Division 3

Stormwater Management

DIVISION 3
STORMWATER MANAGEMENT

3.1 PURPOSE

a. In addition to the purposes outlined under Division 1 of these Design Standards, the purpose of these Standards is to ensure the development of a stormwater management system which will:

1) be of adequate design to safely manage all volumes of water generated upstream and on the site to an approved point of disposal;

2) provide points of disposal for stormwater generated by existing upstream properties and future upstream developments;

3) prevent the uncontrolled or irresponsible discharge of stormwater onto adjoining public or private property;

4) prevent the capacity of downstream channels and storm drainage facilities from being exceeded, unless downstream improvements to increase capacity are provided as part of the project;

5) have sufficient structural strength to resist erosion and all external loads which may be imposed;

6) maximize the use of the City's natural drainage system;

7) be designed in a manner to allow economical future maintenance;

8) require the use of design and materials to provide a system with a minimum practical design life of not less than 50 years.

9) shall not negatively impact existing water quality.

Alternate materials and methods will be considered for approval on the basis of these objectives.

b. These Standards cannot provide for all situations. They are intended to assist but not to substitute for competent work by professional design engineers.

3.2 APPLICABILITY

a. These Standards shall govern all construction and upgrading of all public and private drainage and associated facilities in the City of Independence and applicable work within the City's service areas. This standard shall apply to all drainage facilities which impact any public storm drain system, public right-of-way or easement dedicated to or located within the City of Independence and within all off-street

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parking and loading areas.

b. All storm water runoff shall be conveyed to a public storm drain or natural drainage channel having adequate capacity to carry the flow without overflowing or otherwise causing damage to public and private property. In the case of private development, the developer shall pay all costs associated with designing and constructing the facilities necessary to meet this requirement.

c. Permanent storm drain facilities shall be provided to serve all properties within the City of Independence in accordance with these Standards. This shall generally be interpreted to mean that permanent storm drainage facilities shall be provided for the following types of development:

1) Existing legal lots of record at the time development occurs;

2) All partitions and subdivisions;

3) Developments entailing construction which will change the point of discharge of surface waters, the quantity of discharge, or will discharge water at a higher velocity than that of the preconstruction discharge rate.

4) Construction or reconstruction of public or private streets and temporary detours;

5) Developments entailing construction in or adjacent to any existing stream or watercourse including intermittent streams.

3.3 SPECIAL ITEMS

a. The design of the following are considered special items and are not covered in detail in these Standards:

1) Stormwater Pump Stations and Force Mains
2) Siphons
3) Water Quality Facilities
4) Energy Dissipators
5) Flow Measurement Devices
6) Bore Crossings
7) Concrete Box Culverts *(where standard culverts are not feasible)*

b. Review and approval of the above special items by the City Engineer and the Public Works Director shall be required. When requested by the City, full design calculations shall be submitted for review prior to approval.

3.4 APPROVAL OF ALTERNATE MATERIALS AND METHODS

a. Any alternate material or method not explicitly approved herein will be considered

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for approval on the basis of the objectives set forth in Paragraph 3.1, Purpose. Persons seeking such approval shall make application in writing to the City Engineer and Public Works Director. Approval of any major deviation from these Standards shall be in written form. Approval of minor matters will be made in writing, if requested. Any and all such requests shall be submitted in writing to the Public Works Director prior to City approval of the design drawings.

b. Any alternate must meet or exceed the minimum requirements set forth in these Design Standards *(also see "equal" & "substitute" definitions under PWDS 1.4)*.

c. The written application is to include, but is not limited to, the manufacturer's specifications and testing results, design drawings, calculations and other pertinent information.

d. Any deviations or special problems shall be reviewed on a case-by-case basis and approved by the City Engineer and the Public Works Director. When requested by the City, full design calculations shall be submitted for review with the request for approval.

3.5 CONSTRUCTION DRAWINGS

a. Construction drawings shall conform to the requirements of Division 1 of these Design Standards.

b. Detail drawings shall be included on the construction drawings for all storm drain appurtenances including but not limited to manholes, catch basins, junction boxes, ditch inlets, service lateral connections, outlet structures, riprap outlets, detention facilities, water quality features, rain gardens, etc.

3.6 STANDARD DETAILS

a. Standard details included in the Appendix are supplemental to the text of these design standards and show the City's minimum requirements for the construction of certain standard system components.

b. In the case of conflicts between the text of these design standards and the standard details, the more stringent as determined by the City Engineer and Public Works Director shall apply.

c. As required by Division 1 of these standards, all applicable standard details shall be included on the construction drawings. Details shall be placed in numerical order on the detail sheets, for ease of reference during construction.

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3.7 DEFINITIONS AND TERMS

a. In addition to the definitions contained in Division 1 of these Standards, the following definitions may apply particularly to stormwater systems. Unless otherwise defined in these Design Standards, the following definitions and abbreviations shall apply whenever used. Other definitions as outlined in the Oregon Plumbing Specialty Code (OPSC) shall also apply.

1) Abbreviations: Acceptable abbreviations for showing types of new and existing pipe materials and facilities on the plans are as follows:

a) AC - Asbestos Cement
b) CAP - Corrugated Aluminum Pipe
c) CI - Cast Iron
d) CHDPE - Corrugated High Density Polyethylene
e) CMP - Corrugated Metal Pipe (Aluminum)
f) CP - Non-reinforced Concrete Pipe
g) DI - Ductile Iron
h) HDPE - High Density Polyethylene
i) PVC - Polyvinyl Chloride
j) RCP - Reinforced Concrete Pipe

2) Building Drain: The building drain is that part of the lowest piping of the drainage system which receives the discharge from stormwater drainage pipes inside or within 5 feet of the outside walls of the building and conveys it to the building sewer, which begins five (5) feet outside the building wall or building foundation.

3) Building Storm Drain: That part of the piping of a stormwater drainage system which begins at the connection to the building drain and conveys stormwater to an approved point of disposal.

4) Catch Basin: An approved receptacle designed to receive surface drainage and direct it to a stormwater collection system.

5) Creek: Any and all surface water generally consisting of a channel having a bed, banks, and/or sides in which surface waters flow to drain higher land to lower land, both perennial and intermittent, excluding flows which do not persist for more than 24-hours after the cessation of ½-inch of rainfall in a 24-hour period from October through March.

6) Detention: The holding of runoff for a short period of time while releasing it to the downstream drainage system at a controlled rate.

7) Drainage Facilities/System: Pipes, ditches, detention basins, creeks, culverts, etc. used singularly or in combination with each other for the purpose of conveying or storing stormwater runoff.

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8) Impervious Areas/Surfaces: Those hard surface areas located upon real property which either prevent percolation of water into the land surface or reduce the percolation rate which existed under natural conditions prior to development. Also surfaces which cause water to run off the land surface in greater quantities or at increased flow rates than under natural conditions which existed prior to development. Common impervious surfaces include but are not limited to rooftops, driveways, parking lots or storage areas, sidewalks, patios, etc.

9) Natural Location: The location of those channels, swales, and other non-man-made drainage conveyance systems as defined by the first documented topographic contours existing for the subject property either from maps or photographs.

10) On-site Detention: The storage of excess runoff on the development site and gradual release of the stored runoff into a public storm drain system after the peak of the runoff has passed.

11) Peak Discharge: The maximum water runoff rate determined for the design storm.

12) Pre-Development Conditions. Defined as a site with natural vegetation on native soil, unless otherwise approved in writing by the City Engineer and the Public Works Director, based on the storm system having adequate remaining available downstream capacity for the site being developed *(as defined in these standards)*, based on calculations and storm system modeling provided by the developer's engineer to the satisfaction of the City.

13) Private Storm Drain: A storm drain located on private property serving parking lot catch basins or more than one structure on the same premises, and not operated or maintained by the City.

14) Public Storm Drain: Any storm drain in a public right-of-way or easement operated or maintained by the City.

15) Receiving Body of Water: Creeks, streams, lakes, and other bodies of water into which runoff is naturally or artificially directed.

16) Release Rate: The controlled rate of release of drainage and runoff water from property, storage ponds, detention basins, or other facility during and following a storm event.

17) Remaining Available Downstream Capacity. See description/definition under "Detention Facilities" section of these standards.

18) Retention Facility: Facilities which hold water for a considerable length of time and then consume it by evaporation, plant transpiration, or infiltration into the soil.

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19) Sedimentation: Deposition of erosional debris and soil sediment displace by erosion and transported by water from a higher elevation to an area of lower gradient where sediments are deposited as a result of slack water.

20) Terrace: A relatively level step constructed in the face of a slope for drainage, erosion control and maintenance purposes.

21) Trunk Drainage System: That portion of the drainage system which receives waters from upstream land areas in excess of 20 acres, or with pipe diameters of 18-inches or larger. The drainage system may consist of watercourses or man-made facilities such as pipes, ditches, and culverts.

22) Wetlands: As defined by the Division of State Lands and the US Army Corps of Engineers.

3.8 MATERIALS

a. General

1) Unless otherwise approved by the City Engineer, materials shall conform to the minimum requirements outlined herein and as shown on the Standard Details. This listing is not intended to be complete nor designed to replace the City's Public Works Construction Standards (PWCS).

2) In the case of conflicts between the provisions of these design standards and the PWCS, the more stringent as determined by the City Engineer and Public Works Director shall apply. Acceptable materials shall be as outlined in these Design Standards.

3) It is not intended that materials listed herein are to be considered acceptable for all applications. The design engineer shall determine the materials suitable for the project to the satisfaction of the City Engineer.

4) Granular backfill shall be ¾"-0 conforming to OSSC (ODOT/APWA) 02630.10 *(Dense Graded Base Aggregate)*, with no more than 10% passing the #40 sieve and no more than 5% passing the #200 sieve.

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b. **Pipe Type By Cover Depth**: Unless otherwise approved by the City Engineer, storm drain pipe materials shall conform to the table below. Uniform pipe material shall be used on each pipe run between structures. Special requirements for use of jointed HDPE pipe for slopes exceeding 6% for or cover depths greater than 10 feet are listed in the following table.

