endeavor to approve, return for revision, or reject subsequent submittals within 10 working days.

2.04.4 Revised Plan Submittal and Approval

a. Plan Re-Submittal
After the initial review pursuant to section 2.04.3 is completed, a set of plans with comments and/or revisions shown in red shall be returned to the Engineer. Two sets of revised construction plans addressing all comments made by the District shall then be submitted for approval. Upon approval of the plans, a minimum of five plan sets shall be provided to the District.

b. Bonding Calculation Requirement
Upon approval of the plans, an Engineer's cost estimate of construction, erosion control (EC), and planting details shall be submitted to the District for the calculation of bonds and fees. Onsite area is defined as the pre-development parcel limits. The cost estimate shall be itemized as follows:

1. Onsite Storm Sewer Improvements itemized for each pipe size and type.
2. Offsite Storm Sewer Improvements itemized for each pipe size and type.
3. Onsite Sanitary Sewer Improvements itemized for each pipe size and type.
4. Offsite Sanitary Sewer Improvements itemized for each pipe size and type.
5. Water Quantity/Quality Approach Construction itemized by public and private facility type for the following:
   A) Excavation/Site Preparation
   B) Control Structures, piping and water quality manholes
   C) Fencing and maintenance access road costs
6. Water Quantity/Quality Approach Landscaping. This includes any plantings in the treatment area or on the side slopes, along with any trees planted solely to provide shade.
7. Vegetated Corridor/Water Quality Sensitive Area Site Preparation and Planting for Enhancement and Mitigation requirements.
8. Erosion Control Installation and Maintenance
   A) Cost to install and maintain Erosion Control measures for the period of construction.
   B) If significant erosion control installation and maintenance costs are anticipated following construction due to project size or duration, or if the erosion control plan will be amended due to changing site conditions or differing recovery times between areas, a separate estimate for Post-Construction Erosion Control shall be provided.

c. Expiration of Plan Approval
District plan approval is valid for two years from the date of approval, or until the project's current land use approval expires, unless substantial construction has started and is continuing. After two years, if a Site Development Permit has not been issued and if substantial construction is not continuing, then the plans must be resubmitted to the District for review and approval and the District shall require revisions so that the plans meet the current construction standards.

2.04.5 Notification of Start of Construction

The Owner or their designee shall notify the District or City at least two working days in advance of starting construction on any project covered by these rules.

2.04.6 Post-Approval Plan Modifications

a. When modification of the approved plan is requested by the Owner, four sets of plans showing the revisions shall be submitted to the District for approval. With District or City concurrence, the modifications may be submitted in an electronic format approved by the reviewing jurisdiction.

b. No construction of the modified section can commence until these revised plans are approved. Plan review fees for modification of the approved plans will be charged at the District's established plan review rates.

2.05 Requirements for Plan Approval for Existing Single Family Lots of Record

2.05.1 Plan Submittal Minimum Requirements

The following plan submittal requirements are the minimum required to satisfy the District's standards. Cities may require additional information. No submittal shall be considered complete until the following information is received and all the requirements of this section are met, unless specifically waived in writing by the District or City.

a. A plan sheet(s) on 11" x 17" paper at a scale of 1" = 60' or less, showing all the following information:

1. Property lines.
2. Existing and proposed structures for the project site.
3. Existing and proposed storm and sanitary laterals and connection locations at public infrastructure.
4. Sanitary and storm sewer easements that benefit District or City, Public Utility Easement (PUE) and other easements on the property.
5. Clearing and grubbing limits.
6. Proposed ground contours.

b. If an erosion control inspection permit is required in accordance with Chapter 2, a plan sheet shall be submitted in accordance with Chapter 6 and Section 2.04.2.k. The District or City standard detail that shows use and placement of BMPs and list of approved BMPs may be used in lieu of a site-specific plan.

c. If a water quantity or quality approach is required in accordance with Chapter 4, a plan sheet(s) showing all of the following information:

1. Profile of water quantity or quality approach including inlet and outlet locations and elevations.
2. District standard drawing(s), or approved alternative.
3. Planting Plans and Specifications meeting the requirements of the LIDA Handbook.
4. Square footage of impervious area draining to each water quantity or quality approach.
5. Square footage of treatment area for each water quantity or quality approach.
6. Partition Plat or Subdivision name and lot number, if applicable.

d. If vegetated corridor restoration is required in accordance with Chapter 3, a plan sheet(s) showing all of the following information:

1. A plan view showing the location and dimensions of the Vegetated Corridor.
2. Design information to meet the requirements of the Service Provider Letter.
3. Planting Plans and Specifications meeting the requirements of Appendix A, Planting Requirements.
4. Maintenance Schedule per Appendix A 2.6.e

2.06 Easements

a. Off-site easements and on-site easements for projects not involving a land division shall be granted to the District in a form approved by the District prior to the issuance of the Site Development or Construction Permits. On-site easements for projects involving land division shall be granted to the District and shown on the final plat before plat approval and recording.

b. Easement dimensions for public sanitary sewers and storm facilities shall meet the requirements of Section 5.03.

c. Easements for publicly maintained water quality or quantity facilities shall meet the requirements of Section 4.02.5.

d. Easement for vegetated corridors and sensitive areas shall meet the requirements of Section 3.06.3 and comply with the requirements of the Service Provider Letter.

2.07 Performance Assurances

2.07.1 Performance Assurance Requirement

a. Performance assurances shall be submitted by the Owner for work authorized by the District to ensure quality and completeness of the project. Assurances should be in the form of a letter of commitment, performance bond, or cash deposit in form and substance satisfactory to the District.

b. If the Contractor provides the performance assurance for the project, both the Contractor and Owner are required to execute the Construction Permit Agreement required by Chapter 2.08.

c. The District will require submission of certificates of insurance in form and substance satisfactory to the District by the Owner and/or the Contractor prior to the permitting of any project under these rules.

2.07.2 Performance Assurance Amount and Duration

Except as may be allowed in Section 2.07.3, the amount of the performance assurance shall be as identified in Table 2-1. Modifications to plans approved by the District may require an increase in the performance bond amount.

TABLE 2-1
PERFORMANCE ASSURANCES

Type of Performance Assurance	Purpose	Amount	Required	Duration and Conditions for Release
1. Performance Assurance (if development is to be platted prior to completion of construction or if no plat is required)	Ensures that all public facilities and all public or private water quality and quantity approaches are built in accordance with terms and conditions of development permit	• 100% of the cost to construct all public sanitary and storm sewer systems; PLUS • 100% of the cost to construct all public or private water quality and quantity approaches, including landscaping; PLUS • 100% of the cost to install Erosion Control; PLUS • 100% of the costs related to vegetated corridor restoration	Prior to issuance of a Site Development Permit	• Released upon completion of all terms and conditions of the Site Development Permit, EC Plan, Construction Permit Agreement; and • Completion and acceptance of the public sanitary and storm sewer systems, water quality and quantity approaches, and vegetated corridor restoration • NO Partial Releases are allowed
2. Performance Assurance (if development will not be	Ensures that all public facilities and all public or private water quality and	• 100% of the cost to construct all OFFSITE public sanitary and storm	Prior to issuance of a Site Development	• Released upon completion of all terms and conditions of the Site

Type of Performance Assurance	Purpose	Amount	Required	Duration and Conditions for Release
platted prior to completion of construction)	quantity approaches are built in accordance with terms and conditions of development permit	sewer systems; PLUS • 100% of the cost to construct all public or private water quality and quantity approaches, including landscaping; PLUS • 100% of the cost to install Erosion Control; PLUS • 100% of the costs related to vegetated corridor restoration; PLUS • 10% of the cost to construct all ONSITE public sanitary and storm sewer systems	Permit	Development Permit, EC Plan, Construction Permit Agreement; and • Completion and acceptance of the public sanitary and storm sewer systems, water quality and quantity approaches, and vegetated corridor restoration • NO Partial Releases are allowed
3. As Built Drawings and O&M Manuals	Ensures completion of as-built drawings in accordance with Section 2.10, pump station as-built drawings in accordance with Section 9.01.8 and pump station O&M manuals in accordance with Section 9.01.7.	$2000 or 1% of cost of construction of the sanitary and storm systems and the water quality and quantity approaches, whichever is greater	Prior to issuance of a Site Development Permit	Released upon completion and acceptance of as-built drawings in accordance with Section 2.10, pump station as-built drawings in accordance with Section 9.01.8 and pump station O&M manuals in accordance with Section 9.01.7.
4. Vegetated Corridor, water quality and quantity approach landscaping performance assurance	Ensures completion of vegetated corridor restoration and water quality and quantity approach landscaping in accordance with the terms and conditions of development permit.	100% of the costs related to vegetated corridor restoration and water quality and quantity approach landscaping	Prior to issuance of a Site Development Permit	Released upon completion and acceptance of vegetated corridor restoration and water quality and quantity approach landscaping

2.07.3 Performance Assurance Exemptions

The District may at its discretion, exempt a project of a governmental unit from the performance assurance requirements of Section 2.07.2 when the governmental unit provides a letter of intent and commitment, satisfactory to

the District, to complete the project in accordance with the District approved construction plans.

2.07.4 Performance Assurance Release

The District shall release its interest in public facility performance assurances and any additional performance assurances when a project meets the criteria for Project Completion set out in Section 2.09.1. No partial releases of performance assurances will be given.

2.08 Agreements

2.08.1 Construction Permit Agreement

A Construction Permit Agreement, in a form approved by the District, shall be fully executed by the Owner and submitted to the District prior to the issuance of the Site Development Permit.

2.08.2 Private Stormwater Facilities Agreement

For privately maintained water quantity or quality approaches, a Private Stormwater Facilities Agreement, in a form approved by the District or City, shall be fully executed by the Owner and submitted to the District or City prior to the issuance of the Site Development or Connection Permit. This agreement, recorded with Washington County Assessment and Taxation Department Recording Division, identifies maintenance requirements, schedule, and the party responsible for long-term maintenance of private facilities.

2.09 Project Construction Phase Completion and Acceptance

2.09.1 Project Completion

The construction phase of a project is complete when all of the following criteria are met, where applicable:

a. All components of the sanitary and storm sewer systems have been constructed, tested, and accepted by the District according to the standards described in this Resolution and Order.

b. Water quantity and/or water quality facilities have been constructed, landscaped, and accepted by the District.

c. Vegetated corridors have been established, restored, and enhanced in accordance with the requirements of Chapter 3 of these rules.

d. Post-construction erosion control measures have been installed and accepted by the District.

e. As built drawings and O&M manuals have been submitted and accepted by the District.

f. Maintenance Assurances have been submitted and accepted by the District.

2.09.2 Substantial Completion

A project shall be deemed substantially complete and eligible for issuance of sanitary and stormwater connection permits when all the requirements of Section 2.09.1 are met, with the following exceptions:

a. Construction and testing is completed on those portions of the public sanitary and storm sewer systems required for the systems to function, with the exception of final manhole frame and lid grouting and manhole testing.

b. Water quality and/or water quantity facilities have been constructed according to the approved plans and protected from erosion. Vegetation in the treatment area of the facility must be established prior to Substantial Completion. The facility vegetation outside of the treatment area is either established or a written request for a delay in planting is submitted and approved by the District. The request shall include justification for the delay, a planting schedule, name of the contractor who will perform the planting work, and date of completion of the planting. The planting work shall be completed on a schedule approved by the District, but no later than April 1st, following Substantial Completion of the project. As a condition of acceptance of the planting schedule, the District may limit the number of connection permits until the planting has been completed. If planting has not been completed and accepted consistent with the approved schedule, no additional sanitary or stormwater connection permits shall be issued and no inspections shall be performed until planting work has been completed.

c. Vegetated corridors have been established, restored, and enhanced according to the approved plans and protected from erosion. New vegetation is established or a written request for a delay in planting is submitted and approved by the District. The request shall include justification for the delay, a planting schedule, name of the contractor who will perform the planting work, and date of completion of the planting. The planting work shall be completed on a schedule approved by the District, but no later than April 1st, following Substantial Completion. As a condition of acceptance of the planting schedule, the District may limit the

number of connection permits until the landscaping has been completed. If landscaping has not been completed and accepted consistent with the approved schedule, no additional sanitary or stormwater connection permits shall be issued and no inspections shall be performed until landscaping work has been completed.

2.09.3 Model Home Connection Permit

a. Criteria for Issuance
Connection Permits may be issued for model homes prior to substantial completion of the Site Development Project when all the requirements of this section are met.

1. Construction and testing is completed on those portions of the public sanitary sewer conveyance system required to provide sewer service to all model home lots;
2. Construction and testing is complete on those portions of the storm sewer conveyance system required to provide service to the model home lots, including any curbs, gutters, and inlets necessary to collect runoff from the model home lots and impervious areas, such as ROW, that provide access to the lots; and
3. Water quality and quantity approaches have been constructed according to the approved plans, and vegetation has been established, to provide functional water quality and quantity management of runoff from the model home lots and all impervious areas, such as ROW, necessary to provide access to the lots.

b. Submittal Requirements
Model Home Connection Permits will not be issued until the Owner or its authorized agent has satisfied the following requirements:

1. Payment of the Model Home Application Fee.
2. Submitted a complete Model Home Application.
3. Received written approval from the Building jurisdiction for the model homes.
4. Provided the address for each model home, as assigned by Washington County Department of Land Use and Transportation Surveyor's Office.
5. Submitted a site plan that includes all lots and right-of-ways; location of proposed model home sites; and extent of completed utilities, right-of-way and other infrastructure improvements (on and off-site) needed to serve the model homes.
6. Paid all required permit fees including plan review and inspection fees, erosion control fees, and systems development charges.

7. For model homes served by privately-maintained water quantity or quality approaches, submitted an executed Private Stormwater Facilities Agreement which has been accepted and approved by an authorized representative of the District.

2.10 As-Built Drawings

The Owner or Engineer shall submit a full set of reproducible as-built drawings of the project, stamped and signed by the Engineer of Record and in a form acceptable to the District. An electronic copy of the as-built drawings shall also be submitted in a format determined by the District. The as-built drawings shall accurately represent the constructed project as determined by a post-construction survey. As-built survey notes may be required by the District if a discrepancy is noted between the submitted as-built drawings and the District inspection notes.

2.11 Maintenance Assurance

2.11.1 Maintenance Assurance Requirement

Maintenance Assurances shall be required for work to ensure post-construction quality in accordance with Table 2-2. Assurances shall be in the form of a letter of commitment, bond, or cash deposit in form and substance satisfactory to the District or City.

2.11.2 Maintenance Assurance Exemptions

Upon request, the District may exempt a project of a governmental unit from the requirements of Section 2.11.

2.11.3 Maintenance Assurance Amount and Duration

Except as allowed in 2.11.2, the amount and duration of the maintenance assurance shall be as identified in Table 2-2.

TABLE 2-2
MAINTENANCE ASSURANCES

Type of Performance Assurance	Purpose	Amount	Required	Duration and Conditions for Release
1. Maintenance Assurance	Ensures correction of defects in materials and workmanship after initial construction	• 10% of the cost to construct all public sanitary and storm sewer systems; PLUS • 100% of the cost to construct all public or private water quality and quantity approaches.	Prior to Release of Performance Assurance	• Released one year after completion and acceptance of construction; and • After correction of all defects identified during the maintenance assurance period
2. Performance and Landscaping Maintenance Assurance	Ensures correction of any performance or landscaping defects after initial installation	• 100% of the cost to install all required landscaping; PLUS • 100% of the cost to maintain the public and private water quality and quantity approaches, and all landscaping for a period of 2 years	Prior to Release of Performance Assurance	Released two years after acceptance of landscaping if the requirements of Section 2.12.2.b are met, the landscaping is established and healthy, and all water quality and quantity approaches are functioning as designed
3. Post-Construction Erosion Control	Ensures maintenance and effectiveness of EC measures after construction	• 100% of cost to install and maintain post-construction erosion control for one year • 100% of cost to remove temporary post-construction erosion control measures	• Prior to Release of Performance Assurance; and • Prior to issuance of connection permits	Released one year after completion and acceptance of construction providing that site is stable, vegetation is established, and exposed soil does not remain.

2.12 Maintenance Period Inspection and Completion

2.12.1 Infrastructure Inspection for One Year Warranty

The District or City shall perform a visual and video inspection of the storm and sanitary conveyance systems and visual inspection of the water quality/quantity approaches during the one-year warranty period and identify any maintenance deficiencies or defects in the systems. The Owner shall correct any defects identified prior to conclusion of the one-year warranty period. The maintenance assurance shall not be released until all defects have been corrected and inspected.

2.12.2 Performance and Landscaping Inspection for Two Year Warranty

a. The Owner or their representative shall submit maintenance reports in a form acceptable to the District or City which identifies the condition, performance, and corrective actions taken for the water quality/quantity approaches and Vegetated Corridor landscaping. Following completion of the planting maintenance reports shall be submitted twice a year no later than June 15 and October 1.

b. The District or City shall inspect the condition and performance of the water quality/quantity approaches and Vegetated Corridor landscaping periodically throughout the required maintenance period. The District or City may provide an interim inspection report to the Owner with a specific summary of any deficiencies. Failure of the District or City to provide the interim report shall not release the Owner from their responsibility to provide functional water quality/quantity approaches free from maintenance deficiencies and established landscaping at the end of the required performance and landscaping maintenance period.

c. If at any time during the warranty period the landscaping falls below 80% survival of trees and shrubs, or 90% areal coverage by herbaceous plants, or if the amount of undesirable vegetation cover including target non-native species exceeds 10%, the Owner shall remove undesirable vegetation and reinstall all deficient planting at the next appropriate planting opportunity. The required maintenance period may be extended from the date of replanting if, in the opinion of the District or City, an additional time period is needed to ensure the required landscaping becomes established and can survive long term. The extension of the maintenance period may be up to two years.

d. If at any time during the warranty period the water quality or quantity approach fails to function as designed, or has indicators present that would suggest maintenance is needed, the Owner shall take corrective action to maintain or correct the deficiency. If the approach is a proprietary system, maintenance must be performed in accordance with the manufacturer's recommendation. This may include replacing the water quality filtration media, cartridges, cleaning sumped water quality pretreatment structures, or performing other maintenance activities necessary to achieve a functional system. The Owner shall correct any deficiencies identified prior to conclusion of the two-year warranty period, and the maintenance assurance shall not be released until all deficiencies have been corrected and inspected.

2.12.3 Post-Construction Erosion Control for One-Year Warranty

The District or City shall inspect the condition of the post-construction

erosion control measures periodically through the required maintenance period. The Owner shall correct any defects identified prior to conclusion of the one-year warranty period. The maintenance assurance shall not be released until all defects have been corrected and inspected, vegetation has been established, and temporary post-construction erosion control measures have been removed per Section 6.04.4.

2.12.4 Warranty Period Completion

The one-year warranty period shall be complete when all the requirements of Section 2.09.1 have been met, the one-year maintenance assurance period, including any extensions, has expired on all elements of the project, and any repairs required during the maintenance period have been completed and accepted.

2.13 General Administrative Rules

2.13.1 Additional Permits

Nothing in these standards alleviates the need for the Owner to obtain and comply with all required local, special district, state or federal permits. Any required permits for the project issued by other jurisdictions, including but not limited to the Oregon Division of State Lands and the US Army Corps of Engineers, shall be maintained on site and available to District Inspectors upon request.

2.13.2 District Inspection

a. A District representative may inspect the project at any time, and check materials, equipment, and the construction of the project to determine whether the work is proceeding in accordance with the approved plans and the requirements of this Resolution and Order. The purpose of these inspections is to monitor compliance with District construction standards and the inspections are for the benefit of the District.

b. The Owner has primary responsibility for project inspection. The District's inspections are to monitor the quality of work performed by others only. The District has no responsibility, by virtue of such inspections, for any construction means, methods, or techniques, or compliance with safety requirements, all of which remain the sole responsibility of the Contractor.

2.13.3 Change in Plans/Standards

The District has the right to require changes in the plans or in standards contained herein in order to protect the public interest or the normal

operations of the District. Such changes are at the sole discretion of the District and may include, but are not limited to, the allowance of new or different materials or products that are equivalent to or better than the product specified in the approved plans.

2.13.4 Guarantee

If the Owner, after notice of defective work, fails within thirty days to proceed to comply with the terms of Section 1.08.5, the District may have the defects corrected. The Owner's surety or issuer of the performance or maintenance assurances under Section 2.07 and Section 2.11 shall be liable for all expenses incurred, provided, however, that in case of an emergency where, in the opinion of the District, delay would cause serious loss or damage, repairs may be made without notice being given to the Owner, and the Owner and the Owner's surety shall be jointly and severally liable for the cost thereof.

2.13.5 District Maps/Plans Not Guaranteed

The District may provide property owners, engineers, contractors and other members of the public with information from District maps, "as-built" plans, etc. The District does not guarantee and is not liable for the accuracy of the measurements, locations or other information on such maps and plans.

2.13.6 Technical Guidance Documents

The District may develop Technical Guidance documents to provide assistance in compliance with this Resolution and Order. The District shall review the Technical Guidance documents periodically in order to comply with new laws, regulations, or permit requirements, to correct deficiencies or to respond to changes in technology.

The guidance documents are for guidance only and are not intended to supersede any provisions of these standards.

The District may solicit review of the Technical Guidance documents and any revisions by the interested public. Revisions shall become effective upon approval by the General Manager and Conveyance Department Director.

Chapter 3

SENSITIVE AREAS AND VEGETATED CORRIDORS

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Chapter 3

SENSITIVE AREAS AND VEGETATED CORRIDORS

3.01 General Provisions

3.01.1 Introduction

The purpose of this chapter is to outline design requirements for storm and surface water management related to water quality Sensitive Areas and Vegetated Corridors. The provisions of this chapter are intended to prevent or reduce adverse impacts to the drainage system and water resources of the Tualatin River Basin. In combination with other state, federal, and local laws and ordinances, these requirements are intended to protect the beneficial uses of waters within the Tualatin River Basin and within the District.

3.01.2 Application and Interpretation of Chapter

The provisions of this chapter shall apply to storm and surface water systems within the District jurisdiction. Interpretations of such provisions and their application in specific circumstances shall be made by the District. Any City operating a local program may adopt stricter design specifications within its jurisdiction than the specifications stated in this chapter. No person shall undertake development activities within the District's jurisdiction without first obtaining a Stormwater Connection Permit from the District pursuant to Ordinance 27 and these rules, or receiving a written determination from the District that no Stormwater Connection Permit is required. Applicants may apply for permits as a single project or as part of a master planned activity.

3.01.3 Unbuildable Lots

If the application of these Vegetated Corridor regulations results in a lot being unbuildable, the Vegetated Corridor shall be reduced to ensure the lot will be buildable while still providing for the maximum Vegetated Corridor to the greatest extent practicable.

3.01.4 Other Permits

The Applicant shall obtain and comply with all permits and approvals required under applicable local, state and federal law.

3.01.5 Prohibited Activities

Except as allowed in Sections 3.04 and 3.05, no person shall erect any structure, conduct any development or construction activities, establish or maintain any garden or lawn, clear native vegetation, remove non-native

invasive vegetation other than with an integrated vegetation management approach, store uncontained hazardous materials, dump or dispose of materials of any kind (including pet waste), or conduct other activities within a Sensitive Area and Vegetated Corridor that may negatively impact water quality.

3.02 Service Provider Letter and Permits Required

3.02.1 Service Provider Letter (SPL)

a. In order to determine if the proposed activity will require a Service Provider Letter, the applicant may apply for a Prescreening Site Assessment. If no Water Quality Sensitive Areas appear to exist on or within 200 feet of the site, then no further site assessment or service provider letter is required. The Prescreening Site Assessment does not eliminate the need to evaluate and protect Water Quality Sensitive Areas if they are subsequently discovered on, or within 200 feet of, the site.

b. Prior to land use application or issuance of a building permit for a development activity as defined in the Definitions in Chapter 1, the applicant shall secure a Service Provider Letter from the District, which specifies the conditions and requirements associated with Vegetated Corridors and Sensitive Areas necessary for the District to issue a Stormwater Connection Permit pursuant to Ordinance 27 and these rules and regulations. If allowed by the land use jurisdiction, the applicant may begin the land use permit application process and secure the service provider letter prior to completing the land use permit application.

c. In order to secure a Service Provider Letter from the District, the applicant shall perform a Site Assessment in accordance with Section 3.02.2. The applicant shall perform a Tier 1, 2 or 3 Alternatives Analysis pursuant to Section 3.07 if the proposed site plan can not meet the standards outlined in Sections 3.04 and 3.05

d. No person shall perform development activities without first obtaining a Stormwater Connection Permit from the District as required pursuant to Ordinance 27, Section 4.B. The Stormwater Connection Permit shall be issued upon District approval of final construction plans showing that all of the applicable conditions from the service provider letter have been met.

e. Exceptions to the process outlined in 3.02.1(a)-(d) include:

1. For lot line adjustments that are not part of a land use or building permit application, and that do not result in any physical construction or grading, the applicant shall complete a Prescreening Site Assessment. If Sensitive Areas appear to exist on or within 200 feet of the site, then further site assessment may be required.

The lot line adjustment shall be reviewed by the District to ensure the proposed configuration of the lots retain buildable status. Vegetated Corridor enhancement conditions shall not be required as conditions for the lot line adjustment approval, but shall apply to subsequent land use or development applications or activity on any of the subject property. A storm, surface water drainage and detention easement over the sensitive area and Vegetated Corridor granted to the District may be required.

2. For redevelopment, the standards in Section 3.10 shall apply only when the activity alters 10% or more of existing improved impervious area within 100 feet of the Sensitive Area.

3.02.2 Site Assessment Required

a. If Water Quality Sensitive Areas appear on or within 200 feet of a site, a Simplified or Standard Site Assessment is required unless specifically waived in writing by the District.

b. A Simplified Site Assessment may be used when the activity is not likely to adversely impact the Sensitive Area or Vegetated Corridor and the activity meets all the following criteria:

1. Adds less than 500 square feet of impervious surface.
2. Does not encroach closer to the Sensitive Area than existing development on the property.
3. Is not located on a slope greater than 25%.

c. A Standard Site Assessment shall be used when the criteria for a Simplified Site Assessment are not met.

d. Site Assessments shall be performed and documented in accordance with the provisions of Section 3.13.

e. Submittals will not be reviewed for Service Provider Letter issuance unless a complete submittal is received by District staff.

3.03 Vegetated Corridors

3.03.1 Extent of Vegetated Corridors

a. Vegetated Corridor widths shall be measured from the Edge of Sensitive Area as defined in Chapter 1.

b. Vegetated Corridor widths described in this section are for each side of the Vegetated Corridor.

c. Vegetated Corridor widths shall be as defined by Table 3-1.

d. Slopes Greater than or Equal to 25%

   1. For development sites containing slopes greater than or equal to 25% adjacent to the Sensitive Area, the boundary of the Vegetated Corridor shall be 35 feet beyond the Break in Slope as defined in Chapter 1, unless otherwise indicated in Table 3-1.

   2. Slope measurements and determination of Break in Slope shall be accomplished in accordance with Section 3.14.4

e. Vegetated Corridor widths for intermittent streams, as identified in Table 3-1, may change within a development site when the drainage basin area passes a size threshold within the development site.

TABLE 3-1
Vegetated Corridor Widths Adjacent to the Sensitive Area
Where Activity is Not Redevelopment

Sensitive Area Type	Width Slope <25%	Width Slope ≥25%
Existing or created wetlands:		
< 0.5 acres and isolated*	25 ft	Variable from 25-200 ft.
<0.5 acres and not isolated*	50 ft.	Variable from 50-200 ft.
≥ 0.5 acres	50 ft.	Variable from 50-200 ft.
Natural lakes, ponds, and in-stream impoundments	50 ft.	Variable from 50-200 ft.
Springs:		
Intermittent flow	0	15 ft.
Perennial flow	50 ft.	Variable from 50-200 ft.
Intermittent Streams draining:		
< 10 acres	0	0
≥10 to <50 acres	15 ft.	Variable from 50-200 ft.
≥50 to <100 acres	25 ft.	Variable from 50-200 ft.
≥100 acres	50 ft.	Variable from 50-200 ft.
Perennial Streams:		
Other than Tualatin River	50 ft.	Variable from 50-200 ft.
Tualatin River	125 ft.	Variable from 125-200 ft.

*See definition of Isolated Wetland in Chapter 1.

3.03.2 Vegetated Corridor Width Reductions and Adjustments

In addition to the requirements in Sections 3.03.1, Vegetated Corridor width shall be based on the following considerations.

a. Pre-Existing Conditions

The Vegetated Corridor shall not extend beyond an existing building or improved roadway separating the proposed development from the Sensitive

Area. For the purposes of this section, an "improved roadway" shall be gravel or paved, a minimum of 12-feet in width, and actively used for vehicular traffic. The building or roadway must remain as part of the proposed development and not planned for future demolition.

b. Reduction for Very Wide Corridors

If a Vegetated Corridor in marginal or degraded condition extends 125 feet or more from the boundary of the Sensitive Area, and averaging is not practicable in the opinion of the District, the required width of the Vegetated Corridor shall be reduced by 20%. A stamped geotechnical report confirming that slope stability can be maintained with the reduced setback may be required by the District. This reduction shall not be used in combination with minor averaging or with the encroachment allowed through a Tier 1 or Tier 2 Alternatives Analysis.

c. Reduction for Corridors with Steep Slopes

When the slope is greater than 25% and the Vegetated Corridor extends 35 feet from break in slope and the Vegetated Corridor is in marginal or degraded condition, the outer boundary of the Vegetated Corridor may be reduced from 35 feet beyond the break in slope, as long as the resulting vegetated corridor is no less than 50 feet beyond the edge of the sensitive area. This reduction is allowed only if a stamped geotechnical report confirms that slope stability can be maintained with the reduced setback from the break in slope. This reduction shall not be used in combination with minor encroachment or with the encroachment allowed through a Tier 1 or Tier 2 Alternatives Analysis.

d. Adjustment for Ordinary High Water Mark (OHWM) on Streams

On streams where OHWM is below the Top of Bank (TOB) resulting in a horizontal offset between the OHWM and the TOB, the District shall require enhancement of the offset between OHWM and TOB and allow the outside edge of the Vegetated Corridor to be adjusted the lesser of the width of the offset or:

1. up to 3 feet for Vegetated Corridors ≤25 feet
2. up to 5 feet for Vegetated Corridors >25 feet

3.03.3 Vegetated Corridor Condition

a. Each plant community type within the Vegetated Corridor shall be determined to be in Good, Marginal or Degraded condition as follows:

1. Good Corridor Condition

Combination of native trees, shrubs and groundcover covering greater than 80% of the community and greater than 50% tree canopy exists (areal measure).

2. Marginal Corridor Condition
Combination of native trees, shrubs and groundcover covering 50% to 80% of the community and 26% to 50% tree canopy exists (areal measure).

3. Degraded Corridor Condition
Combination of native trees, shrubs and groundcover covering less than 50% of the community and less than 25% tree canopy exists (areal measure).

b. Vegetated Corridor Condition Assessments shall be prepared in accordance with Section 3.14.

c. When a single plant community type contains multiple condition characteristics, the higher quality condition shall prevail.

3.04 Activities Allowed in a Sensitive Area

a. The following activities are allowed within a Sensitive Area when impact is minimized through choice of mode, sizing, and placement:

1. Maintenance practices and enhancement activities, as defined or permitted by the DSL or COE, are allowed within the Sensitive Area per criteria set forth by DSL and/or COE.

2. Development within the Sensitive Area shall be allowed if the required permits are issued, when necessary, by the DSL and/or the COE.

3. On-site relocation of intermittent streams that drain less than 50 acres and have a perpendicular land slope of less than 25%, provided that the pre-existing discharge point off the site is maintained.

4. As approved by the District through an alternatives analysis set out in Section 3.07 of these rules, the activities listed in Section 3.05.3 through 3.05.8 within Water Quality Sensitive Areas that are not regulated by DSL and the COE.

b. Mitigation shall be required per the DSL and COE rules and regulations or as determined by the District for areas or activities not regulated by COE or DSL.

3.05 Activities Allowed in a Vegetated Corridor

3.05.1 General

a. Upon review and approval by the District, the activities in this section are allowed within a Vegetated Corridor when the impact is minimized through choice of mode, sizing, and placement.

b. Mitigation for negative impacts to the Vegetated Corridor and/or enhancement of the Vegetated Corridor to Good Corridor Condition, as defined in Section 3.14, Table 3-3, is required for the activities listed in 3.05.3 through 3.05.8.

3.05.2 Non-Development Activities

a. Activities excluded from the definition of Development in Chapter 1 are allowed in the Vegetated Corridor without a Service Provider Letter and without approval of the District.

b. Other regulating jurisdictions may require review and approval for the proposed activities.

3.05.3 Riparian Enhancement Projects

Enhancement of the riparian corridors for water quality or quantity benefits and improved aquatic habitat shall be allowed without a Service Provider Letter, provided any grading does not require an Erosion Control Permit.

3.05.4 Grading

a. Grading for the purpose of enhancing the Vegetated Corridor shall be allowed if the impacted area of the Vegetated Corridor is re-vegetated to Good Corridor Condition.

b. Grading within the Vegetated Corridor for purposes other than enhancement of the Vegetated Corridor shall be allowed, when all the following conditions are met:

1. The Vegetated Corridor condition is degraded.
2. The proposed grading does not result in a permanent change to existing contours.
3. The proposed grading does not result in the removal of native vegetation.
4. The final graded slopes are no more than 4H:1V.
5. The impacted area of the Vegetated Corridor is re-vegetated to Good Corridor Condition.

c. The provisions of Chapter 6, Erosion Prevention and Sediment Control, and the requirements for an Erosion Control Permit apply to activities conducted under this section.

3.05.5 Utility Infrastructure

a. Construction of utility infrastructure, including but not limited to storm and sanitary sewers, sewer laterals, water mains, phone and cable lines, power lines, and gas lines shall be allowed if all the following conditions are met:

1. The permanent utility corridor is no greater than 20 feet wide.
2. The temporary construction/access corridor is no greater than 50 feet wide.
3. Native trees greater than 6" dbh are not removed.
4. The impacted area of the Vegetated Corridor is re-vegetated to Good Corridor Condition.

b. If the utility corridor can be replanted with native herbs and shrubs, the encroachment will be considered a temporary encroachment mitigated in place. The re-vegetation for the area above or below the utility lines shall be designed to avoid conflicts with the utility. For example, trees shall not be required directly over pipes.

c. Placement of manholes, or other minor permanent encroachments associated with the utility construction, within the Vegetated Corridor shall be allowed without replacement mitigation.

d. Individual permanent encroachments greater than 100 square feet shall be required to be mitigated in accordance Section 3.08.

3.05.6 Surface Stormwater Facilities

a. Stormwater outfalls where the permanent encroachment area is less than 100 square feet shall be allowed without mitigation.

b. Stormwater outfalls with permanent encroachments greater than 100 square feet shall be allowed if replacement mitigation is provided in accordance with Section 3.08.

c. Stormwater vegetated swales within a Vegetated Corridor for an intermittent stream draining less than 50 acres and having a slope less than 25% shall be allowed without mitigation if the facility is planted with appropriate native vegetation and impacts to the corridor are minimized.

3.05.7 Road and Path Crossings

Roads, pedestrian or bike paths crossing a Vegetated Corridor from one side to the other, in order to provide access to a Sensitive Area or across a Sensitive Area, shall be allowed if all the following conditions are met:

a. Impacts to the Vegetated Corridor are minimized through choice of mode, sizing and placement.
b. Replacement mitigation is provided in accordance with section 3.08.

3.05.8 Paths

a. Paths, 12 feet or less in width, including any structural embankment, shall be allowed if all the following conditions are met:

    1. Paths shall be constructed so as to minimize disturbance to existing vegetation and maintain slope stability.
    2. For the Tualatin River, the path shall be located no closer than 30 feet from the two-year 24-hour design storm elevation.
    3. For all other Sensitive Areas, the path shall be located in the outermost 40% of the Vegetated Corridor.
    4. The area of the path beyond the first 3 feet of width shall be mitigated in accordance with Section 3.08.
    5. Path construction shall not remove native trees greater than 6" dbh.

b. Paths greater than 12 feet, but less than or equal to 14 feet in width shall be considered an allowed use if constructed using low impact development approaches in accordance with Chapter 4 of these standards. If these conditions cannot be met, the project shall be reviewed in accordance with section 3.07.

3.05.9 Other Uses

Other uses not listed in 3.05.2 through 3.05.8 above, as approved by the District through an Alternatives Analysis process as described in Section 3.07.

3.06 General Requirements for Development Activities

3.06.1 Protection of Sensitive Area and Vegetated Corridor during Construction

Prior to any site clearing, grading or construction, the applicant shall survey, stake, and demarcate with standard orange construction fencing or equivalent the outer boundary of the combined Sensitive Area and Vegetated Corridor per the approved plans. During construction the outer boundary of the combined Sensitive Area and Vegetated Corridor shall remain fenced and undisturbed except as allowed in the Service Provider Letter.

3.06.2 Required Vegetated Corridor Enhancement

The applicant shall enhance the Vegetated Corridor in accordance with the following requirements:

a. For Vegetated Corridors up to 50 feet wide the applicant shall enhance the entire corridor to meet or exceed good corridor condition as defined in Section 3.14.2, Table 3-3.

b. For Vegetated Corridors greater than 50 feet in width, the applicant shall enhance the first 50 feet closest to the Sensitive Area to meet or exceed good corridor condition as defined in Section 3.14.2, Table 3-3.

c. Enhancement shall be accomplished in accordance with Section 3.14.2, Table 3-3.

3.06.3 Easements

The District may require an easement over the Sensitive Area and Vegetated Corridor for surface and stormwater management in order to prevent the Owner of the Sensitive Area and Vegetated Corridor from carrying out activities and uses inconsistent with the purpose of the corridor and any easements therein.

3.06.4 Unauthorized Pre-Development Clearing

a. If trees or native vegetation have been cleared from the Vegetated Corridor or Sensitive Area prior to development without the approval of the District, then the following provisions shall be included as Service Provider Letter conditions for any subsequent development activity:

    1. The maximum Vegetated Corridor widths for the resource type and pre-existing site condition shall apply.
    2. Mitigation and enhancement of the entire impacted Sensitive Area and Vegetated Corridor shall be required for the full extent of the Sensitive Area and Vegetated Corridor in the impacted area.
    3. Trees removed shall be replaced at a 1:1 ratio based on the removed trees' total cumulative caliper size at dbh.
    4. Tree density for the plant community shall equal or exceed a Good Condition Vegetated Corridor standard for re-vegetation.
    5. Shrub and herbaceous material replacement shall meet the Good Condition Vegetated Corridor standard for re-vegetation.

b. The requirements of subsection (a) above shall not apply to:

    1. The removal of "hazard" trees if they threaten a structure or public area. Hazard trees shall be topped and standing trunks retained, if

possible.

2. Vegetated Corridors or Sensitive Areas in which clearing occurred prior to February 22, 2000.

3.07 Encroachment Standards

3.07.1 General

The applicant shall conduct an Alternatives Analysis if the proposed activity is not an allowed use as outlined in Section 3.05 or cannot meet the standards outlined in Section 3.07.2. In conducting the Alternatives Analysis:

a. The applicant shall prepare the submittal requirements outlined in this section for the type of encroachment proposed;

b. The District may require that the applicant to participate in one or more meetings with the District to negotiate the Vegetated Corridor encroachment and mitigation;

c. The District shall review the Alternatives Analysis pursuant to the criteria for acceptance as outlined in this section for the type of encroachment proposed; and

d. The District shall review the proposed project and accept or deny the proposed encroachment based on the criteria for acceptance detailed in this Section.

e. If the encroachment is approved, the District shall prepare a Service Provider Letter documenting the results of the Alternatives Analysis and District's requirements necessary to comply with water quality protection.

f. If the District denies the proposed encroachment, the applicant shall be provided with the reasons for the denial in written form.

3.07.2 Minor Encroachment

a. Applicability

Proposed encroachments into marginal or degraded Vegetated Corridors shall be determined to be a minor encroachment where the encroachment does not exceed either of the following criteria:

1. 20% of the depth of the Vegetated Corridor
2. 20% of the length of the Vegetated Corridor

b. Submittal Requirements

A Standard Site Assessment required in Section 3.02.2.

c. Criteria for Acceptance

Acceptance of a Minor Encroachment shall be based on meeting all the following criteria:

1. The proposed encroachment shall be mitigated at a 1:1 ratio.
2. The mitigation area shall be incorporated into the remaining Vegetated Corridor on the project site and meet the Good Corridor Condition standards as defined in Section 3.14.2 regardless of its distance from the Sensitive Area.

3.07.3 Tier 1 Alternatives Analysis

a. Applicability

Proposed encroachments into marginal or degraded Vegetated Corridors where the encroachment does not exceed either of the following criteria:

1. 30% of the depth of the Vegetated Corridor
2. 40% of the length of the Vegetated Corridor

b. Submittal Requirements

Unless specifically waived in writing by the District, the applicant shall submit the following information with the Standard Site Assessment required in Section 3.02.2:

Description of why the encroachment is needed including rejected alternatives that would result in less encroachment.

c. Criteria for Acceptance

Acceptance of the encroachment proposed as part of a Tier 1 Alternatives Analysis shall be based on meeting all the following criteria:

1. The proposed encroachment area is mitigated in accordance with Section 3.08.
2. Enhancement of the replacement area, if not already in good condition, and either the remaining Vegetated Corridor on the site or the first 50 feet of width closest to the resource, whichever is less, to a Good Corridor Condition.
3. A District Stormwater Connection Permit is likely to be issued based on proposed plans.

4. Location of development and site planning minimizes incursion into the Vegetated Corridor.
5. No practicable alternative to the location of the development exists that will not disturb the Sensitive Area or Vegetated Corridor.

3.07.4 Tier 2 Alternatives Analysis

a. Applicability

A Tier 2 Alternatives Analysis shall be required when:

1. The proposed encroachment is into a Vegetated Corridor in Good Corridor Condition, or
2. The proposed encroachment is into a marginal or degraded Vegetated Corridor where the encroachment exceeds either of the following criteria:
   A) 30% of the depth of the Vegetated Corridor
   B) 40% of the length of the Vegetated Corridor
3. Activities listed in Section 3.05 which are proposed to occur in a water quality sensitive area.

b. Submittal Requirements

Unless specifically waived in writing by the District, the applicant shall submit the following information with the Standard Site Assessment required in Section 3.02.2:

1. Description of why the encroachment is needed including rejected alternatives that would result in less encroachment.
2. Functional Analysis Report, as described in Section 3.14.7

c. Criteria for Acceptance

Acceptance of the encroachment proposed as part of a Tier 2 Alternatives Analysis shall be based on meeting all the following criteria:

1. The proposed encroachment area is mitigated in accordance with Section 3.08.
2. The replacement mitigation protects the functions and values of the Vegetated Corridor and Sensitive Area.
3. Enhancement of the replacement area, if not already in Good Corridor Condition, and either the remaining Vegetated Corridor on the site or the first 50 feet of width closest to the resource, whichever is less, to a Good Corridor Condition.
4. A District Stormwater Connection Permit is likely to be issued based on proposed plans.
5. Location of development and site planning minimizes incursion into

the Vegetated Corridor.

6. No practicable alternative to the location of the development exists that will not disturb the Sensitive Area or Vegetated Corridor.
7. The proposed encroachment provides public benefits.

3.07.5 Tier 3 Alternatives Analysis (Redevelopment Sites only)

a. Applicability

Tier 3 Alternative Analysis shall be required for sites with existing encroachments into a Vegetated Corridor where the proposed activity meets the definition of redevelopment.

b. Submittal requirements

Unless specifically waived in writing by the District, the applicant shall submit the following information with the Standard Site Assessment required in Section 3.02.2:

Description of why the encroachment is needed under proposed redevelopment plan including rejected alternatives that would result in less encroachment.

c. Criteria for Acceptance

Acceptance of the encroachment proposed as part of a Tier 3 Alternatives Analysis shall be based on meeting all the following criteria:

1. The proposed encroachment area is mitigated in accordance with Section 3.08.
2. Enhancement of the remaining Vegetated Corridor on the site or the first 50 feet of width closest to the resource, whichever is less, to a Good corridor condition, if not already in Good condition.
3. A District Stormwater Connection Permit is likely to be issued based on proposed plans.
4. Location of the redevelopment and site planning minimizes incursion into the Vegetated Corridor.
5. There is no practicable alternative to the location of the redevelopment that will not disturb the Sensitive Area or Vegetated Corridor.

3.08 Vegetated Corridor Mitigation Standards

3.08.1 General

a. Replacement mitigation for encroachments allowed in this chapter shall be accomplished by any of the methods described in Sections 3.08.2 through 3.08.4.

b. Replacement mitigation shall not include enhancing an existing Sensitive Area unless approved by the District through a Tier 2 Alternatives Analysis.

3.08.2 Vegetated Corridor Replacement as Mitigation

a. The Vegetated Corridor replacement area required for approved encroachments shall be at the ratio of replacement to impacted vegetated corridor as shown in Table 3-2.

TABLE 3-2
Replacement Mitigation Ratios Required for Approved Encroachments into a Vegetated Corridor

Location of Replacement Mitigation	Condition of Vegetated Corridor to be Replaced		
	Good	Marginal	Degraded
On development site	1:1	1:1	1:1
Off-Site:			
Less than 0.25 miles from site and within same drainage basin	1.5:1	1:1	1:1
0.25 miles or more from site and within same drainage basin	1.75:1	1.25:1	1.25:1
Different drainage subbasin (Drainage subbasin must be located within the Tualatin River Basin and no further than 1 mile outside the District's Boundary)	2:1	1.5:1	1.5:1

b. The replacement Vegetated Corridor shall be in addition to the existing Vegetated Corridor.

c. The replacement Vegetated Corridor must be contiguous with existing Vegetated Corridor.

d. Replacement Vegetated Corridor areas that are in marginal or degraded condition shall be improved to Good corridor condition as described in Section 3.14.2, Table 3-3.

3.08.3 Payment to Provide Mitigation

a. Replacement mitigation through the Payment to Provide method shall be allowed when one of the following criteria is met:

1. Elimination of the Sensitive Area adjacent to the Vegetated Corridor is allowed by the Department of State Lands (DSL) through approval of payment to provide for the Sensitive Area; or
2. The approved encroachment to the Vegetated Corridor is less than 300 square feet.
3. As provided in Section 3.11.2 (c)

b. Payment to Provide shall be based on the area of Vegetated Corridor that will be eliminated at a 1:1 ratio.

c. The cost of replacement mitigation using Payment to Provide is described in the District's Rates and Charges Ordinance.

3.08.4 Enhancement of Existing Vegetated Corridor as Mitigation

Vegetated Corridor may be replaced by enhancing an existing Vegetated Corridor. The method of replacement mitigation may be used if all the following criteria are met:

a. In the opinion of the District, the proposed Vegetated Corridor to be enhanced is unlikely to be enhanced in the future.

b. The Vegetated Corridor to be enhanced is in Marginal or Degraded Corridor Condition.

c. The area replacement ratio of existing Vegetated Corridor to enhanced Vegetated Corridor shall be no less than 1:2.

d. The enhanced Vegetated Corridor shall be protected by an easement in accordance with Section 3.06.3 or tract in accordance with Section 3.09.

3.09 Land Division

3.09.1 Creating Multiple Parcels

For any development which creates multiple parcels or lots intended for separate ownership, the Sensitive Area and Vegetated Corridor shall be contained in a separate tract. The first 50 feet of Vegetated Corridor on intermittent streams draining 10-100 acres shall be contained in a separate tract covered by an easement in accordance with 3.06.3; the remainder may be placed in an easement. The District, City, or County may also require that the

Sensitive Area and Vegetated Corridor be signed, fenced, or otherwise physically set apart from parcels that will be developed. Signage shall meet the requirements of Standard Detail No. 790. Signs may also be available for purchase from the District.

3.09.2 Lot Line Adjustments without Physical Development

For lot line adjustments that are not part of a land use or building permit application and do not result in any physical development, the following special considerations shall apply:

a. The proposal shall be reviewed by the District to ensure that the proposed configuration of the lots retain buildable status.

b. The Applicant shall complete a Sensitive Area and Vegetated Corridor Prescreen. If a Sensitive Area appears to exist on or within 200 feet of the site, then the District may require a Site Assessment.

c. Requirements for easements, tracts, and improvements to the Vegetated Corridor shall not apply, but may apply to subsequent land use or development applications on the subject property.

3.10 Redevelopment

3.10.1 Purpose

The purpose of this Section is to decrease encroachments into Vegetated Corridors when major alterations occur to existing development on a site.

3.10.2 Modified Vegetated Corridor Widths

If a redevelopment activity alters 10% or more of existing impervious area within 100 feet of a Sensitive Area, then the impervious areas shall be the following minimum distances from the Sensitive Area:

a. 50 feet for the Tualatin River

b. 25 feet for Sensitive Areas with Vegetated Corridors 25 feet or more

c. Vegetated Corridor widths in Table 3-1 where these widths are less than 25 feet

3.10.3 Corridor Averaging

Corridor Averaging is permitted for redevelopment activities and shall exclude any existing building footprint area already encroaching into the Vegetated

Corridor.

3.10.4 Exemptions

The following activities are exempted from the requirements of this Section:

a. Alterations of impervious areas associated with a single family residence, provided the use of the property does not change from single family residential.

b. The impervious surface to be altered is fully separated from the Sensitive Area by a building.

c. Properties with pre-existing Vegetated Corridors or setbacks averaging at least 25 feet from streams and 50 feet from the Tualatin River.

d. Properties bordering wetlands at least 25 feet from a stream may utilize the wetlands as the Vegetated Corridor. If not already in Good Corridor Condition, enhancement of the wetlands to a Good Corridor Condition for a width of 25 feet towards the stream is required.

3.11 Wetland Fills

a. For Wetland Fills Where Physical Sensitive Area Mitigation is Required.
Where Department of State Lands and/or Corps of Engineers permits fill of wetland and requires mitigation through Sensitive Area creation, restoration, or enhancement, a Vegetated Corridor meeting the requirements of this Chapter shall be provided adjacent to the Sensitive Area mitigation site and the Vegetated Corridor shall meet the following conditions:

1. The Vegetated Corridor adjacent to the Sensitive Area mitigation site shall meet the width requirements in Table 3-1 and shall be restored to Good condition.
2. If the Sensitive Area mitigation site is located in an area where the full required Vegetated Corridor width cannot be obtained, then the difference shall be considered an encroachment and be reviewed and mitigated in accordance with Sections 3.07 and 3.08.
3. Mitigation shall occur on-site where possible. If the square footage of the replacement Vegetated Corridor cannot be mitigated on-site, off-site mitigation shall be allowed and the square footage adjusted in accordance with Table 3-2.
4. All remaining on-site Vegetated Corridor shall be enhanced to Good Corridor Condition in accordance with Section 3.14.2, Table 3-2.
5. A Vegetated Corridor of zero (0) feet in width shall be allowed along the edge of a partial wetland fill.

b. For Wetland Fills with Marginal or Degraded Vegetated Corridors and Not Requiring DSL/COE Permits.
The District shall not require mitigation for the Vegetated Corridor associated with total wetland fills if all of the following conditions are met:

1. The Vegetated Corridor associated with the total wetland fill is in Marginal or Degraded condition per Table 3-3.
2. The wetland to be filled is isolated.
3. The wetland requires less than 50 cubic yards of material to be filled entirely and will be filled entirely as a result of the proposed project.
4. No permits are required from the Department of State Lands and the Army Corps of Engineers.

c. Payment to Provide For Total Wetland Fills with Good Condition Vegetated Corridors.
The District shall allow Payment to Provide for Vegetated Corridor mitigation on total wetland fills when the associated vegetated corridor is in good condition if the following conditions are met:

1. The wetland to be filled is isolated.
2. The wetland requires less than 50 cubic yards of material to be filled entirely and will be filled entirely as a result of the proposed project.
3. No permits are required from the Department of State Lands and the Army Corps of Engineers.

d. If the wetland fill is to be mitigated through payment to provide for the Sensitive Area then the Vegetated Corridor shall be mitigated in accordance with Section 3.08.3, Payment to Provide Vegetated Corridor mitigation.

e. Other Situations.
Where a wetland fill situation is not covered under Sections 3.11.1.a-d, the District shall have the discretion to regulate the Vegetated Corridor related to the fill in a manner consistent with Sections 3.11.1.a-d and the other parts of this Chapter.

3.12 Linear Development Projects

a. For Linear Development Projects where the applicant does not own or control the parcel, all the following shall apply:

1. The remaining Vegetated Corridor within the limits for the existing permanent easement shall be enhanced to good corridor condition.
2. Subject to the limits provided in 3.05, permanent encroachment into the Vegetated Corridor shall be mitigated in accordance with Section 3.08.
3. Temporary encroachments in to the Vegetated Corridor within the limits of the existing permanent easement shall be enhanced to good corridor condition.
4. All native vegetation within the Vegetated Corridor that is removed as a result

of the project shall be replaced at a 1:1 caliper size at Diameter Breast Height (DBH) for trees and on a 1:1 quantity basis for shrubs.

b. For linear Development Projects where the applicant owns or controls the parcel, all the following shall apply:

1. The Vegetated Corridor enhancement area shall be equal to the total project footprint or the total Vegetated Corridor area on the affected parcels, whichever is less.
2. Subject to the limits provided in 3.05, encroachment into the Vegetated Corridor shall be mitigated in accordance with Section 3.08.

3.13 Site Assessment Requirements

3.13.1 General

Site Assessments shall be required for all activities where Water Quality Sensitive Areas exist or appear to exist on or within 200' of the project site.

