

CHAPTER III

STORM DRAINAGE

310 GENERAL

The City of Beaverton has adopted the Clean Water Services (CWS) *Design and Construction Standards*. All City standards meet or exceed these requirements.

The *Beaverton Code*, the City's *Development Code*, and the City's current Storm Drainage System Facility Plan have established the requirements for the design of facilities intended to protect the public health, safety, and welfare from damage due to flooding. Beyond that level of protection, additional measures are specified in this chapter, which are intended to minimize any potential flooding damage and allow for efficient operation, repair, and maintenance of the storm drainage system.

Provisions must be made for gravity drainage of roofs and foundation drains for all new buildings and structures. For multi-family residential, commercial, or industrial developments, these drains shall be piped to the storm drain system. In single-family residential developments, these drains shall be piped to the street gutter or directly to the public storm drain system. The connection to the street gutter must be through a three (3) inch plastic pipe set in the curb during construction or bored through an existing curb (see Chapter VIII Standard Drawings). In single family residential developments where topography prevents connecting foundation and roof drains as required above, or if the street is superevelated and the lot is on the high side of the street, drains for each lot shall be directly piped to the public storm drain system; pipe and easement requirements shall conform to subsection 125 of this manual. Public storm drain located along the back lot line of single family residential shall be a minimum depth of 30 inches.

Geotechnical engineering reports shall consider or address as applicable the City requirement that pond berm embankments shall be constructed on stable native consolidated soil which is free of loose surface soil materials, roots, and other organic debris.

These requirements shall apply to all storm drainage facilities in existing and proposed public right-of-way, public drainage easements, and tracts of common ownership in the City. Storm drainage systems include, but are not limited to inlets, pipes, ditches, creeks, rivers, wetlands, and storm water quality and quantity facilities.

The City enforces CWS standards as written unless otherwise noted herein. Two CWS standards that the City enforces vigorously are as follows.

1. “Variance from the established line and grade shall not be greater than 1/32-inch per inch of pipe diameter and shall not exceed ½-inch, providing that such variation does not result in a level or reverse-sloping invert.”
2. “All pipe for side sewers shall be white in color.”

The City has adopted CWS standards with the following amendments

- A. All steps within structures must comply with OSHA standards for fixed metal individual rung ladders (OAR 437) and CWS, except that there shall be no more than 24 inches between the top of the casting and the rung of the top step, not 27 inches as CWS requires.
- B. Manhole components shall conform to the following requirements:
 1. One 2-inch concrete grade ring conforming to CWS requirements shall be installed on every new manhole.
 2. No more than one 2-inch grade ring shall be used per manhole, except that on pavement overlays, up to eight (8) inches of grade rings may be used for adjusting the elevation of each manhole’s castings.
 3. Manhole castings (frames and covers) shall conform to CWS requirements, including but not limited to, the following. “Casting shall be tough, close-grained gray iron, smooth and clean, free from blisters, blowholes, and defects, and conform to ASTM A48, Class 30. Covers shall be true and set within the ring [frame] at all points. To ensure flat, true [bearing] surfaces *that attain a true bearing all around*, all bearing surfaces shall be planed, [machined] or ground” by the manufacturer prior to delivery to the jobsite. Each casting shall be delivered to the jobsite with a packing slip or other document provided by the manufacturer or vendor stating that the casting has been manufactured in conformance with these specifications and that the warranty for the casting warrants that the bearing surfaces meet these specifications. Castings shall not make any noise whatsoever when exposed to traffic.
 4. Paving rings are not allowed without the City Engineer’s written approval except on overlay projects.
 5. Adjustment of manhole castings shall conform to the City’s Standard Drawing for same.
- C. The City does not allow outside drop manholes in new sewer lines. All enclosed inside drops, pollution control, and flow control manholes shall be constructed with pipe or structural partition. No fiberglass or plastic panel partitions will be allowed. Water quality vaults with a minimum horizontal dimension of five feet by seven and one-half feet may have a partition as specifically approved by the City Engineer on a case-by-case basis.
- D. All inside drop manholes, pollution control, and flow control manholes must be 60-inch or larger diameter structures or equivalently sized rectangular structures approved by the City Engineer.