ALLOWABLE STORM DRAINAGE PIPE BASED ON COVER DEPTH	
↓ COVER DEPTH ↓ *(from finish grade)*	**10" – 18" DIAMETER**
Less than 1½' Cover	Class 50 Ductile iron pipe with bell & spigot joints and rubber gaskets.
1½' to 2½' Cover	Pipe specified for lesser depths **-OR-** Class 3, ASTM C-14 non-reinforced concrete pipe with bell & spigot joints and rubber gaskets. **-OR-** PVC pipe conforming to AWWA C900 PVC DR 18 with bell and spigot gasketed joints.
2½' to 10' Cover	Pipe specified for lesser depths **-OR-** PVC pipe conforming to ASTM D-3034 solid wall PVC SDR 35 (6"-15") or ASTM F-679 PVC solid wall SDR 35 (18") with bell and spigot joints and rubber gasket **-OR-** HDPE *(High Density Polyethylene)* pipe conforming to AASHTO M-252 (8"-10") or AASHTO M-294 (12"-18"). For slopes less than 6% the pipe shall be ADS N-12 IB ST, Hancor Sure-Lok F477, or approved equal. For slopes greater than 6% the pipe shall be ADS N-12 IB WT, Hancor Blue Seal, or approved equal with watertight pressure testable fittings.
More than 10' Cover	Case by case basis.
↓ COVER DEPTH ↓ (from finish grade)	**21" – 30" DIAMETER**
Less than 1½' Cover	Class 50 Ductile iron pipe with bell & spigot joints and rubber gaskets.
1½' to 2½' Cover	Pipe specified for lesser depths **-OR-** Class IV *(minimum)*, ASTM C-76 reinforced concrete pipe with bell & spigot joints and rubber gaskets **-OR-** PVC pipe conforming to AWWA C900 PVC DR 18 with bell and spigot gasketed joints.
2½' to 10' Cover	Pipe specified for lesser depths **-OR-** ASTM F-679 PVC solid wall SDR 35 pipe with bell and spigot joints and rubber gasket **-OR-** HDPE *(High Density Polyethylene)* pipe conforming to AASHTO M-294. For slopes less than 6% the pipe shall be ADS N-12 IB ST, Hancor Sure-Lok F477, or approved equal. For slopes greater than 6% the pipe shall be ADS N-12 IB WT, Hancor Blue Seal, or approved equal with watertight pressure testable fittings.
More than 10' Cover	Case by case basis.
GREATER THAN 30" DIAMETER, OTHER PIPE MATERIALS - Case by case basis.	
Driveway Culverts or Open Storm Inlets: Pipe type based on cover depth, minimum size 12-inch diameter *(or size based on flow capacity, adjacent existing street crossing or storm drain size, whichever is greater).* **Pipe End Protection**: PVC or HDPE pipe is not allowed for culverts or for exposed inlets/outfalls without structures unless concrete end caps are provided *(6" min thickness, typically 12" larger than pipe OD unless larger size required by Public Works Director).* **Detention Systems**. Piping associated with detention systems *(ie. including detention pipe where applicable, piping between the detention basin & the flow control manhole, overflow piping, etc.)* shall conform with the minimum requirements of this table. This pipe material table also does not apply to other private storm piping which fully complies with the material and slope requirements of the Oregon Plumbing Specialty Code (OPSC).	

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c. **Storm Drain Pipe**

1) **Ductile Iron**

a) Ductile iron storm pipe shall be Class 50 pipe conforming to AWWA C-151, and cement-mortar lined and seal coated in accordance with AWWA C-104.

2) **Non-Reinforced Concrete Pipe (CP)**

a) Non-reinforced concrete pipe and specials shall conform to AASHTO M86 (ASTM C-14), Class 3 minimum.

b) Joints shall be bell and spigot with an O-ring as specified or shown on the drawings and conforming to the following:

(1) Bell and Spigot joints shall be sealed with flexible watertight gaskets meeting or exceeding all requirements of Federal Specifications SS-S-06210 (GSA, FSS Washington, DC) "Sealing Compounds, Preformed Plastic for Pipe Joints," type 1 Ropeform. Such gaskets may be RAMNEK as manufactured by K.T. Snyder Co., Inc., of Houston, Texas; KENTSEAL No. 2 Joint Sealant as manufactured by Hamilton Kent Mfg., Co., of Kent, Ohio, or approved equal.

(2) O-Ring joints shall conform to ASTM C-443. The gaskets shall conform to material requirements of ASTM C-361.

3) **Reinforced Concrete Pipe (RCP)**

a) Reinforced concrete pipe shall meet the requirements of AASHTO M170 (ASTM C-76) Class IV minimum.

b) Joints shall be O-ring type in conformance with non-reinforced concrete pipe joint and gasket specifications above.

4) **PVC Pipe**

a) Pipe and fittings shall conform to ASTM D-3034, SDR 35 or ASTM F 679, SDR 35 as outlined above.

b) Pipe shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM classification.

c) The joints shall conform to ASTM D-3212, Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

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5) **High Density Polyethylene Pipe (HDPE)**

a) Pipe and fittings shall have integrally formed smooth interior pipe surface.

b) Pipe and fittings shall conform to the requirements as listed in the table above.

c) HDPE *(High Density Polyethylene)* pipe conforming to AASHTO M-252 (8"-10") or AASHTO M-294 (≥12"). For slopes less than 6% the pipe shall be ADS N-12 IB ST, Hancor Sure-Lok F477, or approved equal. For slopes greater than 6% the pipe shall be ADS N-12 IB WT, Hancor Blue Seal, or approved equal with watertight pressure testable fittings.

d. **Joints**

1) Except as otherwise specified, joints for pipe shall be watertight joints using elastomeric ring gaskets. The gaskets shall be securely fixed into place so that they cannot be dislodged during joint assembly.

2) The gaskets shall be of a composition and texture which is resistant to common ingredients of drainage, including oils and groundwater, and which will endure permanently under the conditions of the proposed use.

e. **Pipe Accessories**

1) Fittings shall be of the same material as the pipe, molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations as required.

2) Manufactured fittings shall be used for all connections to existing or new storm drains.

f. **Catch Basins**

1) Catch basin construction and dimensions shall conform to the Standard Details. Side inlet grated catch basins shall be required.

2) Catch basin frame and grate shall conform to standard details, and shall be fabricated of structural steel, ASTM A-7, A-36 or A-273.

3) Solid lids on junction boxes shall be minimum 3/4-inch steel plate, and shall be provided with at least one lifting hole. Junction boxes located in a travel lane shall have a manhole frame and cover.

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g. **Manholes**

1) Except as modified herein, precast concrete pipe manhole sections, transition sections, eccentric cones, flat slab tops, and adjusting rings shall conform to the requirements outlined under Division 4, Sanitary Sewers and as shown in the standard details.

2) Storm manholes shall be equipped with permanent factory installed steps to provide a continuous ladder of 12-inch center-to-center rung spacing. Steps shall be same as specified for sanitary sewer manholes. Steps shall not be required for manholes 4 feet or less in depth *(rim to invert)*.

3) Manhole castings for storm manholes shall have 16-hole lids.

4) Unless otherwise required by the Public Works Director, connections to existing storm manholes shall comply with the requirements for manhole taps on sanitary sewer manholes, as outlined under Division 4, Sanitary Sewers and as shown in the standard details *(except for vacuum testing requirement)*.

5) Pollution/Flow Control Manholes

a) Unless otherwise required by the Public Works Director, pollution/flow control manholes shall be provided with a 24-inch diameter casting and lid, with a separate access hole over the orifice.

h. **Mainline Storm Cleanouts**

1) Except as modified herein, mainline storm cleanouts *(where approved by the City)* shall conform to the requirements outlined under Division 4, Sanitary Sewers and as shown in the standard details.

2) A 3500 psi concrete collar is required for cleanouts located outside of paved areas. The shaft or chimney of the cleanout shall be a minimum of 8-inches in diameter.

i. **Concrete (Cast-in-Place)**

1) All concrete shall conform to the requirements of OSSC (ODOT/APWA) 00440, Commercial Grade Concrete, 3500 psi min @ 28 days, max 5" slump, 4.5% air (±1.5%).

j. **Underground Warning Tape**

1) Warning tape shall conform with the requirements noted on the standard details and standard construction notes *(6-inch width, green color & "Caution: Buried Storm Line Below" or approved equivalent printed continuously down the length of the tape)*.

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2) Underground warning tape shall be detectable or non-detectable acid and alkali resistant safety warning tape. The tape shall consist of a minimum 4.0 mil (0.004") thick, virgin low density polyethylene plastic film formulated for extended use underground. The tape shall be in accordance with the APWA national color code and shall be permanently imprinted in lead free black pigments suitable for direct burial.

k. **Toning / Tracer Wire**

1) A continuous insulated 10 gauge solid core copper toning wire shall be supplied with storm pipe *(both public & private)*. Insulation shall be green in color for storm piping.

2) Wire shall penetrate into manholes and catch basins within 18 inches of the rim elevation.

l. **Bore Casings and Accessories**

1) Carrier pipe used in bore casings shall be Ductile Iron or PVC as specified herein.

2) Bore casing and carrier pipe design and installation shall conform to the requirements outlined under Division 5, Water Distribution.

3.9 GENERAL DESIGN CONSIDERATIONS

a. **General Requirements**

1) The design of storm drainage systems shall include provisions to adequately control runoff from all public and private streets and the roof, footing, and area drains of residential, multifamily, commercial and industrial developments, and to provide for the future extension of the storm drainage system to serve the entire drainage basin.

2) Approved Point of Disposal: All storm water runoff shall be conveyed to an approved point of disposal as summarized below. In the case of private development, the developer shall pay all costs associated with designing and constructing the facilities necessary to meet this requirement.

3) Allowable Discharge: The design storm peak discharge from the subject property may not be increased from conditions existing prior to the proposed development except where it can be satisfactorily demonstrated by the applicant that there is no adverse impact to downstream properties, and that the "remaining available downstream capacity for the site being developed" *(per PWDS 3.18.b)* is not exceeded.

4) Public storm drains within easements will be permitted only upon a showing that drainage cannot be provided from within a right-of-way. Minimum

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easement widths shall be as outlined herein.

5) Gravity Flow: Where possible, all public & private storm drains shall be designed to flow by gravity to an existing or new storm drain system without lift stations.

6) Self-Cleaning. Except for pollution control or water quality structures, all storm drain system components shall be designed to be self-cleaning to the extent possible.

b. **Approved Point of Disposal**

1) Surface or subsurface drainage *(caused or affected by changing of the natural grade of the existing ground or removal of natural ground cover of placement of impervious surfaces)* shall not be allowed to flow over adjacent public or private property in a volume or location materially different from that which existed before development occurred unless written approval is first granted by the all agencies with jurisdiction and by affected property owners, and all such drainage shall be collected and conveyed in an approved manner to an approved point of disposal.

2) The approved point of disposal for all stormwater may be a storm drain, existing well defined open channel or creek as approved by the City Engineer and the Public Works Director. Acceptance of proposed point of disposal will depend upon the prevailing site conditions, condition and capacity of existing downstream facilities, and feasibility of alternate design.

3) When private property must be crossed in order to reach an approved point of disposal *(or if downstream improvements are required across private property in order to provide required capacity or depth)*, it shall be the developer's responsibility to acquire a recorded drainage easement from the private property owner meeting the approval of the City Engineer and the Public Works Director.

4) Where existing open channels must be improved to provide adequate slopes and/or capacity for design flows, the design and construction of such on-site or downstream off-site improvements shall be the developer's responsibility, including acquisition of access rights for surveying, design and construction of such improvements.

5) New drainage facilities installed must be a closed conduit system. Temporary drainage ditch facilities, when approved, must be engineered to contain the stormwater without causing erosion or other adverse effects to the private property.

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c. **Providing for Future Development & Collection of Upstream Drainage**

1) To & Through. As a condition of building/infrastructure construction, all developments will be required to provide public storm drainage systems *(or private storm drainage systems where approved by the City)* to serve adjacent upstream parcels in order to provide for the orderly development of the drainage area, as well as connection *(to the new system)* of existing storm lines or laterals crossed or intercepted by the new storm lines *(including manholes or catch basins which can be served by the new storm lines)*, at locations as required by the City Engineer and Public Works Director *(see also PWDS 1.6.e)*.

2) The requirement above shall include the extension of storm drain lines in easements across the property as required to collect drainage from adjoining upstream/uphill properties, and across street frontages of the property to adjoining properties when the storm drain system is located in the street right-of-way.

   This shall also include extension to the far side of streets fronting or adjacent to the development as required to avoid work within or under these streets in the future.

