

Section 5 Index

Storm Drain

- 5-1 Storm Drain Pipe
- 5-2 Trench Excavation and Backfill
- 5-3 Pipe Bedding
- 5-4 Catch Basin
- 5-5 Standard Manhole
- 5-6 Standard Dry Well
- 5-7 Dry Well Percolation Tests
- 5-8 Abandoned Conduits
- 5-9 Storm Drainage Design

CITY OF BENTON CITY

SECTION 5

STANDARD SPECIFICATIONS FOR:

STORM DRAIN

5-1 STORM DRAIN PIPE

5-1.01 GENERAL

The work covered in this section shall include storm drainage design criteria and the furnishing, installation and testing of storm drain pipe of the types and sizes specified and shown on the plans together with other appurtenances and incidental work required to construct the storm drainage facilities in accordance with SWSS Section 7-04 except as herein modified. The minimum pipe size for catch basin runs is 10 inches. The minimum pipe size for main line runs is 12 inches.

Developer and builder storm drainage systems will be required to meet, or exceed the requirement of Section 5-9 of these standard specifications.

All storm sewer mainline under crossings of 6-inch and 8-inch AC water mains will require removal and replacement of a section of the AC water main as herein specified.

5-1.02 APPROVED PIPE MATERIALS

The storm drain pipe shall be one of the types indicated unless a different type and class of pipe is called for in the special provisions. The only pipes approved for open-ended culverts will be concrete, or CMP.

- A. NON-REINFORCED CONCRETE PIPE shall conform to the requirements of AASHTO M86 Class 2 and be designed for H20 loading at the design depth. All concrete pipe over 30" shall be reinforced.
- B. REINFORCED CONCRETE PIPE shall conform to the requirements of SWSS Section 9-05.7(2) and be designed for H20 loading at the design depth.
- C. DUCTILE IRON PIPE shall conform to the requirements of AWWA designation C151 with Class 2 up through 12-inch diameter and Class 1 for 14-inch diameter and larger.
- D. HIGH DENSITY POLYETHYLENE PIPE – HDPE pipe, as specified herein, is approved for 10-inch and 12-inch catch basin runs, with a minimum 1.5 feet bury and for main line pipes, with a minimum height of cover below finish grade of 3.0 feet. The high-density polyethylene pipe shall be WSDOT approved for culvert use under H-20 rated roadways. The high-density polyethylene pipe shall be manufactured in accordance with the most recent AASHTO M252 and M294, ASTM F405 and ASTM F667, for smooth interior walled, corrugated polyethylene pipe.

Bell and spigot joints shall be a testable, water tight, rubber gasket and spigot pipe joint. The components shall be manufactured by the supplier of the pipe and shall be designed to meet or exceed the requirements of Section 5-1.04 and 5-1.05 of this specification section.

- E. POLYVINYL CHLORIDE (PVC) PIPE, 10-INCH THROUGH 24-INCH PVC pipe. As specified herein, is approved for 10-inch and 12-inch catch basin runs, with a minimum height of cover below finish grade of 1.5 feet and for main line pipes, with a minimum height of cover below finish grade of 3.0 feet. PVC pipe shall meet or exceed one of the below specifications.
 - a. Solid wall PVC pipe manufactured in accordance with the requirements of ASTM D3034, SDR41 or SDR35.

- b. Smooth interior, corrugated PVC pipe with bell and spigot joints, manufactured in accordance with ASTM F949. Minimum pipe stiffness shall be 50 psi in accordance with the requirements of ASTM D 2412.

F. GALVANIZED CORRUGATED STEEL PIPE, SHALLOW BURY AND 27 INCHES AND LARGER

Galvanized corrugated steel pipe conforming to the requirements of AASHTO M36, with ½-inch deep corrugations, or ¾ x ¾ x 7-1/2-inch" pitch spiral rib pipe may be utilized for main line storm sewers where a minimum 3.0 foot bury cannot be obtained, for installations that require 27 inch and larger pipes and when utility conflicts prevent the required minimum 18-inch pipe bury for catch basin runs. All CMP pipe shall be coated per the requirements of Section 5-1.03, unless otherwise required by the contract special provisions. Gauge shall be a minimum 16 gauge, or as called for by the contract special provisions.