- E. All pipes shall be installed with watertight joints.
- F. All non-ferrous pipe for side storm sewers shall be laid with magnetic tape per CWS standards.
- G. All backfill material shall be specified by referencing the *Oregon Standard Specifications for Construction* and *Oregon Standard Drawings*.
- H. No private storm drain shall be located within any lot other than the lot which is the site of the building or structure served by such sewer. The exception to this will be common areas in planned unit developments, and/or City rights-of-way, or as otherwise approved by the City Engineer.
- I. Signs identifying permanent surface water quality and quantity facilities shall conform to CWS standards, except that the City of Beaverton logo shall be placed on the sign instead of the CWS Surface Water Management logo.
- J. All intersections, changes in direction and changes in pipe cross-sectional dimensions of public lines shall have an access structure approved by the City Engineer.
- K. No change of pipe materials permitted unless specifically approved by the City Engineer on a project-specific basis. Approved changes in pipe materials on main lines shall occur only at access structures.
- L. Manhole barrels that are less than 36-inches high from top of manhole cover to top of pipe shall be constructed using short cones (or “shorty” cones) rather than “flat-tops” unless otherwise specified by the City Engineer. Short cones shall be as manufactured by Cascade Concrete Products, Inc., Scappoose, Oregon, or Hanson Pipe and Products, Portland, Oregon. (Other manufacturers’ short cones may be approved by the City Engineer as a Design Modification if, in the judgment of the City Engineer, the manufacturer has submitted sufficient structural calculations demonstrating that their short cone meets all City requirements.) Flat-tops may only be used in the construction of shallow manholes that are less than 20-inches high from top of manhole cover to top of pipe (i.e., in cases where the shortest available approved short cone would be too high). The use of a flat-top in such cases requires the express prior approval of the City Engineer as a Design Modification pursuant to Section 145. The structural design of flat-tops shall conform to CWS standards, except that the CWS “optional rubber gasket flat top” is not approved by the City.
- M. All manholes, including 60-inch and larger oversized manholes (manholes with diameters greater than 48-inches), shall have tongue and groove or key lock joints with flush exterior walls at the joints. Bell and spigot pipe with the outside diameter of the bells larger than the outside diameter of the pipe is not acceptable. This precludes the use of Clean Water

Services' (CWS) standard drawing No. 030 "Precast Rubber Gasket Manhole" in CWS's "Design and Construction Standards for Sanitary Sewer and Surface Water Management." The manhole joints shown in this standard drawing are not approved for use in the City of Beaverton.

- N. Pipe manufacturers supplying oversized manholes (manholes with diameters greater than 48-inches) in the City of Beaverton shall use the wet pour pre-cast process for the manufacture of flush-walled manhole joints. During the wet pour process, the manufacturer shall provide block-out openings in the walls of the manholes for pipe penetrations. Each such opening shall be provided with additional steel reinforcement around it where required to meet ASTM standards for manholes.
- O. All manhole joints shall be grouted with "Tams Speedcrete Redline" non-shrink grout or "Allcrete" non-shrink grout. Contractor shall not re-temper grout after initial mixing. Any re-tempered grout shall be rejected.
- P. Contrary to ASTM Standard Specification No. C 478, Section 9, the City of Beaverton does not allow the repair of manhole products used in new manholes, except that the City may allow a repair on a project-specific basis where the City finds that there are sufficient extenuating circumstances, a repair method acceptable to the City is proposed, and sufficient additional maintenance securities are submitted to the City before the repair(s) is/are made. Any manhole products exhibiting imperfections in manufacture, damage during handling or other damage shall be rejected, except in the following cases:
 - 1. The City Engineer may approve a repair of a new manhole if the applicant submits a Request for Design Modification detailing the extent of the defect or damage, the method of repair and all other documentation required by section 145 of the Manual and the City Engineer, the repair is made in accordance with the repair method that the City Engineer has approved previously, and the repair passes all tests required by the City.
 - 2. The City Engineer may allow the repair of a manhole with a pre-cast opening for a pipe penetration that becomes unnecessary or is incorrectly located if the repair is performed by the manufacturer pursuant to ASTM C 478, section 8.2.1.6 and passes all tests required by ASTM C 478 and the City.
 - 3. Generally, the City Engineer will only approve Requests for Design Modifications for field repairs if the repairs are very minor and do not affect the structural integrity of the manhole. Manhole products that are field-repaired and do not pass the tests referenced above shall be rejected. Rejected repairs may be corrected no more than three (3) times, after which the City Engineer may require that the unsatisfactorily repaired product or products be replaced by a new, defect-free product or products meeting all City requirements, and at no cost to the City. Field repairs made without the City Engineer's prior approval shall be rejected without exception.