3.13.2 Simplified Site Assessment

Unless specifically waived in writing by the District, the Simplified Site Assessment shall contain the following information:

a. Sensitive Areas Certification Form

b. Written description of the site and proposed activity, including:

1. Landscape setting, topography, land uses and site alterations
2. Description of proposed development activity
3. General description of the Sensitive Area and Vegetated Corridor

c. Site plan of the entire property, including the following:

1. Property lines and dimensions
2. Location of proposed development activity
3. Existing and proposed conditions for property and surrounding area within 200 feet
4. Location and dimensions of roads, driveways, utilities, parking areas, and building footprints
5. Location and dimensions of yards and cultivated areas
6. Locations of existing Sensitive Areas, Stormwater Infrastructure, and drainage ditches
7. Locations, boundaries, and conditions of the Vegetated Corridors including plant communities, contours, data points, and notation of slopes greater than 25%

8. Site plan at a scale of 1 inch equals 60 feet or less (1"=60')

d. Photographs of the site labeled and keyed to the site plan.

3.13.3 Standard Site Assessment

Unless specifically waived in writing by the District, the Standard Site Assessment shall contain the following information:

a. Sensitive Areas Certification Form

b. Standard Site Assessment

1. Written description of the existing site and adjacent property, Sensitive Area, Vegetated Corridor condition, proposed development, and off-site improvements
2. Description of each plant community within the vegetated corridor
3. Wetland and Vegetated Corridor Sample Points (Prepared in accordance with DSL and Corps Procedures for wetland delineation and Section 3.14)
4. Project Vicinity Map showing entire tax lots for project site and any off-site improvements
5. Existing Condition Figure in accordance with 3.13.3(c)(1)
6. Proposed Development Figure in accordance with 3.13.3(c)(2)
7. Final Conditions Site Plan Figure in accordance with 3.13.3(c)(3)

c. Standard Site Assessment Figures and Site Plan

All figures shall include property lines and dimensions, north arrow and scale bar. Site plans shall be at a standard engineering or architect scale not to exceed one inch equals 60 feet or less (1"=60'). Differing scales may be required in order to show greater detail of site plans.

1. Existing Condition Figure
   A) Location, boundary, and condition of existing sensitive areas, stormwater infrastructure, and drainage ditches for project site and surrounding area within 200 feet; and any off-site improvements
   B) Location, boundary, and condition of existing vegetated corridors including plant communities
   C) Location of wetland and Vegetated Corridor data points
   D) Vegetated Corridor slope measurements and break in slope line
   E) Topographic lines

2. Proposed Development Figure
   A) Location of existing sensitive areas (streams, ponds, wetlands, etc) and proposed sensitive area mitigation, both on-site and off-site, stormwater infrastructure, and drainage ditches on site and within 200 feet
   B) Location of existing vegetated corridors and proposed vegetated corridor mitigation; including plant communities on site and within 200 feet
   C) Topographic lines
   D) Proposed encroachment
   E) Proposed off-site improvement areas
   F) Location of proposed mitigation
   G) Area of Vegetated Corridor as square footage

3. Final Conditions Site Plan Figure (may be combined with Proposed Development Figure)
   A) Location of proposed boundary of Sensitive Area and Vegetated Corridor
   B) Location of proposed development
   C) Location of proposed off-site improvement area
   D) Sensitive Area and Vegetated Corridor easement/Tract limits.

d. Additional Submittal Requirements

Based on existing site conditions and the proposed project, the following information may be required:

1. Intermittent stream hydrology data and drainage basin calculation in accordance with 3.14.3
2. Geotechnical Report in accordance with 3.14.6
3. Alternatives Analysis for Tier 1, Tier 2, and Tier 3 level reviews, in accordance with Section 3.07
4. Off-site Mitigation Proposal
5. Functional Assessment Requirements in accordance with Section 3.14.7

3.14 Assessment Methods

3.14.1 Assessment Method Definitions

a. Plant Community

A Plant Community is defined as: a grouping of plants that often occur together growing in a uniform habitat.

b. Saturated

A condition in which all voids (pores) between soil particles are filled with water.

c. Sample Point

A representative area within a plant community in which the visually determined characteristics best represent the plant community as a whole.

3.14.2 Requirements for Vegetated Corridor Enhancement and/or Mitigation

Enhancement and/or mitigation of the Vegetated Corridor shall be accomplished in accordance with the requirements in Table 3-3.

Table 3-3
Vegetated Corridor Standards

Vegetated Corridor Condition Definition[1]	Requirements of Vegetated Corridor, Enhancement, and/or Mitigation
Good Corridor Condition: Combination of native trees, shrubs, and groundcover covering greater than 80% of the area and greater than 50% tree canopy exists (areal measure)	• Provide certification to District, per Section 3.14.5, that the Vegetated Corridor meets condition criteria. • Remove any invasive non-native species[2] within the corridor by hand and re-vegetate cleared area using low impact methods.[3] • If impact is to occur, provide District with a native plant re-vegetation plan appropriate to the site conditions developed by an ecologist/biologist or landscape architect to restore condition. See Appendix A: Planting Requirements. • Re-vegetate impacted area per approved plan to re-establish Good Corridor Conditions
Marginal Corridor Condition: Combination of native trees, shrubs, and groundcover covering 50%-80% of the area and 26-50% tree canopy exists (areal measure) (Enhancement up to Good Corridor Condition required regardless of planned impact)	• Provide certification to District, per Section 3.14.5, that the Vegetated Corridor meets condition criteria. • Remove any invasive non-native species within the corridor by hand or mechanically with small equipment, to minimize damage to existing native vegetation.[2] • Provide District with a native plant re-vegetation plan appropriate to the site conditions developed by an ecologist/biologist or landscape architect to restore to a Good Corridor Condition. See Appendix A: Planting Requirements. • Vegetate corridor to establish Good Corridor Conditions.
Degraded Corridor Condition: Combination of native trees, shrubs, and groundcover covering is less than 50% of the area and less than 25% tree canopy exists (areal measure) (Enhancement up to Good Corridor Condition required regardless of planned impact)	• Provide certification to District, per Section 3.14.5, that the Vegetated Corridor meets condition criteria. • Remove any invasive non-native species within the corridor by hand or mechanically.[2] • Provide District with a native plant re-vegetation plan appropriate to the site conditions developed by an ecologist/biologist or landscape architect to restore to a Good Corridor Condition. See Appendix A: Planting Requirements. • Vegetate Corridor to establish Good Corridor Condition

1. When a single plant community type contains multiple condition characteristics, the higher quality condition shall prevail.
2. See Appendix A for plant lists and references.
3. Refer to Integrated Vegetation Management Guidelines for appropriate methodology

3.14.3 Methodology for Documenting Intermittent Status of Streams

a. A stream shall be determined to be intermittent through one of the following methods:

1. The stream channel is dry (without visible flow or standing water) for a period of 30 consecutive days during a year with wet to average precipitation patterns (see Table 3-4 below to determine precipitation pattern). This method requires a minimum of two samples per 100 feet of stream length, collected at the beginning and end of the 30 day period, with supporting data (including maps with photos keyed to each sample location), indicating that the stream is dry. During a year with a dry precipitation pattern, all sampling must be completed prior to August 15. If standing water is present at the first site visit, Method 2 shall be used, or the applicant must wait until the project reach is completely dry to start the 30 day sampling period. For the purposes of this section, the District shall have the discretion to accept data taken up to 37 consecutive days apart.

2. The channel must not have saturated soil in the upper 12 inches, during a year with wet to average precipitation patterns. This method requires representative samples (one per 100 feet of stream length) on only one date. Samples shall include supporting data (including soil texture, level of saturation, and maps with photos keyed to each sample location). During a year with a dry precipitation pattern, all sampling must be completed prior to August 15.

b. If the applicant attempts to make a determination of intermittence during the wet season (November 1 – June 30), the applicant should consider all other available data (historic photos, data, reports, eyewitness accounts, etc.). The District shall review the available data and, if approved, the intermittent determination shall be considered preliminary until status can be definitively confirmed through one of the field methodologies described in Subsection 3.14.3(a).

Table 3-4
Precipitation for Use in Determining
Perennial and Intermittent Flow Status

		30% chance will have	
Month	Average Monthly	less than (Dry Year)	more than (Wet Year)
January	5.76	3.70	6.93
February	4.72	3.17	5.65
March	3.93	2.96	4.59
April	2.46	1.65	2.94
May	1.90	1.13	2.30
June	1.46	0.87	1.78
July	0.61	0.22	0.76
August	0.93	0.25	1.12
September	1.61	0.72	2.03
October	2.68	1.45	3.27
November	6.03	4.07	7.21
December	6.44	4.44	7.67
ANNUAL		32.50	42.01

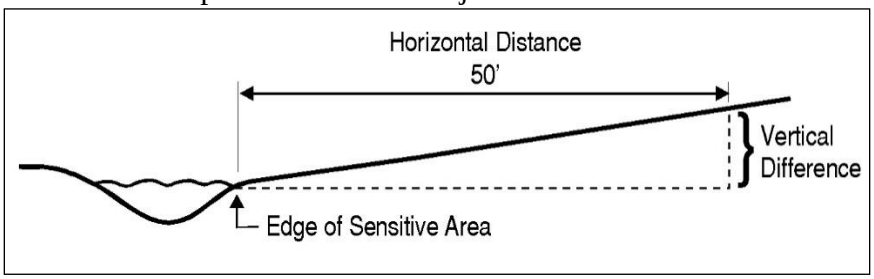
- Precipitation data and calculations from the Hillsboro, OR3908 WETS Table available at ftp://ftp.wcc.nrcs.usda.gov/support/climate/wetlands/or/41067.txt
- If other long-term precipitation data is used, provide location and statistical analysis with submittal.
- To determine status of the precipitation levels, review the previous Water Year (October 1 – September 30) to date. For determinations conducted during the month of October, use the previous complete Water Year to determine precipitation levels. Daily and monthly data are available at http://www.weather.gov/climate/

3.14.4 Methodology for Measuring Slope and Determining Break in Slope

a. Slopes shall be measured perpendicular to the contours. To meet this requirement, the line along which the slope is measured may bend horizontally so it remains perpendicular to the contours.

b. The slope adjacent to the Sensitive Area is measured horizontally 50 feet from the Edge of Sensitive Area as shown in Figure 3-1. The slope is equal to the vertical distance divided by the horizontal distance, expressed as a percentage.

Figure 3-1
Slope Measurement Adjacent to Sensitive Area

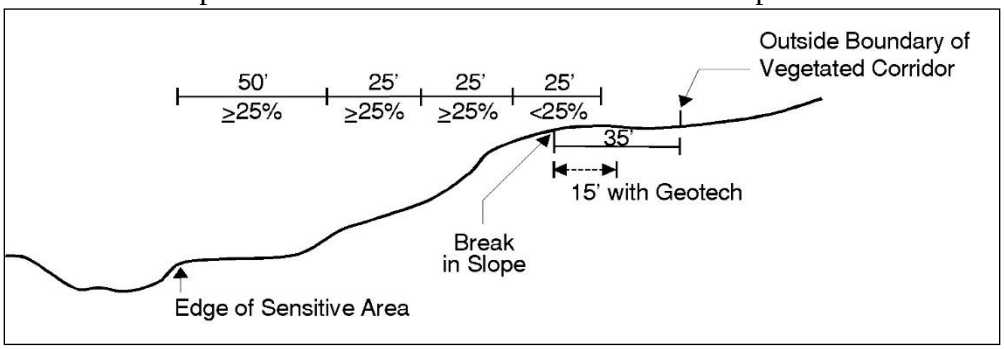


c. A minimum of three slope measurements along the Sensitive Area, spaced at no more than 100-foot increments, shall be made for each site.

d. The break in slope shall be determined by measuring 50 feet horizontally from the edge of the Sensitive Area. If the slope is greater than 25% continue measuring in 25 foot horizontal increments until *either*:

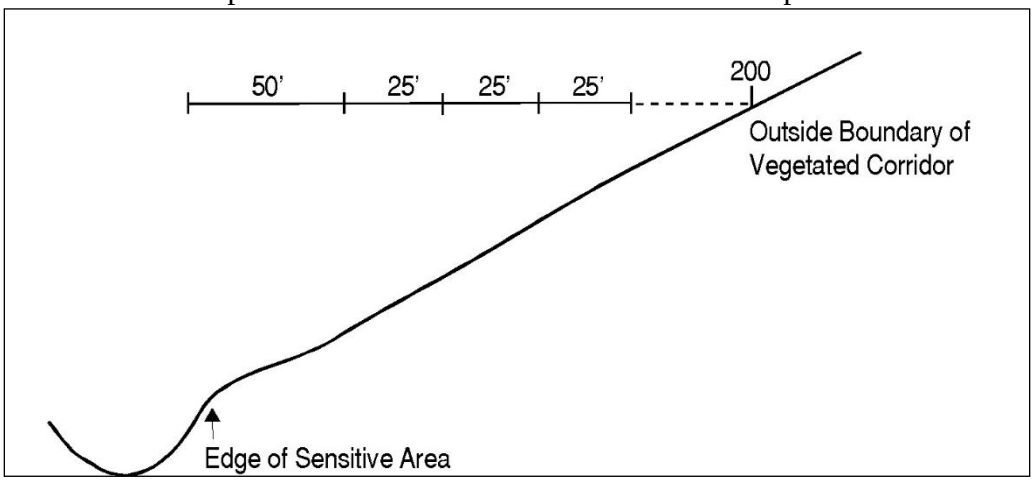
1. A slope is encountered that is less than 25 %. In this case, determine the break in slope and add an additional 35 feet to mark the outside boundary of the Vegetated Corridor; *or*

Figure 3-2
Slope Measurement to Determine Break in Slope



2. 200 feet is reached (all slope measurements >25%)

Figure 3-3
Slope Measurement to Determine Break in Slope



3.14.5 Methodology for Vegetated Corridor Condition Assessment

a. Establish at least one representative sample point per acre per community type. All communities must be sampled.

b. At the sample point, visually determine and document the cover of all plant species providing greater than 5 percent cover within the plot boundary.

c. Sample Points shall use a 10-foot radius plot for herbs (non-woody vegetation) and a 30-foot radius plot for woody vegetation.

d. Plot boundaries may be adjusted to ensure that only one plant community is represented in a plot.

e. For each community type, determine the cover provided by both native and invasive species as follows:

   1. Native species as listed in the most current version of Metro or local Native Plant List, whichever is more comprehensive.
   2. Invasive species are limited to Himalayan or evergreen blackberry (*Rubus discolor, lacinatus*), reed canarygrass (*Phalaris arundinacea*), teasel (*Dipsacus fullonum*), Canada or bull thistle (*Cirsium sp.*), Scotch broom (*Cytisus scoparius*), purple loosestrife (*Lythrum salicaria*), Japanese knotweed (*Polygonum cuspidatum*), morning glory (*Convolvulus sp.*), giant hogweed (*Heracleum mantegazzianum*), English ivy (*Hedera helix*), nightshade (*Solanum* sp.), and clematis (*Clematis ligusticifolia* and *C. vitabla*)

f. For each community determine the percent areal cover of the tree canopy.

g. For each community determine if the Vegetated Corridor within that community is in Good, Marginal, or Degraded Corridor Condition in accordance with Section 3.03.3.

h. If more than one condition (Good, Marginal, or Degraded) exists within a Vegetated Corridor, indicate the condition of each plant community within the Vegetated Corridor on the site base map.

3.14.6 Geotechnical Report Requirements

If development is proposed closer than 35' from the break in slope at the top of the ravine, a geotechnical analysis is required. The geologist or geotechnical engineer shall provide a stamped report containing:

a. Description and map of soil type and erosion potential of the slope.

b. Documentation of evidence of potential historic slope movement, if any.

c. Limits of impact to the slope necessary for it to remain stable.

d. Estimation of weight that can be applied to the top of a slope and remain stable.

e. Other relevant information deemed appropriate to include.

3.14.7 Functional Assessment Requirements for Tier 2 Alternatives Analysis

If a Tier 2 Alternatives Analysis is proposed, a functional assessment is required. The report shall be prepared using methodology outlined in Oregon Division of State Lands Hydrogeomorphic (HGM) approach of assessment for wetland and riparian functions.

Chapter 4

RUNOFF TREATMENT AND CONTROL

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Chapter 4

RUNOFF TREATMENT AND CONTROL

4.01 General Provisions

4.01.1 Introduction

The purpose of this Chapter is to outline design requirements for storm and surface water management related to water quality, quantity control for conveyance capacity, hydromodification, and Low Impact Development Approaches (LIDA). The provisions of this chapter are intended to prevent or reduce adverse impacts to the drainage system and water resources of the Tualatin River Basin.

4.01.2 Application and Interpretation of this Chapter

a. The provisions of this Chapter shall apply to all development projects within District and City jurisdictions. Interpretations of such provisions and their application in specific circumstances shall be made by the District and City, unless otherwise noted.

b. Any City operating a local program may adopt stricter design specifications within its jurisdiction than the specifications stated in this chapter.

c. Notwithstanding 4.01.2.b, where District and City standards conflict, the District's standards shall apply.

d. The use of development techniques that mimic natural systems, including LIDA and green infrastructure, shall be emphasized.

4.01.3 Organization of Chapter

The organization of this Chapter is intended to follow the site evaluation and design process, as described below:

a. Sections 4.01- 4.05
The beginning sections of this Chapter describe the stormwater management requirements that are applicable given a project's characteristics and location.

b. Section 4.06
The middle section of this Chapter provides an overview of stormwater management approaches that may be used on a project to meet applicable stormwater management requirements.

c. Section 4.07- 4.09
The final sections of this Chapter describe sizing and design criteria for stormwater management facilities and approaches.

4.02 Water Quantity Control Requirements for Conveyance Capacity

4.02.1 Mitigation Requirement

Each new development shall incorporate techniques for mitigating its impacts on the public stormwater system in accordance with Section 5.05. The District or City shall determine which of the following techniques may be used to satisfy this mitigation requirement.

a. Construction of permanent on-site stormwater quantity detention facilities designed in accordance with this Chapter; or

b. Enlargement or improvement of the downstream conveyance system in accordance with this Chapter and Chapter 5; or

c. Payment of a Storm and Surface Water Management System Development Charge (SWM SDC), as provided in CWS Ordinance 28, which includes a water quantity component to meet these requirements. If District or City requires that an on-site detention facility be constructed, the development shall be eligible for a credit against SWM SDC fees, as provided in District Ordinance and Rules.

4.02.2 Criteria for Requiring On-Site Detention for Conveyance Capacity

On-site facilities shall be constructed when any of the following conditions exist:

a. There is an identified downstream deficiency, and the District or City determines that detention rather than conveyance system enlargement is the more effective solution.

b. There is an identified regional detention site within the boundary of the development.

c. Water quantity facilities are required by District-adopted watershed management plans or subbasin master plans or District- approved subbasin strategy.

4.03 Hydromodification Approach Requirements

4.03.1 General

Owners of new development and other activities which create and/or modify 1,000 square feet or greater of impervious surface, or increase the amount or rate of surface water leaving a site, are required to implement or fund techniques to reduce impacts to the downstream receiving water body. The following techniques may be used to satisfy this requirement:

a. Construction of permanent LIDA designed in accordance with this Chapter; or

b. Construction of a permanent stormwater detention facility designed in accordance with this Chapter; or

c. Construction or funding of a hydromodification approach that is consistent with a District-approved subbasin strategy; or

d. Payment of a Hydromodification Fee-In-Lieu.

4.03.2 Hydromodification Assessment Requirement

Unless specifically waived in writing by the District, a Hydromodification Assessment is required of all activities described in Section 4.03.1, unless the activity meets any of the following criteria:

a. The project results in the addition and/or modification of less than 12,000 square feet of impervious surface.

b. The project is located in an area with a District approved subbasin strategy with an identified regional stormwater management approach for hydromodification.

4.03.3 Hydromodification Assessment Methodology

A Hydromodification Assessment is necessary to determine the Reach-Specific Risk Level, Development Class, and Project Size Category for a project. These three parameters are used to determine the Hydromodification Approach requirements for a project.

A Hydromodification Map is published on the District's website to assist with the assessment, and below is the methodology for determining each parameter:

a. Risk Level

1. Locate the Project Site on the Hydromodification Map.

2. Determine the Point of Discharge by evaluating the existing or

proposed surface water conveyance system, and find the location where stormwater outfalls to a Sensitive Area. If the Sensitive Area is a wetland or pond, continue to follow the flow path until it reaches a stream. The Point of Discharge is the location where stormwater enters a stream. If a project drains in more than one direction, each drainage basin and Point of Discharge should be evaluated independently.

3. Identify the Receiving Reach, which is the section of stream that begins at the Point of Discharge and extends along the centerline of the stream for ¼ mile downstream from the Point of Discharge.

4. Determine the Risk Level

   A) Locate the Receiving Reach on the Hydromodification Map and use the Map Key to determine the mapped Risk Level. If the Receiving Reach includes more than one Risk Level, select the highest level.

   B) If the applicant, City, or District identifies additional Receiving Reach conditions that may result in a different Risk Level than is identified on the Hydromodification Map, conduct a site-specific evaluation of each Receiving Reach in accordance with the Risk Level Evaluation described in Section 4.03.4.

5. Use the result of Section 4.03.3.(a)(4) above to identify the Risk Level, which will be one of the following categories:

   A) High
   B) Moderate
   C) Low

b. Development Class

1. Determine the Development Class at the location of the Project Site by using either of the following two methods:

   A) Locate the Project Site on the Hydromodification Map and use the Map Key to determine the Development Class.

   B) Identify the date that the area which includes the Project Site was incorporated by Metro into the Urban Growth Boundary. For the purposes of the Hydromodification Assessment, areas added prior to 2002 are classified as Developed Area and areas added after 2002 and remain largely undeveloped are classified as Expansion Area.

2. Use the result of Section 4.03.3.(b)(1) to identify the Development Class, which will be one of the following categories:

   A) Developed Area
   B) Expansion Area

c. Project Size Category

1. The Project Size Category is determined by calculating the area of proposed new and/or modified impervious surface. Calculate this area using the methodology described in Section 4.08.1.

2. Use the results to identify the Project Size Category, which will be one of the following:

   A) Small: 1,000 to 12,000 square feet
   B) Medium: over 12,000 to 80,000 square feet
   C) Large: over 80,000 square feet and larger

4.03.4 Reach-Specific Risk Level Evaluation

If the applicant, City, or District identifies additional Receiving Reach conditions that may result in a different Risk Level than is identified on the Hydromodification Map (per Section 4.03.3), a reach-specific evaluation of the Receiving Reach may be used to determine the Risk Level. Use the evaluation results for the following four parameters in conjunction with Table 4-1 to determine the Risk Level. Identify the Risk Level associated with each parameter in Table 4-1. If there is more than one Risk Level, select the highest to represent the Receiving Reach.

a. Stream Gradient

Determine the longitudinal slope of the Receiving Reach using one of the following methods:

1. Desktop Methodology: Using current LiDAR bare earth model, determine the slope of the stream channel along the centerline within the Receiving Reach at 50 foot intervals. Determine channel slope for each interval, and use the average slope of the steepest three segments to determine the Risk Level in Table 4-1.

2. Field Methodology: Measure the slope of the stream along the deepest part of the channel within the Receiving Reach at 50 feet intervals. Determine the channel slope for each interval. Use the average slope of the steepest three segments to determine the Risk Level in Table 4-1.

b. Stream Bank Height Ratio

Measure the height difference between the toe of the streambank and the top of the streambank (measurement A), and the toe of the streambank and ordinary high water ("bankfull"; measurement B). Take measurements beginning at the upstream limit of the Receiving Reach and repeat at 100 foot increments throughout the Receiving Reach. Calculate the stream Bank Height Ratio, as A/B, for each 100 foot increment. Use the average of the three highest values to determine the Risk Level in Table 4-1.

c. Valley Confinement

Determine the square footage of area adjacent to and within 135 feet laterally of the stream ("adjacent land" in Table 4-1) that is confined by steep (>25%) or moderately steep (10-25%) slopes using the current LiDAR bare earth digital elevation model. Use the result to determine the Risk Level in Table 4-1.

d. Landslide Susceptibility

Determine the Landslide Susceptibility of land adjacent to and within 135 feet laterally of the stream ("adjacent land" in Table 4-1) using one of the following methods:

1. Desktop Methodology: Using the current landslide susceptibility map issued by the Oregon Department of Geology and Mineral Industries, determine the landslide susceptibility within 135 feet laterally of the stream in the Receiving Reach. Polygons that are less than 1,000 sq. ft. in area may be ignored. Use the result to determine the Risk Level in Table 4-1.

2. Field Methodology: A site specific evaluation may be made by Certified Engineering Geologist or a Geotechnical Engineer that the areas within 135 feet laterally of the stream in the Receiving Reach contains no location susceptible to slope failure under current climatic and land cover conditions. The evaluation must describe how changes in the condition or pattern of land cover, drainage, or vertical or lateral channel migration or inundation would affect slope stability within the Receiving Reach. The result of the analysis may be used to demonstrate risk level or low, otherwise the result of the Desktop Methodology will apply.

TABLE 4-1

REACH-SPECIFIC PARAMETERS FOR RISK LEVEL

Parameter	**Low**	**Moderate**	**High**
Stream Gradient	< 2%	2% - 4%	> 4%
Bank Height Ratio	< 1.2	1.2 - 1.4	> 1.4
Valley Confinement	50% or less of the Receiving Reach and adjacent land has land surface slopes exceeding 10%.	More than 50% of the Receiving Reach and adjacent land has land surface slopes that exceed 10%.	More than 50% of the Receiving Reach and adjacent land has land surface slopes that exceed 25%.
Landslide Susceptibility	No portion of the Receiving Reach and adjacent land is mapped as "moderate", "high" or "very high" landslide susceptibility.	Any portion of the Receiving Reach and adjacent land is mapped as "moderate", and no areas are mapped as "high" or "very high" landslide susceptibility.	Any portion of the Receiving Reach and adjacent land is mapped as "high" or "very high" landslide susceptibility.

4.03.5 Hydromodification Approach Selection

Using the results of the Hydromodification Assessment described in Section 4.03.3, determine the corresponding project category from Table 4-2 below.

TABLE 4-2
HYDROMODIFICATION APPROACH PROJECT CATEGORY TABLE

<table>
<tr><th>Development Class/
Risk Level</th><th>Small Project
1,000 – 12,000 SF</th><th>Medium Project
>12,000 – 80,000 SF</th><th>Large Project
> 80,000 SF</th></tr>
<tr><td>Expansion/High</td><td rowspan="6">Category 1</td><td rowspan="2">Category 3</td><td rowspan="4">Category 3</td></tr>
<tr><td>Expansion/ Moderate</td></tr>
<tr><td>Expansion/ Low</td><td>Category 2</td></tr>
<tr><td>Developed/ High</td><td>Category 3</td></tr>
<tr><td>Developed/ Moderate</td><td rowspan="2">Category 2</td><td rowspan="2">Category 2</td></tr>
<tr><td>Developed/ Low</td></tr>
</table>

Stormwater management options for each category are listed below:

a. Category 1
Projects in Category 1 represent those with the lowest anticipated risk. Any of the following options may be used to address hydromodification:

1. Infiltration facility, using the Simplified Sizing, as described in Section 4.08.4;or

2. Payment of a Hydromodification Fee-In-Lieu in accordance with District Rates and Charges; or

3. Any option listed in Category 2 or 3.

b. Category 2
Projects in Category 2 represent those with a moderate anticipated risk. Any of the following options may be used to address hydromodification:

1. Infiltration facility, using the Standard Sizing, described in Section 4.08.5; or

2. Peak-Flow Matching Detention, using design criteria described in Section 4.08.6; or

3. Combination of Infiltration facility and Peak-Flow Matching Detention, using criteria described in Section 4.08.5 and 4.08.6; or

4. Any option listed in Category 3.

c. Category 3
Projects in Category 3 represent those with the highest anticipated risk. Any of the following options may be used to address hydromodification:

1. Peak-Flow Matching Detention and LIDA:

A) Peak-Flow Matching Detention using the design criteria described in Section 4.08.6, and

B) Management of runoff from 30% of the impervious area using any LIDA in Table 4-3, sized in accordance with Section 4.08.4.b, and designed as described in Section 4.09; or

2. Flow Duration Curve Matching Detention, using the sizing methodology described in Section 4.08.7

d. Tualatin River Adjustment

The project category may be adjusted to Category 1 for projects that discharge directly to the Tualatin River. An applicant may request a project category adjustment if a project meets the following criteria:

1. The Point of Discharge is directly to the Tualatin River, and

2. The stormwater conveyance system from the project site to the River is completely piped, or if open channel conveyance, the system is lined with rock or other material that is not at risk of downcutting or damage caused by increased stormwater discharge.

4.03.6 Design Considerations

a. Site design which includes a combination of more than one stormwater management approach (e.g. detention pond and infiltration facility) may be used to reduce the size of any one individual facility.

b. Site design which reduces the amount of new and modified impervious surface may be used as a strategy to reduce the size of water quality and/or detention facilities.

c. If an onsite stormwater management approach cannot be constructed or implemented to manage the runoff from the development's impervious surface, then with District approval, an on- or off-site hydromodification approach may be designed to manage runoff from an equivalent area of existing impervious surface.

d. Discharges to water quality sensitive areas shall maintain the hydroperiod and flows of pre-development site conditions to the extent necessary to protect the characteristic functions of the water quality sensitive area. Conversely, discharge of flows that may be critical to downstream water quality sensitive areas into other catchments will not be permitted unless addressed in the applicant's Service Provider Letter.

e. Per Section 1.06, alternate methods to address hydromodification may be considered for approval.

4.03.7 Criteria for Requiring Implementation of a Hydromodification Approach

a. A Hydromodification Approach shall be implemented on-site unless any of the following conditions exist:

1. The result of Section 4.03.5 is that the project is Category 1 and the applicant selects Fee-In-Lieu; or

2. The project is located within a District-approved stormwater management strategy area, and implementation of an approach is not a requirement of the development; or

3. In the judgment of the District, implementation of an on-site hydromodification approach is impracticable or ineffective due to topography, soils, landslide risk, high water table, or other site conditions. The District may require a site-specific analysis (e.g., infiltration testing, geotechnical evaluation) to support such a determination; or

4. In the judgment of the District, on-site implementation results in the inefficient use of District or City resources for long-term operations and maintenance; or

5. In the judgment of the District, the proposed development is likely to have a negligible impact and on-site implementation of a hydromodification approach will result in little or no benefit to the Receiving Reach, based on the District's analysis of the stream or the applicant's request for an Infill Exemption demonstrating all of the following factors:

A) The Risk Level associated with the Receiving Reach is Low or Moderate. This is to ensure that highly sensitive stream reaches are not negatively impacted.

B) The size of the impervious surface created and/or modified by a project is moderate to small. Until the District has performed its analysis, a project's impervious surface is moderate to small when the proposed new and/or impervious surface created by the development is 25,000 square feet or less. Calculate this area using the methodology described in Section 4.08.1.

C) The discharge from the project is small compared with the total tributary drainage flow in the receiving stream. Until the District has performed its analysis, a project's discharge will be considered small when the additional flow from the proposed development is less than 10 percent of the total tributary drainage flow at the Point of Discharge.

D) The project is located in a drainage basin with a high level of

existing development tributary to the downstream end of the Receiving Reach. Until the District has performed its analysis, drainage basins with less than 10 percent of remaining developable area shall be considered to have a high level of existing development. The remaining developable area within a drainage basin may exclude land uses that are not likely to be developed, including but not limited to parks, cemeteries, undevelopable tracts, and protected natural resources.

b. If construction or implementation of a hydromodification approach is not required as a result of meeting any condition outlined in Section 4.03.7.a, the applicant shall pay a Fee-In-Lieu of construction or implementation of a Hydromodification Approach in accordance with District Rates and Charges.

4.04 Water Quality Treatment Requirements

4.04.1 General

Owners of new development and other activities which create or modify 1,000 square feet or greater of impervious surfaces, or increase the amount of stormwater runoff or pollution leaving the site, are required to implement or fund permanent water quality approaches to reduce contaminants entering the storm and surface water system.

4.04.2 Criteria for Requiring Implementation of a Water Quality Approach

a. A water quality approach shall be implemented on-site unless, in the judgment of the District or City, any of the following conditions exist:

1. Due to topography, soils or other site conditions, implementation of an on-site approach is impractical, ineffective or results in the inefficient use of District or City resources for long-term operations and maintenance; or

2. There is a more efficient and effective regional approach within the subbasin that was designed to incorporate the development, or there is an approach in the subbasin which is demonstrated to have the capacity to treat the site.

b. If construction or implementation of a water quality approach is not required as a result of meeting any condition outlined in Section 4.04.2 (a) (1)-(2), the Owner of the development shall pay a Fee-In-Lieu of construction or implementation of Water Quality Approaches in accordance with District Rates and Charges.

4.04.3 Required Treatment Design Efficiency

a. Stormwater quality approaches shall be designed to remove 65 percent of the total phosphorous from the runoff from the impervious area that is tributary to the facility.

b. The phosphorous removal efficiency specifies only the design requirements and is not intended as a basis for performance evaluation or compliance determination of the stormwater quality control approach installed or constructed pursuant to this Chapter.

c. The following approaches are available for meeting the treatment design efficiency standard in this section:

1. Pretreatment as specified in Section 4.07.1 in combination with one of the following vegetated water quality approaches:
   A) Vegetated Swale
   B) Extended Dry Basin
   C) Constructed Water Quality Wetland
   D) Structural Infiltration Planter
   E) Non-structural Infiltration Planter (rain garden)
   F) Structural Flow-through Planter
   G) Non-Structural Flow-Through Planter/Rain Garden
   H) Street-Side Planter
   I) Landscape Filter Strip
   J) Vegetated Corridor as a Filter Strip

2. Proprietary treatment systems meeting the requirements of Section4.07.8.
3. Alternative water quality approaches that can be demonstrated, to the satisfaction of the District, to meet the removal efficiency standard in this section.

4.04.4 Design Considerations

a. If an onsite water quality approach cannot be constructed or implemented to treat the runoff from the development's impervious surface, then with District or City approval, an on- or off-site water quality approach may be designed to treat runoff from an equivalent area of existing untreated impervious surfaces.

b. Approaches shall be designed so that flow from the development is treated off-line from the storm conveyance system and reconnected to upstream flows following treatment. If an off-line approach is not feasible, additional capacity in the approach may be required for upstream flow.

c. Discharges to sensitive areas shall maintain the hydro period and flows of

pre-development site conditions to the extent necessary to protect the characteristic functions of the sensitive area. Conversely, discharge of flows that may be critical to downstream water quality sensitive areas into other catchments will not be permitted unless addressed in the applicant's Service Provider Letter.

d. All water quality approaches shall be designed in accordance with this Chapter.

4.05 Low Impact Development Approach (LIDA) Requirements

4.05.1 Purpose

LIDA provides pollutant reduction associated with urban development. Generally, the first priority for LIDA is to conserve existing resources and minimize stormwater runoff generated from urban development to mimic natural hydrologic processes.

Selection of appropriate LIDA, including surface infiltration, should ensure there are no adverse downstream drainage impacts and an appropriate maintenance program can be developed to sustain the functionality of the LIDA.

4.05.2 LIDA Design Considerations

Through conservation of natural resources, minimization of impervious surface, and mimicking natural hydrologic processes, each development shall reduce its hydrologic impacts through approaches described in Section4.05.3, unless any of the following criteria apply:

a. Due to topography, soils or other site conditions, implementation of an onsite approach is impractical or inefficient.

b. Hydromodification or stormwater quality treatment requirements are being met by a regional or subbasin approach.

c. The hydromodification and water quality treatment requirements are being met through a Fee-In-Lieu in accordance with Section 4.03.7.b and 4.04.2.b.

4.05.3 LIDA Approvable by the District

a. Vegetated water quality treatment as specified in Section 4.04.3.c.1.

b. Vegetated Corridor preservation and enhancement consistent with the Service Provider Letter issued for the project.

c. Green roofs and green walls.

d. Pervious surfaces such as porous pavement and boardwalks.

e. On-site tree preservation when protecting significant habitat or as a result of City or County plans, programs or requirements.

f. Rainwater catchment and harvesting systems for re-use.

g. When approved by the District or City, other approaches that provide stormwater infiltration, evapotranspiration, runoff re-use, or otherwise mimic natural hydrologic processes.

4.06 Summary of Stormwater Management Approaches

Table 4-3 shows the approaches the City or District may approve to meet the requirements of this Chapter and whether these approaches may be used in a publicly maintained system.

TABLE 4-3
SUMMARY OF APPROVABLE APROACHES

Stormwater Management Approach	May be approved for Public System[2]	Quantity for Conveyance Capacity	Hydromod-ification Approach	Water Quality Treatment Approach	Low Impact Development Approach
Water Quality Manhole[1]	✓	✓	✓	✓	
Detention Pond	✓	✓	✓		✓
Underground Detention	✓	✓	✓		
Vegetated Swale	✓			✓	✓
Extended Dry Basin	✓	✓	✓	✓	✓
Constructed Water Quality Wetland	✓	✓	✓	✓	✓
Structural Infiltration Planter	✓	✓	✓	✓	✓
Non-Structural Infiltration Planter (Rain Garden)	✓	✓	✓	✓	✓
Structural Flow-Through Planter	✓			✓	✓
Non-Structural FlowThrough Planter/Rain Garden	✓			✓	✓
Street-Side Planter	✓	✓	✓	✓	✓
Landscape Filter Strip	✓			✓	✓
Vegetated Corridor as a Filter Strip	✓			✓	✓
Green Roofs		✓	✓		✓
Porous Pavement	✓	✓	✓		✓
Stormwater Tree			✓		✓
Structural Soils	✓		✓		✓
Proprietary Treatment System	✓			✓	
Vegetated Corridor Preservation					✓

1. Pretreatment only.
2. Approaches in the right-of-way must be approved by the local road authority.

4.07 Stormwater Management Approach Design Considerations

4.07.1 Pretreatment

a. Pretreatment Required

Unless approved by the District, flow from impervious surfaces to stormwater management approaches shall not be allowed without pretreatment or as specified in the design criteria for specific approaches in Section 4.09. Incoming flows to the stormwater management approach shall be pretreated using a water quality manhole in accordance with Subsection 4.09.1 or as specified within the design criteria for specific

approaches. Other pre-treatment methods such as a proprietary device, filter strip, or trapped catch basin may be approved by the District or City.

b. Proprietary Pre-Treatment Devices

1. The use of proprietary pre-treatment devices may be permitted on a case by case basis with approval by the District or City.

2. The devices shall be sized in accordance with the manufacturer's recommendations using the minimum treatment flow as the water quality flow.

3. Technical submittals from the manufacturer are required, including hydraulic design criteria, particulate removal efficiency, and maintenance requirements and schedule.

4.07.2 Erosion Protection

a. Inlets to stormwater management approaches shall be protected from erosive flows through the use of an energy dissipater or rip rap stilling basin of appropriate size based on flow velocities. Flow shall be evenly distributed across the treatment area.

b. Coconut matting or District approved alternative shall be used in the treatment area of swales and below the water quality volume levels of ponds, and all other zones.

4.07.3 Vegetation

a. Except as specified in Section 4.09, vegetation shall be in accordance with Appendix A: Planting Requirements.

b. No invasive species shall be planted or permitted to remain within an area used for water quality treatment or water quantity management, including, but not limited to invasive species identified in the most current version of the District's Integrated Pest Management Plan.

4.07.4 Fencing

a. Unless otherwise approved by the District or City, delineation fencing shall be required around facilities and/or tracts containing facilities.

b. When a facility is fenced, the fence shall be 4-feet high, vinyl-clad chain link fence conforming to CWS Standard Drawing No. 792. The fence shall include a 12-foot wide lockable gate for maintenance access conforming to CWS Standard Drawing No. 792.

c. If a facility is located adjacent to a Vegetated Corridor, wildlife friendly fencing shall be utilized.

d. If, in the opinion of the District or City, risk of damage to the facility and/or public safety is minimal, split rail fencing, dense vegetated hedges, or other approved method may be used to delineate the facility boundary. Fencing or similar barriers which blend into the surrounding neighborhood or site may be used, to the extent that they do not impede maintenance access or increase operation and maintenance costs to the District or City.

4.07.5 Walls

a. Retaining walls may serve as pond walls if the design is prepared and stamped by a registered professional engineer and a fence is provided along the top of the wall. At least 25% of the pond perimeter shall be vegetated to a side slope of 3H:1V or flatter.

b. Walls are not allowed in the treatment areas of any water quality approach.

c. Structural walls and walls that are 4 feet or higher (not including footings), or that are periodically inundated, shall meet all of the following criteria:

1. Be approved by a licensed structural or geotechnical engineer; and

2. The District shall not have maintenance responsibility for the wall. The party responsible for maintenance of the walls within the tract or easement shall be clearly documented on the plat or in alternate form as approved by the District.

4.07.6 Access

a. General Access Requirement

Unless otherwise approved by the District or City, access roads shall be provided for maintenance of all stormwater management approaches. The following criteria are considered to be the minimum required for facilities maintained by the District or Cities. Other permitting jurisdictions may have more restrictive requirements. If the design Engineer anticipates that any of the requirements will not be met due to the configuration of the proposed development, the design Engineer is advised to meet with District or City staff to gain approval for the deviation prior to submittal.

b. Standard Road Design

1. The road section shall be three (3) inches of class “C” asphaltic concrete; over two (2) inches of ¾”-0” compacted crushed rock;

over six (6) inches of 1½"-0" compacted crushed rock; over subgrade compacted to 95-percent AASHTO T-99; or, the design Engineer may submit an alternate design certified as capable of supporting a 30-ton maintenance vehicle in all weather conditions.

2. Strengthened sidewalk sections shall be used where maintenance vehicles will cross.

3. Maximum grade shall be 10-percent with a maximum 3-percent cross-slope.

4. Minimum width shall be 12 feet on straight runs and 15 feet on curves.

5. Curves shall have a minimum 40-foot interior radius.

6. Access shall extend to within 10 feet horizontal of the center of all sumped structures unless otherwise approved by the District or City.

7. The District or City may require a curb or other delineator at the edge of the road for drainage, a curb stop, or to demarcate the road where the road edge is not apparent.

8. The side slope for road embankments shall be 2H:1V or flatter.

9. A vehicle turnaround shall be provided when the access road exceeds 40 feet in length.

c. Alternate Access Road

An alternate access road design meeting the requirements of this section may be approved by the District or City for facilities in which access is required for general maintenance and long term care of the facility, but where there is no structure, as determined by the District or City, requiring regular maintenance.

1. The road section shall meet the requirements of 4.07.6(b)(1) or an alternate section certified as capable of supporting AASHTO HS-20 loading.

2. As an alternative to the requirements of 4.07.6(c)(1), a concrete grid paver surface may be constructed by removing all unsuitable material, laying a geotextile fabric over the native soil, placing a structural border and pavers, filling the honeycombs/grids with soil, and planting appropriate grasses.

3. Strengthened sidewalk sections shall be required where maintenance vehicles will cross.

4. Maximum grade shall be 20-percent with a maximum 3-percent cross-slope.

5. Minimum finished width shall be 12 feet.

6. The District or City may require a curb or other delineator at the edge of the road for drainage, a curb stop, or to demarcate the road where the road edge is not apparent.

7. The side slope for road embankments shall be 2H:1V or flatter.

8. A vehicle turnaround shall be provided when the access road exceed 40 feet in length.

4.07.7 Maintenance Responsibilities

a. Unless otherwise approved by the District, newly constructed stormwater management approaches serving multiple parcels or public roads shall be publicly maintained.

b. Publicly maintained stormwater management approaches shall be covered by a surface and stormwater management easement dedicated to the District or City. The District or City shall also be granted an access easement to maintain the approaches. The District will typically not own the land the approach is on.

c. Unless otherwise approved by the District or City, development creating multiple parcels intended for separate ownership shall enclose the publicly maintained stormwater management approaches in a tract.

d. Unless otherwise approved by the District or City, private stormwater management approaches shall be maintained by the Owner and have a Private Stormwater Facility Agreement per Section 2.08.2.

4.07.8 Proprietary Treatment Systems

a. Proprietary treatment systems shall meet the removal efficiency requirement defined in Section 4.04.3(a) and be approved by the District for use in the situations identified in Subsection (c) below.

b. Maintenance

1. Proprietary treatment systems shall be maintained by the District or Cities except those systems used in the situations specified in

Section 4.07.8(c)(1) and (2) below.

2. Proprietary systems require a long-term maintenance plan identifying maintenance techniques, schedule, and responsible parties. This maintenance plan shall be submitted and approved with the drainage report for a project.

c. Proprietary treatment systems shall be allowed in situations meeting one of the following criteria:

1. Treatment of runoff from a single commercial, industrial, multi-family, or condominium parcel.
2. Treatment of runoff from an adjoining commercial, industrial, or multi-family, or condominium parcels which share a common parking lot.
3. Treatment of runoff from new and expanded collector and arterial roadways where no other opportunities exist for treatment without necessitating the removal of homes or businesses.
4. Treatment of runoff from new developments in transit-oriented or similar high-density zoning classifications where the development is primarily single-family residential and the average lot size is less than 2,500 square feet.
5. Treatment of runoff as part of a master planned regional facility approved by the District.

4.07.9 Underground Detention

a. Underground detention systems to meet the requirements of quantity control for conveyance capacity or hydromodification must be designed in accordance with sizing requirements outlined in Section 4.08, and be approved by the District for use only in the situations identified in Subsection (c) below.

b. Maintenance

1. Underground detention systems shall be maintained by the District or Cities except systems used in the situations specified in Section 4.07.9(c)(1) and (2).

2. Underground detention systems require a long-term maintenance plan identifying maintenance techniques, schedule, and responsible parties. This maintenance plan shall be submitted and approved with the drainage report for a project.

c. Underground detention systems shall be allowed in situations meeting one of the following criteria:

1. Detention of runoff from single commercial, industrial, multi-

family, or condominium parcel.

2. Detention of runoff from adjoining commercial, industrial, or multi-family, or condominium parcels which share a common parking lot.
3. Detention of runoff from new and expanded collector and arterial roadways where no other opportunities exist for detention without necessitating the removal of homes or businesses
4. Detention of runoff from new developments in transit-oriented or similar high-density zoning classifications where the development is primarily single-family residential and the average lot size is less than 2,500 square feet.
5. Detention of runoff as part of a master planned regional facility or retrofit project approved by the District.

4.08 Stormwater Management Approach Sizing

4.08.1 Impervious Area Used In Design

The following apply for development which creates or modifies 1,000 square feet or greater of impervious surface. Development which results in both new and modified impervious surface will result in a combined stormwater management requirement, as described below:

a. For new home construction on a single family or duplex lot of record, the stormwater management approach shall be sized based on 2,640 square feet of impervious surface per dwelling unit. The actual new and modified impervious surface may be utilized when the lot size is less than 3,000 square feet.

b. For residential additions, remodels, and other activities on a single family lot other than new home construction, the stormwater management approach shall be sized based on the actual new and modified impervious area, up to a maximum of 2,640 square feet.

c. For single family and duplex residential partitions and subdivisions, stormwater management approaches shall be sized using the following criteria:

    1. Actual impervious surface area in all public and private rights-of-way and common space created by the development and for existing impervious area proposed to remain on site.

    2. An assumed rate of 2,640 square feet of impervious surface area for lots greater than 3,000 square feet.

    3. For lots that are 3,000 square feet or smaller, impervious area may be based on either of the following:

A. The maximum allowed impervious area per lot, including driveways and buildings, as calculated using the local jurisdiction's development code, or

B. An assumed rate of 2,640 square feet of impervious surface area per lot.

d. For all developments and re-development, other than single family and duplex, stormwater management approaches shall be sized based on the following:

1. Quality:

All new impervious surfaces and three times the modified impervious surface, up to the total existing impervious surface on the site. The area requiring treatment is shown in the formula below:

Area = New Impervious + 3(Modified Impervious)

When modification results in the permanent removal of 1,000 square feet or greater of impervious surface, the treatment approach shall be sized for three times the replaced impervious surface, in addition to the new impervious surface. In this case, the area requiring treatment is shown in the formula below:

Area = New Imp. + 3(Modified Imp. - Permanently Removed Imp.)

Impervious areas shall be determined based upon building permits, construction plans, or other appropriate methods of measurement deemed reliable by District and/or City.

2. Quantity required for conveyance capacity or hydromodification: All new and modified impervious area created by the development.

4.08.2 Storm Events Used in Design

a. Design Storms to be used in Water Quality Evaluation

Stormwater quality approaches shall be designed for a dry weather storm event totaling 0.36 inches of precipitation falling in 4 hours with an average storm return period of 96 hours.

b. Design storms to be used in Peak Flow Hydrologic Analysis

TABLE 4-4

Recurrence Interval	**Total 24-Hour Precipitation Depth (water equivalent inches)**
2-year	2.5
5-year	3.10
10-year	3.45
25-year	3.90

4.08.3 Infiltration-based Design

a. For purposes of sizing infiltration-based facilities, the following apply:

1. Soil data should be obtained from either:

A) Soil series data as mapped on the NRCS WebSoil Survey . The more common soil series within the District, and key data for design purposes, are listed in Table 4-5.

B) Onsite infiltration tests at multiple locations (1 per ¼ acre or 1 per 2 proposed infiltration-based facilities, as needed to support facility design), performed at the depth of the base of the infiltration facility.

2. Where required, infiltration testing of native soil shall use either open pit or encased falling head infiltration methods, or a double-ring infiltrometer. For medium and large projects, these tests must be performed by a qualified civil engineer (PE) or certified engineering geologist (CEG). A factor of safety of 2 shall be used.

3. The following conditions will be assumed to preclude infiltration, and will require appropriate documentation of site conditions:

A) "High" or "very high" landslide susceptibility. (Note: areas with moderate landslide susceptibility require dispersed infiltration unless accompanied by a geotechnical report describing conditions under which infiltration can be safely implemented.)

B) Depth to seasonal high groundwater, persistent restrictive layer, or competent bedrock < 36 inches below ground surface.

C) Presence of subsurface contamination, such as would be documented in a "no further action" determination following site cleanup or listing as an active cleanup site by Oregon Department of Environmental Quality.

D) Slopes across the site >25%. (Note: slopes consistently across the site ≥15% but ≤25% require dispersed infiltration unless accompanied by a geotechnical report describing conditions under which infiltration can be safely implemented.)

TABLE 4-5
HYDROLOGIC PROPERTIES OF COMMON SOILS IN URBAN WASHINGTON COUNTY

Soil Series	Hydrologic Soil Group	Drainage Class	Depth to Restrictive Layer (inches)	Depth to Ground-water (inches)	Infiltration Rates For Simplified Sizing (inches/ hour)
Aloha silt loam	C/D	somewhat poorly drained	>80	18-24	0.2
Amity silt loam	C/D	somewhat poorly drained	>80	6-18	0.2
Briedwell stony silt loam	B	well drained	25	>80	2
Cascade silt loam	C	somewhat poorly drained	20-30*	18-30	0.5
Cascade-Urban complex	C	somewhat poorly drained	20-30	18-30	0.5
Chehalis silty clay loam	B	well drained	>80	48-80	2
Cornelius & Kinton silt loams	C	moderately well drained	30-40*	27-37	0.5
Cornelius variant silt loam	C	moderately well drained	30-40*	27-37	0.5
Cove clay	D	poorly drained	>80	0-12	0.1
Cove silty clay loam	D	poorly drained	>80	0-12	0.1
Dayton silt loam	D	poorly drained	0-24	0-24	0.1
Delena silt loam	D	poorly drained	20-30*	0-18	0.1
Helvetia silt loam	C	moderately well drained	>80	36-72	0.5
Hillsboro loam	B	well drained	>80	>80	2
Huberly silt loam	C/D	poorly drained	38*	0-8	0.2
Laurelwood silt loam	B	well drained	>80	>80	2
McBee silty clay loam	C	moderately well drained	>80	24-36	0.5
Quatama loam	C	moderately well drained	>80	24-36	0.5
Saum silt loam	C	well drained	20-30*	18-30	0.5
Urban land	Not specified; site-specific infiltration testing required				
Verboort silty clay loam	D	poorly drained	12-26	0-8	0.1
Wapato silty clay loam	C/D	poorly drained	>80	0-12	0.2
Willamette silt loam	B	well drained	>80	>80	2
Woodburn silt loam	C	moderately well drained	>80	25-32	0.5
Xerocrepts & Haploxerolls	B	well drained	>80	>80	2
Xerocrepts-rock outcrop	B	well drained	>80	>80	2

* indicates presence of fragipan below which infiltration increases
Source: USDA/NRCS National engineering Handbook, Chapter 7, "Hydrologic Soil Groups" (2009), City of Gresham Stormwater Manual Appendix D (2018), and Web Soil Survey
Note: data for soil series not listed in this table are available from Web Soil Survey, except for Assumed Infiltration Rate, which can be determined from Hydrologic Soil Group.

4.08.4 Simplified Sizing

a. Simplified sizing may be used for facilities where the contributing impervious area to an individual water quality approach is no greater than 15,000 square feet per facility inlet or contributing drainage area.

b. Water Quality Sizing

A 6% sizing factor shall be used to calculate the required water quality surface area of the selected treatment facility. A sizing factor of 6% assumes the site infiltration rate is less than 2 inches/hour.

c. Hydromodification Sizing

A 12% sizing factor shall be used to calculate the required vegetated surface area of the selected facility to meet both the hydromodification and water quality requirement. A sizing factor of 12% assumes the site infiltration rate is less than 2 inches per hour.

d. Alternative Sizing

1. The vegetated surface area of the facility may be reduced by 25% when the growing media depth is increased to 30 inches or more.

2. A site specific design with a reduced sizing factor may be considered if on-site infiltration tests are performed at the soil depth of the proposed base of a facility, and the result of those tests show an infiltration rate that exceeds 2 inches per hour.

3. A site specific design with an alternate sizing factor may be considered when the impervious area contributing to an individual water quality approach is greater than 15,000 square feet.

e. Water Quality for Vegetated Corridor as a Filter Strip (applies to Section 4.04.3.c.1(J)).