3) The requirements above shall include storm drains which are oversized to provide capacity for future upstream development, or as required to meet the minimum sizes shown in the applicable storm master plan *(see also PWDS 1.6.h)*.

4) Swales along Property Lines to Intercept Upstream Drainage. Where swales along property lines are necessary to intercept uphill surface runoff, the swales shall be a minimum of 1 foot in depth *(3H/1V max side slopes)* and inlets shall be provided at spacing & location acceptable to the City Engineer *(typically on the upstream side of each property line crossed, unless otherwise approved)*.

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d. **Design Factors**

1) The following factors as a minimum shall be addressed in the design of storm drain systems and determination of design flows.

a) Drainage basin to be served.
b) Topography of the area
c) Depth of excavation
d) Soils conditions
e) Land use within the area to be served.
f) Projected population within the area to be served at build-out.
g) Flows from commercial, industrial or institutional users.
h) Condition and size of existing storm drains
i) Location of approved disposal point
j) Maintenance, including accessibility for cleaning and inspection personnel and equipment.

3.10 DESIGN CALCULATIONS AND CAPACITY

a. **Design Calculations**

1) Design calculations shall be submitted for all drainage facilities and shall be stamped by a professional engineer licensed in the State of Oregon. Peak flows for detention and water quality design shall be calculated using the Santa Barbara Urban Hydrograph (SBUH) method *(see PWDS 3.18.b for list of approved alternatives to SBUH method)* subject to requirements herein and direction from the City Engineer and/or other agencies with jurisdiction. Peak flows for conveyance design shall be calculated using either the Rational Method or the SBUH method, subject to requirements herein and direction from the City Engineer and/or other agencies with jurisdiction.

a) A summary of these drainage calculations, including basin maps, shall be included on the site plan drawings *(see PWDS 1.10.g)*.

2) Rational Method: One method used for calculating peak flows from small drainages less than 200 acres is the Rational Method.

a) Peak design discharges shall be computed using the rational method formula, $Q=CiA$, where Q = flow in cfs, C = runoff coefficient, i = rainfall intensity, and A = area in acres.

3) SBUH: Another method of involves the use of the Santa Barbara Urban Hydrograph (SBUH) method to develop runoff hydrographs using 24 hour storm data for the local area, based on current NOAA Atlas 24 hour isopluvials for Oregon.

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a) For Independence, the 24-hour precipitation values from the NOAA Atlas 2, Volume X, for use with the SBUH method are as follows *(ODOT design rainfall intensities may differ)*:

(1) ½ 2-YR 24-Hr = 1.5"
(2) 2-YR 24-Hr = 3.0"
(3) 5-YR 24-Hr = 3.6"
(4) 10-YR 24-Hr = 4.2"
(5) 25-YR 24-Hr = 4.6"
(6) 50-YR 24-Hr = 5.2"
(7) 100-YR 24-Hr = 5.7"

b) The City Engineer reserves the right to verify all calculations using the Rational Method, and require larger pipe sizes if the Rational Method calculations result in higher flows than the SBUH methodology.

b. **Design Storm**

1) Rational Method Rainfall Intensity-Duration Curve - The rainfall intensity-duration-frequency (IDF) curve for use under the Rational Method in the City of Independence is the ODOT Zone 8 IDF curve *(enclosed herein)*.

2) Rational Method Design Frequency - The intensity-duration design frequency for use under the Rational Method is based on the time of concentration for the area and the size of the drainage facility. The adopted criteria are listed in the following table.

Rational Method - DESIGN STORM FREQUENCY[1]	
AREA	**FREQUENCY**
Residential areas[2]	10-year storm
Commercial and high value districts[2]	10-year storm
Trunk lines *(18" pipe and larger)*	25-year storm
Minor creeks, open channels and drainage ways *(not shown as a flood plain on the Flood Insurance Rate Map (FIRM))*	50-year storm
Major creeks/channels *(shown as a flood plain on the FIRM)*	100-year storm
[1] See PWDS 3.10.a.3 regarding design storm when SBUH methodology is used for pipe sizing. [2] See categories below for trunk lines, creeks, open channels, drainage ways, etc. in these areas.	

3) **SBUH Design Storm for Pipe Sizing:** Where Santa Barbara Urban Hydrograph (SBUH) based computer program is proposed for use in sizing storm drain pipes, a 50 year 24 hour SBUH storm event must be used in lieu of the 10 year or 25 year rational storm frequency to provide equivalent capacity for peak discharge.

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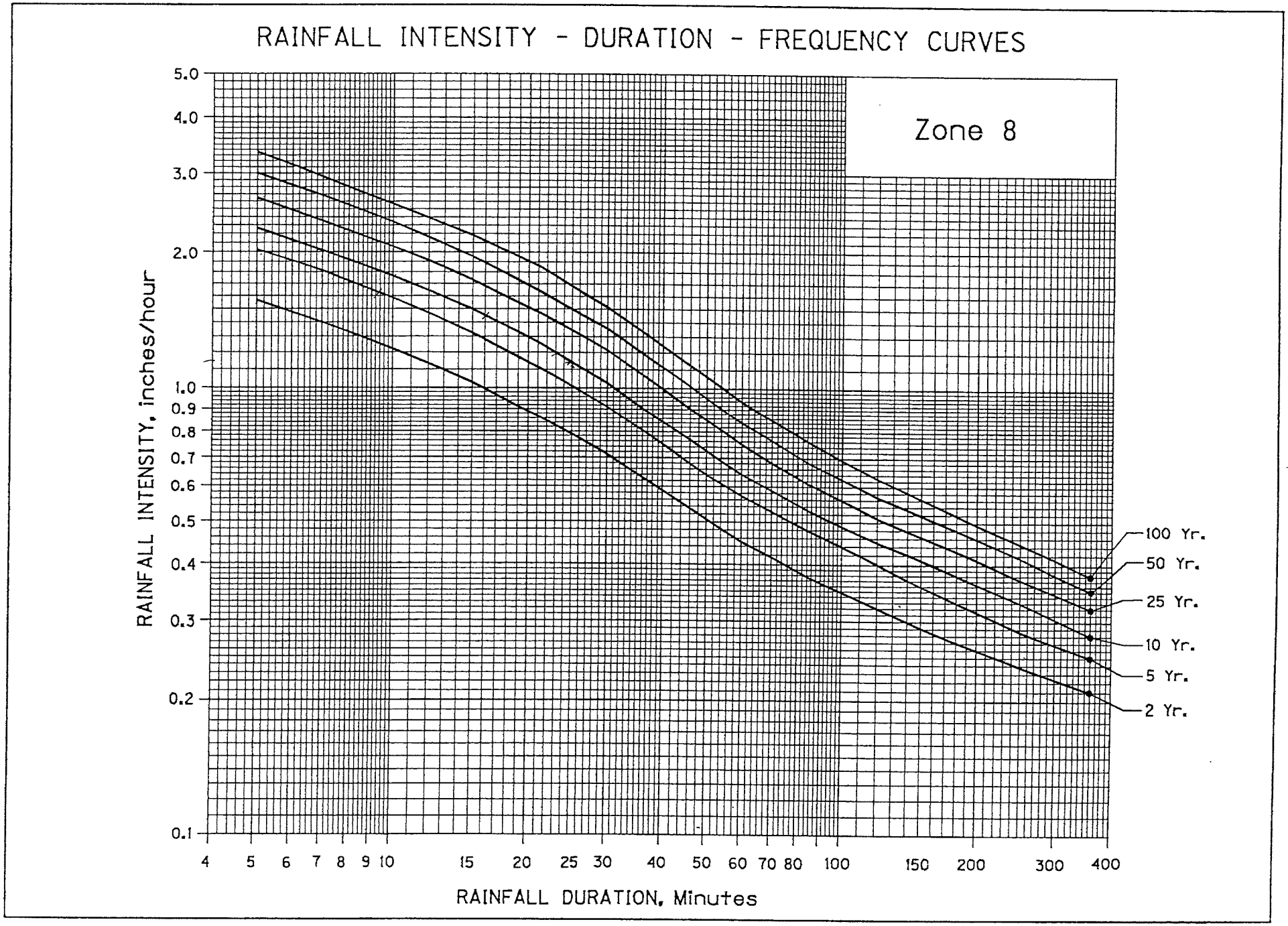
ODOT Zone 8 IDF Curve Tabular Data (Independence)

Rainfall Duration (Min)	Rainfall Intensity, inches/hour				
	5 year Storm	10 year Storm	25 year Storm	50 year Storm	100 year Storm
5	2.01	2.25	2.63	3.00	3.35
6	1.90	2.12	2.50	2.81	3.12
7	1.81	2.01	2.35	2.68	2.95
8	1.71	1.91	2.24	2.55	2.80
9	1.65	1.83	2.14	2.43	2.69
10	1.60	1.78	2.07	2.33	2.58
11	1.51	1.70	1.98	2.25	2.48
12	1.48	1.65	1.90	2.18	2.40
13	1.41	1.60	1.85	2.10	2.31
14	1.38	1.55	1.79	2.01	2.24
15	1.32	1.50	1.72	1.95	2.19
20	1.13	1.30	1.50	1.69	1.90
25	1.00	1.14	1.35	1.50	1.69
30	0.91	1.02	1.21	1.36	1.51
35	0.82	0.92	1.10	1.21	1.38
40	0.75	0.84	0.98	1.11	1.24
45	0.69	0.78	0.92	1.02	1.15
50	0.64	0.73	0.85	0.95	1.08
55	0.60	0.68	0.80	0.89	1.00
60	0.57	0.64	0.75	0.84	0.94
70	0.53	0.59	0.68	0.76	0.85
80	0.49	0.54	0.63	0.70	0.78
90	0.46	0.52	0.59	0.66	0.74
100	0.44	0.49	0.56	0.62	0.69
110	0.42	0.47	0.53	0.60	0.66
120	0.40	0.45	0.51	0.57	0.63
130	0.385	0.44	0.49	0.55	0.60
140	0.37	0.420	0.48	0.53	0.58
150	0.36	0.410	0.46	0.520	0.56
160	0.35	0.400	0.45	0.50	0.540
170	0.340	0.390	0.44	0.49	0.53
180	0.33	0.38	0.43	0.48	0.52


RAINFALL INTENSITY - DURATION - FREQUENCY CURVES
Zone 8
RAINFALL INTENSITY, inches/hour
5.0
4.0
3.0
2.0
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
4 5 6 7 8 9 10 15 20 25 30 40 50 60 70 80 100 150 200 300 400
RAINFALL DURATION, Minutes
100 Yr.
50 Yr.
25 Yr.
10 Yr.
5 Yr.
2 Yr.

c. **Runoff Coefficients**

1) The Rational Method coefficients of runoff "C" are listed below *(ie. for use with rational method calculations)*. Use of coefficients other than those listed must be based on field investigations which demonstrate conclusively that the proposed coefficients are justified. See requirements above for CN runoff curve numbers required for use with Santa Barbara Urban Hydrograph (SBUH) calculations.