4. Manhole channels constructed with insufficient depth shall be repaired only by removing the defective channel completely and re-pouring the channel to the correct depth in accordance with CWS standards. Adding a layer of non-shrink grout to the top of the manhole floor to increase the channel's depth is not acceptable.
- Q. Storm water structures employing proprietary water quality equipment within the structure shall be drawn to scale. The equipment's manufacturer, model number, outside dimensions, "in" and "out" pipe sizes, materials, invert elevations and method(s) of attachment, shall be clearly noted in the drawings. The minimum clearance between any equipment, supports, or connections that requires side access for maintenance, repair or replacement and any interior wall shall be twenty-seven (27) inches except for removable filter-cartridge canister installations.
 - R. Non-shrink grout used in storm water structures shall be "Tams Speedcrete Redline" non-shrink grout or "Allcrete" non-shrink grout. Contractor shall not re-temper grout after initial mixing. Any re-tempered grout shall be rejected.
 - S. Type CG-2 catch basins may be used as access structures, but in no case shall two (2) consecutive catch basins on a storm sewer line be used as access structures.
 - T. Unless expressly approved by the City Engineer, no repair sleeves shall be installed on new lines.
 - U. No manhole shall be placed where future maintenance access cannot be assured. Where practical, a hard all-weather surface capable of supporting an 80,000-pound vehicle in all weather conditions shall be constructed to provide access to manholes in common areas or parks. Maintenance accesses shall conform to the following requirements:
 1. The hard, all-weather surface shall meet the following minimum criteria:
 - a. Three (3) inches of class "C" asphaltic concrete; over two (2) inches of $\frac{3}{4}$ inch - 0 inch compacted crushed rock; over six (6) inches of 1½ inch - 0 inch compacted crushed rock; over subgrade compacted to 95-percent AASHTO T-99; or,
 - b. The design engineer may submit a certified road design capable of supporting an 80,000-pound vehicle in all weather conditions.
 2. The access shall include strengthened sidewalk sections designed for driveway crossings per the Standard Drawings for sidewalks where maintenance vehicles will cross.

3. Maximum grade shall be ten (10) percent with a maximum three (3) percent cross slope. All turn-arounds and landings shall have a maximum slope of five (5) percent in any direction.
 4. The minimum pavement width shall be 12 feet on straight runs and 15 feet on curves. Curves shall be designed with a minimum of a 40-foot interior radius.
 5. The access shall be designed with approved grading and drainage to protect the access and adjacent land from erosion and flooding from concentrated and diverted surface drainage.
- V. To the extent commercially reasonable and practicable, catch basins in private roads or streets serving residential lots shall only be of the type approved by the City for public streets and for the specific conditions of service. (Catch basins of the type approved for private drainage systems are discouraged by the City in residential subdivisions because they require frequent maintenance, which often becomes an onerous burden on the lot owners served by the private streets.) Private-type catch basins shall be used only within residential subdivisions as expressly directed by the City Engineer. An engineer desiring to include a private-type catch basin in a private road or street design within a residential subdivision shall submit to the City Engineer a written request for approval accompanied by cost data, technical information, references, and documentation in support of the request. The requirements of this paragraph shall not in any way obligate the City to maintain catch basins connected to private drainage systems, regardless of catch basin type, whether approved by the City Engineer or not.
- W. Prior to acceptance, all new public storm sewer lines shall be thoroughly cleaned, mandrelled and TV scanned in accordance with the City's requirements for such work. Such work shall be performed prior to paving over said lines and again a second time during the maintenance period or as directed by the City Engineer.