The sizing of a Vegetated Corridor as a Filter Strip must meet all of the following criteria:

1. The maximum contributing impervious surface is 2,640 square feet, distributed uniformly across 50 feet of adjacent Vegetated Corridor.

2. The contributing impervious surface must be adjacent to the Vegetated Corridor, or within the outer 40% and approved as an allowed use consistent with the Service Provider Letter.

3. The minimum depth is three times the depth of the contributing impervious surface, or one single family residence. The depth of the Vegetated Corridor treatment area shall be measured from the edge of the Sensitive Area and in the direction of stormwater flow.

4.08.5 Standard Sizing

a. Water Quality Volumes and Flows (applies to approaches in Section 4.04.3.c.1 (A)-(C))

1. Water Quality Storm
The water quality storm is the storm required by regulations to be treated. The storm defines both the volume and rate of runoff. The water quality storm is defined in Subsection 4.08.2.

2. Water Quality Volume (WQV)
The WQV is the volume of water that is produced by the water quality storm. The WQV equals 0.36 inches over the impervious area that is required to be treated as shown in the formula below:

$$\text{Water Quality Volume (cu.ft.)} = \frac{0.36\text{ (in.)} \times \text{Area (sq.ft.)}}{12\text{ (in./ft.)}}$$

3. Water Quality Flow (WQF)
The WQF is the average design flow anticipated from the water quality storm as shown in the formulas below:

$$\text{Water Quality Flow (cfs)} = \frac{\text{Water Quality Volume (cu.ft.)}}{14{,}400\text{ seconds}}$$

or

$$\text{Water Quality Flow (cfs)} = \frac{0.36\text{ (in.)} \times \text{Area (sq.ft.)}}{12\text{(in/ft)}(4\text{ hr})(\text{ 60 min/hr})(60\text{ sec/min})}$$

b. Sizing Infiltration facilities for Hydromodification

1. Hydromodification Storm and Drawdown

A) Infiltration facilities shall be designed to manage the 10-year, 24-hour storm in Subsection 4.08.2.b. and infiltrate this volume in 36 hours or less.

B) Facilities that cannot meet this standard but can provide partial infiltration may be used. Overflow must be managed as described in Subsection 4.08.6.b.

2. Hydromodification Volume

A) Infiltration design shall be assessed by dynamic flow routing through the facility or facilities to underlying soil. Documentation of the proposed design shall be included in the drainage report. Acceptable analysis programs include those listed below, as well as others using the SBUH or TR-55 methodology, provided the considerations outlined in Section 5.04.2 are followed.

1. HEC-HMS (or HEC-1)
2. SWMM
3 City of Portland's Presumptive Approach Calculator (PAC): facility must pass the Flow Control criteria
4. Tualatin River Urban Stormwater Tool (TRUST) interface to HSPF or site specific HSPF model with local climate and geographic data, as approved by the District
5. Others as approved by the District

B) Alternately, a facility may be sized to store the entire runoff volume from the design storm and subsequently drain as described above.

4.08.6 Peak-Flow Matching Hydraulic Design Criteria

a. Peak-Flow Matching Detention design shall be assessed by dynamic flow routing through the basin. Documentation of the proposed design shall be included in the drainage report. Acceptable analysis programs include those listed below, as well as others using the SBUH or TR-55 methodology, provided the considerations outlined in Section 5.04.2 are followed.

1. HYD
2. HEC-HMS (or HEC-1)
3. SWMM
4. HYDRA
5. Others as approved by the District

b. When quantity management is required due to a downstream conveyance capacity deficiency, a combination of on-site detention and infiltration approaches may be used. Approaches shall be designed such that the post-development runoff rates from the site do not exceed the pre-development runoff rates in the table below. If the resulting orifice size is less than the minimum diameter listed in under the Design Standards in Section 4.09, then the post-development flow may be permitted to exceed the target to comply with the minimum orifice size requirement.

TABLE 4-6

Post-Development Peak Runoff Rate	**Pre-Development Peak Runoff Rate Target**
2-year, 24-hour	2-year, 24-hour
10-year, 24-hour	10-year, 24-hour
25-year, 24-hour	25-year, 24-hour

c. When required as a hydromodification approach, a combination of on-site detention and infiltration approaches may be used. Approaches shall be designed such that the post-development runoff rates from the site do not exceed the pre-development runoff rates in the table below. If the resulting orifice size is less than the minimum diameter listed in under the Design Standards in Section 4.09, then the post-development flow may be permitted to exceed the target to comply with the minimum orifice size requirement.

TABLE 4-7

Post-Development Peak Runoff Rate	**Pre-Development Peak Runoff Rate Target**
2-year, 24-hour	50% of 2-year, 24-hour
5-year, 24-hour	5-year, 24 hour
10-year, 24-hour	10-year, 24-hour

d. If a proposed project includes modified impervious surface (Redevelopment), a curve number (CN) of 75 shall be used as the pre-developed condition for all modified impervious surfaces. The CN for new impervious surfaces shall be based on actual Pre-Development site conditions.

4.08.7 Flow Duration Curve Matching Hydraulic Design Criteria

a. Flow Duration Curve Matching Detention design shall be assessed by dynamic flow routing through the basin. Acceptable analysis programs include those listed below.

1. TRUST interface to HSPF
2. Site specific HSPF model with local climate and geographic data, as approved by the District

c. When using Flow Duration Curve Matching Detention, stormwater discharges shall maintain the duration of high flows at their pre-development levels for all flows greater than one-half of the 2-year peak flow to the 10-year peak flow. Projects that also require detention due to a downstream conveyance capacity deficiency must also maintain the post-development 25-year peak flow rate at the pre-development 25-year peak flow rate. If the resulting orifice size is less than the minimum diameter listed in under the Design Standards in Section 4.09, then the post-development flow may be permitted to exceed the target to comply with

the minimum orifice size requirement.

c. If a proposed project includes modified impervious surface (Redevelopment), assume a curve number (CN) of 75 shall be used as the pre-developed condition for all modified impervious surfaces. The CN for new impervious surfaces shall be based on actual Pre-Development site conditions.

4.09 Stormwater Management Approach and Facility Standards

4.09.1 Water Quality Manholes

a. Application
   1. Water quality pretreatment, used in combination with other stormwater management approaches to meet the requirements of this Chapter.

b. Hydraulic Criteria

   1. Minimum Design Flow: Water Quality Flow per Section 4.08.2
   2. Upstream flow splitter may be used to bypass conveyance flows in excess of the Water Quality Flow.

c. Design Criteria

   1. Shall conform to Appendix B, Standard Drawing No. 250 & 260 or an equivalent detail approved by the District or City.
   2. Minimum Manhole Diameter: 60-inch
   3. Maximum size of incoming pipe: 18-inch
   4. Sump Depth: No deeper than 5 feet from invert out to bottom of sump
   5. Volume of sump: 20 cubic feet/ 1.0 cfs of flow into the water quality manhole, up to the 25-year flow. Flow calculations shall include the effect of an upstream flow splitter.
   6. Maintain a 3-foot clear access zone between the inside structure and manhole walls.
   7. Orient access to structure in a clear zone.
   8. Flat Top Section shall have 2 access points and meet ASTM C - 478 and H – 20 Traffic Loading

4.09.2 Detention Pond

a. Applications
   1. Quantity control for conveyance capacity
   2. Hydromodification
   3. LIDA

b. Sizing Criteria

1. Peak-Flow Matching, per Section 4.08.6, is applicable in the following scenarios:

   A) Detention is required as a result of conveyance capacity requirements outlined in Section 4.02
   B) Peak-Flow Matching Detention is required as a result of Hydromodification Requirements identified in Table 4-2.

2. Flow Duration Curve Matching, per Section 4.08.7, is required when identified as the applicable Hydromodification Requirement in Table 4-2.

c. Design Criteria

1. The facility can be a combined water quality and quantity facility provided it meets all relevant criteria.
2. Interior side slopes up to the Maximum Water Surface: 3H:1V or flatter.
3. If interior slopes need to be mowed side slope: 4H:1V or flatter.
4. Exterior Side Slopes: 2H:1V or flatter, unless analyzed for stability by a geotechnical engineer.
5. Minimum Freeboard: 1-foot from 25-year design water surface elevation.
6. Provide an approved outlet structure for all flows.
7. Certain situations require use of multiple orifice plates to achieve desired outflow rates.
8. Minimum orifice size: ½-inch diameter, unless a local jurisdiction has an alternate, but the minimum may be no greater than 1-inch.
9. Maximum ponding depth: 5 feet.
10. A pond overflow system shall provide for discharge of the design storm event without overtopping the pond embankment or exceeding the capacity of the emergency spillway.
11. Provide an emergency spillway sized to pass the 100-year storm event or an approved hydraulic equivalent. Emergency spillway shall be located in existing soils when feasible and armored with riprap or other approved erosion protection extending to the toe of the embankment.
12. Construction of on-site detention shall not be allowed as an option if such a detention facility would have an adverse effect upon receiving waters in the basin or subbasin in the event of flooding, or would increase the likelihood or severity of flooding problems downstream of the site.
13. Landscaping plan
    A) Plant species selection per Appendix A, LIDA Handbook, or approved alternate; must include 3 or more evergreen species

and be suitable for site conditions.

B) Pond bottom, side slopes, and freeboard must be fully vegetated for erosion protection, with establishment of 90% aerial coverage.

d. Maximum Pond Depth Variance

The City or District may approve a maximum pond depth greater than 5 feet, if the design complies with all other standards and design criteria and the following:

1. The ponding depth is not greater than 9 feet.

2. The design does not result in an embankment regulated under dam safety rules. The City or District may require an inundation analysis pursuant to OAR 690-020.

3. The facility is accessible and maintainable with the standard equipment used by the jurisdiction responsible for maintenance.

4. If water quality treatment is co-located with the detention pond, all water quality design criteria must be met.

5. Perimeter walls that are higher than 30 inches (not including footings) shall not surround more than 50% of the facility.

6. The design complies with the local jurisdiction's development codes and design standards.

4.09.3 Underground Detention

a. Applications
   1. Quantity control for conveyance capacity
   2. Hydromodification

b. Sizing Criteria

1. Peak Flow Matching, per Section 4.08.6, is applicable in the following scenarios:
   A) Detention is required as a result of conveyance capacity requirements outlined in Section 4.02
   B) Peak Flow Matching Detention is required as a result of Hydromodification Requirements identified in Table 4-2.

2. Flow Duration Curve Matching, per Section 4.08.7, is required when identified as the applicable Hydromodification Requirement in Table 4-2.

c. Design Criteria

1. The facility can be used to meet water quantity requirements provided it meets all relevant criteria.
2. The following criteria must be demonstrated through design alternatives, calculations, details, and specifications:
    a. Material design life of minimum 100 years;
    b. Meets access 4.07.06 access road requirements;
    c. Apply standard trench backfill/compaction methods for the entire trench / pipe section;
    d. Provide an inspection port every 50 feet, or as approved by the District and City.
    e. Provide maintenance access points every 200 feet, and manhole at the upstream and downstream terminus, or as approved by the District and City;
    f. A pre-treatment water quality manhole (CWS detail 250/260 or equivalent) shall be provided prior to the detention system;
    g. Provide an approved outlet structure for all flows. Certain situations require use of multiple orifice plates to achieve desired outflow rates;
    h. Construct outlet invert of detention system no lower than the discharge stream's 10 year storm event water surface elevation; Facilities designed at or below the 100-year flood elevation shall include additional analysis of backwater effects during the 10, 25, and 100-year storms; and
    i. Design of the detention system shall provide a minimum 1 foot freeboard between the hydraulic grade line and the top of the structure or finish grade above pipe for 25-year post development peak rate of runoff.
3. Underground detention systems may only be used in the street right of way if the road authority and the agency responsible for maintenance approves the system in writing.

4.09.4 Vegetated Swale

a. Applications
    1. Water Quality

b. Hydraulic Design Criteria

1. Design Flow: Water Quality Flow per Section 4.08.5
2. Minimum Hydraulic Residence Time: 9 minutes
3. Maximum Water Design Depth: 0.5 feet
4. Minimum Freeboard: 1.0 foot (for facilities not protected from

high flows)

5. Manning "n" Value: 0.24
6. Maximum Velocity: 2.0 fps based on 25-year flow

c. Design Criteria

1. Provide an energy dissipater at the entrance to the swale, with a minimum length of 4 feet. It will be designed to reduce velocities and spread the flow across the treatment cross section.
2. The use of intermediate flow spreaders may be required.
3. Minimum Length: 100 feet
4. Minimum Slope: 0.5%
5. Minimum Bottom Width: 2 feet
6. Maximum Treatment Depth (measured from top of media): 0.5 feet
7. Maximum Ponding Depth (measured from top of media): 3 feet
8. Side Slope:
   A) In Treatment Area: 4H:1V or flatter
   B) Above Treatment Area: 2.5H:1V or flatter
9. The treatment area shall have coconut matting over 12 inches of amended topsoil or base stabilization method as approved by the District or City. District or City may require 2"-¾" river run rock in areas where sustained flow is anticipated to occur. Extend amended topsoil and coconut matting to the top of the slope.
10. Provide an approved outlet structure for all flows.
11. Where swales wrap 180-degrees forming parallel channels, freeboard shall be provided between each of the parallel channels. A 1-foot (above ground surface) wall may be used above the treatment area to provide freeboard while enabling a narrower system. As an alternative, a soil-based berm may be used. The berm shall have a minimum top width of 1 foot and 2.5H:1V or flatter side slopes.
12. Where swales are designed with ditch inlets and outlet structures and design of maintenance access to such structures may be difficult due to swale location, swales may be designed as flow-through facilities with unsumped structures. Maintenance access to one end of the facility will still be required.
13 Landscaping plan
   A) Treatment area: 6 herbaceous plants (1-inch plugs or equivalent) per square foot. Plant species selection per Appendix A, LIDA Handbook, or approved alternate; must include 3 or more evergreen species and be suitable for site conditions.
   B) Freeboard area: Low grow seed mix per Standard Detail, Appendix B.

4.09.5 Extended Dry Basin

a. Applications
   1. Water Quality

b. Hydraulic Design Criteria:

   1. Permanent Pool Depth: 0.2 feet
   2. Permanent pool is to cover the entire bottom of the basin.
   3. Minimum Water Quality Detention Volume: 1.0 x Water Quality Volume (WQV)
   4. Water Quality Drawdown Time: 48 hours
   5. Orifice Size:
      USE: $D = 24 * [(Q/ (C[2gH]^{0.5})) / \pi]^{0.5}$
      Where:
      D (in) = diameter of orifice
      Q(cfs) = WQV(cf) /(48*60*60)
      C = 0.62
      H(ft) = 2/3 x temporary detention height to centerline of orifice.
   6. Minimum orifice size: ½-inch diameter, unless a local jurisdiction has an alternate, but the minimum may be no greater than 1-inch.
   7. Maximum Depth of Water Quality Pool (not including Permanent Pool): 5 feet or as limited by issuing jurisdiction.

c. Design Criteria

   1. Provide a stilling basin designed to dissipate outfall energy and spread flows.
   2. Inlet and outlet structures shall be designed to avoid direct flow between structures without receiving treatment (i.e. short circuiting of flow).
   3. Minimum Bottom Width: 4 feet
   4. Side Slopes in Basin Treatment Area: 3H:1V
   5. Minimum Freeboard: 1 foot from the design water surface elevation.
   6. The treatment area shall have coconut matting over 12 inches of amended topsoil or base stabilization method as approved by the District or City. Extend amended topsoil and coconut matting to the top of the slope.
   7. Provide an approved outlet structure for all flows.
   8. The Engineer shall certify that the pond storm sewer design is in compliance with Chapter 5 and that at normal design water surface that the upstream storm sewer will not be in a surcharged condition for longer than 24 hours.
   9. Landscaping plan
      A) Treatment area: 6 herbaceous plants (1-inch plugs or equivalent) per square foot. Plants per Appendix A, LIDA

Handbook, or approved alternate; plant selection must include 3 or more evergreen species.
B) Freeboard area: Low grow seed mix per Standard Detail, Appendix B.

4.09.6 Constructed Water Quality Wetland

a. Applications
   1. Water Quality

b. Hydraulic Design Criteria

   1. Permanent Pool Volume: 0.55 x Water Quality Volume (WQV)
   2. Water Quality Detention Volume: 1.0 x Water Quality Volume (WQV)
   3. Water Quality Drawdown Time: 48 hours
   4. Orifice Size:
      USE: $D = 24 * [(Q/ (C[2gH]^{0.5})) / \pi]^{0.5}$
      Where:
      D (in) = diameter of orifice
      Q(cfs) = WQV(cf) /(48*60*60)
      C = 0.62
      H(ft) = 2/3 x temporary detention height to centerline of orifice.
   5. Minimum orifice size: ½-inch diameter, unless a local jurisdiction has an alternate, but the minimum may be no greater than 1-inch.
   6. Maximum Depth of Permanent Pool: 2.5 feet or as limited by issuing jurisdiction
   7. Maximum velocity through the wetland should average less than 0.01-fps for the water quality flow. Design should distribute flows uniformly across the wetland.
   8. Provide for a basin de-watering system with a 24-hour maximum drawdown time.

c. Design Criteria

   1. Provide a stilling basin designed to dissipate outfall energy and spread flows.
   2. Permanent pool depth to be spatially varied throughout wetland.
   3. Provide a perimeter zone 10 to 20 feet wide, which is inundated during storm events.
   4. Side Slopes for Wetland Planting: 5H:1V or flatter
   5. Side Slopes for Non-Wetland Planting: 3H:1V or flatter
   6. Over-excavate by a minimum of 20 percent to allow for sediment deposition.
   7. Minimum Freeboard: 1 foot from the design water surface elevation.
   8. The treatment area and exposed side slopes shall be stabilized with

coconut matting to the top of the slope.

9. Provide an approved outlet structure for all flows.

4.09.7 Structural Infiltration Planter

a. Applications
   1. Water Quality
   2. Hydromodification
   3. LIDA

b. Hydraulic Design Criteria

   1. Sizing: Simplified Sizing per Section 4.08.4 or Standard Sizing per Section 4.08.5
   2. Maximum Water Design Depth: 0.5 feet.
   3. Minimum Freeboard: 2 inches.

c. Design Criteria

   1. Provide pretreatment when contributing impervious area is greater than 15,000 square feet.
   2. Provide an energy dissipater at the outfall designed to reduce scour.
   3. Minimum Bottom Width: 30 inches regardless of shape.
   4. Minimum Length: to be calculated based on incoming flows.
   5. Maximum Slope: 0.5% in any direction.
   6. Minimum Cross-sectional Depths:
      A) Growing Medium: 18 inches
      B) Choker Course: 3 inches
      C) Drain Rock: 9 inches
   7. Provide an approved outlet (overflow) structure for all flows. Piping to a minimum of the plumbing code or to convey the 25-year storm.
   8. If using the native soil infiltration for sizing, the rate shall be determined by ASTM standard testing methods.
   9. Construction practices must be used to protect the infiltration capacity of native soils, or re-establish native infiltration capacity through soil amendment or mechanical means.
   10. Rain drains and overflow structure to maintain maximum linear separation.
   11. Building jurisdiction approval required for building setback distance and impermeable liners.
   12. Vegetation quantities per 100 square feet:
      A) 115 herbaceous plants, 1 foot on center spacing, ½-gallon container size; or
      B) 100 herbaceous plants, 1 foot on center, and 4 shrubs, 1-gallon container size, 2 feet on center.

4.09.8 Non-Structural Infiltration Planter (Rain Garden)

a. Applications
   1. Water Quality
   2. Hydromodification
   3. LIDA

b. Hydraulic Design Criteria

   1. Sizing: Simplified Sizing per Section 4.08.4 or Standard Sizing per Section 4.08.5
   2. Minimum Freeboard: 6 inches

c. Design Criteria

   1. Provide pretreatment when contributing impervious area is greater than 15,000 square feet.
   2. Minimum length: Facility length to be calculated based on incoming flows and facility width, and on shape of facility
   3. Maximum slope: Planters are designed to evenly distribute and filter flows. Surface longitudinal slopes should be less than 0.5%
   4. Minimum Bottom Width: 30 inches
   5. Maximum Treatment Depth (measured from top of soil medium): 0.5 foot.
   6. Minimum Cross-Sectional Depths:
      A) Growing medium: 18 inches
      B) Choker course: 3 inches
      C) Drain rock: 9 inches
   7. Maximum Side Slopes: 3H:1V
   8. Flow dissipaters should be used if entry slope to the basin is greater than 3:1 or for sheet flow in landscape filter strips. Flow dissipaters shall be constructed out of rock or gravel per design flow velocity at entry of the facility.
   9. Provide an approved outlet (overflow) structure for all flows. Piping to a minimum of the plumbing code or to convey the 25-year storm.
   10. If using the native soil infiltration for sizing, the rate shall be determined by ASTM standard testing methods.
   11. Construction practices must be used to protect the infiltration capacity of native soils, or re-establish native infiltration capacity through soil amendment or mechanical means.
   12. Rain drains and overflow structure to maintain maximum linear separation.
   13. Building jurisdiction approval required for building setback distance and impermeable liners.
   14. Vegetation quantities per 100 square feet:

A) 115 herbaceous plants, evergreen, 1 foot on center spacing, ½-gallon container size; or
B) 100 herbaceous plants, evergreen, 1 foot on center, and 4 shrubs, 1-gallon container size, 2 feet on center.

15. Treatment area shall have coconut matting over the entire surface, or District approved equivalent.

4.09.9 Flow-through Planter

a. Applications
1. Water Quality
2. LIDA

b. Hydraulic Design Criteria

1. Sizing: Simplified LIDA Sizing per Section 4.08.4
2. Minimum Freeboard: 2 inches

c. Design Criteria

1. Provide pretreatment when contributing impervious area is greater than 15,000 square feet.
2. Minimum length: Facility length to be calculated based on incoming flows and facility width.
3. Maximum slope: Planters are designed to evenly distribute and filter flows. Surface longitudinal slopes should be less than 0.5%.
4. Minimum Width: 30 inches
5. Maximum Treatment Depth (measured from top of soil medium): 0.5 feet
6. Minimum Cross-Sectional Depths:
A) Growing medium: 18 inches
B) Choker course: 3 inches
C) Drain rock: 9 inches
7. Provide an energy dissipater at the entrance to the planter. It will be designed to reduce velocities and prevent scour.
8. Provide an approved outlet (overflow) structure for all flows.
9. Rain drains and overflow structure to maintain maximum linear separation.
10. Building jurisdiction approval required for: building setback distance, impermeable liner, structural wall and when depth of the facility is below the building footing.
11. A perforated pipe system under the planter drains water that has filtered through the topsoil to prevent long-term ponding.
12. Vegetation quantities per 100 square feet:
A) 115 herbaceous plants, evergreen, 1 foot on center spacing, ½-gallon container size; or

B) 100 herbaceous plants, evergreen, 1 foot on center, and 4 shrubs, 1-gallon container size, 2 feet on center.

4.09.10 Non-Structural Flow-Through Planter/Rain Garden

a. Applications
   1. Water Quality
   2. LIDA

b. Hydraulic Design Criteria

   1. Sizing: Simplified Sizing per Section 4.08.4
   2. Minimum Freeboard: 6 inches

c. Design Criteria

   1. Provide minimum 18 inch sumped inlet with a minimum 18 inch diameter drain basin for pretreatment.
   2. Minimum length: 15 feet.
   3. Slope: no greater than 6%. Sloped facilities must demonstrate adequate distribution of flow throughout treatment area.
   4. Minimum Bottom Width: 24 inches
   5. Maximum Treatment Depth (measured from top of soil medium): 0.5 feet
   6. Side Slope
      A) With 1 foot shelf: 3H:1V
      B) Without 1 foot shelf: 4H:1V
   7. Minimum Cross-Sectional Depths:
      A) Growing medium: 18 inches
      B) Choker course: 3 inches
      C) Drain rock: 9 inches
   8. Inflow structure to be provided per location jurisdiction and approved District structure types.
   9. Provide an energy dissipater at the entrance to the swale. It will be designed to reduce velocities and spread flow across the treatment cross section.
   10. Provide an approved overflow structure sized to jurisdictional plumbing code or to convey the 25-year storm.
   11. Check dams will be provided for slopes in excess of 5%.
   12. Street-side swales will have a 30 mil impermeable liner, or approved equivalent per jurisdictional road authority, along the street-side.
   13. Vegetation quantities per 100 square feet:
      A) Treatment Area: 115 herbaceous plants, evergreen, 1 foot on center spacing, ½-gallon container size; or 100 herbaceous plants, 1 foot on center, evergreen, and 4 shrubs, 1-gallon container size, 2 feet on center.

B) Vegetation to be used in the swale bottom conforms to plantings approved for the wet moisture regime.
C) Vegetation to be used along the swale side conforms to plantings approved for the moist moisture regimes.

14. Treatment area shall have high density jute or coconut matting over the entire surface or other base stabilization method as approved by the District.

4.09.11 Street-side Planter

a. Applications
1. Water Quality
2. LIDA

b. Hydraulic Design Criteria
1. Sizing: Simplified Sizing per Section 4.08.4
2. Minimum Freeboard: 2 inches

c. Design Criteria

1. Provide minimum 18 inch sumped inlet with a minimum 18 inch diameter drain basin for pretreatment.
2. Minimum length: Facility length to be calculated based on incoming flows and facility width.
3. Maximum slope: Planter shall be flat bottom in all directions to within 1 inch. Check dams shall be placed according to individual project plans per standard detail.
4. Minimum Bottom Width: 30 inches.
5. Minimum Treatment Depth: 4-inch pond depth
6. Maximum Treatment Depth (measured from top of soil medium): 18 inches
7. Minimum Cross-Sectional Depths:
A) Growing medium: 18 inches
B) Choker course: 3 inches
C) Drain rock: 15 inches
8. Inflow structure to be provided per approved District structure types.
9. Provide minimum 6-inch wide splash rock around inlet structure to reduce velocities and spread flow across the treatment cross section.
10. Provide an approved overflow structure sizedper standard detail.
11. Inlet/outlet elevations to allow overflow to drain to street or piped overflow system as applicable.
12. Minimum of 4 feet of 8-inch perforated drain pipe required to direct flows to overflow conveyance.
A) Infiltration facilities: bottom of pipe shall be set at 2 ½ inches above subgrade.

B) Flow through facilities: Bottom of pipe shall be set at the base of the drain rock layer

.

13. Vegetation quantities per 100 square feet: 115 herbaceous plants, evergreen, 1 foot on center spacing, ½-gallon container size; or 100 herbaceous plants, evergreen, 1 foot on center, and 4 shrubs, 1-gallon container size, 2 feet on center.

4.09.12 Landscape Filter Strip

a. Applications
   1. Water Quality
   2. LIDA

b. Hydraulic Design Criteria

   1. Sizing: Simplified Sizing per Section 4.08.4
   2. Flows must be distributed in uniform sheet flow that will not cause channelization or erosion.

c. Design Criteria

   1. Provide pretreatment when contributing impervious area is greater than 15,000 square feet, or when flows are concentrated within conveyance system prior to sheet flow distribution.
   2. Slope: At least 0.5% and no more than 6%
   3. Minimum Width: 5 feet, measured in direction of flow.
   4. Minimum Growing Medium Depth: 18 inches
   5. A Concrete spreader, or gravel trench may be required to disperse the runoff evenly across the filter strip to prevent point of discharge/channelization.
   6. Check dams shall be placed according to the facility design and:
      A) Equal to the width of the filter
      B) Placed every 10 feet where slope exceeds 5%, 2.5 to 3 inches deep.
   7. Collection and conveyance of overflow from filter strip shall be specified on plans to the approved public conveyance system.
   8. Entire filter strip must have 100% coverage by approved native grasses, wildflower blends, ground covers or any combination thereof.
   9. Coconut matting shall cover the growing medium except in check dam and flow spreader locations.

4.09.13 Vegetated Corridor as a Filter Strip

a. Applications
   1. Water Quality
   2. LIDA

b. Hydraulic Design Criteria

   1. Sizing: Simplified Sizing per Section 4.08.4.
   2. Flows must be distributed in uniform sheet flow that will not cause channelization or erosion.

c. Design Criteria

   1. Provide pretreatment when contributing impervious area is greater than 15,000 square feet, or when flows are concentrated within a conveyance system prior to sheet flow distribution.
   2. A Concrete spreader, or gravel trench may be required to disperse the runoff evenly across the vegetated area
   3. Slope: At least 0.5% and no more than 6%
   4. Vegetation: the vegetated corridor shall be enhanced to Good Corridor condition in accordance with Appendix A, Planting Requirements.

4.09.14 Green Roofs

a. Applications
   1. LIDA
   2. Reduction in impervious surface, which results in reduction in sizing for Water Quality, Quantity control for conveyance capacity, and Hydromodification.

b. Sizing: Green Roofs replace conventional impervious roof area at a 1:1 ratio.

c. Design Criteria

   1. Growing Medium: 3-4 inches or more lightweight mix designed for plant growth. Typical components include pumice, perlite, organic fiber, expanded slate, diatomaceous earth, or polymers.
   2. Drainage: collection and conveyance of excess water shall be specified on plans with connection to an approved discharge location.
   3. Slope: 4:12 (3H:1V slope) maximum roof pitch, unless alternate design addresses runoff retention and erosion control
   4. Vegetation: 90% plant coverage, with at least 70% evergreen

species within 2 years of establishment. Typical species include sedum, ice plant, blue fescue, sempervivum and creeping thyme.

5. Structural Design: Site specific evaluation of the facility, saturated weight of all components, waterproof membrane, and root barrier must be complete and is subject to approval by appropriate building department.

4.09.15 Porous Pavement

a. Applications
   1. LIDA
   2. Reduction in impervious surface, results in reduction in sizing for Water Quality, Quantity control for conveyance capacity, and Hydromodification.

b. Sizing: Porous Pavement replaces conventional impervious pavement area at a 1:1 ratio.

c. Design Criteria

   1. Surface Material: Porous asphalt, concrete, or pavers may be used.
   2. Choker Course: place 2" minimum depth layer of clean, crushed ¾" to ¼" drain rock between surface material and aggregate base.
   3. Aggregate Base: Clean, crushed 3/4" to 2" uniformly graded aggregate must be designed to provide a subsurface reservoir for infiltration and detention storage.
   4. Drainage: collection and conveyance of excess water shall be specified on plans with connection to an approved discharge location.
   5. Slope: 20H:1V maximum slope, unless alternate design addresses runoff retention and erosion control.
   6. Subgrade: Avoid compaction of the subgrade and scarify soils to promote infiltration.
   7. Structural Design: Site specific design of the pavement cross-section based on site conditions and loading requirements must be complete and approved by appropriate building or transportation authority.

4.09.16 Stormwater Tree

a. Applications
   1. LIDA
   2. Retention or planting of a Stormwater Tree, which results in reduction of impervious area for the purposes sizing reductions for hydromodification.

b. Sizing

1. Retained Evergreen Tree: at least 6 inch Diameter at Breast Height (DBH), providing an area credit of 20% of the canopy area or a minimum of 100 sq. ft.
2. Planted Evergreen Tree: at least 5 feet tall at planting, providing area credit of 50 sq. ft.
3. Retained Deciduous Tree: at least 6 inch DBH, providing an area credit of 10% of the canopy area or a minimum of 50 sq. ft.
4. Planted Deciduous Tree: at least 1.5 inch DBH, providing area credit of 20 sq. ft.
5. Canopy area shall be measured as the area within the tree drip line. Overlapping canopy areas shall be apportioned between multiple trees to avoid double counting of canopy area.

c. Eligibility Criteria

1. Trees protected and described as Stormwater Tree on approved plans.
2. Trees located in non-buildable tracts.
3. Street trees, as approved by the road authority.

d. Non-eligibility List

1. Trees located within the Sensitive Area or Vegetated Corridor.
2. Trees on individual residential lots.

4.09.17 Structural Soils

a. Applications
1. Hydromodification, if subsurface infiltration is allowable and post-construction infiltration rates are at least 0.2 inches/hour.
2. LIDA.

b. Hydraulic Criteria

1. Sizing: larger of 1) as needed to support any intended vegetation or 2) to manage the 10-year 24-hour storm such that post-development peak flow is less than or equal to pre-development peak flow.
2. Assume porosity: 20%.

c. Design Criteria

1. Structural soil shall be composed of 80% by weight crushed gravel graded to ¾ -1-½: 20% by weight clay loam (>20% clay). Additives to improve water retention properties may substitute for <2% of clay loam. Loam may be used in portions of the structure

that are not load bearing (e.g., to cover tree roots at the surface of a tree well.

2. Provide pretreatment when contributing impervious area is greater than 15,000 square feet.
3. Provide an energy dissipater at the inflow and outfall designed to reduce scour.
4. Minimum Bottom Width: 30 inches.
5. Minimum Length: Facility length to be calculated based on hydraulic criteria and facility width.
6. Minimum Depths:
   A) Supporting trees: 36 inches
   B) Supporting pervious surface: 15 inches
7. Bed and sides of structural soil well to be scarified before placement of structural soils as needed to maintain post-construction infiltration rate of 0.2 in/hr.
8. Provide an approved outlet (overflow) structure for all flows. Piping to a minimum of the plumbing code or to convey the 25-year storm.
9. Building jurisdiction approval required for building setback distance and impermeable liners.

Chapter 5

CONVEYANCE DESIGN

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Chapter 5

CONVEYANCE DESIGN

5.01 General Provisions

a. The provisions of this chapter shall apply to all public conveyance systems within District and City jurisdiction. Interpretations of such provisions and their application in specific circumstances shall be made by the District and City.

b. In addition to these rules, all sanitary sewers shall be designed and constructed to the rules of the Oregon Department of Environmental Quality. Where these rules conflict with the state rules, the state rules shall apply.

c. Any City operating a local program may adopt stricter design specifications within its jurisdiction than the specifications stated in this Chapter.

d. Except as otherwise provided, the extension of the public conveyance systems to serve any parcel or tract of land shall be done by and at the expense of the Property Owner or applicant. The District and City reserve the statutory right to perform the work or cause it to be performed and bill the Owner for the cost or to pursue special assessment proceedings as otherwise provided by District and City ordinance or permit conditions.

e. Except as otherwise provided, the Standard Details shall be followed for all aspects of conveyance design. Variances from the Standard Details shall require approval of the District or City.

5.02 Extension of Public Conveyance Systems

A development requiring connection to the public sewer system shall extend the public sanitary sewer and storm conveyance systems to allow all adjacent uphill and/or upstream parcels to be served by the public systems. The District or City may waive this requirement for sanitary sewer or storm conveyance when one of the following conditions is met:

a. The proposed connection to the public conveyance system is for an existing building.
b. Topography prevents uphill and/or upstream parcels from being effectively served by the required conveyance extension.
c. The uphill and/or upstream parcels are outside the Urban Growth Boundary and, in the District's or City's view, the boundary is not likely to be expanded in the future to include uphill and/or upstream parcels.
d. An analysis is provided demonstrating that the uphill and/or upstream parcels are likely to be served via another routing of the conveyance system and the District or City agrees with this analysis.

When physical extension of the conveyance system is not required for reasons other than topography, the District or City may require an easement for future sanitary sewer or storm conveyance.

5.03 Conveyance Easements

5.03.1 General

a. Public sanitary sewers and storm conveyance facilities, not located within public right-of-way, shall be located within an easement granted to the District or City.

b. The District or City may require that an area 5 feet in all directions from the edge of a manhole, catch basin, cleanout, or field inlet be encompassed in a public right of way or easement granted to the District or City.

c. Access easements shall be provided to manholes, where required by the District or City.

5.03.2 Standard Conveyance Easement Widths

a. Easements for single lines shall be a minimum of 15-feet wide. Easements for multiple lines shall be a minimum of 20-feet wide. The District or City may require wider easements in the following situations:
   1. Large trunk sewers
   2. Sewers greater than 10 feet deep
   3. Areas with topographic constraints such as steep slopes or sites where bore pits may be required in the future.

b. When a pipe will be stubbed, the easement shall extend a minimum of five feet past the end of the stub.

5.03.3 Reduced Conveyance Easement Widths

a. Conveyance easement widths may be reduced to 10-feet for single lines and 15-feet for two lines if all the following conditions are met to the satisfaction of the District or City:
   1. A reduced easement width is needed due to the location of existing buildings that prevent a standard easement width.
   2. Another conveyance route within the development site and public right-of-way is not possible due to topography.

b. When reduced conveyance easements are allowed, all the following additional requirements shall apply to the conveyance system within the reduced easement:
   1. The sewer shall be constructed of ductile iron pipe or, where approved

by the District or City, enclosed within a steel-casing pipe.
2. Manholes shall be located at the points where the conveyance system enters and exits the reduced easement section.
3. The sewer lines shall not be more than 8-feet deep.
4. If feasible, sewer lines shall not be located directly on the property line.

5.03.4 Encroachments

a. Structures constructed within conveyance easements shall require an encroachment agreement with the District or City. Approval of the encroachment is at the discretion of the District or City.

b. The encroachment agreement shall allow the District or City to remove the structure, as needed, to access the conveyance system. Replacement of the structure shall be at the property owner's expense.

c. The District or City may require special protection for the conveyance system in the vicinity of the encroachment.

5.04 Flows

5.04.1 Flow Determination – Sanitary Conveyance

a. Public sanitary sewers shall be sized to carry the ultimate flow for a basin in accordance with the current District adopted master plan and any applicable amendments and updates.

b. When required by the District or City, a report shall be submitted showing design calculations for sizing the proposed sanitary sewer system. The report shall include the information below. The District or City may waive parts of the informational requirements that they deem as unnecessary.

1. Drainage Basin
A reference map showing the drainage basin in which the project is located may be required. The map shall show the major basin that is consistent with the current District adopted master plan and any applicable amendments and updates.

2. Population Density
The population density figures shall be from the most recent information obtained for use by the zoning or planning department of the applicable public agency. If these figures vary from those of the applicable master plan estimates, this difference shall be noted in the design calculations.

3. Flow Variations and Peaking Factor
   Accepted flow design practice shall be employed. The current adopted Master Plan Update, and any applicable amendments and updates, shall be used for approved flow parameters and peaking factor unless more current information particular to the basin in which the project is located is available and this information is approved by the District and City.

4. Infiltration and Inflow
   Infiltration and inflow shall be represented in flow calculations in the design of the sanitary system. The infiltration and inflow figures shall be from the current adopted Master Plan or any applicable amendments or updates.

5. Sewage Flows
   Sewage flows shall be calculated based on the design criteria in this chapter.

5.04.2 Flow Determination – Storm Conveyance

a. Land Use Assumptions for Flow Determination
   25 and 100-year flows for design of conveyance systems shall be based on full build-out of the upstream basin based upon the most recent approved County or City Comprehensive Land Use Plan and realistic estimates of development densities in areas included in recent additions to the Urban Growth Boundary.

b. Computational Methods for Runoff Calculations
   Unless an alternative method is approved by the District or City in writing, calculation of storm runoff used for conveyance design shall be based on one of the following methods with the limitations on use of each listed.

   1. Rational Method
      The rational method is allowed with the following limitations:
      A) Drainage subbasin area cannot exceed 1 acre for a single calculation without approval from District or City.
      B) The time of concentration shall be five minutes when computed to be less than five minutes.
      C) Rainfall intensities shall be from the IDF table included in the Appendix as Standard Drawing 1275.

   2. Santa Barbara Urban Hydrograph (SBUH)
      SBUH methods shall be based on the following information:
      A) The rainfall distribution to be used within the District is the design storm of 24-hour duration based on the standard NRCS Type 1A

rainfall distribution using the chart in Standard Details CA-3.

B) Curve numbers shall be derived from the National Resources Conservation Service's (NRCS) runoff curve numbers contained in Technical Release 55 (TR-55)-Urban Hydrology for Small Watersheds.

C) Soil types shall be derived from the NRCS Soil Survey for Washington County.

3. TR-55

The TR-55 method developed by NRCS when used for runoff calculations shall be based on the following information:

A) A standard NRCS Type 1A storm shall be assumed.

B) Curve numbers shall be derived from the National Resources Conservation Service's (NRCS) runoff curve numbers contained in Technical Release 55 (TR-55)-Urban Hydrology for Small Watersheds.

C) Soil types shall be derived from the NRCS Soil Survey for Washington County.

4. Stormwater Management Model (SWMM)

The SWMM method developed by EPA may be used on medium to large projects for computing runoff volumes for conveyance.

5.05 Storm Conveyance Design Considerations

5.05.1 Design for Full Build Out

Storm drainage facilities shall be designed and constructed to accommodate all future full build-out flows generated from upstream property.

5.05.2 Storm Conveyance Design Criteria

a. Design of the storm conveyance system shall provide a minimum 1 foot freeboard between the hydraulic grade line and the top of the structure or finish grade above pipe for 25-year post development peak rate of runoff.

b. Design surcharge (hydraulic grade line) in pipe systems for the 25-year design storm event shall not cause flooding in portions of a habitable structure, including below floor crawl spaces, or otherwise create a hazard or danger to the health and safety of the public.

c. Flows in streets during the 25-year event shall not run deeper than 4 inches against the curb or extend more than two feet into the motor vehicle travel lane.

d. This overland flow component to accommodate the 100-year event shall

not be allowed to flow through or inundate an existing building.

e. Open channel systems shall be designed for minimum 1 foot freeboard from bank full provided no structures are impacted by the design water surface elevation.

f. A maximum overland distance for sheet flow used in calculations shall be 50 feet.

5.05.3 Upstream Impacts

Modifications to the existing on-site storm drainage facilities shall not restrict flows thereby creating backwater onto off-site property to levels greater than the existing situation, unless approved by the impacted off-site Property Owners and the District or City. When approved, the off-site Property Owner(s) shall agree to and sign a permanent easement legally describing the location of the backwater storage and authorizing the use of their property for stormwater drainage and detention purposes. The easement shall be in a form approved by the District or City.

5.05.4 Downstream Impacts

a. Downstream restrictions that create backwater during the 25-year design storm in the current or post-development condition may be required to be removed by the developer, at the discretion of the District or City.

b. Removal of downstream obstructions shall not be allowed if the removal will cause, contribute, or exacerbate damage from flooding to existing buildings or dwellings in the 100-year design storm.

c. When downstream restrictions are not removed, an on-site detention facility shall be required.

5.05.5 Cross-Lot Drainage

a. Developments shall not materially increase or concentrate runoff onto adjacent properties, except when the runoff is contained in an existing drainage way.

b. Developments shall accommodate existing off-site drainage entering a development site so as to not impact upstream property owners.

5.05.6 Dissipation of Runoff Discharge

Runoff exiting a development site shall be discharged with adequate energy dissipaters to prevent downstream damage.

5.06 Pipe Design

5.06.1 Pipe Size

a. General
   1. Sanitary and storm conveyance systems shall be designed to accommodate flows identified under Section 5.04, with storm design also recognizing the design considerations of Section 5.05.
   2. The Manning's coefficient value ("n") to be used in design shall be 0.013 for pipes.
   3. Sewers of sizes which are obviously larger than necessary for flows, but what are designed oversized to meet grade requirements, are not allowed.
   4. Sewers shall not decrease in size as they move downstream.

b. Sanitary Sewer Minimums
   1. Public sanitary sewers shall be a minimum of 8 inches in diameter unless otherwise approved by the District.
   2. 6-inch sanitary sewers may be approved by the District or City, if the line is no more than 250 feet long and is located at the end of a system with no requirement or anticipated need to be extended.
   3. Side sewers shall have a minimum 4-inch inside diameter.

c. Storm Sewer Minimums
   1. Pipes from catch basins to the main line in the public right-of-way shall be minimum nominal 10-inch diameter.
   2. Main line pipe shall be a minimum nominal 12-inch diameter. Where there is no requirement or anticipated need to extend the pipe for adjacent development, the main line pipe diameter may be nominal 10-inch diameter for the furthest upstream section.
   3. Storm pipes serving area drains and located out of a public street right-of-way with no requirement to be extended shall be a minimum 8-inch diameter.
   4. Side Sewers serving roof drains and foundation drains shall be a minimum 4-inch diameter.

5.06.2 Location

a. Sanitary
   1. Sanitary sewers within a public right of way shall be located within 5 feet of the right of way center line and no closer than 10 feet from the edge of the right of way, unless otherwise approved by the District or City.
   2. Sanitary sewers in easements shall be located no closer than five feet from the easement line, unless otherwise approved by the District or City.

3. The District or City may require maintenance access easements.

b. Storm
   1. Storm sewers within a public right of way for a local street with curbs, shall be located in the street and 5 feet from the curbs, unless otherwise approved by the District or City.
   2. Storm pipes within a public right of way for a collector or arterial may be located behind and parallel to the curb with the approval of the District or City.
   3. Storm pipes in easements shall be located no closer than 5 feet from the easement line, unless otherwise approved by the District or City.

5.06.3 Separation

a. General
   Unless approved by the District or City, the minimum separation distance between parallel sanitary and storm sewers and utilities shall be 5 feet clear. If vertical separation between utilities is greater than 3 feet, additional horizontal spacing may be required to allow for maintenance access.

b. Sanitary Sewer in Vicinity of Water Supplies
   1. No sanitary sewer shall be less than 10 feet from any well, spring, or other source of domestic water supply.
   2. All sanitary sewers which are located within 50 feet from any such source of domestic water supply shall be constructed of ductile iron water pipe with watertight joints, C 900/905 PVC (Polyvinyl Chloride), or other District approved pipe.
   3. Sanitary sewers and domestic water lines shall not be laid in the same trench.
   4. Parallel water and sanitary sewer lines, wherever possible, shall be at least 10 feet apart horizontally when there is less than 18 inches of vertical clearance between water and sanitary sewer. When physical conditions render this spacing impossible or impractical, ductile iron pipe with watertight joints, concrete encasement, C-900/905 PVC, or pipe approved by District shall be required.
   5. Wherever it is necessary for sanitary sewer and water lines to cross each other, the crossing should be at an angle of approximately 90 degrees. The sanitary sewer shall be located 18 inches or more below the water line or be constructed of District approved pipe for a distance of 9 feet on both sides of the water line.

5.06.4 Alignment

Public sanitary and storm sewers shall be laid on a straight alignment and at uniform grade.

5.06.5 Grade

a. Sanitary
Sanitary sewer grades shall meet both the following requirements:
1. Sanitary sewers shall have sufficient slope to maintain a minimum flow velocity of 2.0 feet per second when flowing full or half full.
2. The minimum grades for sanitary sewers shall be those specified in Table 5-1.

TABLE 5-1
SANITARY SEWER MINIMUM GRADES

Inside Pipe Diameter (Inches)	Grade (ft per 100 ft)
6	0.60
8	0.40
10	0.28
12	0.22
15	0.15
18	0.12
21	0.10
24	0.08
27	0.07
30	0.06

b. Storm
Storm sewers shall have sufficient slope to maintain a minimum flow velocity of 2.5 feet per second when flowing full, except that storm sewers in flow-through systems, as defined in subsection 5.07.3(a)(3), shall have a minimum flow velocity of 3.0 feet per second.

5.06.6 Steep Slopes

Sewers on slopes in excess of 20 percent shall be secured with anchor walls or metal pipe slope anchors as shown in Standard Details.

5.06.7 Pipe Cover

a. In paved areas or areas anticipated to receive vehicular traffic, pipe cover shall be measured from the top of the paved surface (finish grade) to the upper exterior surface of the pipe barrel. The pipe bell shall not intrude

into the subbase. In areas without pavement or vehicular traffic, pipe cover shall be measured from finish grade to the upper exterior surface of the pipe barrel.

b. Except as specified in subsection c, minimum cover shall comply with Table 5-2, unless an exception is approved by the District, City, or County.

TABLE 5-2
MINIMUM PIPE COVER

Type of Pipe	Paved Areas (inches)	Unpaved Areas (inches)
Other Approved Pipe	48	36
RCP Class III	30	18
RCP Class IV	24	12
RCP Class V	18	6
AWWA C900	24	12
AWWA C905	24	12
Ductile Iron	18	6

c. Pipe cover for catch basin leads in paved areas can be reduced to 18 inches if AWWA C900 or C905 pipe is used.

5.07 Conveyance Structure Design

5.07.1 Manholes

a. Sanitary and Storm
   1. Manholes shall be provided at least every 500 feet, at every grade change, and at every change in alignment. When pipe slopes are 5% or greater, manholes shall be provided at least every 300 feet.
   2. Manhole lids shall not be in a wheel path of the motor vehicle travel way.
   3. All manholes shall be a minimum of 48 inches in diameter and have a minimum 12 inch ledge in the base.
   4. A detail shall be submitted with the plans where pipes into or out of a manhole are larger than 24 inches or where more than four mainline connections are made.
   5. A minimum of 8 inches of un-perforated wall separating the cut-outs or break-outs for the individual pipe connections shall be provided in manholes.
   6. Where a connection is proposed to an existing manhole, elevation of the existing ledge, location of steps, and elevations of existing inlets and outlets shall be submitted with the plans.

7. Manholes constructed on lines with 12 inch or smaller pipes shall have a minimum 0.2 foot fall through the manhole unless otherwise approved by the District or City.
8. Where different size public conveyance pipes enter a manhole, the crowns of the upstream pipes shall be no lower than the crown on the downstream pipe without District or City approval.
9. A lateral entering a manhole at the end of the public conveyance system shall be designed so that the invert of the lateral is 6 inches above the invert of the outlet pipe.
10. All manhole bases shall be properly channelized.
11. No more than three side laterals or side sewers are allowed to be connected to a manhole unless an exception is approved by the District or City.
12. Manhole lids shall be in conformance with the Standard Details.

b. Sanitary – Additional Requirements:
   1. A manhole shall be located at the upstream end of the pipe except as allowed in Section 5.07.2.
   2. Unless approved by the District or City, manholes shall not be closer than five feet to a curb line.
   3. If the vertical distance from the inlet pipe invert to the lowest pipe invert exceeds 12 inches, an inside drop may be required.

c. Storm – Additional Requirements:
   1. Manhole lids shall have a minimum of 12 inches of clearance from the edge of a curb and gutter.
   2. All piped inside drop manholes with 12-inch or larger pipe shall be a minimum of 60 inches in diameter.
   3. Permanent Clean Outs shall not be allowed in storm sewers. Temporary Clean Outs will be evaluated by the District or City on a case-by-case basis.
   4. Pipes entering manholes may have a maximum free fall of 48 inches as measured to the lowest invert of the manhole base.
   5. A Curb Inlet Manhole or Modified Curb Inlet Manhole per Standard Details may be used in lieu of a manhole, when approved as part of a flow-through system. Standard inlets shall not be allowed in lieu of manholes in any system.

5.07.2 Cleanouts (Sanitary only)

a. Cleanouts shall be allowed only on pipelines where the sewer line has no possibility for future extension and the distance between the cleanout and a manhole is a maximum of 150 feet. The standpipe shall be the same size as the pipeline up to a maximum of 8-inches.

b. Locations of permanent cleanouts shall be approved by the District or City. Permanent cleanouts shall not be installed within a paved street or driveway.

c. Temporary cleanouts may be installed within the right of way at the end of a stub street where the street is expected to be extended in the future and the design of the sewer system does not warrant that a manhole be constructed at this location. The maximum distance of a main line extension without a temporary cleanout is 15 feet. The District or City will make the determination when and where temporary cleanouts are allowed. When the sewer is extended, the temporary cleanout shall be removed.

5.07.3 Catch Basins and Inlets (Storm only)

a. Types of Systems

1. Standard Catch Basin System
All catch basins shall be sumped. The main storm line shall not pass through any catch basins or sumped manholes unless approved by the District. No more than three catch basins may be connected in series before connecting to the main storm line. A ditch inlet or area drain may be connected directly to the end of the main storm line.

2. Series Catch Basin System
Unsumped catch basins located on non-arterial and collector roadways are allowed provided a sumped manhole is constructed below the unsumped catch basins before the flow enters the main storm line. No more than three unsumped catch basins may be constructed above a sumped manhole. The main storm line may not pass through the catch basins or sumped manholes. No ditch inlet or area drain may be part of a series of unsumped catch basins. All catch basins located on arterial or collector roadways that may receive wintertime sanding shall be sumped.

3. Flow-through Catch Basin System
This system is allowed within an arterial or major collector road, provided the main line storm pipe has a design velocity of at least 3.0 feet per second. All catch basins shall be sumped. An adequately sized water quality manhole is required at the downstream end of the flow-through system.

b. Design Considerations

1. All inlets and catch basins shall be designed to accept a 10-year storm event. Grates shall, as far as practical, be designed to avoid failure due to accumulation of debris.

2 Precast and poured in place catch basins, and gutter inlets are allowed.

3. All sumped catch basins shall be constructed with an 18-inch minimum sump.

4. The spacing of catch basins along a street shall be determined by the capacity of each catch basin to pass a 10-year storm event. Where finish street grade is greater than or equal to 5 percent, catch basin spacing shall not exceed 300 feet. Where finish street grade is less than 5 percent, catch basin spacing shall not exceed 400 feet. In addition, catch basins shall be provided just prior to curb returns on streets with a centerline gradient of three percent or more and a street gutter drainage run of 100 feet or more.

5. Catch basins, except for CG-48 manholes shall be a maximum depth of 60 inches from the top of grate to the lowest pipe invert elevation, unless approved by the District or City.

6. The maximum distance for storm sewer connections between catch basins, inlets, and other structures shall be 250 feet.

7. In the case of inlets in streets, the maximum length of sewer between the inlet and a mainline structure shall be 40 feet for 10-inch pipe and 60 feet for 12-inch pipe unless additional length is required to cross the street right-of-way.

8. Tee connections from the main line sewer to catch basins and inlets may only be used in street rights of way if the jurisdiction having authority over the street approves them and the lateral connecting the main line and the catch basin or inlet is no longer than 10 feet.