Rational Method - RUNOFF COEFFICIENTS			
SOIL COVER	FLAT TERRAIN S<2%	ROLLING TERRAIN 2%<S□10 %	STEEP TERRAIN S>10%
Cultivated Land	0.30	0.35	0.40
Parks & Cemeteries	0.15	0.20	0.30
Woodlands & Forests	0.10	0.15	0.20
Meadows & Pasture Land	0.25	0.30	0.35
1) Single-family residential in urban areas, except corner lots with duplex potential	0.40	0.45	0.50
2) Gravel parking lots	0.50	0.55	0.60
3) Mobile home parks	0.60	0.65	0.70
4) Multi-family residential, zero-lot-line single-family residential and potential duplex lots in single-family residential	0.70	0.75	0.80
Highly impermeable *(roofs and paved areas)*	0.90	0.90	0.90

2) All CN parameters *(runoff curve number)* used for SBUH calculations shall be as conservative or more conservative than the equivalent Rational Method runoff coefficients listed in these standards.

d. **Time of Concentration**

1) For land in a pre-development condition, the minimum time of concentration from the most remote point in the basin to the first defined channel *(ie. gutter, ditch or pipe)* shall be 10 minutes.

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2) For developed residential and commercial/industrial property, the maximum post-development time of concentration from the most remote point in the development to the closest inlet shall be 10 minutes, unless calculations by an acceptable method show the time to be longer for very large developments.

3.11 OPEN CHANNELS

a. Within the UGB, creation of new open channels will not generally be allowed *(Planning Commission approval is required for new open channels (IDC 55.020.F)*, and existing open channels shall be rerouted at the time of development so as not to be located in backlot areas of residential developments or other non-residential backlot areas without maintenance vehicle access along one side of the open channel.

1) Where open channels are allowed by the City, ditches or open channels shall be offset from lot lines, such that maintenance access can be provided and survey monuments are not required to be set within the open channel.

b. For reasons of maintenance and safety, bank slopes generally shall be 3H:1V or flatter unless otherwise required by the Public Works Director or the Public Works Director. Unless otherwise required by Public Works Director or the City Engineer, open channels shall generally be provided with a minimum of 1 foot freeboard above the design high water level, where required to ensure that the channel does not overflow onto private property between periods when the ditch is mowed or cleaned by the agency with jurisdiction.

c. The maximum allowable design velocity shall be 7 fps.

d. The minimum allowable design velocity shall be 2 fps. The installation of a concrete lined low-flow channel may be required to achieve minimum velocity necessary to ensure that the channel is self-cleaning to the extent feasible.

e. Unless otherwise approved by the City Engineer, all piped discharges to open channels *(existing or new)* shall be mitered to match the channel side slope and include a reinforced concrete collar *(6" minimum thickness)* to prevent settlement or erosion of the pipe trench at the discharge location, and to protect the end of the pipe. Unless otherwise approve by Public Works Director and the City Engineer, the concrete collar shall extend from the channel bottom to the top of bank. Grates shall be provided on all inlets or outlets 18" or larger unless otherwise specifically approved by Public Works Director and the City Engineer, as well as at any locations required by Public Works Director to accommodate maintenance or mowing requirements.

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f. If grated inlets are provided at locations where swales or open channels flow into a piped storm drainage system, such grated inlets shall be slanted or mitered to match the channel end slope *(to minimize the risk grates blinding off with debris during storm events)*.

1) The overflow path where stormwater will be routed if the grated inlet is obstructed by debris shall be identified to verify that water will not flow onto private property which does not normally receive such flows or otherwise cause downstream damage.

3.12 STORM DRAIN ALIGNMENT AND LOCATION

a. General

1) Generally, storm drains shall be laid on a straight alignment between catch basins and between manholes.

a) Where approved by the City Engineer & the Public Works Director, lines 15-inch in diameter and smaller may be laid on horizontal curves conforming to the street curvature provided the radius of the horizontal curve is not less than 200 feet.

b) Variance for horizontal curves on larger size pipes shall be reviewed by the City Engineer on a case by case basis.

2) Where storm drains are being designed for installation parallel to other utility pipe or conduit lines, the vertical location shall be in such a manner that will permit future side connections of main or lateral storm drains and avoid conflicts with parallel utilities without abrupt changes in vertical grade of main or lateral storm drains.

b. Storm Drain Location in Relation to Water and Sewer Lines and Other Utilities

1) Public storm drainage lines shall be separated from all other parallel public utilities by a minimum of 5 feet between utility centerlines unless otherwise approved in writing by the Public Works Director and the City Engineer, but in all cases a minimum of 3 foot clear separation shall be provided.

2) Installation of franchise or private utilities in a common trench with storm drain lines shall be prohibited.

c. Storm Drain Location in Street Right-of-Ways

1) Unless otherwise approved by the City Engineer and the Public Works Director, storm drain lines shall generally be located in the street right-of-way within six (6) feet of the face of curb.

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2) Variance for horizontal curves on larger size pipes shall be reviewed on a case-by-case basis for approval by the City Engineer.

d. **Storm Drain Location in Easements, Easement Widths, Maintenance Access Requirements**

1) Minimum Easement Widths: Unless otherwise specified or authorized by the City, minimum easements widths for storm drains shall be as follows:

MINIMUM STORM DRAIN EASEMENT WIDTHS		
Storm Drain Diameter	Depth to Invert	
	≤ 6 feet	> 6 feet
10 - 15 inches	12 feet	12 feet plus 2 feet for each foot *(or fraction thereof)* deeper than 6 feet to invert.
18 - 24 inches	16 feet	16 feet plus 2 feet for each foot *(or fraction thereof)* deeper than 6 feet to invert.
> 24 inches	20 feet	20 feet plus 2 feet for each foot *(or fraction thereof)* deeper than 6 feet to invert.
Note: Easements shall be a constant width between manholes or other in-line structures. Easement width shall be based on the deepest portion of the line between such structures.		

2) Open channels located outside of public right-of-ways shall be provided with easement widths as follows:

a) Channel width less than 14 feet at top of banks: Channel width plus 12 feet on one side and 2 feet on the other *(20 foot minimum per IDC 55.020.F)*.

b) Channel width greater than 14 feet at top of banks: Channel width plus 12 feet on both sides.

3) Public storm drains in easements will be allowed only after all reasonable attempts to place the mains in a right-of-way have been exhausted. All easement installations must be approved in writing by the City Engineer and the Public Works Director on a case-by-case basis.

4) Offset. When storm drains in easements are approved by the City, the storm line shall be offset a minimum of 6 feet from any property line or easement boundary, or 1/3 the required easement width *(rounded up to the nearest foot)*, whichever is greater.

5) Easement locations for public storm drain lines serving a PUD, apartment

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complex or commercial/industrial development shall be in parking lots, private drives or similar open areas which will permit an unobstructed vehicle access for maintenance by City forces.

6) **Maintenance Access Requirements**. Where required by the Public Works Director, public storm drain lines or detention systems located outside of developed street right-of-ways *(public or private)* will require maintenance access similar to that required for sewers under PWDS 4.15.d *(ie. all-weather access lanes required along mainlines and/or for access to manholes including flow control manholes, inlets or other structures, maintenance agreement, etc.)*.

7) City standards require that easements granted to the City shall not be used for any purpose which would interfere with the unrestricted use for storm drain purposes. Under no circumstances shall a building or structure or tree be placed over a storm drain pipe or easement, nor shall any parallel fences or parallel utilities be constructed within the easement (*access gates acceptable to the City shall be installed in fences which the City allows to be constructed across City easements*). Prohibited structures shall include decks, as well as footings or overhanging portions of structures located outside the easement.

8) Common placement in the easement of a sanitary sewer and storm drain line may be allowed under certain conditions subject to approval by the City Engineer and the Public Works Director. Easements wider than the minimum may be required.

9) Franchise Utility Limitations in City Easements. Franchise utilities shall not be placed in City utility easements unless approved in writing by the Public Works Director, subject to separation requirements in excess of minimums as dictated by Public Works Director.

10) Common easements will be reviewed on a case-by-case basis. Separation of utilities must meet City, Oregon State Department of Environmental Quality (DEQ) and OHA-DWS requirements.

11) Public Works Review/Approval Required prior to Recording. All easements must be furnished to the City Public Works and City Engineer for review and approval prior to recording. All recording costs shall be borne by the Developer.

3.13 STORM DRAIN MINIMUM PIPE SIZE

a. Public mainline, lateral or connector pipe storm drains shall not be less than 12-inches inside diameter *(IDC 55.020.E)*, and shall begin at a structure and terminate at an approved point of disposal.

b. Per 3.8.b (table), driveway culverts *(or any other pipe specifically approved with an*

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open inlet end) shall be a minimum of 12-inches diameter. Larger diameters shall be provided where required for flow capacity or where required to match the size of adjacent existing street crossings or storm drain pipes.

c. When two parallel pipes are installed in lieu of a box culvert, the minimum separation between the pipes shall be one foot or 1/3 the diameter, whichever is greater. This requirement may be waived if the void between the pipes below the springline is filled by grouting or other approved method.

3.14 STORM DRAIN MINIMUM COVER

a. All storm drains shall be laid at a depth sufficient to protect against damage by traffic and to drain building footings where practical. Sufficient depth shall mean the minimum cover from the top of the pipe to finish grade at the storm drain alignment.

b. Under normal conditions minimum cover shall be 36-inches above the top of the pipe. *(IDC 55.020.E)*

c. In areas of relatively flat terrain, the design engineer must demonstrate that sufficient depth is provided at the boundary of the development to properly drain the reminder of the upstream basin area tributary to the site.

3.15 STORM DRAIN MINIMUM SLOPE & ROUGHNESS COEFFICIENT

a. All storm drains shall be laid on a grade which will produce a mean velocity *(when flowing full)* of at least 2½ feet per second, based upon Manning's pipe friction formula using a roughness coefficient as noted below.

1) Roughness Coefficient:

a) A minimum "n" value of 0.013 shall be used in Manning's formula for the design of all smooth wall pipe and 0.024 for corrugated wall pipe, or per the pipe manufacturer's recommendations, whichever is greater. The use of higher "n" values for existing pipe may be required by the City Engineer as deemed necessary by the City.

b) In theory, new PVC and HDPE pipes have manufacturer's "n" value of 0.009 to 0.012. However, sand, dirt and rock and other deposits tend to build up in pipes over time. Hence, an "n" value of less than 0.013 will not be considered for approval.

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b. The minimum acceptable slopes for various pipe sizes and types are listed below:

MINIMUM STORM DRAIN PIPE SLOPES (for 2½ fps velocity)	
Inside Pipe Diameter (inches)	Smooth Wall (n=0.013) % Slope (ft/100 ft)
12	0.30
15	0.23
18	0.18
21	0.14
24	0.12
27 & larger	0.10

c. In general, gradients greater than those shown above are desirable and are particularly recommended on connector pipes and the upper ends of laterals.

d. The minimum grade may be reduced from the above table to produce an absolute minimum velocity of 2.0 fps upon approval of the City Engineer. Cases requiring a flatter grade than permitted above shall also be reviewed on a case by case basis for approval by the City Engineer.

e. Engineers are cautioned not to specify sewers of sizes which are obviously larger than necessary for satisfactory carrying capacity but which are specified in order to meet grade requirements *(ie. a 15-inch pipe for an 12-inch pipe to acquire a decrease in slope)*.

1) In cases where using a larger pipe is the only option available to serve a development *(as demonstrated by the design engineer to the satisfaction of the Public Works Director and the City Engineer)*, the larger pipe size so installed shall not be considered as a justification for the developer to be eligible for oversizing or SDC reimbursement.

f. Storm drains shall be laid with uniform slope between structures.

g. Grades *(slopes)* shall be determined to the pipe invert at the edge of the catch basin or manhole and lengths to the center of the catch basin or manhole.

h. The difference between the inlet pipe slope (Si) and outlet pipe slope (So) at any catch basin or manhole shall not exceed 25 percent.

i. Storm drains on slopes of 20 percent or more shall be anchored with concrete anchor walls or other restraining methods approved or specified by the City.