315 STORMWATER DESIGN ELEMENTS

315.1 Maintenance Vehicle (City's Vector Truck) Access Requirements for Publicly Maintained Storm Water Quality/Quantity Facilities and Structures

All structures that provide an element of flow control or changes in direction exceeding 30 degrees shall be required to have an approved vehicular access.

- A. The design criteria in subsection 310.O. shall be used for vehicular access design.
- B. In addition to the criteria in subsection 310.O., access for the City maintenance vehicle (the City's vector truck) shall be within five (5) feet from the front of the vehicle to the structure or within 15 feet from the side of the vehicle as measured from the midpoint of the vehicle.

- C. In the event private property exists between the public right-of-way and the stormwater facilities (located in tract and in some limited cases, an easement), a public access easement between these two points shall be provided. This access easement shall be a minimum of 20 feet wide.

315.2 Geometry and Other Requirements for Publicly Maintained Open Stormwater Quality/Quantity Facilities (Pond)

- A. Any slope in the tract/easement area of a publicly maintained stormwater facility shall be no steeper than 3:1, however, a direct route from the gate(s) to the structures in the pond area shall be no steeper than 4:1. This direct route shall be a minimum of four (4) feet wide and have a paved or unpaved surface consisting of the equivalent of three (3) inches (compacted) of $\frac{3}{4}$ inch-minus crushed rock (to allow walking access in winter), and adjacent vegetation shall not prevent or impair access. This direct access route shall be delineated on the plans.
- B. Retaining walls may serve as pond walls outside of the water quality treatment area if the design is prepared and stamped by a registered professional engineer and a fence is provided along the top of any wall with an exposed face of greater than 18 inches (to provide fall protection). At least 25 percent of the pond perimeter will be vegetated to a maximum side slope of 4:1 for publicly maintained stormwater ponds.

Retaining walls shall not be allowed on more than half the parameter of the facility nor shall any walls be greater in height than six (6) feet (foundation base bottom to top) within 20 feet of a treatment and detention area. Additionally, the landscape plans for the facility shall be prepared with provisions considering sun/shade conditions. Retaining walls or solid fences with a northern exposure of greater than four (4) feet shall not be directly adjacent to the treatment and detention area.

- C. Over-excavate by a minimum of 20 percent of the water quality volume below the lowest stormwater release structure control elevation so as to allow for sediment deposition.
- D. A landscape architect prepared plan for topsoil preparation and vegetation planting is required. The landscape architect shall show on the plans the depth and placement method of topsoil in order to ensure healthy growth of vegetation shown on the landscape plans. Topsoil will be placed on all areas within the stormwater quality/quantity facilities tract/easement area with the exception of the vehicle maintenance accessways. Appropriate soil amendments (compost) shall be incorporated into the topsoil. The use of topsoil generated from the on-site grading that is relatively weed free will be allowed. Refer to CWS's *Design and Construction Standards* for guidance on the vegetation planting.

- E. Vegetated swales of a serpentine configuration or with artificially created switchbacks shall not be allowed within storm water detention ponds or other areas that may accumulate sediment, blow out, or short-circuit over time. Surface water quality swales shall be designed and constructed in a linear configuration with an accumulative change in direction no greater than 135 degrees from a line tangent to the flow at the upper end of the swale to the bottom of the treatment length.

316 PARKING LOT DETENTION PONDS

- A. This section applies to parking lot detention ponds that occupy all, or parts of, the paved or landscaped areas of a parking lot, or a combination thereof.
- B. Applicants are advised to refer to Chapter II for related requirements pertaining to parking lots and their driveways, because those requirements may affect the design of the parking lot detention pond.
- C. A person requesting the City's consideration of an on-site parking lot storm water detention pond as an alternative to other methods of storm water detention storage shall submit to the City Engineer a written application for a section 145 Design Modification containing the information required by that section, for preliminary approval of the general concept described in the application. However, for the applicant's initial request for City consideration of parking lot detention storage, the City does not require submittal of the formal application form typically required for such requests, which is entitled "Request for a Modification of the Engineering Design Manual." If an applicant wishes to use the formal application form, copies are available in hard copy at the City's Engineering Department or online from the Engineering Department's webpage at the City's Internet website. Otherwise, the applicant may use any application format s/he prefers. In any case the request shall be well organized and reasonably clear and shall contain at least the information required by section 145 of the Manual. In addition, the request shall be accompanied by preliminary construction plans containing a site plan, a grading plan, and a plan showing the approximate area of the proposed detention ponding in plan view, subject to completion of the final grading plan.

