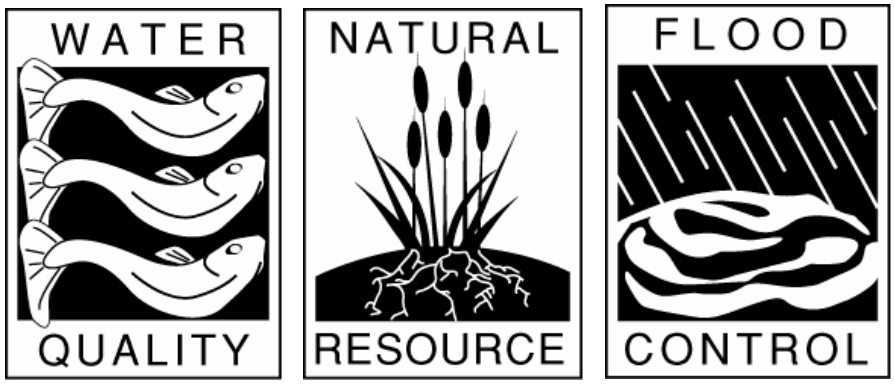
APPENDICES

2014



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APPENDIX A

EUGENE CITY CODE SECTIONS
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Eugene City Code Sections 9.6790 - 9.6796

9.6790 **Stormwater Management Manual.** In order to implement Section 9.6791 through 9.6797 of this code, the City Manager shall adopt in accordance with EC 2.019, City Manager – Administrative and Rulemaking Authority and Procedures, a Stormwater Management Manual. The Stormwater Management Manual may contain forms, maps and facility agreements and shall include requirements that are consistent with the following goals:

(1) Reduce runoff pollution from development by reducing impervious surfaces and capturing and treating approximately 80% of the average annual rainfall.

(2) Control and minimize flows from development in the Headwater Areas using a variety of techniques to release water to downstream conveyance systems at a slower rate and lower volume, thereby reducing the potential for further aggravation of instream erosion problems.

(3) Emphasize stormwater management facilities that incorporate vegetation as a key element, and include design and construction requirements that ensure landscape plant survival and overall stormwater facility functional success.

(4) Operate and maintain stormwater management facilities in accordance with facility-specific O & M Plans.

(5) Reduce pollutants of concern that are generated by identified site uses and site characteristics that are not addressed solely through the stormwater quality measures by implementing additional specific source control methods including reducing or eliminating pathways that may introduce pollutants into stormwater, capturing acute releases, directing wastewater discharges and areas with the potential for relatively consistent wastewater discharges to the wastewater system, containing spills on site, and avoiding preventable discharges to wastewater facilities, surface waters or ground waters.

(6) Except as otherwise allowed by this land use code, allow disturbances or development within drainage ways only when all of the following conditions exist:

(a) The disturbance or development will not impede or reduce flows within the drainage way;

(b) The disturbance or development will not increase erosion downstream; and

(c) The constructed pipe system is sized to convey all of the runoff from the upstream watershed when the upstream watershed is completely developed.

(Section 9.6790 added by Ordinance No. 20369, enacted June 14, 2006, effective July 14, 2006; amended by Ordinance No. 20417, enacted August 11, 2008, effective July 7, 2009; and Ordinance No. 20521, enacted January 13, 2014, effective March 1, 2014.)

9.6791 **Stormwater Flood Control.**

(1) **Purpose.** The purpose of EC 9.6791 is to protect life and property from flood and drainage hazards by maintaining the capacity of the city's stormwater conveyance system through the establishment of flood control regulations for stormwater runoff.

(2) Applicability and Exemptions.

(a) Except as provided in EC 9.6791(2)(b), flood control standards apply to all development permit applications and land use applications.

(b) The standards in EC 9.6791(3) do not apply to development permit applications where the proposed development will be served by a flood control facility that is a manmade drainage system designed to accommodate stormwater run-off generated by the stormwater basin area.

(3) Standards.

(a) Stormwater flood control facilities shall be designed and constructed according to adopted plans and policies, and in accordance with standards in EC Chapters 6 and 7, and the stormwater flood control provisions and the facility design requirements set forth in the Stormwater Management Manual.

(b) Based on the Rational Method flow calculation, stormwater runoff from the development site for the flood control design storm shall be:

1. Discharged into existing stormwater flood control facilities that, considering all developments that have received tentative or final plan approval as of the date the applicant submits a complete application, have the capacity to handle the stormwater runoff; or
2. Retained or detained onsite; or
3. Discharged into a new stormwater flood control facility constructed by the applicant.

(4) Underground Injection Control Systems. Stormwater runoff discharged in underground systems is also regulated through the federal Underground Injection Control (UIC) program under Part C of the Safe Drinking Water Act (42 U.S.C. § 300, Chapter 6A, Subchapter XII) and Oregon Administrative Rule Chapter 340, Section 044.

(Section 9.6791 added by Ordinance No. 20369, enacted June 14, 2006, effective July 14, 2006; amended by Ordinance No. 20417, enacted August 11, 2008, effective July 7, 2009; and Ordinance No. 20521, enacted January 13, 2014, effective March 1, 2014.)

9.6792 Stormwater Quality.

(1) Purpose. The purpose of EC 9.6792 is to reduce runoff pollution and mitigate the volume, duration, time of concentration and rate of stormwater runoff from development by implementing stormwater management techniques that promote the use of natural and built systems for infiltration, evapotranspiration and reuse of rainwater and that use or mimic natural hydrologic processes while capturing and treating approximately 80% of the average annual rainfall.

(2) Applicability and Exemptions.

(a) The standard in EC 9.6792(3)(a) applies to all land use applications submitted after March 1, 2014, that do not propose construction of a public street, private street or a shared driveway.

(b) The standards in EC 9.6792(3)(b), (e)-(g) apply to all land use applications submitted after March 1, 2014, that propose construction of a public street.

(c) The standards in EC 9.6792(3)(c), (e)-(g) apply to all land use applications submitted after March 1, 2014, that propose construction of a private street or shared driveway.

(d) Except as exempt under EC 9.6792(2)(e), the standards in EC 9.6792(3)(d)-(g) apply to applications for all development permits submitted after March 1, 2014.

(e) The standards in EC 9.6792(3)(d)-(g) do not apply to development permit applications:

1. For the construction of less than 1,000 square feet of new or replaced impervious surface within a 12 month period;
2. For interior alterations of an existing structure;
3. For the construction of more than 1,000 square feet of impervious surface that replaces existing impervious surface for purposes of maintenance or repair for the continuance of the current function, providing that as part of such maintenance and repair the applicant is replacing less than 50% of the length of the stormwater drainage system (including pipes, drainageway catch basins and drywells) on the development site;
4. For the construction of new or replaced impervious surface where all of the stormwater runoff from the impervious surface will discharge into an on-site, privately maintained underground injection control system that is registered and approved by the Oregon Department of Environmental Quality;
5. For the construction of a one or two family dwelling on a lot or parcel that was created by a land division application submitted and approved by the City prior to March 1, 2014, that is consistent with the approved land use application and the City's stormwater quality (pollution reduction) standards in place at the time of the land division application; or
6. For the construction of a one or two family dwelling on a lot or parcel that was created by a land division application that included the construction of a public or private street or shared driveway submitted and approved by the City after March 1, 2014, if the lot or parcel adjoins the public or private street or shared driveway and the facility within the public or private street or shared driveway is an infiltration or filtration facility designed and sized to accommodate stormwater runoff from the adjoining lots or parcels at full buildout of the lots or parcels.

(3) Standards.

(a) For land use applications not proposing the construction of a public or private street or shared driveway, the applicant shall submit a site development plan that delineates the following conditions existing on the development site:

1. Infiltration rates less than 2 inches per hour;
2. Bedrock less than 5 feet below the ground surface;
3. Groundwater elevations less than 6 feet; or,
4. Ground surface slopes greater than 10%.

(b) For land use applications proposing the construction of a public street, stormwater quality facilities to treat the stormwater runoff from the proposed public street shall be selected from the Stormwater Management Manual and shall be based on the following priority order: infiltration, filtration, mechanical treatment.

1. If selecting an infiltration or filtration facility to treat the stormwater runoff from the public street, the facility can be sized to also treat

the stormwater runoff from the one and two family dwelling lots or parcels adjoining the public street based on full buildout of those lots or parcels.

2. If using a mechanical facility to treat the stormwater runoff from the public street or if the infiltration or filtration facility is not sized to also treat the stormwater runoff from the adjoining lots or parcels at full buildout, all lots or parcels created by the land division application shall comply with EC 9.6792(3)(d)-(g) at the time of development permit application.

(c) For land use applications proposing construction of a private street or shared driveway, stormwater quality facilities to treat the runoff from the proposed private street or shared driveway shall be selected from the Stormwater Management Manual and shall be based on the following priority order: infiltration, filtration.

1. An infiltration or filtration treatment facility to treat the stormwater runoff from the shared driveway or private street can be sized to treat the stormwater runoff from the proposed one and two family dwelling lots or parcels that adjoin the shared driveway or private street based on full buildout of those lots or parcels.
2. If the infiltration or filtration facility is not sized to treat the stormwater runoff from the adjoining lots or parcels at full build out, all lots or parcels created by the land division application must comply with EC 9.6792(3)(d)-(g) at the time of development permit application.

(d) For development permit applications, stormwater quality facilities shall be selected from the Stormwater Management Manual and shall be based on the following priority order: infiltration, filtration, off-site stormwater quality management.

1. If selecting a filtration treatment facility, the applicant shall submit a report that demonstrates at least one of the following development site conditions exist:
   a. Infiltration rates are less than 2 inches per hour;
   b. Bedrock is less than 5 feet below the ground surface;
   c. Groundwater elevations are less than 6 feet; or,
   d. Ground surface slopes are greater than 10%.
2. If selecting off-site stormwater quality management by contributing to the public off-site stormwater quality facilities, through payment of a higher stormwater system development charge adopted as part of the City's system development charge methodology, the applicant shall submit a report that demonstrates there is insufficient land area to construct an approved infiltration or filtration facility by setting forth the required size of the smallest infiltration or filtration facility needed for the development's impervious surface area and a site plan demonstrating that an approved infiltration or filtration facility cannot be located on the development site without reducing the size of the proposed development which is otherwise consistent with all other applicable lot and development standards.

(e) The selected stormwater quality facilities shall treat all stormwater runoff from all new or replaced impervious surface areas, or an equivalent on-site area, that will result from the water quality design storm except that

the selected the stormwater quality facility does not need to treat the stormwater runoff from new or replaced impervious surface that is 500 sq. feet or less and does not gravity-feed into the selected treatment facility.

(f) All stormwater quality facilities shall be sited, designed and constructed according to the water quality provisions and the facility design requirements set forth in the Stormwater Management Manual.

(g) The standards in EC 9.6792(3) may be adjusted pursuant to EC 9.8030(24).

(Section 9.6792 added by Ordinance No. 20369, enacted June 14, 2006, effective July 14, 2006; and Ordinance No. 20521, enacted January 13, 2014, effective March 1, 2014.)

9.6793 Stormwater Flow Control (Headwaters).

(1) Purpose. The purpose of EC 9.6793 is to protect waterways in the headwaters area from the erosive affects of increases in stormwater runoff peak flow rates and volumes resulting from development.

(2) Applicability and Exemptions.

(a) Except as exempt under EC 9.6793(2)(c), the standards in EC 9.6793(3) apply to all land use applications for development sites in the headwaters area that drain directly into a headwater stream or drain into a pipe that discharges into a headwater stream that are submitted after July 14, 2006 requesting approval of one or more of the following:

1. A cluster subdivision - tentative plan (EC 9.8055);
2. A conditional use (EC 9.8090 or 9.8100);
3. A partition - tentative plan (EC 9.8215 or 9.8220);
4. A planned unit development - tentative plan (EC 9.8320 or 9.8325);
5. Site review (EC 9.8440 or 9.8445);
6. A subdivision tentative plan (EC 9.8515 or 9.8520).

(b) Except as exempt under EC 9.6793(2)(c), the standards in EC 9.6793(3) apply to all applications for development permits for development sites in a headwaters area that drain directly into a headwater stream or drain into a pipe that discharges into a headwater stream that are submitted after July 14, 2006.

(c) The standards in EC 9.6793(3) do not apply to:

1. A land use application that will result in the construction or creation of less than 1,000 square feet of new or replaced impervious surface at full buildout of the development.
2. A development permit application for any of the following:
   a. Development of a lot or parcel included in a land use application that was determined by the city to comply with the standards in EC 9.6793(3). For such a development permit, the approved land use plan shall control.
   b. Development of a lot or parcel that was not included in a land use application that was determined by the city to comply with the standards in EC 9.6793(3) and:
      (1) Will result in less than 1,000 square feet of new or replaced impervious surface within a 12 month period; or
      (2) Is to construct or alter a one or two family dwelling; or

(3) Is for the replacement of more than 1,000 square feet of impervious surface for purposes of maintenance or repair for the continuance of the current function, providing that as part of such maintenance and repair the applicant is replacing less than 50% of the length of the stormwater drainage system (including pipes, drainageway catch basins and drywells) on the development site.

3. Development sites within a drainage basin for which the city has constructed or approved a project to restore the receiving waterway, and the entire downstream system has been designed to accommodate full build-out conditions within the drainage basin.

(3) Standards.

(a) Applications shall demonstrate, using methodology in the Stormwater Management Manual, that peak rates of flow delivered to an existing open waterway at a point above 500 feet in elevation will not increase during storms larger than the water quality design storm and smaller than the flood control design storm as a result of the development that is the subject of the application;

(b) For purposes of designing the system as required by the standards in this section, the amount of impervious surface per lot is assumed to be the maximum lot coverage allowed for the use in the zone in which it is located, unless the applicant demonstrates otherwise.

(c) All facilities to control the rate of stormwater runoff shall be sited, designed and constructed according to the flow control provisions and the facility design requirements set forth in the Stormwater Management Manual. Flow control facilities must be designed using one of the methodologies outlined in the Stormwater Management Manual.

