

SECTION 200 STORMWATER MANAGEMENT

200.1 General Stormwater Requirements

1. The general design and construction requirements for the City of Puyallup shall be those contained in the Standard Specifications for Road, Bridge, and Municipal Construction (hereinafter referred to as the “Standard Specifications”), Washington State Department of Transportation and American Public Works Association, Washington State Chapter, latest edition; and the Uniform Plumbing Code as adopted by the Washington State Building Code Council, latest edition, unless superseded or amended by the City of Puyallup Design Standards for Public Works Engineering and Construction (hereinafter referred to as the “City Standards”).
2. The following paragraphs outline the requirements specific to the City of Puyallup which shall be used in conjunction with the regulations noted above and the design principles outlined in the following referenced stormwater manuals. Any conflict or inconsistency in the information provided by these documents shall be resolved by giving precedence in the following order:
 1. City of Puyallup Phase II Municipal Stormwater Permit (NPDES Permit)
 2. City of Puyallup Municipal Code (PMC)
 3. City of Puyallup Design Standards including Standard Details
 4. City of Puyallup Stormwater Management Plans (Comprehensive Plans, Basin Plans, and/or Water Clean-up Plans)
 5. The version of the Dept. of Ecology Stormwater Management Manual for Western Washington (Ecology Manual) most recently adopted by the City Council
3. The City may adopt a comprehensive stormwater plan, individual watershed basin plan(s), or water clean-up plans which may place additional stormwater requirements on a proposed project. The applicant shall incorporate any conditions required by these plans which are applicable to the proposed project. Current stormwater management plans are available on the City’s website at: <https://www.cityofpuyallup.org/161/Stormwater-Management>
4. Public right-of-way runoff shall be detained and treated independently from the private stormwater facilities. This shall be accomplished by providing separate publicly maintained storm facilities within a tract or dedicated right-of-way; enlarging the private facilities to account for bypass runoff; or other methods as approved by the Engineering Services Department.
5. All public stormwater facilities associated with single-family residential plats and subdivisions shall be located in public right-of-way or within a separate dedicated tract of appropriate dimensions and improved to the standards set forth below and in accordance with the Puyallup Municipal Code (PMC).
6. All private storm drainage facilities shall be covered by a maintenance agreement provided by the City and recorded with Pierce County. Under this agreement, if the owner fails to properly maintain the facilities, the City, after giving the owner written notice, may perform necessary maintenance at the owner’s expense in accordance with PMC 21.10. See Section 205 for additional information.
7. Stormwater will not be permitted to discharge directly onto City roads or into a City system without the prior approval of the City. Once approved, discharges to a City system shall first discharge into a catch basin or approved equal on private property then into a structure such as a catch basin, manhole, through an approved curb drain, or into an existing or created City

ditch. Concentrated drainage will not be allowed to discharge across sidewalks, curbs, driveways or in a location that would in any way create what the City would consider a potentially hazardous condition.

8. All buildings are required to have roof downspouts and subsurface drains directed to either an infiltration system, dispersion system, or to the stormwater conveyance system. Refer to the appropriate stormwater design manual chosen from Section 201 below for additional information on roof downspout infiltration and dispersion.
9. All stormwater facilities installed within paved areas shall be designed to withstand HS-20 load requirements.
10. Ecology block walls will not be permitted as baffles within the City of Puyallup's stormwater facilities.
11. For wetpond designs, the City of Puyallup will require the use of berms. Baffles shall be second preference for the City of Puyallup, and when allowed through the use of the Alternative Methods Request (AMR) process approved by the City Engineer, shall be cast in place concrete as designed by a professional engineer licensed in the State of Washington. Wet ponds shall not be constructed within the ground water table or under the influence of groundwater, including springs when iron bacteria is suspected by the Design Engineer, Geotechnical Engineer, or City Staff.

201 Stormwater Management Requirements

201.1 Stormwater Manual Selection

1. On February 16, 2010 the City of Puyallup adopted new storm water regulations in accordance with the requirements of the City's NPDES Permit. Permit applications shall comply with the new regulations contained in PMC Chapter 21.10 and these City Standards.
2. Any proposed project e.g., plats and binding site plans, will be required to adhere to the requirements of the Dept. of Ecology Stormwater Manual for Western Washington (hereinafter referred to as the "Ecology Manual") that has most recently been adopted by the Puyallup City Council, unless the project has been vested to other Stormwater requirements at the time of Land Use application as required by state law and the City's NPDES Municipal Permit.
3. All applicants shall complete and submit the stormwater flowchart, Figures 3.1, 3.2, and 3.3, contained in the City's Phase II Municipal Stormwater Permit, Appendix I. The completed flowchart shall be submitted with the permit application and included in the Stormwater Site Plan (SSP).

201.2 Stormwater Site Plan (SSP)

1. All projects requiring stormwater management shall submit a Stormwater Site Plan (SSP) in accordance with Volume I, Chapter 3 of the Ecology Manual.
2. All projects requiring stormwater management shall provide an offsite analysis and mitigation report, contained in the SSP, that conforms to the description and specific task elements described in Volume I, Section 2.6.2 of the Ecology Manual.
3. Each section of the SSP shall be individually indexed and tabbed with each permit application, and every re-submittal thereafter, prior to review by the City.

202 Low Impact Development (LID)

202.1 General Requirements

1. Low Impact Development (LID) shall be required for all land developed within the City of Puyallup, unless determined infeasible. The City Engineer or designee must agree with the evaluation for each LID BMP and shall have the final say on the factors that preclude the use of LID.
Exception: Direct discharge to the Puyallup River in accordance with Section 204.2(2).
2. A LID Site Analysis shall be submitted with the development application.
3. A detailed evaluation of LID feasibility, including a geotechnical report, to address feasibility of infiltration, permeable pavement and bioretention is required. Each evaluation must be documented in the Drainage Report.
4. Projects incorporating LID BMPs shall be in accordance with these standards, the adopted Ecology Manual, and PMC 21.10.210.

202.2 Permeable Pavement

1. The following conditions describe when permeable pavement is infeasible:
 - a. Roadways with an ADT greater than 400 vehicles per day or roadways projected to have an ADT greater than 400 vehicles per day within five years.
 - b. Roadways classified as, or roadways with future classification designation of Major Arterial, Minor Arterial, Major Collector and Minor Collector as defined in the Comprehensive Plan or by the City Engineer.
 - c. Roadways with a high speed, greater than 35 miles per hour.
 - d. Commercial development and redevelopment with more than 400 trips per day or PM peak greater than 40 vehicles per hour.
 - e. Areas with more than very low truck traffic or frequent deliveries. Areas with very low truck traffic are roadways or other traffic bearing surfaces not subject to through truck traffic. Weekly or daily use by garbage, recycling, school busses, mail/parcel delivery trucks and utility maintenance vehicles are considered low truck traffic.
 - f. Areas with dumpsters, dumpster enclosures, trash compactors, fueling operations, frequent long-term sediment loading after construction, frequent use of chemicals or chemical storage, automotive repairs, or other locations with high pollution potential where the infiltration will result in the transport of pollutants to groundwater.
 - g. Areas zoned as Limited Manufacturing (ML) and Rail Manufacturing (MR).
 - h. Areas where frequent sanding or deicing occur or will occur, as determined by the Public Works Director or designee.