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j. Where velocities greater than fifteen (15) feet per second are attained, the pipe material shall be ductile iron and special provision shall be made to protect manholes against erosion and displacement by shock. This may be accomplished by installing one additional manhole to decrease the slope or to split a 90° horizontal direction change into two 45° incremental changes.

3.16 UNDERGROUND WARNING TAPE & TONING / TRACER WIRE

a. Detectable or non-detectable acid and alkali resistant safety warning tape shall be provided along the full length of all service laterals and all mainlines not located under sidewalks or paved portions of public streets.

b. Underground warning tape shall be placed a minimum of 12-inches and a maximum of 18-inches below the finish ground surface, and shall be continuous the entire length of the service laterals installed from the mainline to the back of the PUE. Where required for mainlines not located under sidewalks or paved portions of public streets, the warning tape shall be continuous between manholes or cleanouts.

c. All storm piping *(both public lines and private lines serving parking lots, detention basins, etc.)* shall have an electrically conductive tracer wire, 10 gauge minimum size single strand insulated copper with green sheathing, installed in the trench for the purpose of locating the pipe in the future. The tracer wire shall run the full length of the installed pipe with each end accessible from the surface through a manhole, cleanout or catch basin.

3.17 MANHOLES AND CATCH BASINS

a. General

1) All junctions between storm drains shall be made at manholes, catch basins or detention basins.

2) Manholes or junction boxes shall be required at the following locations or as determined by the City Engineer:

   a) All changes in horizontal or vertical alignment. Minor horizontal curvature in pipe less than 15 degrees may be allowed, *(without manholes or cleanouts)*, depending on pipe size, street alignment, degree of curvature and reason. Maximum joint deflection shall be per manufacturer's recommendation.

   b) All connections unless otherwise noted herein.

   c) All changes in pipe size.

   d) At a spacing no greater than five hundred (500) feet.

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3) For new storm mainline and/or new catch basin construction, catch basin laterals of 10 feet or less in length and 12 inches in diameter may connect to the main line with a shop fabricated 90 degree "T", provided the connections is located not more than one hundred (100) feet from a manhole or cleanout on the main line and the main line is a minimum of 15-inches or larger in diameter.

4) In lieu of connecting to manholes, catch basins or junction boxes, storm drain laterals draining private property may be connected directly to the public main line, provided the private storm lateral diameter is 8-inches or less and is no more than half the diameter of the main line. Unless otherwise approved by Public Works Director, the connection to the mainlines shall be with an Inserta-Tee connection so as to provide a strong, leak-proof joint. The lateral shall not project inside the main line.

b. **Catch Basins**

1) General

a) Side inlet grated catch basins shall be used at all locations. Exceptions will be considered on a case by case basis.

b) Catch basins may be used for the junction of pipes 15-inches in diameter.

c) Maximum Catch Basin Depth. As noted on standard details, catch basins shall typically not be deeper than 4 feet from the gutter grade to the outlet pipe invert. Deviation requires a written request & justification from the design engineer, and approval by the City Engineer.

d) Catch basins shall be designed to completely intercept the 5 year design storm gutter flow.

2) Catch Basin Locations

a) Maximum Gutter Length Drained. The maximum length of curb and gutter which may be drained by a catch basin is 300 feet *(IDC 55.020.D)*. Storm water shall not be permitted to drain across a street or across an intersection *(IDC 55.020.D)*.

b) Maximum Area Drained. The maximum impervious area which may be drained by a catch basin is 20,000 square feet.

c) Descending Stub Streets or Curbs Ends. Catch basins shall be installed where the improvement ends on all streets and/or curbs terminating on a descending grade, and piped to an approved point of disposal.

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d) Catch basins in the middle of blocks shall be located within 5 feet of the extension of a common property line.

e) Catch basins shall be installed at all low spots, whether on private or public property, and shall be connected to a storm drainage facility.

f) Catch Basins in Relation to Pedestrian Ramps.

(1) Catch basins shall not be located in front of pedestrian access ramps.

(2) Catch basins shall be set to minimize gutter flows across new pedestrian access ramps to the extent practicable, as determined by the Public Works Director and City Engineer.

A catch basin shall be set on the uphill side of pedestrian ramps, unless otherwise approved on a case-by-case basis.

g) Maintenance of Private Catch Basins. In order to ensure compliance with City requirements regarding stormwater discharge, all catch basins on private property (*parking lots, etc.*) which drain to a public storm system shall be provided with a recorded agreement allowing for inspection entry by Public Works Director, unless catch basins are located within a City easement, or otherwise covered by a detention system maintenance agreement. Maintenance of private catch basins and private stormwater systems shall be an ongoing responsibility of the property owner, whether or not a maintenance agreement is recorded.

3) Drop Across Catch Basin Structure

a) The vertical drop across flow-through storm drain catch basins shall not be less than 0.1 feet.

c. **Manholes**

1) Manhole Size

a) Manhole size shall conform to the requirements outlined under Division 4, Sanitary Sewers and the standard details.

2) Manhole Location

a) Manholes shall be installed at all pipe junctions where the depth from rim to invert exceeds 4 feet or where the pipe is 18-inches in diameter or greater. Exceptions will be reviewed on a case by case basis.

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3) Drop Across Manhole Structure

a) The vertical drop across storm drain manholes shall conform to the requirements outlined under Division 4, Sanitary Sewers.

b) Match Crowns. Where storm pipes of different sizes enter the same manhole, the design shall generally provide that the crowns of the smaller incoming pipes are set at or above the same elevation as the outlet pipe crown. Deviation requires a written request & justification from the design engineer, and approval by the City Engineer.

c) Opposing Inlet Pipes with Significantly Differing Slopes. In cases where two pipes discharge into a manhole from opposite directions and one pipe has a slope more than 4% steeper than the pipe opposite, the invert of the pipe with the lower slope shall be set a minimum of 0.35 feet or ½ the pipe diameter, whichever is greater, above invert of the steeper pipe.

4) Rim Elevation

a) The rims of all manholes located within paved or other hard surfaced areas *(or where paved pads are required around manholes per standard details)* shall be set to finished grade. Manholes outside of these areas shall be set above finish grade as shown on the standard details.

b) Concrete riser rings shall be used to bring casting to grade. The height from the top of the cone or flattop section to the rim shall not exceed 18 inches.

d. **Mainline Storm Cleanouts**

1) Mainline storm cleanouts will not be approved as substitutes for manholes or terminal catch basins. Cleanouts shall only be allowed at the upper end of main storm lines less than 150 feet long which will be extended on the same grade and alignment during the next construction phase of a multiphase development, and which do not have any laterals.

2) All mainline cleanouts will be considered on a case-by-case basis and approved by the City Engineer and the Public Works Director. In all cases, plan and profile showing the alignment and depth of the anticipated future extension from the proposed cleanout to the next manhole shall be submitted prior to approval of cleanouts.

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3.18 DETENTION FACILITIES

a. Where Required

1) Peak storm water runoff shall be controlled by detention facilities for the following:

   a) All commercial, industrial and multi-family developments, or

   b) Projects with 10,000 square feet or more of impervious area, or

   c) Projects which expose more than 60,000 square feet of soil (*IDC 55.010.B&C*), or

   d) All other developments where such control is needed to prevent the capacity of the downstream system from being exceeded.

2) Developers shall be responsible for demonstrating to the satisfaction of the City Engineer that the downstream system has capacity for the proposed flows.

3) Developers proposing to not provide detention or control shall be responsible for demonstrating to the satisfaction of the Engineer that such control is not necessary.

b. Allowable Runoff Rate (Outflow) *(also remaining available downstream capacity)*

1) Peak runoff rate shall be limited to that which would occur under pre-development conditions for the design storms as defined below, or the *remaining available downstream capacity for the site being developed*, whichever is more stringent.

   a) The allowable runoff rate from the developed site shall be less than or equal to the pre-development conditions for the ½ 2-year, 10-year, and 50-year, 24-hour design storm events using a Type 1A storm rainfall distribution.

   b) Storm intensities for the design storms are provided above in PWDS 3.10.3.a.

   c) Acceptable analytical methods to determine stormwater runoff calculations are the Santa Barbara Unit Hydrograph (SBUH) method, Natural Resource Conservation Service (NRCS) TR-20 or TR-55 methods, or the Environmental Protection Agency Stormwater Management Model (SWMM).

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2) Remaining Available Downstream Capacity. Remaining available downstream capacity is defined as the downstream capacity unused during the design storm event. The *remaining available downstream capacity for the site being developed* is that portion of the remaining available downstream capacity equivalent to the ratio of the site being developed to the total undeveloped land in the basin.

c. **Detention Facility Siting & Maintenance**

1) Unless otherwise approved by the City Engineer and Public Works Director, all detention facilities shall be located on private property. Detention facilities located within a public right-of-way shall be configured as piped detention facilities (*ie. surface detention within right-of-way is not allowed*).

2) Detention Easement & Maintenance Responsibility. All detention facilities shall be maintained by the property owner or Home Owner's Association *(or similar entity acceptable to the City)*, including but not limited to cleaning and maintenance of outlet/flow control structures, irrigation (*via a permanent irrigation system*), mowing, etc.

a) Maintenance shall be assured through a recorded maintenance agreement acceptable to the City *(see Appendix D)*.

b) All detention basins, with the exception of parking lot detention basins, shall be within a storm/detention and access easement to the City.

3) Flow Control Structure **Maintenance Access Requirements.** Unless otherwise approved in writing by the Public Works Director, provisions for all weather maintenance vehicle access to detention flow control structure shall be installed by the developer *(see also PWDS 3.12.d.6)*.

4) Irrigation & Landscaping.

a) Grass and a permanent automatic underground irrigation system shall be provided and installed by the developer for open detention basins outside of parking lots *(number of zones as required based on basin size and full irrigation coverage of interior & exterior slopes & bottom)*.

b) Irrigation controllers shall be mounted in a secure location, and shall be battery or solar powered unless a permanent power supply is installed and provided by the developer *(as approved by the Public Works Director and the City Engineer)*.

c) Any deficiencies in the irrigation system coverage or irrigation controllers during the warranty period shall be corrected by the

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contractor.

d. **Detention Facility Design**

1) General

a) All detention facilities and drainage calculations shall be designed and stamped by a Professional Engineer registered in the State of Oregon. Detention facilities shall be designed to protect public and private property.

b) Unless otherwise approved by the City Engineer, all open detention basins *(as well as detention chambers with open bottoms)* shall be designed as off-stream storage basins, sloped to drain completely between design storms.

(1) Open detention basins approved as flow-through systems *(rather than off-stream storage)* shall be limited to applications where such configuration is required by other permits *(wetland, water quality, etc.)*, and shall be provided with fencing around the perimeter of the basin.

c) The water level in the receiving stream during the design storm event must be lower than the bottom of the detention basin, unless otherwise approved by the City Engineer and the Public Works Director on a case-by-case basis. Any portion of the detention basin below the design water level in the receiving stream or storm system, or below the highest seasonal groundwater level *(for open basins or detention systems with open bottoms)*, may not be utilized for storage volume in detention calculations.