(d) The standards in EC 9.6793(3) may be adjusted pursuant to EC 9.8030(24).

(Section 9.6793 added by Ordinance No. 20369, enacted June 14, 2006, effective July 14, 2006.)

9.6794 <u>Stormwater Oil Control</u>.

(1) Purpose. The purpose of EC 9.6794 is to protect the city's stormwater system from oil and grease from stormwater runoff of impervious surface areas on properties that produce high concentrations of these pollutants.

(2) Applicability. Oil control standards set forth in EC 9.6794(3) apply to:

(a) All new commercial and industrial development with parking lots that store wrecked or impounded vehicles; or

(b) Any development that would result in an expected daily traffic count greater than one hundred vehicles per 1,000 square feet of gross building area, based on the most recent version of The Institute of Transportation Engineers' Trip Generation Manual; or

(c) Any development that would result in 100 or more off-street parking spaces; or

(d) Any commercial or industrial development that receives an adjustment approving the installation of 125 percent or more of the minimum off-street parking spaces required by EC 9.6410(3), Minimum Number of

Required Off-Street Parking Spaces and that adjustment will result in, at least, a total of 10 parking spaces.

(3) Standards. Unless adjusted pursuant to EC 9.8030(24), all oil control facilities shall be sited, designed and constructed according to the oil control provisions and the facility design requirements set forth in the Stormwater Management Manual.

(Section 9.6794 added by Ordinance No. 20369, enacted June 14, 2006, effective July 14, 2006.)

9.6795 Stormwater Source Controls.

(1) Purpose. The purpose of EC 9.6795 is to prevent stormwater pollution by eliminating pathways that may introduce pollutants into stormwater.

(2) Applicability and Exemptions. Except as exempted below and except when the source control would duplicate source controls required by a state or federal permit obtained by the applicant, source control standards set forth in EC 9.6795(3), apply to all land use applications, development permits and tenant improvements that result in any of the defined site uses or characteristics listed in EC 9.6795(2)(a)–(h).

(a) Fuel dispensing facilities and surrounding traffic areas where vehicles, equipment, or tanks are refueled on the premises. A fuel dispensing facility is the area where fuel is transferred from bulk storage tanks to vehicles, equipment, and/or mobile containers. Exempt from this subsection are:

1. Propane tanks.
2. Fuel dispensing areas generally used to service oversized equipment, for example cranes, that cannot maneuver under a roof or canopy.
3. Existing fueling areas where scope of work is limited to a new canopy installation over an existing fuel pad that is not being upgraded, an underground tank replacement for compliance with state regulations, or the replacement of a fuel pump on an existing fuel pad that is not being upgraded.

(b) Exterior storage of liquid materials, for example chemicals, food products, waste oils, solvents, process wastewaters, or petroleum products in aboveground containers, in quantities of 50 gallons or more, including permanent and temporary storage areas. Exempt from this subsection are underground storage tanks or installations requiring a Water Pollution Control Facility (WPCF) permit and containers with internal protections (such as double-walled containers).

(c) All facilities that store solid waste. A solid waste storage area is a place where solid waste containers, including compactors, dumpsters, and garbage cans, are collectively stored. Solid waste storage areas include, areas used to collect and store refuse or recyclable materials collection areas. Exempt from this subsection are solid waste storage areas for one and two family dwelling and areas used for the temporary storage of wood pallets or cardboard.

(d) Developments that stockpile or store high-risk or low-risk bulk materials in outdoor containers, as the terms “high risk” and “low risk” are in the Stormwater Management Manual. Exempt from this subsection are:

1. Materials which have no measurable solubility or mobility in water and no hazardous, toxic or flammable properties.

2. Materials which exist in a gaseous form at ambient temperature.
3. Materials, except for pesticides and fertilizers, that are contained in a manner that prevents contact with stormwater.

(e) Developments proposing the installation of new material transfer areas as defined in the Stormwater Management Manual, or structural alterations to existing material transfer areas, such as access ramp re-grading and leveler installations. Exempt from this subsection are areas used only for mid-sized to small-sized passenger vehicles and restricted by lease agreements or other regulatory requirements to storing, transporting or using materials that are classified as domestic use, for example, primary educational facilities (elementary, middle or high schools), buildings used for temporary storage and churches.

(f) All development with a designated equipment or vehicle washing or steam cleaning area, including smaller activity areas such as wheel-washing stations. Exempt from this subsection are:

1. Washing activity areas generally used to service oversized equipment than cannot maneuver under a roof or canopy, for example cranes and sail boats.
2. Evaporation unit installed as part of a wash recycling system are exempt from the wastewater connection requirement.
3. One and two family dwelling sites.

Development that is intended for the storage of 10 or more fleet vehicles shall include a designated vehicle washing area.

(g) All development projects that disturb property suspected or known to contain contaminants in the soil or groundwater.

(h) All development with new covered vehicle parking areas, or existing parking structures that are being developed. Exempt from this subsection are single-level canopies, overhangs and carports.

(3) Standards. Unless adjusted pursuant to EC 9.8030(24), all source controls shall be designed and constructed according to the source control provisions set forth in the Stormwater Management Manual.

(4) Enforcement. Failure to construct, operate and maintain source controls when a land use application, development permit or tenant improvement has resulted in a defined site use or characteristic listed in EC 9.6795(1)(a)-(h) is subject to enforcement in accordance with EC Chapter 6.

(Section 9.6795 added by Ordinance No. 20369, enacted June 14, 2006, effective July 14, 2006.)

9.6796 Dedication of Stormwater Easements.

(1) Purpose. The purpose of EC 9.6796 is to ensure that city maintained stormwater management facilities designed and constructed in accordance with EC 9.6791-9.6795 and the Stormwater Management Manual can be accessed by the city for routine and/or emergency maintenance to protect life and property from flood and drainage hazards, ensure that water quality is protected, and to ensure that waterways in the headwaters area are protected from the erosive effects of runoff.

(2) Applicability. Stormwater easement standards set forth in EC 9.6796(3) apply to all land use applications and development permits that result in the construction of a city maintained stormwater management facility.

(3) Standards. The applicant must dedicate public easements approved by the city over city maintained stormwater management facilities provided the city

makes findings to demonstrate consistency with constitutional requirements. The conveyance of ownership or dedication of easements may be required in any of the following circumstances:

(a) Except for areas on the city's acknowledged Goal 5 inventory, where the subject property in the proposed development is or will be periodically subject to accumulations of surface water or is traversed by any open drainage way, headwater, stream, creek, wetland, spring, or pond, including those not maintained by the city which drain onto or from city-owned property or into city maintained facilities.

(b) For areas on the city's acknowledged Goal 5 inventory, where the subject property in the proposed development is or will be periodically subject to accumulations of surface water or is traversed by any water course or channel.

(c) Where necessary to extend public drainage facilities and services to adjoining undeveloped property.

(d) To provide necessary drainage from the public right-of-way.

(e) Where the facility will provide treatment for runoff from the public right-of-way and the City will be maintaining the facility.

(Section 9.6796 added by Ordinance No. 20369, enacted June 14, 2006, effective July 14, 2006; administratively corrected January 1, 2008; and Ordinance No. 20521, enacted January 13, 2014, effective March 1, 2014.)

9.6797 Stormwater Operation and Maintenance.

(1) All stormwater facilities shall be operated and maintained in accordance with EC Chapters 6 and 7, and the Stormwater Management Manual.

(2) Unless the applicant proposes private maintenance of the facility, a stormwater facility that will provide treatment for runoff from the public right-of-way shall be:

(a) Designed and constructed through the Privately Engineered Public Improvement (PEPI) process; and

(b) Located in public rights of way or public easements dedicated in accordance with EC 9.6796; and

(c) Selected from the list of stormwater facilities identified in the Stormwater Management Manual as a type of facility that the City will operate and maintain.

(Section 9.6797 added by Ordinance No. 20369, enacted June 14, 2006, effective July 14, 2006; and Ordinance No. 20521, enacted January 13, 2014, effective March 1, 2014.)

Eugene City Code Section 6.615

6.615 Stormwater Facility Operation and Maintenance.

(1) Purpose. The purpose of section 6.615 is to ensure that stormwater management facilities designed and constructed in accordance with sections 9.6790 through 9.6797 of this code and the Stormwater Management Manual adopted by administrative order of the city manager are operated and maintained in a manner that protects life and property from flood and drainage hazards, protects water quality, and protects the waterways in the headwaters area from the erosive effects of runoff.

(2) Applicability. Section 6.615 applies to all stormwater facilities designed and constructed in accordance with sections 9.6791 through EC 9.6797 of this code and the Stormwater Management Manual.

(3) Maintenance responsibility.

(a) Unless the city accepts the responsibility to operate and maintain a stormwater facility, all stormwater management facilities shall be privately operated and maintained.

(b) All stormwater facilities shall be operated and maintained in accordance with the applicant's Operations and Maintenance Plan submitted to the city with the application proposing the private operation and maintenance of the stormwater facility.

(4) Reports. Periodic reports verifying that the stormwater facility is and has been operated and maintained as required in (3)(b) above, shall be prepared and submitted to the city within the time and manner required by administrative rules adopted by the city manager pursuant to section 2.019 of this code.

(5) Enforcement.

(a) Inspections. The city may make periodic inspections to ensure compliance with this code, the Stormwater Management Manual, and the Operations and Maintenance Plan. Authorized representatives of the city may enter private property at reasonable times to ensure such compliance and to conduct on-site inspections or routine maintenance of stormwater facilities. If the premises are occupied, the city representative shall first present proper credentials and request entry. If the premises are unoccupied, reasonable efforts shall first be made to locate the owner or person in charge of the premises and request entry. No person shall deny a request for, or interfere or prevent any inspection authorized by this section. Should entry be refused, the city shall have recourse to every remedy provided by law to secure entry, including the issuance of a search warrant.

(b) Violations. Failure to operate and maintain a stormwater facility in accordance with section 6.615, the Stormwater Management Manual or the Operations and Maintenance Plan may result in:

1. The issuance of a stop work order or compliance order by the city;
2. The issuance of a citation into municipal court for violation of this code;
3. The imposition of an administrative civil penalty pursuant to the provisions of section 2.018 of this code as authorized by section 6.995 of this code;

4. An order to investigate all of the impacts caused by the violation; and/or
5. Abatement of the unlawful actions as a nuisance as provided in sections 6.005 through 6.115 of this code, including, but not limited to, complete restoration of all impacts to open waterways resulting from the unlawful actions.

(c) For purposes of subsections (5)(b)2 and (5)(b)3 of section 6.615, each date that the unlawful condition exists shall constitute a separate violation.

(d) For purposes of enforcing an administrative civil penalty imposed under this section and, if applicable, entry of a lien pursuant to section 2.018(11), if the violation for which the penalty was imposed involves a stormwater facility located on a portion of a planned unit development, condominium or other development that is commonly owned or owned by a homeowners' association, each parcel or unit in the development shall be liable for the administrative civil penalty, and the city may enter a lien for the full amount of the unpaid administrative civil penalty against each parcel or unit in the development.

(e) Failure to file a periodic report required by subsection (4) of this section and administrative rules adopted pursuant to that section may result in imposition of an administrative civil penalty pursuant to the provisions of section 2.018 of this code.

(f) Appeal. Any person to whom a stop work order or compliance order is issued may appeal the stop work order or compliance order within the time and in the manner prescribed in section 2.021 of this code. Notwithstanding any other provision of this code, a stop work order or compliance order shall be effective upon issuance, and shall continue in effect during the pendency of any appeal.

(6) Rules and fees. The City manager may adopt rules and fees for implementation of section 6.615, using the procedures in sections 2.019 and 2.020 respectively of this code.

(Section 6.615 added by Ordinance No. 20373, enacted November 22, 2006, effective December 22, 2006.)

Eugene City Code Section 7.143

7.143 <u>Public Improvement Construction – Wastewater Sewer Systems and Stormwater Management Facilities</u>.

(1) Unless physical constraints prevent construction or unless adjoining properties are outside the service basin, all public improvements to unimproved public ways not already containing a wastewater sewer system must include a wastewater sewer system constructed in accordance with section 7.085 of this code.

(2) All public improvements to public ways must include stormwater management facilities that are constructed in accordance with the Design Standards for Stormwater Facilities in Public Improvement Projects. Capacity of the stormwater management facilities shall be sized in accordance with the flood control design storm. The pollution reduction facilities must treat all stormwater runoff from all new or replaced impervious surface exceeding 1000 square feet, or an equivalent on-site area, that will result from the water quality design storm.

(Section 7.143 added by Ordinance No. 20390, enacted August 13, 2007, effective September 14, 2007.)