5-1.03 COATING FOR GALVANIZED STEEL PIPE

Unless otherwise called for by the contract special provisions, galvanized steel pipe shall be coated on the outside with an asphalt, or protective coating. The protective polymer coating shall conform to AASHTO M-246 and shall be a minimum 10 mils thick, and composed of polyethylene and acrylic acid copolymer.

5-1.04 COUPLING AND JOINT MATERIALS

Rubber gasket jointing materials for concrete (reinforced and non-reinforced) pipe, ductile iron pipe, high density polyethylene pipe, and PVC pipe shall be in accordance with SWSS Sections 9-05.7(3), 9-05.12 and 9-05.13.

Corrugated and spiral rib coupling bands shall meet the requirements of SWSS Section 9-05.4(7), or Section 9-05.10(1) All bands shall use a full width 3/8-inch thick neoprene rubber gasket in conformance with SWSS Section 9-04.4(3).

5-1.05 TESTING

The Contractor shall provide all required test equipment and gauges and test all mainline storm sewers 24 inches and smaller by the exfiltration pressure test per SWSS Section 7-04.3(4) B as herein modified, or the below described air test. Prior to testing, the pipe shall be thoroughly cleaned and flushed by the Contractor and visually inspected by the City, by lamping or televising as the Engineer chooses. Any protruding gaskets, pipe breaks or obvious imperfections, shall be repaired as directed by the Engineer. Infiltration leaks at a seam or joint that exceed the flow of adjoining sections, or leaks that appear to be the result of improper installation or faulty material shall be repaired by the Contractor as directed by the Engineer. The contractor shall inspect completed storm sewer main lines by lamping, prior to acceptance. Storm sewer lines may be subject to television inspection by the City.

Exfiltration Test: Leakage shall be no more than one (1.0) gallon per hour per inch of diameter per 100 feet of storm sewer pipe, with a minimum test pressure of six (6) feet of water column above the crown at the upper end of the pipe.

The length of pipe shall be limited so that the pressure on the low end of the test section shall not exceed 16 feet. For each two (2)-foot interval that the high-end test water level is above six (6) feet over the crown of the pipe at the lower end of the pipe test section, the allowable leakage shall be increased 10 percent.

Low Pressure Air Test: For pipe 24-inches in diameter and smaller, the Contractor may, at his option, test by a low-pressure air test. The pipe shall be plugged and pumped to 4.0 PSI. The pressure shall be allowed to drop to 3.5 PSI and a watch used to measure the time in seconds that it takes for the pressure to drop from 3.5 to 2.5 PSI. The time required in seconds for the pressure to drop from 4 PSI to 3.5 PSI or from 3.5 PSI to 2.5 PSI must exceed that calculated by the following equation:

Time in seconds = 14.15 x diameter in inches.

This test allows double the allowable loss over what is allowed for a sanitary sewer test.

5-1.06 MEASUREMENT AND PAYMENT

The unit contract price for each size of pipe shown on the plans and in the proposal shall be paid per linear foot, and shall be measured along its length through manholes, dry wells, and catch basins. The unit contract price, per linear foot, shall be full compensation for furnishing all labor, equipment, materials, pipe fittings, tees, elbows, flared end sections, and all other incidentals necessary to place the pipe in the trench to the line and grade as shown on the plans and in accordance with these specifications or as directed by the Engineer.

5-2 TRENCH EXCAVATION AND BACKFILL

5-2.01 GENERAL

All trench excavation and backfill for storm drain pipe shall be to the depth as shown on the plans and/or as indicated in the proposal for the various depths. Trench excavation and backfill shall be completed in accordance with the requirements of SWSS Section 7-04.3 as herein modified. Pavement restoration shall meet the requirements of City Standard Drawing 2-6 and Section 2-29 of these standards.