- i. Where installations would threaten the safety or reliability of existing utilities, or where installation would affect existing road sub-grades.
 - j. Any other infeasibility criteria listed in the Ecology Manual, as applicable.
Exception: Infeasibility criteria a-f does not extend to sidewalks and non-traffic bearing surfaces, unless otherwise determined by the City Engineer or designee.
- 2. The following uses of permeable pavement are prohibited, unless otherwise approved by the City Engineer or designee:
 - a. On ADA ramps and driveway aprons within the public right-of-way.
 - b. Permeable Interlocking Concrete Pavers (PICP) and Grid Pavements within public right-of-way.
- 3. Design Criteria shall be as follows:
 - a. Minimum setback from property lines shall be two and one-half (2.5) feet.
Exception: This requirement does not extend to sidewalks and non-traffic bearing surfaces within public-right-of-way.
 - b. Maximum design slope is six (6) percent for both the subgrade and wearing course.
 - c. A minimum of one inspection port is required per system. An additional inspection port is required for every 5,000 square feet of permeable pavement. Inspection ports shall be located a minimum of three (3) feet from the edge of pavement, be located at the low point of the system and in accordance with standard detail 02.01.10.
Exception: This requirement does not extend to sidewalks and non-traffic bearing surfaces.
 - d. Adequate drainage facilities should still be designed as if the road surface was impermeable.
 - e. Geogrid shall be required between the subgrade and permeable ballast where fine-grained weak soils are encountered to provide tensile strength.
 - f. The use of geotextile fabric to bridge between materials shall not be used, unless approved by the City Engineer or designee. The design engineer shall use best engineering practice to provide base layer stratification to bridge underlying soil and base layers.
 - g. Any other design criteria listed in the Ecology Manual, as applicable.

202.3 Bioretention Cells

- 1. Bioretention cells should be applied to small drainage areas and are encouraged to be dispersed throughout subdivisions, commercial development, and short plats. They may be located within chokers, traffic circles, planter strips, or bulbs. One central cell may also be used if designed following the standards herein and the Ecology Manual.

2. Design criteria shall be as follows:

- a. Bioretention cells within public drainage tracts shall be grass lined or planted with mowable plant species and have maximum side slopes of 5H:1V. Vertical walls are prohibited.
- b. Bioretention cells within public right-of-way should be grass lined or planted with mowable plant species and have maximum side slopes of 3H:1V. Vertical walls are prohibited. Other plantings and mulch may be allowed with approval of a maintenance agreement recorded with the “Stormwater Management/BMP Facilities Agreement” in accordance with Section 205.3.
- c. Bioretention cells in the public right-of-way shall only be used for stormwater runoff from the public roadway.
- d. Bioretention cells within private drainage tracts or commercial development may be grass lined or planted and have maximum side slopes of 3H:1V.
- e. All planting shall be in accordance with Section 602.01.
- f. All grass lined cells shall be in accordance with Section 602.03.
- g. Bioretention soil media (BSM) shall be in accordance with Section 602.04.
- h. Cells shall have a minimum bottom width of two (2) feet and minimum shoulder width of 18 inches.
- i. Where a piped entrance is used, a floatable separator is required in the upstream catch basin or manhole.
- j. A 10-foot minimum setback from structures, measured from the shoulder of the cell, and one (1) foot separation, measured from the bottom elevation of the bioretention cell, from seasonal groundwater is required where the drainage area served is less than:
 - i. 5,000 sq. ft. of pollution-generating impervious surface, and
 - ii. 10,000 sq. ft. of impervious surface, and
 - iii. three-quarter (3/4) acres of pervious surface.
- k. A 10-foot minimum setback from structures, measured from the shoulder of the cell, and three (3) foot separation, measured from the bottom elevation of the bioretention cell, from seasonal groundwater is required where the drainage area served is equal to or exceeds:
 - i. 5,000 sq. ft. of pollution-generating impervious surface, or
 - ii. 10,000 sq. ft. of impervious surface, or
 - iii. three-quarter (3/4) acres of pervious surface.
- l. A mounding analysis may be used to demonstrate feasibility of separation from the seasonal groundwater less than that stated in 202.3(2)k. A minimum of one (1) foot separation shall be maintained. A mounding analysis shall be required for a single

bioretention cell serving a drainage area greater than one (1) acre, or when required by the City Engineer or designee.

- m. Bioretention cells may be required to meet the UIC Program Rule, see Section 203 for Underground Injection Control requirements.
 - n. An overflow shall be provided beyond the treatment capacity of the cell. City preference is infiltration, dispersion, or a connection to the city drainage system.
 - o. Any other design criteria as outlined in the Ecology Manual, as applicable.
3. The following conditions describe when bioretention cells are infeasible:
- a. When the slope within the bottom of the cell exceeds 8% in any direction. Stepped cells should be used to reduce the slope of the cell to the maximum extent feasible and improve ponding depth for treatment capacity. Ponding calculations shall account for slope.
 - b. When any portion of the cell is under the influence of groundwater. If groundwater is encountered during construction or the maintenance and bonding period, the City Engineer or designee shall be notified, and the system redesigned accordingly.
 - c. Any other infeasibility criteria listed in the Ecology Manual, as applicable.

203 Underground Injection Control (UIC)

1. Projects incorporating infiltration or stormwater management BMPs shall review WAC 173-218, Underground Injection Control Program Rule, and the Ecology Manual to determine if the facility meets the definition of a Class V injection well.
2. All Class V UIC wells shall be designed, evaluated, and sited in accordance with the Ecology Manual.
3. The determination and evaluation shall be documented in the Drainage Report.
4. Projects meeting the definition of a Class V injection well shall register the facility with the Washington State Department of Ecology. The project proponent is responsible for registering the facility. Registration shall be completed through the Department of Ecology's UIC website.
Exception: Single Family Residential Homes - Injection wells used at single family homes to collect residential roof-runoff or prevent a basement from flooding. Registration is not required for most injection wells meant to serve a single-family home or duplex.
5. Projects proposing a Class V UIC wells within a public drainage tract or public right-of-way shall register the UIC well for the City in accordance with Section 203(4).
6. Registration with the Department of Ecology is required for all UIC wells and must be submitted sixty (60) days prior to well construction. Proof of registration is required for all Class V UIC wells within public drainage tracts or public right-of-way and a copy of the online registration shall be submitted to the City prior to construction.

204 Conveyance Systems

204.1 Conveyance System Design Flows

1. Design flows for sizing conveyance systems shall be determined using an approved calibrated continuous simulation hydrologic model, i.e., HSPF, Western Washington Hydrology Model (WWHM), MGS Flood, or KCRTS. Conveyance capacity shall be based on the historic September 17, 1969 25-year storm flow event.

Exception: For project sites in the City with tributary areas less than 10-acres, and a developed time of concentration less than 60-minutes, either the Rational Method or Santa Barbara Urban Hydrograph Method (SBUH) may be used to determine conveyance design flows. The 25-year, 24-hour storm event total precipitation used for analysis shall be 3.5-inches.

2. Design flows for conveyance facilities that also operate as water quality or flow control BMP's, shall be determined using the hydrologic design method described in the stormwater manual chosen in Section 201.
3. Culverts shall be designed in accordance with Section 204.5.