APPENDIX B

TYPICAL FACLITY DETAILS

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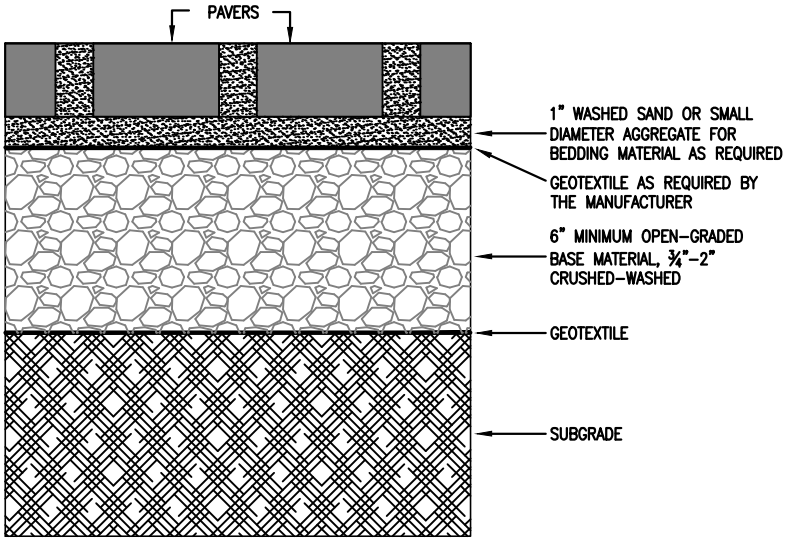
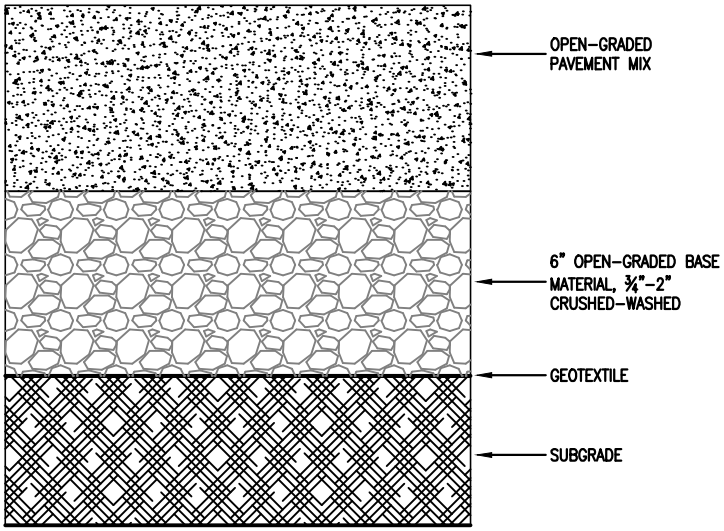
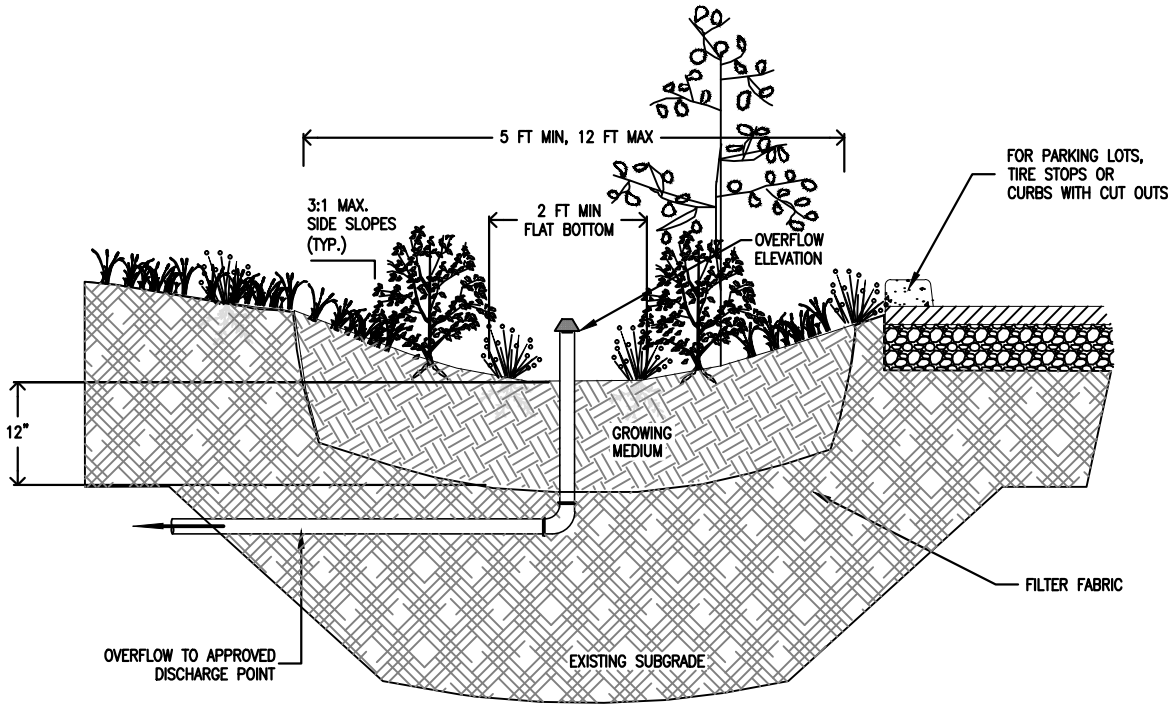


PERMEABLE CONCRETE BLOCK
OR "PAVER" SYSTEMS



PERVIOUS (OPEN GRADED) CONCRETE
AND ASPHALT

Eugene	CITY OF EUGENE, OREGON DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION	PERMEABLE PAVEMENTS TYPICAL DETAILS	DATE 1/2/2014 SCALE NTS DRAWN BY SNG



1. Provide protection from all vehicle traffic, equipment staging, and foot traffic in proposed infiltration areas prior to, during, and after construction.

2. Dimensions:
   a. Width of swale: 5' - 12'.
      Depth of swale: 12"
   b. Longitudinal slope of swale: 0.5% min and 6% max.
   c. Flat bottom width: 2' minimum.
   d. Side slopes of swale: 3:1 maximum.

3. Setbacks (from centerline of facility):
   a. Infiltration swales must be 10' from foundations and 5' from property lines.
   b. Filtration swales must have a waterproof liner when within 10' from foundation of 5' from property lines.

4. Overflow:
   a. Overflows are required to an approved point discharge point unless sized to fully infiltrate the flood control design storm.
   b. Inlet elevation must allow for 2" of freeboard, minimum.

5. Piping: Minimum 3" pipe required for up to 1,500 sq ft of impervious area, otherwise 4" min. Piping material, slopes and installation shall follow the Uniform Plumbing Code.

6. Drain rock:
   a. Size: 3/4" - 2-1/2" washed
   b. Depth: 12" minimum

7. A geotextile is required to isolate the drain rock from the subgrade and growing medium

8. Growing medium:
   a. 12" minimum
   b. Import topsoil or amended native soil

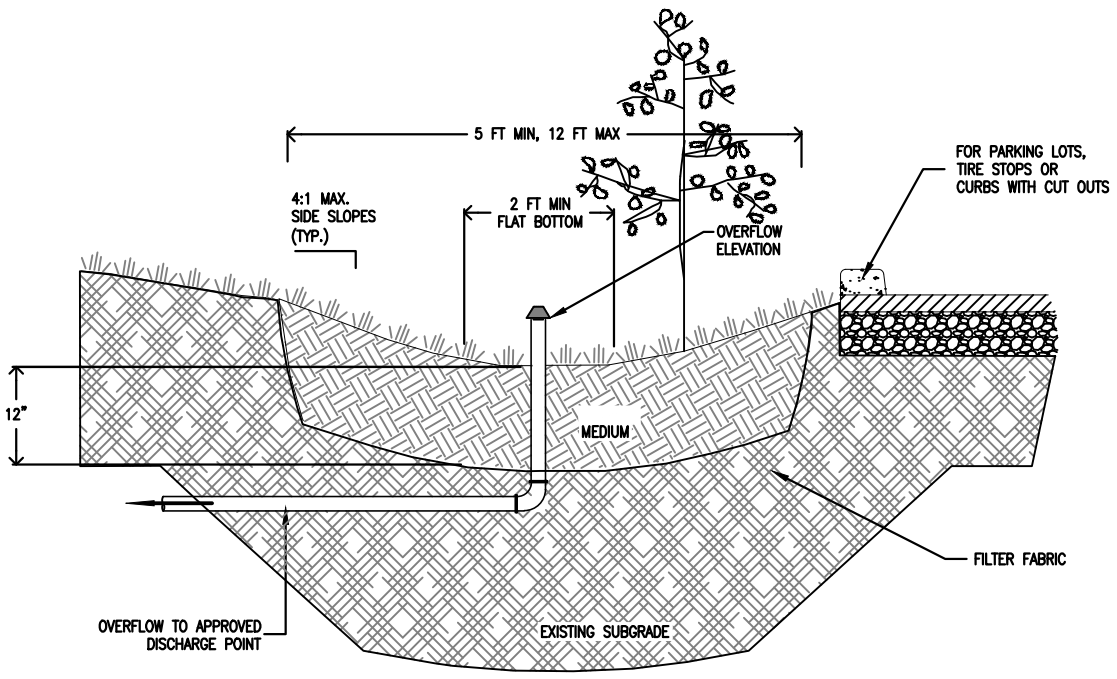
9. Vegetation: Follow landscape plans otherwise refer to plant list in SWMM Appendix F. Vegetative swales must have following plantings per 100sf of facility area:
   a. 100 Ground Covers, OR
   b. 80 Ground Covers, 2 Small Shrubs, 4 Large Shrubs, and 1 Tree (deciduous or evergreen)

10. Waterproof liner: Shall be 30 mil PVC or equivalent for flow-through facilities.

11. Install washed pea gravel or river rock to transition from inlets and splash pad to growing medium.

12. Check dams: Shall be placed at 12" intervals along the length of the swale.

Eugene	CITY OF EUGENE, OREGON DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION	VEGETATED SWALE TYPICAL DETAILS	DATE 1/2/2014 SCALE NTS DRAWN BY SNG



1. Provide protection from all vehicle traffic, equipment staging, and foot traffic in proposed infiltration areas prior to, during, and after construction.

2. Dimensions:
   a. Width of swale: 5' - 12'.
      Depth of swale: 12"
   b. Longitudinal slope of swale: 0.5% min and 6% max.
   c. Bottom width: 2' minimum.
   d. Side slopes: 3:1 maximum for vegetative and 4:1 for grassy.

3. Setbacks (from centerline of facility):
   a. Infiltration swales must be 10' from foundations and 5' from property lines.
   b. Filtration swales must have a waterproof liner when within 10' from foundation of 5' from property lines.

4. Overflow:
   a. Overflows are required to an approved point discharge point unless sized to fully infiltrate the flood control design storm.
   b. Inlet elevation must allow for 2” of freeboard, minimum.

5. Piping: Minimum 3” pipe required for up to 1,500 sq ft of impervious area, otherwise 4” min. Piping material, slopes and installation shall follow the Uniform Plumbing Code.

6. Growing medium:
   a. 12” minimum
   b. Import topsoil or amended native soil

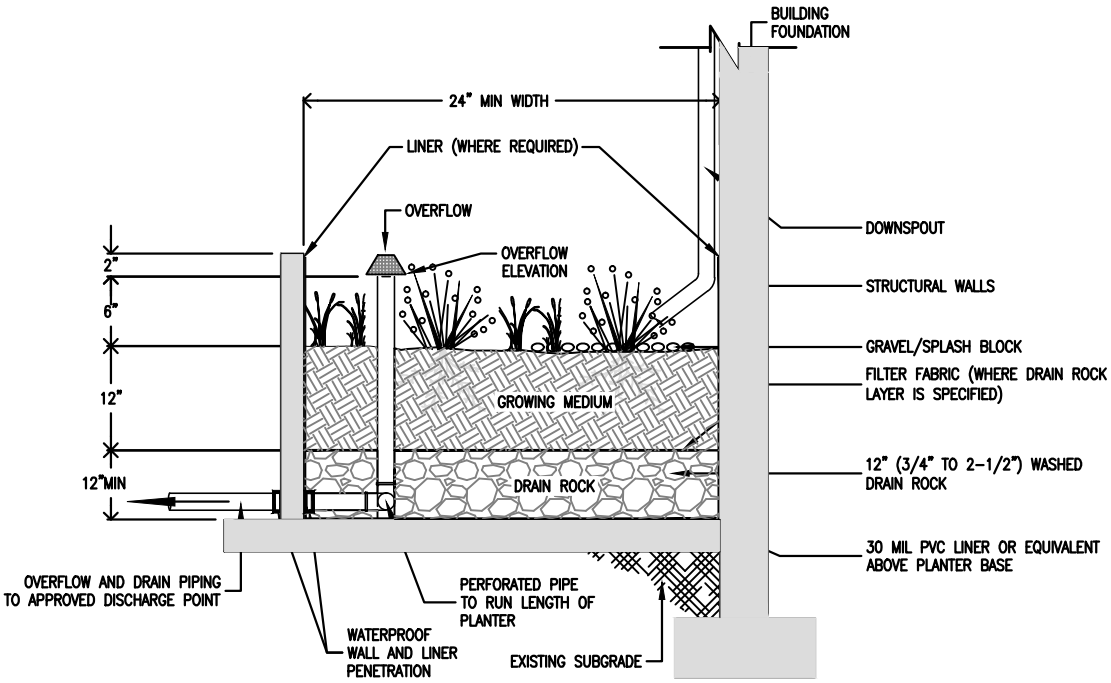
9. Vegetation: Follow landscape plans otherwise refer to plant list in SWMM Appendix F. Grassy swales must have 100 coverage. Vegetative swales must have following plantings per 100sf of facility area:
   a. 100 Ground Covers, OR
   b. 80 Ground Covers, 2 Small Shrubs, 4 Large Shrubs, and 1 Tree (deciduous or evergreen)

10. Waterproof liner: Shall be 30 mil PVC or equivalent where required.

11. Install washed pea gravel or river rock to transition from inlets and splash pad to growing medium.

12. Check dams: Shall be placed at 12" intervals along the length of the swale.

Eugene	CITY OF EUGENE, OREGON DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION	GRASSY SWALE TYPICAL DETAILS	DATE 1/2/2014 SCALE NTS DRAWN BY SNG



1. Provide protection from all vehicle traffic, equipment staging, and foot traffic in proposed infiltration areas prior to, during, and after construction.

2. Dimensions:
   a. Width of planter: 24” minimum.
   b. Depth of planter: 6" minimum from top of growing medium to overflow elevation.
   c. Slope of planter: 0.5% or less.

3. Setbacks:
   a. Infiltration planters must be 10' from foundations and 5' from property lines.
   b. Filtration planters do not require a setback with an approved waterproof liner.

4. Overflow:
   a. Overflows are required to an approved discharge point when using the Simplified Method
   b. Overflows are not required when sized to fully infiltrate the flood control event using the Presumptive Method.
   c. Minimum 2" freeboard from overflow elevation to the top of the planter walls.