Trench excavation shall be unclassified unless rock excavation is listed as a pay item, and shall include all excavation, disposal of surplus and unsuitable material, and all other work incidental to the construction of trenches for drains, gravity sewers, force mains or culverts, including manholes, catch basins, inlets or other appurtenances which are part of the pipeline.

Rock excavation shall include solid rock formation requiring systematic drilling and blasting with explosives and any boulders or broken rock larger than one-half cubic yard in volume. Hardpan or cemented gravel, even though it may be advantageous to use explosives in its removal, shall not be classified as solid rock excavation. The bottom of the trench shall be brought up to grade by backfilling with selected backfill material and be compacted to the satisfaction of the Engineer.

The Contractor shall notify the Engineer at least 24 hours prior to any blasting. All blasting shall be done in accordance with local, county, and state regulations governing this class of work. Any damage to persons or property resulting from blasting operations shall be the sole responsibility of the Contractor and his surety.

Trench backfill material shall be compacted per the requirement of City Standard 1-13, by means approved by the Engineer, as required to preclude future settlement and to achieve a minimum of 95 percent maximum density when tested, in accordance with SWSS 7-04.3(3) as herein modified.

As a minimum, all trenches, which parallel the street centerline, shall be water-flooded and compacted with a hoe-mounted or double drum, vibratory mechanical compactor. Water content during compactions shall exceed optimum at all times. Hand-operated jumping jacks or shoe-type mechanical tampers will not be approved.

All trench excavation shall have adequate safety systems for the trench excavation that meet the requirements of the Washington Industrial Safety and Health Act, Chapter 49.17 RCW. The Contractor shall be fully responsible for providing the necessary back sloping, cribbing, trench boxes, etc., as required to meet the specified safety requirements for the trench, manhole, drywell, etc.

The Contractor is advised that all water main lines have thrust blocks typically located as shown on Standard Drawing 4-6. These thrust blocks have been found to be constructed of rocks, blocks, concrete or other materials. The Contractor shall take such precautions, shoring, etc. as required to protect and not disturb the existing thrust blocks.

When a sanitary sewer main line, or storm sewer main line will cross under a 6-inch or 8-inch AC water main, then prior to excavation under the water main, the section of AC water main which is estimated to span the trench and to a minimum of three feet each side of the trench, shall be removed and replaced with a section of city standard C900 PVC water main. After completion of the excavation and backfill, the repair couplings shall remain firmly on undisturbed ground, or the contractor will be required to replace the water repair.

Sewer service locates and repairs shall be made in accordance with Section 10-19 of these specifications.

5-2.02 MEASUREMENT

A. Trench Excavation and Backfill

Measurement for payment of "Trench Excavation and Backfill" shall be by the linear foot for the appropriate depth increment of trench excavation and backfill, including measurement through manholes.

Measurement shall be the depth from the pipe invert to original grade, except that where the storm sewer is constructed in conjunction with new street construction, and unless excavation to subgrade is not allowed by the contract special provisions. Measurement shall be from the pipe invert to the street design subgrade regardless of when the Contractor chooses to excavate the street to subgrade.

B. Rock Excavation

Measurement for payment of "Rock Excavation" shall include boulders exceeding one-half cubic yard in volume and solid rock, which requires systematic drilling and blasting. Rock Excavation will be measured on a cubic yard basis computed as follows:

a. LENGTH

Length will be the entire horizontal distance where rock is encountered measured on a linear foot basis along centerline of the trench.

All excavation for dry wells and other structures will be excluded and will be measured separately. Measurement will commence at the first location where rock is encountered and continue to the point where rock terminates.

b. WIDTH

The trench width for payment of "Rock Excavation" shall be as follows:

Size of Pipe	Pay Width of Trench
10" - 15"	2.5 feet
18" - 36"	Outside pipe diameter plus 12"
42" and larger	Outside pipe diameter plus 24"

c. DEPTH

Measurement for depth will be the vertical distance from six inches (6") below the pipe invert to the top of the solid rock strata. Depth will be measured at intervals of 25 feet along centerline of trench, beginning at the first location that solid rock is encountered, and the average depth between measuring points will be the depth used for computing depth of rock.