204.2 Conveyance System General Requirements

1. All new pipe systems, both onsite and offsite, shall be designed with sufficient capacity to convey and contain (at minimum) the 25-year storm flow event, assuming developed conditions for onsite tributary areas, and existing conditions for any offsite tributary areas.
2. Stormwater may be discharged directly to the Puyallup River provided the following conditions are met:
 - the project site is located within one of the direct discharge basins outlined in the 2012 Comprehensive Stormwater Drainage Plan
 - the discharge is consistent with federal, state, and city regulations governing water quality and flow control
 - the discharge is solely through a stable, man-made stormwater conveyance system that extends from the project site to the mean high water line of the river
 - the man-made conveyance system has adequate hydraulic capacity (Note: The applicant shall provide supporting calculations of system capacity which may be subject to third party review prior to project approval.)
 - the discharge will not cause, or aggravate, downstream flooding problems
 - the discharge does not reduce natural flows to other streams or wetlands
3. On projects considering direct discharge to the Puyallup River, conveyance capacity shall be determined based on the 25-year storm flow event *and* the corresponding river elevations at the specific river outfall. Reference City of Puyallup Comprehensive Storm Drainage Plan, Appendix C, Table C-9.
4. Pipe system structures may overtop for runoff events that exceed the 25-year design capacity provided the overflow from a 100-year runoff event does not create or aggravate an existing flooding problem or erosion problem. Any overflow occurring onsite for runoff events up to and including the 100-year event must discharge at the natural location for the *project site*. In

residential subdivisions, this overflow must be contained within an onsite drainage easement, tract, covenant, or public right-of-way.

5. In areas of the City with insufficient conveyance capacity (25-year storm), new development and redevelopment must either enlarge on-site stormwater facilities to reduce downstream flows, or construct any necessary capital improvement(s).
6. Project related off-site conveyance systems are permitted only if the downstream property owner(s) grant easements for construction, operation, and maintenance of the system. If easements are not provided, runoff management shall conform to drainage law and shall, at a minimum, include provisions for detention, water quality, and/or dispersion prior to leaving the development site.
7. New stormwater mains shall be extended along the entire frontage of the property to be served.

204.3 Pipe System Design Criteria

1. Basic conveyance system design shall be accomplished using the Uniform Flow Analysis Method (Manning's Equation). When using this method, each pipe within the conveyance system shall be sized and sloped such that its barrel capacity at normal full flow is equal to, or greater than, the required conveyance capacity described above. Pipes should not be designed to surcharge.
2. The City, at its discretion, may request a Backwater Analysis for the conveyance system design. When a backwater calculation is required, the design engineer shall analyze the system for the 25-year and 100-year peak flows.
 - If overtopping occurs, the additional flow over the ground surface shall be analyzed using the methods for open channel flow. Any additional surface flow shall not exceed 4-inches depth at its deepest point, and shall not extend beyond half the lane width of the outside lane of the traveled way.
3. Pipe systems shall be designed to accommodate the developed condition 25-year storm flow event with a minimum 0-feet of freeboard without overtopping catch basins and manholes.
4. Public stormwater pipe shall be minimum 12-inch diameter. Private stormwater pipe shall be minimum 12-inch diameter for mains, and minimum 8-inch diameter for laterals.
5. The minimum design velocity at full flow should be 3-feet per second. If site constraints result in velocities less than 3-feet per second at full flow, concerns associated with sedimentation in the pipe system shall be addressed with larger pipes, closer spacing of structures, sediment basins, or other similar measures.
6. The minimum slope of the pipe shall be 0.5%.
7. All pipe reaches shall be summarized in a Conveyance Table containing the following minimum information and included in the TIR:

- | | |
|-----------------------------|------------------------------------|
| ○ Pipe Reach Name | ○ Pipe-Full Flow (cfs) |
| ○ Structure Tributary Area | ○ Water Depth at Design Flow (in) |
| ○ Pipe Diameter (in) | ○ Critical Depth (in) |
| ○ Pipe Length (ft) | ○ Velocity at Design Flow (fps) |
| ○ Pipe Slope (%) | ○ Velocity at Pipe-Full Flow (fps) |
| ○ Manning's Coefficient (n) | ○ Percent full at Design Flow (%) |
| ○ Design Flow (cfs) | ○ HGL for each Pipe Reach (elev) |

204.4 Closed System Requirements

1. Publicly maintained stormwater pipe shall be only PVC, concrete, ductile iron, or dual walled Polypropylene pipe as follows:
 - a. PVC pipe shall be per ASTM D3034, SDR 35 for pipe size 15-inch and smaller and F679 for pipe size 18- to 27-inch. Minimum cover on PVC pipe shall be 3-feet.
 - b. Concrete pipe shall conform to AASHTO M 86, Class 2 only, for unreinforced pipe and AASHTO M 170, Classes II through V, for reinforced concrete pipe. Minimum cover on concrete pipe shall be 3-feet.
 - c. Ductile iron pipe shall be Class 50, conforming to AWWA C151. Minimum cover on ductile iron pipe shall be 1-foot.
 - d. Polypropylene Pipe (PP) shall be dual walled, have a smooth interior and exterior corrugations and meet WSDOT 9-05.24(1). 12-inch through 30-inch pipe shall meet or exceed ASTM F2736 and AASHTO M330, Type S, or Type D. 36-inch through 60-inch pipe shall meet or exceed ASTM F2881 and AASHTO M330, Type S, or Type D. Testing shall be per ASTM F1417. Minimum cover over Polypropylene pipe shall be 3-feet.
2. Solid wall, fusion-welded high density polyethylene pipe (HDPE), may be used in unique situations, i.e. steep slopes or horizontal directional boring, upon approval of the City Engineer or Public Works Director. Projects utilizing HDPE pipe shall include consideration of the material's thermal expansion/contraction properties for the design of connections and anchorages. Minimum cover on buried HDPE pipe shall be 3-feet.

If approved, HDPE pipe shall conform to the following criteria:

- compliance with the requirements of Type III C5P34 as tabulated in ASTM D1248;
 - shall have the PPI recommended designation of PE3408;
 - shall have an ASTM D3350 cell classification of 345534C;
 - a hydrostatic design stress rating of 800-psi based on a material with a 1600-psi design basis determined in accordance with ASTM D2837-69;
 - a design working pressure of 50-psi at 73.4° F and an SDR value of 32.5.
3. Privately maintained stormwater pipe shall be PVC, concrete, ductile iron or dual walled Polypropylene pipe meeting the same criteria as specified above.

Exception: The use of corrugated polyethylene pipe (CPEP) in accordance with WSDOT Standard Specifications Section 9-05.20 is acceptable for private stormwater systems. Minimum cover on CPEP pipe shall be 3-feet.

4. The use of any other pipe material shall only be allowed upon submission and approval of an "Alternative Methods Request". The Alternative Methods Request form shall clearly indicate the justification for a substitute pipe material other than cost savings.
5. The conveyance pipe diameter, length, material, and slope shall be included on the 'plan view' in addition to the 'profile view' for each pipe reach.
6. Steep slope areas (over 30%) shall require all drainage to be piped from the top to the bottom in fusion-welded HDPE pipe. If slopes exceed 40%, then pipe shall be installed on the surface of the slope, with the minimum disturbance possible, and provided with engineered anchorages.
7. Roof drains, or other stormwater pipe, within 2-feet of a building shall consist of material approved by the Uniform Plumbing Code. (i.e. PVC schedule 40, ABS schedule 40, or ductile iron).
8. For stormwater pipe crossing over sanitary sewers, a minimum of 12-inches of vertical clearance shall be provided between the systems. If the stormwater pipe is crossing below the sanitary sewer, a minimum of 18-inches of vertical separation shall be provided.
 - a. A pipe sleeve is required for some installations to provide additional protection of stormwater from potential leakage from other utilities. A pipe sleeve shall be a single section of PVC pipe (no joints) with a minimum length of 10-feet to each side of the pipe crossing. The pipe sleeve shall be placed around the stormwater pipe with the annular space between the sleeve and the stormwater pipe filled with grout.
9. A minimum of 10-feet of separation shall be provided between building structures and any closed system, or 10-feet from the utility easement line in a public system.
10. Trees shall not be located within 10-feet horizontally of stormwater pipes unless root barriers are provided. With root barriers, trees may be no closer than 3-feet to pipes.