5. Piping: Minimum 3” pipe required for up to 1,500 sq ft of impervious area, otherwise 4” min. Piping material, slopes and installation shall follow the Uniform Plumbing Code.

6. Drain rock:
   a. Size: 3/4” to 2-1/2" diameter open graded
   b. Depth: 12” Minimum
   c. Length and Width: Full length and width of facility

7. Drain rock layer shall be separated from the growing medium by a geotextile

8. Growing medium:
   a. 12” minimum
   b. Import topsoil or amended native topsoil

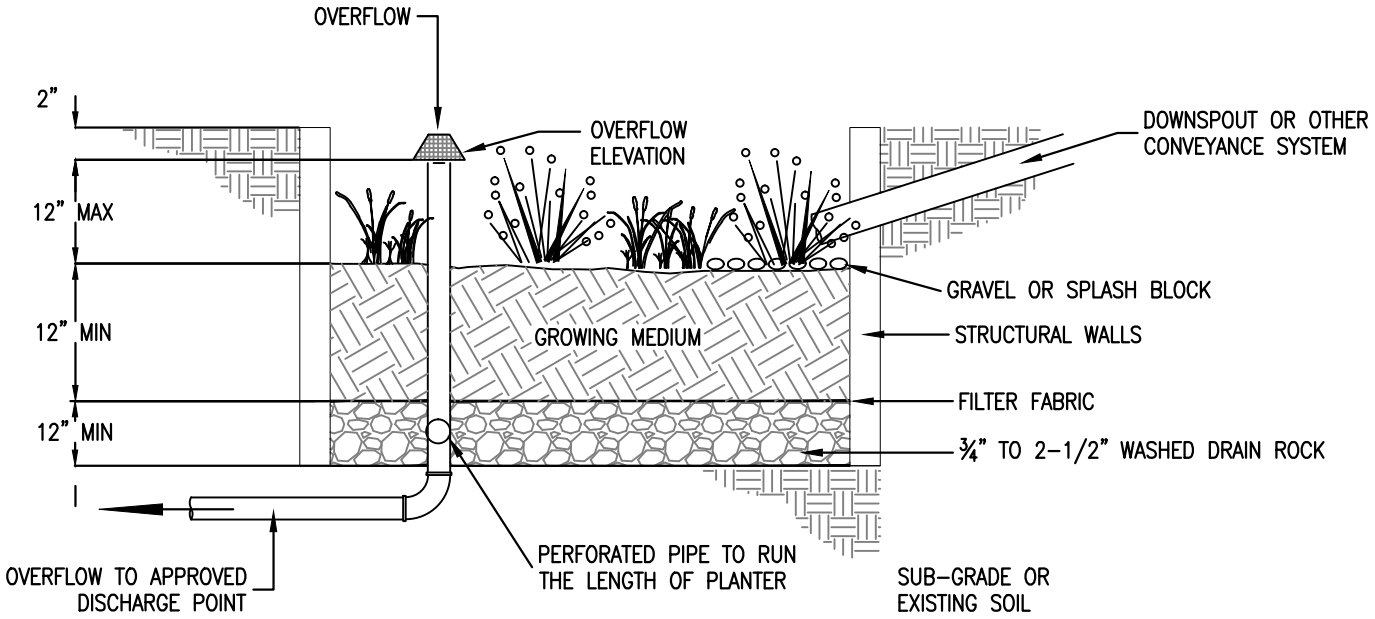
9. Vegetation: Follow landscape plans otherwise refer to plant list in SWMM Appendix F. Number of plantings per 100sf of facility area:
   a. 100 Ground Covers, OR
   b. 80 Ground Covers and 4 Small Shrubs, OR
   c. 60 Ground Covers and 12 Small Shrubs

10. Planter walls:
   a. Material shall be stone, brick, concrete, wood, or other durable material (no chemically treated wood).
   b. Walls shall be included on building plans here incorporated into foundations or other permitted structures..

11. Waterproof liner (where required): Shall be 30 mil PVC or equivalent.

12. Install washed pea gravel or river rock to transition from inlet or splash pad to growing medium.

Eugene	CITY OF EUGENE, OREGON DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION	FOUNDATION FILTRATION PLANTER TYPICAL DETAILS	DATE 1/2/2014 SCALE NTS DRAWN BY SNG



1. Provide protection from all vehicle traffic, equipment staging, and foot traffic in proposed infiltration areas prior to, during, and after construction.

2. Dimensions:
   a. Width of planter: 24” minimum.
   b. Depth of planter: 6" minimum from top of growing medium to overflow elevation.
   c. Slope of planter: 0.5% or less.

3. Setbacks:
   a. Infiltration planters must be 10' from foundations and 5' from property lines.
   b. Filtration planters do not require a setback with an approved waterproof liner.

4. Overflow:
   a. Overflows are required to an approved discharge point when using the Simplified Method
   b. Overflows are not required when sized to fully infiltrate the flood control event using the Presumptive Method.
   c. Minimum 2" freeboard from overflow elevation to the top of the planter walls.

5. Piping: Minimum 3” pipe required for up to 1,500 sq ft of impervious area, otherwise 4” min. Piping material, slopes and installation shall follow the Uniform Plumbing Code.

6. Drain rock:
   a. Size: 3/4” to 2-1/2" diameter open graded
   b. Depth: 12” Minimum
   c. Length and Width: Full length and width of facility

7. Drain rock layer shall be separated from the growing medium by a geotextile filter fabric

8. Growing medium:
   a. 12” minimum
   b. Import topsoil or amended native topsoil

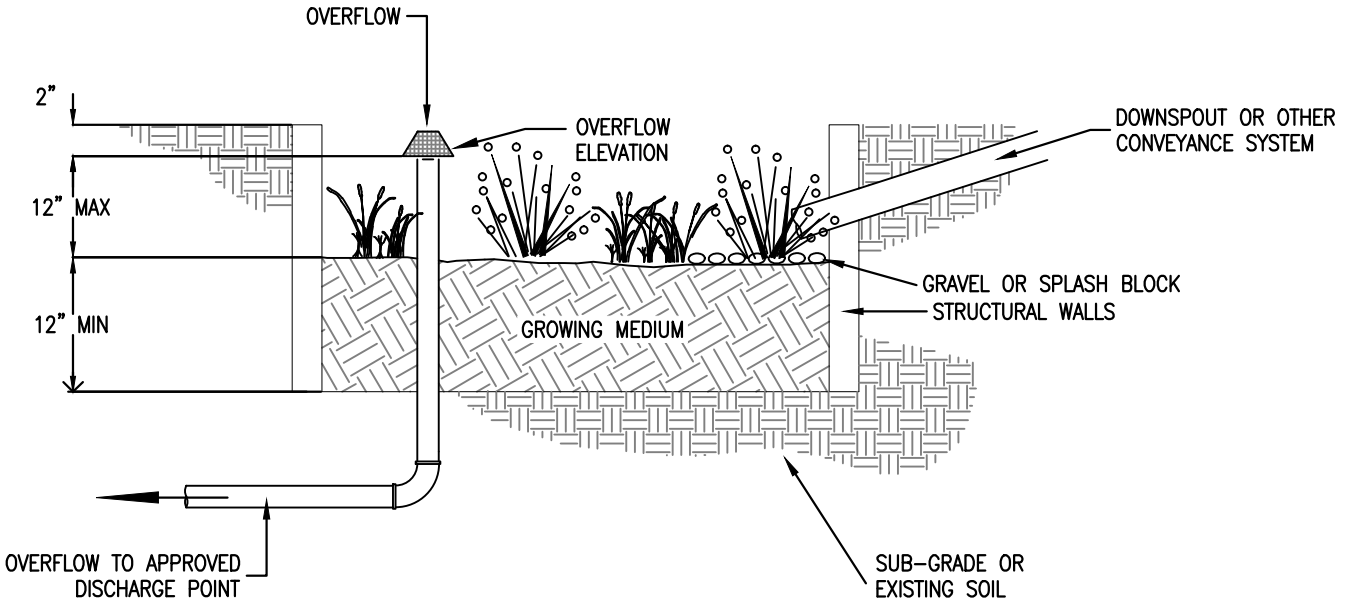
9. Vegetation: Follow landscape plans otherwise refer to plant list in SWMM Appendix F. Minimum container size is 1 gallon. # of plantings per 100sf of facility area:
   a. 100 Ground Covers, OR
   b. 80 Ground Covers and 4 Small Shrubs, OR
   c. 60 Ground Covers and 12 Small Shrubs

10. Planter walls:
   a. Material shall be stone, brick, concrete, wood, or other durable material (no chemically treated wood).
   b. Walls shall be included on building plans here incorporated into foundations or other permitted structures..

11. Waterproof liner (where required): Shall be 30 mil PVC or equivalent.

12. Install washed pea gravel or river rock to transition from inlet or splash pad to growing medium.

Eugene	CITY OF EUGENE, OREGON DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION	FILTRATION PLANTER TYPICAL DETAILS	DATE 1/2/2014 SCALE NTS DRAWN BY SNG



1. Provide protection from all vehicle traffic, equipment staging, and foot traffic in proposed infiltration areas prior to, during, and after construction.

2. Dimensions:
   a. Width of planter: 24" minimum.
   b. Depth of planter: 6" minimum from top of growing medium to overflow elevation.
   c. Slope of planter: 0.5% or less.

3. Setbacks:
   a. Infiltration planters must be 10' from foundations and 5' from property lines.
   b. Filtration planters do not require a setback with an approved waterproof liner.

4. Overflow:
   a. Overflows are required to an approved discharge point when using the Simplified Method
   b. Overflows are not required when sized to fully infiltrate the flood control event using the Presumptive Method.
   c. Minimum 2" freeboard from overflow elevation to the top of the planter walls.

5. Piping: Minimum 3" pipe required for up to 1,500 sq ft of impervious area, otherwise 4" min. Piping material, slopes and installation shall follow the Uniform Plumbing Code.

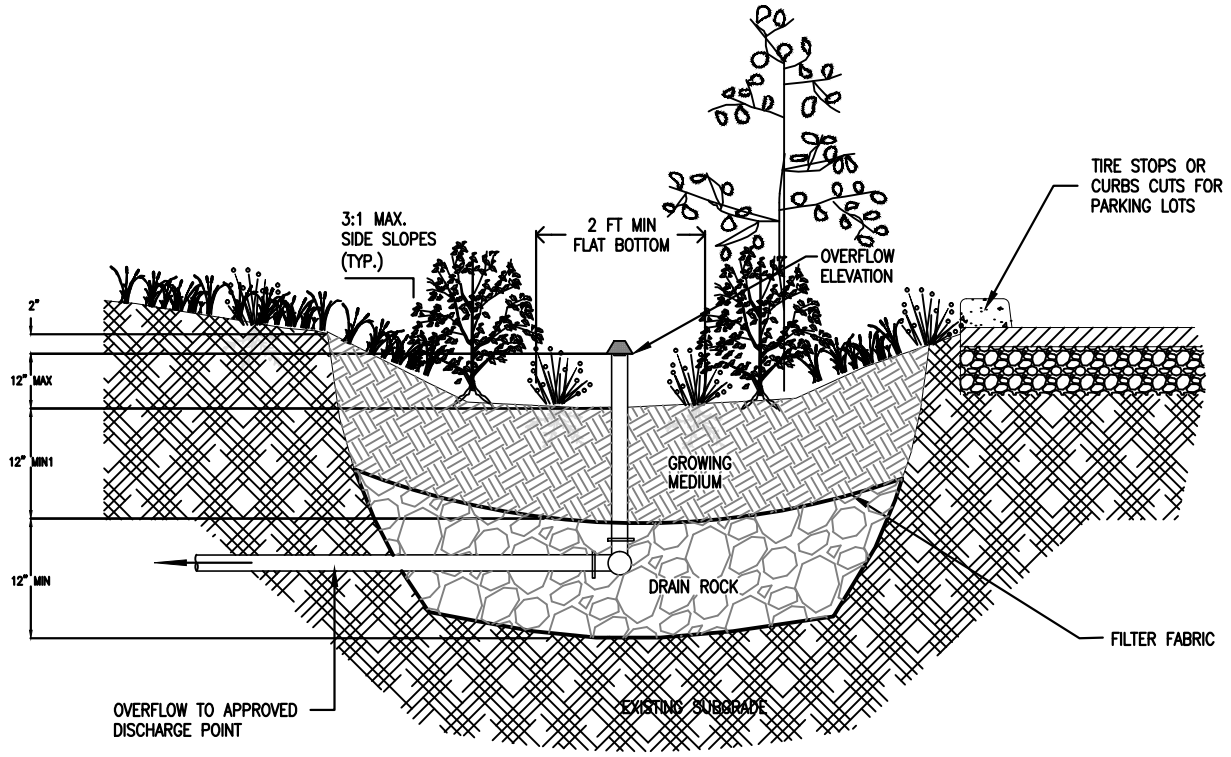
6. Growing medium:
   a. 12" minimum
   b. Import topsoil or amended native topsoil

9. Vegetation: Follow landscape plans otherwise refer to plant list in SWMM Appendix F. Minimum container size is 1 gallon. # of plantings per 100sf of facility area:
   a. 100 Ground Covers, OR
   b. 80 Ground Covers and 4 Small Shrubs, OR
   c. 60 Ground Covers and 12 Small Shrubs

10. Planter walls:
   a. Material shall be stone, brick, concrete, wood, or other durable material (no chemically treated wood).
   b. Walls shall be included on building plans here incorporated into foundations or other permitted structures..

11. Install washed pea gravel or river rock to transition from inlet or splash pad to growing medium.

Eugene	CITY OF EUGENE, OREGON DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION	INFILTRATION PLANTER TYPICAL DETAILS	DATE 1/2/2014 SCALE NTS DRAWN BY SNG



1. Provide protection from all vehicle traffic, equipment staging, and foot traffic in proposed infiltration areas prior to, during, and after construction.