9. Inlet grates or tops shall be marked with "Dump No Waste" in accordance with the Standard Details.

10. Where design criteria and methodology are not specified in this Chapter, the following publications shall be used:
    A) ODOT Hydraulics Manual
    B) Hydraulic Engineering Circular No. 12 (FHWA-TS-84-202) Drainage of Highway Pavements

5.07.4 Area Drains and Ditch Inlets (Storm only)

a. Area drains in rear or side yards shall not be sumped and shall be properly channelized. Ditch inlets shall be equipped with an 18-inch sump.

b. A main storm line shall not pass through an area drain or ditch inlet.

c. Area drains or ditch inlets may be located at the upper terminus of a main storm line, may connect to the main storm line at a manhole, or may connect to the main storm line through a tee with a lateral no longer than 10 feet.

d. The maximum acceptable intake flow rates for Type II area drains and ditch inlets with a grate angle of 30 degrees are shown in Table 5-3 where H is the Hydraulic Head measured in feet from the bottom of the grate to headwater and Q is the flowrate in cubic feet per second.

TABLE 5-3
MAXIMUM INTAKE FLOW RATES FOR TYPE II AREA DRAINS AND DITCH INLETS WITH GRATE ANGLE OF 30°

H	0.5	1.0	1.5	2.0	2.5	3.0	4.0	5.0	7.0	10.0
Q	2.0	5.6	10.3	11.9	13.3	14.6	16.8	18.8	22.3	26.6

5.07.5 Constructed Channels (Storm only)

a. Application

This section shall apply to open channels constructed to convey runoff to the existing public storm and surface water conveyance system. This section does not apply to design or construction of new roadside ditches or work within existing stream channels.

Development which re-grades existing roadside ditches or constructs new roadside ditches shall meet Washington County Uniform Road Improvement Design Standards and applicable City regulations.

b. Channel Design

1. Open channels shall be designed to prevent scouring of the channel.

2. Vegetation-lined channels shall be used whenever practicable as determined by the District or City. Rock-lined channels shall be used only where a vegetative lining will not provide adequate protection from erosion.

3. Where riprap protection is specified, riprap shall be placed over a

woven geo-textile fabric.

4. Constructed open channels shall be sized to pass the required flows without causing erosion and shall have side slopes no steeper than 2H:1V.

5. No protruding pipes, culverts or other structures, which reduce or hinder the flow characteristics of the channel, will be allowed. Channels connections shall be designed to prevent scouring. All pipe connections shall match side slopes and incorporate a headwall.

6. Open channel designs shall be based on the minimum level or protection shown in Table 5-4.

TABLE 5-4
PROTECTION FOR NEW CHANNEL CONSTRUCTION

Velocity at Design Flow (fps)				
Greater than	Less than or Equal	Required Protection	Thickness (ft)	Min. Ht. above Design Water Surface (ft)
0	5	Vegetation Lining	Not Applicable	0.5
5	8	Bioengineered lining	Not Applicable	1
		ODOT Class 50 Riprap*	1.5	
8	12	ODOT Class 200 Riprap	2.5	2
12	20	Slope Mattress, etc.	Varies	2
20		Engineer designed		

* - The District or City may require ODOT Class 100 Riprap in areas with a likelihood of vandalism.

5.07.6 Culverts (Storm only)

a. Application

1. This section shall apply to culverts placed across streams and drainageways. Culverts pass water under or through obstructions.

2. For culverts with diameters of 36 inches or greater or for driveway culverts which are part of a roadside ditch system, the County or City is the jurisdictional entity and their road design standards shall apply.

3. Culverts within FEMA floodplains shall be reviewed and approved by the local FEMA designated authority.

4. For culverts which convey flows from or through water quality sensitive areas; a local representative of Oregon Department of Fish and Wildlife (ODFW) or other applicable state or federal agency shall be contacted to determine if fish passage is required and to identify site specific design criteria. All culverts shall be designed for fish passage in accordance with ODFW guidance for fish passage unless otherwise exempted by ODFW and the District or City.

b. Hydraulic Design

1. Culverts will be designed to safely pass the 25-year flow.

2. Headwater

A) For new culverts 18 inches in diameter or less, the maximum allowable design storm event headwater elevation (measured from the inlet invert) shall not exceed two times the pipe diameter or three times the pipe diameter with a seepage collar unless an exception is approved by the District or City.

B) For new culverts larger than 18 inches in diameter the maximum allowable design storm event headwater elevation (measured from the inlet invert) shall not exceed 1.5 times the pipe diameter unless an exception is approved by the District or City.

C) The maximum headwater elevation of a design storm event for new culverts shall be at least one-foot lower than the road or parking lot sub-grade.

3. Inlet

For culverts 18 inches in diameter and larger, the embankment around the culvert inlet shall be protected from erosion by lining around inlet with rock or other protection. The lining shall extend upstream from the culvert a minimum of five feet and shall be as high as the designed headwater elevation.

4. Outlets

For culverts 12 inches in diameter and larger, the receiving channel of the outlet shall be protected from erosion by rock lining, bio-engineering, or other District or City approved energy dissipater.

5. Inlet Control Analysis

   The headwater depth for pipes under inlet control shall be determined using the nomographs contained in the Standard Details, ODOT Hydraulics Manual, or a modeling methodology consistent with FHWA's HY8.

6. Outlet Control Analysis

   The headwater depth for pipes under outlet control shall be determined using the nomographs contained in the Standard Details, the ODOT Hydraulics Manual, or a modeling methodology consistent with FHWA's HY8.

5.07.7 Outfalls (Storm only)

a. Outfalls will be designed to prevent scouring at the outfall discharge and provide velocity reduction prior to discharge to the receiving channel.

b. Where riprap protection is specified, riprap protection shall be placed over a woven geo-textile fabric.

c. Outfalls shall be above the mean low water level unless an exception is approved by the District or City.

d. Engineered energy dissipaters, including but not limited to, stilling basins, drop pools, hydraulic jump basins, baffled aprons, and bucket aprons, shall be designed using published references such as Hydraulic Design of Energy Dissipaters for Culverts and Channels published by the Federal Highway Administration of the United States Department of Transportation, the ODOT Hydraulics Manual and others. The design reference shall be cited on the construction plan submittal.

e. All outfalls shall be provided with a rock splash pad or other approved erosion control measure. Rock protection at outfalls shall be designed in accordance with Table 5-5.

TABLE 5-5
ROCK PROTECTION AT OUTFALLS

Discharge Velocity at Design Flow (fps)		Minimum Required Protection Dimensions				
Greater than	Less than or Equal	Type	Thickness (ft)	Width	Length (use greater of)	Height Over Crown
0	5	ODOT Class 50 Riprap*	1.5	Diam. + 6 ft	8 ft. or 4 x diam.	1 ft
5	10	ODOT Class 200 Riprap	2.5	Greater of: Diam. + 6 ft	12 ft. or 4 x diam.	1 ft
10		Engineered Energy Dissipater Required				

* - The District or City may require ODOT Class 100 Riprap in areas with a likelihood of vandalism.

5.07.8 Headwalls (Storm only)

Pipe headwalls or other approved end protection shall be required where pipe material other than concrete or ductile iron is exposed in the design of an outlet or inlet pipe or where required to stabilize slope. Details of all headwalls and end protection shall be included in the construction drawings.

5.07.9 Trash Racks and Debris Barriers (Storm only)

If trash racks or debris barriers are required by the District or City for pipe or culvert systems, the Engineer shall submit the trash-rock-debris barrier system design to the District or City for approval.

5.08 Other Requirements for Public Conveyance Systems

5.08.1 Surveying

The Owner's Engineer or Surveyor shall be responsible for establishing the location of the sanitary and storm sewer system by means of construction stakes offset along the center lines prior to commencement of construction. Moving upstream, there shall be a construction stake placed within 25 feet of each manhole, and at no more than 100-foot intervals along the mainline. Each lateral location shall be staked.

5.08.2 Railroad Crossings

Crossing of railroad rights-of-way shall be done in a manner which conforms to the requirements of the railroad having jurisdiction. If bonds or certificates of insurance protection are required, they shall be furnished by the Contractor or Owner to the railroad company concerned. The District or City shall be named as an additional insured.

Actual permits or easements for such crossings shall be obtained by the Owner and all terms for such permits or easements shall be met by the Owner and Contractor.

5.09 Laterals

5.09.1 General Provisions

a. The specifications contained herein, together with the State of Oregon Uniform Plumbing Code and all other applicable requirements of federal, state, and local law shall govern the installation of laterals.

b. The provisions of District ordinances requiring permits, fees, and other requirements shall be complied with prior to the start of work on any portion of the sanitary or storm pipeline systems.

5.09.2 Planning Considerations

a. Where a parcel requiring connection to a public sanitary sewer or storm conveyance system cannot connect through a lateral meeting the requirements of this section, then extension of the public conveyance system shall be required. This extension of the public system is in addition to the requirements of Section 5.02.

b. Each parcel shall be served by individual laterals for sanitary and storm, except in the following situations:
   1. Duplexes, townhouses, and other buildings that cross property lines may be served by a single storm lateral.
   2. Two adjacent single-family dwellings or two duplexes may be served by a single sanitary or storm lateral where, in the judgment of the District or City, all the following conditions are met:
      A) An existing public street must be trenched to install the lateral(s).
      B) The elevation of the lowest floor with plumbing in the buildings to be served does not differ by more than 1 foot.
      C) The laterals are at least 6 inches in diameter and meet all requirements for public sewer construction as specified in Chapter 8 of these standards.
      D) A cleanout meeting the requirements of Standard Drawing 500 is

installed at the boundary of the right of way line or at a location approved by the District or City.

E) Backflow prevention devices are installed on each sanitary building sewer upstream of the cleanout at the right-of-way or public sewer easement.

5.09.3 Design Considerations

a. Gravity Service

1. Laterals shall provide gravity service to a parcel.
2. Sanitary laterals shall provide gravity service to the main living area of a dwelling or primary use area of a non-dwelling such that a majority of the fixtures units, including those in kitchens, can achieve gravity sanitary sewer service.
3. Grinder pumps shall only be used to serve portions of buildings that cannot be served by gravity, such as daylight basements.
4. Storm laterals shall provide gravity service to the roof drains of buildings on a parcel.
5. The District or City may require the minimum first floor finished floor elevations to be shown on the plans to demonstrate that gravity service can be provided.

b. When allowed by the local Building Official, laterals may cross a single adjoining property if the following criteria are met:

1. The portion of the lateral on the adjoining property has a minimum 3 feet of cover over the pipe and the pipe is ductile iron.
2. The portion of the lateral on the adjoining property contains no bends.
3. The lateral crosses the adjoining property in a private easement that is a minimum of 10 feet wide.
4. A copy of the private easement is provided to the District or City, demonstrating the legal right of the parcel being served to install and maintain a private lateral on the adjoining property.
5. The portion of the lateral crossing the adjoining parcel is less than 100 feet long.
6. The lateral can be used for only one property.
7. The lateral crossing is not one of a number of lateral crossings in a new development designed to avoid constructing a sanitary sewer extension.
8. The Engineer provides justification, to the satisfaction of the District or City, that the crossing is needed.

c. Side sewers shall be less than 50 feet in length. The District or City may approve side sewers in excess of 50 feet in extraordinary circumstances.

d. Side sewers shall connect to the mainline sewer with a 90 degree tee or connect to a manhole at an angle of 60 to 90 degrees from the mainline sewer.

e. Side sewers shall contain no bends.

f. A minimum grade of 2 percent is required for side sewers, unless a lesser grade is approved by the District or City.

g. The use of weepholes in place of storm laterals shall be allowed where all the following conditions are met:
   1. Adequate fall exists so that foundation drains discharge by gravity through the weepholes or other approved discharge point.
   2. Calculations are provided with submitted plans showing pipe slope and cover meet the minimums required by the reviewing authority.
   3. All portions of the lot can be adequately drained so runoff does not cross onto other property.

5.09.4 Installation

a. Material

   Side sewer pipes shall meet the requirements of Section 8.04.2.

b. Excavation and Backfill

   All excavation and backfill for laterals shall comply with Section 7.02.

c. Markings

   1. Laterals shall be marked with a detectable underground magnetic tape. The magnetic tape shall be placed from the main pipeline to the end of the lateral with 18-inches vertical separation between the tape and pipe. The magnetic tape shall be green in color and have the following marking depending on whether it is a sanitary or storm line:

      A) CAUTION SEWER BURIED BELOW

      B) CAUTION STORM DRAIN BURIED BELOW

      A 2 x 4 stake shall be installed at the end of the sanitary or storm lateral extending from the invert of the pipe to 3 feet above the ground surface. The stake shall be marked as whether it is a sanitary or storm lateral. A magnetic tape shall be placed alongside the 2 x 4.

   2. The location of laterals shall be indicated by a permanent marker,

acceptable to the District or City.

A) Where the sewer is in a street with curbs, the marker shall be on the curb.
B) Where the sewer is in a street without curbs, the marker shall be on the sidewalk.
C) Where the sewer is in a street without curbs or sidewalks, the Engineer shall present to the District or City for approval an alternative permanent marking method.
D) A sanitary sewer cleanout located on the private side of the right-of-way boundary is an acceptable permanent marker.

5.09.5 Testing

Sanitary laterals shall be tested in accordance with the requirements of Chapter 8.

5.10 Flood Management Design Standards

5.10.1 Purpose

The purpose of these standards is to reduce the risk of flooding, prevent or reduce the risk to human life and property, and maintain the functions and values of floodplains, such as allowing for the storage and conveyance of stream flows through existing and natural flood conveyance systems.

5.10.2 Flood Management Areas Defined

a. Flood management areas shall include, but are not limited to, the following:

1. Land identified within the 100-year floodplain and floodway as shown on the Federal Emergency Management Agency Flood Insurance maps

2. Land identified in updated flood studies or any other authoritative data documenting flood elevations as approved by the District or City/County

b. Applicants shall use the most recent and technically accurate watershed model information available from the District, or other updated data as approved by the District, to determine flood areas.

c. Notwithstanding any other provisions of these rules, the area within the town center of the City of Tualatin is not subject to the Flood Management Design Standards set out in Section 5.10 of these rules.

5.10.3 Design Criteria

The standards that apply to the flood management areas apply in addition to local, state, and federal restrictions governing floodplains and flood hazard areas.

a. All fill placed in a floodplain shall be balanced with an equal amount of soil material removal and shall not decrease floodplain storage capacity at any stage of a flood (2, 25, or 100-yr event). No net fill in any floodplain is allowed except when all of the following conditions are met:

    1. When an area has received special protection from floodplain improvement projects which either lower the floodplain, or otherwise protect affected properties;

    2. Where the exceptions comply with adopted master plans, watershed management plans, or subbasin plans, if any; and

    3. When all required permits and approvals have been obtained in compliance with FEMA rules and other local, state, and federal laws regarding fill in floodplains.

b. Large areas may not be excavated in order to gain a small amount of fill in a floodplain. Excavation areas shall not exceed the fill areas by more than 50 percent of the square footage, unless approved by the District.

c. Any excavation dug below the winter "low water" elevation shall not count toward compensating for fill since these areas would be full of water in the winter and not available to hold stormwater following a rain. Winter "low water" elevation is defined as the water surface elevation during the winter when it has not rained for at least three days, and the flows resulting from storms have receded. This elevation may be determined from records, studies, or field observation. Any fill placed above the 100-year floodplain will not count towards the fill volume.

d. The excavated area shall be designed to drain if it is an area identified to be dry in the summer, e.g., if it is used for a park or mowed in the summer. Excavated areas identified to remain wet in the summer, such as a constructed wetland, shall be designed not to drain. For areas that are to drain, the lowest elevation shall be at least 6 inches above the winter "low water" elevation, and sloped to drain. One percent slopes will be allowed in areas less than 1,000 square feet.

e. Excavation to balance a fill shall be located on the same parcel as the fill unless it is not reasonable or practicable to do so. In such cases, the excavation shall be in the same drainage basin, within points of

constriction on the conveyance system, if any, as near as practical to the fill site, and shall be constructed as a part of the same development project.

f. Short term parking (motor vehicles remain parked for less than 18 hours per day) in the floodplain may be located at an elevation of no more than one foot below the ten year floodplain so long as the parking facilities do not occur in a Water Quality Sensitive Area or vegetated corridor. Long term parking (motor vehicles remain parked for greater than 18 hours without being moved) in the floodplain may be located at an elevation of no more than one foot below the 100-year floodplain so long as the parking facilities do not occur in a Water Quality Sensitive Area or Vegetated Corridor.

g. Temporary fills permitted during construction shall be removed upon completion of construction prior to the close of the in-stream work window as defined by Oregon Department of Fish and Wildlife or other local, state or federal authority.

h. Excavation and fill required for the construction of detention facilities or other facilities, such as levees, shall be specifically designed to reduce or mitigate flood impacts. Levees shall not be used to create vacant buildable land.

i. Excavation and fill required to restore or enhance floodplains, riparian areas, wetlands, uplands, and streams, including but not limited to the planting of vegetation and daylighting existing storm pipes, shall be permitted as long as the design complies with applicable federal, state and local standards.

j. The floodplain may not be modified to increase water velocities such that stream bank erosion will be increased, unless the stream banks are protected to prevent the increased erosion.

k. Uncontained areas of hazardous materials are prohibited within flood management areas.

l. Existing nonconforming uses are allowed to continue in the flood management area. Existing nonconforming uses may be modified with approval from the District or City/County.

m. Any proposed work within or modification to a floodway shall be certified by an Oregon Registered Professional Engineer as to how it conforms to these standards and all other local, state, and FEMA regulations.

n. For streams, creeks, rivers and other watercourses where the floodway has

not been identified, the entire floodplain shall be treated as a floodway unless a study has been prepared by an Oregon Registered Professional Engineer and approved by the District/City/County to define the floodway limits for a stream section.

Chapter 6

EROSION PREVENTION AND SEDIMENT CONTROL

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Chapter 6

EROSION PREVENTION AND SEDIMENT CONTROL

6.01 General Provisions

a. The requirements of this Chapter shall apply to all activities requiring an Erosion Control Permit. The applicant for the Erosion Control Permit shall be responsible for meeting these requirements.

b. Nothing in this section shall relieve any person of the obligation to comply with the regulations or permits of any federal, state, or local authority.

c. The use of erosion prevention techniques, including proper site planning and construction phasing, shall be emphasized, rather than sediment control measures.

d. These erosion control rules apply to all properties within the CWS boundary, regardless of whether that property is involved in a construction or development activity.

6.02 Erosion Prevention and Sediment Control (EPSC) Standards

6.02.1 Erosion Prohibited

a. Visible or measurable erosion as defined in Chapter 1, which enters, or is likely to enter, the public or private storm and surface water system or other properties, is hereby prohibited, and is a violation of these rules, unless authorized by a State or Federal permit or certification. The owner of the property, permittee under a Site Development Permit, together with any person or persons, including but not limited to the Contractor or the Engineer causing such erosion, shall be held responsible for violation of these rules.

b. Unless authorized by a State or Federal permit or certification, no person shall create physical erosion by dragging, dropping, tracking, or otherwise placing or depositing, or permitting to be deposited, mud, dirt, rock or other such debris upon a public street or into any part of the public storm and surface water system, or any part of a private storm and surface water system which drains or connects to the public storm and surface water system. Any such deposit of material shall be immediately removed using hand labor or mechanical means. No material shall be washed or flushed into any part of the storm and surface water system until all mechanical means to remove the debris have been exhausted and preventative sediment filtration is in place. The owner of the property, permittee, under a Site Development Permit, together with any person or persons, including

but not limited to the Contractor or the Engineer who causes such erosion, shall be held responsible for violation of these rules.

6.02.2 EPSC Plans

An EPSC plan shall be prepared in accordance with the requirements of Chapter 2 for all sites where an Erosion Control Permit is required.

6.02.3 Approved BMPs

The best management practices (BMPs) prescribed in subsection 6.03 are the approved BMPs that shall be used to meet subsection 6.02.1. Use of other BMPs shall require approval from the District or City.

6.02.4 Minimum BMPs

The minimum BMPs required shall include all the Base Measures described in subsection 6.03.2. In addition, for sites requiring an EPSC plan, the additional BMPs described in the EPSC plan shall be required.

6.02.5 Additional BMPs Required

Depending on site-specific conditions, the required base measures may be inadequate to prevent erosion and control sediment discharges. In these cases, additional BMPs shall be applied to the site to meet the requirements of section 6.02.1.

6.02.6 Wet Weather Measures

a. On sites where vegetation and ground cover are removed, vegetative ground cover shall be planted and established by October 1 and continue to function through May 31 of the following year, or as approved by the District. If ground cover is not established by October 1, the open areas shall be protected through May 31 of the following year with straw mulch, erosion blankets, or other methods approved by the District or City.
b. On active sites ground cover is required at the end of each day between October 1 and May 31.

6.02.7 NPDES 1200-CN and 1200-C Permit

In addition to the District or City Erosion Control Permit, a NPDES 1200-CN or 1200-C permit is required for projects disturbing greater than one acre.

6.02.8 Maintenance and Removal of BMPs

a. The permittee shall maintain the BMPs contained in the approved EPSC

plan to continue to be effective during the construction phase, post construction phase, establishment of permanent vegetation, or any other permitted activity. If the BMPs approved in an EPSC plan are not effective or sufficient as determined by the District or City site inspection, the permittee shall submit a revised plan within three working days of written notification by the District or City. Upon approval of the revised plan by the District or City, the permittee shall immediately implement the additional BMPs included in the revised plan. In cases where erosion is likely to occur, the District or City may require the applicant to install interim control measures prior to submittal and/or approval of the revised EPSC plan.

b. Temporary BMPs, such as sediment fences, shall be removed after permanent vegetation is established.

6.02.9 Removal of Sediment

When erosion occurs and sediment is deposited in locations where it can enter the storm and surface water system, the sediment shall be immediately removed using hand labor or mechanical means. No material shall be washed or flushed into any part of the storm and surface water system until all mechanical means to remove the debris have been exhausted and preventative sediment filtration, e.g., inlet protection, is in place.

6.02.10 Contaminated Soils

In the event the construction process reveals soils contaminated with hazardous materials or chemicals, the Contractor shall stop work immediately, ensure no contaminated material is hauled from the site, remove the Contractor's work force from the immediate area of the contaminated area, leaving all machinery and equipment, and secure the area from access by the public until such time as a response team has relieved them of that responsibility. The Contractor shall immediately notify an emergency response team, the District or City, and Department of Environmental Quality of the situation.

6.02.11 Other Requirements

a. To the degree practicable, existing vegetation shall be protected and left in place, in accordance with the clearing limits on the approved EPSC plan.

b. Trees shall not be used as anchors for stabilizing working equipment.

6.03 Best Management Practices

6.03.1 General

This section provides a list of approved BMPs. Each BMP shall be implemented consistent with additional information in the Standard Details.

6.03.2 Base Measures

The following BMPs, as described in Table 6-3, shall be implemented on all sites requiring an Erosion Control Permit:

a. Gravel Construction Entrance/Exit

b. Linear Barrier or Perimeter Control

c. Storm Drain Inlet Protection

6.03.3 Erosion Prevention BMPs

Erosion prevention is the highest priority in the overall EPSC plan and shall be integrated into a project throughout the planning, design, scheduling, and construction phases. Erosion prevention BMPs shall be included in the approved EPSC plan. Table 6-1 is a list of approved erosion prevention BMPs.

TABLE 6-1
EROSION PREVENTION BMPs

BMP	Std. Detail	Description
Preserve Natural Vegetation		Maintain existing vegetation or place vegetative buffer strips. This BMP is especially effective for sites with sensitive resources like wetlands, stream corridors, lakes, and steep slopes.
Buffer Zone		An undisturbed area or strip of natural vegetation or an established suitable planting adjacent to a disturbed area that reduces erosion and runoff. A Vegetated Corridor shall not be used or considered a buffer zone under this chapter.
Temporary and Permanent Seeding		Vegetative cover established on disturbed areas to reduce erosion by seeding (applied by hand or hydroseeding) with appropriate and rapidly growing grasses. Permanent seeding can be used in conjunction with erosion control blankets and mats to provide both temporary and permanent erosion prevention control.
Ground Cover		A protective layer of straw or other suitable material applied to the soil surface. Various ground cover methods include straw mulch and compost blankets.
Hydraulic Application		A mechanical method of applying erosion control materials, other than simply hydro-seeding, to bare soil. This BMP is often called Bonded Fiber Matrix (BFM). BFM can be used without seed in upland areas to stabilize and prevent erosion. This BMP cannot be used in areas of concentrated flow or water quality facilities. This BMP may be used in place of straw, mulch, compost, or matting depending on site and weather conditions.
Sod		Permanent or temporary turf for immediate erosion protection and stabilization.
Matting	800 805	A class of products that includes manufactured mulch materials that are produced in a roll configuration that is placed on the ground and held in place by stakes, metal staples, geotextile pins, or other fastening system. Matting shall be 100% biodegradable fibers, or approved equal. Refer to the Floodplain, Wetland and Stream Construction Strategies Handbook for a comparison of matting types for work in sensitive areas.

BMP	Std. Detail	Description
Soil Binders		Materials that are applied to the soil surface for dust control and temporary erosion control. These are also known as hydraulic soil stabilizers.
Stockpile Management	810	Methods to reduce or eliminate loss of sediment from temporary stockpiles of soil.
Dust Control		Water applied over susceptible areas, typically due to dry soil conditions, during high wind periods. (Also see section 6.03.6).

6.03.4 Runoff Control BMPs

The purpose of runoff control BMPs is to control stormwater runoff and drainage patterns at construction sites. Runoff control BMPs shall be included in the EPSC plan. Table 6-2 is a list of approved runoff control BMPs.

TABLE 6-2
RUNOFF CONTROL BMPs FOR ALL SITES

BMP	Std. Detail	Description
Pipe Slope Drain	815	The pipe slope drain carries concentrated runoff down steep slopes without causing gullies, erosion, or saturation of slide-prone soils. It should be designed to intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device, or stabilized area.
Outlet Protection	820 825	Outlet protections are physical structures that reduce the velocity and energy of concentrated flow to prevent scour at conveyance outlets. Outlet protection includes riprap-lined basins, concrete aprons, and stilling basins.
Surface Roughening	830 835	Soil surface is roughened by mechanical methods. All slopes prepared by surface roughening shall meet engineering compaction requirements. This BMP is intended to only affect the surface of soils and is not intended to compromise slope stability or overall compaction.
Check Dams	840 845	Small, temporary dams placed across a natural or man-made channel or drainage ditch and designed to reduce drainage ditch erosion caused by stormwater runoff by reducing the velocity of flow in the ditch. Check dams are often used as a temporary measure while a channel is being permanently lined with vegetation or other materials to prevent erosion.
Diversion Swale or Dike	850	A ridge of compacted soil or a vegetated lined swale located at the top, base or somewhere along a sloping disturbed area.

6.03.5 Sediment Control BMPs

a. Sediment control BMPs include any practice that traps soil particles after they are dislodged and moved by wind, water, or mechanical means. These BMPs are usually passive systems that rely on filtering or settling particles out of the water or wind once they have become suspended. Soil that accumulates in or near sediment control BMPs is a waste product that must be removed and disposed of at an approved location. Uncontaminated sediment/soil can be placed back on site and protected with appropriate erosion control BMPs.

b. Sediment control BMPs are considered the last line of defense before stormwater runoff leaves a site and are not to be used as the primary methods for erosion prevention and sediment control.

c. These BMPs are to be applied prior to and during earthwork.

d. Sediment control BMPs shall be included in the approved EPSC plan.

e. The perimeter sediment barrier identified in Table 6-3 is not required where:

    1. Flows are collected through the use of temporary or permanent grading or other means such that the flows are routed to an approved settling pond, filtering system, or sediment control BMP.

    2. There are no concentrated flows, slopes are less than 10 percent, and runoff passes through a grass area which is either owned by the applicant or such use is allowed, through written agreement, by the Owner of the grass area. The grass area shall be at least equal in dimensions to the project area. The grass area shall not be located in a Vegetated Corridor or Sensitive Area.

    3. The surface is protected by re-established permanent vegetation.

f. Table 6-3 is a list of approved sediment control BMPs.

TABLE 6-3
SEDIMENT CONTROL BMPs

BMP	Std. Detail	Description
Gravel Construction Entrance/Exit *	855	Gravel construction entrances/exits shall be required at each entrance/exit to and from the site. If a property contains or is adjacent to a stream, watercourse, stormwater facility, wetlands or other water quality sensitive area, BMPs in addition to a gravel construction entrance/exit shall be required to prevent physical erosion into the water quality sensitive area.
Tire Wash Facility	865 870	The wheel wash, which shall be incorporated with a stabilized construction entrance, shall be designed and constructed for anticipated traffic loads.
Linear Barrier or Perimeter Control *	875 880	Linear barrier shall be installed around the down-gradient perimeter of the site to control sheet flow from the site. Sediment fence shall not be placed in areas of concentrated flow or across stream channels.
Wattles	880 885	Wattles are small, cylindrical barriers composed of biodegradable fibers encased in photodegradable open-weave netting. Wattles are placed in shallow trenches and staked along the contour of newly constructed or disturbed slopes.
Storm Drain Inlet Protection *	900-925	Temporary inlet protection shall be provided for all active inlets for the duration of construction to keep sediment, trash, and other construction-related pollutants out of the storm drain system.
Rock or Compost Berm	890	Rock or compost filter berms are temporary barriers composed of compost or rock. These are designed for sheet flow, not concentrated flow, and shall not be placed across a stream or channel.
Sidewalk Subgrade Gravel Barrier	895	Undercut lots or sidewalk subgrades with rock base are linear drainage barriers that provide an effective sediment filtration and retention area behind the curb. If weep holes exist, they must be plugged when using this BMP.
Dewatering		Separation of sediment and water achieved through filtration, either by gravity or with pressure.
Sediment Trap	930	A sediment trap consists of a small, temporary ponding area with a rock weir or approved alternate BMP at the outlet. This BMP shall not be used for a drainage basin greater than 5 acres.

BMP	Std. Detail	Description
Sediment Basin	935	A temporary sediment basin has one or more inflow points and baffles to spread the flow for wet and dry storage. The outlet shall be a floating skimmer or approved alternate BMP. The sediment basin is effective for about one year with a drainage area less than 10 acres.
Turbidity Curtains		A turbidity curtain is a pre-manufactured floating geotextile structure which minimizes turbidity transport from a disturbed area adjacent to or within a body of water. This BMP can be used to minimize the mixing of turbid water with adjacent clean water and/or contain soil particles during construction and/or repair activities.
Sediment Entrapment Mats		This BMP is a flat layered pad that provides filtration and settling of sediment. This BMP may be incorporated into the permanent stabilization/re-vegetation process if used in conjunction with mulch and/or seed.

* - These measures are minimum requirements for all projects per Section 6.03.2.

6.03.6 Dust Control BMPs

Dust shall be minimized to the extent practicable, utilizing all measures necessary, including, but not limited to the following BMPs.

a. Sprinkling haul and access roads and other exposed dust producing areas with water.

b. Application of dust palliatives on access and haul roads as approved by the District.

c. Establishing temporary vegetative cover.

d. Placing wood chips or other effective mulches on vehicle and pedestrian use areas.

e. Maintaining the proper moisture condition on all fill surfaces.

f. Pre-wetting cut and borrow area surfaces.

g. Use of covered haul equipment.

6.03.7 Non-Stormwater Pollution Control BMPs

a. For the purposes of this section, non-stormwater pollution includes, but is not limited to, concrete truck wastewater, paint, fuel, hydraulic fluid, solvents, glues, and other waste materials characteristic of construction sites. Non-stormwater pollutants are prohibited from entering a public or private street or storm system or surface waters.

b. Non-stormwater pollution controls consist of general site and materials management measures that directly or indirectly aid in minimizing the discharge of sediment and other construction related pollutants from the construction site.

c. Approved non-stormwater pollution control BMPs include:

1. Concrete truck washout areas

2. Written spill prevention and response procedures

3. Employee training on spill prevention and proper disposal procedures

4. Protected areas for equipment storage and maintenance where the risk of pollution is minimal

6.03.8 Supplemental Plan Requirements

a. Mass Grading and Runoff Control

A phased mass grading and runoff control plan is required for projects where clearing and mass grading activities are proposed during the wet weather period defined in Section 6.02.6. The runoff control plan shall identify BMPs from Chapter 6 Table 6-2, or approved alternatives, and be submitted with, or as a revision to, the EPSC plan. All BMPs specified on the runoff control plan shall be in place and functional prior to commencement of mass grading.

b. Dewatering

A dewatering plan is required for projects with anticipated excavation activities at or below the ground water table, or if ground water is encountered during construction. The supplemental plan shall be submitted with, or as a revision to, the EPSC plan and shall identify how dewatering discharges will be managed.

c. Cement Treatment

A cement treatment plan is required for projects where cement treatment is proposed as a soil amendment. The supplemental plan shall indicate an application rate, work schedule, and limits of work areas proposed for cement treatment. If cement treatment will occur during the wet weather period, the following conditions will also apply:

1. The project shall be phased in small manageable areas to minimize the risk for erosion.

2. Contractor shall have sufficient erosion prevention BMPs on site to cover all exposed soil.

3. Each phase must be stabilized with temporary or permanent erosion prevention BMPs before disturbing additional phases.

4. The plan shall indicate how runoff from areas treated with cement will not cause or accelerate erosion of soils not treated with cement.

5. If visible or measureable erosion is occurring, all cement treatment activities shall be suspended and approved erosion prevention BMPs shall be applied to all exposed soil.

d. Chitosan Treatment Systems

A chitosan treatment plan is required where chitosan is proposed as a BMP. The supplemental plan must include a statement of the intent to use chitosan, the reason for its use and the name, experience and training of the qualified operator who will be monitoring the use of chitosan. Additional requirements are dependent on the form of chitosan proposed, as detailed below:

1. Chitosan acetate
   If chitosan acetate is proposed, the system must be a Chitosan Enhanced Sand Filtration system. The supplemental plan must demonstrate that the system is consistent with the protocol outlined in Washington Department of Ecology's General Use Level Designation for Chitosan Enhanced Sand Filtration (CESF).

2. Chitosan lactate (cartridge)
   If chitosan lactate is proposed, the system shall be designed by a registered Professional Engineer to meet site specific conditions and comply with the manufacturer's recommendations. A supplemental plan must include the following:

   A) Location and design schematic of treatment system, location of inlet and location of discharge and dispersion device design.

   B) Method for ensuring filtration or settlement of treated stormwater to comply with the following discharge standards:
      i. Residual chitosan must not exceed 1 mg/L,
      ii. Turbidity must not exceed DEQ's Water Quality Standard
      iii. pH must remain within a range of 6.5-8.5

   C) Installation protocol, including at minimum:
      i. Qualified operator inspection and certification of consistency with the design, prior to system operation and use.

   D) Testing and monitoring protocol, including at minimum:
      i. Qualified operator must field test discharge using a Residual Chitosan Lactate Field Screening Test Kit, or District approved equal.
      ii. Field tests shall be performed during the first discharge of treated water and weekly thereafter for as long as chitosan is being used.
      iii. Response protocol, if field testing demonstrates exceedance of discharge standards, including immediate notification to the District or City, modification to the treatment system, and implementation of additional erosion control BMPs.

E) Notification protocol to the District or City, if any modifications to the treatment system are made.

F) Maintenance protocol of treatment system.

6.04 Inspection

6.04.1 Pre-Construction Conference

a. Prior to the initial EPSC inspection, the District or City may require, or the permittee, Owner or Contractor may request, a pre-construction conference to review and discuss the EPSC plan for the site.

b. A pre-construction conference shall be required when the risk of erosion is high due to one or more of the following factors:

1. Wet weather construction

2. Steep slopes with severe erosion potential

3. Construction adjacent to a sensitive area or vegetated corridor

4. Mass grading on a large site

6.04.2 District or City Initial EPSC Inspection

a. On all projects, except single family home construction sites, erosion prevention and sediment control base measures shall be installed by the permittee and then inspected and approved by the District or City inspector prior to the start of any permitted activity.

b. For single-family home construction sites, erosion prevention and sediment control measures for each property shall be installed by the permittee and then inspected and approved by the District or City inspector prior to the building foundation installation. Foundation approvals shall not be given until erosion prevention and sediment control measures are approved.

6.04.3 Permittee Inspections

The permittee or owner's authorized agent shall provide ongoing inspection of the site in accordance with approved plans to ensure compliance with the standards specified in Chapter 6. If the permittee or representative determines the BMPs approved in the EPSC plan are not effective or sufficient to ensure compliance, additional BMPs must be implemented and identified in a revised

plan.

6.04.4 Final Inspection

a. A final erosion control inspection shall be required on all sites prior to the sale or conveyance to a new Property Owner(s) or prior to the removal of EPSC measures.

b. Unless otherwise approved, sites seeking final erosion control inspection require approved ground cover or established permanent vegetation before the site can be deemed complete. A waiver to this requirement may be requested, and will be evaluated based on the timing of construction activities, and topography, soils, and other site conditions.

Chapter 7

GENERAL CONSTRUCTION SPECIFICATIONS FOR CONVEYANCE SYSTEMS

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Chapter 7

GENERAL CONSTRUCTION SPECIFICATIONS FOR CONVEYANCE SYSTEMS

7.01 General Provisions

The specifications contained in this Chapter, together with Oregon Department of Environmental Quality and U.S. Environmental Protection Agency standards and any other applicable requirements of the District and City, shall govern the character and quality of material, equipment, installation and construction procedures for gravity flow portions of public sanitary sewer and storm systems. Each city or county which operates a Local Program may adopt regulations stricter than specified in this Chapter for their Local Program.

7.01.1 Scheduling

a. Sequence of Operations
The Contractor shall plan and execute construction work to cause a minimum of interference to the operation of existing District and City facilities. It may be necessary to do certain parts of the construction work outside normal working hours in order to avoid undesirable conditions, and it shall be the obligation of the Contractor to make this change to the work schedule. This scheduling, however, is subject to the District or City approval, and does not relieve the Contractor from making its work available for inspection.

Connections between existing work and new work shall not be made until necessary inspections and tests have been completed on the new work and it is found to conform in all respects to the requirements of the plans and specifications, unless otherwise approved by the District or City.

b. Progress of Construction
Construction shall proceed in a systematic manner that will result in minimum inconvenience to the public. Construction staking for the work being performed shall be completed prior to the start of excavation. The Contractor shall limit its operations to a small length of work area per crew. At no time shall the trenching equipment be farther than 300 feet ahead of the pipe laying crews, unless advance written permission is given by the District or City. The trench shall be backfilled so that no section of trench is left open longer than 24 hours. Trenches located in a right-of-way shall be completely backfilled before the Contractor leaves the site for the day unless the trench is adequately secured with steel plates.

Cleanup of all construction debris, excess excavation, excess materials, and complete restoration of all fences, mail boxes, ditches, culverts, signposts, and similar items shall be completed immediately following the

final backfilling of the trench.

Any area disturbed by the Contractor's operations inside dedicated easements shall be restored to its original condition. Any area that is disturbed by the Contractor's operations outside the dedicated easement shall be restored to the Property Owner's satisfaction.

7.01.2 Preservation, Restoration, and Cleanup

a. Site Restoration and Cleanup
The Contractor shall keep the premises clean and orderly at all times during the work and leave the project free of rubbish or excess materials of any kind upon completion of the work. During construction, the Contractor shall stockpile the excavated trench materials so as to do the least damage to adjacent lawns, grassed areas, gardens, shrubbery, trees, or fences, regardless of the ownership of these areas. All excavated materials shall be removed from these areas, and these surfaces shall be left in a condition equivalent to their original condition and free from rock, gravel, boulders, or other foreign material. The Contractor shall replace topsoil areas over all trenches with a minimum finished depth of 12 inches of topsoil. All existing drainage ditches and culverts shall be reopened and graded, and original drainage restored. All damaged irrigation and house drainage pipe, drain tiles, sanitary sewer or storm laterals, and culverts shall be repaired expeditiously. The finished surface shall conform to the original surface and shall be free-draining, free from holes, rough spots, or other surface features detrimental to a seeded area.

b. Preservation of Irrigation and Drainage Ditches
Following the backfill of the trenches, the Contractor shall restore all public and private irrigation and storm drain ditches that have been destroyed, damaged, or otherwise modified during construction to the condition equal to or better than the condition of the ditch before construction, and as approved by the District or City. Ditches shall be built in their original locations unless otherwise redesigned as part of the project.

c. Stream and Creek Crossings
The Contractor shall comply with all provisions of the permits required by the Oregon Division of State Lands, the U.S. Army Corps of Engineers, Washington County, the District and any other agencies having jurisdiction.

7.01.3 Interferences and Obstructions

a. General
Various obstructions may be encountered during the course of the work.

Maps and information regarding underground utilities shall be obtained from the utility owning and operating such utilities, but the location of such utilities is not guaranteed. A minimum of 48 hours notice shall be given to all utility offices that may be affected by the construction operation. The contractor shall comply with the Oregon "locate law" ORS 757.557. If services of any utility are interrupted due to the construction operation, the proper authority shall be notified immediately.

b. Protection
The Contractor shall exercise all due care in protecting property along the route of the improvement. This protection shall include, but not be limited to, trees, yard, fences, drainage lines, mail boxes, driveways, shrubs and lawns. If any of the above has been disturbed, they shall be restored to as near their original condition as possible.

7.01.4 Permanent Survey Monuments

The Contractor shall not disturb permanent survey monuments, property corners, stakes or benchmarks without prior written consent of the appropriate county surveyor. It shall be the responsibility of the Contractor to protect such survey markers. Survey markers which are disturbed or lost shall be replaced by a registered land surveyor. When a change is made in the finished elevation of the pavement, or any roadway in which a permanent survey monument is located, the monument cover shall be adjusted to the new grade.

7.02 Trench Excavation and Backfill

7.02.1 Definitions

a. Trench Excavation
Trench excavation is the removal of all material encountered in the trench to the depths shown on the plans or as directed by the District or City.

b. Trench Foundation
The bottom of the trench on which the pipe bedding is to lie. The trench foundation provides the support for the pipe.

c. Pipe Bedding
The furnishing and placing of specified materials on the trench foundation to uniformly support the barrel of the pipe from the trench foundation to the springline of the pipe.

d. Pipe Zone
The full width of the trench from six inches above the top outside surface of the barrel of the pipe to the springline of the pipe.

e. Spring Line
Halfway up the sides of the pipe when it has been laid on the pipe bedding.

f. Trench Backfill
The furnishing, placing, and compacting of material in the trench between the top of the pipe zone material and the bottom of the pavement base rock, ground surface, or surface materials as directed.

g. Native Material
Earth, gravel, rock, or other common material free from humus, organic matter, vegetative matter, frozen material, clods, sticks, and debris, isolated points or areas, or larger stones which would cause fracture or denting of the structure or subject it to undue stress.

7.02.2 Materials

a. Trench Foundation
Trench foundation shall be native material in all areas except where ground water or other conditions exist and, in the opinion of the Engineer, the native material is such that it cannot support the bedding and pipe. In those conditions, geotextile fabrics approved by the District or City shall be installed or the unsuitable material shall be removed as required and the trench backfilled with approved crushed aggregate.

b. Pipe Bedding
Pipe bedding material shall be clean crushed rock with a maximum size of 3/4 inch, uniformly graded from coarse to fine or as approved by District or City.

c. Pipe Zone
The pipe zone material shall consist of approved bedding material except when using reinforced concrete pipe, ductile iron pipe or C 900 pipe, where native material, i.e. earth, gravel, rock, or combination thereof may be used. All pipe zone materials shall be subject to the District or City approval.

d. Trench Backfill
Above the pipe zone will be divided into the following classifications:

1. Class A Backfill. Class A backfill shall be native or common material, which in the opinion of the Engineer meets the desired characteristics required for the specific surface loading.
2. Class B Backfill. Class B backfill shall be clean crushed rock with a maximum size of 3/4 inch, uniformly graded from coarse to fine or as approved by District or City.

e. Geotextile Fabric
The geotextile fabric used in trench stabilization shall be lightweight, nonwoven filter fabric, such as Mirafi 140N or equal, for unstable soil conditions. High strength woven filter fabric (Mirafi 600x or equal) may be used for highly unstable soil conditions. The Engineer shall select the appropriate fabric based on the soil conditions.

7.02.3 Construction

a. Excavation

1. Clearing the Right-of-Way
Clearing shall be completed prior to the start of trenching. Brush shall be cut as near to the surface of the ground as practicable and removed to a disposal site approved by the District or City. The Contractor shall observe all federal, state, and local laws relating to fire permits, burning materials and other requirements. Under no condition shall brush be covered by excavated materials prior to being cleared and removed.

Excavated material shall be placed at locations and in such a manner that it does not create a hazard to pedestrian or vehicular traffic, nor interfere with the function of existing drainage facilities.

2. Open Trench Limit
The length of the open trench shall always be kept to a minimum. The District or City shall determine the amount of open trench allowed based upon work conditions of the area. In normal cases, the open trench length shall not exceed 300 feet. Related trench construction such as pavement, road gravel, concrete restoration, etc., shall be completed within 800 feet of the open trench limit unless otherwise authorized.

3. Trench Width
The trench width at the surface of the ground shall be kept to a minimum necessary to install the pipe in a safe manner. In all cases, trenches shall be of sufficient width to allow for shoring, proper joining of the pipe, and backfilling of material along the sides of the pipe. The minimum trench width in the pipe zone shall provide a clear working space of six inches outside the maximum outside diameter of the pipe.

No maximum width of trench at the top of the pipe is specified in this Chapter. When required by design, the maximum trench width shall be shown on the plans. If the maximum width shown is exceeded by

the Contractor without written authorization, the Contractor will be required to provide pipe of a higher strength designation, a higher class of bedding, or both, as approved by the District or City. Excavation for manholes and other structures shall be wide enough to provide a minimum of 12-inches between the structure's surface and the sides of the excavation.

b. Installation

1. Shoring
The Contractor shall provide all materials, labor, and equipment necessary to adequately shore trenches to protect the work, existing property, utilities, pavement, etc., and to provide safe working conditions in compliance with all OSHA requirements. That portion of cribbing or sheeting extending below the springline of rigid pipe or below the crown elevation of flexible pipe shall be left in place unless satisfactory means of consolidating bedding or side support, disturbed by cribbing or sheeting removal, can be demonstrated. If a movable box is used in lieu of cribbing or sheeting and the bottom cannot be kept above the springline of the crown elevation of flexible pipe, the bedding or side support shall be carefully reconsolidated behind the movable box prior to placing backfill. The use of horizontal strutting below the barrel of pipe or the use of pipe as support for trench bracing will not be permitted.

2. Dewatering
The Contractor shall provide and maintain ample means and devices with which to promptly remove and dispose of all water entering the excavation during the time the trench is being prepared for the pipe, during the laying of the pipe, and until the backfill at the pipe zone has been completed. Groundwater shall be controlled such that softening of the bottom of excavations or formation of "quick" conditions or "boils" during excavation shall be prevented. Dewatering systems shall be designed to prevent removal of the natural soils, and maintained in such a manner that the groundwater level outside the excavation is not reduced to the extent that adjacent structures or property would be damaged or endangered.

3. Trench Foundation
When, in the judgment of the Engineer, the existing material in the bottom of the trench is unsuitable for supporting the pipe, the Contractor shall install geotextile fabrics or excavate below the pipe, as directed. The Contractor shall place trench foundation material to the bottom of the pipe bedding. The trench foundation material shall be placed over the full width of the trench and compacted in layers not exceeding six inches deep to the required grade.

4. Pipe Bedding
   Pipe bedding consists of leveling the bottom of the trench on the top of the foundation material and placing bedding material to the horizontal centerline of the pipe, unless otherwise specified. The Contractor shall spread the bedding smoothly to the proper grade so that the pipe is uniformly supported along the barrel, and excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Bedding under the pipe shall provide a firm, unyielding support along the entire pipe length. Particular attention shall be given to the area from the flow line to the horizontal centerline of the pipe or top of bedding to ensure that firm support is obtained to prevent any lateral movement of the pipe during the final backfilling of the pipe zone. Pipe bedding shall be placed the full width of the trench.

5. Grade
   The Contractor shall follow Standard Detail 590. The subgrade upon which the bedding is to be placed shall be firm, undisturbed, and true to grade. If the trench is over-excavated, the Contractor shall restore to grade with material of the type specified for pipe bedding and place the material over the full width of the trench.

6. Backfill
   Backfill shall not be placed in the trench in such a way as to permit free-fall of the material until a minimum of two feet of cover is provided over the top of the pipe. Under no circumstances shall the Contractor allow sharp, heavy materials to drop directly onto the pipe or pipe zone material around the pipe. If the required compaction density has not been obtained, the Contractor shall remove the backfill from the trench and recompact. This process shall be repeated until the Contractor has established a procedure that will provide the required field density. The Contractor will then be permitted to proceed with backfilling and compact the remainder of the pipeline under the approved procedure.

   With approval of the District or City, the Contractor may substitute water settling as an alternate compaction method. Water settling shall be done only with approved jetting equipment and methods. Water settlement shall not relieve the Contractor of the responsibility for compaction of trench backfill as specified in this Chapter for standard compaction methods. The location and extent of trench water settling will be determined by the Engineer. The Contractor shall backfill the trench as specified to a point level with or slightly above the required grade to allow for settlement. After all structures are completed and all subsurface utilities have been restored to their original condition, the Contractor shall place water in the trench section in such quantities

and in such a manner that all portions of the backfill for the entire trench depth become saturated. The Contractor shall determine the procedures and provide the quantity of water required in every case to effect complete water settlement of the backfilled materials. Under no circumstances will the jetting pipe be inserted closer than two feet above the top of the pipeline. Any subsequent settlement of the trench during the warranty period shall be considered to be the result of improper water settlement or compaction and shall be promptly corrected.

The granular backfill within three feet of finished grade shall be compacted to not less than 95 percent relative compaction as determined by Method A of AASHTO T99. Backfill more than three feet from finished grade shall be compacted to not less than 90 percent relative compaction. Tests to determine compliance with the compaction requirements shall be provided as required by the District or City.

7. Impervious Zone
When installing sanitary sewers within a stream corridor or wetland area, an impervious zone of clay or other approved material shall be installed to prevent draining the wetland. The impervious zone shall be 2 feet thick parallel to the pipe, extending from 6 inches below the bottom of the pipe bedding to the top of the pipe zone, and extending one foot beyond each side of the trench wall. This zone shall be compacted to 90 percent relative compaction as determined by Method A of AASHTO T99.

7.03 Pavement Restoration

7.03.1 General

The stricter of the requirements of this section or the standards of the jurisdiction having authority over the road being repaired shall be followed.

7.03.2 Materials

a. Crushed Rock
The following rock specifications shall be required unless modified by the local jurisdiction.

1. Base Course Rock
Rock for the base course of the street shall be 1-1/2-inches and shall conform to the applicable portions of the standard specifications for highway construction of the Oregon State Highway Division for course aggregate base material.

2. Leveling Course Rock
   Rock for leveling course shall be 3/4-inch minus, conforming to the applicable portions of the Standard Specifications for Highway Construction of the Oregon State Highway Division for leveling course.

b. Asphalt Concrete

1. Prime Coat
   Materials for prime coat shall be emulsified asphalt type CMS 2 or approved equal.

2. Tack Coat
   Materials for tack coat shall be emulsified asphalt-type RS 1, CRS 1, or approved equal.

3. Base Course
   When more than two inches of asphalt concrete is required, the asphalt concrete shall be placed in two or more courses. The base course shall be Class B asphaltic concrete mix conforming to the Standard Specifications for Highway Construction of the Oregon State Highway Division.

4. Surface Course
   Asphaltic concrete for the surface course shall be Class C mix conforming to the Standard Specification of the Oregon State Highway Division. All surface course mix design is subject to final approval by the District or City.

7.03.3 Workmanship

a. Subgrade

The Contractor shall:

1. Bring the trench to a smooth, even grade at the correct distance below the top of the existing pavement surface, allowing for base rock, leveling rock and asphalt concrete.

2. Trim existing pavement so that the trench width plus 12-inches of asphalt is removed creating a "t" cut section as shown in Standard Detail 600.

3. Remove any pavement which has been damaged or which is broken

and unsound and provide a smooth, sound edge for joining the new pavement.

4. Compact the top three feet of pavement subgrade to 95 percent relative density, ASTM D2049.

5. And accomplish supplementary compaction where required with approved mechanical vibrating or power tampers.

b. Base Aggregate Course and Leveling Course
The Contractor shall obtain approval of the subgrade by the District or City prior to placing any base course material on the subgrade. Workmanship in manufacturing, placing, compacting, and maintaining base, or leveling course, shall be in conformance with the requirements of the Standard Specifications for Highway Construction of the Oregon State Highway Division, except as modified in this Chapter.

c. Tack Coat
After the leveling course has been compacted, the Contractor shall apply the tack coat to the edges if the existing pavement and manhole frames at 0.06 to 0.12 gallons per square yard. The surface upon which the tack coat is applied shall be dry and clean of dirt, dust, and other matter inhibiting asphalt adherence.

d. Asphaltic Concrete

1. Weather Conditions
Asphaltic concrete shall not be placed when the atmospheric temperature is lower than 40 degrees F., during rainfall, or when the surface is frozen or wet. Exceptions will be permitted only in special cases and only with prior written approval of the District or City.

2. Base Course
If a base course of asphaltic concrete is required, the Contractor shall place the asphaltic concrete on the prepared subgrade over the trench to a depth of two inches. The Contractor shall spread and level the asphaltic concrete and compact it by rolling or by use of hand tampers where rolling is impossible. Power rollers shall be capable of providing compression of 250 pounds per inch of width.