204.5 Culvert Design Requirements

1. Culverts and bridges associated with natural channels must convey the 100-year storm event from the contributing area assuming fully developed conditions.
2. All other culverts and bridges shall convey the 25-year peak flow from the contributing area assuming fully developed conditions.
3. Bridges shall be the first choice for crossing streams with salmonids. Bridges proposed in streams with salmonids shall be designed to provide for fish passage in accordance with the City's critical areas regulations and the Washington State Department of Fish and Wildlife (WDFW) requirements. A WDFW Hydraulic Permit Authorization (HPA) or exemption will be required prior to permit approval.
4. Flow capacity shall be determined by analyzing inlet and outlet control for headwater depth. All calculations and nomographs used for culvert design shall be included in the stormwater report.

5. The maximum design headwater depth shall be 1.5 times the diameter of the culvert with no saturation of roadbeds.
Minimum culvert diameters are as follows:
 - Culverts crossing under public roadways – 18-inches minimum
 - Roadside culverts, including driveway culverts – 15-inches minimum
 - Culverts on private property – 8-inches minimum
6. Inlets and outlets shall be protected from erosion by rock lining, riprap, or bio-stabilization.
7. Culvert velocity shall be 2-feet per second minimum and 15-feet per second maximum. For ductile iron, polypropylene or HDPE pipe, no maximum velocity shall be established, but an engineered outlet protection design shall be provided and included in the stormwater report.
8. Driveway culverts shall be a minimum of 20-feet in length. All driveway approaches 24-feet and wider shall have concrete headwalls at each end of the culvert. Culverts shall have beveled end sections to match the side slope.

204.6 Open Systems Design Requirements

1. These provisions apply only to “Open Systems” which are not part of a natural drainage system regulated under the City’s Environmentally Critical Areas Management Ordinance (CAO). Design requirements for modification of regulated natural drainage systems shall be site specific and developed in accordance with provisions contained in the CAO and approved by the Planning Department.
2. Open channels shall be sized to adequately carry the design rate of flow without damage. Whenever practical, the channel shall be characterized as slow flowing, be wide and shallow, and natural in its appearance and functioning.
3. Open systems shall be designed with side slopes no steeper than 3H:1V and back slopes no steeper than 2H:1V with adequate slope stabilization and a minimum freeboard of 1-foot.
4. Ditches may be either trapezoidal or ‘V’-shaped.
5. Open ditches designed at 2 to 5-feet per second (fps) shall be hydro-seeded with a grass approved by the City. Steep grades (5 to 15 fps) will require check dams, rock spalls, rip rap, or other approved energy dissipation methods.
6. A minimum of 20-feet shall be provided between a building structure and any open system.
7. Ditch cross sections shall be provided at a minimum of every 50-feet. The cross section shall extend 25-feet beyond the top of bank on either side of the ditch and include the water surface elevation for the 2-yr, 10-yr, 25-yr and 100-yr storm events.

204.7 Pump System Requirements

1. Pumping stormwater is the method least desirable for conveying stormwater and is not an acceptable alternative for publicly maintained systems. When no other alternatives are feasible for privately owned systems, pump systems may be considered provided they meet the following criteria:

- a. A pump system may be substituted for the City Standard control riser provided the pump system is designed to release detained stormwater in accordance with the discharge requirements specified by the appropriate manual required in Section 201.
- b. The pump system shall be used to convey water from one location or elevation to another within the limits of the project site. Gravity discharge to the downstream public conveyance system is required.
- c. A backup pump shall be incorporated into the system.
- d. An alternative power source shall be provided, i.e., emergency generator or battery backup power. Use of a portable generator as an alternative power source is not acceptable.

Any alternative power source shall include an auto-transfer switch that disconnects the alternative power source from the public grid.

- e. External High water / Pump Failure alarm system shall be provided.
- f. The gravity-flow components of the drainage system to and from the pump system must be designed so that pump failure does not result in flooding of a building, an emergency access route, an adjacent property, or cause overflow to a location other than the natural discharge point for the project site.

204.8 Vaults, Catch Basin and Manhole Requirements

1. All concrete cast-in-place stormwater structures shall be designed by a registered professional engineer licensed in the State of Washington and shall be approved and permitted by the City of Puyallup Building Department. The building permit number shall be referenced on the engineering record drawings prior to final acceptance by the Engineering Services Department.
 - a. Cast-in-place vaults shall be provided with commercially available PVC or rubber waterstop at all cold joints. The waterstop shall be physically embedded and bonded to the concrete on each side of the joint.
 - b. Cast-in-place manholes and catch basins shall be provided with a commercially available flexible waterstop which expands when exposed to water.
 - c. All waterstop material(s) shall be installed in accordance with the manufacturer's recommendations.
2. A stormwater structure shall be installed at the end of all dead-end mainlines, at changes in direction or slope, at changes in pipe size or material, and at pipe junctions.
3. Catch basins shall be provided within 50-feet of the entrance to a pipe system to provide for silt and debris removal.
4. Catch basins and manholes shall be easily accessible to maintenance vehicles, equipment, and personnel.
5. Pipe inverts shall be matched at manholes and catch basins with like diameter pipe. With dissimilar pipe diameters, the crowns shall be matched.

6. Maximum spacing between structures (i.e., manholes or catch basins) for closed systems shall be 400-feet of pipe length.

7. Maximum surface run (gutter flow) for storm drains on paved roadway surfaces shall be as follows:

<u>Pavement Slope</u>	<u>Maximum Surface Run</u>
Less than 1%	200 ft
1% to 6%	300 ft
6% to 12%	200 ft

8. For slope grades greater than 6%, or as determined by the City Engineer or Public Works Director, it may be necessary to use concrete pipe and manholes in lieu of catch basins to help stabilize the storm system and control pipe flow velocities.

9. The maximum depth for catch basins/manholes shall be as follows:

- a. Type I Catch Basin: 5-feet, measured from the pipe invert to the finished surface.
- b. Type II Catch Basin: 20-feet, measured from the bottom of structure to the finished surface.
- c. For depths greater than 20-feet, stormwater structures shall be channeled manholes without sumps and designed by a licensed professional engineer registered in the State of Washington.

10. Street drainage requirements for public systems shall be as follows:

- a. The minimum longitudinal gutter slope shall be 0.5%.
- b. Catch basins shall be installed at all low points in the surface drainage area.
- c. At gutter line low points, insure positive flow to catch basins. In some situations, this may require variation from the vertical curve at the low point in the gutter line.
- d. A catch basin shall be provided within 20-feet upstream of a reverse slope driveway.

11. Catch basins and manholes within the limits of a new or redevelopment project, located in the public right-of-way, and not required to be used as inlets, shall be:

- a. removed, or if not feasible;
- b. removed and replaced with a Type II Catch Basin, and;
- c. provided with a round manhole ring and cover.