2. Dimensions:
   a. Depth of rain garden: 6" minimum and 12” maximum
   b. Flat bottom width: 2' min.
   c. Side slopes of Rain Garden: 3:1 maximum.

3. Setbacks:
   a. Infiltration rain gardens must be 10' from foundations and 5' from property lines. Filtration Rain Garden do not require a setback with an approved waterproof liner.

4. Overflow:
   a. Overflows are required unless sized to fully infiltrate the flood control design storm.
   b. Inlet elevation must allow for 2” of freeboard, minimum.

5. Piping: Minimum 3” pipe required for up to 1,500 sq ft of impervious area, otherwise 4” min. Piping material, slopes and installation shall follow the Uniform Plumbing Code.

6. Drain rock:
   a. Size: 3/4"-2-1/2" washed
   b. Depth: 12” Minimum

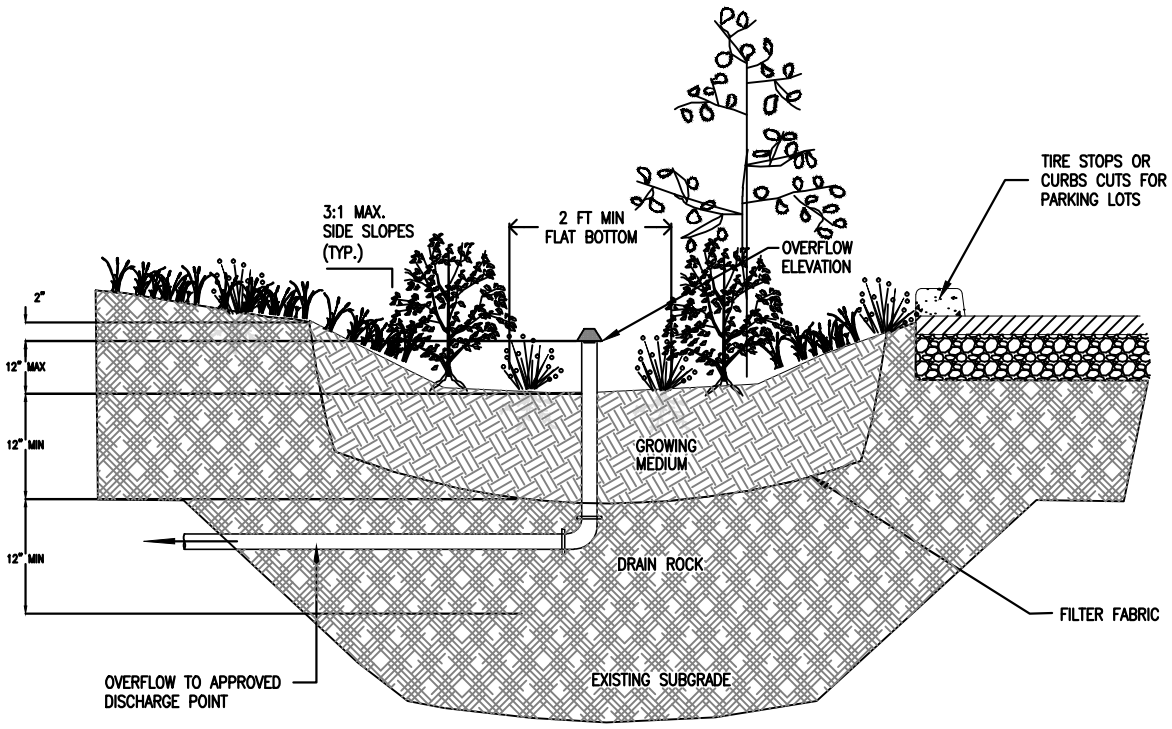
7. Drain rock later shall be separated form the growing medium and the surround soils by a geotextile filter fabric.

8. Growing medium:
   a. 12” minimum
   b. Imported topsoil or amended native topsoil.

Vegetation: Follow landscape plans otherwise refer to plant list in SWMM Appendix F. Number of plantings per 100sf of facility area:
   a. 100 Ground Covers, OR
   b. 80 Ground Covers, 2 Large Shrubs 4 Small Shrubs and 1 tress (deciduous or evergreen)

10. Install washed pea gravel or river rock to transition from inlets and splash pad to growing medium.

Eugene	CITY OF EUGENE, OREGON DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION	FILTRATION RAIN GARDEN TYPICAL DETAILS	DATE 1/2/2014 SCALE NTS DRAWN BY SNG



1. Provide protection from all vehicle traffic, equipment staging, and foot traffic in proposed infiltration areas prior to, during, and after construction.

2. Dimensions:
   a. Depth of rain garden: 6" minimum and 12” maximum
   b. Flat bottom width: 2' min.
   c. Side slopes of Rain Garden: 3:1 maximum.

3. Setbacks:
   a. Infiltration rain gardens must be 10' from foundations and 5' from property lines. Filtration Rain Garden do not require a setback with an approved waterproof liner.

4. Overflow:
   a. Overflows are required unless sized to fully infiltrate the flood control design storm.
   b. Inlet elevation must allow for 2” of freeboard, minimum.

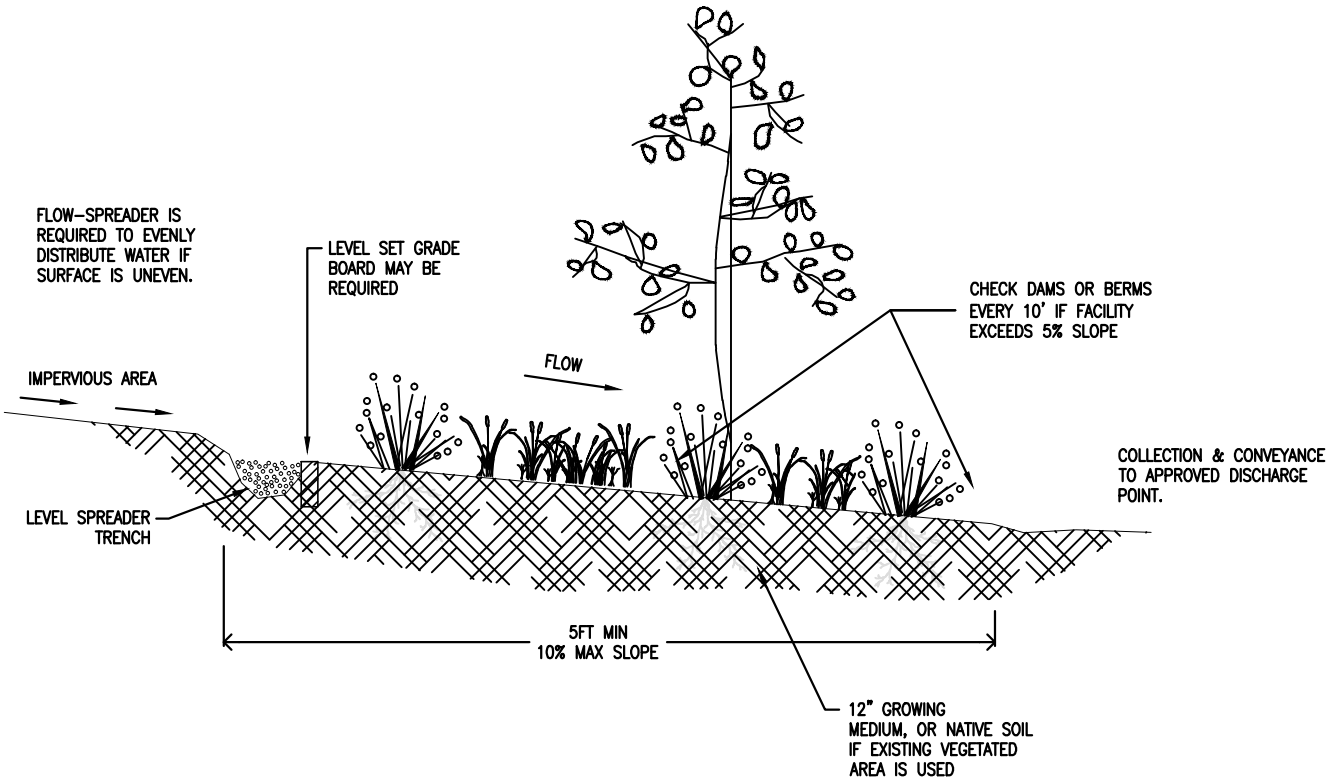
5. Piping: Minimum 3” pipe required for up to 1,500 sq ft of impervious area, otherwise 4” min. Piping material, slopes and installation shall follow the Uniform Plumbing Code.

6. Growing medium:
   a. 12” minimum
   b. Imported topsoil or amended native topsoil.

Vegetation: Follow landscape plans otherwise refer to plant list in SWMM Appendix F. Number of plantings per 100sf of facility area:
   a. 100 Ground Covers, OR
   b. 80 Ground Covers, 2 Large Shrubs 4 Small Shrubs and 1 tress (deciduous or evergreen)

10. Install washed pea gravel or river rock to transition from inlets and splash pad to growing medium.

Eugene	CITY OF EUGENE, OREGON DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION	INFILTRATION RAIN GARDEN TYPICAL DETAILS	DATE 1/2/2014 SCALE NTS DRAWN BY SNG



1. Provide protection from all vehicle traffic, equipment staging, as well as foot traffic for proposed infiltration areas prior to and during construction.

2. Dimensions:
   a. Flow line length: 5' minimum.
   b. Slopes: 0.5 - 10%

3. Setbacks (from beginning of facility):
   a. 5' from property line
   b. 10ft from buildings
   c. 50ft from wetlands, rivers, streams, and creeks where required.

4. Overflow: Collection from filter strip shall be specified on plans to approved discharge point.

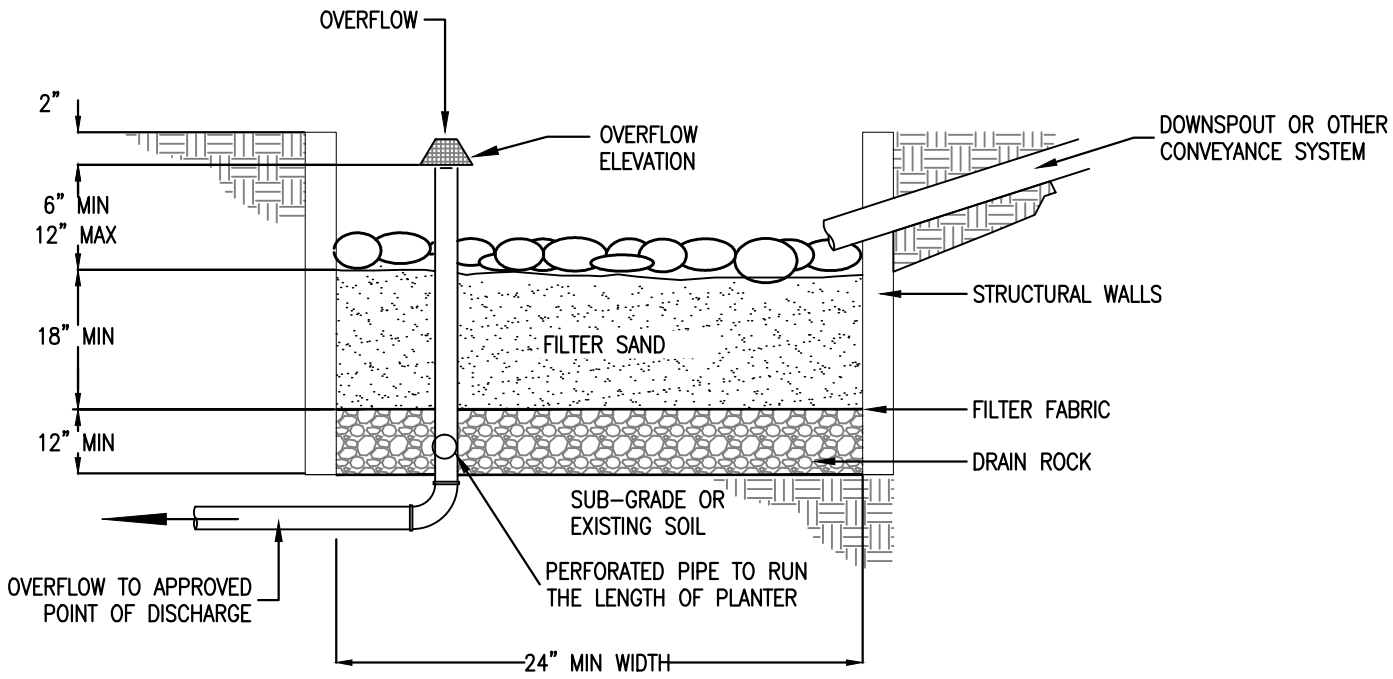
5. Growing medium: Unless existing vegetated areas are used for the filter strip, growing medium shall be used within the top 12".

6. Vegetation: The entire filter strip must have 100% coverage by native grasses, native wildflower blends, native ground covers, or any combination thereof. Follow landscape plans otherwise refer to plant list in SWMM Appendix F. Number of plantings per 100sf of facility area:
   a. 100 Ground Covers, OR
   b. 80 Ground Covers, 4 Small Shrubs, OR
   c. 60 Ground Covers, 12 Small Shrubs

7. Level Spreaders: A grade board, perforated pipe, berm or trench may be required to disperse the runoff evenly across the filter strip to prevent a point of discharge. The top of the level spreader must be horizontal and at an appropriate height to provide sheet flow directly to the soil without scour. Grade boards can be made of any material that will withstand weather and solar degradation. Trenches used as level spreaders can be open or filled with washed crushed rock, pea gravel, or sand

8. Check dams: shall be placed according to facility design otherwise:
   a. Equal to the width of the filter
   b. Every 10' where slope exceeds 5%.

Eugene	CITY OF EUGENE, OREGON DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION	FILTER STRIP TYPICAL DETAILS	DATE 1/2/2014 SCALE NTS DRAWN BY SNG



1. Provide protection from all vehicle traffic, equipment staging, and foot traffic in proposed infiltration areas prior to, during, and after construction.