3. Surface Course
The Contractor shall place the asphaltic concrete to the required depth; spread and level the asphaltic concrete with hand tools or by use of a mechanical spreader, depending upon the area to be paved; bring the asphaltic concrete to the proper grade and compact by rolling or the use of hand tampers where rolling is impossible; roll with power

rollers capable of providing compression of 250 pounds per inch of width; and begin the rolling from the outside edge of the replacement progressing toward the existing surfacing, lapping the existing surface at least one half the width of the roller. If existing surfacing bounds both edges of the replacement, the Contractor shall begin rolling at the edges of the replacement, lapping the existing surface at least one half the width of the roller, and progressing toward the center of the replacement area. Each preceding track shall be overlapped by at least one half the width of the roller and make sufficient passes over the entire area to produce the desired result, as determined by the District or City. The finished surface of the new compacted paving shall be flush with the existing surface and shall conform to the grade and crown of the adjacent pavement. Immediately after the new paving is compacted, all joints between new and original asphaltic pavement shall be painted with hot asphaltic or asphaltic emulsion and be covered with dry paving sand before the asphaltic solidifies.

e. Protection of Structures

The Contractor shall provide whatever protective coverings may be necessary to protect the exposed portions of bridges, culverts, curbs, gutters, posts, guard fences, road signs, and any other structures from the paving operations. All oil, asphalt, dirt, or other undesirable matter that may come upon these structures by reason of the paving operations shall be removed.

Existing and new water valve boxes, manholes, catch basins, or other underground utility appurtenances shall be made level with the finish asphalt grade. The District or City or other appropriate authority shall be contacted prior to any facility adjustments for guidance as to the appropriate procedures, standards and materials to be used. All covers shall be protected during asphalt application.

f. Rock Surfacing

Where so directed by the District or City, the Contractor shall place a minimum of two inches of level course rock, as specified in this Chapter, for the full width of all streets, driveways, parking areas, street shoulders, and other areas disturbed by the construction.

g. Contractor's Responsibility

The Contractor shall repair all settlement of pavement over trenches within the warranty period at no charge to the District or City.

h. Driveways

Driveways shall be replaced to original conditions following the work. Such replacement shall be done in accordance with all applicable legal standards for road shoulders within the limits of the work.

7.04 Bores

7.04.1 General

The carrier pipe in all bores shall be installed within a steel case, unless otherwise approved by the District or City.

7.04.2 Installation

a. Casing
The casing shall be smooth steel of a size to permit proper construction to the required line and grade. The steel casing shall be fabricated in sections for field welded joints. The casing wall thickness shall be a minimum size of 1/4-inch or in accordance with the requirements of the jurisdiction of the right of way.

b. Pipe Supports
The sewer pipe shall be supported on three sides by pipe supports. Pipe supports shall be No. 2 Western Red Cedar or pressure treated Western Douglas Fir, or approved equal.

c. Placing Fill in Casing
The annular space shall be filled between the casing and pipe completely with lean grout or sand to prevent pipe flotation.

d. Concrete Seals
After the sewer pipe has been tested and approved, concrete plugs shall be poured at each end of the casing.

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Chapter 8

TECHNICAL SPECIFICATIONS FOR CONVEYANCE SYSTEMS

8.01 General Provisions

The technical specifications contained in this chapter, together with Oregon Department of Environmental Quality and U.S. Environmental Protection Agency standards and any other applicable requirement of the District and City, shall govern the character and quality of material, equipment, installation and construction procedures for gravity flow portions of public sanitary and storm sewer systems.

The requirements in this Chapter apply to both sanitary and storm conveyance systems, except where the provision is indicated as applying to only one type of system.

8.02 Manholes and Structures

8.02.1 Materials

a. Aggregate and Portland Cement
Aggregate and Portland Cement shall meet the standards set forth in ODOT/APWA "Oregon Standard Specifications for Construction 2002", Sections 02690 and 02010 respectively or updated ODOT/APWA Standard Specifications.

b. Concrete
Concrete shall meet the standards set forth in ODOT/APWA "Oregon Standard Specifications for Construction 2002", Sections 00440.

c. Manhole Frames and Covers
   1. Sanitary and Storm:
      A) Casting shall be tough, close-grained gray iron, smooth and clean, free from blisters, blowholes, and all defects, and conform to ASTM A48, Class 30.
      B) To ensure flat, true surfaces, all bearing surfaces shall be planed or ground. Covers shall be true and set within ring at all points.
      C) Composite watertight and tamper proof frame and covers shall be installed on manholes in all easement and off street areas and on manholes located within the flood plain or along stream corridors.
   2. Sanitary-additional requirements:
      A) Frames and covers shall be standard or suburban, solid (2-hole), depending upon the type and location of the manhole and as approved by the District or City.
   3. Storm-additional requirements:
      A) Frames and covers shall be standard or suburban, solid, 16-hole or slotted depending upon the type and location of the manhole and as approved by the District or City.

d. Precast Manholes
   1. Sanitary and Storm:
      Materials for precast concrete manholes shall conform to the requirements of ASTM C478. Minimum wall thickness shall be five inches. Cones shall have the same wall thickness and reinforcement as riser sections. Joints shall be tongue and groove, rubber ring or keylock type. Cones shall be 3' eccentric. Flat Top Manholes may be approved by the District or City when site conditions preclude the use of a Standard Manhole.
   2. Sanitary-additional requirements:
      Prior to the delivery of any size of precast manhole section to the job site, yard permeability tests shall be conducted at the point of manufacture. The precast sections to be tested shall be selected at random from the stockpile material, which is to be supplied to the project. The sections shall meet the permeability test requirements of ASTM C14.

e. Precast Bases
   At the option of the Contractor, precast base sections or manhole bases may be used provided all the details of construction are approved prior to construction.

f. Pipe Stubouts for Future Connections
   1. Sanitary and Storm:
      Pipe stubouts shall be of the same type as approved for use in the lateral, main, or trunk lines. Strength classifications shall be of the same class as in adjacent trenches. Where two different classes of pipe exist at a manhole, the higher strength pipe will govern strength classification.
   2. Sanitary-additional requirements:
      Rubber-gasketed watertight plugs shall be furnished with each stubout and shall be adequately braced against air test pressures.
   3. Storm-additional requirements:
      The District or City may require the length of the stubout to be as long as it is deep. Knockouts may be used with District or City approval.

g. Preformed Manhole Gaskets
   Gaskets shall be Kent-seal No. 2 or Ram Neck conforming to federal specifications SS-S-00210 or approved equal.

h. Manhole Steps
   Materials shall be plastic with reinforcing bar, a minimum 1/2" Grade 60, meeting requirements of ASTM A615 encapsulated with injection molded copolymer polypropylene with serrated surfaces.

i. Non-shrink Grout

Non-shrink grout shall be Sika 212, Euco N-S, Five Star, or CWS approved equal nonmetallic cementitious commercial grout exhibiting zero shrinkage. Grout shall not be amended with cement or sand and shall not be reconditioned with water after initial mixing. Non-shrink grout shall be placed or packed only with the use of an approved commercial concrete bonding agent. Unused grout shall be discarded after 20 minutes and shall not be used.

j. Chimney Seals (Sanitary only)
The internal and external rubber seal and seal extensions shall be as manufactured by Cretex Specialty Products, or CWS approved equal. The sleeves and extensions shall have a minimum thickness of 3/16-inches and shall be extruded from a high-grade rubber compound conforming to the applicable requirements of ASTM C923. The bands used for compressing the sleeve and extension against the manhole shall be fabricated from 16-gauge stainless steel conforming to ASTM A240 type 304, and screws, bolts, or nuts used on this band shall be stainless steel.

k. Manhole Pipe Connector
A flexible connector that is designed to produce a positive watertight connection for pipes entering a precast manhole. The connector shall be manufactured by A. Lok or a CWS approved equal and meet the requirements of ASTM C-923.

l. Concrete Manhole Closure Collar
All grade rings including casting shall be set in a minimum of one inch of non-shrinking grout. The Contractor may pour concrete closure collars within the entire dimensions, as shown on Standard Detail Sheet No. 140, using approved form materials and or methods. Concrete shall conform to C94 Alternate 2 and shall have a compressive strength of 3000 psi at 28 days.

m. Structure Marker. Posts shall be a minimum of 8 feet in length and shall be 2" galvanized steel, painted orange or as approved by District or City.

8.02.2 Workmanship on Manholes

a. Foundation Stabilization
If, in the opinion of the Engineer unstable material exists that will not support the manhole or other structure, the Contractor shall install geotextile fabric or excavate below grade and backfill with foundation stabilization material.

b. Pipe Connections
1. Sanitary and Storm:
All pipes entering or leaving a manhole shall be placed on firmly compacted bedding. Special care shall be taken to ensure that the

openings through which sewer pipes enter the structure are completely watertight by using non-shrink grout. All flexible pipes shall be connected to manholes by using PVC sanded bell adapter, Kor-N-Seal boot, or solvent cement and clean sand application according to the manufacturer's recommendations.

2. Storm-additional requirements:
   a. Aluminum pipe connections to manholes shall be wrapped where they will be in contact with concrete.
   b. Ribbed pipe connections to manholes shall have 2 gaskets in non-shrink grout as shown on detail #030

c. Drop Manholes
   1. Sanitary Only:
      The maximum fall in a manhole is 12", measured from the existing flowline to the new flowline. When the drop is more than 12", an approved drop connection shall be used.
   2. Storm Only:
      The maximum fall in a manhole is four feet, measured from the existing flowline to the new flowline. When the drop is more than four feet, an approved drop connection shall be used.

d. Concrete Bases-Poured in Place
   The Contractor shall remove water from the excavated area, provide 12 inches minimum layer of compacted 3/4-inch minus of crushed rock for a base, and construct the concrete base so that the first precast manhole section has a uniform bearing throughout the full circumference. There shall be a minimum of eight inches of concrete between the compacted gravel and the lowest invert of the manhole. The Contractor shall deposit sufficient concrete on the base to ensure a 6" min. overlap for watertight seal between base and manhole wall, see detail #020. Twenty-four hours shall be allowed to elapse before placing the remaining sections on the base unless otherwise approved by the District or City.

e. Placing Manhole Section
   The Contractor shall clean the end of sections of foreign materials and install the preformed plastic gasket in conformance with the manufacturer's recommendations.

f. Manhole Inverts
   The Contractor shall construct manhole inverts in conformance with details and with smooth transitions to ensure an unobstructed flow through manhole, and remove all sharp edges or rough sections.

g. Manhole Stubouts
   1. Sanitary and Storm:
      The Contractor shall install stubouts from manholes for sewer extensions as shown or as required by the District or City. The

Contractor shall construct invert channels in accordance with standard drawings. The maximum length of stubouts in manholes shall be 15 feet outside the manhole wall with no connections made to the line. Pipes shall be grouted in precast walls or manhole base to provide watertight seal around the pipes, see detail #030 . The Contractor shall provide compacted base rock as specified to undisturbed earth under all stubouts.

2. Storm-additional requirements:
   Knockouts may be used in place of stubouts with District or City approval.

h. Manhole Extensions, Rings, and Covers

1. Sanitary and Storm:
   Rings shall be set in a bed of non-shrinking grout with the non-shrinking grout carried over the flange or the ring and shall be set so that tops of covers are flush with the surface of adjoining pavement, or one foot above natural ground, unless otherwise directed by the District or City. Manholes outside of paved areas may be adjusted to finish grade through the use of preformed plastic gaskets specified in subsection 8.02.1(g). Extensions shall be limited to a maximum height of 27 inches from the center point of the first step to the top of the casting.
2. Sanitary-additional requirements:
   The Contractor shall install rings and covers on top of manholes to positively prevent all infiltration of surface or groundwater into manholes.

i. Manhole Taps

Taps into existing manholes shall be core drilled unless approved otherwise by the District or City. All non-concrete pipe material used on a manhole tap shall be adapted with a water tight coupling compatible with concrete or approved equal (e.g., sanded manhole adapter, inserted manhole boot). The bonding material used to connect the pipe and/or coupling to the manhole shall be non-shrink material that is approved by the District or City to ensure no ground water infiltration occurs.

j. Structure Marker

The District or City may require that structures located outside the right-of-way be marked with the installation of an approved marking post.

8.02.3 Types of Connections

a. Connection to Existing Manholes

The Contractor shall connect sewer lines to existing manholes at locations indicated; provide all diversion facilities and perform all work necessary to maintain flow in existing systems during connection to the manholes; and break out existing manhole bases or grouting as necessary and regrout

to provide smooth flow into and through existing manholes. The Contractor shall allow no debris to enter the existing system while making the connection.

b. Manholes Over Existing Sewer Systems
   1. The Contractor shall construct manholes over existing sewers at locations shown on plans. All broken edges shall be covered with non-shrinking grout and troweled smooth. The Contractor shall prevent any debris from entering the manhole while breaking into the existing pipe.
   2. Final connection to the existing sanitary sewer shall not be made until the system has been tested in accordance with the requirements of Section 8.05 and is ready for acceptance as outlined in Chapter 2.
   3. The Contractor shall construct the new base under the existing lines and the precast sections as specified.

8.03 Catch Basins and Inlets (Storm only)

8.03.1 Materials

a. Aggregate, cement and concrete shall meet the requirements set forth in Section 8.02.

b. Frames, Grates and Covers
All materials shall be flat bar steel (standard grade), cast iron or ductile iron meeting the requirements of ASTM A28 Class 30B.

c. Forms
All exterior surfaces shall be formed with steel or plywood. Other surfaces shall be formed with matched boards, plywood, or other approved material.

d. Metal Reinforcement
All metal reinforcement shall conform to the requirements of ASTM A615, Grade 60, deformed bars.

e. Precast Concrete Units
All precast units shall conform to the same requirements as manholes ASTM C478.

8.03.2 Workmanship

a. Excavation and backfill will conform to the requirements of subsection 7.02.3 Construction.

b. Bedding
The Contractor shall remove all water and debris from ditch area, provide

8 inches minimum layer of compacted 3/4 inch minus crushed rock for a base.

c. Cast in Place
Cast in place catch basins shall have a minimum of 6 inches of concrete between the compacted gravel and the lowest invert. The forms used for cast in place catch basins shall be tight and well braced. The storm pipe material being used shall extend into the poured concrete of the catch basin. All corners shall be chamfered. Immediately after placement, the concrete shall be consolidated with an approved vibrator. The top surface shall be screed and exposed surfaces troweled to a smooth finish free from marks or irregularities. After forms are removed, the Contractor shall patch any defects in the concrete with approved material.

d. Precast
After the base is prepared the Contractor shall set the precast catch basin to the proper line and grade. The storm pipe material being used shall connect to the precast catch basin.

e. Inverts, Stubouts and Sections
Contractor shall clean the ends of all pipes and sections that come in contact with the catch basin. All inverts, stubouts and sections shall be installed according to the details using a non-shrinking grout, making sure all sharp edges or rough sections are removed, to prevent obstruction of the flow.

f. Catch Basin Steps
All catch basins deeper than four feet, measured from top of frame to flowline, shall have steps.

8.04 Sewer Pipe and Fittings

8.04.1 General

a. Sanitary sewers
Sanitary sewer pipe shall have flexible gasket joints. Joints on all fittings shall be the same as the joints used on the pipe. Caps or plugs shall be furnished with each fitting, outlet, or stub as required with the same type gasket and/or joint in the pipe.

b. Storm sewers
The materials used shall be adequate to carry anticipated dead and live loads within the deflection limits specified by the manufacturer. All pipe and culverts shall have a minimum design service life of 75 years per Oregon Department of Transportation standards. Joints shall be gasketed unless otherwise approved by the District or City.

8.04.2 Materials

Materials shall be the following types or equal when approved in writing by CWS.

a. Concrete Pipe-NRCP/RCP (Storm and Sanitary)
   1. Non-reinforced concrete pipe shall conform to requirements of ASTM C14. Unless otherwise specified, pipe shall conform to Class 3 design requirements.
   2. Reinforced concrete, non-pressure pipe shall conform to the requirements of ASTM C76 or C655 and shall be of the class specified. Unless otherwise specified, pipe shall meet the design requirements of Wall B. Reinforced concrete low head pressure pipe shall conform to the requirements of ASTM C361.
   3. Gaskets shall conform to the requirements of ASTM C443.
   4. All concrete pipe shall be at least seven days old before it can be installed if it has been steam cured. If the pipe has not been steam cured, it must cure for a minimum of 21 days prior to use.

b. Ductile Iron Pipe-DIP (Storm and Sanitary)
   Ductile iron pipe shall conform to the requirements of ANSI A21.50-1 or AWWA C150-1, cement lined push-on joint. The minimum thickness class shall be Class 50 (up through 12-inch diameter pipe) and Class 51 (for 14-inch diameter and larger pipe). Ductile iron pipe and fittings shall also conform to the specifications for line and grade in subsection 8.04.3(a).

c. Polyvinyl Chloride Pipe-PVC (Storm and Sanitary)
   1. Type:
      A) ASTM 3034 SDR 35 or SDR 26 dia. 4-15"
      B) ASTM F-679 SDR 35 dia. 18-24"
      C) ASTM C-900; D-1784 DR 18 dia. 4-12"
      D) ASTM C-905; D-1784, DR 18 dia. 16-24”
   2. Gaskets shall conform to the requirements of ASTM 477 and ASTM 3212.

d. A2000-PVC (Storm only)
   All A2000 PVC pipe and fittings shall conform to ASTM F949 specifications.

e. PVC Rib (Storm only)
   PW Rib pipe and fittings shall be made of PVC, as defined in ASTM D1784. The pipe stiffness shall correspond with the series as determined in accordance with ASTM D2412. Series 46 and 28 are allowed. Gaskets shall conform with ASTM 477.

f. Polypropylene Pipe (Storm only)
   1. Polypropylene pipe shall be corrugated double and triple wall pipe, and shall conform with ASTM F2764, SaniTite HP or approved equal.
   2. Polypropylene pipe shall meet the following conditions:
      A) Pipe diameters 12 inches to 30 inches must be dual-wall polypropylene.
      B) Pipe diameters greater than 30 inches and up to 60 inches must be triple-wall polypropylene.
   3. Joints shall be water tight and installed in accordance with manufacturer's recommendations and ASTM D3212, or approved equal.

g. High Density Polyethylene Pipe (HDPE)
   1. Polyethylene pipe shall be high density polyethylene (HDPE) compound PE 3408 or PE 4710 and shall conform with ASTM D3350, or approved equal.
   2. HDPE shall have a solid wall with a minimum wall thickness of DR 17.
   3. Joints shall be leakproof, thermal, butt joints, welded in accordance with the manufacturer's recommendations and ASTM D3261, or approved equal.

h. Corrugated Aluminum-CAP and Corrugated Aluminum Pipe Arches-CAPA (Storm only)
   1. Corrugated aluminum pipe and fittings shall conform to the requirements of AASHTO M196, M197 with watertight joints.
   2. The connecting bands shall conform to the requirements of AASHTO M196, except the minimum width of bands for 12 inch and larger pipe shall be 12-inches. Minimum width for pipes less than 12-inches shall be 7-inches. The base metal of the connecting bands shall be the same base metal as that of the pipe. The gauge of the connecting bands may be two standard use thicknesses lighter than that used for the pipe, but not less than 0.060 of an inch thick. The band couplers shall be connected with stainless steel bolts of not less than ½ inch diameter.
   3. Corrugated aluminum pipe shall not be placed in a ditch in direct contact with hydrating Portland Cement or lime.

i. Fittings
   1. General
      Tee fittings shall be provided in the sewer main for side sewers. All fittings shall be of sufficient strength to withstand all handling and load stresses encountered. All fittings shall be of the same materials as the pipe unless otherwise approved. Fittings shall be free from cracks and shall adhere tightly to each joining surface. All fittings shall be capped or plugged, and gasketed with the same gasket material as the pipe joint, fitted with an approved mechanical stopper, or have an integrally cast knockout plug. The plug shall be able to withstand all

test pressures without leaking, and when later removed, shall permit continuation of piping with joints similar to those in the installed line.

2. Concrete Pipe
   Fittings shall be manufactured integrally and be of a class at least equal to that of the adjacent pipe.

3. Ductile Iron
   Fittings shall be mechanical or push-on of the class as specified. Mechanical joint cast iron fittings shall conform to AWWA C110 and shall be of a class at least equal to that of the adjacent pipe. Push-on joint fittings shall be gray iron with body thickness and radii of curvature conforming to ANSI A21.10. The inside diameter of the fittings shall match the inside diameter of the pipe.

4. PVC Pipe
   Fittings shall conform to the applicable portions of the following specifications: ASTM D1785, ASTM D2729, ASTM D2466, ASTM 2467, ASTM D3033, and ASTM D3034. Fitting joints shall be the same as the pipe joints.

5. Line Tap Fittings.
   A) Inserta Tee fitting shall be manufactured in accordance with ASTM D3034, and installed with rubber sleeve meeting ASTM F477 specifications, and 9/16-inch wide stainless steel bands meeting series 300 specification. This fitting may be used for gravity flow pipe materials consistent with the manufacturers specifications, e.g., concrete, ductile iron, rib type plastic, PVC, polypropylene. See Standard Detail 530.

i. Grout
   Grout shall be Sika 212, Euco N-S, Five Star, or approved equal nonmetallic cementitious commercial grout exhibiting zero shrinkage per ASTM C-827 and CRD-C-621. Grout shall not be amended with cement or sand and shall not be reconditioned with water after initial mixing.

j. Proof Tests (Sanitary only)
   The District or City may require that a joint system be pre-qualified as to the watertightness capability of the joint system. Material and test equipment for proof testing shall be provided by the manufacturer. When approved, internal hydrostatic pressure may be applied by a suitable joint tester. Pipe material and joint assembly may be subject to the following three proof tests at the discretion of the District or City.

   1. Pipe in Straight Alignment
      No less than three or more than five pipes selected from stock by the District or City shall be assembled according to the manufacturer's

installation instructions with the ends suitably plugged and restrained against internal pressure. The pipe shall be subjected to 10 psi hydrostatic pressure for 10 minutes. Free movement of water through the pipe joint wall shall be grounds for rejection of the pipe.

2. Pipe in Maximum Deflected Position
   A test section description follows for each pipe material. The pipe shall be subjected to 10 psi hydrostatic pressure for 10 minutes. Free movement of water through the pipe joint or pipe wall shall be grounds for rejection of the pipe.

3. Joints under Differential Load
   The test section shall be supported on blocks or otherwise as described for each pipe material. There shall be no visible leakage when the stressed joint is subjected to 10 psi internal hydrostatic pressure for 10 minutes.

   A) Concrete Pipe
      For deflected position, a position one-half inch wider than the fully compressed position shall be created on one side of the outside perimeter. For differential loads, one pipe shall be supported so that it is suspended freely between the adjacent pipes bearing only on the joints. In addition to the weight of the suspended pipe, a test load shall be added as given Table 8-1:

TABLE 8-1
TEST LOADS FOR PIPES UNDER DIFFERENTIAL LOAD
(Concrete Pipe)

Pipe Size (Inches)	Load Per Foot Laying Length Up to 4 Feet (Pounds)	Total Load for Pipe 4 Feet and Over (Pounds)
4	650	2,600
6	1,000	4,000
8	1,300	5,200
10	1,400	5,600
12	1,500	6,000
15	1,850	7,400
18	2,200	8,000
21	2,500	10,000
24 and over	2,750	11,000

   B) Ductile Iron Pipe

For deflected position, a position 1/2-inch wider than the fully compressed section shall be created on one side of the outside perimeter. For differential loads, one of the pipes shall be supported so that it is suspended freely between adjacent pipe bearing only on the joints. A force shall be applied per Table 8-2 along a longitudinal distance of 12 inches immediately adjacent to one of the joints:

TABLE 8-2
TEST LOADS FOR PIPES UNDER DIFFERENTIAL LOAD
(Ductile Iron Pipe)

Pipe Size (Inches)	Force (Pounds)
4	600
6	900
8	1,200
10	1,500
12	1,800
15	3,700
18	4,400
21	5,000
24 and over	5,500

C) PVC Pipe
For deflected position, two 12-1/2 foot lengths shall be joined, then deflected along an arc of 720-foot radius (0.11 feet offset at the end of each length from a tangent at the joint). For differential load, two lengths shall be joined and uniformly supported for at least two feet on both sides of the joint and adjacent pipe to 95 percent of its vertical diameter.

8.04.3 Workmanship

a. Line and Grade
Survey control hubs for both line and grade shall be provided by the Engineer in a manner consistent with accepted practices. The Contractor shall establish line and grade for pipe by the use of lasers or by transferring the cut from the offset stakes to the trench at whatever intervals necessary to maintain the line and grade. The Contractor shall check line and grade as necessary. In the event that the limits prescribed in this Chapter are not met, the work shall be immediately stopped, the Engineer notified, and the cause remedied before proceeding further with

the work. Variance from the established line and grade shall not be greater than 1/32-inch per inch of pipe diameter and shall not exceed 1/2-inch for line and 1/4-inch for grade, providing that such variation does not result in a level or reverse-sloping invert. Variation in the invert elevation between adjoining ends of pipe, including fittings, shall not exceed 1/64-inch per inch of pipe diameter, or 1/2-inch maximum.

b. Side Sewer Connections
All side sewer connections shall be made with tee fittings unless otherwise approved by the District or City. Tee stations will be staked by the Engineer.

c. Pipe Handling
The Contractor shall unload pipe only by approved means. Pipe shall not be dropped to the ground and shall not be dropped or dumped into trenches. The Contractor shall inspect all pipes and fittings prior to lowering into trench to ensure no cracked, broken, or defective materials are used. The Contractor shall clean ends of pipe thoroughly, remove foreign matter and dirt from inside of pipe, and keep it clean during laying and joining. The Contractor shall lower pipe into the trench in such a manner as to avoid any physical damage to the pipe. The Contractor shall remove all damaged pipe from the job site.

d. Unless approved by the District or City, the Contractor shall not break into an existing sewer line until the system has been tested in accordance with the requirements of Section 8.05 and is ready for acceptance by the District or City, as outlined in Chapter 2. When a Contractor ties into a "live" line, the Contractor shall keep the new sanitary line plugged at the downstream end of the construction to prevent entry of groundwater and debris into the public sanitary sewer system.

e. Foreign Material
The Contractor shall take all precautions necessary to prevent excavated or other foreign material from entering into the pipe during the laying operation. At all times, when laying operations are not in progress, the Contractor shall use a mechanical plug at the open end of the last laid section of pipe to prevent entry of foreign material or creep of the gasketed joints.

f. Pipe Laying
Pipe laying shall proceed upgrade with spigot ends pointing in the direction of the flow. After a section of pipe has been lowered into the prepared trench, the Contractor shall clean the end of the pipe to be joined, the inside of the joint, and the rubber ring (if required) immediately before joining the pipe, and make assembly of the joint in accordance with the recommendations of the manufacturer for the type of joint used. The Contractor shall provide all special tools and appliances required for the

joint assembly. After the joint has been made, the pipe shall be checked for alignment and grade. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between joints.

g. Movable Shield
When pipe is laid within a movable trench shield, the Contractor shall take all necessary precautions to prevent pipe joints from pulling apart when moving the shield ahead. The bottom of the shield shall not extend below the springline of the pipe without recompacting the pipe zone.

h. Cutting Pipe
When cutting or machining the pipe is necessary, the Contractor shall use only tools and methods recommended by the pipe manufacturer and approved by the District or City. The Contractor shall cut cast iron or ductile iron pipe with milling type cutter or with rolling pipe cutter and shall not flame cut.

i. Transition Fittings
1. When joining different types of pipes, the Contractor shall use approved rigid fittings. No flexible fittings will be approved.
2. PVC couplers or adapters shall meet the ASTM 3034 SDR 35/C900 DR 18 D1784 specifications.
3. Ductile iron transition couplings shall meet the ASTM A536 80 for center and end rings, ASTM D2000 3 BA75 for gaskets and AWWA C 111 80 for bolts and nuts.

j. Concrete Closure Collars
The Contractor shall pour closure collars against undisturbed earth, remove all water from the excavation, construct suitable forms to obtain shapes that will provide full bearing surfaces against undisturbed earth as indicated, and use closure collars only when approved by the District or City, and then only to make connections between dissimilar pipe or where standard rubber-gasketed joints are impractical. Before the closure collars are installed, the Contractor shall wash pipe to remove all loose material and soil from the surface on which they will be placed.

k. Pipe Bedding
The Contractor shall install pipe zone material uniformly on both sides of the pipe up to the springline of the pipe. Material shall be compacted to ensure proper support within the haunching area.

l. Line Taps
1. Line taps shall be core drilled unless approved otherwise by the District or City. Core drilled holes shall be done using a cylinder style hole saw for plastic pipe material or a diamond core bit for concrete and ductile iron pipes.
2. Prior to installation of the tee, the area around the cored hole shall be

clean and free of all rough edges.

3. While installing the tee, no rock, dirt, or debris shall be allowed to enter the main sewer line.
4. The Contractor shall install 3/4-inch minus gravel in the pipe zone around the line tap, from 4-inches below the pipe or to undisturbed ground and to 6-inches above the pipe.
5. Magnetic tape shall be installed within 18 inches of the top of pipe on all side sewers.
6. The sewer main shall be a minimum of two sizes (nominal inside diameter) larger than the line tap.
7. Inserta Tee's may not be used for newly constructed mainlines with an inside diameter (I.D.) of 10" or smaller.

8.05 Testing and Acceptance

8.05.1 General

a. Sequence of Testing
Testing shall occur in the following order. At the District's or City's discretion, failure of any of the tests may require all testing to be completed again.
1. Compaction
2. Placement of base rock
3. Mandrel
4. Air test (sanitary only)
5. Video

b. Type of tests
1. Sanitary sewers:
All gravity sanitary pipelines shall pass the required air tests, pass the required compaction test in accordance with Section 7.02.3(b)(6), be video inspected, and be free of visible leaks. All flexible pipes shall pass a deflection test. All projects shall pass the required manhole tests. On sanitary sewer pipe 42-inches in diameter and larger, individual joints may be tested by an approved joint testing device. All details of testing procedures shall be subject to approval of the District.
2. Storm sewers:
All gravity storm systems shall be video inspected, pass the required compaction test in accordance with Section 7.02.3(b)(6), and a deflection test for flexible pipes. All details of testing procedures shall be subject to approval of the District

c. Test Equipment
1. Sanitary and Storm:
The Contractor shall furnish all necessary testing equipment and perform the tests in a manner satisfactory to the District or City.

2. Sanitary-additional requirements:
   Any arrangement of testing equipment, which will provide observable and accurate measurements of air leakage under the specified conditions, will be permitted. Gauges for air testing shall be calibrated with a standardized test gauge.

8.05.2 Line Cleaning

Prior to the internal pressure testing for sanitary systems and inspection of sanitary and storm systems by the District or City, the Contractor shall ball and flush and clean all parts of the system. The Contractor shall remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the system at or near the closest downstream manhole. If necessary, the Contractor shall use mechanical rodding or bucketing equipment. Upon the District or City inspection of the system, any foreign matter still present shall be flushed and cleaned from the system as required.

8.05.3 Manholes (Sanitary only)

a. Unless otherwise approved by the District, acceptance tests shall be conducted on a random sample of 25 percent or 3 sewer manholes, whichever is greater, selected by the District or City. Any manhole which fails acceptance testing shall be repaired and retested, and an additional manhole, selected at random, by the District or City shall be tested.

b. Sanitary sewer manholes shall be tested for acceptance after the trench has been backfilled, compaction requirements have been met, road base rock has been installed and the street paved, and chimney seals or concrete manhole closure collars have been installed. If the manholes have passed the tests and the castings have been disturbed by construction activities or need to be reinstalled, the manholes shall be re-tested.

c. Hydrostatic Testing. The test will consist of plugging all inlets and outlets and filling the manhole with water to the rim. Leakage in each manhole shall not exceed 0.2 gallons per hour per foot of head above the invert. Leakage will be determined by refilling to the rim using a calibrated or known volume container. Testing results shall be recorded on a form approved by the District.

d. Vacuum Testing. The test will consist of plugging all inlets and outlets. The test head shall be placed at the inside of the top of the cone, include grade rings and castings, and the seal inflated in accordance with the manufacturer's recommendations. A vacuum of 10-inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9-inches. The manhole shall pass if the time for the vacuum reading to drop to 9-inches meets or exceeds the values indicated in Table 8-3.

TABLE 8-3
VACUUM TESTING TABLE

Depth of Manhole (feet)	Allowable Time (seconds) 48-inch	60-inch	72-inch
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	65
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121

8.05.4 Air Testing, Pipe Line (Sanitary only)

a. General
After construction of the system, including service connections, required backfilling, compaction testing, placement of base rock for streets, and other required testing, the Contractor shall conduct a low-pressure air test. The Contractor shall provide all equipment and personnel for the test. The method, equipment, and personnel shall be subject to the approval of the District and City. The District or City may, at any time, require a calibration check of the instrument used. The pressure gauge used shall have minimum divisions of 0.10 psi and have an accuracy of 0.0625-psi (one-ounce per square inch). All air used shall pass through a single control panel.

b. Safety Precautions
All plugs used to close the sewer for the air test must be capable of resisting the internal pressures and must be securely braced, if necessary. All air testing equipment must be placed above ground and no one shall be permitted to enter a manhole or trench where a plugged line is under pressure. All pressure must be released before the plugs are removed. The testing equipment used must include a pressure relief device designed

to relieve pressure in the test line at 10 psi or less and must allow continuous monitoring of the test pressures in order to avoid excessive pressure. The Contractor shall use care to avoid the flooding of the air inlet by infiltrated ground water. The Contractor shall inject the air at the upper plug if possible. Only qualified personnel shall be permitted to conduct the test.

c. Method
All air testing shall be by the Time Pressure Drop Method. The test procedures are described as follows:

1. Clean the lines to be tested and remove all debris.

2. The Contractor has the option of wetting the lines prior to testing.

3. Plug all open ends with suitable test plugs; brace each plug securely.

4. Check the average height of ground water over the line. The test pressures required below (Section 8.05.4(c)(8)) shall be increased 0.433 psi for each foot of average water depth over the line.

5. Add air slowly to the section of system being tested until the internal air pressure is raised to the test pressure specified below (Section 8.05.4(c)(8)).

6. After the internal test pressure is reached, at least two minutes shall be allowed for the air temperature to stabilize, adding only the amount of air required to maintain pressure.

7. After the temperature stabilization period, disconnect the air supply.

8. Acceptance shall be based upon meeting or exceeding the requirements specified below. Note the test method is dependent upon the type of pipe material.

A) Concrete Pipe:
Air Pressure Drop Method – The tested section, when tested on the air pressure drop method, will be acceptable if the time required for the pressure to drop from 3.5 psi to 2.5 psi is not less than the time in seconds (T) computed by the Formula:

$$T = K/C$$

Where K and C are computed as follows:
K = the sum of the computation $0.011d^2L$ for each size of pipe and its length in the section.
C = the sum of the computation 0.0003882dL for each size of pipe

and its length in the section, except that the minimum value for C shall be 1.
d = the inside diameter of the pipe in inches.
L = the length of pipe in feet.

B) PVC, HDPE, and Ductile Iron Pipe:
The minimum time duration permitted for the prescribed low-pressure exfiltration pressure drop from a starting pressure of 4.0 psi between two consecutive manholes should not be less than that shown in Tables 8-4 or 8-5. The tables list test duration values for pressure drops of 1.0 psi and 0.5 psi in excess of ground water pressure above the top of the sewer pipe, respectively. Values given accommodate both an allowable average loss per unit of surface area and an allowable maximum total leakage rate.

9. Record the diameter (in), length (ft), end manhole number, time, pressure drop, and groundwater level of the test on an inspection form. The recording form shall become a permanent record of the project.

8.05.5 Deflection Test for Flexible Pipe

a. Sewers constructed of flexible pipe materials shall be deflection-tested. The test shall be conducted by pulling an approved mandrel through the completed pipeline. The diameter of the mandrel shall be 95 percent of the nominal pipe diameter unless otherwise specified by the District. The mandrel shall be a rigid, nonadjustable, odd-numbering-leg (9 legs minimum) mandrel having an effective length of not less than its nominal diameter. Testing shall be conducted after placement of base rock for streets and after the line has been completely balled and flushed out with water, compaction tests have been completed and accepted.

b. The Contractor will be required to locate and repair any sections failing to pass the deflection test and to retest the section.

8.05.6 Video Inspection of Gravity Systems

All sewers shall be video inspected and recorded in accordance with the order prescribed in Section 8.05.1 prior to the District or City acceptance of the systems. All pipes shall be thoroughly flushed immediately prior to the video inspection. A 1- inch target ball shall be placed in front of the camera. If the system is video inspected by a private firm or entity other than the District or City, a copy of the video recording and a written TV Inspection Report on a form approved by District, shall be supplied to the District or City. The video recording shall be recorded in color and on an electronic format as approved by the District. All problems discovered during video inspection shall be noted on the video recording and the written report.

8.05.7 Video Inspection for Warranty Acceptance

The sewer lines shall be video inspected during the one year warranty period to determine any defects in the system that are to be corrected by the developer or Contractor.

TABLE 8-4
SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015*

1 Pipe Diam.	2 Min. Time	3 Length for Min. Time	4 Time for Longer Length	Specified Minimum for Length (L) Shown (min:sec)							
Inches	Min:Sec	Feet	Seconds	100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	.380L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5:342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46
42	39:48	57	41.883L	69:48	104:42	139:37	174:30	209:24	244:19	279:13	314:07
48	45:34	50	54.705L	91:10	136:45	182:21	227:55	273:31	319:06	364:42	410:17

*Q is the allowable rate in cu.ft/min/sf of inside surface area of pipe.

TABLE 8-5
SPECIFICATION TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015*

1 Pipe Diam.	2 Min. Time	3 Length for Min. Time	4 Time for Longer Length	Specified Minimum for Length (L) Shown (min:sec)							
Inches	Min:Sec	Feet	Seconds	100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	1:53	597	.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	.760L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54
30	14:10	80	10.683L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23
42	19:74	57	20.942L	34:54	52:21	69:49	87:15	104:42	122:10	139:37	157:04
48	22:67	50	27.352L	45:35	68:23	91:11	113:58	136:46	159:33	182:21	205:09

Chapter 9

WASTEWATER PUMP STATIONS AND FORCE MAINS

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Chapter 9

WASTEWATER PUMP STATIONS AND FORCE MAINS

9.01 General Provisions

The technical specifications contained in this Chapter, together with Oregon Department of Environmental Quality (DEQ) and U.S. Environmental Protection Agency standards and any other applicable requirements of federal, state and local law shall govern the character and quality of material, equipment, installation and construction procedures for wastewater pump stations, force main and other components of pressurized sanitary sewer work. In addition to the provisions within this Chapter, all applicable provisions of this Resolution and Order shall apply. Administrative provisions of Chapter 2 shall apply to the permit process.

9.01.1 Project Management

An Engineer approved by the District shall be retained to prepare the design, to manage all design and construction activities, to prepare the Operation and Maintenance manual, and to certify that construction was completed in accordance with the approved construction documents. The District maintains a list of pre-approved Engineers to provide these services. The Engineer must have current technical expertise and experience using the standards in this Chapter. In the event that the Engineer will not be involved in construction, the Engineer shall provide the District and the DEQ, as applicable, a written project management plan and the Owner shall notify the District in writing as to who will assume project management responsibilities. The District shall not manage construction activities or assume project management responsibilities. Construction shall not be undertaken by the Owner or the construction Contractor until the District has approved the project management plan.

9.01.2 Pump Station in lieu of Gravity Sanitary Sewer

A gravity sanitary sewer system shall be constructed to provide sanitary sewer service to all developments, unless otherwise approved by the District. Owner shall make a request, in writing, to the District for a pump station in lieu of a gravity sanitary sewer prior to submitting an application for a site development permit.

9.01.3 Layout and Sizing Requirements

The design shall provide for the complete construction of a wastewater pump station facility including site improvements; pumps; wetwell structure; valve vault(s); force main piping and appurtenances; gravity sewer piping and appurtenances; surge protection; odor control; plumbing; heating, ventilation,

and air conditioning (HVAC) system; electrical power; secondary emergency power connection to support full station loads and control systems; instrumentation and controls; and other associated work identified by the District as being necessary to make the facility fully functional.

The design shall adhere to and address the minimum layout and sizing requirements described below. Each of the layout and sizing requirements shall be specifically addressed in the pump station design report.

a. Pump Station Style/Configuration

Pump stations shall be of the duplex submersible type, unless otherwise approved in writing by the District.

b. Service Area and Population

Service area shall include all land that can be provided with gravity wastewater collection service, either currently or with future sanitary sewer extensions. Service area shall also include basin(s) which discharge via other wastewater pump stations into the subject basin either currently or in the future as identified through District planning or by District staff. The District shall make the final decision on the extent of the service area. Where applicable, service area shall be consistent with District master planning.

The preliminary design memorandum and final design report shall include a service area map that shows the following:

1. Topography of the pump station site at 1 ft. contours.
2. Topography of the service basin at 2-ft contours.
3. Property boundaries.
4. Existing and planned service areas.
5. District and City Boundaries.
6. Urban Growth Boundary, as applicable.
7. 100-year flood plain line, as applicable.
8. Property zoning.
9. Proposed pump station location and force main alignment.
10. Existing and proposed gravity collection system.

Service population shall be estimated for the entire service area at build-out and for a 25-year period if build-out is forecast to occur beyond 25 years. Initial service population shall also be estimated. Service population shall be calculated in accordance with and consistent with the District's master plan and other applicable jurisdiction's comprehensive plans, with additional input from District staff. For facilities being constructed as part of a new development, service population shall

incorporate actual planned densities.

c. Design Wastewater Flows

Wastewater flows shall be calculated for the following conditions:

1. Start-up, 1-year period, 5-year period, 25-year period, and service area build-out peak hourly flow (PHF).
2. Start-up, 1-year period, 5-year period, 25-year period, and service area build-out average dry weather flow (ADWF).

Flows shall be calculated in accordance with Chapter 5 of these Standards, and shall include domestic, industrial and infiltration and inflow. Final design flows shall be reviewed and approved by the District.

d. Design Period

Wetwell shall be sized to accommodate full build-out within the identified service area contributing to the pump station, unless otherwise approved by the District.

Pumps/motors, force main, and related equipment shall be sized based on the forecast 25-year PHF.

e. Service Life

Electrical/mechanical systems, including but not limited to pumps, motors, and electrical system, shall be designed and specified to provide for a minimum 25-year service life.

Structures and piping shall be designed and specified for a minimum 75-year service life.

The facility shall be capable of accommodating future components that may be needed for projected growth in the service area beyond the identified design period.

f. Hydraulic Analysis

The Engineer shall evaluate and design the pump/force main system and select pump(s) and force main(s) to provide the required capacity and pressure. The Engineer shall develop hydraulic system curves that indicate the required pump operating conditions. System curves shall be developed for pump suction and discharge piping, and shall include all valves, fittings and other items that may cause energy losses. Analysis shall be provided showing the effects of new and old pipe conditions, the

net positive suction head requirements, the hydraulic efficiency, the horsepower requirements, the revolutions per minute, and other operating conditions required for each pump and combination of pumps. Hydraulic system curves shall be developed using the Hazen-Williams equation for "C" factors of 100, 120 and 150, and under high and low wetwell conditions. Hydraulic system curves shall be overlain on the pump curves. Manufacturer pump curves shall be included in the design report. Computer generated curves may also be included.

The Engineer shall provide pump and system curves for the selected pump(s) to the District for review and approval.

g. Wetwell Size

Sufficient operating volume shall be provided in the wetwell to maintain individual pump starts per hour within the requirements stated herein under the "Pump and Motor" sub-section in Section 9.02. Gravity sewer piping entering the wetwell shall not be used to provide storage.

h. Receiving System

Engineer shall evaluate the existing downstream sanitary sewer system of the District or City to determine the impact of the increase in flow (e.g. peak pumping capacity) from the proposed pump station. Evaluation shall be performed under the design flow condition for all pumped and gravity connections to the receiving system. Sanitary sewer system shall be evaluated downstream to a point where no surcharging (caused by the increase in flow from the pump station) above the top of the pipe occurs. Hydraulic profile shall be provided in the design report. The District or City reserves the right to require upgrades to the downstream receiving system to mitigate the impact of the increased flow.

i. Hydrogen Sulfide

Engineer shall evaluate hydrogen sulfide potential in accordance with the following guidelines. Hydrogen sulfide controls shall be designed and constructed based on the following:

1. Detention Time less than 35 minutes: No hydrogen sulfide controls required.

2. Detention Time 35 to 90 minutes: Protect the force main discharge manhole with either a protective coating or with a chemical additive in the concrete. Products shall be approved by the District.

3. Detention Time greater than 90 minutes: Install an active hydrogen sulfide control system.

The detention time shall be calculated as the force main volume divided by the estimated ADWF at the 1-year period after pump station startup.

For pump stations discharging into existing force mains, evaluate existing force main discharge manhole for corrosion per the DEQ guidelines.

j. Reliability/Redundancy

Pumping facilities shall be designed and constructed to meet EPA Class I reliability requirements, which includes pump redundancy, standby power provisions, and a telemetry/SCADA system.

Firm pumping capacity shall be provided. Firm pumping capacity is defined as the ability to discharge the design PHF with the largest unit out of service.

Pumping facilities shall be equipped with a backup control system, which shall operate the entire pump station in the event the primary control system fails. Backup control system shall include water level monitoring device(s) and pump control system(s).

Standby power and telemetry/SCADA systems shall be provided per these Standards.

k. Parcel Size

A standard pump station site requires a minimum of approximately 2000 square feet of land area on a 50’ by 40’ lot. The minimum parcel size shall be based on the need to provide turn-around and parking for maintenance equipment; accommodate all the pump station structure(s), support enclosures, substructure(s), perimeter site buffer; and be in compliance with all development standards, building code requirements and local jurisdiction planning requirements. Turn-around shall be defined as providing sufficient room for the District's pump station O&M crew vehicle to maneuver within the fenced area. Turn-around shall be designed based on a minimum 46-foot vehicle turning radius, and with no more than two (2) turning maneuvers required to turn the vehicle 180 degrees. The entire pump station site shall be fenced as specified herein. A 15-foot wide buffer shall be provided around the pump station fenced area. Parcel size shall also be large enough to provide for future pump station expansion, within the Design Period/Service Life. See Section 9.02.

l. Parcel Zoning and Other Land Use Requirements

Land use designation for the pump station site shall be consistent with the local jurisdiction's requirements for this type of facility. Site and design shall comply with this Resolution and Order, all relevant land use requirements, and all other applicable local/State/Federal rules and regulations.

m. Parcel Ownership

Pump station site and access road shall be dedicated to the District in the form of a permanent easement, as approved, or transferred into direct ownership. All easements or parcel ownership transfers shall be finalized prior to pump station start-up and acceptance by the District.

n. Storm and Surface Water Management

Storm and surface water runoff from the pump station site, including the access road, shall be managed in accordance with District and all other applicable standards.

9.01.4 Design Procedures

a. General

The Engineer shall provide the following minimum scope of work for wastewater pump station and force main designs. The District may modify and supplement this scope of work to more specifically fit the project.

For projects that involve both a new pump station and force main, they shall be designed together and included in the same construction documents. Construction shall also occur concurrently.

The Engineer shall manage all aspects of the project design and construction process, including all plan review and permitting processes. For any plan review processes beyond the District's including, but not limited to, the DEQ plan review process, the Engineer shall provide the District with resulting review comments, and shall be responsible for facilitating resolution of any conflicts. The District's final plan approval shall not occur until final approval has been received by the Engineer from all other applicable jurisdictions or regulatory agencies.

b. Project Design Submittals

Project design submittals, including the design report, construction plans,

and technical specifications, shall be made to the District at the following intervals:

1. 35% completion
2. 60% completion
3. 90% completion
4. 100% completion

c. Project Review Meetings

1. Kick-off Meeting: Prior to the commencement of design and/or construction of any wastewater pump station and/or force main, the Engineer shall contact the District's Wastewater Treatment Department (WTD) to arrange a project kick-off meeting to discuss and review design and equipment requirements. A District project coordinator will be assigned as staff liaison to the Engineer. The District may also form a staff committee to work closely with the Engineer and District project coordinator during the life of the project. The Engineer, after completing the project kick-off, may proceed with the design of the project.

2. Project Review Meetings: Following the project kick-off meeting, the Engineer shall, at a minimum, meet with the District to review the documents and receive comments following District review of each submittal.

3. O&M Staff Meeting: Following the 35% design submittal, the Engineer shall also meet with District pump station operations and maintenance staff to tour and inspect applicable existing pump stations to become familiar with District requirements and to clarify and confirm specific pump station requirements.

Agendas and meeting minutes shall be prepared by the Engineer for all project-related meetings. Meetings shall be scheduled at least ten business days in advance. Agendas and supporting information shall be distributed by the Engineer to all invited attendees at least two business days in advance of any meeting. Meeting minutes shall be distributed to meeting attendees and other interested parties within five business days of the meeting date.

d. Design

The Engineer shall perform the following minimum preliminary design tasks:

1. Review applicable District master plans and design reports.

2. Coordinate with District to finalize the site selection.
3. Coordinate with District to finalize the service area, design population, and design flows.
4. Coordinate with District to confirm downstream receiving system capacity, and to address any hydrogen sulfide control requirements.
5. Perform design surveys.
6. Perform geotechnical investigation work. Develop at least two bore holes where the proposed pump station wetwell will be located, and determine appropriate soil design requirements. Also identify any potential landslide conditions.

The Engineer shall, at a minimum, include the following items with the 35% review submittal:

1. Schematic site design, gravity sanitary sewer connection(s), and force main layout.
2. Preliminary wetwell buoyancy calculations.
3. Preliminary design report. Report shall address how the project responds to the Layout and Sizing requirements specified herein. Report shall also identify all permitting requirements.

Following District review and concurrence with the 35% submittal, the Engineer shall proceed with the design. The Engineer shall perform the following minimum design tasks:

1. Prepare a Final Design Report, consistent with the District and DEQ guidelines.
2. Prepare final construction contract documents, including but not limited to construction drawings and technical specifications.
3. Prepare estimates of construction cost.
4. Submit documents and cost estimate at the scheduled milestones to the District.
5. Meet with District O&M staff as provided in 9.01.4.c.3.

e. Project Construction Documents

Construction drawings shall include, but not be limited to, the following as deemed applicable by the District and the Engineer:

1. Cover sheet
2. Legend, Symbols and Abbreviations
3. Location and Vicinity Map
4. Pump Station Design Data (see sample table in Appendix)
5. Demolition Plan
6. Site Layout, Grading, Drainage, and Paving Plan

7. Site Utilities, Plans, Profiles, and Details
8. Landscaping
9. Exterior Elevations, Sections, and Details
10. Foundation Plans, Sections, and Details
11. Structure(s) Floor Plans, Sections, and Details
12. Architectural/Civil Framing and Roof Plans, Sections, and Details
13. Door and Window Schedules
14. Mechanical Pump and Piping Plans, Sections, and Details
15. Temporary Pumping Plan
16. Piping Schematics
17. HVAC
18. Electrical Site Plan and Power Plan
19. Power Distribution One-Line Diagram(s)
20. Lighting Plan(s)
21. Electrical Enclosures - One-Line Diagram(s) and Elevation Layouts
22. Miscellaneous Devices/Panels One-Line Diagram(s)
23. Panel Schedule(s) and Layout(s); Circuit Schedule(s)
24. Instrumentation Plan
25. Process and Instrumentation Diagram

Technical specifications shall be prepared to supplement and clarify the construction drawings and these Standards.

9.01.5 Approval of Alternative Methods or Materials

See Approval of Alternative Methods or Materials in Section 1.06 of this Resolution and Order.

9.01.6 Construction Management/Facility Testing Procedures

a. General Roles and Responsibilities

General roles and responsibilities during construction shall be as follows:

1. Contractor shall coordinate directly with the Engineer on all construction issues, including interpretation of contract documents.

2. Engineer shall contact the District regarding any interpretation of Standards and other related District requirements.

3. Engineer shall contact and review with the District any proposed changes to the approved documents. For any change to the approved documents, Engineer shall submit a "Field Revision Form" to the District for approval.

4. District will perform periodic construction observation to verify that work is being performed in accordance with the approved documents. District inspector will not have the authority to approve any aspects of construction activities, nor authorize any changes or modifications.

5. Contractor shall attend a District-led tour of pump stations similar in construction and design to the proposed pump station.

b. Submittal Reviews

Engineer shall be responsible for obtaining and reviewing Contractor submittals to verify that proposed materials and equipment meet the specifications. Engineer shall be responsible for obtaining and reviewing Contractor submittals to verify that proposed materials and equipment meet the specifications. Furthermore, Engineer shall forward all submittals associated with the pump station performance and materials to the District for review. Required submittals include but are not limited to:

1. Pumps and motors
2. Valves
3. Flow meter
4. Pipe supports
5. Control panel layout
6. Control logic diagrams
7. Generator and automatic transfer switch
8. Deferred submittals
9. Level control measurement
10. Power panel board
11. Main breaker
12. Transformer

Engineer shall also forward to the District all requested substitutions to the approved documents, for review.

c. Pre-Construction Conference

Engineer shall facilitate and attend a pre-construction conference meeting with the District, the Contractor, the Owner, and other interested parties to review roles and responsibilities and to answer questions about the plans and specifications. Engineer shall prepare meeting agenda and provide the District with meeting minutes. The meeting shall be scheduled at least ten business days in advance.

Engineer shall facilitate an electrical, instrumentation and controls pre-submittal meeting. The contractor, associated electrical subcontractor, and

equipment manufacturer representatives shall attend this meeting. Equipment manufacturer representatives shall bring sample submittals for applicable equipment for review and discussion.

d. Construction Inspection and Meetings

Engineer shall weekly inspect the construction to confirm that the work is being performed in accordance with the approved plans, and to remedy any problems. Engineer shall also meet bi-weekly with the District on site to review construction progress.

e. Construction Check Points

At a minimum, the District will inspect the following items prior to Contractor proceeding with work. Engineer shall provide the District a minimum of two business days notice that the subject work will be completed and ready for inspection. Engineer shall be on site to participate in these inspections. Contractor shall not cover or otherwise obscure these work items until inspected by the District.