2) Detention System Storage Capacity

a) Detention facilities shall have storage capacities to meet the more stringent of the following:

(1) Detain peak runoff from the developed site to match the peak runoff in pre-development conditions for the ½ 2-year, 10-year, and 50-year, 24-hour design storm events *(see also PWDS 3.18.b.1.a)*.

(2) The difference between the *remaining available downstream capacity for the site being developed* (as defined above) under design storm conditions and a 25 year frequency storm under developed conditions.

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3) Detention System Orifice

a) The orifice size and the hydraulic head shall be adjusted to produce the allowable outflow based on the following formula:

$$D = 6.166\left(\frac{Q}{H^{1/2}}\right)^{1/2}$$

Where:

D = Orifice diameter in inches.
Q = Discharge in cubic feet per second.
H = Hydraulic head above the orifice in feet.

b) To prevent excessive plugging, the minimum orifice diameter shall be 1½-inches. The orifice shall be located in a pollution control manhole in an accessible location outside of the detention basin.

c) The outlets of all detention basins shall be provided with suitable debris barriers designed to protect the outlet from blockage or plugging.

d) Flow control orifice assemblies shall substantially conform with the general configuration shown on the City standard details, as approved by the Public Works Director and the City Engineer (*even if installed in a structure other than a manhole as shown on the details*).

(1) Details for alternate structures to house the flow control assembly shall be drawn to scale, and to demonstrate that the assembly fits in the proposed structure while allowing for equivalent maintenance & cleaning access.

(2) If an alternate flow control outlet assembly is proposed which does not allow for continuous outflow from the detention system equivalent to the predevelopment flowrate, the detention storage volume shall be increased to compensate for antecedent rainfall which reduces the available detention storage prior to the start of the design storm event.

4) Detention Overflow System

a) The detention facility shall have a primary overflow system with the capacity to pass a 50-year frequency storm. Detention basin overflows shall discharge into a public storm drain facility or the natural drainage course for the drainage basin where the development is located *(without flowing across adjacent property where a recorded easement or an established natural drainage channel does not exist)*, and shall

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be designed to minimize the impact to downstream systems *(the design engineer shall identify the flow path that overflow water will follow to demonstrate that this requirement is satisfied)*.

b) Primary Overflow. The primary overflow elevation shall be a minimum of 1 foot below the top of the top of the structure designed to contain the water.

c) Emergency Overflow. The design engineer shall also demonstrate how emergency overflow *(for flows which exceed the primary overflow capacity)* will get from the detention basin to an approved downstream storm system without causing damage to the detention system or adjacent properties.

(1) If an emergency overflow channel is proposed from an open basin, it shall, as a minimum, consist of 18" minimum depth of riprap, placed over geotextile fabric which is extended to the surface of the ground at the edge of the riprap, with a minimum flow depth of 12-inches and 3H:1V side slopes.

The riprap shall be either grouted or have all voids filled with ¾"-0 granular baserock to prevent water flow through the riprap and erosion of the underlying subgrade.

The channel shall be extended to the point where flow will not cause erosion damage during an emergency overflow event *(ie. to a natural channel or other area where the flow will spread out and flow velocities will be minimal)*.

d) As a minimum, the design of detention facilities shall ensure that primary or secondary *(emergency)* overflow or system failure will not cause flooding in any habitable building area.

5) Open Detention Basins

a) Water Depth - At maximum storage, the maximum allowable water depth shall not exceed 5 feet.

b) Freeboard - The maximum water surface elevation at overflow shall be a minimum of 1.0 feet below the top of the structure *(curb, bank, berm, etc.)* designed to contain the water.

c) Detention Basin Side Slopes & Top Width, Fencing –

(1) The interior side slopes for detention basins shall be no steeper than 4H:1V. Exterior side slopes shall be no steeper than 3H:1V for maintenance.

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(2) Steeper interior side slopes or retaining walls may be used where approved by the Public Works Director and if access to the detention facility is restricted by chain link or other approved fencing a minimum of six (6) feet high. Chain link fences, posts & hardware along or adjacent to public right-of-ways shall be vinyl coated.

(3) Detention basins configured as flow-through systems shall be provided with fencing around the perimeter of the basin.

(4) Unless greater width is required based on site specific geotechnical or maintenance access considerations, dikes surrounding open basin detention systems shall generally have a minimum top width of 4 feet.

d) Detention Basin Bottom Slope - The bottom of all constructed and graded detention basins shall be sloped a minimum of 1% towards the outlets for drainage. Flatter slopes will require the use of a concrete valley gutter or similar method as approved by the City Engineer.

e) Detention Basin Maintenance and/or Mowing Access, Gates – Provisions for maintenance and/or mowing access shall be provided for interior and exterior slopes, and for the bottom of open basins *(provide an access ramp if mowing is required and side slopes exceed 4H:1V, or provide concrete or similar access steps if mowing is not required, with a locking gate in any fence provided, in order to provide for security and maintenance/mowing access).*

6) Parking Lot Detention Basins

a) Open detention basins utilizing the paved areas of parking lots for water storage are not allowed by Public Works.

7) Piped or Arched Bottomless Underground Detention System

a) Piped Detention. Unless otherwise approved, piped detention systems shall be designed as a watertight subsurface pipeline *(ie. solid wall pipe)*, and shall be sloped a minimum of 0.1% towards the outlet to drain.

(1) Inspection/Maintenance Access - A pollution control manhole with an orifice shall be provided at the downstream end of the piped detention system, and a standard manhole shall be provided at the upstream end.

(2) Pipe type shall be based upon the depth of cover and loading conditions as specified herein.

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b) Arched Bottomless Chambers. Where open-bottom arched subsurface stormwater detention chambers are proposed, they shall be designed as off-stream storage basins *(PWDS 3.18.d.1.b)*, and licensed as infiltration systems by DEQ as applicable.

(1) Fabric Base Liner, Cleaning Access. Where sediment or debris can enter the chambers *(ie. an isolation row)*, a double layer of continuous geotextile fabric *(without seams)* shall be provided on top of the angular stone foundation rock, extended laterally beyond the base legs of the arched detention chambers for a distance per manufacturer's recommendations, to allow the chambers to be cleaned of silt or debris with a hydro-cleaner/jet-vac as applicable.

(2) Cleaning Access. A manhole shall be provided at the downstream end of each isolation chamber row, to allow for hydro-cleaner access and sediment/debris removal.

(3) Chamber Outlet Pipe Invert. The chamber system shall be configured with the outlet pipe invert even with or lower than the fabric base liner, so that sediment and debris can be pulled from the chambers during cleaning. Details or notes defining this configuration shall be included on the design drawings.

Where a chamber outlet cap with a 24" outlet is necessary in order to match the base liner invert *(as is necessary for many chamber styles)*, it is acceptable to install an eccentric reducer on the outlet pipe stub to reduce the pipe size to that appropriate for the design flowrates *(12" minimum typical where cleaning is required)*.

(4) Inspection/Maintenance Access - Inspection ports and/or maintenance access points shall be provided at intervals meeting manufacturer's recommendations *(upstream end and midpoint of each chamber row as a minimum)*.

(5) Piped Cross Connections. If parallel chambers are proposed without each row having a piped inlet, cross connection pipes between chamber rows shall be provided *(at each end of each chamber)*. The cross connection pipes may be raised above the chamber floor to prevent sediment from flowing from the isolation chamber to the remaining chambers.

(6) Chamber Slope or Drainage. If the chamber bottoms are not sloped to drain out between storms, they shall be provided with an underdrain system connected to the outlet manhole in order to accomplish this.

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c) Open-Graded Drainage Stone.

(1) Bedding stone under arched chambers and embedment surrounding the chambers *(or surrounding perforated pipe)* shall be clean, crushed, angular quarry stone, ¾" – 2" gradation size *(clean rock without fines)*.

(2) Open-graded stone shall be laboratory tested to demonstrate minimum 40% void ratio for water storage.

(3) Open-graded stone shall be completely encapsulated in geotextile drainage fabric conforming with chamber manufacturer recommendations and drawing notes.

d) Easement widths shall conform to the minimum requirements outlined herein.

3.19 STORMWATER QUALITY FACILITIES

a. Where Required

1) Development and other activities which create or replace 10,000 square feet or more of impervious surfaces, or increase the amount or concentration of runoff are required to provide permanent water quality facilities to reduce contaminants entering the storm water system and the Ash Creek and the Willamette River.

2) An on-site water quality facility shall be constructed unless, in the judgment of the City Engineer, any of the following conditions exist:

a) There is a more efficient and effective regional site within the sub-basin that was designed to incorporate the development or is in the near vicinity with the capacity to treat the site.

b) The development is for the construction of one or two family *(duplex)* dwellings on existing lots of record.

3) If an on-site water quality facility cannot be constructed to treat the runoff from the development's impervious surface, or if portions of the on-site runoff cannot be treated, then the City Engineer may allow an offsite water quality facility to be designed to treat runoff from an equivalent area of adjacent untreated impervious surfaces.

4) Exempt from this requirement are water lines, sanitary sewer lines, private utilities, or other land development activities that will not directly add impervious surface area or increase the amount of storm water runoff or pollution leaving the site once construction has been completed and the site is either restored to or not altered from its approximate original condition. City projects will be considered on a case-by-case basis by the City Engineer, based

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on existing facilities, nature of construction activities, maintenance considerations, and other factors.

b. **Stormwater Quality Design**

1) The stormwater quality facilities shall be designed to remove suspended solids, debris, oil and grease carried by the storm drain system, and retain them for safe and easy removal. The stormwater quality facility chosen shall possess design features to prevent resuspension of previously collected contaminants and materials.

2) The stormwater quality facilities shall treat the runoff from all newly constructed impervious surfaces. For purposes of stormwater quality requirements, impervious surfaces shall include pavement, gravel roads, buildings, public and private roadways, and all other surfaces with similar runoff characteristics.

3) Design Rainfall. The stormwater quality facilities shall be designed for the runoff the ½-2-year 24-hour storm event (*ie. first flush*). Flows resulting from rainfall greater than the 1/2-2-year 24-hour storm event may either bypass the water quality facility or pass through the water quality facility with a reduced level of treatment.

4) Residential Subdivisions, Impervious Area. The water quality facilities for any residential subdivision shall be adequately sized to accommodate the public streets & infrastructure within the subdivision, as well as for the future construction of housing on the individual lots based on an assumed 3,000 square feet of impervious surface per dwelling unit.

5) An operation and maintenance plan shall be prepared detailing how the water quality facility is to be maintained, and shall be submitted for review with the final design.

6) Maintenance Agreement. For private stormwater quality facilities, an executed operation and maintenance agreement approved by the City Engineer prior to final approval or acceptance of the water quality facility by the City, and recorded against all affected properties.

7) Site Specific Infiltration Testing Requirements. If a design based on stormwater infiltration are proposed, soils infiltration tests shall be performed as summarized under PWDS 3.21, including type of testing, notice of testing, location and depth of testing, etc. A final infiltration report stamped by the Geotechnical Engineer shall be provided with the design drawings submitted for review by the City.

c. **Water Quality BMPs**

1) Approval of the appropriate BMP for each development will be considered on a case-by-case basis by the City Engineer, and shall be based on maintenance

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considerations, nature of activities within the development, and other factors.

2) The following are general guidelines for BMPs generally acceptable to the City. This listing is not all inclusive, and other design options which are functionally equivalent may be proposed for consideration by the City Engineer.