204.9 Oil Control/Spill Containment

1. Commercial, industrial, and multi-family properties shall include, at a minimum, a spill control device in one of the end-of-the-line (lowest) manholes or catch basins in the onsite conveyance system (prior to connecting to the public stormwater system). The spill control device shall be installed upstream of any onsite water quality or flow control facility. If no stormwater facilities are present, then the spill control device must be installed upstream from the final discharge point to the downstream drainage system.
2. The minimum requirement for a spill control device is a T-section, removable for maintenance, located on the outlet pipe leaving a Type 1L or Type-2 catch basin. Depending on the use(s) on the site, the Engineering Services Department may require additional measures for increased protection.

204.10 Grates

1. All grates shall be cast iron or ductile iron castings.
2. Vaned grates shall be used on all public and private systems.

204.11 Storm Drain Stenciling and Marking

1. All storm drains shall be signed as follows:
 - a. Publicly maintained stormwater catch basins shall be signed using glued-down markers supplied by the City and installed by the project proponent.
 - b. Privately maintained stormwater catch basins shall be signed with pre-cut 90ml torch down heavy-duty, intersection-grade preformed thermoplastic pavement marking material. It shall read either "Only Rain Down the Drain" or "No Dumping, Drains to Stream".

204.12 Outfalls

1. All exposed storm lines, 12-inches in diameter and larger, shall have trash racks at both the inlet and outlet ends, in accordance with City Standard Details.

Exception: Trash racks are required on inlet and outlet ends of all culverts greater than 18-inches in diameter. Trash racks are not required on culverts greater than 36-inches in diameter within stream corridors.
2. All concentrated discharges from stormwater conveyance systems shall be provided with energy dissipation/erosion protection measures.

205 Stormwater Maintenance and Operation Requirements

205.1 Stormwater Facilities Maintenance

1. All publicly maintained stormwater facilities shall be within a tract, easement, or right-of-way dedicated to the City of Puyallup. All publicly owned and maintained stormwater tracts/parcels shall be fenced at the property line. Fencing shall meet the minimum requirements of City Standard Detail 06.01.08 – Type 1, Chain Link Fence.
2. The design engineer shall provide the City with a letter certifying the proper installation of permanent stormwater controls and compliance with the approved stormwater site plan.
3. The City of Puyallup will assume maintenance and operation of public facilities located within subdivisions one year after final construction approval of the plat. At time of maintenance and operation transfer, an inspection by the City of the facilities will be completed to ensure they have been properly maintained as outlined in the Department of Ecology Stormwater Manual and NPDES Municipal Permit requirements and are operating as designed. Trees and woody vegetation, not designed as part of the facility, shall be removed by the project applicant, including any associated root system, prior to operation and maintenance handoff.
4. Provision shall be made for the long-term maintenance of all stormwater facilities and shall be accessible to maintenance vehicles and personnel. If not located in, or adjacent to a vehicle access way, then access by an improved roadway surface shall be provided.
5. Maintenance access roads shall be provided to the control structure and all drainage structures associated with any retention/detention facility. In no case shall any structure be located further from an access way than 8-feet when measured from the front of a vehicle, or no further than 20-feet when measured from the side of a vehicle.

205.2 Maintenance Access Road Requirements

1. Materials of construction for an improved roadway surface may include asphalt concrete, cement concrete, cement-treated base (CTB), asphalt-treated base (ATB), structurally stabilized vegetated surface, crushed surfacing base course, or other surfacing as approved by the Engineering Services Department.
 - a. Asphalt surfaces shall conform to the City of Puyallup “Private Roadway” standard.
 - b. Concrete surfaces shall conform to the material requirements and thickness specified in City Standard Detail 01.02.17 “Urban Commercial Approach – Alternate 1”.
 - c. CTB and ATB shall be a minimum of 10-inches thick.
 - d. Crushed surfacing base course shall be a minimum of 10-inches thick and conform to City of Puyallup standards.
 - e. Structurally stabilized vegetated surfaces shall only be used on grades less than 8% and shall comply with the manufacturer’s requirements.
2. Access roads shall be designed with a 48.5’ outside radius on curves, with a maximum slope not to exceed 12% and a minimum width of 15-feet. Access roads steeper than 8% shall be

paved using either asphalt concrete, cement concrete, cement-treated base (CTB), or asphalt-treated base (ATB).

3. For dry ponds with bottom widths of 15-feet or more, the access road shall extend to the pond bottom to a minimum 25-foot long level pad to facilitate cleaning. The access pad shall be designed in accordance with 205.2(1). For ponds less than 15-feet in width, an access road must extend along at least one (1) side of the pond.
4. A paved apron with fencing and a gate shall be provided where access roads connect to paved public roadways. Fencing and gate shall meet the minimum requirements of City Standard Detail 06.01.08 – Type 1, Chain Link Fence.

205.3 Private Maintenance Agreements

1. All non-residential storm drainage facilities shall be covered by a “Stormwater Management/BMP Facilities Agreement” provided by the City and recorded with Pierce County obligating the property owner to perpetual maintenance of the stormwater system.
2. As a condition of permit issuance, the City of Puyallup may inspect all privately maintained drainage facilities for compliance with specified maintenance requirements. If the property owner(s) fails to maintain their facilities to acceptable standards, the City will follow the procedures contained in PMC Chapter 21.10 to ensure compliance with the necessary maintenance standards.

205.4 Operation and Maintenance Manual

1. An operations and maintenance manual shall be prepared for all stormwater facilities as part of the development proposal.
2. At a minimum, the operations and maintenance manual shall include:
 - a. A description and purpose of the facility;
 - b. the dimensions and other characteristics of the facility (site map);
 - c. the party (parties) responsible for maintenance of the facility, with phone numbers and addresses;
 - d. list of any proprietary components along with information from the vendor describing maintenance schedule and costs;
 - e. what maintenance activities are required, and a proposed schedule of the activity;
 - f. care and maintenance of any powered devices;
 - g. inspection procedures and how the maintenance schedule will be modified if inspections determine the facility is not operating properly;
 - h. the minimum requirements for the type of facility as described in Volume V, Section 4.6, of the Ecology Manual;

206 Public Easements and Tracts

1. Publicly maintained storm conveyance systems which cross private property shall be located within a 40-foot wide easement which has been granted to the City. Stormwater facilities shall be placed in the center of the easement unless otherwise approved by the Engineering Services Department.
2. Publicly maintained water quality and R/D facilities shall be located in tracts dedicated to the City. The size of the tract shall be based on the size of the stormwater facility. At a minimum, the tract shall include the entire facility, site access area, and at least 5-feet of clearance around the facility. All publicly owned and maintained stormwater tracts/parcels shall be fenced at the property line. Fencing shall meet the minimum requirements of City Standard Detail 06.01.08 – Type 1, Chain Link Fence.
3. In cases where pipes and/or other facilities are deeper than 8-feet or have other special conditions, larger tracts or easements may be required at the discretion of the Engineering Services Department.
4. All easements needed for City stormwater systems shall be provided by the project proponent in the name of the City. The required easements shall be shown on the construction drawings and a DRAFT easement legal description or plat markup, signed by the property owner, shall be submitted for review at the same time construction drawings are submitted for review. Prior to issuance of an occupancy certificate, the draft easement shall be modified as necessary, signed, and recorded with Pierce County at the property owner's expense.
5. Easements shall be prepared using the City of Puyallup easement form. An alternative to separately recording a City of Puyallup easement form is to record an easement on the face of a plat. If this is the method used, a standard City of Puyallup easement statement shall be included in the plat documents.
6. Easements shall be a minimum of 10-feet clear from any building vertical surface or structure foundation(s).
7. No buildings, structures, garages, carports, dumpster enclosures, decks, rockeries, retaining walls, permanent signs, etc., shall be located within any publicly owned easement. If landscaping is required by the City Planning Department, the landscaping shall be designed and installed to minimize any potential impact to the utility within the easement.