C. Rock Excavation for Structures

Rock excavation quantities for manholes, dry wells, and other storm drain structures shall be computed on a cubic yard basis from the actual profile depth as described above, multiplied by the area within a line parallel to and one foot (1') outside of the actual dimensions of the manhole, dry well, or structure base.

D. Trench Safety Systems

The unit contract price for "Trench Safety Systems", per linear foot, shall be measured along the trench length through manholes, drywells, and catch basins.

5-2.03 PAYMENT

A. Trench Excavation and Backfill

The unit contract price for "Trench Excavation and Backfill", per linear foot, for the various depths indicated in the proposal, shall be full compensation for the cost of excavation, backfill, furnishing all labor, equipment, and all other incidentals necessary to perform the work in accordance with the plans and specifications or as directed by the Engineer.

Unless provided for in the contract special provisions, all costs for labor, equipment and materials as required to replace sections of 6-inch and 8-inch AC water mains at main line trench crossings, shall be considered incidental to the "Trench Excavation and Backfill" bid items as provided in the bid proposal.

B. Rock Excavation

When included in the bid proposal, the unit contract price for "Rock Excavation", per cubic yard, will be paid in addition to the payment for trench excavation and backfill at the various depths indicated in the proposal in which the rock is encountered. If not included in the bid proposal, Trench Excavation is unclassified, and a separate measurement and payment will not be made for rock excavation. Payment for rock excavation shall be full compensation for all work required to excavate and dispose of the rock material. No payment will be made for rock excavated below required grade or outside the widths stated in Section 5-2.02B of these specifications, unless approved by the Engineer.

C. Trench Safety Systems

The unit contract price, per linear foot, shall be full compensation for furnishing all labor, equipment materials and all other incidentals necessary to meet the requirements of the Washington Industrial Safety and Health Act, Chapter 49.17 RCW, including all requirements for drywells, manholes and catch basins.

5-3 PIPE BEDDING

5-3.01 GENERAL

It is the intent of this contract to use select native material from the construction site for backfill around the storm drain piping. Select native material used for pipe bedding shall meet the approval of the Engineer and shall be free of any organic materials, frozen lumps, rocks or pavement chunks. When unsuitable native material exists or is encountered during trench excavation, imported bedding material may be required by the Engineer, depending on the type of pipe being installed, and the type of native material encountered. When directed by the Engineer, the Contractor shall furnish and place imported pipe bedding.

5-3.02 NATIVE AND IMPORTED BEDDING MATERIAL

Pipe bedding shall be placed in accordance with the City of Benton City Standard Drawing No. 4-7. The bedding material shall be placed in lifts of not more than six inches (6") in depth and compacted.

Bedding materials shall meet the requirements of Sections 4-4.02 and 4-4.03 of these specifications.

5-3.03 MEASUREMENT AND PAYMENT

The unit contract price for "Imported Pipe Bedding", per linear foot, shall be full compensation for furnishing all labor, materials, tools, all other equipment and incidentals required to provide and install bedding material in accordance with the plans and specifications or as directed by the Engineer.

Select native materials, which do not require truck hauling and are determined to be acceptable as bedding and utilized as bedding, shall be considered, as incidental to "Trench Excavation and Backfill", and no additional payment will be made for its use as "Imported Pipe Bedding".

5-4 CATCH BASIN

5-4.01 DESIGN AND CONSTRUCTION

Catch basins are to be furnished and installed in accordance with City of Benton City Standard Drawings 5-1 and 5-2 and SWSS Section 7-.05, as herein modified.

Filter fabric shall be placed per the requirements of Section 2-27 of these specifications.