3) Mechanical Treatment

a) The device shall be capable of removing at least 70% of suspended fine and coarse sediment load and 70% of the floatable oil and grease.

b) The selected device shall incorporation a high-flow bypass or contain an internal built-in diversion structure to divert intense runoff events and prevent scouring of the previously collected contaminants.

c) The device shall be capable of storing a minimum of 24-inches of sediment or 15% of the operating volume, whichever is greater. The storage chamber shall incorporate a means of inspecting sediment levels, as well as oil and grease accumulation levels, without entering the structure.

d) The device shall be Storm Filter by Contech, Perk Filter by Oldcastle, or other approved equivalent system with a WADOE gold rating.

e) The devices shall be sized and installed per manufacturer's recommendations and approval by the City Engineer.

4) Water Quality Swale (Bioswale)

a) The swale width and profile shall be designed to convey the water quality design storm event at a maximum design depth of 0.5 feet and maximum design velocity of 0.9 foot per second, maximum slope of 1.5 percent, designed using a Manning "n" value of 0.25, having a minimum of 3H:1V side slopes in the treatment area and a minimum length of 100 feet. A minimum of one foot of freeboard above the design water surface (*ie. high flow storm*) shall be provided for facilities not protected by high flow storm diversion devices.

b) The swale shall have a minimum hydraulic residence time of 9 minutes.

c) Woody or shrubby vegetation shall not be planted in the active treatment area of the swale.

d) The swale shall incorporate an energy dissipation feature and a flow spreading device at the inlet. The flow spreader shall provide a uniform flow distribution across the swale bottom. On a swale wider than 8 feet a flow spreader shall be installed every 50 feet.

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e) To minimize flow channelization, the swale bottom shall be smooth with uniform longitudinal slope, and with a minimum bottom width of 2 feet. Check dams shall be provided as necessary or as directed to reduce flow channelization.

f) Grasses shall be established as soon as possible after the completion of the swale. The initial rate of application shall be 5 pounds of water quality seed mix per 1000 square feet or as approved by the City Engineer. The water quality seed mix shall be a low maintenance variety.

g) Unless otherwise approved by the City Engineer, the swale shall be designed for the storm event described above. Larger storm events may be directed around the water quality swale by a flow diversion structure.

h) Maintenance Access – Provisions for maintenance and mowing access shall be provided for interior and exterior slopes, and for the bottom of Bioswales *(ie. same access provisions as required for open detention basins)*. The City Engineer will determine the acceptability of the proposed maintenance access provisions.

5) Stormwater Planter or Rain Garden

a) Facilities may be designed as strictly filtration systems, or as strictly infiltration systems with an overflow, or as partial infiltration systems with an overflow.

b) Facilities may be designed as a facility to combine both stormwater detention and water quantity treatment in a common facility. In the event of conflicts between water quality standards and detention standards, the more stringent shall apply *(as determined the by City Engineer and the Public Works Director)*.

c) The horizontal bottom dimension of the facility shall be a minimum of 3 feet. Facilities shall be designed to evenly distribute and filter flows. Surface longitudinal slopes must be 0.5% or less.

d) Facilities may be designed with side slopes or structural retaining walls. Where retaining walls taller than 24" are proposed adjacent to areas accessible to pedestrians, rails or fall protection shall be provided along the top of the walls. If side slopes are used, a maximum slope of 3H:1V must be used for systems which do not include stormwater detention *(see PWDS 3.18 for detention basin slope requirements)*.

e) The cross section of the facility is to be composed of the following *(listed from bottom to top)*:

(1) Drain Rock: 12 inches min.-48" inches max., 1½" – ¾" clean,

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open-graded crushed rock.

(2) Choker Course: 3 inches, ¾" – ¼" clean, open-graded crushed rock.

(3) Water Quality Mix: 18 inches.

f) Facilities may be designed without drain rock and choker course rock. If used, however, the above cross section thickness requirements apply.

g) Water Quality Soil Mix (Stormwater Planter or Rain Garden).

(1) The water quality soil mix shall be equal parts organic compost, sand, and loam *(ie. topsoil)*. The compost shall be weed free, decomposed, non-woody plant material; animal waste is not allowed. Compost must be supplied by a member of the Seal of Testing Approval (STA) program. See a list of local providers at www.compostingcouncil.org.

(2) Water quality mix material must be tested *(per ASTM D2434, constant head test)* to meet an infiltration rate of 4 inches per hour. Prior to construction, test results must be submitted to the Design Engineer and City Engineer for approval.

(3) The blended water quality mix must be analyzed for particle gradation in conformance with ASTM C117/C136. The analysis shall include the sieve sizes listed below and meet the following gradation criteria. The material shall also have a Coefficient of Uniformity (D_{60}/D_{10}) of six or greater. Results are to be submitted to the Design Engineer and City Engineer prior to construction.

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

h) Infiltration Testing, Capacity, Design Loading, etc.

(1) A Geotechnical Engineer or geologist investigation and report is required to determine the seasonally high groundwater level. Sites with groundwater levels within 3 feet of the lowest elevation of the stormwater facility cannot use infiltration as a water quality BMP.

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(2) Site Specific Infiltration Testing Required. If a design based on stormwater infiltration into native soils is proposed, soils infiltration tests shall be performed by a registered Professional Geotechnical Engineer licensed in the State of Oregon to document the permeability and infiltration capacity, as summarized under PWDS 3.21, based on ASTM standard testing methods.

(3) Under Drain Requirements. Where the measured infiltration of the underlying native soils is less than 2 inches per hour, a perforated collection pipe must run the length of the facility within the drain rock layer to prevent long-term ponding. The perforated pipe is to collect flows passing through the growing medium and convey it by gravity to an approved point of discharge.

(4) Storage volume within the water quality mix and choker course is to be calculated with a 20% void ratio and storage volume within the drain rock is to be calculated with a 40% void ratio.

(5) Filtration through the water quality mix is to be assumed at 2 inches per hour times the wetted surface area of the facility.

(6) The facility must be designed with a maximum treatment water depth of 12 inches *(measured from top of water quality mix)* and filter the entire water quality storm through the water quality mix. For facilities not protected by a high flow storm diversion device, a minimum freeboard of 12 inches is required above the design water surface (*ie. high flow storm*), except that freeboard may be reduced to 6 inches where perimeter curbs are provided.

(7) The facility must be designed to drain stormwater below the bottom of the water quality mix within 30-hours after the end of the water quality storm event.

(8) For facilities with side slopes, the water quality mix should extend 3 inches minimum above the peak water surface reached during the water quality storm event.

(9) The facility shall incorporate an energy dissipation feature at the inlet. The inlet(s) and outlet must be located to provide the maximum linear separation feasible.

i) Planting Requirements (Stormwater Planter or Rain Garden).

(1) The entire facility should be planted with herbaceous rushes, sedges, perennials, ferns and shrubs that are well-suited to wet-

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to-moist soil conditions. If the facility has side slopes, soil conditions will vary from wet to relatively dry and several planting zones should be considered. Areas above the designed high water line are to be planted with self-sustaining, low maintenance grasses, ground covers, perennials, and shrubs suitable for the local climate.

(2) All vegetation should be planted densely and evenly in quantities per 100 square feet of:

(a) 115 herbaceous plants, 1' on center spacing, 4" pot container size; or

(b) 100 herbaceous plants, 1' on center (4" pot container size), and 4 shrubs 2' on center (1-gal container size).

(3) Prior to planting, facility treatment areas shall install coconut or jute matting over the entire surface or equivalent approved by the City Engineer.

(4) Bark mulch is not allowed on the interior slopes or top of the facility.

(5) Provide supplemental water for a minimum of two years from June 1st to October 15th with 1" of water per week.

j) Construction & Permanent Setbacks (Stormwater Planter or Rain Garden).

(1) Before site work begins, clearly mark infiltration facility areas to avoid soil disturbance during construction. No vehicular traffic should be allowed within 10 feet of infiltration facility areas, except as necessary to construct the facility.

(2) Facilities infiltrating directly to the underlying soils shall be located at least ten feet from building foundations and shall not be located immediately upslope of building structures.

(3) All stormwater treatment facilities shall be set back a minimum of five feet from side lot property lines and easements where the adjoining property is downslope. Where the adjoining property is at the same grade or upslope from the facility, no set back is required.

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3.20 PRIVATE STORM DRAINAGE COLLECTION SYSTEMS

a. Private storm drainage collection systems shall be designed in conformance with main line standards specified herein when plumbing code grade requirements of Oregon Plumbing Specialty Code (OSPC) cannot be met. The private storm drainage collection systems shall conform to the detention requirements contained herein as applicable.

b. These provisions of the PWDS do not, nor are they intended to supersede the Oregon Plumbing Specialty Code (OPSC), but are intended to allow the design engineer flexibility in the design of private storm drainage systems where the OPSC minimum slope requirements cannot be satisfied.

3.21 INFILTRATION SYSTEMS, DRYWELLS AND FRENCH DRAINS

a. Infiltration systems, drywells and french drains are not allowed as the exclusive method for draining public right-of-ways but may be used for developments on private property for buildings, paved driveways, parking and loading spaces, subject to the all of the following conditions:

1) There are no public storm drain facilities, available within a reasonable distance of the development as determined by the City Engineer. The need to acquire easements across private property to access a public storm drain facility that is within a reasonable distance shall not be grounds for allowing an infiltration system unless all other criteria are met.

2) Site Specific Infiltration Testing Required. If a design based on stormwater infiltration are proposed, soils infiltration tests shall be performed by a registered Professional Geotechnical Engineer licensed in the State of Oregon to document the permeability and infiltration capacity. The Geotechnical Engineer shall develop a recommended infiltration testing methodology using test methods and sound engineering principles appropriate to the specific site being tested (*test methods proposed must demonstrate infiltration capacity of the site soils, as opposed to percolation capacity*). A detailed summary of the proposed methodology and test procedures shall be submitted to the City Engineer a minimum of 7 business days in advance of the proposed testing, for review and comment by the City Engineer.

Infiltration tests shall be conducted at the location and depth of the proposed infiltration facility. The Geotechnical Engineer shall perform a field evaluation of the soils to demonstrate that the highest seasonal water table is not within 5 feet of the ground surface, or within 2 feet of the bottom of the proposed infiltration facility. A final infiltration report stamped by the Geotechnical Engineer shall be provided with the design drawings submitted for review by the City.

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3) Reserve Capacity. The system shall be engineered to ensure that adequate reserve capacity is available. Adequate reserve capacity shall include all runoff assuming the maximum amount of impervious area allowed by City Code based on zoning.

4) Replacement Area Agreement. The system shall include an instrument recorded against the property reserving a area adequate for a replacement infiltration system equal in size to the primary system.

5) Grease & Fines Removal, Maintenance Agreement. Provisions shall be made for grease and fines removal, including recording of a maintenance agreement *(acceptable to the City Engineer & City Attorney)* against the property.

6) The site shall be graded so that it does not drain onto a public right-of-way without a storm drain system or neighboring property in the event that the drywell or french drain fails. The site and adjacent down gradient areas shall have no history of groundwater surfacing or being within 12-inches of the ground surface during the wet winter months, and shall not have field tile systems which may convey the infiltration water onto neighboring property.