207 Stormwater Plan Notes

The following applicable notes shall be shown on the plans.

STORMWATER NOTES:

1. All work in City right-of-way requires a permit from the City of Puyallup. Prior to any work commencing, the general contractor shall arrange for a preconstruction meeting at the Development Services Center to be attended by all contractors that will perform work shown on the engineering plans, representatives from all applicable Utility Companies, the project owner and appropriate City staff. Contact Engineering Services to schedule the meeting (253) 841-5568. The contractor is responsible to have their own approved set of plans at the meeting.
2. After completion of all items shown on these plans and before acceptance of the project, the contractor shall obtain a “punch list” prepared by the City’s inspector detailing remaining items of work to be completed. All items of work shown on these plans shall be completed to the satisfaction of the City prior to acceptance of the water system and provision of sanitary sewer service.
3. All materials and workmanship shall conform to the Standard Specifications for Road, Bridge, and Municipal Construction (hereinafter referred to as the “Standard Specifications”), Washington State Department of Transportation and American Public Works Association, Washington State Chapter, latest edition, unless superseded or amended by the City of Puyallup City Standards for Public Works Engineering and Construction (hereinafter referred to as the “City Standards”).
4. A copy of these approved plans and applicable city developer specifications and details shall be on site during construction.
5. Any revisions made to these plans must be reviewed and approved by the developer's engineer and the Engineering Services Staff prior to any implementation in the field. The City shall not be responsible for any errors and/or omissions on these plans.
6. The contractor shall have all utilities verified on the ground prior to any construction. Call (811) at least two working days in advance. The owner and his/her engineer shall be contacted immediately if a conflict exists.
7. Any structure and/or obstruction which require removal or relocation relating to this project, shall be done so at the developer's expense.
8. During construction, all existing and newly installed drainage structures shall be protected from sediments.
9. All storm manholes shall conform to City Standard Detail No. 02.01.01. Flow control manhole/oil water separator shall conform to City Standard Detail No. 02.01.06 and 02.01.07.
10. Manhole ring and cover shall conform to City Standard Detail 06.01.02.
11. Catch basins Type I shall conform to City Standard Detail No.02.01.02 and 02.01.03 and shall be used only for depths less than 5 feet from top of the grate to the invert of the storm pipe.
12. Catch basins Type II shall conform to City Standard Detail No.02.01.04 and shall be used for depths greater than 5 feet from top of the grate to the invert of the storm pipe.

13. Cast iron or ductile iron frame and grate shall conform to City Standard Detail No.02.01.05. Grate shall be marked with “drains to stream”. Solid catch basin lids (square unless noted as round) shall conform to WSDOT Standard Plan B-30.20-04 (Olympic Foundry No. SM60 or equal). Vaned grates shall conform to WSDOT Standard Plan B-30.30-03 (Olympic Foundry No. SM60V or equal).
14. Stormwater pipe shall be only PVC, concrete, ductile iron, or dual walled Polypropylene pipe.
 - a. The use of any other type shall be reviewed and approved by the Engineering Services Staff prior to installation.
 - b. PVC pipe shall be per ASTM D3034, SDR 35 for pipe size 15-inch and smaller and F679 for pipe sizes 18 to 27 inch. Minimum cover on PVC pipe shall be 3.0 feet.
 - c. Concrete pipe shall conform to the WSDOT Standard Specifications for concrete underdrain pipe. Minimum cover on concrete pipe shall not less than 3.0 feet.
 - d. Ductile iron pipe shall be Class 50, conforming to AWWA C151. Minimum cover on ductile iron pipe shall be 1.0 foot.
 - e. Polypropylene Pipe (PP) shall be dual walled, have a smooth interior and exterior corrugations and meet WSDOT 9-05.24(1). 12-inch through 30-inch pipe shall meet or exceed ASTM F2736 and AASHTO M330, Type S, or Type D. 36-inch through 60-inch pipe shall meet or exceed ASTM F2881 and AASHTO M330, Type S, or Type D. Testing shall be per ASTM F1417. Minimum cover over Polypropylene pipe shall be 3-feet.
15. Trenching, bedding, and backfill for pipe shall conform to City Standard Detail No. 06.01.01.
16. Storm pipe shall be a minimum of 10 feet away from building foundations and/or roof lines.
17. All storm drain mains shall be tested and inspected for acceptance as outlined in Section 406 of the City of Puyallup Sanitary Sewer System Standards.
18. All temporary sedimentation and erosion control measures, and protective measures for critical areas and significant trees shall be installed prior to initiating any construction activities.

208 Pollution Prevention

The following requirements are intended to be Best Management Practices (BMPs) to prevent stormwater pollution within commercial development and redevelopment.

208.1 Enclosures (Garbage, Compactors, Recycling, etc.)

1. Enclosures (with roof) shall be required for all new commercial and redevelopment projects where Minimum Requirement #1 through #5 or Minimum Requirement #1 through #9 are required, as outlined in the Ecology Manual. Enclosures shall be covered (roof) and fully enclosed to prevent precipitation from entering garbage dumpsters, containers, compactors, grease dumpsters and the enclosure floor. This does not exempt the requirement for watertight containers.
2. Enclosures shall be large enough for a garbage service vehicle to pick up and dump the waste without the container being rolled outside the enclosure. The gate opening shall be a minimum of 12 feet wide and swing open a minimum of 120 degrees from the closed position. Each gate shall also include a drop rod and receiving posts to keep the gate fixed, or pinned, in the open and closed position. The vertical clearance of the roof shall be a minimum of 15 feet and the minimum depth of the enclosure shall be 12 feet.
3. Where one (1) enclosure is utilized for both garbage and recycling services the gate opening shall be a minimum of 25 feet.
4. Enclosures should be located within 300' of the business or residence it is serving.
5. Enclosures shall be designed to allow walk-in access without having to open the main service gate.
6. Enclosures for compactors shall be designed on a case-by-case basis. The enclosure width, depth and vertical clearance shall be sized and evaluated based on the compactor and the use of the business or residence.
7. Enclosures should be strategically placed for accessibility and designed to accommodate the turning radius of a SU-30 single unit truck.
8. A grade break shall be provided around the enclosure to prevent runoff from entering the enclosure.
9. No stormwater catch basins or manholes should be located within 10 feet of the enclosure, if unavoidable the lid shall be solid and locking.
10. The interior floor of the enclosure area shall slope towards a Type I catch basin, or equivalent, and be plumbed to sanitary sewer.
11. Roof downspouts for enclosures shall be connected to an existing or new stormwater collection system and accounted for during design. Downspouts discharging over sidewalks and parking lots are prohibited.

12. When designing garbage enclosures, developers are encouraged to contact the garbage service provider to verify the location and access.