If the general concept is given preliminary, conceptual approval by the City Engineer, the applicant shall submit a completed formal Request for Design Modification form, supporting information, and construction plans to the City for review in accordance with section 145 of the Manual. Three (3) copies of the completed formal request form, supporting information, and the construction plans shall be submitted in hard copy form to the City Engineer for review. The City Engineer may require additional information for clarification purposes. If the application is incomplete, the City Engineer shall return it to the applicant with comments indicating the parts of the application that must be completed. Once the City Engineer deems the application to be complete, s/he may approve the design of the detention pond, approve the design of it with conditions, or deny

the application. If the City Engineer denies the application, s/he shall notify the applicant in writing within a reasonable time and explain the reason(s) for denying the application.

D. When a parking lot storm water detention pond is authorized by the City Engineer, the following standards shall apply:

1. Maximum depth of standing water in all parking lot detention ponds shall not exceed six (6) inches. An unrestricted catch basin, approved overflow device, approved overflow conveyance route or other approved means shall be provided to ensure the maximum pond depth is not exceeded.
2. No more than fifty (50) percent of the area of any parking lot on a property shall be designed to be inundated by detention ponding.
3. When any part of a landscaped area of a parking lot is within a detention pond area, the landscaped area shall be surfaced with lawn grass, bricks, asphalt concrete, stone or concrete pavers or other hard, durable surfacing, or a combination thereof. Trash cans, bark products, trees, shrubs, and plants (other than lawn grass) are not allowed in parking lot detention pond areas. To prevent debris from plugging detention pond drains, the landscaped areas shall be properly and regularly maintained, and shall be kept free of lawn cuttings, trash, and other loose debris at all times.
4. No parking lot detention pond shall be located within the primary ingress/egress portions of a site. Parking lot detention ponds shall be designed so that, at maximum water level for the design storm, a minimum twenty (20) foot wide emergency vehicle lane to the buildings will remain unflooded, including during storm drainage system overflow conditions.
5. No more than thirty (30) percent of the area of any parking stall shall be within a parking lot detention pond area except as otherwise required by subsections 6. and 7. below.
6. No parking lot detention pond shall obstruct pedestrian access to vehicles, buildings or other improvements or areas served by the parking lot.
7. No part of a parking lot detention pond area shall be located within any parking stall, access aisle or accessible route provided for persons with disabilities.
8. In areas of parking lots designed for vehicular traffic, the detention pond areas may not slope less than one (1) percent or more than five (5) percent.
9. All parking lot detention ponds shall be designed and constructed in such a manner so as to provide a maximum water surface elevation 0.25 feet lower than any and all structures designed to contain the pond (i.e., a 0.25-foot freeboard shall be provided.)

10. Where curbing is used to contain a parking lot detention pond, extruded curbing shall not be used. A standard "Type A Replacement Curb," as shown in the Standard Drawings, shall be used.
11. No parking lot detention pond shall have a maximum or overflow water surface elevation that is higher than one (1) foot below the lowest habitable floor elevation of buildings within the proximity of the pond. Under no circumstance shall detention ponds or related storm water facilities be designed in such a manner that system failure would cause flooding in any habitable building area or compromise the structural integrity of the foundation of a habitable building.
12. No parking lot detention pond shall be designed to occupy any part of a parking lot under a building. Whenever the possibility of flooding an underground parking facility or other uninhabited building area exists, care shall be taken to floodproof electrical equipment areas and other building appurtenances with overflow and/or private pump systems being provided to drain such a flooded facility.
13. All construction plans relating to parking lot detention pond areas shall include a note stating that "Grading is critical to proper functioning of the detention system, and grades for detention pond areas shown on the plan(s) must be strictly followed."
14. The design volumes of parking lot detention ponds shall be shown on the plans and, prior to paving, all detention pond areas shall be inspected for consistency with the design volumes. The Design Engineer or Architect shall certify that the design pond volume(s) has/have been properly constructed in full accordance with the plans.
15. In addition to meeting the requirements above, those areas of parking lots serving as detention ponds shall meet all other requirements of this manual.