2. Dimensions:
   a. Width: 24" minimum.
   b. Depth: 6" minimum
   c. Slope: 0.5% or less

3. Setbacks (from centerline of f):
   a. Infiltration sand filters must be 10' from foundations and 5' from property lines. Filtration sand filters do not have setbacks with an approved waterproof liner.

4. Overflow:
   a. Overflows are required to an approved point of discharge.
   b. Inlet elevation must allow for 2" of freeboard, minimum.

5. Piping: Minimum 3" pipe required for up to 1,500 sq ft of impervious area, otherwise 4" min. Piping material, slopes and installation shall follow the Uniform Plumbing Code.

6. Drain rock (minimum): 12" minimum of 3/4" - 2-1/2" washed.
   .

7. Separation between drain rock: Drain rock shall be separated from sand layer and surrounding sold by a geotextile filter fabric

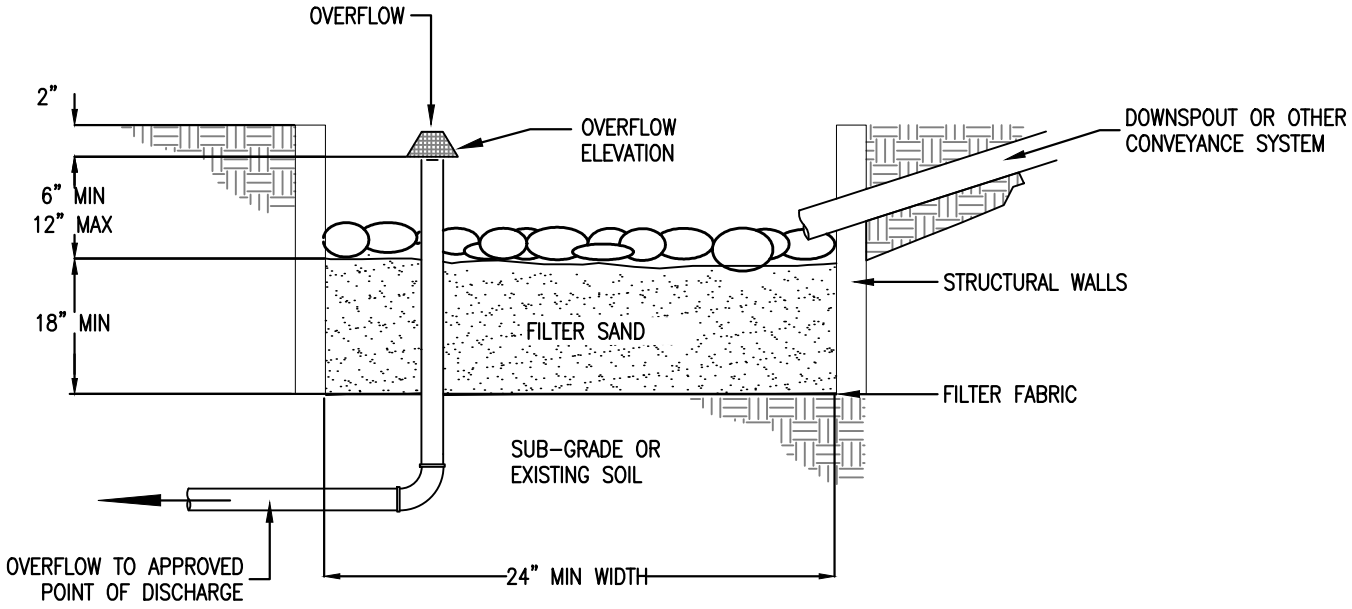
8. Filter sand:
   a. 18" minimum.
   b. See sand specification in SWMM.

9. Sand filter walls:
   a. Material shall be stone, brick, concrete, wood, or other durable material (no chemically treated wood).
   b. Filter walls built into foundation walls shall be shown on building plans.

10. Waterproof liner (where required): Shall be 30 mil PVC or equivalent.

11. Install washed pea gravel or river rock to transition from inlet or splash pad to growing medium.

Eugene	CITY OF EUGENE, OREGON DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION	FILTRATION SAND FILTER TYPICAL DETAILS	DATE 1/2/2014 SCALE NTS DRAWN BY SNG



1. Provide protection from all vehicle traffic, equipment staging, and foot traffic in proposed infiltration areas prior to, during, and after construction.

2. Dimensions:
   a. Width: 24" minimum
   b. Depth: 6" minimum
   c. Slope: 0.5% or less.

3. Setbacks:
   a. Infiltration sand filters must be 10' from foundations and 5' from property lines.
   b. Flow-through sand filters must be less than 30" in height above surrounding area if within 5 feet of property line.

4. Overflow (where required):
   a. Overflow required for Simplified Approach.
   b. Inlet elevation must allow for 2" of freeboard, minimum.
   c. Protect from debris, sand, and sediment with strainer or grate.

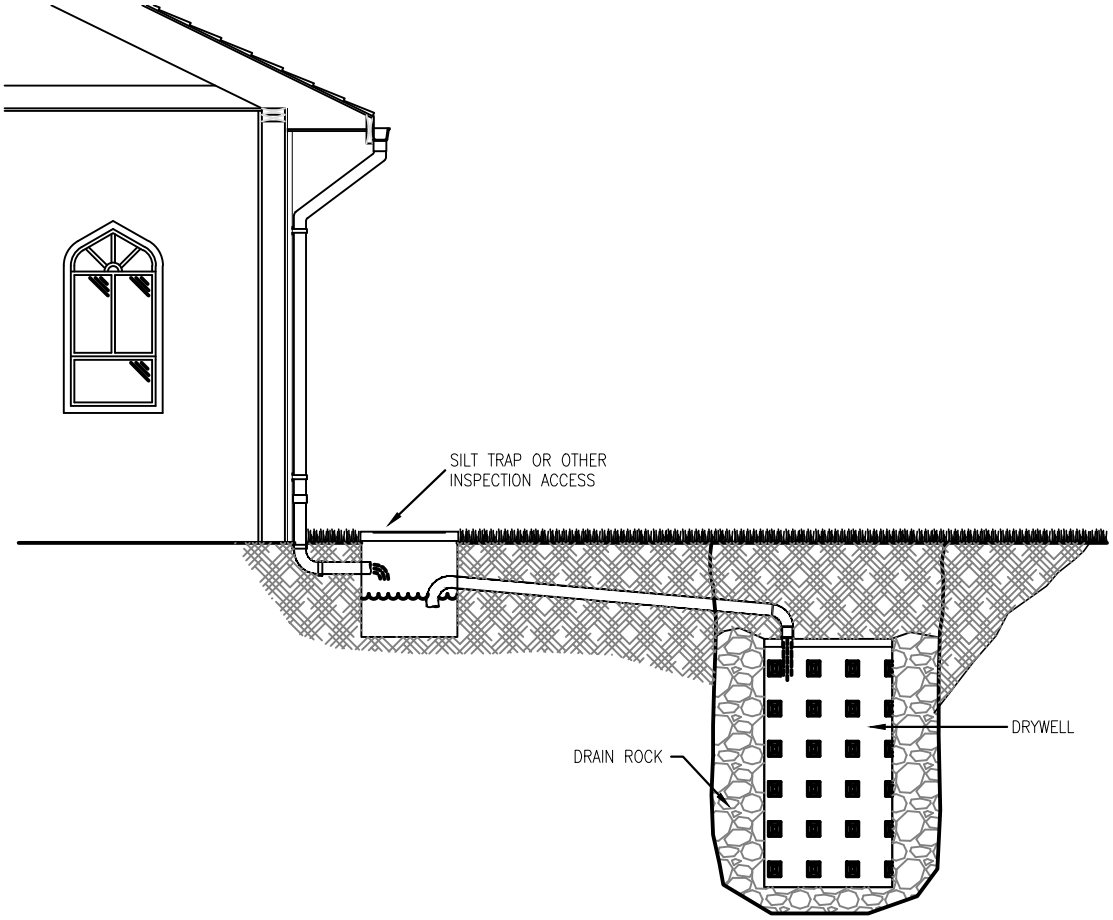
5. Piping: Minimum 3" pipe required for up to 1,500 sq ft of impervious area, otherwise 4" min. Piping material, slopes and installation shall follow the Uniform Plumbing Code.

6. Filter sand:
   a. 18" minimum.
   b. See sand spec in SWMM Exhibit 2-4.

9. Sand filter walls:
   a. Material shall be stone, brick, concrete, wood, or other durable material (no chemically treated wood).
   b. Concrete, brick, or stone walls shall be included on foundation plans.

10. Install washed pea gravel or river rock to transition from inlet or splash pad to growing medium.

Eugene	CITY OF EUGENE, OREGON DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION	INFILTRATION SAND FILTER TYPICAL DETAILS	DATE 1/2/2014 SCALE NTS DRAWN BY SNG



1. All drywells are considered Class 5 injection wells and must be registered with the Oregon Department of Environmental Quality as Underground Injection Control (UIC) systems.

2. Provide protection from all vehicle traffic, equipment staging, and foot traffic in proposed infiltration areas prior to, during, and after construction.

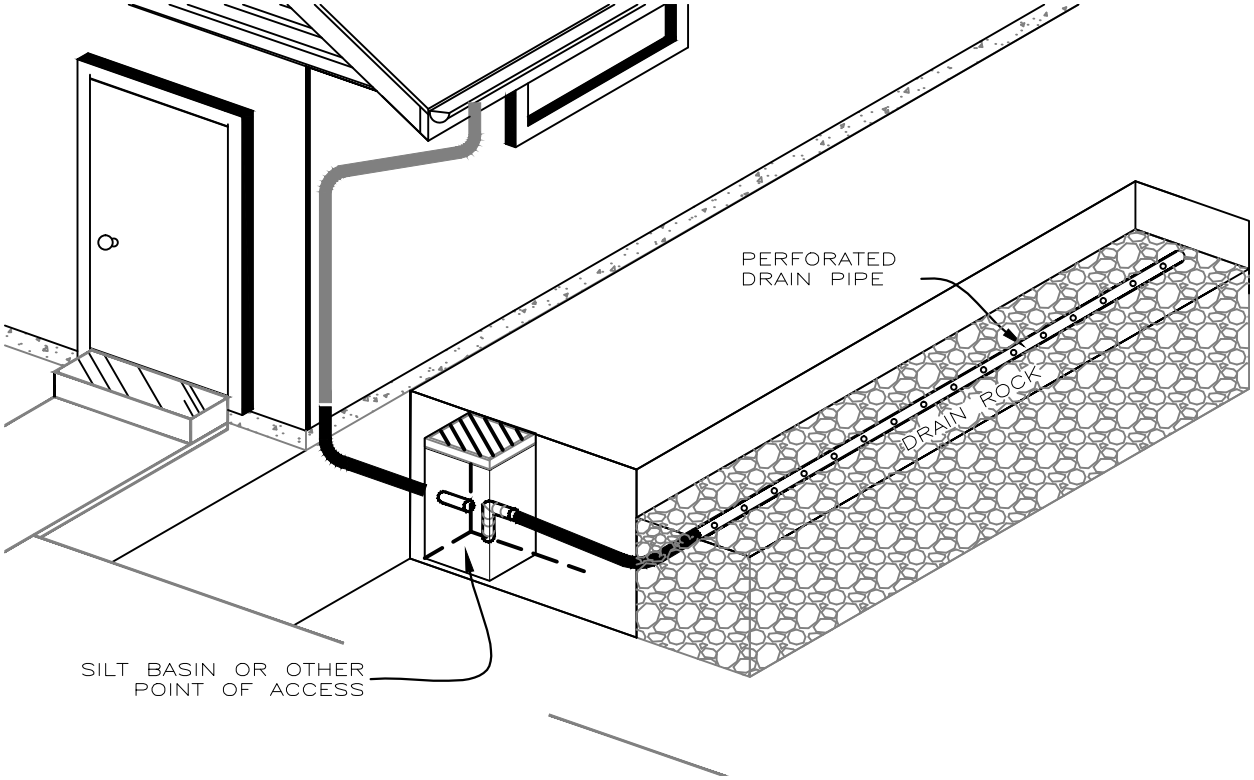
3. Drywells shall be designed using the presumptive approach due to the limited soil conditions in Eugene and the need to fully infiltrate the flood control design storm. This detail is intended to illustrate a typical drywell installation. Installation shall conform to the drywell design provided by the Presumptive Method.

4. Setbacks (from center of facility):
   a. 10' from foundations
   b. 5' from property lines

5. Piping: Minimum 3" pipe required for up to 1,500 sq ft of impervious area, otherwise 4" min. Piping material, slopes and installation shall follow the Uniform Plumbing Code.

6. Silt Traps: A silt trap or other access point is required at finished grade for inspection and maintenance access

Eugene	CITY OF EUGENE, OREGON DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION	DRYWELL TYPICAL DETAILS	DATE 1/2/2014 SCALE NTS DRAWN BY SNG



1. All soakage trenches are considered injection wells and must be registered with the Oregon Department of Environmental Quality as Underground Injection Control (UIC) systems.

2. Provide protection from all vehicle traffic, equipment staging, and foot traffic in proposed infiltration areas prior to, during, and after construction.

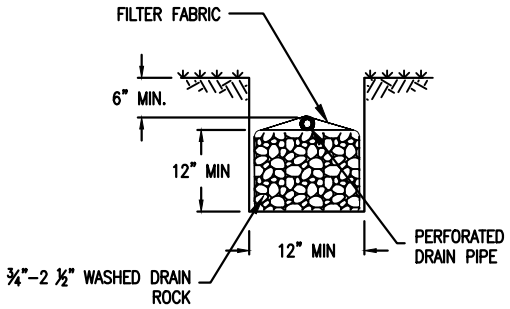
3. Soakage trenches shall be designed using the presumptive approach due to the limited soil conditions in Eugene and the need to fully infiltrate the flood control design storm. This detail is intended to illustrate a typical soakage trench installation. Installation shall conform to the soakage trench design provided by the Presumptive Method.