209 Testing and Inspection

Stormwater system cleaning and testing requirements shall be as outlined in WSDOT Section 7-17.3(2) and the standards herein. Stormwater system cleaning and testing shall be completed to the satisfaction of the City Engineer, or designee, prior to final acceptance. After completion of all project utility work (sewer, water, storm, etc.) and associated utility trench backfill and compaction, stormwater lines shall be cleaned and tested by the Contractor prior to final project acceptance, as outlined in Section 209.1 through 209.4. At the end of the maintenance and warranty period, the developer/contractor is required to clean and flush the lines as outlined in the standards herein. Other testing may be required at the end of the maintenance and warranty period, as determined by the City Engineer.

209.1 Cleaning/Flushing

The Contractor shall arrange to have all water and debris accumulated during construction removed from the system. Stormwater cleaning operations shall consist of jetting all stormwater lines, both main lines and laterals. Jetting lines shall never result in pushing sediment or debris downstream and all sediment, debris and water shall be removed from the stormwater system by a vacuum truck. Sediment or debris introduced to the City's stormwater system because of construction activity shall be removed immediately by the Contractor in conformance with WSDOT Section 7-04.

209.2 Deflection Testing

Stormwater pipes shall be tested for deflection prior to visual inspection. Thermoplastic pipe shall be tested for deflection not less than 30 days after the trench backfill and compaction has been completed. Deflection testing shall be conducted by pulling a mandrel (rigid or adjustable) with a diameter not less than 95 percent of the normal diameter of the pipe being tested. Mandrel testing shall be conducted in conformance with WSDOT Section 7-17.3(2)G.

209.3 Pressure Testing

All new stormwater pipes shall be subject to a low-pressure air test per WSDOT Section 7-17.3(2)F. Pressure testing shall be in accordance with the following, unless otherwise determined by the City Engineer, or designee.

1. Low pressure air testing shall be conducted after backfilling is completed. Backfill material shall be compacted in accordance with the approved plans.
2. Conforming compaction shall be verified by nuclear gauge testing and/or proof rolling. The City Engineer, or designee, shall observe all testing to verify satisfactory completion.
3. The Contractor shall furnish all necessary equipment and personnel for conducting the pressure test. The Contractor shall provide certification from a certified/accredited laboratory that testing equipment is accurate. All equipment and personnel shall be subject to approval.
4. The Contractor shall conduct a preliminary pressure test prior to City observation, any portions of the system that fail the preliminary test should be remedied prior to City observation.
5. If any portion of the stormwater system fails to meet the testing requirements, the Contractor shall determine, at their own expense, the source of leakage and shall repair or replace all defective materials or workmanship. The completed pipe installation shall meet the minimum testing requirements before being considered acceptable.

209.4 Television Inspection

All new stormwater pipes shall be visually inspected in conformance with WSDOT Section 7-17.3(2)H, following satisfactory trench compaction testing, flushing, low pressure air testing, and deflection testing. All manholes and catch basins shall be watertight with grade rings set in place prior to stormwater video inspection. The remote camera used in stormwater visual inspection shall be one specifically designed for such an application, with the ability to rotate the camera 180 degrees and lighting suitable to allow a clear high-quality picture of the entire periphery of the pipe. The camera shall proceed through the pipe at an appropriate velocity to allow adequate inspection of all pipe joints. All pipe joints shall be closely inspected by rotating the camera as needed to provide a clear view. The Contractor shall introduce water, with dye, to the stormwater system immediately prior to the visual inspection. The water shall be added to the upstream manhole until water is seen flowing in the downstream manhole. An incremented 1-inch sewer ball shall be attached to the front of the camera to provide a basis for estimating the depth of the ponding within the stormwater pipe.

All new stormwater pipes shall be inspected by television camera with the City Engineer, or designee, present. Video and inspection reports shall be submitted to the City and include the following:

1. An electronic report of the inspection and copy of the inspection video in electronic form on a flash drive.
2. Video shall be labeled with the date and time, street name or location, upstream/ downstream structure, pipe size, pipe length and pipe material type.
3. Location and depths of all ponding $\frac{1}{4}$ " or greater.
4. Location of deflections, deformation, or structural defects.
5. One file should be submitted with all stormwater pipe runs for the project. One-by-one submittals will not be accepted.
6. Video or inspection reports failing to meet criteria 1-5 above will not be reviewed and will be returned to the contractor/developer.

209.5 Acceptance Criteria

All new storm pipe installed (public and private) shall be tested, in accordance with Section 209, and video shall be reviewed and approved by the City Engineer, or designee, prior to the placement of curb and gutter or pavement. Unless determined otherwise by the City Engineer, or designee, all repairs identified shall be completed as follows:

1. Any ponding within a pipe shall be less than one-half inch ($\frac{1}{2}$ ") in depth.
2. The total accumulated ponding length, regardless of depth, from manhole to manhole shall be less than ten (10) percent of the total length from manhole to manhole.
3. The use of couplers is prohibited.

4. If a pipe needs to be cut into for the repair, the storm pipe run shall be removed and reinstalled from the nearest bell to the nearest catch basin.
5. If removal and replacement of any section of storm pipe is required to make a repair, the entire length of mainline shall be required to be retested after repairs are made.
6. A new video shall be required after the required repairs have been completed, in accordance with Section 209.4.

Any stormwater pipe that exceeds any of the above acceptance criteria will be rejected and require repair and/or replacement by the Contractor.

The Contractor shall bear all costs for the correction of any deficiencies found during TV inspection, including the costs for additional TV inspection and pressure testing needed to verify that the deficiencies were corrected. All components of the video and recording equipment shall be sufficient to provide picture quality to the satisfaction of the City Engineer, or designee.

210 Roof Downspout Controls

210.1 General Requirements

1. Roof downspout control BMP's shall be designed and constructed in accordance with the Ecology Manual, the standards outlined herein, and shall be documented in the Drainage Report and incorporated into the street and drainage plans.
2. Roof downspout control standards in this section only apply to single family residential homes or commercial development of equivalent size. Commercial development of equivalent size refers to commercial developments disturbing less than a half-acre and have a roof area of less than 5,000 square feet.
3. All roof downspouts shall be accounted for in design and shall not discharge over the surface of streets, sidewalks, or direct concentrated flow to an adjacent property.
4. Roof downspout controls shall be located out of all utility easements unless the easement is identified as a drainage easement for the downspout control.
5. When calculating the roof area served by a roof downspout control, the total square footage shall include any eaves, roof overhangs, carports, etc. that will intercept and convey stormwater to the roof downspout control BMP.

210.2 Downspout Infiltration Trench

1. Infiltration trenches shall be installed in accordance with Standard Detail 02.05.01.
2. The design criteria for infiltration trenches shall be as follows:
 - a. Minimum lengths, per linear foot and 1,000 square feet of roof area:
 - i. Coarse sands and cobbles: 20 LF
 - ii. Medium sand: 30 LF
 - iii. Fine sand, loamy sand: 75 LF
 - iv. Sandy loam: 125 LF
 - v. Loam: 190 LF

Exception: A pit test or falling head test may be used to determine the infiltration rate and a design modeled using WWHM.
 - b. The minimum setback from property lines, structures and critical areas is 10 (ten) feet. Setbacks for an infiltration system at the top of steep slopes will be determined on a case-by-case basis.
 - c. A minimum separation of one (1) foot from the bottom elevation of the trench to the high groundwater elevation.
 - d. Trench lengths shall not exceed 100 feet in length.
 - e. Trenches are required to have a cleanout, in accordance with Standard Detail 02.01.09, at the downstream end of the trench.