320 TELEVISION SCANS

The City will scan all new public storm pipes and all existing sections of pipe that are disturbed or affected by new construction. Prior to requesting a television scan, the contractor shall flush, clean, and remove all debris from the system.

330 STORMWATER QUANTITY STANDARDS

All development on sites one-half (0.5) acre or greater in area shall be required to provide on-site detention. Sites smaller than 0.5 acre that are in an area where undetained flows would cause a negative downstream impact shall be required to provide on-site detention. For sites smaller than one-half acre in area or where storm detention would have an adverse affect upon the receiving storm drainage system, as determined by the City Engineer, a system development charge will be assessed in lieu of a constructed facility.

Storm detention facilities shall be designed to provide storage using a 25-year event, with the safe overflow conveyance of the 100-year storm. Calculations of site discharge for both the existing and proposed conditions shall be checked using the King County Hydrograph V4.20. Storms to be evaluated shall include the 2, 10, 25, and 100-year events. Allowable post-development discharge rate for the 2, 10, and 25-year events shall be that of the pre-development discharge rate, with a maximum allowable release rate of one half (0.5) cubic feet per second per acre in the 25-year event. Should the downstream analysis, as outlined in the *CWS Design and Construction Standards* identify a downstream deficiency, then the detention requirement will be either increased to cause no net increase to that deficiency or the deficiency shall be corrected at which time the standard detention requirement shall apply. An outfall structure such as a "Vee-Notch" weir or multiple orifice structure shall be designed to control the release rate for the above events. No flow control orifice for the 25-year event shall be smaller than 2.5 inches. If the allowable release rate cannot be met with all the site drainage controlled by a single 2.5-inch orifice, the allowable release rate provided by a 2.5-inch orifice will be considered adequate at the discretion of the City Engineer.

When using the King County Hydrograph V4.20, use the following precipitation depths for the 24-hour storm:

<u>Event</u>	<u>Intensity</u>
2 year	2.5 inches
10 year	3.5 inches
25 year	4.0 inches
100 year	4.5 inches

340 STORMWATER QUALITY STANDARDS

The minimum standards for the design and construction of storm water quality facilities in the City of Beaverton shall be the same as the current standards of CWS.

If a fence is required to be provided, in addition to the standard CWS requirements, it shall be brown vinyl clad chain link (unless otherwise approved by the City Engineer) with a top bar added.

350 DRAINAGE REPORTS

Drainage reports shall document the final design and shall include adequate documentation and summary sheets to allow City staff to easily follow the assumptions, calculations, and conclusions. The use of a flowchart type graphic shall be provided as part of the drainage report, this graphic will communicate pertinent details for the stormwater quality and quantity control facilities such as, but not limited to, stage/storage/discharge, references to posts of hydrographs, flow control structure elevations, drainage areas, etc. In addition, a sketch of the flow control structure and the relevant elevations shall be included in the calculations. The

elevations shall include the pre and post development 2, 10, 25, and 100-year events, the rim, and the invert elevations of the structure(s) and pipes.

The report shall clearly show any drainage basin that is being proposed to be forced into another basin along with a justification (the City Engineer may at his discretion deny any request to force a basin). All forced basins shall be fully detained through the 100-year event as measured relative to the pre-developed condition to the receiving basin.

360 PUBLICLY MAINTAINED PONDS, SWALES, AND OTHER VEGETATED AREAS

360.1 Topsoil

- A. Topsoil shall be compacted at 90 percent of an AASHTO T-99.
- B. Topsoils shall be placed to a minimum depth of twice the rootball of shrubs and/or trees, or 24 inches, whichever is greater. Care should be taken to prevent pockets of standing water due to poor drainage where clay material is excavated in a pocket. Where grass is proposed, the minimum depth of the topsoil shall be 12 inches. The bottom 12 inches of topsoil shall be tilled into the soil below.
- C. Topsoil shall have an adequate percentage of humus material and shall have adequate properties to promote growth.
- D. Topsoil shall be free of weeds, large roots, and large rocks.