4. Setbacks (from center of facility):
   a. 10' from foundations
   b. 5' from property lines

5. Piping: Minimum 3" pipe required for up to 1,500 sq ft of impervious area, otherwise 4" min. Piping material, slopes and installation shall follow the Uniform Plumbing Code.

6. Silt Traps: A silt trap or other access point is required at finished grade for inspection and maintenance access

SOAKAGE TRENCH
TYPICAL CROSS SECTION



Eugene	CITY OF EUGENE, OREGON DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION	SOAKAGE TRENCH TYPICAL DETAILS	DATE 1/2/2014 SCALE NTS DRAWN BY SNG

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APPENDIX C

FORMS

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SIM FORM: 2014 (Simplified Approach for Stormwater Management)

Application _____ Building Permit # _____

Address _____

_____ Residential/Commercial

Tax Lot # _____ (Circle One)

NRCS Soil Type or

Measured Infiltraiton Rate _____

Facility Sizing

Total Proposed New or Replaced Impervious Surface Area → [ ] Box 1

Impervious Area Reduction

Permeable Pavements _____ sf

Eco-Roof _____ sf

Contained Planter _____ sf

Tree Credit _____ sf

Total Impervious Area Reduction → [ ] Box 2

Total Impervious Area Requiring Stormwater Managemment → [ ] Box 3

(Box 1 - Box 2)

Facility Sizing for Water Quality Only

Surface Facilities	Impervious Area Managed		Sizing Factor		Faclity Surface Area
Rain Garden	_____ sf	x	0.05	=	_____
Stormwater Planter	_____ sf	x	0.03	=	_____
Swale	_____ sf	x	0.06	=	_____
Vegetated Filter Strip	_____ sf	x	0.2	=	_____
Sand Filter	_____ sf	x	0.03	=	_____

Facility Sizing for Water Quality and Flow Control

Surface Facilities	Impervious Area Managed		Sizing Factor		Faclity Surface Area
Rain Garden	_____ sf	x	0.11	=	_____
Stormwater Planter	_____ sf	x	0.07	=	_____
Sand Filter	_____ sf	x	0.07	=	_____

Facility Sizing for Water Quality, Flow Control and Flood Control * Only for use in Type A & B Soils**

Surface Facilities	Impervious Area Managed		Sizing Factor		Faclity Surface Area
Rain Garden	_____ sf	x	0.13	=	_____
Stormwater Planter	_____ sf	x	0.11	=	_____
Sand Filter	_____ sf	x	0.11	=	_____

Sum of Total Impervious Area Managed [ ] Box 4

(Box 4 must be equal or greater than Box 3)

Point of Discharge (check one)

Overflow to gutter (weephole)	
Overflow to public storm drain pipe	
Overflow to Open Drainage	
Subsurface Infiltration	

2014 SIM FORM: Tree Credit and Rainwater Harvesting Worksheet

See "Tree Credits" section for more information regarding the use of trees to meet Stormwater Impervious Area Reduction.

New Evergreen Trees

To receive Impervious Area Reduction Credit, new evergreen trees must be planted within 25 feet of the new or replaced impervious surfaces. New trees cannot be credited against rooftop areas. Minimum tree height **(at the time of planting)** to receive credit is 6 feet

Enter number of new evergreen trees that meet qualification requirements in Box A		Box A
Multiply Box A by 200 and enter result in Box B		Box B

New Deciduous Trees

To receive Impervious Area Reduction Credit, new large deciduous trees must be planted within 25 feet of the new or replaced impervious surfaces and new small deciduous trees must be plantd within 10 feet of new or replaced impervious surfaces. New trees cannot be credited against rooftop areas. Minimum tree caliper **(at the time of planting)** to receive credit is 2 inches.

Enter number of new deciduous trees that meet qualification requirements in Box C		Box C
Multiply Box C by 100 and enter result in Box D		Box D

Existing Tree Canopy

To receive Impervious Area Reduction Credit, existing large tree canopies must be within 25 feet and existing small tree canopies must be within 10 feet of ground-level impervious surfaces (cannot be credit against roof top surfaces). Existing tree canopy credited towards Impervious Area Reduction must be preserved during and after construction throughout the life of the development. Minimum tree caliper to receive credit is 4 inches. No credit will be given to existing tree canopy located within environmental conservation areas.

Enter square footage of existing tree canopy that meet qualification requirements in Box E.		Box E
Multiply Box E by 0.5 and enter result in Box F.		Box F

Total Tree Credit

Add Boxes B, D and F and enter the result in Box G		Box G
Multiply Box 1 of Form SIM by 0.1 and enter the result in Box H.		Box H
Enter the lesser of Box G and H in Box I. (This is the amount to be entered as "Tree Credit" on Form SIM.)		Box I

SIM FORM 2014 Instructions

1. Enter square footage (sf) of total impervious area being developed into BOX 1.
2. Enter square footage (sf) for impervious area reduction techniques.
3. Enter sum of the impervious area reduction techniques into BOX 2.
4. Subtract BOX 2 from BOX 1 to find BOX 3, the amount of impervious area that requires stormwater management.
5. Select appropriate stormwater management facilities.
6. Enter the square footage of impervious area managed that will flow into each facility type.
7. Multiply each impervious area managed by the corresponding sizing factor. Enter this area as the facility surface area, This is the size of faclity required to manage runoff
9. Where selecting facilities that will overflow, select the point of discharge location.
10. Enter the sum of the total of all the impervious area managed into BOX 4. BOX 4 must be greaer than or equal to BOX 3.

After Recording Return To:
Name:
Address:

Place Label Recording Here

Notice of Operation and Maintenance Plan

The undersigned owner(s), hereby gives notice that stormwater runoff from impervious surfaces constructed on the premises described below require stormwater management facilities located, design and constructed in compliance with The City of Eugene's Stormwater Management Manual.; and shall be operated and maintained in accordance with the "Operations and Maintenance Plan" to be placed on file with the City of Eugene.

References are made to said plan for all terms, conditions, provisions and particulars thereof which are hereby incorporated by reference as though fully set forth herein.

The requirement to operate and maintain this facility in accordance with the on-file Operations & Maintenance Plan is binding on all current and future owners of the property. The Operations & Maintenance Plan may be modified under written consent of new owners with written approval by and re-filing with the City. The Operations & Maintenance Plan for facilities constructed pursuant to this notice are available at the Eugene Public Works Department, located at 1820 Roosevelt, Eugene, Oregon, between the hours of 8 a.m. and 5 p.m., Monday through Friday. Call (541)682-4800.

The on-going operational, maintenance and financial responsibility of the stormwater facility(ies) shall be the responsibility of (*check one*).

☐ Homeowner's Association ☐ Property Owner Account

☐ Other (*described*) _____

The Subject premises, is legally described as follows:
(Map and taxlot numbers are not legal descriptions)

This instrument is intended to be binding upon the parties hereto, their heirs, successors and assigns.

In Witness whereof, the undersigned has executed this instrument on this _____ day of _____, 20___.

Owner(s):

Signature _____ _____
Print name

STATE OF OREGON,
County of Lane, ss:

This instrument was acknowledged before me this_____ day of_____
20_____ by _____, Owner(s) of the above described premises.

_____
Notary Public For Oregon

_____
My Commission Expires

FORM O & M: OPERATIONS & MAINTENANCE PLAN
REQUIRED IN ACCORDANCE WITH THE CITY CODE

Project Building Application No._____

Owner's Name: _____

Phone No. _____

Mailing Address: _____

Site Address: _____

Site Map and Tax lot No. _____

Requirements

1) Stormwater Management Site Plan, (min. 8 ½" x 11" attached to this form) showing the location of the facility(ies) in relation to building structures or other permanent monuments on the site, sources of runoff entering the facility(ies), and where stormwater will be discharged to after leaving the facility(ies).

   The stormwater management facility(ies) shown on the site plan are a required condition of building permit approval for the identified property. The owner of the identified property is required to operate and maintain the facility(ies) in accordance with the Operations and Maintenance (O&M) Plan on file with the City. The O&M Plan for the facility(ies) is/are available at the Public Works Department, located at 1820 Roosevelt, Eugene, Oregon between the hours of 8 a.m. and 5 p.m., Monday through Friday. Call (541)(682-4800).

2) Description of the financial method used to cover future operations and maintenance. *Check One*

   ☐ Homeowner's Association ☐ Property Owner Account

   ☐ Other *(described)*_____

3) Party(ies) responsible for maintenance (only if other than owner).
   Daytime Phone no. (____) ____-_____
   Emergency/After-hours contact phone no. (____) _____-____

   Maintenance Contact party(ies) Name & Address:

---

4) Maintenance practices and schedule for the stormwater facility is included in the facility-specific O&M Plan filed with the Public Works Department, City of Eugene. The operation and maintenance practices are based on the publication date of the City of Eugene's Stormwater Management Manual.

Preparation Date:_____, 20___

Revision Date: _____, 20___

Estimated Date of Installation _____, 20___

By signing below, filer accepts and agrees to the terms and conditions contained in the operations & maintenance plan and in any document executed by filer and recorded with it.

Signature of Filer: _____

Print Name: _____

STORMWATER MANAGEMENT FACILITY INSPECTION & MAINTENANCE LOG

Property Address:

Inspection Date:

Inspection Time:

Inspected By:

Type of Stormwater Management Facility:

Location of Facility on Site (In relation to buildings or other permanent structures):

Water levels and observations (ponded water, Oil sheen, smell, etc.):

(Approximate Date/Time of Last Significant Rainfall):

Sediment accumulation & areas of erosion. Record sediment removal/erosion repair:

What is the current condition of vegetation? Record survival rates, invasive species present, number of dead plants, etc.) Record any replacement plants and type of vegetation management (mowing, weeding, etc.)

What is the condition of physical properties such as inlets, outlets, piping, fences, and irrigation facilities? Record maintenance performed and replacement activities:

Presence of insects or damage from animals. Record control activities:

Identify safety hazards present. Record resolution activities:

For assistance please call Public Works Maintenance at 541-682-4800.

DISCHARGE AUTHORIZATION REQUEST
for
Source Control(s)

Discharge Authorizations are required for source controls in areas that have site characteristics and facility uses that have activities at risk for source point pollutant releases that are regulated or prohibited by local, state and federal regulations.

NOTE: *A separate Authorization shall be filled out for each activity area, and Special Requests are available on the second page of this form.*

GENERAL INFORMATION (*to be completed for all Discharge Authorization Requests*)

Applicant's Name: _____ Date: _____

Facility Name: _____ Owner/Operator Name: _____

Facility Address: _____

Business Mailing Address: _____

Phone No.: _____ Type of business/facility: _____

Building Permit No. (*if applicable*): _____

SOURCE CONTROL INFORMATION

Installation of Source Control(s) are a result of:

- ☐ Tenant Improvements to an existing facility and/or building.
- ☐ New Development of a site or property that was unimproved.
- ☐ Re-Development of a site or property that had prior uses.
- ☐ Code Compliance in response to local, state or federal notification.
- ☐ Other: _____

Proposed Source Control(s) (*check <u>all</u> that apply*):

- ☐ Oil/Water Separator
- ☐ Dock Leveler Pit with Retrofit
- ☐ Wall Valve for Containment Area
- ☐ Collection Device/ Structure
- ☐ Other:
- ☐ Containment Area
- ☐ Sedimentation Manhole with Retrofit
- ☐ Discharge Line Shut-Off Valve
- ☐ Cooling Towers
- ☐ Other: _____

*[**NOTE:** Additional City approved "Standard Maintenance" appendices will be required for each Source Control listed above, or provide a vendor's Maintenance document (if available). Contact PW at 541-682-5291 for applicable appendices.]*

Describe the site activity (ies) the source control(s) apply to:

_____

_____

_____

(DISCHARGE AUTHORIZATION REQUEST FORM CONT.)

Attach a site plan with the location of the Source Control. Be sure to identify the location in reference to a permanent structure, for assistance in field verification. *(A hand-drawn sketch, not to scale, is acceptable as long as it is legible.)*

SPECIAL REQUEST (check only if applicable)

- ☐ Request to remove or abandon existing source control(s).
- ☐ Request to propose alternative source control(s).
- ☐ Request to ADJUST source control requirement(s).
- ☐ Request for review of ADJUSTMENT qualifications.