Catch basins shall be designed for the grade of the street, in order to maintain a maximum three foot wide flow during the design 25 year storm; however, the maximum catch basin spacing allowed shall be 400 feet, and in addition, catch basin(s) shall also be installed prior to each intersecting street.

5-4.02 CATCH BASIN PROTECTION

Prior to construction, the Contractor shall supply and install a section of filter fabric under the grate of all existing catch basins on the project and downstream as directed by the Engineer and required by Sections 5-4.01 and 2-27 of these specifications. Catch basins installed in conjunction with the project shall also be similarly protected.

5-4.03 MEASUREMENT AND PAYMENT

The unit contract price for "Catch Basin", per each, shall be full compensation for furnishing all labor, materials, equipment, rings, grates, fabric protection, and all other incidental work required to complete the catch basin in accordance with the plans and specifications or as directed by the Engineer. All costs for fabric protection of off-site and existing catch basins shall be incorporated into the project maintenance, or storm pipe bid items as provided for in the bid proposal.

5-5 STANDARD MANHOLE

5-5.01 GENERAL

Manholes shall be furnished and installed in accordance with the City of Benton City Standard Drawings 3-2, 3-3, and 3-5 and as herein modified. Storm drain manholes may have either a poured-in-place base or a precast base. Channelization is not required.

5-5.02 CONSTRUCTION

Construction of manholes shall conform to the SWSS Section 7-05 as herein modified. The following provisions shall apply to the construction of all manholes:

- A. Manhole steps shall be fabricated from three-quarter inch (3/4") galvanized or aluminum deformed bars and have a three-inch (3") drop for personnel safety, or co-polymer polypropylene steel reinforced steps as manufactured by M.A. Industries or approved equal.
- B. Precast concrete cones shall be eccentric. If used in conjunction with flat top, sections in shallow bury areas; the access openings shall be aligned.
- C. All manhole joints shall be made with flexible gaskets or a positive self-sealing mastic.
- D. Where directed by the Engineer, the channelization of manhole bases will be covered by a rigid material such as three-quarter inch (3/4") plywood or better. This cover shall remain in place until street construction is completed and the manhole castings are grouted and then shall be removed, along with any the debris, prior to acceptance of construction.
- E. Manhole connections shall be reconstructed in accordance with the requirements of SWSS Section 7-05.
- F. Manhole sections installed below the high static ground water level shall be infiltration tested. A water infiltration allowance of 0.20 gallons per hour, per foot of static head above the lowest manhole invert, shall be considered as a satisfactory manhole test.

5-5.03 MEASUREMENT AND PAYMENT FOR STANDARD MANHOLE

The unit contract price for "Standard 48-Inch Manhole," per each, shall be full compensation for furnishing all materials, labor, frames, covers, ladder rungs, and all other incidental work required to construct a ten-foot (10') deep standard manhole in accordance with the plans and specifications.

5-5.04 MEASUREMENT AND PAYMENT FOR ADDITIONAL MANHOLE DEPTH

Payment for additional depth manholes, which are over ten feet (10') in depth, shall be in accordance with the unit contract price for "Additional Manhole Depth," per vertical foot, as measured from the invert thereof, to the top of the cover, less ten feet (10'), and shall be full compensation for furnishing all labor, materials, and equipment required to construct the manhole in accordance with the plans and specifications or as directed by the Engineer.

5-5.05 MEASUREMENT AND PAYMENT FOR DROP CONNECTIONS

Payment for drop connections shall be in accordance with the unit contract price for "Drop Connection", per vertical foot, as measured from the invert thereof to the invert of the pipe from which the drop was made, and shall be full compensation for furnishing all labor, materials, and equipment required to construct the drop connection in accordance with the plans and specifications or as directed by the Engineer.

5-6 STANDARD DRY WELL

5-6.01 GENERAL

Dry wells are to be furnished and installed in accordance with the City of Benton City Standard Drawings, 5-4, or 5-5 for the type of dry well as indicated on the plans or as directed by the Engineer. Drywells may have a poured-in-place, or a precast base.