1. Wetwell Excavation/Base Rock - inspect prior to setting structure; verify compaction.
2. Vault Excavation/Base Rock - inspect prior to setting structure; verify compaction.
3. Piping connections between all structures and the force main - inspect prior to backfilling.
4. Base slabs for generator, electrical and other enclosures - inspect base rock, and verify compaction.
5. Pump base elbow anchor bolts - concurrent with structural testing as specified in Section 9.02.6(e).
6. Factory test of the pump station control panel.
7. Generator test.
8. Conduit installation.
9. Electrical wiring.

District inspection of these and any other items does not relieve the Contractor or Owner of responsibility for a complete and operating system.

Copies of compaction test results shall also be provided to the District.

f. Start-up

Engineer shall coordinate with Contractor to prepare a start-up plan to submit to the District for review and approval a minimum of 30 days prior to start-up. Engineer shall coordinate with Contractor and District to

schedule a start-up plan review meeting a minimum of 14 days prior to witness testing. Engineer shall coordinate with Contractor and District to schedule witnessing of facility readiness testing at the pump station prior to commissioning and start-up. Prior to facility readiness testing, Engineer shall coordinate with Contractor to provide all proper installation certifications and factory, field and readiness testing reports a minimum of 7 days prior to start-up. Engineer shall notify the District in writing that the pump station has been tested and operates in accordance with the construction document requirements, and provide a performance log which identifies any issues during performance testing. Engineer shall be on site to witness and oversee the formal pump station start-up testing. Prior to start-up, Engineer shall coordinate with Contractor for the equipment manufacturer's field service representative to be on site during all inspection and testing as detailed in an approved start-up plan schedule. District representatives shall inspect the installation and witness the start-up activities. District staff shall not perform any work during facility start-up.

All equipment shall be tested in accordance with the manufacturer's recommendations and as specified or required herein.

g. Warranties

The Engineer shall obtain and provide to the District a copy of the manufacturers' warranties for all equipment. These shall be included in the O&M manual.

h. Training

After field and readiness testing and prior to facility commissioning, the Engineer and manufacturer's representative shall train the District's personnel in the proper operation and maintenance of the pump station and all equipment. As part of the start-up plan mentioned in 9.01.6.f. a training plan shall be developed that includes the items covered during training and the day/time each of the items will be trained upon. The District may videotape the training.

i. Punch List

Following construction and start-up testing, Engineer and District shall develop a punch list of items to be completed or repaired. Contractor shall be responsible for correcting all identified punch list items. Engineer shall provide written confirmation that the work is completed.

j. Project Completion

The Engineer shall obtain and provide to the District a copy of the start-up report as prepared by the manufacturer's representative. The Engineer shall provide certification to the DEQ that all construction was completed per the approved plans and specifications.

9.01.7 Operation and Maintenance Manual

The Engineer shall prepare an Operation and Maintenance manual in accordance with District requirements. The manual shall constitute no less than two separate volumes. Volume 1 shall address the fundamental O&M procedures specific to the new pump station. Volume 2 shall provide the equipment manufacturer's O&M literature specific to the pump station. The District will provide an electronic copy (Microsoft Word format or searchable PDF) of the District's standard format for Volume 1. Engineer shall supplement with project specific information.

Specific information that shall be provided in the O&M manual shall include, but not be limited to, the following:

a. Electrical and control diagrams based on as-constructed conditions. Diagrams shall show the wire colors and numbers, coordinated with the field installation.
b. Calibration sheets for all calibrated equipment, including model number and serial number of the equipment.
c. Hard copy of all programming, including (as applicable) Missions , soft start/VFD, flow meter, and pump station level controller.
d. Hard copy of the generator test results.
e. Vendor list and contact information for all supplied equipment.
f. Complete set of reduced size record drawings 11x17.

The Engineer shall adhere to the following O&M Manual submittal process:

a. Draft O&M Manual - A draft O&M manual, Volume 1, shall be submitted to the District and the DEQ for review no later than eight (8) weeks prior to pump station start-up. Formatting and attachments shall meet District and DEQ requirements. A 90% version, including both Volumes 1 and 2, shall be submitted to the District for review two (2) weeks prior to pump station start-up.
b. Final O&M Manual - The final Volume 2 O&M manual, incorporating all District review comments, shall be submitted to the District prior to pump station start-up. Pump station start-up testing shall not proceed without the Volume 2 manual being complete. The final Volume 1 O&M manual shall be updated to address District review comments and to incorporate start-up records, and shall be submitted no later than two (2) weeks following pump station start-up.

9.01.8 As-Built Drawings

For the purposes of this section, as-built drawings will also mean drawings of record, record drawings, or terms indicative of an attempt to record the as-constructed state of the facility.

Following completion of construction, the Engineer shall submit as-built drawings. As-built drawings shall describe any and all revisions to the previously approved construction plans, and shall be accompanied by a certification letter from the Engineer, indicating that the as-built drawings have been reviewed and revised as necessary, to accurately show all known as constructed details, and that the improvements have been completed in accordance with the District Standards to the best of his/her knowledge. The words "As-Built Drawing" or "Record Drawing" shall appear as the last entry in the revision block along with the month, day, and year the as-built drawing was prepared.

One complete full-size draft set on paper shall be submitted first for checking by District staff. Submission of as-built drawings shall be made within two (2) weeks of acceptance of facilities by the District.

After making changes prompted by District review of the draft paper copy, final As-Built Drawings shall be submitted. All plans shall be prepared using Computer Aided Drafting (CAD), and the final submittal shall include the following:

a. An AutoCAD compatible digital form (DWG Format) of the as-built drawings (version per District requirements).
b. Basic layering scheme.
c. Standard symbols for appurtenances.

9.01.9 Project Review and Acceptance Process

Key aspects of the Project Review and Acceptance Process are as follows:

a. Request for Pump Station Installation

   Owner shall first submit a written request to District for permission to install a wastewater pump station in lieu of a gravity sewer.

b. Gain Approval to Construct Pump Station

   District will determine the need for a pump station. If District determines that a proposed pump station is an acceptable alternative to a gravity sewer, District will grant permission to proceed with pump station design.

c. Number of Copies

Unless otherwise noted, for all project submittals, submit six (6) copies to the District.

d. Wastewater Treatment Department (WTD) Design Review

Pump station/force main design and construction documents shall first be reviewed and approved by WTD. All submittals shall be delivered to WTD. Upon approval by WTD, the approved construction documents shall be submitted to Development Services. Development Services will perform a final review of the documents and issue the required construction permits.

e. Coordination with Development Services Reviews

Engineer shall coordinate with Development Services reviews to satisfy requirements associated with the gravity sanitary sewer and additional site layout requirements.

f. DEQ Plan Review

Concurrent with final Development Services review, the Owner shall submit final WTD approved plans and specifications to DEQ for review. A copy of the DEQ approval shall be submitted to the District before final design approval is issued.

g. Final Design Approval

Upon final District and DEQ reviews and approvals and receipt of appropriate review fees (including separate payment to DEQ for their review fees), Development Services will issue final design approval and the required construction permits. Following issuance of the construction permits, two (2) sets of construction documents will be returned to the Engineer for use during construction. The construction Contractor shall at all times use approved plans during construction, and shall maintain such on site.

h. As-built Drawings

Submit one (1) complete set of both paper and electronic as-built drawings.

i. Operation and Maintenance Manual

Submit draft copies to District and DEQ for review. Submit six (6) copies

of the final manual. Pump station start-up shall not proceed if the O&M manual submittals are not complete. District will submit final approved copy of Volume 1 to DEQ.

j. Project Acceptance

The pump station can be placed into operation and the District will assume facility operations after all start-up, testing, punch list, O&M manual, and maintenance assurance requirements have been completely satisfied. The pump station shall not be placed into operation until all these requirements have been addressed, including completion of all punch list items.

k. Timing for Project Reviews

The WTD review process is separate and independent from the Development Services processes, including those related to public/private sanitary sewer improvements. Development Services' pump station/force main plan review timing will not start until the WTD review process is complete. Upon acceptance of the complete submittals as described in these Standards, WTD will endeavor to approve, return for revision, or reject the documents within 10 working days. Reviewed submittals will be returned to the Engineer, with comments and/or revisions to the documents shown in red.

For construction submittals/substitution requests, the District will endeavor to approve, return for revision, or reject the submittal within 10 working days.

9.01.10 Performance and Other Assurance Requirements

Project performance assurance, "as-built" assurance and maintenance assurance shall be provided as required in Chapter 2 of these Standards. As specified in Chapter 2, construction punch list generated for the pump station and force main shall be completed prior to release of performance assurance. WTD staff will prepare the construction punch list, following successful pump station start-up.

9.02 Design and Construction Requirements

9.02.1 General

The following requirements are the minimum for the design and construction of wastewater pump stations and force mains. The Engineer shall prepare the design to conform to these requirements and any additional project specific requirements identified during the Project Kick-off meeting and subsequent District reviews. In addition, the design and construction shall comply with

all other District standards, as applicable and as referenced herein. In the event of conflicts, these Chapter 9 Standards shall govern.

In general, these Design and Construction Standards require a complete submersible sewage pumping system, equipped with a minimum of two submersible sewage pumps installed in a concrete wetwell. The pumps shall discharge into a sewage force main that empties into a gravity sanitary sewer pipeline. Equipment redundancy shall be provided, unless otherwise specifically noted. The pumping system shall be operated with a fully independent and automatic control system. Sufficient valves and a flow meter, installed in concrete vaults, shall be provided on the force main. The pump station shall be constructed on a parcel of sufficient size to allow for all required District operations, and the site shall be accessible under any weather condition by District vehicles. The pump station site shall be protected from flooding, and shall be fenced. The pump station shall be provided with all required public and private utility services.

9.02.2 Site

a. Flood Plain

The entire pump station site and access to the site shall be no less than two (2) feet above the 100-year flood plain level. Mapping shall be provided to verify that this requirement has been met.

b. Clearances/Setbacks

Clearances/setbacks from all equipment and structures shall be in accordance with applicable codes, including but not limited to building and electrical codes. Minimum clearances shall be 42 inches in front of all electrical control panels, and 48 inches around the standby generator. Sufficient clearances shall be maintained within the fenced site for access to and ease of equipment maintenance. Setbacks shall also be maintained consistent with local planning requirements.

c. Grading and Drainage

Surface water around the perimeter of the site shall be directed away from the pump station. Floors shall be sloped to prevent ponding and to direct water to drains and sumps. All on-site drainage shall drain off the pump station site to an approved point of disposal with the exception of the pump wash-down area. Catch basins, if required, shall be Lynch-style, trapped, and minimum four square feet open area. If the catch basin is for the pump wash-down area, it shall be a standard catch basin style and have a minimum four square feet open area. Drainage provisions shall be in compliance with District standards for water quality and erosion control

and with all local building codes.

Provisions shall be constructed to prevent flooding of below grade structures with the exception of the pump station wet well. Footing/subsurface drains shall be installed where such drains can be daylighted. See also Section 9.02.3.

The entire site shall be graded for positive sloping at a minimum of 2% and a maximum of 7%, including equipment pads. No bird paths shall be constructed.

d. Access

A minimum twenty (20) foot wide right-of-way and minimum fifteen (15) foot wide asphalt surfaced access road shall be provided for access to the pump station site. Access roads longer than 50 feet shall include at least one turn-around outside the fenced area. Turn-around shall be of sufficient size for the District's pump station O&M crew vehicle. Turn-around shall be designed based on a minimum 30 foot vehicle turning radius, and with no more than two (2) turning maneuvers required to turn the vehicle 180 degrees. Road grades shall not exceed seven (7) percent. No private gates will be permitted across the access road. Access road shall be designed to provide safe entrance/exit and stopping areas, in accordance with standard road design guidelines.

Within the pump station site, access shall be provided to all structures/equipment for the District's equipment maintenance vehicles.

Access of a minimum of 5 feet shall also be provided around the entire fenced site to perform required maintenance (see also Parcel Size requirements in Section 9.01).

e. Fencing/Security

The pump station site, including all equipment and structures, shall be enclosed by a six-foot high fence with access gate. Fencing may consist of chain link or it may consist of decorative split face concrete masonry units. Chain link fence shall be 2-inch mesh, 9-gauge copper bearing steel wire, with minimum 15-mil PVC coating. Color shall be black conforming to ASTM F934, with a minimum of 10-15 mils of thermal bonded and fused coating. Fence installation shall maintain sufficient clearance, per Standard Detail 1005, from the station and associated structures such that maintenance operations can be accomplished without removal of the fence. Inside of the fence to the nearest equipment shall be a minimum of

six feet. See also Clearances/Setbacks.

Access gates shall be rolling or swinging. Swinging gates shall be placed such that both panels can be fully opened to allow entry into the pump station. Gate opening shall be a minimum 15 feet. As applicable, the gate shall be installed to allow a maintenance vehicle to be pulled completely off the public roadway prior to unlocking the gate, 32 feet minimum. Access gates shall allow for padlocking, but security wire and inclined brackets at the fence top shall not be required except in special situations. Gate stops shall be provided for swinging gates (see Drawings). Swinging gate center stop shall be mushroom-type.

f. Paving

The access road and entire pump station site shall be surfaced with 8-inches of 3/4 inch minus crushed rock overlain by a 1-1/2 inch thick lift of Class 'B' asphaltic concrete and a 1-1/2 inch thick lift of Class 'C' asphaltic concrete. Compact the crushed rock to 95% maximum dry density in accordance with AASHTO T-99. Compact the asphalt to 92% maximum density in accordance with AASHTO T238 (Method A or B). Place the crushed rock on compacted subgrade. Install geosynthetic fabric on top of compacted subgrade for the full width/length of the access road and within the pump station site. Perform a minimum of two compaction tests for both the base rock and asphalt surface.

g. Landscaping

Landscaping shall be provided as required by the development's Land Use Permit. In general, it should be designed to blend-in with surroundings and require little regular maintenance, and be drought resistant to eliminate the need for an automatic irrigation system. Shrubs and/or bushes with thorns shall not be allowed.

Landscaping Drawings and Specifications shall be included in the Contract Documents and submitted for District review. They shall include the Standard Details presented within this document.

The irrigation controller shall be a Rainbird ESP-SMTe Smart Controller, or equal.

Sprinkler heads shall be Rainbird 1800-SAM-PRS, or equal.

h. Lighting

Area lighting shall be provided in accordance with the Electrical requirements as specified herein.

i. Site Sign

District will provide a sign. The sign is 18 inches by 24 inches and made of aluminum. The sign shall be securely mounted to the fence gate, unless otherwise specified or required by the District.

9.02.3 Wetwell, Vaults, and Other In-Ground Structures

a. General

1. Applicable Building Codes - Structures shall be designed and constructed consistent with the seismic zone and applicable requirements as specified in the Oregon Structural Specialty Code (OSSC).

2. Testing - Special inspections and/or testing shall be performed on all cast-in-place concrete, anchors, and other structural items as specified in the OSSC.

3. Structural base fill shall consist of 3/4-inch minus crushed rock, compacted to 95% maximum dry density in accordance with AASHTO T-99. Total thickness shall be a minimum of 12 inches. Design shall also incorporate recommendations from the geotechnical investigations. Backfill shall be 3/4-inch minus crushed rock, compacted to 95% maximum dry density in accordance with AASHTO T-99. Backfill shall not be placed against forms or temporary construction materials, or over any debris material. Backfill shall not be placed against poured concrete until 28 days have passed from completion of original concrete pour. Compaction within 5 feet of the walls shall be accomplished using hand operated vibratory plate compactors or tamping units. Particular care shall be taken to avoid damage to the pipe connections and to the structure.

b. Wetwell (see also Chapter 8 of these Standards)

1. Configuration - The wetwell shall be a circular configuration, with consistent diameter throughout. The floor shall be sloped for proper installation and function of the pump inlets. The wetwell shall be designed to minimize the potential for vortexing, rag and debris build-up, and other possible inlet problems. If needed to prevent inlet problems, a stainless steel plate can be placed in front of the influent sewer entrance into the wet well to direct the

influent in the downward direction. Flow from the influent sewer shall not be directed towards the pump chains and cables. Pump inlets shall be designed at a distance of 0.3D to 0.5D above the wetwell floor (where D is the diameter of the inlet), but not less than 3 inches. Sump bottom shall be grouted to provide inclined surfaces (60-degree angle to horizontal) to direct solids to the pump inlets. Grout shall be anchored into the precast concrete structure using rebar or other similar products. Wetwell shall have one common sump; no split sumps or any barriers shall be installed between pump inlets.

2. Finished Grade Elevation - Wetwell lid shall be a minimum 2 inches and a maximum of 7 inches above finished grade, to prevent surface water from draining over the lid and into the wetwell. The lip of the wet well shall be painted safety yellow to indicate a potential trip hazard.

3. Materials of Construction - Structure shall preferably be precast. Precast concrete wetwells shall meet the standards in Chapter 8 of the District's Standards. Floor slab shall be a minimum 12 inches thick. Top slab shall be designed for H20 loading. Joints shall be watertight, sealed with rubber ring per ASTM C 443 or mastic gaskets. Joints shall be grouted outside with high strength, non-shrink grout (see also Chapter 8). No lift holes shall be allowed. Alternative lifting mechanisms shall be designed into the structure.

4. Explosion Resistance - All equipment and fixtures installed in the wetwell shall be explosion proof rated in accordance with the applicable electrical codes and as specified herein.

5. Sanitary Sewer Inlet Piping/Isolation - Only one sanitary sewer inlet into the wetwell shall be allowed. Connection shall be flexible, in accordance with Chapter 8 of these Standards. Penetration shall be pre-cast into structure; field constructed penetrations shall not be allowed. No wetwell penetrations shall be made within 6 inches of a wetwell joint. Inside/outside drops shall not be allowed. A pipe joint shall be provided within 12 inches of outside wall of the wetwell. Inlet discharge shall be above the normal pump operating levels, while minimizing the vertical drop to prevent air entrainment conditions. Inlet piping shall be designed to avoid vortexing and cavitation. Additional items on this topic are located in 9.02.3. b.1. The design shall provide for the isolation of the wetwell, to allow for maintenance.

6. Force Main and Other Pipe Penetrations - Penetrations for the force mains, vault drains, and other required connections shall be

pre-cast into structure; field constructed penetrations shall not be allowed. Such pipe penetrations shall be sealed with link seal type seals. For pipe sizes too small for link seals, seal with epoxy sealant.

7. Operating Levels - Inlet piping shall not be used for storage. 'Pumps off' level shall be established to prevent vortexing, and also to provide motor cooling as required by the motor specified. See also pump and motor design requirements and Instrumentation and Control section for additional requirements.

8. Installation - The construction installation method shall be specified and shown on the construction drawings. For any proposed special installation procedures, such as caisson construction, sufficient detail shall be provided for District review.

9. Testing - Perform hydrostatic test in accordance with District standards for manholes.

c. Vaults

1. Size - Vaults shall be no deeper than five feet (5'-0") from the rim to the vault floor. Minimum of 12-inch spacing shall be provided between all piping, edge of pipe to edge of pipe. Minimum of 6-inch spacing shall be provided between valves, edge of valve to edge of valve. Minimum of 24-inch spacing shall be provided between all piping and vault walls/floor, edge of pipe to inside surface of vault. Vaults shall be large enough to allow for a worker to enter and perform routine maintenance.

2. Finished Grade Elevation - Vault lids shall be a minimum 2 inches and maximum of 7 inches above finished grade, to prevent surface water from draining over the lid and into the vaults.

3. Materials of Construction - Vaults shall be constructed of precast concrete, unless otherwise approved by the District. Vaults shall comply with the requirements of ACI 318-99. Concrete shall have minimum 4000 psi, 28 day compressive strength. Joints shall be keyed and shall be provided with a watertight gasket.

4. Construction - Vaults may be formed with separate top and bottom slabs. Walls shall be cast so that all sides are continuous at corners and their full length with no blockouts or knockouts. All pipe penetrations shall be pre-formed or core drilled at the required locations.

5. Pipe Penetrations - Seal all wall pipe penetrations with link seal type seal. For pipe sizes too small for link seals, seal with epoxy sealant.

6. Drain - Vault shall gravity drain to the wetwell. Sump pump shall not be allowed. Drain pipe shall be minimum 4-inch diameter. A maintenance-accessible flap valve shall be provided at the discharge end. A P-trap, primed continuously through a connection to the on-site water supply shall be provided as follows. Extend minimum 3/4-inch diameter water line into the vault, terminating at a non-freeze hose bib mounted on the vault wall. Install 1/4-inch tee and ball valve, and extend 1/4-inch diameter copper tubing to the vault drain to serve as the priming supply. Secure all piping to the vault with stainless steel hardware. If water cannot be supplied to the pump station site prior to Facility Startup, a bell drain may be used in place of a P-trap.

7. Testing - Perform hydrostatic tests in accordance with District Standards for manholes.

d. Force Main Discharge Manhole

Discharge manholes shall comply with the District's standards for sanitary sewer collection systems. When required herein under hydrogen sulfide management requirements, discharge manholes shall be coated with a District approved protective coating or chemical additive in the concrete. Discharge manhole lids shall be fitted with carbon baskets.

e. Access

Wetwell and vault access shall be provided through a minimum double door, 3-foot square opening. The door shall be aluminum, diamond plated, H20 rated, and spring assisted to produce an apparent weight less than 50 pounds. The door shall be provided with a recessed padlock clip for locking with a standard padlock.

The wetwell access hatch shall be provided with the fall prevention system described herein and vault access hatches shall be provided with perimeter drain channels, which shall discharge to daylight through minimum 1-inch diameter pipes at the perimeter of the concrete lid.

f. Fall Prevention Equipment/Personnel Removal System

Wetwell and vaults shall be designed to conform to Oregon-OSHA requirements. Design shall also comply with District safety standards for personnel entry/removal. Railings, safety grates, or other approved and acceptable systems shall be provided. Safety nets will not be approved. For wetwells, a grated fall prevention system integral with the access hatch system shall be provided that meets the following minimum specifications:

1. Provides complete coverage of the wetwell opening when access hatch has been opened.
2. Design allows for visual inspection of the wetwell without opening the fall prevention system.
3. Grating shall be of aluminum construction, with epoxy powder coating, color orange.
4. All stainless steel hardware.
5. 300 psf pedestrian rated.
6. Opens separately from the access hatch. Access hatch must be opened first.
7. Installs and operates without interfering with the pump guide rails. Does not interfere with pump removal.
8. Apparent weight shall be less than 50 pounds.

System shall be the Aluminum Safe Hatch, as manufactured by Syracuse Castings, or equal.

g. Ladders and Miscellaneous Hardware

Access ladders shall not be installed in the wetwell or vaults.

h. Buoyancy

Engineer shall evaluate the buoyancy potential for all buried structures. Engineer shall perform evaluations assuming ground water level at ground surface, and for the wetwell assume that the water level is at "pumps off." Factor of safety against buoyancy shall be a minimum of 1.25 under gravity conditions.

9.02.4 Mechanical

a. Heating and Ventilation

Wetwell and vaults shall be passively ventilated. Electrical equipment

within these structures shall be designed to comply with the National Fire Protection Association (NFPA) 820 requirements and the applicable electrical code for this ventilation condition. For the wetwell, passive ventilation through the access hatch alone shall not be sufficient. Vent(s) shall be installed so as not to interfere with vehicular or pedestrian activity related to accessing and maintaining the pump station facility. Above grade vent pipe shall be Schedule 80 galvanized pipe, protected with a non-corrosive wire mesh screen at the end of the pipe to prevent the entrance of birds, rodents and other small animals. See also the District's Electrical and Instrumentation Control requirements elsewhere in these Standards for the design of electrical components inside these structures.

Heating and ventilation shall be provided for all electrical and control panels, in accordance with the requirements herein under the "Electrical and Instrumentation Control Requirements."

b. Plumbing

1. Drainage - Vault drain piping material shall be in accordance with the Uniform Plumbing Code. Site drainage piping material shall be as required for the depth of bury and traffic loading condition. For PVC piping, glue system shall be two-part, including primer and glue. "One Step" systems shall not be allowed. Minimum pipe size shall be 4 inches in diameter.

2. Water Supply - On site potable water supply shall be provided through a metered 1-inch water supply connection to the municipal water supply, with a backflow preventer and a 1-inch yard hydrant. Water piping shall be copper. Yard hydrants in exposed locations subject to freezing shall be of the non-freeze type. Yard hydrant shall be located out of the way of traffic, and shall be secured to and protected by 4-inch diameter galvanized steel bollard filled with concrete.

3. Backflow Prevention - A Conbraco Apollo 40-200 series (1-inch diameter) reduced pressure backflow device shall be installed on the potable water piping entering the pump station site and upstream of any service connections. This device also shall be approved by the Oregon State Health Division. Double check valve assemblies are not acceptable. Backflow device shall be installed above grade in a fiberglass enclosure. Above-ground water pipe shall be provided with PVC jacketed insulation and thermostat-controlled heat tape. Power supply to the enclosure shall be provided through a dedicated circuit breaker.

4. Plumbing shall be tested in accordance with Uniform Plumbing

Code requirements. A copy of certified test results for the backflow prevention device shall be provided.

c. Hydrogen Sulfide Control System

Where an active hydrogen sulfide control system is required by these Standards, system type shall be as directed by the District and design shall be approved by the District and comply with DEQ guidelines. Systems shall be designed to maintain the dissolved sulfide content of the pumped sewage below 0.1 milligrams per liter at the point of discharge into the gravity sewer manhole.

9.02.5 Force Main and Appurtenances

a. General

Engineer shall design the force main and appurtenances in accordance with American Water Works Association (AWWA) requirements. Minimum force main size shall be four (4) inches in diameter. Design force main velocity shall be 3.5 to 8.0 feet per second. Force main shall be designed to continuously ascend from the pump station to its discharge location, unless otherwise approved by the District. Alignment shall minimize distance from pump station to discharge manhole. Force main shall be installed inside a public right-of-way or permanent easement dedicated to the District (minimum 15 feet wide). Horizontal bends shall be minimized. Use two-45 degree bends in lieu of 90-degree bends. The system shall be designed to allow for the easy removal of pumps, check valves, and flow meter while maintaining the facility in continuous operation.

b. Force Main Pipe and Fittings

All force main piping shall be of the same diameter. Force main piping in the wetwell and through all vaults shall be cement lined, minimum thickness class 53 ductile iron pipe conforming to AWWA C151, without exception. Buried pipe between the vaults and discharge manhole may be cement lined, minimum thickness class 52 ductile iron pipe or polyvinyl chloride (PVC). PVC pipe shall meet AWWA C900, Class 200 (less than or equal to 12 inch diameter) or C905, Class 235 (greater than 12 inch diameter) standards. PVC pipe joints shall meet ASTM D3139 and F477 standards. Fittings shall be factory fabricated cement lined ductile iron, minimum 250 psi rated. Merging of the pump discharge manifold into a common force main shall be made using a 'wye'. Buried joints shall be push-on or mechanical. Flanged buried joints shall not be allowed. Exposed joints shall be flanged. For vertically oriented flanged pipe (e.g. inside the wetwell), piping shall be installed with permanent flanges

located on the lower end at all times. Joint restraint shall be accomplished mechanically or with concrete thrust blocks. Flexible, restrained connections shall be made outside and within 12 inches of each structure.

Copper solid core toning wire (Copperhead SoloShot #12 AWG hard drawn or equal, color green) and locate tape shall be installed with all buried force main piping. Toning wire shall be installed inside 1-1/2" PVC SCH 80 conduit and terminated at Pipe Warning Signs as shown in the Standard Details every 500 feet along the force main alignment, or as otherwise required by the District. If approved by the District, offset boxes may be replaced with Copperhead SnakePit Tracer Roadway RB14*TP valves boxes. Conduit for the toning wire shall be taped to the top of forcemain at a minimum of every 10 feet. Toning wire shall also be installed for all piping associated with the pump station and forcemain. This includes air/vacuum valve piping and drain piping. Prior to pulling wire through conduit, wire shall be lubricated. Locate tape shall be 4 inches wide, with "WARNING-SANITARY SEWER PIPELINE" or similar printed in large letters on the tape. Toning wire shall be installed within conduit on top of the force main; locate tape shall be installed 12 inches above the force main.

Installation of force main and appurtenances shall conform to Chapters 7 and 8 of these Standards, AWWA C600 for ductile iron pipe installation, and AWWA C605 for PVC pipe installation. Prior to installation of the forcemain, the Contractor shall submit survey cutsheets.

c. Check Valves

Each pump discharge shall be fitted with an AWWA C508 check valve installed inside a valve vault. Check valves shall be swing check-type with weighted external arm using metal bushings, mounted in the horizontal position, with flanged end connections. Valves shall be of cast/ductile iron construction, with cast/ductile iron disc, stainless steel hinge pin shaft passing through a stuffing box, replaceable body seat ring, and epoxy lining and coating. O ring shaft seals shall not be acceptable. Check valves shall be provided with valve (with threaded ends) for pressure relief installed in the top plate or inspection cover, with drain tubing to the vault drain. The valve operators and their orientation shall be drawn to scale on the drawings to clearly identify available operating space. Check valves shall not be installed in the wetwell.

d. Isolation Valves

Each pump discharge shall be fitted with an isolation valve, located inside the check valve vault and immediately downstream of the check valve. An isolation valve shall be installed in the common force main

downstream of the flow meter.

Isolation valves shall be cast or ductile iron eccentric plug valves, with flanged end connections and with cast/ductile iron plug. Plug valves 4 inches and larger in diameter shall be gear driven. Valves shall have grit seals on both the upper and lower stem journals. Seat area shall be raised, with raised area completely covered with not less than 90% pure nickel weld. Shaft seals shall be of the multiple V-ring type and shall be externally adjustable and repackable without removing the actuator or bonnet from the valve under pressure. Plug valves shall be installed such that the plug opens to the top and the valve seat is located on the pump side of the valve. Valves in vaults shall have handwheels, with the handwheels operating facing up. Buried valves shall have gear box hermetically sealed and be equipped with 2-inch square AWWA operating nut. The valve operators and their orientation shall be drawn to scale on the drawings to clearly identify available operating space.

e. Air Release Valves

Air relief and air vacuum release, or combination air release and vacuum valves shall be installed at locations along the force main to prevent air from being captured inside the piping, and to allow for draining of the force main. Each such valve shall be sized with the proper orifice size suitable for the volume of air to be admitted or released. Such valves shall be provided with an isolation valve, and with a bleed-off valve at the base. Air release valves shall be stainless steel as manufactured by Vento-o-Mat. Air release valves shall be installed above ground, within an enclosure if feasible. Above ground enclosures and underground vaults shall be adequate size for equipment installation and large enough to allow a worker to enter and perform routine maintenance. Above ground enclosures, if approved shall be composed of fiberglass 6 feet length by 6 feet width by 4 feet height minimum. Additional details on the above ground enclosures can be found on the Air Release Valve Standard Details. For the underground vault, the minimum horizontal vault dimensions shall be 4 feet by 6 feet depth of vault shall be no greater than 5 feet from the rim to the vault floor. Vault access shall be provided through a double door, with a minimum 3 feet by 3 feet square opening. Door shall be aluminum, diamond plated, H20 rated, spring assisted. Door shall be provided with a recessed padlock clip for locking with a standard padlock. All components shall be corrosion resistant, appropriately cathodically protected if key components are buried, and composed of schedule 40 stainless steel, schedule 80 PVC, or approved equal.

f. Bypass Connection

Force main shall be provided with a bypass connection at the pump station to allow for temporary bypass pumping and for force main cleaning. The connection shall be exposed, unless otherwise approved by the District to be placed in an underground vault. The connection shall be downstream of the common force main isolation valve. The connection shall be as shown in the Standard Details.g. Force Main Discharge

Force main shall discharge into a manhole at the manhole invert. Force main invert elevation shall not be greater than five feet below ground surface. Where existing sanitary sewer collection system manholes exceed this depth, a separate, dedicated force main discharge manhole shall be provided, with a gravity connection to the sanitary sewer collection system. Where possible, discharge alignment shall be in line with the manhole outlet. Discharge alignment shall not be less than at a 90-degree angle with the outlet.

h. Flow Meter

A flow meter shall be provided on the common force main, either installed in the valve vault or in a separate vault. Flow meter shall be as specified under Electrical and Instrumentation Control Requirements. Flow meter display shall be mounted between four and six feet above finish grade.

i. Gauges

A pressure gauge shall be installed on each pump discharge, upstream of the check valve. A pressure gauge shall also be installed on the common force main, downstream of the check valves. Gauges shall be 3-1/2-inch diameter with stainless steel case, polycarbonate glass window, stainless steel movement, blowout disc and 1/2-inch NPT stainless steel lower connection. Gauge shall be selected such that the gauges will read from 40 to 70 percent of full scale under normal operating conditions and not exceed 90 percent of full scale under pump curve shut-off condition. Gauges shall be Ashcroft or equal. Gauges shall be mounted to a stainless steel diaphragm seal and filled with glycerin. Gauges and diaphragm seals shall be connected to the force main per the Force Main Pressure Gauge Standard Drawing.

j. Surge Protection

Engineer shall evaluate the pump and force main system to identify the potential for transient pressures or column separation conditions that could damage the pump-force main system. Documentation of the surge

analysis shall be included in the design report. Surge protection shall be designed as necessary to avoid a pressure gradient change from positive to negative. Surge protection/column separation prevention measures shall include air cushion check valves, surge anticipation/relief valves, or air relief valves.

k. Supports

Engineer shall size and design pipe supports, as required, for piping in the wetwell and vaults. Supports shall be designed to meet UBC seismic requirements, as applicable, and shall also be designed to resist maximum expected surge. Pipe supports in vaults shall be laid out considering maintenance and removal of valves and the flow meter. Pipe supports in the wetwell shall be designed to minimize horizontal movement of the pipe. In all cases supports shall be provided to prevent transfer of load to flanges, valves, and flow meter.

Supports shall be constructed of 316 stainless steel. Anchors and bolts/nuts shall be minimum Type 316 stainless steel. All concrete anchors shall be epoxy-based.

l. Odor Control System

Engineer shall evaluate the potential for generating odors within the wet well, at the force main discharge manhole and at any air valve locations. As required, the Engineer shall size and design an odor control system to minimize or prevent production of odorous compounds. The proposed odor control system shall be reviewed and approved by the District during preliminary design.

m. Painting

Piping and valves in the wetwell and vault(s) shall be painted with epoxy. Prepare and paint in accordance with the Steel Structures Painting Council standards. Paint system shall be applied in minimum three coats, with the first coat being a zinc-based primer. Each paint coat shall be 4 to 6 mils thick. Color shall be as selected by the District.

n. Force Main Testing

Field testing of the force main and appurtenances shall be completed by a hydrostatic test with potable water that meets the following requirements. Contractor shall be responsible for making all necessary provisions for conveying water to the points of use and for disposal of the test water, including temporary taps and plugs.

1. Prior to the start of the hydrostatic test, all trenching shall be backfilled and compacted per the requirements of Chapter 7.

2. When concrete thrust blocks are used, the hydrostatic test shall be conducted at least five days after thrust block installation.

3. Seal pipe ends and secure pipe with temporary thrust restraint, as required, to maintain line and grade and to prevent damage.

4. Furnish all equipment and materials for the test including:

   A) Test pump approved by the District.
   B) Suitable suction and discharge pipes and hoses.
   C) Suitable graduated containers for measuring water loss.
   D) Pressure gages with pressure range at least 20% greater than the required test pressure and with graduations in 2 psi maximum increments. Gages shall have been calibrated within 90 days of the test.

5. Conduct the hydrostatic test so the lowest point along the test section is subjected to a hydrostatic pressure of 150 psi or 1.5 times the operating pressure, whichever is greater.

6. Fill the test section with water and allow it to stand at two-thirds of the test pressure for a minimum of 12 hours. Expel air from the test section. Apply and maintain the test pressure for a minimum duration of two hours and measure the leakage during this period. Operate the test pump as required to maintain the pressure within plus or minus 5 psi of the test pressure throughout the test period.

7. At the conclusion of the test period, operate the pump until the test pressure is obtained. The pump suction shall be in the graduated container so the amount of water required to restore the test pressure is accurately measured.

8. The measured leakage shall not exceed the allowable leakage amount calculated by the following formula:

$$AL = \frac{LD(P)^{1/2}}{133{,}200}$$

where: AL = Allowable Leakage in gallons per hour
L = Length of pipe tested in feet
D = Diameter of pipe (nominal) in inches, and
P = Test Pressure in pounds per square inch

9. If the measured leakage is in excess of the allowable leakage, the section of pipe tested shall be repaired and re-tested until the actual leakage is reduced below the allowable amount.

10. Visible leaks in the wetwell and vaults shall be eliminated regardless of the leakage amount.

9.02.6 Pump and Motor

a. General

1. Materials and equipment shall be standard products of both a manufacturer and distributor regularly engaged in both the manufacture and distribution of such products for at least 2 years, and shall be suitable for the service intended. All materials and equipment shall be new and unused.

2. The pumps shall be supplied by a distributor authorized to service them throughout the warranty period and beyond. The distributor shall be located within a 50-mile radius of the site, and shall be capable of providing 24-hour, 7-day service.

3. The pumps shall be warranted by the manufacturer for a minimum of two (2) years from the date the pump station is placed into operation and accepted by the District.

4. Where two or more pieces of equipment performing the same function are required, they shall be duplicate products of the same manufacturer.

5. Wetted parts shall be compatible and suitable for use with raw wastewater.

6. Nameplates - Equipment shall be fitted with a stainless steel nameplate indicating (as applicable) serial number, rated head and flow, horsepower, impeller size, rotating speed and manufacturer's name and model number. Attach second name plate to starter/VFD cabinet.

7. The entire pump station assembly shall be UL approved as Explosion Proof for operation in a Class 1, Division 1, Group D hazardous location.

b. Compatibility

Pumps and pump station equipment shall be compatible with other District

pumping stations, and final equipment selection shall be approved by the District.

c. Solids Handling

Pumps shall be capable of handling and passing minimum 3-inch spherical solids and any trash or stringy material.

d. Pumps

1. The Engineer shall select pump(s) that will operate under the determined hydraulic system curve conditions and at the highest efficiency possible. Selection of pump(s) with flat operating curves (e.g. where a small change in total dynamic head results in a large change in pumped flow) shall be avoided. Pump(s) shall operate in accordance with the manufacturer's recommendations under all operating conditions. The entire pump curve shall be non-overloading.

2. Pumps shall be manufactured by Flygt.

3. Pumps shall be designed for continuous operating service for pumping raw, unscreened sewage, and constructed to meet the intended service.

4. A minimum of two pumps per station shall be provided.

5. Pumps shall have tandem double mechanical seals. Lower (primary) seal faces shall be silicon-carbide or tungsten-carbide. Metal parts shall be Type 316 or 316L stainless steel. Probes shall be provided between seals to detect moisture and associated seal failure. A seal leak monitoring system shall be provided by the pump manufacturer. System shall monitor probes continuously for seal leakage. Seal leak monitoring system shall be integrated into the Pump Sequence Control Panel, with a discrete alarm light provided on the front of the control panel.

6. Pumps shall have replaceable impeller and volute/impeller wear rings. Wear rings shall be constructed of stainless steel.

7. Impeller shall be of cast/ductile iron construction, non-clog type with pump-out vanes on the back side to reduce pressure on the shaft seal and help eliminate buildup of foreign materials.

8. Pump assembly shall be painted with a zinc-based primer and a water-based air-dried enamel finish coat. Total paint system

thickness shall exceed 2.0 mils, with each coat exceeding 1.0 mil minimum thickness.

9. Rotational Direction - All pumps shall have the same rotational direction.

10. Submersible pumps shall not exceed 50 HP. Where a two-pump system would require greater than 50 HP units, three or more units less than or equal to 50 HP shall be installed, with a minimum of two units delivering the design flow rate.

e. Discharge Elbows

Each pump shall include a separate cast iron discharge base elbow, securely mounted to the wetwell floor with stainless steel epoxy anchors and as specified by the manufacturer. Anchor installation shall be tested in accordance with UBC requirements prior to installation of base elbow. Base elbow shall be a reducing diameter type, as necessary, to transition between pump discharge and the full diameter force main. Pump shall be designed to automatically and firmly connect to the discharge connection, with sealing of the pump unit to the discharge connection accomplished by a machined metal-to-metal watertight contact.

f. Motors

1. Motors shall be Factory Mutual or Underwriter's Laboratories approved. Pump motor shall be induction type with a squirrel cage rotor, shell type design. Motor shall be housed in a sealed, submersible and explosion proof rated, air or oil filled shell. Motor shall be rated for continuous duty either completely dry or fully submerged in the pumped liquid. A minimum 1.15 service factor shall be specified.

2. Motor shall be minimum NEMA design B with minimum Class F insulation. Stator windings shall be of high conductivity copper magnet wire. Heat sensors shall be embedded into the motor windings, and shall be set to open upon exceeding the motor design temperature. The sensors shall be connected to an alarm in the control panel. Upon a thermal overload, control system shall turn off and lock out pump operation until manually reset.

3. Bearings - The pump and motor assembly shall rotate on two bearings. An upper radial bearing and lower thrust bearing shall be required. These shall be heavy-duty single row ball bearings which are permanently lubricated. Bearings requiring lubrication according to a prescribed schedule are not acceptable. The

bearings shall be rated at a minimum B-10 bearing life of 50,000 hours at design loads.

4. Motor nameplate horsepower shall exceed the maximum required by the pump under all possible operating conditions. Significant motor oversizing, however, shall be avoided.

5. Electric Cables - Motor and sensor cables shall be heavy duty, submersible type rated to 600 volt and 60 degrees C. The power cable and cap assembly shall be designed to prevent moisture from wicking through the cable assembly. Electrical cables shall be of sufficient length to require no splicing between motor and air gap panel.

6. Cable Entry - The cable entry seal shall be designed to ensure a watertight and submersible seal. Power and control cable entry into the lead connection chamber shall include elastomer grommets, washers, and epoxy sealed leads. Epoxies, silicones, or other secondary sealing systems alone shall not be considered acceptable.

7. Motor Starting Frequency - Sufficient wetwell operating volume shall be provided such that motor starting frequency and minimum time between motor starts complies with NEMA requirements.

g. Guide Rails

Each pump shall be easily removed and replaced on two, 2-inch diameter stainless steel guide rails without disturbing the discharge piping. Single rail or cable systems shall not be allowed. Pump assembly shall have lower guide rail supports securely fastened to the base elbow. Guide rails shall be secured to the wetwell lid. Intermediate guide rail supports shall be provided as recommended by the pump manufacturer. Guide rail supports shall not interfere with pump removal or re-installation. Pump discharge shall automatically connect to the base elbow when lowered into place. The entire rail system assembly shall be constructed of stainless steel.

h. Lifting Devices

Each pump assembly shall be provided with a stainless steel lifting chain and stainless steel lifting knuckles of adequate strength to support 150% of the entire assembly weight. Chain links shall be minimum 5/16-inch inside diameter. Chain shall be continuous and rated for lifting.

i. Pump Removal

An on-site hoist and crane shall be provided for pump assembly removal, unless the District's truck-mounted lift has sufficient capacity to lift the pump assembly.

j. Testing

1. Prior to startup testing, Contractor shall remove and re-install each pump to verify that the removal system functions correctly, and that the pump/base elbow/guide rail system was installed correctly.

   Following successful completion of the startup testing, each pump shall again be removed and re-installed. Each pump shall then be operated to verify that operating conditions at the actual operating point remained constant.

2. Pumps - At a minimum, perform the following tests on each pump:

   A) Startup, check, and operate the pump system over its entire range. Perform vibration analysis as applicable. Vibration analysis shall be within the amplitude limits specified and recommended by the Hydraulic Institute Standards.
   B) Measure and record the shutoff head and power draw at shutoff head.
   C) Measure and record flow rate, operating head and power draw at actual operating point and at two partially throttled conditions.
   D) Measure and record static head.

   Verify that each pump is operating in accordance with its pump curve and as designed. Coordinate with pump manufacturer's representative and Contractor to correct any problems. The pump station shall not be accepted until design pump capacity has been demonstrated.

   For all pump tests, ensure that the force main is full of liquid during the testing. The facility shall be tested using potable water, unless otherwise approved in writing by the District.

   The Engineer shall obtain and provide to the District written certification from the manufacturer's representative that the installation is correct and that the equipment has operated satisfactorily.

3. Motors - Simulate High Motor Temperature and Seal Failure to verify that the system provides warnings and protects each pump

and motor.

9.02.7 Standby Power

a. General

1. A permanent, skid mounted standby AC power engine generator shall be provided on site. The unit shall be mounted on structural channel rails. Install generator on a concrete pad.

2. The generator shall be capable of starting and operating the entire pump station, including all pumps.

3. The entire engine-generator system shall be built, tested, and shipped so as to ensure the unit is factory engineered and assembled so there is one source of supply, service, and warranty responsibility.

4. The height of the engine-generator shall not exceed 8 feet. The height of the control panel shall not exceed 5 feet.

5. The unit shall be provided with a minimum of four spring-type vibration isolators with adjusting screws and earthquake restraints for mounting.

6. The generator unit shall be provided with enclosure that yields a "quiet" operation with a maximum average free-field of 69 decibels measured at a distance of 23 feet (7 meters) from the center of the unit. Additional sound dampening shall be provided to meet local noise control code requirements, as required. The entire engine-generator enclosure shall be rated for all-weather outdoor operation. All bolts shall be rust resistant, with lock washers. Doors shall be provided on each side for easy access to the unit, and shall be provided with continuous hinges. Doors shall be equipped with adjustable plated pad type locking latches with matched keys. Interior lights shall be provided.

7. The engine-generator system shall be UL rated under Standard 2200 for Stationary Engine Generator Assemblies.

b. Generator Unit

1. Generator frequency output shall be 60 Hertz, adjustable from 56

to 64 Hertz.

2. Voltage output shall be 480 volt, 3-phase. The generator shall have a solid-state voltage regulator capable of maintaining voltage within 1.5 percent at any constant load from 0-100 percent of rating.

3. Upon application of pump station rated load (all pumps), the instantaneous voltage dip shall not exceed 20 percent (15 percent for VFD driven pumps), and shall recover to the rated voltage within one second.

4. The generator shall be the brushless alternator type, and windings shall be constructed of copper only.

5. The generator shall be provided with a unit-mounted circuit breaker with terminals sized for the actual feeder cable.

6. A hospital grade spark arresting silencer connected to the engine via a stainless steel flexible coupling shall be provided.

c. Fuel

1. The engine generator shall be diesel fueled. The fuel tank shall be full at the time of District acceptance of the facility.

2. The day tank shall provide for a minimum of 24 hours of operation under design peak influent flow loading conditions. The fuel tank shall be a double walled steel tank. The fuel tank shall be integral with the engine generator and installed under the generator, unless such installation would cause the engine generator unit height to exceed that specified herein. A separately mounted tank shall be installed on a concrete pad, and in close proximity to the engine generator.

3. The tank shall be provided with a desiccant dry air filter on vents to prevent condensation of water within the tank. The fuel line to the engine shall be fitted with a large capacity fuel filter and water separator.

4. The fuel tank shall be installed and oriented such that fuel re-filling can be accomplished with no more than 16 feet of hose.

5. The fuel tank shall be equipped with a fuel gauge.

d. Engine Unit

1. Engines shall be air cooled whenever possible. Water cooled engines shall be provided with anti-freeze protection.

2. Turbochargers shall not be allowed.

3. The maximum engine speed shall be 1800 rpm.

4. The engine shall be equipped with an oil sump heater for air cooled types, or an engine block coolant heater with a pumped circulation system for water cooled types. Heater units shall be rated to ensure a preheating temperature of 100 degrees F, and shall provide anti-freeze protection equal to zero (0) degrees F. Heaters shall automatically disconnect upon engine start. Heaters shall be provided with a dedicated circuit breaker in the main electrical panel.

5. The engine shall be equipped with a heavy duty battery starting system. The battery shall be sized to provide sufficient charge for minimum five (5) cranking cycles at minimum 10-seconds per cycle. A 120-volt trickle charging battery charger with a dedicated circuit breaker in the main electrical panel shall be provided. Chargers shall be equipped with an ammeter and voltmeter. Chargers shall be capable of recharging the battery to full charge within one hour. Generators shall provide power to the charger when it is operating.

6. The engine shall have an electronic speed governor that shall hold the engine speed to within 1/2 cycle per second of rated value.

e. Controls

1. The following instruments shall be provided to monitor the engine: oil pressure gauge, engine temperature gauge, RPM tachometer, and total run time meter (hours, non resettable). If the option is available, fuel tank volume shall be displayed on the control panel.

2. The following instruments shall be provided to monitor the generator: voltmeter, ammeter, and frequency meter. A panel illumination light shall also be provided.

3. Panel lights shall be provided for the following conditions: emergency generator run status, engine failure due to overheat, low oil pressure, speed (RPM) exceeded, low fuel, and low battery charge.

4. A push-to-test button shall be provided for testing all panel indicator lights.

5. A test-auto-off switch shall be provided for operating the generator.

6. Automatic-emergency shut down shall be provided for the following conditions: over cranking, over speed, low oil pressure, and high coolant temperature. Controls shall be interlocked to drop the electrical load prior to an emergency shut down, and the controls or transfer switch shall include an unloaded generator cool-down delay.

f. Transfer Switch

1. An automatic transfer switch shall be provided that will integrate with and operate the standby generator. The transfer switch shall be UL rated under Standard 1008 for Transfer Switch Equipment. The switch shall be furnished in a UL rated NEMA 1 enclosure and shall be mounted inside weatherproof electrical enclosure #2. The transfer switch shall be provided with a manual operating handle, shielded termination, and over-center type contact mechanisms to allow effective, manual operation.

2. The transfer switch shall be electrically operated and mechanically held. The switch shall be mechanically interlocked to ensure only one of two possible positions - normal or emergency.

3. A manual operating handle shall be provided for maintenance purposes. The handle shall permit the operator to manually stop the contacts at any point throughout their entire travel to inspect and service the contacts when required.

4. The switch shall be provided with a microprocessor-based control panel to direct operations. The control panel shall be provided with a keyed disconnect plug to enable the panel to be disconnected from the transfer switch for routine maintenance.

5. Voltage and Frequency Sensing:

A) Voltage for each phase of the primary power source shall be monitored continuously, with pickup adjustable from 85% to 100% of nominal, and dropout adjustable from 75% to 98%.
B) Single-phase voltage sensing of the emergency source shall be provided, with pickup voltage adjustable from 85% to 100% of

nominal and independent frequency sensing with pickup adjustable from 90% to 100%.

C) Accuracy shall be within ±2%.
D) Voltage and frequency settings shall be field adjustable in 1% increments without the use of tools, meters, or power supplies.

6. Time Delays - the following time delays shall be provided, which shall be field adjustable without use of tools:

   A) Time delay Start: adjustable (0-15 sec) - to prevent nuisance generator set starts in the event of momentary power system loss.
   B) Transfer Time Delay: adjustable (2-120 sec) - to allow generator set to stabilize before application of load.
   C) Retransfer Time Delay: adjustable (6-30 minutes) - to allow the power system to stabilize before retransfer of the load.
   D) STOP delay: adjustable (2 sec to 10 minutes) - to maintain availability of generator set for immediate reconnection in the event the normal source fails shortly after retransfer and to allow gradual generator set cool down by running unloaded.

7. A "commit/no commit to transfer" selector switch shall be provided to select whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.

8. Auxiliary contacts shall be provided, consisting of one contact when the switch is connected to the normal source and a second contact when the switch is connected to the emergency source.

9. Indicating lights shall be provided, one to indicate when the switch is connected to the normal source (green) and one to indicate when the switch is connected to the emergency source (red).

10. The switch manufacturer shall be certified to ISO 9001 and shall have third party certification verifying quality assurance in design/development, production, installation, and servicing in accordance with ISO 9001.

11. A minimum 100-hour battery backup power supply shall be provided to maintain clock settings during normal loss of power.

g. Testing

1. A factory test shall be performed and a logged test report provided to the District. The test shall be performed using a load bank, with both full load and half load tests performed. Each test shall be performed for a minimum of 4 hours, and all operating parameters recorded on 15 minute intervals.

2. The generator unit shall be tested on site under full load conditions for two hours. All operating parameters shall be recorded on 15 minute intervals.

3. Generator shall be refueled after startup testing.

9.03 Electrical and Instrumentation Control Requirements

9.03.1 General

a. The pump station is a typical duplex configuration and is equipped with two submersible pumps. The design intent is that one pump is capable of fully operating the pump station and the other pump is a backup. The operating elevations of the pump station are based from the pump system curves and the known pump station flow capacities as well as the projected future flows. The primary control system of the pump station shall be through a submersible level transducer.. The level unit controls the starting and stopping of the pumps automatically.

b. An independent backup high level float switch with a true time off cycle timer hardwired relay logic to start and stop both pumps (sequentially start) in the event the primary level control system should fail. The true off timer is to eliminate the need for a low level float switch to shut down pumps. The pump station control modes in descending priority are:

1. Level transmitter
2. High level float switch and hardwired cycle off-timer relay logic.
3. Manual control.

c. Both pumps shall automatically alternate after each pumping cycle. A pump lead selector switch shall be provided for dedicated pump lead selection. The pump equipment is protected by hardwired interlock to shutdown the pump on motor over temperature alarm or motor overload alarm condition. The pump shall not be shut down on motor seal leak/moisture alarm condition.

d. A Wireless Mission Control unit shall monitor a minimum of eight discrete critical alarms from the pump station and four analog inputs for both motor amps, level and flow. The high level alarm should be generated by the

primary level control and the high level float switch which shall turn on the external flashing beacon light at the pump station and call out the high level condition over Missions. The beacon light is automatically reset when the high alarm condition is cleared and the Missions alarm has to be acknowledged by authorized personnel..

e. The pump station has a utility (normal) power and an in-station permanent standby generator for backup power capable of operating the entire station with all connected loads. The generator is capable of starting one pump while the other pump and miscellaneous equipment are running.

f. Electrical Service: Standard voltage services for pump station is 480Y/277-Volts, three-phase, 4-wire underground service, unless otherwise approved by the District. The name and phone number of the power company customer service engineer or the Contractor shall be listed in the specifications in case they need to be contacted during construction.

g. Area Definitions

1. Dry: Location within electrical enclosures shall be defined as dry locations.
2. Wet: Locations which are not dry locations shall be defined as wet locations.
3. Hazardous: Hazardous locations per NEC Article 501 are identified in the Drawings.