- f. Minimum spacing between trenches shall be 4 ft, from edge of trench to edge of trench.
 - g. Infiltration trenches under impervious or hard surfaces should be avoided, where unavoidable, an overflow shall be provided one (1) foot below the impervious or hard surface elevation.
 - h. Yard drains shall be located upstream of the trench in accordance with Standard Detail 02.05.02.
 - i. Roof drain lines shall provide positive flow (slope > 1.0%) from the downspouts to the yard drains.
Exception: Pipe slope may be reduced when, as demonstrated with a hydraulic analysis, the flushing velocity is greater than or equal for 2.5 feet per second along the length of the proposed pipe.
 - j. Perforations in the pipe shall be smaller than the smallest diameter aggregate in the washed rock.
 - k. Setbacks from Onsite Sewage Systems shall conform to WAC 246-272A-0210.
 - l. Any other design criteria listed in the Ecology Manual, as applicable.
3. The following conditions describe when infiltration trenches are infeasible:
- a. Slopes exceeding 4H:1V.
 - b. When any portion of the trench is under the influence of groundwater. If groundwater is encountered during construction, the City Engineer, or designee, shall be notified and the trench redesigned accordingly.
 - c. Three (3) feet of permeable soil does not exist from the proposed final grade to the seasonal high groundwater table.
 - d. When an infiltration trench can only be placed under impervious or hard surface and an overflow cannot be provided.
 - e. When an overflow is required, and the overflow cannot be designed without creating downstream impacts to properties or existing drainage systems.
 - f. Any other infeasibility criteria listed in the Ecology Manual, as applicable.

210.3 Downspout Drywells

- 1. Drywells shall be installed in accordance with Standard Detail 02.05.04.
- 2. The design criteria for drywells are as follows:
 - a. Drywells shall be a minimum of 48 inches in diameter and 48 inches deep.

- b. One (1) drywell may serve up to 1,000 square feet of impervious surface.
 - c. A minimum separation of one (1) foot from the bottom elevation of the drywell to the high groundwater elevation.
 - d. The minimum setback from property lines, structures and critical areas is 10 (ten) feet. Setbacks for drywells at the top of steep slopes will be determined on a case-by-case basis.
 - e. Drywells shall be separated by a minimum of ten (10) feet, from edge of drywell to edge of drywell.
 - f. Yard drains shall be located upstream of the drywell in accordance with Standard Detail 02.05.02.
 - g. Roof drain lines shall provide positive flow (slope>1.0%) from the downspouts to the yard drains.
Exception: Pipe slope may be reduced when, as demonstrated with a hydraulic analysis, the flushing velocity is greater than or equal for 2.5 feet per second along the length of the proposed pipe.
 - h. Drywells shall not be located under impervious surface.
 - i. An inspection port shall be provided in the center of the drywell in accordance with Standard Detail 02.01.10.
 - j. Setbacks from Onsite Sewage Systems shall conform to WAC 246-272A-0210.
 - k. Any other design criteria listed in the Ecology Manual, as applicable.
3. The following conditions describe when drywells are infeasible:
- a. Slopes exceeding 4H:1V.
 - b. When any portion of the drywell is under the influence of groundwater. If groundwater is encountered during construction, the City Engineer, or designee, shall be notified and the drywell redesigned accordingly.
 - c. Five (5) feet of permeable soil does not exist from the proposed final grade to the seasonal high groundwater table.
 - d. Any other infeasibility criteria listed in the Ecology Manual, as applicable.

210.4 Downspout Splash Blocks

- 1. Splash Blocks shall be designed in accordance with Standard Detail 02.05.05.
- 2. The design criteria for splash blocks are as follows:

- a. Splash blocks shall have a minimum vegetated flow path of 50 feet measured from the downspout to the downstream property line, structure, stream, wetland, or any other impervious surface. Critical area buffers may count towards the 50-foot flow path, where applicable.
 - b. A maximum of 700 square feet of roof area may drain to a splash block.
 - c. If rock pads are used, they shall have minimum dimensions of two (2) feet wide by three (3) feet long and eight (8) inches in depth.
 - d. Any other design criteria listed in the Ecology Manual, as applicable.
3. The following conditions describe when splash blocks are infeasible:
- a. Slopes greater than 6.5H:1V.
 - b. Any other infeasibility criteria listed in the Ecology Manual, as applicable.

210.5 Downspout Dispersion Trenches

1. Dispersion trenches shall be designed in accordance with Standard Detail 02.05.06.
2. The design criteria for dispersion trenches are the following:
 - a. Dispersion trenches shall have a minimum vegetated flow path equal to the width of the trench and 25 feet in length measured from the edge of the dispersion trench to the downstream property line, structure, stream, wetland, or any other impervious surface. Critical area buffers may count towards the 25-foot flow path, where applicable.
 - b. Trenches shall be 10 feet in length per 700 square feet of roof area served.
 - c. Total trench length shall not exceed 50 feet.
 - d. Trenches shall be setback a minimum of five (5) feet, measured from the edge of the trench to any structure, property line, stream, wetland, or any other impervious surface.
 - e. Trenches shall be a minimum of 50 feet apart, measured from edge of trench to edge of trench.
 - f. Perforations in the pipe shall be smaller than the smallest diameter aggregate in the washed rock.
 - g. Setbacks from Onsite Sewage Systems shall conform to WAC 246-272A-0210.
 - h. Any other design criteria listed in the Ecology Manual, as applicable.
3. The following conditions describe when dispersion trenches are infeasible:
 - a. Slopes greater than 6.5H:1V.

- b. Any other infeasibility criteria listed in the Ecology Manual, as applicable.

210.6 Perforated Stub-out Connections

Perforated stub-out connections may be used when all other roof downspout BMPs are infeasible. Perforated stub-outs are the last BMP that should be considered when determining feasibility.

1. Perforated stub-outs shall be installed in accordance with Standard Detail 02.05.07.
2. The design criteria for perforated stub-outs shall be as follows:
 - a. Stub-out trenches shall have a minimum length of ten (10) feet per 5,000 square feet of roof area served.
 - b. The minimum setback from property lines, structures and critical areas is ten (10) feet.
 - c. A minimum separation of one (1) foot from the bottom elevation of the trench to the seasonal high groundwater elevation.
 - d. Yard drains shall be located upstream of the trench and in accordance with Standard Detail 02.05.02.
 - e. Roof drain lines shall provide positive flow (slope > 1.0%) from the downspouts to the yard drains.
Exception: Pipe slope may be reduced when, as demonstrated with a hydraulic analysis, the flushing velocity is greater than or equal for 2.5 feet per second along the length of the proposed pipe.
 - f. Perforations in the pipe shall be smaller than the smallest diameter aggregate in the washed rock.
 - g. The perforated stub-out shall be connected to an existing drainage system. If the connection is made within public right-of-way, it shall be connected at a catch basin.
 - h. Setbacks from Onsite Sewage Systems shall conform to WAC 246-272A-0210.
 - i. Any other design criteria listed in the Ecology Manual, as applicable.
3. The following conditions describe when perforated stub-outs are infeasible:
 - a. The perforated stub-out cannot feasibly be designed without exceeding a 5H:1V slope.
 - b. When any portion of the perforated sub-out is under the influence of groundwater. If groundwater is encountered during construction, the City Engineer, or designee, shall be notified and the trench redesigned accordingly.
 - c. Any other infeasibility criteria listed in the Ecology Manual, as applicable.