When unsuitable soil conditions are encountered at the standard depth, and when authorized or directed by the Engineer, the Contractor shall construct an extra depth standard, or modified dry well.

A filter fabric shall be required as per the standard drawings. The filter fabric shall be designed for use as a soil filtration media. The fabric shall be a non-woven fabric consisting of polypropylene fibers treated to resist degradation caused by exposure to sunlight. The fabric shall be resistant to commonly encountered soil chemicals, mildew, and insects and be non-biodegradable with a minimum fabric weight of 6.0 ounces per square yard, minimum roll thickness of 80 mils. Fabric shall be Trevira, AMOCO 4551, Ling GTF 150 Ex, Geotex 601, or equal.

The Contractor's attention is hereby called to Section 5-7 of these specifications for additional requirements concerning dry well presoak and testing.

5-6.02 MEASUREMENT AND PAYMENT

The unit contract price for "Standard Dry Well, (Drawing 5-5), or "Modified Dry Well, (Drawing 5-4)", per each, shall be full compensation for furnishing all labor, materials, equipment, and all other incidentals necessary to construct the dry well complete in accordance with the plans and specifications. A separate measurement and payment will be made for testing, per Section 5-7 of these specifications.

5-6.03 PAYMENT FOR ADDITIONAL DRYWELL DEPTH

When an extra depth standard dry well, or an extra depth modified dry well, is required, an additional payment will be made in accordance with the unit contract price for "Additional Dry Well Depth," per vertical foot as measured from the top of the footing to the cover finish grade, less the standard depth, and shall be full compensation for additional dry well depth.

5-7 DRY WELL PERCOLATION TESTS

5-7.01 GENERAL

The work covered in this section pertains to the hauling, piping, and measuring of water into a newly constructed dry well for the purpose of presoaking and determining dry well percolation rates, as per City of Benton City Standard Drawing 5-3.

5-7.02 CONSTRUCTION

The Contractor shall place a minimum amount of 3,000 gallon of water into the dry well a minimum of 12 hours prior to actual percolation rate measurements, to presoak the underlying strata. At the

end of the 12-hour period, and in the presence of the Engineer, the Contractor shall then place a minimum amount of 3,000 gallons of water into the dry well and the Engineer will make the dry well percolation rate measurements.

It shall be the responsibility of the Contractor to provide the means to accurately measure the total amount of water placed in the dry well regardless of whether it is by tank truck, piping, or by fire hose.

Water used to presoak and test will be provided by the City, at no cost to the Contractor, at the closest point of delivery to the dry well being tested.

5-7.03 MEASUREMENT AND PAYMENT

The unit contract price for "Drywell Percolation Test" per each shall be full compensation for all labor, materials and equipment, as required to haul, pipe, and measure the water in the dry well, presoak the underlying strata, and testing.

5-8 ABANDONED CONDUITS

All pipes, conduits and other openings determined to be abandoned, which are cut or opened during the storm sewer installation, shall be capped or concrete plugged, prior to backfilling of the trench. Measurement and payment for required pipe cuts, labor, equipment, work and materials required to complete the specified plug shall be incidental to the pipe installation pay items.

5-9 STORM DRAINAGE DESIGN

5-9.01 COMMERCIAL DEVELOPMENT/PRIVATE STREETS

Commercial sites and private streets shall be designed to retain and dispose of a 10-year 24-hour storm on-site. Drywells, perforated pipe systems and other means of infiltration may be used, where there is no potential for groundwater contamination.

Oil/water separators shall be installed with all sub-surface infiltration facilities within the city's wellhead protection area.