7) The design shall include pretreatment conforming with Oregon DEQ standards for groundwater injection wells, shall be acceptable to the City Engineer, and shall be approved by and registered with DEQ prior to final plan approval by the City.

b. DEQ Registration Required. Where drywells, french drains or other infiltration systems are authorized & allowed, they shall be registered with the Oregon DEQ to the extent required by DEQ under OAR 340-044-005 through 340-044-055 prior to final approval by the City and construction *(in addition to the standards above)*. Only DEQ "rule authorized" infiltration systems are acceptable, unless otherwise approved by DEQ and the City Engineer. Under these DEQ regulations, stormwater dry wells are "rule authorized" if they meet certain standards as determined by DEQ *(conformance with current DEQ/EPA standards must be confirmed prior to submittal for review by the City)*. These standards restrict the use of dry wells under the rule authorized provisions to the following.

1) No other method of storm water disposal, including construction or use of surface discharging storm sewers or surface infiltration systems, is appropriate. An appropriate method shall protect groundwater quality and may consider management of surface water quality and watershed health issues.

2) No domestic drinking water wells are present within 500 feet of the injection system.

3) The injection system does not exceed a depth of 100 feet and the bottom of the infiltration structure is a minimum of 10 feet above the highest seasonal groundwater level.

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c. It should be noted that DEQ standards consider water draining from building roof areas *(that has not been mixed with any other stormwater)* differently, in that it can be discharged in a dry well without the same level of treatment required for other types of runoff, although it must still comply with the City and DEQ criteria above and receive DEQ approval prior to final City approval or construction.

3.22 STORM DRAIN SERVICE LATERALS

a. All single family and duplex lots shall be served with a private storm drain service lateral or private storm drain mainline located to provide drainage to the entire lot, as well as being provided with an approved private area drain at the lowest back corner of the lot in order to provide for positive drainage of the lot and to prevent roof & surface drainage from flowing onto adjacent properties or across pedestrian access routes.

b. The Public Works Director may grant a Public Works variance to this requirement under the following conditions:

1) The finish grade of the lot shall have a minimum 2% slope from the back of the lot to the fronting curb so as to allow the roof drains, footing drains and back of the lot to flow to the fronting curb, and a curb weephole and drain pipe under the sidewalk is provided at the low end of the lot frontage.

2) The Subdivision Design Engineer certifies the subdivision grading is constructed in accordance with the approved drawings and is adequate to meet the requirements of this section.

3) The Subdivision Design Engineer shall certify that the subdivision grading does not block drainage from any adjacent properties.

4) The Subdivision Design Engineer shall provide as-built elevations for each lot to document Number 1 above.

5) The Subdivision Design Engineer shall provide a preliminary lot grading plan for each lot. This does not need to be a detailed grading plan. It merely needs to show the following information.

a) Finish Floor (FF) elevation of the proposed home.

b) Finish Grade (FG) of the ground immediately adjacent to the home.

c) FG at each lot corner.

d) Slope/Grade away from the home in accordance with Appendix F of the Oregon Structural Specialty Code and the Oregon Residential Specialty Code, as applicable.

e) Slope/Grade from the rear property line to the street curb. The

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slope/grade must be set at a minimum 2% to be in compliance with the PWDS.

6) The plan described in 5 above shall be provided to each individual lot owner for incorporating into the actual home design for each lot. The modified lot grading plan shall be submitted to the Building Official and incorporated into the building permit set. A Building Permit will not be issued if this plan is not provided.

c. Additional storm laterals must be stubbed into the property lines sufficient to serve all residential parcels *(including those which can be further partitioned in the future)* where such service or future partition would require that new streets be cut to install such services, or where the service line must cross intervening property to provide such future service.

d. As a minimum criterion, construction of the storm service laterals shall be of the same quality and meet the same requirements as the public storm drain with regard to materials, watertightness, and location. In addition, these storm drains shall conform to the State and local plumbing codes and restrictions.

e. Storm Lateral Connection Location.

1) Storm drainage service laterals shall not tie into public storm manholes unless approved by City Engineer and Public Works Director on a case-by-case basis. Where allowed, lateral inverts shall provide a minimum of 0.5 feet fall across the manhole, or the lateral shall match crowns with the outlet pipe, whichever is higher.

2) Connection of a storm lateral to a public catch basin is allowed, subject to approval by the Public Works Director.

f. An easement shall be recorded for any storm lateral which encroaches on or crosses any property other than one being served.

g. Storm Service Lateral Cleanouts.

1) A cleanout *(set in a cleanout box conforming with City standard details)* shall be installed at the right-of-way or easement line for all storm drain service laterals.

a) The storm drain service lateral shall extend beyond the property line/storm easement boundary cleanout to the back of any PUE fronting the right-of-way or easement, or to the far side of easements for public utilities, whichever is further.

2) Where storm laterals are required or shown along flagstem or common use driveways *(or which cross property other than that being served)*, the pipe shall be extended to the end of the driveway or to the boundary of the lot

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being served *(whichever is farther)* in conjunction with the development infrastructure construction.

h. Minimum Storm Lateral Diameter and Slope.

1) For storm service laterals connected to storm mainlines, manholes or catch basins, the minimum inside diameter of a storm drain lateral shall be four (4) inches and shall be equal to or greater than the building drain or private site storm drain diameter.

2) Typical minimum diameter for multi-family, commercial, industrial or public properties shall be 6-inch *(in part to avoid the need to cut public streets in the future, if a more intense use is proposed for the property, which results in increased flows)*.

3) Storm service lateral slope shall be uniform from the mainline connection to the property line *(or easement)* cleanout, and shall conform with the City standard details *(2% minimum)*.

i. Storm Laterals Crossing Other Property. Any storm lateral intended to serve/drain a parcel located to the rear and above *(in elevation)* another parcel fronting a right-of-way that contains a storm drain mainline, must be directly connected to such storm mainline, and shall not daylight through a curb weep hole.

1) In all cases, the storm lateral from the rear parcel shall be located within a private utility easement granted by the lower property owner.

2) In addition to any cleanouts required by the Oregon Plumbing Specialty Code, there must also be a cleanout installed at the right-of-way boundary where the lateral exits the lower property, as well as where the storm drain lateral exits the upper property.

j. Curb/Gutter Stamp. Where storm drain laterals tied to storm mainlines in the street, the top of curb and the gutter pan shall be stamped at the point of the service crossing as required by the standard details and standard notes.

k. Perpendicular. Unless otherwise approved in writing by the City Engineer and the Public Works Director on a case-by-case basis, storm drain laterals shall be installed from the mainline to the property line perpendicular to the street centerline.

1) Permanent installation of storm service laterals parallel with the right-of-way is generally prohibited, except where extenuating circumstances exist which meet the criteria for a PWDS variance.

l. Backlot Storm Drain Systems and Area Drain Locations.

1) Where lots are proposed or required to be served by backlot drainage systems *(ie. public or private drainage system outside of the public right-of-way)*, each

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lot shall be provided with an approved private area drain at the lowest back corner of the lot in order to provide for positive drainage of the lot and to prevent roof & surface drainage from flowing onto adjacent properties.

m. Private Storm Pump Systems.

1) As noted under PWDS 3.9.a.5, gravity storm service is required where possible. Installation of private storm pumps is not typically allowed except with express prior written approval by the Public Works Director and/or the Building Official as applicable *(written approval during building permit review where Type B Public Works permits are not required, and prior to submittal of project design drawings for review otherwise).*

2) A private storm pump system shall not be allowed to serve more than one legal lot of record.

3) Any private storm pump stations approved by the City shall meet standards established by the Oregon Plumbing Specialty Code (OPSC), the Public Works Director *(see PWDS 3.3)* and other applicable codes or standards *(whichever is more stringent).*

a) Per OPSC Chapter 11, capacity of each private storm pump shall be designed based on the maximum projected roof or paved area to be handled and rainfall intensities per OSPC Table D101.1 for western Oregon *(0.014 gpm per square foot).*

b) In areas with the potential for seasonal high groundwater levels, the storm pump system basin shall be anchored with concrete or equivalent method to prevent floatation.

c) The storm pump system discharge shall be equipped with a swing check valve to prevent backflow from the discharge line into the receiving basin, and with an isolation valve located on the discharge side of the check valve *(per OPSC 1101.6.2.5).* The sump pump check valve shall be placed in a suitable location and/or box/vault that provides adequate access for inspection, repairs and replacement *(provide unions on both sides of check valves in facilitate removal for cleaning and/or replacement).*

d) Per OPSC 1101.14, any storm pump system serving any "public use" shall have duplex alternating pumps arranged to function alternatively in normal use and independently in case of overload, clogging or mechanical failure. Duplex pump systems shall be equipped with an accessible visible and audible alarm activated in the event of pump failure *(overload, mechanical failure or high water condition).*

e) Drawings shall be submitted for review by Public Works Director and/or the Building Official as applicable, with enough information to allow

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review of design features, including listing of the area being drained and the design flowrates as noted above. Provide cut sheets and manufacturer's information for the proposed pumps & controls, anchor block or ballast sizing, etc.

f) Unless larger piping sizes are required by the Plumbing Official *(based on OPSC capacity sizing noted above)*, discharge lines from the pumped storm system to the discharge point should be a minimum diameter of 1½-inches.

4) Easements. The developer shall be responsible for obtaining and recording private utility & access easement(s) for any portions of the storm pump discharge system *(including piping)* which encroaches on or crosses a legal lot other than that being served by the private storm pump system.

5) An operation & maintenance agreement acceptable to the City shall be recorded against the property.

3.23 STORM DRAIN MAINLINE & LATERAL TV INSPECTION

a. In addition to other testing and inspections required by City standards, the following pipeline TV inspection standards shall apply to new public storm drain mainlines and associated storm drain laterals constructed within the jurisdictional limits of the City, or as part of City projects.

1) All storm systems shall be color video-inspected and approved prior to City acceptance. Video inspection shall take place after trench backfill and compaction and mandrel testing has been completed and accepted, and channels have been poured in manholes. All pipes shall be thoroughly flushed immediately prior to the video inspection; only that water remaining from flushing shall be present in the system.

2) The camera shall have the ability to tilt up to 90 degrees and rotate 360 degrees on the axis of travel. An inspection of all lateral connections shall be conducted using the tilt capabilities of the camera.

3) A 1.0-inch target ball shall be placed in front of the camera *(suspended so that it touches or drags on the pipe bottom, within the camera field of view)*. Observed sags must be less than 0.5 inch.

4) The City's authorized representative shall be notified and shall be present during video-inspection of the system, unless otherwise approved by the City's authorized representative.

5) A copy of the video and a written video inspection report, on a City-approved form, shall be supplied to the City's authorized representative. The video shall be recorded in color and in DVD, thumb drive, or downloadable format.

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Video must be in a format readable using standard Microsoft video applications shall include a visual footage meter recording. Problems revealed during the inspection shall be noted on the video and in the written report. After repairs have been made, the line shall be re-inspected and re-tested. If excessive foreign material, in the opinion of the City's authorized representative, is encountered during video inspection, the line shall be balled and flushed, and re-video inspected.

6) Pipeline evaluation applications must be Granite XP, WinCan, IT Pipes, PipeLogix, or other City approved product.

7) Video camera operator shall take the time to visually document all offset joints, connections, cracks and other pipe damage. Notations in reports shall include location and orientation in pipe so that the reviewer can accurately identify surface location in the field using wheel, tape or other measuring device.

8) Mainline launched video inspections of all storm laterals *(ie. lateral launch camera)* are required and shall extend at least five (5) feet beyond the right-of-way/property line, or to the back of the PUE, whichever is further.

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