9.03.1.01 Summary

a. Furnish the electrical control equipment as shown on the Drawings and as specified herein.

b. The Control System Supplier/Integrator shall have a panel shop located within 250 miles of the Project Site that is equipped to perform a factory demonstration test.

c. The Control System Supplier/Integrator shall provide a factory demonstration function test of both electrical enclosures-01 and -02 in the presence of the District's representative. The test shall be performed per District's Operational Readiness Test (ORT) standard. Prior to the factory demonstration test, continuity and function tests for all connected components and wires must have been thoroughly inspected for proper use of materials, methods of construction, function test, and nameplate spelling. Provide a minimum of 7 days notice prior to the demonstration test.

d. Unless otherwise specified, electrical and instrumentation

equipment and materials shall be listed and labeled for the purpose for which they are used by Underwriters Laboratories Inc. (UL) or Factory Mutual (FM).

9.03.1.02 Qualifications

a. Certification for custom control panel (electrical enclosure) construction and labeling under UL 508 and UL 698.

b. The Control System Supplier/Integrator shall be regularly engaged in the design and assembly of systems of similar scope and complexity for at least 3 years, with demonstrated experience in providing control systems for municipal sewage pump stations.

c. The Control System Supplier/Integrator shall be a single firm which shall be responsible for engineering and furnishing technical advice for installation, documentation, testing and startup of the complete control system. All control panels (EE-01 & EE-02) shall be affixed with a UL 508 and UL 698 label prior to shipment to the jobsite. Any control panels which arrive to the jobsite without a UL 508 and UL 698 labels and without District's approved factory demonstration test shall be rejected and sent back to the panel shop.

d. PVC-Coated, Rigid Steel Conduit Installer: Shall be certified by conduit manufacturer as having received a minimum of 2 hours of training on installation procedures.

e. Testing Firm Qualifications: Professionally independent of manufacturers, suppliers, and installers, or electrical equipment and system being tested.

9.03.1.03 Definitions

a. AHJ: Authority Having Jurisdiction.
b. TVSS: Transient Voltage Surge Suppressor.
c. SVR: Surge Voltage Arrestor
d. EE-0X: Electrical Enclosure 0X or Electrical Control Panel 0X
e. ATS: Automatic Transfer Switch
f. LP: Lighting Panel, Load Center
g. PSCP: Pump Sequence Control Panel
h. ISR: Intrinsically Safe Relay
i. MOV: Metal Oxide Varistor
j. RVSS: Reduced Voltage Soft Starter

9.03.1.04 Submittals

a. Action Submittals, Shall include the following information:
   1. Electrical Enclosures, EE-01 & EE-02: Arrangement drawings, schematic and wiring diagrams, bill of materials, nameplate schedules, manufacturer information on each component.
   2. Bill of Materials for each electrical enclosure, EE-01 & EE-02, and each sub control panel, PSCP, Motor Control Panel, etc. shall include:
      A) Equipment item number
      B) Quantity
      C) Tag number
      D) Description
      E) Manufacturer
      F) Model # or Part #
      G) Serial #
      H) Vendor/Supplier
      I) Vendor Phone Number
   3. Arrangement Drawings shall include:
      A) Panel and sub panel materials of construction, dimensions, and weights.
      B) Panel access openings.
      C) Internal-external conduit and wireway layouts.
      D) Internal wiring and terminal block layouts including wire and terminal block numbers.
   4. Lighting controls
   5. Luminaries
   6. Instruments, including flow transmitter, wet well level transmitter, Mission unit, float switches, and level flood switch.
   7. Service entrance main breaker and metering equipment
   8. Load center and circuit breakers
   9. Feeder breakers
   10. Transformer
   11. Wiring devices
   12. Conduit, fittings, and accessories
   13. Conduit tags and tag number schedule
   14. Wireways
   15. Conductors, cables, and accessories
   16. Conductor tags and tag numbers
   17. Control devices, terminal blocks, and relays
   18. Boxes and device plates
   19. Precast manholes and handholes
   20. Underground cable trays
   21. Support and framing channels

22. Panel unit heaters and thermostats
23. Surge arrester and Transient Voltage Surge Suppressor
24. Nameplates and nameplate schedule
25. RVSS motor starter
26. Across the line motor starter

b. Information Submittals:
   1. Submit Proof of Qualifications described in Article Qualifications.
   2. Factory test reports.
   3. Field test reports.
   4. Signed permits indicating Work is acceptable to regulatory authorities having jurisdiction.
   5. Operation and Maintenance Data:
      A) As specified in other related Operation and Maintenance Section for Operation and Maintenance Data.
      B) Provide for all equipment, as well as each device having features that can require adjustment, configuration, or maintenance.
      C) Minimum information shall include manufacturer's preprinted instruction manual, one copy of the approved submittal information for the item, tabulation of any settings, and copies of any test reports.
      D) Electrical enclosure Drawings and information as described in Article Submittals. Electrical enclosure operation and maintenance data shall be submitted in hard copy and electronic copy on jump drive.

9.03.1.05 Approval by Authority Having Jurisdiction

a. Provide the Work in accordance with the latest NFPA 70, National Electrical Code (NEC).

b. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listed mark or label.

9.03.1.06 Extra Materials

Furnish, tag, and box for shipment and storage the following spare parts and special tools.

a. Fuses, 0 to 600 Volts: Six of each type and each current rating installed.
b. Indicating Lights: Six lamps each type provided.

9.03.2 Products

9.03.2.01 General

a. Products shall comply with all applicable provisions of NFPA 70.

b. Like Items of Equipment: End products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.

c. Hazardous Areas: Products shall be acceptable to the regulatory authority having jurisdiction for the class, division, and group of hazardous area indicated.

d. Equipment Finish:
   1. Manufacturer's standard finish color, except where specific color is indicated.
   2. If manufacturer has no standard color, finish equipment in accordance with light gray color finish as approved by Engineer and District.

9.03.2.02 Service Entrance Equipment and Metering

Equipment, installation arrangement, and scope of work shall be provided in accordance with requirements of power company service provider.

a. Provide meter base per power company's standards.
b. Provide main breaker rated for use as service entrance. UL 489 listed for use at location of installation.
   1. Main breaker shall be thermal-magnetic, quick-make, quick-break, indicating type showing ON/OFF and TRIPPED indicating positions of operating handle.
   2. Suitable for use with 75 degree C wire at full NFPA 70, 75 degrees C ampacity.
   3. Locking: Provisions for padlocking handle.
   4. Enclosure: NEMA 4X stainless steel 304.
   5. Interlock: Enclosure and switch shall interlock to prevent opening cover with breaker in the ON position.
   6. Minimum Interrupting Rating: Per Drawing.
   7. Manufacturers: Eaton, General Electric Co., Square D Co., or Siemens Co.

9.03.2.03 Pump Disconnect Air-Gap Enclosure

a. Provide a disconnect air-gap panel to intercept the submersible pump power and control cables. The air-gap enclosure shall be installed on a stainless steel pedestal at 4-feet height above ground level, and at minimum 5-feet HORIZONTAL from the wet well wall to leave room for pump service access. The air-gap enclosure mounting distance incorporated with the UNDERGROUND CABLE TRENCH configuration is to eliminate the need of providing conduits seal-offs for all homerun conduits between the wet well and the air-gap enclosure, and between the air-gap enclosure and the electrical enclosure.

b. Fabricate the disconnect air-gap enclosure with equipment arrangements as shown on the Drawings.

c. The air gap shall be NEMA 4X, stainless steel 304 enclosure with back panel, hasp and staple for padlock.

d. Provide each cable cutout hole with rubberized edges and rubberized skirt to prevent bees inside the panel.

e. Pump power cable and pump control (motor over temp and seal-leak) cables shall use the same disconnect of non-fused mechanical interlock ON-OFF disconnect receptacles for connecting one end of pump submersible cables with the matching plugs. Provide strain relief at matching plug cables. The ON-OFF switch shall enable control of a plug connected load which includes an interlocking feature to prevent the plug from being pulled/disconnected while the receptacle is energized.

f. High and Overflow float switches shall also be intercepted at the air-gap enclosure. Provide float cables disconnects which consist of gray terminal strips mounted on DIN rail.

g. Wet well pressure level transducer cable shall also be intercepted at the air-gap enclosure. Provide float cables disconnects which consist of blue terminal strips mounted on DIN rail. Transmitter/controller is located in the electrical enclosure. Cable splice for transducer is NOT allowed, order correct cable length needed.

h. Panels shall be labeled and listed UL 508.

9.03.2.04 Underground Cable Trench

a. Provide one common underground cable trench between the wet well and air-gap enclosure.

b. Install cable trench per details shown on Drawings with template pictures. One end of the cable trench shall penetrate the wet well under the top ring, the other end shall intercept the hand box located below the air-gap box.
   1. The cable trench shall be sized accordingly per total cable size requirement and also per the next factory available standard sizes to minimize the delivery time. The cable trench shall be a minimum of 6-inches wide by 9-inches deep with ½-inch thick removal top cover, and with a divider to separate the homerun power and control cables.
   2. Manufacturers and Products: The cable trench shall be by Synertech Product. No substitution allowed.

9.03.2.05 Electrical Control Panels

a. Electrical Enclosure-01 and –02:
   1. Electrical enclosure shall be a minimum NEMA 3R, stainless steel 304, free-standing 72”H x 72”W x 24”D, with 12-inch-tall floor stands welded to the enclosure, with back panel, padlock compatible doors with no center post, door stops, back panels, and work platform for laptop. The front of the enclosure shall be provided with 24” stainless steel extended rain shields with spacers as shown on the Drawings.
   2. All enclosure hardware shall be stainless steel. Enclosure exhaust fan with filter louver shall be sized adequately for all heat loss generated by interior equipment in the enclosure. Exhaust fan shall be located near upper part of enclosure.
   3. Fabricate each electrical enclosure with equipment arrangements as shown on the Drawings.
   4. Interior raceways: Provide metal raceways for all wiring connected between panels, located within the electrical enclosures. Interior raceway shall be EMT conduit or metal wireways and routing layouts shall be submitted to District for approval prior to panel construction. Exposed wire is not acceptable.
   5. Exterior raceways: All homerun raceways/conduits shall be entered from the bottom of the electrical enclosure directly into the bottom wire way.
   6. The entire assembly of electrical enclosure shall be affixed with a UL 508 and UL 698 labels.
   7. Both electrical enclosures shall be installed side by side; unless site condition prohibit. The site layout has to be approved by the District.

8. Install cabinet light with fixture mounted motion sensor.
   A) Light 4' LED 5K Color, 7000 Lumens – Lithonia type CLX L48 or current model
   B) Occupancy Sensor – Wattstopper – HBP-112-L7
9. All grounding/bounding shall be routed and landed at one ground bar location.

9.03.2.06 Pump Sequence Control Panel (PSCP)

a. The panel shall be NEMA 12 enclosure. Provide enclosure dimensions per actual equipment requirement, plus a minimum of 10-percent spare space available within the panel.

b. The entire assembly shall be UL 508 and UL 698 labels.

c. Control power to the pump sequence control panel shall be separately fed from the power panelboard as shown on the Drawing.

d. Install the wet well control set points in chart format on front of PSCP with bottom of wet well, top of wet well lid elevations, pump on levels, pump off levels.

e. PSCP shall be provided with controls and control devices as shown on the Drawings

   1. Control Relays:
      A) Relay Mounting: Plug-in type socket.
      B) Relay Enclosure: Clear polycarbonate dust cover with clip fastener with energized status indication and override flip for testing.
      C) Socket Type: Screw terminal interface with wiring.
      D) Socket Mounting: DIN rail mounted.
      E) Blade type connector.
      F) Contact Arrangement: 3 Form C contacts.
      G) Contact Materials: Silver Cadmium oxide alloy.
      H) Contact Resistance: 50 m ohm max (initial value).
      I) Switching capacity: 10 amps.
      J) Coil Voltage: 120V ac or 24V dc as shown.
      K) Life Expectancy:
         (i) Electrical: 500,000 operations or more.
         (ii) Mechanical: 50,000,000 operations or more.
      L) Indication Type: LED indicator lamp.
      M) Push-to-Test button.
      N) Manufacturers and Products:
         (i) Idec Corporation.

(ii) Potter and Brumfield, Series KUP.

2. Time Delay Relays – On Timer and True Off Timer:
   A) Heavy Duty.
   B) Operates on 117V ac (plus or minus 10 percent) power source.
   C) Contact Rating: 10 amp resistive at 240V ac.
   D) Solid-state construction.
   E) Multi-function operation with two Form-C delayed output contacts.
   F) Time delay range as specified or shown in the Drawings.
   G) True Off Timer is built with internal capacitor and is capable to initiate a time delay for up to ten minutes after the power has been removed from the timer.
   H) Manufacturers:
   Idec Corporation: On Timer - GT3A, True Off Timer – GT3F.

3. Alternator Relay:
   A) Duplex pump alternator, 120V ac, SPDT.
   B) Contacts and coil rated for 120V ac, 60-Hz.
   C) Alternator relay shall alternate the state of its contacts in response to impulses applied to its coil.
   D) Manufacturers and Products: Diversified Electronics, ARA-120-ABA.

4. Pump Amp Digital Display
   A) 120 Vac digital display by Red Lion with capacity to provide 24Vdc loop power for analog signal from CT to Mission.

5. Intrinsically Safety Barriers (Relays):
   A) GEMS Model 14460 Intrinsically Safe Relays provided in a segregated intrinsically safe zone inside the PSCP enclosure.
   B) Ul or FM approved for use with remote pilot device contacts located in Class 1, Division 1, Groups C & D atmospheres.
   C) Provide a grounded metal partition inside the PSCP enclosure to separate the intrinsically safe relays from non-intrinsically safe components.
   D) Route the Float Switches Cables in conduit directly into the PSCP intrinsically safe zone.
   E) Use a low-power, electrically isolated relay to safely interface with devices located in hazardous areas.

F) Provide with green and red LED for indication of module and field circuit status.
G) Provide 750 ohms resistor in parallel/across the intrinsically output contact to minimize the leaked current which may be introduced to the control circuit.
H) External Power: 120V ac, 60-Hz.
I) Pole reversal protection.
J) Response Time: less than 20 ms.
K) DIN rail mounting except the GEMS

6. Wireway Within PSCP:
Plastic slotted wall, wiring duct. Type F with sizes as indicated plus 25-percent extra space. Color shall be the manufacturer's standard. Plastic wireway shall be used inside PSCP only as shown on the Drawings. Use EMT raceway inside the electrical enclosure between panels/fixtures.

7. Wires Within PSCP:
A) Type: 600-volts class insulated, stranded copper, MTW type.
B) Size: For current to be carried, but not less than No. 14 AWG enclosed in either sheet metal raceway or wiring duct.
C) Analog or dc Signal Circuit: Twisted shield pairs minimum 18 AWG, separated at least six inches from power wiring.
D) Wire Identification: Numbered and tagged at each termination. Wire tag names shown on wiring diagrams, to be assigned during submittal and approved by the District prior to construction. Wire Tags: Printed sleeve of the heat shrink type. All such sleeves shall be shrunk to the conductor insulation.
E) Restrain by plastic ties or ducts or metal raceway.
F) Hinge Wiring: Secure at each end so that bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve.

8. Fuses:
A) Terminal strip mounted on fuse blocks designed to snap into contact strips.
B) Manufacturers and Products: Allen-Bradley part No. 1492-H4 or equal with typewritten identification on each one.
C) Provide fuse blown-out indicator.

9. Terminals:

A) Heavy duty double screw type with strap screw clamp, 600-volt rated and mounted on mounting channels.
B) Manufacturers and Products: Entrelec or Allen-Bradley Part No. 1492-H1 for control signal. Provide type written terminal block identification for all terminals.

10. Pushbuttons, Indicating Lights, and Selector Switches:
    A) Type: Heavy-duty, corrosion resistant, NEMA 250 Type 4X. Provide contact arrangements, colors, inscriptions, and functions as shown.
    B) Standard size, white field, legend plates with black markings, for service legend.
    C) Labels will also be provided and installed on the back of PSCP door above device.
    D) Contact Rating: NEMA ICS 2, Type A600.
    E) Manufacturers and Products:
        (i) Eaton; Type T.
        (ii) Square D; Type K.
    F) Unless otherwise shown, provide the following features:
        (i) Selector Switch Operating Lever: Block knob type. Single hole mounting, accommodating panel thicknesses from 1/16 to ¼-inch.
        (ii) Indicating Lights: Push-to-Test, LED-Type.
        (iii) Pushbutton Color:
            (I) Test: Black
            (II) Reset: Red.
        (iv) Contacts rated 10 amps continues at 120V ac.

11. Elapsed Time Meters:
    A) Type: Synchronous motor drive, 0 to 99,999.9 hours range, nonreset, suitable for semiflush, panel mounting, spare case, 4-inches, minimum.
    B) Manufacturers:
        (i) Eagles Signal Controls.
        (ii) General Electric Co.
        (iii) Veeder-Root.

9.03.2.07 Outlet and Device Boxes

a. Cast Metal:
    1. Box: Cast ferrous metal, Deep.
    2. Cover: Gasketed, weatherproof, and cast ferrous metal with stainless steel screws.
    3. Hubs: Threaded.
    4. Lugs: Cast Mounting.
    5. Manufacturers and Products, Nonhazardous Locations:

A) Crouse-Hinds; Type FS or FD.
B) Appleton; Type FS or FD.

6. Manufacturers and Products, hazardous Locations:
   A) Crouse-Hinds; Type GUA or EAJ.
   B) Appleton; Type GR.

9.03.2.08 Junction and Pull Boxes

a. Outlet Boxes Used as Junction or Pull Box: As specified under article Outlet and Device Boxes.

b. Conduit Bodies Used as Junction Boxes: As specified under Article Conduit and Fittings.

c. Concrete Box, Nontraffic Areas: As shown on Drawings.

9.03.2.09 Wiring Devices

a. Receptacle, Single:
   1. NEMA WD 1 and FS W-C-596.
   2. Specification grade, two-pole, three-wire grounding type with screw type wire terminals suitable for No. 10 AWG.
   3. High strength, thermoplastic base color.
   4. Color: Ivory.
   5. Contact Arrangement: Contact to be made on two sides of each inserted blade without detent.
   6. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps.
   7. One-piece mounting strap with integral ground contact (rivetless construction).
   8. Manufacturers and Products:
      A) Arrow Hart; 5262 Series.
      B) Leviton; 5262/5362 Series.
      C) Bryant; 5262/5362 Series.
      D) Hubbell; 5262/5362 Series.

b. Receptacle, Ground Fault Circuit Interrupter:
   1. Duplex, listed Class A to UL Standard 943, tripping at 5mA.
   2. Color: Ivory.
   3. Rating: 125 volts; NEMA WD 1, Configuration 5-20R, 20 amps.
   4. Size: For 2-inch by 4-inch outlet boxes.
   5. Standard Model: NEMA WD 1, with screw terminals and provisions for testing.
   6. Impact resistant nylon face.
   7. Manufacturers and Products:

A) Arrow Hart.
B) Leviton.
C) Bryant.
D) Hubbell.

9.03.2.10 Device Plates

a. General: Sectional type plates not permitted.

b. Cast Metal:
   1. Materials: Malleable ferrous metal.
   2. Screw: Oval-head stainless steel.

c. Weatherproof:
   1. Receptacles, Wet Locations.
      A) Impact-resistant, nonmetallic, single-gang, horizontal-mounting, providing, while in-use, NEMA 3R rating; unless otherwise noted on the Drawings.
      B) Stainless steel mounting and hinge hardware.
      C) Lockable, paintable.
      D) Color: Gray.
      E) Manufacturers:
         (i) Carlon.
         (ii) Leviton.

9.03.2.11 Equipment Nameplates

a. Provide nameplates on all equipment. Nameplate schedule shall be included in all equipment submittal.

b. Provide weatherproof rating for all nameplates located outdoors.

c. Color: Black backgrounds with white letters.

d. Exterior Enclosures: Enclosures-01 and 02, main breaker enclosure, Current Transformer (CT) can, air-gap enclosure, etc., the nameplates shall be:
   1. Located on the enclosure face.
   2. Rectangular screw-on type with self-tapping 316 stainless steel screws for weatherproof rating.
   3. Provide 2.25-inch high with 1-inch high lettering.

e. Interior Panels: Enclosure located within electrical enclosure –01 or –02, such as pump sequence control panel, motor control panels, automatic transfer switch, load center, transformer, Mission panel, etc., the nameplates shall be:

1. Located on the enclosure face.
2. Rectangular screw-on type with self-tapping 316 stainless steel screws.
3. Provide 1-inch high with ½-inch high lettering.
4. Provide and install pump name plate on the front of each starter cabinet.

f. Component nameplates-Panel Face (Front): Component nameplate located on panel face under or near component, the nameplates shall be:
   1. Materials: Adhesive backed, laminated plastic.
   2. Provide ½-inch high with 3/16-inch high lettering.

g. Component nameplates-Back of Panel: Component nameplate located on or near component inside of the enclosure, the nameplates shall be:
   1. Materials: Adhesive backed, laminated plastic.
   2. Provide ½-inch high with 3/16-inch high lettering.

9.03.2.12 Circuit Breaker, Individual, Heavy Duty Disconnect 0 To 600 Volts

a. UL 489 listed for use at location of installation.

b. Main breaker shall be thermal-magnetic, quick-make, quick-break, indicating type showing ON/OFF and TRIPPED indicating positions of operating handle.

c. Main Heavy Duty Disconnect shall be non-fuses after main breaker. Main Heavy Duty Disconnect shall be mounted downstream of the Main breaker. This disconnect will be used to test the standby generator by manually disconnecting the utility power from the station.

d. Suitable for use with 75 degree C wire at full NFPA 70, 75 degrees C ampacity.

e. Locking: Provisions for padlocking handle.

f. Enclosure: NEMA 4X stainless steel 304 for outdoor installation and NEMA 1 for indoor.

g. Interlock: Enclosure and switch shall interlock to prevent opening cover with breaker in the ON position.

h. Minimum Interrupting Rating: Per Drawing.

i. Manufacturers:
   1. Eaton.
   2. Square D Co.
   3. Siemens Co.

9.03.2.13 Dry Type Power Transformers, 0 To 600 Volts Primary

a. Type: Self-cooled, two-winding.

b. UL 1561 and NEMA ST 20.

c. Insulation Class, Temperature Rise, and Impedance: Manufacturer's standard designed for 115 degrees C maximum temperature rise.

d. Enclosure: NEMA 250, Type 3R, non ventilated.

e. Voltage Taps: Full capacity, 2-1/2 percent, two above and two below normal voltage rating.

f. Sound Level: Not to exceed NEMA ST 20 levels.

g. Vibration isolators to minimize and isolate sound transmission.

h. Manufacturers:
   1. Eaton.
   2. Square D Co.
   3. Siemens Co.

9.03.2.14 Lighting Power Distribution Panel

a. Nema PB 1 NFPA 70, and UL 67.

b. Panelboard and Circuit Breakers: Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

c. Short-Circuit Current Equipment Rating : Fully rated; series connected unacceptable.

d. Rating: Applicable to a system with available short-circuit current of 10,000 amperes rms symmetrical at 120/240 volts.

e. Cabinet:
   1. Eaton,
   2. NEMA 250, Type 12

3. Material: Code-gauge, hot-dip galvanized sheet steel with reinforced steel frame. Interior and exterior paint shall be manufacturer's standard.
4. Wiring Gutter: Minimum 4-inch square; both sides, top and bottom.
   A) Trim Size: As required by mounting.
   B) Finish: Manufacturer's standard.
5. Interior:
   A) Factory assembled; complete with circuit breakers.
   B) Spaces: Cover openings with easily removable metal cover.
6. Door Hinges: Concealed
7. Locking Devices:
   A) Flush type.
   B) Doors over 30 inches in height: Multipoint.
   C) Identical keylocks, with two milled key each lock.
8. Circuit Directory:
   Metal frame with transparent plastic face and enclosed card on interior of the door. Provide a type written circuit directory with actual circuit assignments.

f. Bus Bar:
   1. Material: Copper full sized throughout length.
   2. Neutral: Insulated, rated same as phase bus bars with at least one terminal screw for each branch circuit.
   3. Ground: Copper, installed on panelboard frame, bonded to box with at least one terminal screw on each circuit.
   4. Lugs and Connection Points:
      A) Suitable for copper conductors.
      B) Solderless main lugs for main, neutral, and ground bus bars.
      C) Subfeed or through-feed lugs as shown.

g. Circuit Breakers:
   1. UL 489.
   2. Thermal-magnetic, quick-make, quick-break, molded case, of indicating type showing ON/OFF and TRIPPED positions of operating handle.
   3. Type: Plug-in circuit breakers.
   4. Multi-pole circuit breakers designed to automatically open all poles when an overload occurs on one pole.
   5. Do not use tandem or dual circuit breakers in normal single-pole spaces. Ground Fault Equipment Protector (GFEP): 30mA trip, 10,000 amps interrupting capacity circuit breaker, and UL listed for equipment ground fault protection.

6. Use GFCI breakers for circuits the feed exterior circuits (example – Heat Trace or Hot Box)

h. Manufacturers:
   1. Eaton.
   2. Square D Co.
   3. Siemens Co.

9.03.2.15 Combination Full-Voltage, Magnetic Motor Starter Panels, RVSS

a. For all pump motors rated less than 20 horse power, each combination motor starter panel shall be furnished with motor circuit protection (MCP), magnetic type only breaker, and a NEMA full size rated across-the-line starter. NEMA half sizes and IEC contactors are not permitted. Combination motor starter panel shall be in NEMA 250 Type 1 enclosure. The front of the enclosure shall consist with an ammeter, which has a range double the actual motor full load amps, and a motor overload reset pushbutton.

b. Panels shall be labeled and listed UL 508.

c. General:
   1. Make adjustments as necessary to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate motors and motor ratings actually provided.
   2. Rating: Horsepower rated at 600 volts, UL labeled for actual short-circuit rating as shown on the Drawings.
   3. Control: As shown on the Drawings.
   4. Thermal Overload Protection:
      A) Inverse-time limit characteristic.
      B) Heater: Bimetallic overload, adjustable trip.
      C) Relay Trip: Standard, Class 20.
      D) Provide in each ungrounded phase.
      E) Mount within starter unit.
      F) Manual Reset. External to the enclosure.
   5. Control Transformer:
      A) Two winding, 120-volt secondary, primary voltage to suit.
      B) Two current-limiting uses for primary circuit.
      C) One fuse in secondary circuit.
      D) Mount within starter unit.
      E) Capacity: 140 percent of load.
   6. Enclosure: NEMA 250, Type 1. Padlockable operating handle.
   7. Operating Conditions:

A) Ambient Temperature: Maximum 40 degrees C.
B) Equipment to be fully rated without any derating for operating conditions listed above.

8. Equipment finish:
   A) Electrocoating process applied over rust-inhibiting phosphated base coating.
   B) Exterior Color: Manufacturer's standard.
9. Pump protection monitor (MiniCas or MasCas)
   A) Pump protection monitor shall be provided by the furnished pump manufacturer. Coordinate and install the pump protection monitor as part of the combination starter cabinet. Wire the unit as per design intent.
   B) Pump protection monitor shall be panel mount type.
10. Manufacturers:
    A) Eaton.
    B) Siemens.
    C) Allen Bradley.
    D) Reduced Voltage Soft Start:
       A. For pump motors rated over 20 horsepower or where deemed necessary the station will employ a reduced voltage starter to ramp the motor up to full speed. The RVSS panel will include a separate across the line bypass starter to act as a back-up ONLY in the event of a failure of the RVSS. The selection of RVSS or bypass starter will be via a local switch located on the RVSS panel.

       B. Manufacturers:

Eaton 8119.03.2.16 TVSS Design

a. Balanced Suppression Platform: The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform shall provide equal impedance paths to each matched MOV.

b. Electrical Noise Filter: Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 55 dB at 100 kHz using MIL-STD-220A insertion loss test method.

c. Internal Connections: No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.

d. Overcurrent Protection Fusing:

MOVs shall be individually fused.

e. Safety and Diagnostic Monitoring: Each unit shall provide the following three levels of monitoring:
   1. Continuous monitoring of fusing system.
   2. Continuous monitoring of individual MOVs (including neutral to ground). The system shall be capable of identifying open circuit.
   3. A green/red solid state indicator light shall be provided on each phase. The absence of a green light and the presence of a red light shall indicate which phase(s) have been damaged. Fault diction will activate a flashing trouble light. Units which cannot detect open-circuit damage, thermal conditions, and over current will not be accepted.
   4. The unit shall be equipped with a transient event counter.
   5. All monitoring diagnostics features such as indicator lights, trouble alarms, and surge counter shall be mounted on the display.
   6. Remote Status Monitor: The TVSS device shall include Form C dry contacts (one NO and one NC) for remote annunciation of unit status. The remote alarm shall change state during all fault conditions.
   7. Push-to-Test Feature: Each suppression unit shall incorporate an integral test feature which verifies the operational integrity of the unit's monitoring system.

f: Prior to manufacture submit Shop Drawing which also includes:
   1. Dimensioned tap enclosure drawing showing component arrangement.
   2. Bill of Material.
   3. Catalog cut sheets.
   4. Verification of UL 508.

9.03.2.17 Wet Well Float Switch

a. Free floating float switch suspended from PVC coated, multi-core connecting cable to hermetically sealed CPVC coated non-mercury switch.

b. Switch shall be Anchor Scientific Eco-Float Model G Type SI Suspended with a normally open, single pole contact and with manufactured cable length as required to run from installed level in the wet well to Disconnect Air-Gap Enclosure with appropriate slack, as shown on the Drawing.

9.03.2.18 Level Switch, Vault Flood

a. Type: Float actuated switch mounted to wall to actuate on water level 4 inches above floor.

b. Feature: Float, stem, cage, and guide tube connected to a switch enclosure.

c. Materials: Wetted parts 316 stainless steel.

d. Contact: DPDT snap action rated 10A continuous at 120V ac.

e. Enclosure: NEMA 4X.

f. Manufacturers: GEMS, Model LSP-800.

9.03.2.19 Remote Telemetry Unit

a. District will commission the Mission unit with support from Contractor.

b. Alarm inputs to each Mission unit shall be connected using normally open contacts as shown on the Drawings; unless otherwise noted. Field wiring connections to the Mission unit shall be made using No. 18 twisted shielded stranded copper conductors routed away from all other wiring.

A. M850: "My Dro" RTU – Wireless Real-Time Alarm System with Streaming Data – NEMA 1 Enclosure (Indoor wall mounting enclosure; Includes all parts for standard installation

a. ADAM: Option Board - Analog Input (4 additional analog inputs)
b. SP850-12: Service Package – MyDro M850 Series - 1 year
c. PW442: Battery - 7 Amp-hour (Sealed, Lead-Acid, 12 VDC)
d. Plug in Power supply unit
e. Unless otherwise stated, the standard configuration for the I/O of the Missions system will be:
    i. Discrete:
        1) Pump 1 Run
        2) Pump 2 Run
        3) Pump 1 Fail
        4) Pump 2 Fail
        5) Generator Running
        6) Generator Fail
        7) High Wet Well with valve or meter vault flood alarms if applicable.
        8) Overflow
    ii. Analog:

1) Pump 1 amps
2) Pump 2 amps
3) Flow
4) Wet Well Level

iii. Additional:

1) The power supplying the Missions RTU shall be tied to the PSCP power through an isolating relay such that if the PSCP control power is lost the Missions RTU also loses power which will trigger an AC lost alarm.

A 12Vdc light (ex ABB LC-501R) shall be wired through the #1 output relay powered by the Mission RTU's onboard power to indicate when the RTU is in Service Mode.

d. Manufacturers
1. Mission

9.03.2.20 Exterior Alarm Flashing Beacon Light

a. Beacon light shall be mounted above the Electrical enclosure; unless otherwise noted. The conduit shall be extended a minimum of 18-inches above the top of the electrical enclosure or high enough to be visible from the nearest public roadway. Conduit and conduit support and hardware shall be stainless steel materials.

b. Alarm exterior strobe beacon light shall be red color, weatherproof type, LED, and 120V ac.

c. Beacon light shall be connected to the high wet well level alarm contactors, initiated either from pressure level transducer high level or high float switch. Overflow float doesn't connect to the beacon light.

d. Manufacturer:
1. Federal Signal – 191XL
2. Allen Bradly – 855F.

9.03.2.21 Yard Light and Control Station

Provide and install yard light pole and fixture as shown on the Drawings. Pole shall have a hinged base that will lay down clear of anything.

b. Control station for the yard light shall be located in the electrical enclosure as shown on the Drawings. The control station shall be NEMA 1 enclosure and shall be manufactured by Intermatic switch Model FF32H, 2 hour adjustable timer.

9.03.2.22 Pressure Level Transducer and Level Controller

a. Level Indication Controller shall be by Endress+Hauser. Panel Meter RIA452, Model # RIA52-C114A11A
   1. 1 Channel, scalable, Panel mounting, Loop power supply, 7 digital LCD display.
   2. C – Approval: FM
      1 – Power Supply 90-250vac
      1 – Measuring Signal: 0/4-20mA
      4 – Output: 8x relay SPDT limit + 1x analogue + 1x pulse + integration + linearization for open channel
      A – Communication: Standard
      1 – Housing: 96x96 panel mounting, front IP65
      1 – Additional Option: Basic version
      A – Version: Standard, de,en,fr

b. Transducer shall be WIKA LH-20 Part #52730013. This type of transducer requires a stilling well as shown on drawings.
   1. LH-20 - High performance submersible pressure transmitter
   2. Specifications according to data sheet: PE 81.56
   3. Pressure range: 0...250 inWC gauge
   4. Cable material: PUR
   5. Unit of cable length: feet
   6. Cable length: 40
   7. Signal output: 4...20 mA, 2-wire HART compatible
   8. Accuracy: 0.2% of span
   9. Housing: stainless steel
   10. Approval: FM
   11. Type of protection: (IS) Intrinsic Safety
   12. Atmosphere: Dust and Gas Div. 1 (Cl I, II, III, Div.1)
   13. Process Connection: M14x1 female with protection cap
   14. Sealing Sensor: dual FKM (VP2/A)
   15. Pin assignment el. connection: U+=BN, U-=BU
   16. Power supply: 8...30 V DC
   17. Approval marking: FM (IS) CL I,II,III, DIV 1, GP ABCDEFG

c. Cable shall be of adequate length with appropriate slack for homerun from wet well to air-gap enclosure.

d. Operating Level Set Points: As shown on the Drawings.

9.03.2.23 Magnetic Flow Meter

a. Flow meter shall be electromagnetic type with a remote indicator converter/transmitter. Flow meter shall be rated for use in Class 1, Division 2 location, suitable for continuous submergence IP68.

Provide with standard features, zero stability feature to eliminate the need to stop flow to check zero alignment, no obstructions to flow, very low pressure loss.

b. The only electrical components within the flow tube shall be the flow tube coils, electrodes, and the cables necessary to connect the flow tube coils to the converter/transmitter.

c. Flow tube coils and connections to surface wiring shall be completely encapsulated and isolated from contact with fluid.

d. The cable between the flow tube and the transmitter shall be continuous, without splice, and potted The manufacturer shall provide adequate length of cable as shown on the Drawings. The flow transducer shall be located in the meter vault while the transmitter is located in the electrical enclosure.

e. Materials: The electrodes shall be made of Type 316 stainless and shall not be adversely affected by raw sewage. Flow tube housing shall be cast or ductile iron, Teflon lined, with ANSI Class 150 stainless steel flange materials, 316L stainless steel grounding electrodes or stainless steel grounding rings, and shall be sized to maintain an accuracy of 0.5 percent of flow above 3 feet per second.

f. Converter/Transmitter: The transmitter shall include a digital display of the instantaneous flow rate and totalized flow. The flow meter shall be equipped with a signal converter/transmitter to convert signal from the flow tube to an analog 4-20mAdc signal proportional to flow rate. Output span and zero shall be manually adjustable. Provide span adjustable capable of producing a full-scale analog output at flow rates that are 30 percent of maximum. Signal shall be linear with flow within the accuracy specified above. The transmitter shall operate from 120V ac, 60-Hz power supply.

g. Flow indicator/transmitter shall be programmed for
   1. Instantaneous Flow
   2. Totalized Flow: Thousand of gallons.

h. Special Tools: Furnish special tools that are necessary for the replacement of parts and the adjustment of the equipment.

i. Calibrations and Diagnostics:
   1. Advanced diagnostic (ex Rosemount DA2 option)

2. HART compatible

j. Factory Testing: The flow meter shall be factory tested and certified over entire specified flow range. Certified test records shall be submitted to the District for review.

k. Manufacturer:
   1. Rosemount:
      A) Transducer: 8705 Series
      B) Converter/Transmitter: 8712D Series

9.03.2.24 Conduit and Fittings

a. Electrical Metallic Tubing (EMT).
   1. Meet requirements of NEMA C80.3 and UL 797.
   2. Material: Hot-dip galvanized, with chromated and lacquered protective layer.

b. PVC Schedule 40 Conduit.
   1. Meet requirements of NEMA TC 2 and UL 651.
   2. UL listed for concrete encasement, underground direct burial, concealed, or direct sunlight exposure, and 90 degrees C insulated conduit.

c. PVC-Coated Rigid Galvanized Steel Conduit.
   1. Meet requirements of NEMA RN 1.
   2. Material:
      A) Meet requirements of NEMA C80.1 and UL 6.
      B) Exterior Finish: PVC coating, 40 mils nominal thickness, bond to metal shall have tensile strength greater than PVC.
      C) Interior Finish: Urethane coating, 2 mils nominal thickness.
   3. Threads: Hot-dipped galvanized and factory coated with urethane.
   4. Bendable without damage to either interior or exterior coating.

d. Flexible Metal, Liquid-Tight Conduit.
   1. UL 360 listed for 105 degrees C insulated conduit.
   2. Material: Galvanized steel, with an extruded PVC jacket.

e. Flexible Coupling, Hazardous Location.
   1. Approved for use in the atmosphere involved.
   2. Rating: Watertight and UL listed for use in Class 1, Division 1 and Division 2 ares.
   3. Outer bronze braid and insulating liner.
   4. Conductivity equal to a similar length of rigid metal conduit.

5. Manufacturers and Products:
   A) Crouse-Hinds, Type ECGJH or ECLK
   B) Appleton; EXGJH or EXLK.

f. Fittings.
   1. Provide bushings, grounding bushings, conduit hubs, conduit bodies, couplings, unions, conduit sealing fittings, drain seals, drain/breather fittings, expansion fittings, and cable sealing fittings, as applicable.
   2. Rigid Galvanized Steel Conduit:
      A) Meet requirements of UL 514B.
      B) Type: Threaded, galvanized.
   3. Electrical Metallic Tubing (EMT):
      A) Meet requirements of UL 514B.
      B) Type: Steel body and locknuts with steel or malleable iron compression nuts. Setscrew and drive-on fittings not permitted.
      C) Electro zinc-plated inside and out.
      D) Raintight.
   4. PVC Conduit:
      A) Meet requirements of NEMA TC 3.
      B) Type: PVC, slip-on.
   5. PVC-Coated Rigid Galvanized Steel Conduit:
      A) Meet requirements of UL 514B.
      B) Fittings: Rigid Galvanized steel type, PVC-coated by conduit manufacturer.
      C) Conduit Bodies: Form 7 – Only Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC-coated by conduit manufacturer.
      D) Finish: 40-mil PVC exterior, 2-mil urethane interior.
      E) Overlapping pressure sealing sleeves.
      F) Conduit Hangers, Attachments, and Accessories: PVC-coated.
      G) Manufacturers:
         (i) Robroy Industries.
         (ii) Ocal.
   6. Flexible Metal, Liquid-Tight Conduit:
      A) Metal insulated throut connectors with integral nylon or plastic bushing rated for 105 degrees C.
      B) Insulated throat and sealing O-ring.
      C) Exterior PVC-coating
   7. Flexible Coupling, Hazardous Locations:
      A) Approved for use in the atmosphere involved.
      B) Rating: Watertight and UL listed for use in Class I, Division 1 and Division 2 areas.

C) Outer bronze braid and an insulating liner.
D) Conductivity equal to a similar length of rigid metal conduit.
E) Manufacturers and Products:
(i) Crouse-Hinds; Type ECGJH or ECLK.
(ii) Appleton; EXGJH or EXLK

9.03.2.25 Metal Wireways

a. Meet requirements of UL 870.
Meet requirements of NEMA C80.3 and UL 797.

b. Type: Steel-enclosed, with removable, hinge cover.

c. Rating: Indoor.

d. Finish: Gray, baked enamel.

e. Manufacturers:
1. Circle AW.
2. Hoffman.

9.03.2.26 Conduit Accessories

a. Duct Bank Spacers.
1. Type: Nonmetallic, interlocking, for multiple conduit sizes.
2. Suitable for all types of conduit.
3. Manufacturers:
A) Underground Devices, Inc.
B) Carlon.

b. Conduit Identification (Tag)
1. Provide 12GA stainless steel ¾-inch by 2-inch minimum length tag with raceway number stamped in ¼-inch minimum height characters. Circular shape tag is also acceptable.
2. Neatly attached identification to the raceway with 316 stainless steel wire.
3. A combined homerun conduit with multi-circuit conductors shall have multi-identification tag, one for each circuit.

9.03.2.27 Support and Framing Channels

a. Stainless steel Framing Channel: Rolled, ASTM A167, Type 316 stainless steel, 12 gauge.

b. Manufacturers:

1. B-Line Systems, Inc.
2. Unistrut Corp.

9.03.2.28 Fittings and Boxes

a. Stainless steel Framing Channel: Rolled, ASTM A167, Type 316 stainless steel, 12 gauge.

b. Manufacturers:
   1. B-Line Systems, Inc.
   2. Unistrut Corp.

9.03.2.29 Conductors and Cables

a. Conductors 600 volts and Below:
   1. Conform to applicable requirements of NEMA WC 71, WC 72, and WC 74.
   2. Conductor Type:
      A) 120- and 277- Volts Lighting, No. 10 AWG and Smaller: Solid copper.
      B) 120-Volt Receptacle Circuits, No. 10 AWG and Smaller: Solid copper.
      C) All Other Circuits: Stranded copper.
   3. Insulation: Type THHN/THWN, except for sizes No. 6 and larger, with XHHW-2 insulation.
   4. Flexible Cords and Cables:
      A) Type SOW-A/50 with ethylene propylene rubber insulation in accordance with UL 62.
      B) Conform to physical and minimum thickness requirements of NEMA WC 70.

9.03.2.30 600-Volt Rated Cable

a. General:
   1. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 20,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.
   2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
   3. Suitable for installation in open air, in cable trays, or conduit.
   4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
   5. Overall Outer Jacket: PVC, flame-retardant, sunlight-and-oil-resistant.

b. Type WTD, No. 18 AWG, Twisted, Shield Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55 requirements.
   1. Outer Jacket: 45 mils nominal thickness.
   2. Individual Pair Shield: 1.35 mils, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
   3. Dimension: 0.31-inch nominal outside diameter.
   4. Conductors:
      A) Base soft annealed copper, Class B, seven-stranded concentric, meeting requirements of ASTM B8.
      B) 20 AWG, seven-strand tinned copper drain wire.
      C) Insulation: 15 mils nominal PVC.
      D) Jacket: 4 mils nominal nylon.
      E) Color Code: Pair conductors black and red.
      F) Manufacturers: Okonite Co.

c. Accessories:
   1. Tape:
      A) General Purpose, Flame Retardant: 7mils, vinyl plastic, Scotch Brand 33, rated for 90 degrees C minimum, meeting requirements of UL 510.
      B) Flame Retardant, Cold and Weather Resistant: 8.5 mils, vinyl plastic, Scotch Brand 88.
   2. Indication Devices:
      A) Sleeve of the heat shrink type, permanent, PVC, yellow or white, with legible machine-printed black markings. All such sleeves shall be shrunk to the conductor insulation.
      B) Manufacture and Products: Raychem, Type D-SCE or ZH-SCE.
   3. Connectors and Terminations:
      A) Nylon, Self-Insulated Crimp Connectors.
      B) Manufacturers and Products:
      C) Thomas & Betts; Sta-Kon.
      D) Burndy; Insulug.
      E) ILSCO.
   4. Cable Lugs:
      A) In accordance with NEMA CC 1.
      B) Rated 600 volts of same material as conductor metal.
      C) Uninsulated Crimp Connectors and Terminators:
         (i) Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
         (ii) Manufacturers and Products.
            (I) Thomas & Betts; Color-Keyed.
            (II) Burndy; Hydent.

(III) ILSCO.

5. Uninsulated, Bolted, Two-Way Connectors and Terminators:
   A) Manufacturer and Products:
      (i) Thomas & Betts; Locktite.
      (ii) Burndy; Quiklug.
      (iii) ILSCO.
6. Cable Ties:
   A) Nylon, adjustable, self-locking, and reusable.
   B) Manufacturer and Products:
      (i) Thomas & Betts; TY-RAP.
7. Heat Shrinkable Insulation:
   A) Thermally stabilized, crosslinked polyolefin.
   B) Manufacturer and Products:
      (i) Thomas & Betts; SHRINK-KON.
8. Grounding:
   A) Ground Rods: Provide copper-clad steel with minimum diameter of ¾-inch, and length of 10-feet.
   B) Ground Conductors: As specified in Article Conductor and Cable.
   C) Connectors
      (i) Exothermic Weld Type:
      (ii) Outdoor Weld: Suitable for exposure to elements or direct burial.
      (iii) Indoor Weld: Utilize low-smoke, low-emission process.
   D) Manufacturer and Products:
      (i) Erico Products; Inc.; Cadweld and Cadweld Exolon.
      (ii) Thermoweld.
      (iii) ILSCO.

9.03.3 Execution

9.03.3.01 General

a. Install materials and equipment in accordance with manufacturer's instructions and recommendations.

b. Work shall comply with all applicable provision of NECA 1.

c. Install materials and equipment in hazardous areas in manner acceptable to regulatory authority having jurisdiction for the class, division, and group of hazardous areas shown.

d. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.

9.03.3.02 Protection Following Installation

a. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation.

b. Cap conduit runs during construction with manufactured seals.

c. Close openings in boxes or equipment during construction.

d. Energize space heaters furnished with equipment.

9.03.3.03 Conduit and Fittings

a. General:
   1. Crushed or deformed raceways are not permitted.
   2. Maintain raceway entirely free of obstruction and moisture.
   3. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.
   4. Sealing Fittings: Provide drain seal in vertical raceways where condensation may collect above sealing fitting.
   5. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.
   6. Group raceways installed in the same area.
   7. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.
   8. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.
   9. Block Walls: Do not install raceways in the same horizontal course with reinforcing steel.
   10. Install watertight fittings in outdoor, underground, or wet locations.
   11. Joints shall be tight, thoroughly grounded, secure, and free of obstructions in the pipe. Conduit shall be adequately reamed to prevent damage to the wires and cables inside. Strap wrenches and vises shall be used to install conduit to prevent wrench marks on conduit. Conduit with wrench marks shall be replaced.
   12. Paint threads and cut ends, before assembly of fittings, or PVC-coated galvanized conduit installed in exposed or damp location with zinc-rich paint or liquid galvanizing compound.
   13. Metal conduit to be reamed, burrs removed, and clean before installation of conductors, wires, or cables.
   14. Do not install raceways in concrete equipment pads, foundations, or beams.

15. Horizontal raceways installed under floor slabs shall lie completely under stab, with no part embedded within slab.
16. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.
17. Install conduits for telephone cables, and data cables in strict conformance with the requirements of EIA/TIA 569.
18. Fittings for use with PVC-Coated rigid galvanized steel shall be PVC-Coated and shall be products of the same manufacturer as the conduit.
19. Male and female threads and internal surface shall have a 2-mil urethane coating.
20. Installation of steel conduit though a core-drilled hole in an exterior wall below grade shall utilize sealing devices manufactured by Link Seal or equal.
21. Conduit passing through wall or floors shall have plastic sleeves if the penetration is not fire-rated. Core drilling shall be performed in accordance with other specified Sections. UL-approved fire stopping shall be installed per manufacturer's instructions in the annular spaces to maintain fire ratings between rooms where the wall or floor is fire-rated.
22. Conduit, fittings, and boxes required for installation in hazardous classified areas shall be approved for the application and installed in strict accordance with NEC requirements.
23. Empty conduits shall be tagged at both ends to indicate the final destination. A 1/8" polypropylene pull-cord shall also be installed in each empty conduit. Empty conduits that terminate below grade, in vaults, manholes, handholes, and junction or pullboxes shall have a removable plug installed.

b. Conduit Application:
   1. Conduit, Adapters, and Fitting Application:
      A) Diameter: ¾-inch, minimum.
      B) Wet Locations: PVC-Coated rigid galvanized steel.
      C) Outdoor, in Vaults, Wet Well, Exposed: PVC-Coated rigid galvanized steel.
      D) Inside electrical enclosure-01 & -02: EMT.
      E) Direct Earth Burial:
         (i) PVC-Coated rigid galvanized steel for cables to flow or level elements.
         (ii) PVC Schedule 40 with PVC-Coated rigid galvanized steel elbows for all other locations.
   2. Provide conduit seal-offs at the following locations:
      In hazardous classified locations, in strict accordance with NEC.

c. Fitting and Boxes:
   1. General:
      A) Cast and malleable iron fittings for use with metallic conduit shall be the thread type with 5 full threads.
      B) Fittings and boxes shall have neoprene gaskets and non-magnetic stainless steel screws. Covers shall be attached by means of holes tapped into the body of the fitting. Covers for fittings attached by means of clips or clamps will not be acceptable.
      C) Boxes larger than standard cast or malleable types shall be 304 stainless steel, NEMA 4X.
      D) Conduits shall be terminated at panels in raintight hubs with grounding locknuts as manufactured by Myers, O.Z. Gedney, Appleton, or equal. Sealing locknuts shall not be used in lieu of hubs; except at the metal raceway located at the electrical enclosure-01 and -02 per District's approval. Provide PVC-Coated hubs when with PVC-Coated rigid steel conduit.
   2. PVC-Coated Fittings and Boxes:
      A) Fittings for use with PVC-Coated RGS shall be PVC-Coated and shall be products of the same manufacturer as the conduit.
      B) Where flex fittings are used where PVC-Coated rigid galvanized steel conduits/raceways are required fittings shall also be PVC-Coated and shall be products of the same manufacturer as the flex.
      C) Stainless steel 304 NEMA 4X boxes shall be used with PVC-Coated rigid galvanized steel conduit and where indicated.
   3. Malleable Iron Fittings and Boxes:
      A) Fittings for use with galvanized steel conduit and EMT shall be of malleable iron or gray-iron alloy with zinc plating.
   4. PVC Fittings and Boxes:
      A) Fittings for use with non-metallic conduit shall be PVC, solvent welded type.

d. Conduit Connections and Transition:
   Instrumentation, and other equipment where flexible connection is required to minimize vibrations:
   1. General: Flexible metal, liquid-tight conduit.
   2. Hazardous Areas: Flexible coupling suitable for Class 1, Division 1 and 2 areas.
   3. Length: 18-inches maximum, sufficient to allow movement or adjustment of equipment.

4. Outdoor areas, process areas exposed to moisture, and areas required to be oil-tight and dust-tight: PVC-Coated flexible metal, liquid-tight conduit.
5. Transition From Underground or Concrete Embedded to Exposed: PVC-Coated galvanized steel conduit to 12 inches below grade.

e. Support:
Application/Type of Conduit Strap:
1. EMT Conduit: Zinc-coated steel, pre-galvanized steel, or malleable iron.
2. PVC-Coated Rigid Galvanized Steel Conduit: PVC-coated metal or stainless steel.

9.03.3.04 Grounding

a. Grounding shall be in compliance with NFPA 70 and as shown.

b. Ground electrical service neutral at service entrance equipment to supplementary grounding electrodes.

c. Ground each separately derived system neutral to nearest effectively grounded building structural steel member or separate grounding electrode.

d. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceway and cables, receptacle ground connections, and metal piping systems.

e. Shield Instrumentation Cables:
1. Ground shield to ground bus at power supply for analog signal.
2. Expose shield minimum 1-inch at termination to field instrument and apply heat shrink tube.
3. Do not ground instrumentation cable shield at more than one point.

f. Equipment Grounding Conductors: Provide in all conduits containing power conductors and control circuits above 50 volts.

g. Ground Rods: Install full length with conductor connection at upper end. Install one ground rod in each handhole.

9.03.3.05 Low Voltage Motor Control

a. Install equipment in accordance with NEMA ICS 2.3 and manufacturer's instructions and recommendations.

b. Field adjust trip settings of motor starter magnetic-trip-only circuit breakers. Adjust to approximately 11-times motor rated current.

c. Select and install overload relay heaters or adjust electronic overload protection after the actual nameplate full-load current rating of motor has been determined.

9.03.3.06 Luminaires and Accessories

a. Install in accordance with manufacturer's recommendations.

b. Install plumb and level at mounting height shown.

c. Pole Mounted Fixtures: Provide cast-in-place concrete bases as shown.
   1. Pole Head fixtures shall be Hubble, Beacon style no photo cell.
   2. Part # VPS 60NB-136 5K T4 UNV RA BZT or new model.
   3. Poles shall be of the type which are hinged at the bottom and installed in such a manner as to allow the pole to be lowered to ground level unobstructed.

d. Install symmetrically with suspended ceiling pattern in finished areas.

e. Unfinished Areas: Locate luminaires to avoid conflict with other building systems or blockage of luminaire light output.