The developer is advised that the Department of Ecology has determined that infiltration facilities are Class V injection wells. Prior to acceptance of the project by the city, the owner of the facility must register the drywell/infiltration system with the Washington State Department of Ecology. A copy of the registration form and well assessment shall be submitted to the city prior to project acceptance. Registration forms may be obtained from the Department of Ecology web page at: http://www.ecy.wa.gov/programs/wq/grndwtr/uic/registration/reg_info.html

Parking lots may not be used for storm water storage in conjunction with an infiltration system. Where the "Rational" method is used for design, the minimum storage volume for an infiltration system shall be based on the peak hour.

Grassy swales and retention ponds may also be used. Due to winter ground freeze conditions, where surface retention is used without sub-surface infiltration mechanism, the facility shall be designed to store the entire 10-year 24-hour event, without regard to surface infiltration. Detention facilities using controlled outfall to the city's storm drain system (ponds, vaults, etc.) are not allowed.

Design calculations, bearing a registered professional engineer's stamp, are required for all storm drainage designs.

The City will not assume ownership or maintenance of the on-site commercial storm drainage facilities. Connection to city-owned drainage facilities is not allowed.

5-9.02 RESIDENTIAL DEVELOPMENT

Storm drainage systems for all collector and arterial streets shall be designed to retain and dispose of a 25-year 24-hour event.

Storm drainage systems for all other streets, to be dedicated to the public, shall be designed to retain and dispose of the calculated difference between a 25-year 24-hour event for the developed state and the 10-year 24-hour event for the natural pre-developed state. The developed state shall include streets, sidewalks, an estimated average driveway and one-half of an estimated average building roof for impervious surfaces and 50-foot from back of sidewalk for pervious surfaces.

All street low points, including localized curb return low points, shall have a positive overflow. An analysis of downstream impacts is required for off-site overflows.

Catch basins shall be designed, spaced and installed as required by Section 5-4.01. The main line storm sewer shall be designed with a minimum 5.0 foot bury, to provide for water and other utilities to be installed in the corridor above the storm sewer. The storm sewer shall be designed as required to not conflict with sewer laterals.

Sub-surface infiltration is preferred where there is no potential for groundwater contamination. The City Engineer may restrict or deny the use of sub-surface infiltration where percolation rates are marginal and a retention pond will be required. Infiltration facilities shall be constructed in accordance with city standards.

Retention ponds (no outfall) are required within the city's wellhead protection area and may be required where percolation rates are marginal. In other areas, retention ponds may be used in lieu of sub-surface infiltration, with prior approval from the City Engineer. Where retention ponds are required and/or approved for use, the facility shall be designed to store the entire 25-year 24-hour event, without regard to surface infiltration. A drywell shall be utilized in conjunction with the retention pond to provide pond drainage when the ground is frozen. The owner, or homeowners association of the facility must register the drywell/infiltration system within the retention pond with the Washington State Department of Ecology. A copy of the registration form and the well assessment shall be submitted to the City, prior to acceptance of the project. Registration forms may be obtained from the Department of Ecology web page at: http://www.ecy.wa.gov/programs/wq/grndwtr/uic/registration/reg_infor.html.

Detention ponds (controlled outlet) may be used only where it can be clearly demonstrated that infiltration, or retention, are not feasible. Detention ponds may only be used with prior approval of the City Engineer. Where detention ponds are approved for use, the release rate shall not exceed the 5-year natural state peak hour flow. An emergency spillway shall be constructed and shall include an analysis of downstream impacts. Detention vaults may be used in lieu of a detention pond only where it can be clearly demonstrated that a detention pond is not feasible and only with prior approval from the City Engineer.

Retention and detention ponds shall be designed with a minimum two foot of free board. Side slopes shall be 3:1 or flatter. All ponds with a slope steeper than 4:1 shall have at least one stairway constructed of stone block steps, or similar, suitable for a child to exit on the steeper slope.

The city will not assume ownership or maintenance of retention and/or detention ponds. Ownership and maintenance of ponds and internal drywells shall be the responsibility of a homeowners association approved by the Director of Community Planning.

Swales and detention vaults are not allowed for residential development.

Design calculations, bearing a registered professional engineer's stamp, are required for all storm drainage designs.