9.03.3.07 Conductors and Cables

a. Conductor storage, handling, and installation shall be in accordance with manufacturer's recommendation.

b. Do not exceed manufacturer's recommendations for maximum pulling tensions and minimum bending radii.

c. Conduit system shall be complete prior to pulling conductors. Lubricate prior to pulling into conduit. Lubrication type shall be as approved by conductor manufacturer.

d. Terminate all conductors and cables, unless otherwise shown.

e. Do not splice conductors, unless specifically indicated or approved by District.

f. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 12 inches.

g. Wiring within Equipment and Panels: Remove surplus wire, dress, bundle, and secure.

h. Power Conductor Color Coding:
   1. No. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1-1/2 to 2 inches wide.
   2. No. 8 AWG and Smaller: Provide colored conductors:
      A) Neutral wire: White.
      B) Live wires, 120/240 volt, single phase: Black, red.
      C) Live wires, 277/480 volt, three phase: Brown, orange, or yellow.
      D) Ground wire: Green.
      E) Control Wire:
         (i) 120V wire within control panel: Red.
         (ii) 120V wire external to control panel: Yellow.
         (iii) DC positive wire: Blue
         (iv) DC negative wire: White with blue strip
         (v) 480V wire: Brown, Orange, Yellow
         (vi) 277 neutral wire: Gray

9.03.3.08 Operational Readiness Test (ORT) Template

a. Factory Demonstration Test, witness by the District's Representative, for electrical enclosure-01 and 02 shall be per District's standard.

Clean Water Services

Template Only Change to what is needed

Operational Readiness Test (ORT)

Factory/Field Demonstration Test Template

Provide necessary activities for successful factory demonstration test of Electrical Enclosure-01

Project Name: _____ **Project #:** _____

Demonstration Date: _____ **Witness By:** _____

Integrator: _____

Verified	Item	Description
	1.	**Enclosure 01 Power:**
	a.	Verify receptacles are energized.
	b.	Verify light illuminates when panel door is opened.
	c.	Simulate high temperature and verify fan runs.
	d.	Simulate low temperature and verify heater runs.
	e.	Verify power outlets, connectors, etc. have proper cover.
	2.	**Enclosure 01 Labels:**
	a.	Verify labels on doors, receptacles, cables, conduits, RTU, etc.
	3.	**Enclosure 01 Controls:**
	a.	Verify **Pump Sequence Control Panel Control Power ON** light is illuminated.
	4.	**High Level Beacon Light:**
	a.	Switch Beacon Enable switch to ON, jumper terminals at the wetwell

Verified	Item	Description
		High Level float intrinsically safe relay and verify High Level Beacon Light illuminates.
	b.	Verify High WetWell alarm calls out. (RTU Input # 7)
	c.	Remove jumper and verify High Level Beacon Light stays illuminated for 5 minutes (until TD3 times out).
	d.	Switch Beacon Enable switch to OFF, jumper terminals at the wetwell High Level float intrinsically safe relay and verify High Level Beacon Light does not illuminate.
	e.	Turn sector switch High Level Beacon Light Test switch and verify High Level Beacon Light illuminates.
	f.	Verify Beacon Light is mounted properly and securely.
	5.	**Pump#1 Control:**
	a.	Switch Pump #1 HOA switch to HAND and verify Pump #1 starter is energized.
	b.	Verify Pump #1 Running light is illuminated.
	c.	Switch Pump #1 HOA to OFF and verify Pump #1 starter does not energize regardless if wetwell high level float or level transmitter call for Pump #1 to run is jumpered.
	d.	Switch Pump #1 HOA to AUTO and switch Lead Selector switch to Pump #1. Jumper Lead Pump On level contact at level transmitter and verify Pump #1 starter energizes.
	e.	Remove jumper and verify Pump #1 starter de-energizes.
	f.	Again jumper Lead Pump On level contact at level transmitter and verify Pump #1 starter energizes again (there is no alternation).
	g.	Verify Run-Time meters are working.
	6.	**Pump#2 Control:**
	a.	Switch Pump #2 HOA switch to HAND and verify Pump #2 starter is energized.
	b.	Verify Pump #2 Running light is illuminated.
	c.	Switch Pump #2 HOA to OFF and verify Pump #2 starter does not energize regardless if wetwell high level float or level transmitter call

Verified	Item	Description
		for Pump #2 to run is jumpered.
	d.	Switch Pump #2 HOA to AUTO and switch Lead Selector switch to Pump #2. Jumper Lead Pump On level contact at level transmitter and verify Pump #2 starter energizes.
	e.	Remove jumper and verify Pump #2 starter de-energizes.
	f.	Again jumper Lead Pump On level contact at level transmitter and verify Pump #2 starter energizes again (there is no alternation).
	g.	Verify Run-Time meters are working.
	7.	**Both Pumps Control: (AUTO)**
	a.	Repeat steps **6.**a thru **6.**e for Pump #2.
	b.	Switch both pumps HOA to AUTO and Lead Selector switch to ALT. Jumper Lead Pump On level contact at level transmitter and verify Pump #1 or 2 starter energizes.
	c.	Remove jumper and verify that energized starter de-energizes.
	d.	Jumper Lead Pump On level contact at level transmitter again and verify the other pump starter energizes for Alternator relay function.
	e.	Jumper Lag Pump On level contact at level transmitter and verify both pump starters energize.
	f.	Verify Both Pumps Running alarm calls out. (RTU Input #_____)
	g.	Remove both jumpers and verify both pump starters de-energize.
	h.	Jumper terminals at the wetwell High Level float intrinsically safe relay and verify both pump starters energize.
	i.	Remove jumper and verify both pump starters stay energized for 5 minutes (until TD3 times out).
	8.	**Pump#1 Overtemp and Seal Leak:**
	a.	Switch Pump #1 HOA switch to OFF and remove temporary resistor connected to the Pump #1 Mini Cas to simulate an overtemp condition and verify Pump #1 Overtemp light is illuminated.
	b.	Verify Pump #1 Fail alarm does not call out.

Verified	Item	Description
	c.	Switch Pump #1 HOA switch to AUTO and verify that the Pump #1 Fail alarm calls out. (RTU Input # 3)
	d.	Switch Pump #1 HOA switch to HAND and verify that the Pump #1 Fail alarm calls out. (RTU Input # 3)
	e.	Verify Pump #1 starter does not energize until the simulated overtemp condition is removed and the reset pushbutton is pressed.
	f.	Jumper the temporary resistor to the Pump #1 Mini Cas to simulate a seal leak condition and verify Pump #1 starter can be energized.
	g.	Verify Pump #1 Seal Leak light is illuminated and stays on until the simulated seal leak condition is removed and the reset pushbutton is pressed.
	9.	**Pump#2 Overtemp and Seal Leak:**
	a.	Switch Pump #2 HOA switch to OFF and remove temporary resistor connected to the Pump #2 Mini Cas to simulate an overtemp condition and verify Pump #2 Overtemp light is illuminated.
	b.	Verify Pump #2 Fail alarm does not dial out.
	c.	Switch Pump #2 HOA switch to AUTO and verify that the Pump #2 Fail alarm calls out. (RTU Input # 4)
	d.	Switch Pump #2 HOA switch to HAND and verify that the Pump #2 Fail alarm calls out. (RTU Input # 4)
	e.	Verify Pump #2 starter does not energize until the simulated overtemp condition is removed and the reset pushbutton is pressed.
	f.	Jumper the temporary resistor to the Pump #2 Mini Cas to simulate a seal leak condition and verify Pump #2 starter can be energized.
	g.	Verify Pump #2 Seal Leak light is illuminated and stays on until the simulated seal leak condition is removed and the reset pushbutton is pressed.
	10.	**RTU:**
	a.	Turn off power to Pump Sequence Control Panel and verify PSCP Control Power Fail calls out. This may have a 30 second delay.
	b.	Jumper terminals at the wetwell Overflow Level float intrinsically safe

Verified	Item	Description
		relay and verify WetWell Overflow alarm calls out. RTU Input # 8).
	c.	Jumper the wetwell High Level On level contact at level transmitter and verify High WetWell alarm calls out. RTU Input # 7).
	d.	With Pump #1 HOA switch in AUTO, jumper Pump #1 overload and verify Pump #1 Fail alarm calls out. RTU Input # 3).
	e.	Switch Pump #1 HOA switch to OFF, jumper Pump #1 overload and verify Pump #1 Fail alarm does not dial out.
	f.	Switch Pump #1 HOA switch to HAND, jumper Pump #1 overload and verify Pump #1 Fail alarm calls out. RTU Input # 3).
	g.	With Pump #2 HOA switch in AUTO, jumper Pump #2 overload and verify Pump #2 Fail alarm calls out. RTU Input # 4).
	h.	Switch Pump #2 HOA switch to OFF, jumper Pump #2 overload and verify Pump #2 Fail alarm does not dial out.
	i.	Switch Pump #2 HOA switch to HAND, jumper Pump #2 overload and verify Pump #2 Fail alarm calls out. RTU Input # 4).
	j.	Jumper terminals at the Valve Vault Flood switch intrinsically safe relay and verify Valve Vault Flood alarm calls out. RTU Input # .
	k.	Jumper terminals at the Meter Vault Flood switch intrinsically safe relay and verify Meter Vault Flood alarm calls out. RTU Input # .
	l.	Run generator and verify Standby Generator ON calls out. This may have a 90 minute delay. RTU Input # .
	m.	Verify alarms are calling out correct to Pump Crew and coming into Mission web site
	11.	**Flow Meter Transmitter & Indicator: (If applicable)**
	a.	Verify settings such as scale & range.
	b.	Verify display settings units for GPM or MGD.
	c.	Verify display for current gallons (GPM) and Totalized gallons (GPM) * 1000) pumped.
	d.	Was this instrument factory certified for installation? (data sheet)
	12.	**Level Transmitter & Indicator:**

Verified	Item	Description
	a.	Verify settings such as scale & range.
	b.	Verify display settings for units for FEET.
	c.	Double check Transducer head in stilling well.
	d.	Have the factory installer input levels to watch controller respond.
	e.	Was this instrument factory certified for installation? (data sheet)
	f.	Verify pump operation elevation set points: • Bottom wetwell = xxx ft • Both pumps stop = xxx ft. • Lead pump on = xxx ft. • Lag pump on = xxx ft. • Hi level alarm clear/reset = xxx ft. • Hi level = xxx ft. • Hi Float = xxx ft • Overflow Float = xxx ft • Top of Wetwell = xxx ft
	g.	**Engine Generator –** • Field testing generator per specifications • E-Stop. Shutdown engine only without tripping the generator main breaker. • Generator Run • Generator Trouble • Generator Failed
	13.	**ATS Testing** • Field testing ATS per specification
	a.	Record actual ATS time delay settings for Transfer to Emergency and Transfer to Normal power.
	b.	Test ATS manual transfer function.
	c.	Check Alarm, Control and Equipment Test per specification.
	d.	Provide Operational Tests per specification.
	e.	Provide Endurance Tests per specification.

Template Forms:

CWS Pump Station Panel Factory/Field Test – Template		
Project#:		
Date:		
Verified	Item	Description
	1. Enclosure 01 Power:	
	a.	Verify receptacles are energized.
	b.	Verify light illuminates when panel door is opened.
	c.	Simulate high temperature and verify fan runs.
	d.	Simulate low temperature and verify heater runs.
	e.	Verify power outlets, connectors, etc have proper covers.
	2. Enclosure 01 Labels:	
	a.	Verify labels on doors, receptacles, cables, conduits, Auto-Dialer, etc…
	3. Enclosure 01 Controls:	
	a.	Verify **Pump Sequence Control Panel Control Power ON** light is illuminated.
	4. High Level Beacon Light:	
	a.	Switch Beacon Enable switch to ON, jumper terminals at the wetwell High Level float intrinsically safe relay and verify High Level Beacon Light illuminates.
	b.	Verify High WetWell alarm dials out. (Mission Input #_____)
	c.	Remove jumper and verify High Level Beacon Light stays illuminated for 5 minutes (until TD3 times out).
	d.	Switch Beacon Enable switch to OFF, jumper terminals at the wetwell High Level float intrinsically safe relay and verify High Level Beacon Light does not illuminate.
	e.	Press High Level Beacon Light Test switch and verify High Level Beacon Light illuminates.
	f.	Verify Beacon Light is mounted properly and securely.
	5. Pump#1 Control:	
	a.	Switch Pump #1 HOA switch to HAND and verify Pump #1 starter is energized.

Verified	Item	Description
	b.	Verify Pump #1 Running light is illuminated.
	c.	Switch Pump #1 HOA to OFF and verify Pump #1 starter does not energize regardless if wetwell high level float or level transmitter call for Pump #1 to run is jumpered.
	d.	Switch Pump #1 HOA to AUTO and switch Lead Selector switch to Pump #1. Jumper Lead Pump On level contact at level transmitter and verify Pump #1 starter energizes.
	e.	Remove jumper and verify Pump #1 starter de-energizes.
	f.	Again jumper Lead Pump On level contact at level transmitter and verify Pump #1 starter energizes again (there is no alternation).
	h.	Verify Run-Time meters are working.
	6. Pump#2 Control:	
	a.	Switch Pump #2 HOA switch to HAND and verify Pump #2 starter is energized.
	b.	Verify Pump #2 Running light is illuminated.
	c.	Switch Pump #2 HOA to OFF and verify Pump #2 starter does not energize regardless if wetwell high level float or level transmitter call for Pump #2 to run is jumpered.
	d.	Switch Pump #2 HOA to AUTO and switch Lead Selector switch to Pump #2. Jumper Lead Pump On level contact at level transmitter and verify Pump #2 starter energizes.
	e.	Remove jumper and verify Pump #2 starter de-energizes.
	f.	Again jumper Lead Pump On level contact at level transmitter and verify Pump #2 starter energizes again (there is no alternation).
	h.	Verify Run-Time meters are working.
	7. Both Pumps Control: (AUTO)	
	a.	Repeat steps **6.**a thru **6.**e for Pump #2.
	b.	Switch both pumps HOA to AUTO and Lead Selector switch to ALT. Jumper Lead Pump On level contact at level transmitter and verify Pump #1 or 2 starter energizes.
	c.	Remove jumper and verify that energized starter de-energizes.
	d.	Jumper Lead Pump On level contact at level transmitter again and verify the other pump starter energizes for Alternator relay function.
	e.	Jumper Lag Pump On level contact at level transmitter and verify both pump starters energize.
	f.	Verify Both Pumps Running alarm dials out. (Missions Input #_____)
	g.	Remove both jumpers and verify both pump starters de-energize.
	h.	Jumper terminals at the wetwell High Level float intrinsically safe relay and verify both pump starters energize.
	i.	Remove jumper and verify both pump starters stay energized for 5 minutes (until TD3 times out).

Verified	Item	Description
	8. Pump#1 Overtemp and Seal Leak:	
	a.	Switch Pump #1 HOA switch to OFF and remove temporary resistor connected to the Pump #1 Mini Cas to simulate an overtemp condition and verify Pump #1 Overtemp light is illuminated.
	b.	Verify Pump #1 Fail alarm does not dial out.
	c.	Switch Pump #1 HOA switch to AUTO and verify that the Pump #1 Fail alarm dials out. (Auto-Dialer Input #_____)
	d.	Switch Pump #1 HOA switch to HAND and verify that the Pump #1 Fail alarm dials out. (Auto-Dialer Input #_____)
	e.	Verify Pump #1 starter does not energize until the simulated overtemp condition is removed and the reset pushbutton is pressed.
	f.	Jumper the temporary resistor to the Pump #1 Mini Cas to simulate a seal leak condition and verify Pump #1 starter can be energized.
	g.	Verify Pump #1 Seal Leak light is illuminated and stays on until the simulated seal leak condition is removed and the reset pushbutton is pressed.
	9. Pump#2 Overtemp and Seal Leak:	
	a.	Switch Pump #2 HOA switch to OFF and remove temporary resistor connected to the Pump #2 Mini Cas to simulate an overtemp condition and verify Pump #2 Overtemp light is illuminated.
	b.	Verify Pump #2 Fail alarm does not dial out.
	c.	Switch Pump #2 HOA switch to AUTO and verify that the Pump #2 Fail alarm dials out. (Auto-Dialer Input #_____)
	d.	Switch Pump #2 HOA switch to HAND and verify that the Pump #2 Fail alarm dials out. (Auto-Dialer Input #_____)
	e.	Verify Pump #2 starter does not energize until the simulated overtemp condition is removed and the reset pushbutton is pressed.
	f.	Jumper the temporary resistor to the Pump #2 Mini Cas to simulate a seal leak condition and verify Pump #2 starter can be energized.
	g.	Verify Pump #2 Seal Leak light is illuminated and stays on until the simulated seal leak condition is removed and the reset pushbutton is pressed.
	10. Missions:	
	a.	Unplug dialer and verify internal power fail alarm dials out. Missionsr Input #_____).
	b.	Turn off power to Pump Sequence Control Panel and verify PSCP Control Power Fail dials out. This may have a 30 second delay. Missions Input #_____).

Verified	Item	Description
	c.	Jumper terminals at the wetwell Overflow Level float intrinsically safe relay and verify WetWell Overflow alarm dials out. Missions Input #_____).
	d.	Jumper the wetwell High Level On level contact at level transmitter and verify High WetWell alarm dials out. Missions Input #_____).
	e.	With Pump #1 HOA switch in AUTO, jumper Pump #1 overload and verify Pump #1 Fail alarm dials out. Missions Input #_____).
	f.	Switch Pump #1 HOA switch to OFF, jumper Pump #1 overload and verify Pump #1 Fail alarm does not dial out.
	g.	Switch Pump #1 HOA switch to HAND, jumper Pump #1 overload and verify Pump #1 Fail alarm dials out. Missions Input #_____).
	h.	With Pump #2 HOA switch in AUTO, jumper Pump #2 overload and verify Pump #2 Fail alarm dials out. Missions Input #_____).
	i.	Switch Pump #2 HOA switch to OFF, jumper Pump #2 overload and verify Pump #2 Fail alarm does not dial out.
	j.	Switch Pump #2 HOA switch to HAND, jumper Pump #2 overload and verify Pump #2 Fail alarm dials out. Missions Input #_____).
	k.	Jumper both pumps running and verify Both Pump Running alarm dials out. Missions Input #_____).
	l.	Jumper terminals at the Valve Vault Flood switch intrinsically safe relay and verify Valve Vault Flood alarm dials out. Missions Input #_____).
	m.	Jumper terminals at the Meter Vault Flood switch intrinsically safe relay and verify Meter Vault Flood alarm dials out. Missions Input #_____).
	n.	Jumper bubbler system fail (Low Air) and verify Bubbler System Fail alarm dials out. Missions Input #_____).
	o.	Run generator and verify Standby Generator ON dials out. This may have a 60 minute delay. Missions Input #_____).
		Note: Are all voice messages clear and understandable locally at the Missions **and through the phone?**
	11. Bubbler Panel/Compressor Cabinet: (If applicable)	
	a.	Verify compressor #1 run and check for excessive vibrations.
	b.	Verify compressor #2 run and check for excessive vibrations.
	c.	Verify compressors #1 & #2 alternate every cycle.
	d.	Verify LEAD compressor starts at 40 (?) psi.
	e.	Verify LEAD compressor stops at 50 (?) psi.
	f.	Verify both LEAD/LAG compressors start at 30 (?) psi.
	g.	Verify compressor high pressure pop-off is tested at 60 (?) psi.
	h.	Check for access to nuts and bolts for maintenance of equipment.
	i.	Check all air line fittings for leaks.
	J.	Verify purge valve and purge cycle are functioning.
		FOR GASTON STARTUP: BOTTOM wetwell = 152.03’

Verified	Item	Description
		Ramp Down Complete (120 sec) = 155.5' Both Pumps Stop = 156.8' – (PS-2 = 1.3') – (0.56 psi) Lead Pump On = 158.3' – (PS-3 = 2.8') – (1.21 psi) Lag Pump On = 159.4' – (PS-4 = 3.9') – (1.69 psi) Hi Level = 160.5' – (PS-5 = 5.0') – (2.16 psi) Hi Float = 160.5' Overflow Float = 175.6' TOP wetwell = 178.0' Existing Influent Sewage IE =158.28
	12. Flow Meter Transmitter & Indicator: (If applicable)	
	a.	Verify settings such as scale & range.
	b.	Verify display settings units for GPM or MGD.
	c.	Verify display for current gallons (GPM) and Totalized gallons (GPM) * 1000) pumped.
	d.	Was this instrument factory certified for installation? (data sheet)
	13. Level Transmitter & Indicator: (If applicable)	
	a.	Verify settings such as scale & range.
	b.	Verity display settings for units for INCHES or FEET.
	c.	Was this instrument factory certified for installation? (data sheet)
	14. Engine Generator:	
	a.	Record actual ATS time delay settings for Transfer to Emergency and Transfer to Normal power.
	b.	Test ATS manual transfer function.
	c.	Check Alarm, Control and Equipment Test per Spec Section 13101-3.02.C.
	d.	Provide Operational Tests per spec section 13101-3.02.D.
	e.	Provide Endurance Tests per spec section 13101-3.02.E

Chapter 10

SEPTIC TANK EFFLUENT PUMP (STEP) SYSTEMS

10.01 General Provisions

10.02 Technical Specifications
- 10.02.1 On-Site Interceptor Tank
- 10.02.2 Risers and Lids
- 10.02.3 Pumping Assemblies

10.03 Application

10.04 Inspection

Chapter 10

SEPTIC TANK EFFLUENT PUMP (STEP) SYSTEMS

10.01 General Provisions

a. With the approval of the District, STEP systems which pump to a public sewer line may be installed when:

1. A public gravity sewer is adjacent to the lot, and

2. Gravity access to a public sewer line cannot reasonably be obtained, and

3. The District determines that a public pump station serving multiple properties is not a more appropriate solution, and

4. Only one house or building is connected to the STEP system and pressure line, and

5. Unless approved by the District, the public sewer line at the point of connection is a polyvinyl chloride (PVC) material, and flows in the public line are such that hydrogen sulfide generation will not be a problem.

b. The STEP system operation, maintenance, electricity, replacement, and sludge removal costs are the responsibility of the property owner. The property owner is also responsible for the repair or replacement of the tank and connections if infiltration occurs.

c. The District or City shall be permitted to enter upon private property for the purpose of inspection, observation, measurement, sampling, and testing of the STEP system.

10.02 Technical Specifications

10.02.1 On-Site Interceptor Tank

a. Tanks shall be 1000 gallon precast concrete, fiberglass or polyethylene and shall have been designed by a registered engineer and approved by the local regulatory agencies. The manufacturer shall provide the structural design and certification to the District or City for review.

b. The tank shall be guaranteed in writing by the tank manufacturer for a period of two years from the date of delivery to the site.

c. The tank shall successfully pass a hydrostatic test at the time of manufacture and after installation at the site. An alternate method is a vacuum test. The hydrostatic test shall measure the water loss due to exfiltration during a two-hour period where the tank is filled with water to

the riser. The two-hour loss shall not exceed six gallons for concrete, and no loss for polyethylene and fiberglass tanks.

d. The tank shall be installed in accordance with the manufacturer's instructions. The installation and testing shall be witnessed by District or City personnel.

10.02.2 Risers and Lids

a. Inlet risers, if required, shall be ribbed PVC. Risers shall be at least 12-inches high and shall have a minimum nominal diameter of 21-inches.

b. Outlet risers shall be ribbed PVC. Outlet risers shall be at least 12-inches high and a minimum nominal diameter of 24-inches.

c. Lids shall be Orenco Systems Model FL-21g or FL-24g, or equal, and provided with neoprene gasket, and stainless steel bolts.

d. Risers and lids shall be free from infiltration.

10.02.3 Pumping Assemblies

The pumping system shall be an Orenco Pumping System, or equal, that is designed by a registered engineer to meet the application of its intended use.

10.03 Application

The applicant shall submit to the District or City two copies of the engineering plans prepared by a licensed professional engineer. The application shall also show that gravity sewer is not available to the lot, that there is no practical way to serve the lot with gravity sewer, and that there will not be a hydrogen sulfide problem at the point of connection to the gravity system.

The District or City may set and charge additional fees for the plan review and inspection of STEP system installations.

Prior to final acceptance by the District or City, the Property Owners shall furnish an easement for access to the property stating that a STEP system exists on the property, that it is a private system (not owned or maintained by the District), and that the District or City shall be permitted to enter upon the subject property for the purpose of inspection, observation, measurement, sampling, and testing of the STEP system.

10.04 Inspection

Inspection and testing of the individual STEP system, by the appropriate jurisdiction, shall be required prior to final acceptance by the District or City.

Appendix A

PLANTING REQUIREMENTS

1.0 INTRODUCTION

1.1 General

The District recognizes the importance of Water Quality Sensitive Areas, Vegetated Corridors, and Stormwater Facilities that, along with the Tualatin River, are under its jurisdiction. To improve water quality and preserve aquatic species, and meet the intent of both the federal Clean Water and the Endangered Species Acts, the District developed requirements for planting of Vegetated Corridors, Sensitive Areas, and Stormwater Facilities.

Successful revegetation is critical to the proper function of Sensitive Areas, Vegetated Corridors, and Stormwater Facilities for the benefit of water quality and quantity management, and aquatic species preservation. This Appendix aids professionals, the development community, and field crews in planning, designing and implementing successful revegetation projects in these areas. This document guides design decisions to promote successful planting efforts, while allowing flexibility to address opportunities and constraints at each site.

1.2 Jurisdiction

Most Sensitive Areas are regulated by the Division of State Lands (DSL) and/or the U.S. Army Corps of Engineers (Corps). Where the Corps and/or DSL permit mitigation, planting plans for these areas shall follow DSL and Corps guidelines and approved plans. Vegetated Corridors and Stormwater Facilities are regulated by the District and the plans and management strategies for these areas shall follow the steps outlined in this document. Alternative plans and management strategies may be approved by the District.

1.3 Professional Assistance

Revegetation in Sensitive Areas, Vegetated Corridors and Stormwater Facilities should facilitate succession toward low-maintenance plant communities. Consultation with a professional landscape architect, ecologist, or horticulturist knowledgeable in native plants is highly recommended when preparing plans. Satisfying the landscaping requirements may require the services of a registered landscape architect. See ORS 671.310 through 671.459.

Non-native, invasive plant management and wildlife damage management strategies are provided in Clean Water Services *Integrated Pest Management (IPM) Plan*. Especially challenging management situations may require assistance from a landscape maintenance contractor or a wildlife biologist.

2.0 PLANTING PLAN METHODS

Planting plans shall be required for development projects with Vegetated Corridors or Stormwater Facilities. When a planting plan is required, four major components shall be addressed: hydrology, soils, plant materials, and maintenance. When developing planting plans, the following steps should be used:

2.1 Step 1: Assess Hydrologic and Hydraulic Conditions

a. Determine the frequency and duration of water inundation, including appropriate elevations of the revegetation area. Watershed hydrology and hydraulic models for major streams are available from the District. In some cases, current site conditions (i.e. wetland presence) will suffice. For Stormwater Facilities, the models used to design and size the facility shall be used to determine frequency, duration and surface water elevations within the facility.

b. Assign appropriate hydrologic zones to the revegetation area and apply them to the plan. Most project sites include one or more of the following planting zones with respect to hydrology during the growing season:

   1. Wet - standing or flowing water/nearly constant saturation; anaerobic soils

   2. Moist - periodically saturated; anaerobic and/or aerobic soils

   3. Dry - infrequent inundation/saturation, if any; aerobic soils

2.2 Step 2: Assess Soil Conditions and Assign Appropriate Preparation Specifications to Plans

a. Determine the organic content and non-native, invasive seed bank likely in the soil. For most Stormwater Facilities, the soil is often high in clay, gravel, or minerals devoid of topsoil and organic material, and/or high in non-native, invasive weed content. The conditions in Sensitive Areas and Vegetated Corridors vary greatly.

b. For upland sites with at least one foot of native topsoil, but containing a non-native, invasive seed bank or plants, add notes to the plan to remove the undesirable plants, roots, and seeds (*see IPM Plan*) prior to planting.

c. For upland sites with either disturbed and compacted soils or less than one foot of topsoil and invasive, non-native seed bank or plants that have become established, the following notes shall be added to the plan:

   1. Remove the undesirable plants, roots, and seeds (*see IPM Plan*) prior to adding topsoil.

2. Till the sub-grade in these areas to a depth of at least four inches and add at least 12 inches of clean compost-amended topsoil. The compost-amended topsoil shall have the following characteristics to ensure a good growing medium:
   A) Texture – material passes through one-inch screen
   B) Fertility – 35% organic matter

3. In the event of floodplain grading, over-excavate the sub grade to ensure 12 inches of topsoil can be applied without impacting surface water elevations.

d. For wet areas in Sensitive Areas and Stormwater Facilities, the soil conditions shall be hydric or graded to hold sufficient water to promote hydric soil formation. The addition of organic muck soil will improve plant establishment for some bulbs and tubers.

e. Where appropriate and necessary for erosion control or to enhance organic matter, leaf compost may be placed uniformly on topsoil. (Refer to Chapter 6, Erosion Prevention and Sediment Control). Other amendments, conditioners, and bio-amendments may be added as needed to support the specified plants or adjust the soil pH. Traditional fertilization techniques (applying N-P-K) are not necessary for native plants.

2.3 Step 3: Identify Plants to be Preserved, Select Revegetation Plant Materials, Quantities, Placement, and Assign Planting Zones and Specifications to Plans

a. Preservation: Every effort shall be made to protect a site's existing native vegetation. Native vegetation along Sensitive Areas and Vegetated Corridors shall be retained to the maximum extent practicable.

b. Selection: Plant selection shall be from a native species palette and shall consider site soil types, hydrologic conditions, and shade requirements. Containerized or bare root plants may be used. A list of common native plant community types appropriate for planting Sensitive Areas, Vegetated Corridors and Stormwater Facilities is provided in Table A-1. Upon approval from the District, limited use of non-invasive non-native plants may be permitted in highly urbanized and other unique settings such as regional town centers. Unless approved by District staff, planting restrictions are limited to the following:

1. Deep rooting trees and shrubs (e.g. willow) shall not be planted on top of concrete pipes, or within 10 feet of retaining walls, inlet/outlet structures or other culverts; and

2. Large trees or shrubs shall not be planted on berms over four feet tall that impound water. Small trees or shrubs with fibrous root systems may be installed on berms that impound water and are less than four feet tall.

c. Quantities:

1. Vegetated Corridors and Sensitive Areas
Trees and shrubs shall be planted using the following equations to achieve the specified densities on a per acre basis.

A) Total number of trees per acre = area in square feet x 0.01
B) Total number of shrubs per acre = area in square feet x 0.05
C) Groundcover = plant and seed to achieve 100% areal coverage

2. Stormwater Facilities
A) Stormwater Facilities in tracts or easements less than 30 feet wide shall be planted using the following equations to achieve the specified densities on a per acre basis:
i. Total number of shrubs per acre = area in square feet x 0.05
ii. Groundcover = plant and seed to achieve 100% areal coverage
B) Stormwater Facilities in tracts or easements 30 feet wide or more shall be planted using the following equations to achieve the specified densities on a per acre basis:
i. Total number of trees per acre = area in square feet x 0.01
ii. Total number of shrubs per acre = area in square feet x 0.05
iii. Groundcover = plant and seed to achieve 100% areal coverage

d. Size: Potted plants shall follow size requirements outlined in Table A-1. Bare root plants shall be 12 to 16 inches long.

e. Placement: Plant placement shall be consistent with naturally occurring plant communities. Trees and shrubs shall be placed in singles or clusters of the same species to provide a natural planting scheme. This arrangement may follow curved rows to facilitate maintenance. Distribution and relative abundance shall be dependant on the plant species and on the size of the revegetation area. The Vegetated Corridor revegetation area shall be overseeded with native seed mixes appropriate to the plant community and hydrologic zone of the site (see Table A-1: Plant Communities for Revegetation). Plant placement and seeding shall promote maximum vegetative cover to minimize weed establishment.

2.4 Step 4: Determine Plant Installation Requirements and Assign Specifications to Plans

a. Timing
Containerized stock shall be installed only from February 1 through May 1 and October 1 through November 15. Bare root stock shall be installed only from December 15 through April 15. Plantings outside these times may require additional measures to ensure survival which shall be specified on the plans.

b. Erosion Control
Grading, soil preparation, and seeding shall be performed during optimal weather conditions and at low flow levels to minimize sediment impacts. Site disturbance shall be minimized and desirable vegetation retained, where possible. Slopes shall be graded to support the establishment of vegetation. Where seeding is used for erosion control, an appropriate native grass, Regreen (or its equivalent), or sterile wheat shall be used to stabilize slopes until permanent vegetation is established. Biodegradable fabrics (coir, coconut or approved jute matting (minimum 1/4" square holes) may be used to stabilize slopes and channels. Fabrics such as burlap may be used to secure plant plugs in place and to discourage floating upon inundation. No plastic mesh that can entangle wildlife is permitted. Consult Chapter 6 - Erosion Prevention and Sediment Control for additional information.

c. Mulching
Trees, shrubs, and groundcovers planted in upland areas shall be mulched a minimum of three inches in depth and 18 inches in diameter, to retain moisture and discourage weed growth around newly installed plant material. Appropriate mulches are made from composted bark or leaves that have not been chemically treated. The use of mulch in frequently inundated areas shall be limited, to avoid any possible water quality impacts including the leaching of tannins and nutrients, and the migration of mulch into waterways.

d. Plant Protection from Wildlife
Depending on site conditions, appropriate measures shall be taken to limit wildlife-related damage (*see IPM Plan*).

e. Irrigation
Appropriate plant selection, along with adequate site preparation and maintenance, reduces the need for irrigation. However, unless site hydrology is currently adequate, a District/City approved irrigation system or equivalent (i.e., polymer, plus watering) shall be used during the two-year plant establishment period. Watering shall be at a minimum rate of at least one inch per week from June 15 through October 15. Other irrigation techniques, such as deep watering, may be allowed with prior approval by District staff.

f. Access
Maintenance access for plant maintenance shall be provided for Sensitive Areas and Vegetated Corridors via a five-foot easement or shared boundary with Stormwater Facilities. Stormwater Facilities access requirements are provided in Chapter 4.

2.5 Step 5: Determine Plant Monitoring and Maintenance Requirements

a. Monitoring
Site visits are necessary throughout the growing season to assess the status of the plantings, irrigation, mulching, etc. and ensure successful revegetation.

b. Weed Control
The removal of non-native, invasive weeds shall be necessary throughout the maintenance period, or until a healthy stand of desirable vegetation is established (*see IPM Plan*).

c. Plant Replacement and Preservation
Installed plants that fail to meet the acceptance criteria (see Chapter 2) shall be replaced during the maintenance period. Prior to replacement, the cause of loss (wildlife damage, poor plant stock, etc.) shall be documented with a description of the corrective actions taken.

2.6 Step 6: Prepare Construction Documents and Specifications

The construction documents and specifications shall include:

a. Sensitive Area and Vegetated Corridor boundaries as shown on the Service Provider Letter, including limits of approved, temporary construction encroachment. Orange construction fencing shall be noted at Vegetated Corridor boundaries as well as at encroachment limits during construction. Note permanent type fencing and signage between the development and the Vegetated Corridor for project completion is required.

b. Site Preparation plan and specifications, including limits of clearing, existing plants and trees to be preserved, and methods for removal and control of invasive, non-native species, and location and depth of topsoil and or compost to be added to revegetation area.

c. Planting plan and specifications, including all of the following:
   1. Planting table that documents the common name, scientific name, distribution (zone and spacing), condition and size of plantings
   2. Installation methods for plant materials
   3. Mulching
   4. Plant tagging for identification
   5. Plant protection
   6. Seeding mix, methods, rates, and areas

d. Irrigation plan and specifications, including identification of water source, watering timing and frequency, and maintenance of the system.

e. Maintenance schedule; including responsible party and contact information, dates of inspection (minimum three per growing season and one prior to onset of growing season) and estimated maintenance schedule (as necessary) over the two-year monitoring period.

f. Easement descriptions for all Vegetated Corridor and Sensitive Areas that are required as part of the development.

g. Good rated corridor notes i.e. invasive species removal resulting in cleared areas exceeding 25 square feet shall be replanted with native vegetation.

h. Access points for installation and maintenance including vehicle access if available.

i. Standard drawing details (north arrow, scale bar, property boundaries, project name, drawing date, name of designer and Property Owner).

TABLE A-1
SUGGESTED PLANT COMMUNITIES FOR REVEGETATION

Plant Commiunities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	Spacing Format
Riparian Forest (RF)							
Red alder (Alnus rubra)	X	Tree	Moist	Sun	1 gal	3'	Single
Western red cedar (Thuja plicata)	X	Tree	Moist	Shade	2 gal	2'	Single
Red elderberry (Sambucus racemosa)	X	Shrub	Moist	Part	1 gal	1.5'	Single
Black twinberry (Lonicera involcrata)		Shrub	Moist	Part	1 gal	1.5'	Single
Red-osier dogwood (Cornus stoniferia)	X	Shrub	Wet	Part	1 gal	2'	Cluster
Indian plum (Oemleris cerasiformis)	X	Shrub	Moist	Shade	2 gal	2'	Cluster
Swamp rose (Rosa pisocarpa)		Shrub	Moist	Part	1 gal	1.5'	Cluster
Pacific ninebark (Pysocarpus capitatus)		Shrub	Moist	Shade	1 gal	2'	Single
Snowberry (Symphoricarpos albus)	X	Shrub	Dry	Part	1 gal	1.5'	Cluster
Salmonberry (Rubus spectabilis)	X	Shrub	Moist	Shade	1 gal	1.5'	Cluster
Maidenhair fern (Adiatum aleuticum)		Herb	Moist	Shade	4"	na	Cluster
Lady fern (Athyrium filix-femina)		Herb	Moist	Shade	1 gal	na	Cluster
Skunk cabbage (Lysichiton americanum)		Herb	Wet	Shade	bulbs	na	Cluster
False lily-of-the-valley (Maianthemum dilatatum)		Herb	Moist	Shade	bulbs, 4"	na	Cluster
Candy flower (Claytonia sibirica)		Herb	Moist	Shade	4"	na	Cluster
Miners lettuce (Montia perfoliata)		Herb	Moist	Shade	4"	na	Cluster
Stream violet (Viola glabella)		Herb	Moist	Shade	4"	na	Cluster
Youth-on-age (Tolmiea menziesii)		Herb	Moist	Shade	4"	na	Cluster
Insideout flower (Vancouveria hexandra)		Herb	Moist	Shade	4"	na	Cluster
Dewey's sedge (Carex deweyana)		Herb	Dry	Shade	plugs, 4"	4"	Mass
Hair bentgrass (Agrostis scabra)		Grass	Moist	Part	seed	na	Mass
Spike bentgrass (Agrostis exarata)	X	Grass	Moist	Part	seed	na	Mass
Tall manna-grass (Glyceria elata)	X	Grass	Moist	Part	seed	na	Mass

Plant Commiunities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	Spacing Format
Upland Forest (UF)							
Red alder (Alnus rubra)	X	Tree	Moist	Sun	1 gal	3'	Single
Big leaf maple (Acer macrophyllum)	X	Tree	Dry	Sun	2gal	3'	Single
Douglas Fir (Pseudotsuga menziesii)	X	Tree	Dry	Sun	2gal	3'	Single
Grand fir (Abies grandis)	X	Tree	Dry	Sun	2 gal	2'	Single
Pacific yew (Taxus brevifolia)		Tree	Moist	Shade	2 gal	2'	Single
Cascara (Rhamnus purshiana)		Tree	Dry	Part	2 gal	2'	Single
Pacific dogwood (Cornus nuttallii)		Tree	Moist	Shade	1 gal	2'	Single
Bitter cherry (Prunus emarginata)		Tree	Moist	Part	2 gal	2'	Single
Vine Maple (Acer circinatum)	X	Tree	Moist	Part	2 gal	2'	Single
Oceanspray (Holodiscus discolor)	X	Shrub	Dry	Sun	1 gal	1.5'	Single
Red elderberry (Sambucus racemosa)	X	Shrub	Moist	Part	1 gal	1.5'	Single
Red flowering currant (Ribes sanguineum)	X	Shrub	Dry	Sun	1 gal	1.5'	Cluster
Cascade Oregon grape (Mahonia nervosa)		Shrub	Moist	Part	1 gal	4"	Cluster
Tall Oregon grape (Mahonia aquifolium)		Shrub	Dry	Sun	1 gal	6"	Single
Red huckleberry (Vaccinium parvifolium)		Shrub	Moist	Shade	1 gal	1.5'	Cluster
Thimbleberry (Rubus pariflorus)		Shrub	Moist	Shade	1 gal	1.5'	Cluster
Snowberry (symphoricarpos albus)	X	Shrub	Dry	Part	1 gal	1.5'	Cluster
Baldhip Rose (Rosa gymnocarpa)	X	Shrub	Dry	Part	1 gal	1.5'	Cluster
Serviceberry (Almelanchier alnifolia)		Shrub	Dry	Part	2 gal	2'	Single
Sword fern (Polystichum munitum)		Shrub	Moist	Shade	2 gal	na	Cluster
Deer fern (Blechnum spicant)		Herb	Moist	Shade	1 gal	na	Cluster
Orange honeysuckle (Lonicera ciliosa)		Herb	Moist	Shade	2 gal	na	Single
Salal (Gaultheria shallon)		Herb	Moist	Part	1 gal	4"	Cluster
Wood strawberry (Fragaria vesca)		Herb	Moist	Shade	4"	na	Cluster
Western trillium (Trillium ovatum)		Herb	Moist	Shade	4"	na	Cluster
Five-stemmed mitrewort (Mitella pentandra)		Herb	Moist	Shade	1 gal	na	Cluster
Red columbine (Aquilegia formosa)		Herb	Dry	Part	4"	na	Cluster
False solomon's seal (Smilacina racemosa)		Herb	Moist	Shade	4"	na	Cluster
Native California brome (Bromus carinatus)	X	Grass	Dry	Sun	seed	na	Mass
Blue Wildrye (Elymus glaucus)	X	Grass	Dry	Part	seed	na	Mass

Plant Commiunities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	Spacing Format
Oak Woodland / Savanna (OW)							
Oregon white oak (Quercus garryana)	X	Tree	Dry	Sun	2 gal	2'	Single
Snowberry (Symphoricarpos albus)	X	Shrub	Dry	Part	1 gal	1.5'	Cluster
Serviceberry (Almelanchier alnifolia)	X	Shrub	Dry	Part	1 gal	2'	Single
Oceanspray (Holodiscus discolor)	X	Shrub	Dry	Sun	1 gal	1.5'	Cluster
Training blackberry (Rubus ursinus)		Shrub	Dry	Sun	1 gal	1.5'	Cluster
Cascade Oregon grape (Mahonia nervosa)		Herb	Moist	Part	1 gal	4"	Cluster
Blue wild-rye (Elymus glacus)	X	Grass	Dry	Part	seed	na	Mass
Native California brome (Bromus carinatus)	X	Grass	Dry	Sun	seed	na	Mass
Ash Forested Wetland (FW)							
Oregon Ash (Fraxinus latifolia)	X	Tree	Moist	Part	2 gal	3'	Single
Pacific Ninebark (Physocarpus capitatus)	X	Shrub	Moist	Shade	2 gal	2'	Single
Red-osier dogwood (Cornus sericea)	X	Shrub	Wet	Part	1 gal	2'	Cluster
Snowberry (Symphoricarpus albus)	X	Shrub	Dry	Part	1gal	1.5'	Cluster
Slough sedge (Carex obnupta)	X	Herb	Moist	Part	plugs	6"	Mass
Candy flower (Claytonia sibirica)		Herb	Moist	Shade	4"	na	Cluster
Streambank springbeauty (Montia parvifolia)		Herb	Moist	Shade	4"	na	Cluster
Dewey's sedge (Carex deweyana)		Herb	Dry	Shade	plugs	4"	Mass
Small fruited bulrush (Scirpus microcarpus)		Herb	Wet	Sun	plugs	4"	Mass
Tall mannagrass (Glyceria elata)	X	Grass	Moist	Shade	seed	na	Mass

Plant Commiunities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	Spacing Format
Shrub / Scrub Wetland (SS)							
Pacific willow (Salix lasiandra)	X	Tree	Wet	Sun	1 gal	3'	Single
Sitka willow (Salix sitchensis)		Tree	Moist	Sun	1 gal	3'	Cluster
Douglas hawthorne (Crataegus douglasii)		Tree	Moist	Part	2 gal	2'	Cluster
Pacific Crabapple (Malus fusca)	X	Tree	Moist	Part	2 gal	2'	Cluster
Scouler willow (Salix scouleriana)	X	Shrub	Moist	Sun	1 gal	3'	Cluster
Red-osier dogwood (Cornus sericea)	X	Shrub	Wet	Part	1 gal	2'	Cluster
Clustered rose (Rosa pisocarpa)		Shrub	Wet	Part	1 gal	1.5'	Cluster
Douglas's spiraea (Spiraea douglasii)	X	Shrub	Wet	Sun	1 gal	1.5'	Cluster
Nodding beggartick (Bidens cernua)		Herb	Wet	Sun	1 gal	1.5'	Cluster
Spreading rush (Juncus patens)		Herb	Moist	Part	plugs	6"	Mass
Western manna-grass (Glyceria occidentalis)	X	Grass	Wet	Sun	seed	na	Mass
Emergent Marsh (EM)							
Nodding beggarstick (Bidens cernua)	X	Herb	Moist	Sun	1 gal	1.5'	Cluster
Hardstem bulrush (Scirpus acutus)		Herb	Wet	Sun	plugs	1.5'	Cluster
Small-fruited bulrush (Scirpus microcarpus)	X	Herb	Wet	Sun	plugs	6"	Mass
Creeping spike rush (Eleocharis palustris)	8	Herb	Wet	Sun	seed, plugs	4"	Mass
Wapato (Sagittaria latifolia)		Herb	Wet	Sun	bulbs	na	Cluster
American water plantain (Alisma plantago-aquatica)		Herb	Wet	Sun	bulbs	na	Cluster
Soft stemmed bulrush (Scirpus taberaemontani)		Herb	Wet	Sun	plugs	1.5'	Cluster
American brooklime (Veronica americana)		Herb	Wet	Sun	plugs	na	Cluster
Marsh speedwell (Veronica scutellata)		Herb	Wet	Sun	plugs	na	Cluster
American sloughgrass (Beckmannia syzigachne)	X	Grass	Wet	Sun	seed, plugs	na	Mass
Western manna-grass (Glyceria occidentalis)	X	Grass	Wet	Sun	seed	na	Mass

Plant Commiunities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	Spacing Format
Storm Water Facility (SWF)							
Oregon Ash (Fraxinus latifolia)		Tree	Moist	Part	2 gal	3'	Single
Vine Maple (Acer circinatum)	X	Tree	Moist	Part	2 gal	2'	Single
Cascara (Rhamnus purshiana)		Tree	Moist/Dry	Part	1 gal	2'	Single
Bitter cherry (Prunus emarginata)		Tree	Moist	Part	2 gal	2'	Single
Mock orange (Philadelphus lewisii)		Shrub	Wet/dry	Part	1 gal	2'	Cluster
Red-osier dogwood (Cornus sericea)	X	Shrub	Wet	Part	1 gal	2'	Cluster
Pacific ninebark (Pysocarpus capitatus)		Shrub	Moist	Shade	1 gal	2'	Single
Oceanspray (Holodiscus discolor)	X	Shrub	Dry	Sun	1 gal	1.5'	Single
Serviceberry (Almelanchier alnifolia)	X	Shrub	Dry	Part	1 gal	2'	Single
Clustured rose (Rosa pisocarpa)		Shrub	Moist	Sun	1 gal	1.5'	Cluster
Snowberry (Symphoricarpus albus)	X	Shrub	Dry	Part	1gal	1.5'	Cluster
Douglas's spiraea (Spiraea douglasii)	X	Shrub	Wet	Sun	1 gal	1.5'	Cluster
Red flowering currant (Ribes sanguineum)	X	Shrub	Dry	Sun	1 gal	1.5'	Cluster
Nodding beggartick (Bidens cernua)		Herb	Wet	Sun	1 gal	1.5'	Cluster
Spreading rush (Juncus patens)		Herb	Moist	Part	plugs	6"	Mass
Small-fruited bulrush (Scirpus microcarpus)		Herb	Wet	Sun	plugs	6"	Mass
Slough sedge (Carex obnupta)	X	Herb	Moist	Part	plugs	6"	Mass
Toad rush (Juncus bufonius)*		Herb	Dry	Sun	seed, plugs	4"	Mass
Rossi Sedge (Carex rossi)*		Herb	Moist	Sun	plugs	4"	Mass
NW Native Wildflower mix		Herb	Mix	Sun	seed	na	Mass
Oregon Bentgrass (Agrostis oregonesis)*	X	Grass	Dry	Sun	seed	na	Mass
Idaho bentgrass (Agrostis idahoensis)*		Grass	Dry	Sun	seed	na	Mass
Western manna-grass (Glyceria occidentalis)		Grass	Wet	Sun	seed	na	Mass

* - Grows 5-30 cm tall

Appendix B

STANDARD DETAILS

Manholes and Appurtenances

010 Standard Manhole
020 Pre – Cast/Poured In Place Manhole Base
030 Manhole Connections
040 Shallow Flat Top Manhole
050 Flat Top Manhole
060 Mechanical Inside Drop Manhole
080 Open Inside Drop Manhole
090 Inside Drop Manhole, with Bowl
100 Manhole Step
110 Suburban and Standard Manhole Frame and Cover (Sanitary)
120 Stormwater Manhole Lid
130 Water Tight Manhole Frame and Cover
140 Concrete Manhole Closure Collar
150 Manhole Chimney Seal
160 Large Pre-Cast Concrete Manhole
170 Large Pre-Cast Concrete Manhole – Bases
180 Large Pre-Cast Concrete Manhole – Types
190 Large Pre-Cast Concrete Manhole Base Slabs
200 Large Pre-Cast Concrete Manhole – Long. Base Section Reinforcement
210 Large Pre-Cast Concrete Manhole – Base Section Reinforcement 108" & 120"
220 Large Pre-Cast Concrete Manhole – Top Slabs
230 T- Top Manhole with 48" Riser
250 Water Quality Manhole (Snout) A
260 Water Quality Manhole (Snout) B
270 Flow Control Structure Detail

Storm Structures

300 Gutter and Curb Inlet Catch Basin (CG – 2)
310 Gutter and Curb Inlet Catch Basin (CG – 2) Reinforcement
320 Catch Basin Frame and Grate (CG – 2)
330 Inlet Catch Basin (CG – 30)
340 Inlet Catch Basin (CG – 48)
350 Curb Inlet Manhole (CG - 48 M.H.)
360 Modified Curb Inlet Manhole (MOD.CG – 48 M.H.)
370 Top – Curb Inlet Manhole and Modified Curb Inlet Manhole (CG – 48M.H. and MOD. CG – 48 M.H.)
380 Area Drain Type II
390 Ditch Inlet
400 Ditch Inlet Frame and Grate

Pipes

500 Standard Cleanout
510 Cleanout Frame and Cover
520 Side Sewer / Side Storm Pipeline
530 Inserta – Tee
550 Concrete Cap
560 Concrete Encasement / Closure Collar
570 Concrete Anchor Wall
580 ODOT Pipe Slope Anchor
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600 T – Cut Asphalt Details
610 Bore Detail
620 Creek Crossing Restoration

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701 Detention Pond Construction & Maintenance Notes
705 Water Quality Swale
706 Water Quality Swale Construction & Maintenance Notes
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711 Orifice Plate and Guide
715 Concrete Spreader Detail
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725 Non – Structural Infiltration Planter/Rain Garden
730 Flow Through Planter
735 Non – Structural Flow Through Planter
740 Perforated Pipe Details
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750 Street Side Planter With Street Parking
752 Curb Cut Out
753 Curb Cut Out Top Rail
755 Modified CG – 30 Inlet With Sump
758 Beehive Inlet
760 Overflow/Inlet Structure
762 Concrete Check Dam
765 Public Water Quality Facility Access
770 Vegetated Filter Strip
775 Porous Pavement
780 Porous Pavers
790 Rip Rap Details
791 Removable Bollard
792 Chain Link Fence And Gate
793 Tree Planting – Container/Burlap
794 Vegetated Corridor Sinage

Erosion Control

Erosion Prevention:

800 Matting Channel Installation
805 Matting Slope Installation
810 Plastic Sheeting

Runoff Control:

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820 Outlet Protection - Rip Rap
825 Outlet Protection - Stilling Basin
830 Surface Roughening - Cat Tracking
835 Surface Roughening - Stair Stepping/Grooving Slopes
840 Check Dam - Rock
845 Check Dam - Bio Filter Bag
850 Diversion Dike/Swale

Sediment Control:

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860 Oak Mats
865 Tire Wash - Manual Hose Wash
870 Tire Wash - Drive Through
875 Sediment Fence
880 Wattles
885 Wattles - Single Family Application
890 Filter Berm Rock/Compost
895 Sidewalk Subgrade
900 Concrete Washout
905 Curb and Gutter Inlet Protection
910 Inlet Protection - Type 3
915 Inlet Protection - Type 4
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945 Standard Erosion Control Notes for Sites Less Than 1 Acre
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1000b General CWS Drafting Procedures
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1003 Conceptual Site Schematic
1005 Chain Link Fence & Gate
1007 Force Main Pressure Gauge

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1205 Nomograph
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Computational Aids
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1260 Headwater Depth for Smooth Interior Pipe Culverts with Inlet Control
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1270 Head for Culverts (Pipe / "N" = 0.024), Flowing Full with Outlet Control
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1280 24-Hour Rainfall Depths
1285 Design Storm Distribution Chart