Please provide a brief explanation (Use additional pages if necessary.): _____

_____

_____

_____

TO BE COMPLETED BY CITY:

☐ Approved ☐ Denied

Date: _____ Signature: _____ Dept.: _____

Comments: _____

_____

_____

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APPENDIX D

FACILITY PLANTING DESIGN

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PLANTING OPTIONS
CITY OF EUGENE

Scientific Name	Common Name	Facility Planting Options					Plant Categories					Planting Zones		
*approved for public rights of way		Grassy Swales	Vegetated Swales / Filter Strips	Stormwater Planters	Rain Gardens / Dry Detention Ponds	Wet / Extended Wet Ponds	Ground Cover Plants	Small Shrubs	Large Shrubs	Deciduous Tree	Evergreen Tree	Planting Zone A (wet to moist)	Planting Zone B (moist to dry)	Approved Street Tree Options
Abies grandis	Grand Fir										◆		◆	
Abies koreana	Silver Korean fir										◆		◆	◆
Abies lasiocarpa	Rocky Mountain fir										◆		◆	◆
Acer circinatum	Vine Maple								◆			◆	◆	
Acer ginnala	Amur Maple									◆			◆	◆
Acer glabrum var. douglasii	Rocky Mountain Maple									◆			◆	◆
Acer griseum	Paperbark Maple									◆			◆	◆
Acer macrophyllum	Big leaf Maple									◆			◆	
Agrostis exarata	Spike Bentgrass						◆					◆		
Alisma plantago-aquatica	Water Plantain						◆					◆		
Allium acuminatum	Hooker's Onion						◆					◆		
Allium amplectens	Slim Leaf Onion						◆					◆		
Alnus rhombifolia	White Alder									◆			◆	◆
Alnus rubra	Red Alder									◆			◆	◆
Alopecurus geniculatus	Water Foxtail						◆					◆		
Amelanchier alnifolia	Western Saskatoon Serviceberry									◆			◆	◆
Amelanchier grandiflora	Autumn Brilliance & Forest Prince									◆			◆	◆
Arbutus menziesii	Pacific Madrone									◆			◆	◆
Arbutus unedo	Strawberry Madrone									◆			◆	◆
Arctostaphylos uva-ursi*	**Kinnikinnick**						◆						◆	
Aster hallii	Hall's Aster						◆						◆	
Aster subspicatus	Douglas' Aster						◆						◆	
Athyrium felix-femina	Lady Fern						◆						◆	
Beckmannia syzigachne	American Slough Grass						◆					◆		
Betula nigra 'Heritage'	Heritage River Birch									◆			◆	◆
Bidens cernua	Nodding Beggarticks						◆					◆		
Blechnum spicant	Deer Fern						◆					◆		

Scientific Name	Common Name	Facility Planting Options					Plant Categories					Planting Zones		
*approved for public rights of way		Grassy Swales	Vegetated Swales / Filter Strips	Stormwater Planters	Rain Gardens / Dry Detention Ponds	Wet / Extended Wet Ponds	Ground Cover Plants	Small Shrubs	Large Shrubs	Deciduous Tree	Evergreen Tree	Planting Zone A (wet to moist)	Planting Zone B (moist to dry)	Approved Street Tree Options
Brodiaea congesta	Harvest Brodiaea						◆					◆		
Bromus carinatus	California Brome Grass						◆					◆		
Bromus sitchensis	Alaska Brome						◆					◆		
Bromus vulgaris	Columbia Brome Grass						◆					◆		
Calocedrus decurrens	Incense Cedar										◆		◆	◆
Camassia quamash	Common Camas						◆					◆	◆	
Carex densa*	**Dense Sedge**						◆					◆		
Carex deweyanna	Dewey Sedge						◆					◆		
Carex hendersonii	Henderson Hedge						◆					◆		
Carex obnupta*	**Slough Sedge**						◆					◆		
Carex stipata*	**Sawbeak Sedge**						◆					◆		
Carex tumulicola*	**Foothill Sedge**						◆					◆		
Carpinus betulus	European Hornbeam									◆			◆	◆
Ceanothus cuneatus	Buckbrush								◆			◆		
Ceanothus integerrimus	Deerbrush								◆				◆	
Ceanothus sanquineous	Oregon Redstem Ceanothus								◆				◆	
Ceanothus velutinus	Snowbrush								◆				◆	
Celtis occidentalis	Common Hackberry									◆		◆	◆	◆
Celtis reticulata	Netleaf Hackberry									◆			◆	◆
Chilopsis linearis	Desert Willow									◆			◆	◆
Chitalpa taskhentensis	Pink Dawn Chitalpa									◆			◆	◆
Clarkia amoena	Summer's Darling						◆						◆	
Clarkia purpurea	Four Spot Godetia						◆						◆	
Collomia grandiflora	Large Leaf Collomia						◆						◆	
Cornus kelseyii*	**Kelseyi Dogwood**							◆				◆	◆	
Cornus nuttalii	Western Flowering Dogwood									◆			◆	◆
Cornus stolonifera	Red-osier Dogwood								◆			◆	◆	
Corylus cornuta	Western Beaked Hazlenut								◆					
Crataegus douglasii	Black Hawthorn								◆			◆		
Cupressus arizonica	"Blue Ice" Arizona cypress												◆	◆
Cupressus bakeri	Modoc cypress									◆				◆
Daffodil*	**Daffodil**						◆						◆	
Danthonia califonica	California Oatgrass						◆					◆		

Scientific Name	Common Name	Facility Planting Options					Plant Categories					Planting Zones		
*approved for public rights of way		Grassy Swales	Vegetated Swales / Filter Strips	Stormwater Planters	Rain Gardens / Dry Detention Ponds	Wet / Extended Wet Ponds	Ground Cover Plants	Small Shrubs	Large Shrubs	Deciduous Tree	Evergreen Tree	Planting Zone A (wet to moist)	Planting Zone B (moist to dry)	Approved Street Tree Options
Deschampsia caespitosa	Tufted Hairgrass						◆					◆	◆	
Deschampsia elongata	Slender Hairgrass						◆					◆		
Dichelostemma congestum	Ookow						◆					◆		
Downingia elegans	Calico Flower						◆					◆		
Eleocharis acicularis	Needle Spike-rush						◆					◆		
Eleocharis ovata	Ovate Spike-rush						◆					◆		
Eleocharis palustris	Creeping Spike-rush						◆					◆		
Elymus glaucus	Blue Wildrye						◆					◆		
Elymus trachycaulus	Slender Wheatgrass						◆					◆		
Epilobium densiflora	Dense Spike Primrose						◆					◆		
Eriophyllum lanatum	Oregon Sunshine						◆					◆		
Euonymus altus* (Need water)	**Dwarf Euonymus**							◆					◆	
Festuca occidentali	Western Fescue Grass						◆					◆		
Festuca roemeri var. roemeri	Roemer's Fescue						◆					◆		
Festuca rubra var. commutata	Western Red Fescue						◆						◆	
Fragaria chiloensis*	**Beach or Chilean strawberry**						◆						◆	
Fragaria vesca (virginiana)	Wild Strawberry						◆						◆	
Fraxinus latifolia	Oregon Ash									◆		◆	◆	◆
Gaultheria shallon	Salal							◆					◆	
Ginko biloba	Ginko									◆			◆	◆
Glyceria occidentalis	Western Manna Grass						◆					◆		
Grindelia intergrifolia	Gumweed						◆							
Helictotrichon sempervirens*	**Blue Oat Grass**						◆						◆	
Holodiscus discolor	Oceanspray								◆				◆	
Hordeum brachyantherum	Meadow Barley						◆							
Idesia polycarpa	Chinese Wonder Tree									◆			◆	◆
Iris douglasiana*	**Douglas Iris**						◆						◆	
Iris tenax*	**Oregon Iris**						◆						◆	
Juncus acuminatus*	**Tapertip Rush**						◆					◆		
Juncus effusus var. gracilis*	**Common / Soft Rush**						◆					◆		
Juncus effusus var. pacificus*	**Common Rush**						◆					◆		
Juncus ensifolius*	**Dagger-leaf Rush**						◆					◆		
Juncus oxymeris	Pointed Rush						◆					◆		

Scientific Name	Common Name	Facility Planting Options					Plant Categories					Planting Zones		
*approved for public rights of way		Grassy Swales	Vegetated Swales / Filter Strips	Stormwater Planters	Rain Gardens / Dry Detention Ponds	Wet / Extended Wet Ponds	Ground Cover Plants	Small Shrubs	Large Shrubs	Deciduous Tree	Evergreen Tree	Planting Zone A (wet to moist)	Planting Zone B (moist to dry)	Approved Street Tree Options
Juncus patens*	**Grooved Rush; Spreading Rush**						◆					◆		
Juncus tenuis	Slender Rush						◆					◆		
Juncus unilateralis	One-sided Rush						◆					◆		
Koeleria macrantha	Junegrass						◆							
Koelreuteria paniculata	Goldenrain Tree									◆		◆	◆	◆
Lagerstroemia indica	Crepemyrtle									◆			◆	◆
Lemna minor	Common Lesser Duckweed													
Lonicera involucrata	Black Twinberry								◆				◆	
Lupinus micranthus	Small Flowered Lupine						◆						◆	
Lupinus polyphyllus	Large Leaf Lupine						◆					◆	◆	
Lupinus rivularis	Riverbank Lupine						◆							
Madia elegans	Showy Tarweed						◆							
Mahonia aquifolium	Tall Oregon Grape							◆					◆	
Mahonia nervosa*	**Dull Oregon Grape**							◆					◆	
Mahonia repens*	**Creeping Oregon Grape**							◆					◆	
Malus fusca	Pacific Crab Apple									◆		◆		
Myosotis laxa	Small-flowered Forget-me-not													
Nandina domestica*	**Dwarf Nandina (Heavenly Bamboo)**						◆						◆	
Nyssa sylvatica	Canyon Live Oak									◆			◆	◆
Oemleria cerasiformis	Indian Plum									◆			◆	
Olea europea	Wilsonii fruitless olive									◆			◆	◆
Parrotia persica	Persian Ironwood									◆			◆	◆
Philadelphus lewisii	Mock Orange								◆				◆	
Physocarpus capitatus	Pacific Ninebark								◆			◆	◆	
Picea smithiana	Morinda spruce										◆		◆	◆
Pinus bungeana	Lacebark Pine										◆		◆	◆
Pinus monticola	Western White Pine										◆			
Pinus ponderosa	Ponderosa Pine										◆			◆
Pinus wallichiana	Himalayan Pine													◆
Pistacia persica	Chinese Pistache													◆
Plagiobothrys figuratus	Popcorn Flower						◆							
Polystichum munitum*	**Sword Fern**						◆					◆	◆	
Populus balsamifera	Black Cottonwood									◆			◆	

Scientific Name	Common Name	Facility Planting Options					Plant Categories					Planting Zones		
*approved for public rights of way		Grassy Swales	Vegetated Swales / Filter Strips	Stormwater Planters	Rain Gardens / Dry Detention Ponds	Wet / Extended Wet Ponds	Ground Cover Plants	Small Shrubs	Large Shrubs	Deciduous Tree	Evergreen Tree	Planting Zone A (wet to moist)	Planting Zone B (moist to dry)	Approved Street Tree Options
Populus tremuloides	Quaking Aspen									◆			◆	◆
Potamogeton natans	Floating-leafed Pondweed													
Potentilla gracilis var. gracilis	Graceful Cinquefoil						◆						◆	
Prunella vulgaris var. vulgaris	Heal All						◆							
Prunus emarginata	Choke Cherry								◆					
Pseudotsuga menziesii	Douglas Fir										◆		◆	
Pteridium aquilinum	Bracken Fern						◆						◆	
Quercus bicolor	Swamp White Oak									◆			◆	◆
Quercus chrysolepis	Canyon Live Oak									◆			◆	◆
Quercus douglasii	Blue Oak									◆			◆	◆
Quercus engelmannii	Engelmann Oak									◆			◆	◆
Quercus frainetta 'Schmidt'	Forest Green Hungarian Oak									◆			◆	◆
Quercus garryana	Oregon White Oak									◆			◆	◆
Quercus imbricaria	Shingle Oak									◆			◆	◆
Quercus kelloggii	California Black Oak									◆			◆	◆
Quercus lobata	Valley Oak									◆			◆	◆
Quercus shumardii	"Southern Plains" Shumard Oak									◆		◆	◆	◆
Quercus suber	Cork Oak									◆			◆	◆
Quercus virginiana	"Cathedral" Southern Live Oak									◆		◆	◆	◆
Ranunculus occidentalis	Western Buttercup						◆							
Rhamnus purshiana	Cascara Buckthorn									◆		◆	◆	◆
Ribes sanquineum	Red-Flowering Current								◆				◆	
Rosa gymnocarpa	Baldhip Rose								◆				◆	
Rosa nutkana	Nootka Rose								◆				◆	
Rosa pisocarpa	Swamp Rose								◆			◆	◆	
Rubus calycinoides*	**Creeping Bramble**						◆						◆	
Rubus parviflorus	Thimbleberry								◆			◆		
Rubus pentalobus*	**Creeping Rubus**						◆						◆	
Rubus spectabilis	Salmonberry								◆			◆		
Sagittaria latifolia	Broadleaf Arrowhead													
Salix fluviatilis	Columbia Willow									◆		◆	◆	
Salix hookeriana	Hookers Willow									◆		◆	◆	

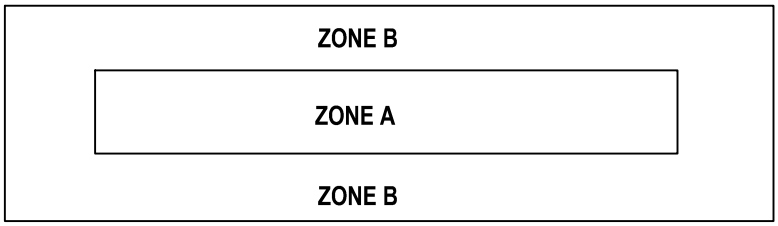
Scientific Name	Common Name	Facility Planting Options					Plant Categories					Planting Zones		
*approved for public rights of way		Grassy Swales	Vegetated Swales / Filter Strips	Stormwater Planters	Rain Gardens / Dry Detention Ponds	Wet / Extended Wet Ponds	Ground Cover Plants	Small Shrubs	Large Shrubs	Deciduous Tree	Evergreen Tree	Planting Zone A (wet to moist)	Planting Zone B (moist to dry)	Approved Street Tree Options
Salix lucida	Pacific Willow									◆		◆		
Salix scouleriana	Scouler's Willow									◆		◆	◆	
Salix sessilifolia	Soft leafed Willow											◆		
Salix sitchensis	Sitka Willow									◆		◆		
Sambucus nigra cerulea	Blue Elderberry								◆				◆	
Sambucus racemosa	Red Elderberry								◆				◆	
Sciadopitys verticillata	Japanese Umbrella pine										◆		◆	◆
Scirpus americanus	American Bulrush						◆					◆		
Scirpus microcarpus	Small Fruited Rush						◆					◆		
Sedum oreganum	Oregon Sedum						◆						◆	
Sisyrinchium douglasii	Purple-eyed Grass						◆							
Sisyrinchium idahoense	Blue-eyed Grass						◆							
Sophora japonica	Chinese Scholar Tree									◆			◆	◆
Sparganium emersum	Narrowleaf Bureed													
Spirea betulifolia	Shiny-leaf Spirea							◆				◆	◆	
Spirea douglasii	Douglas Spirea								◆			◆	◆	
Spirea sp*	**Dwarf Spirea**							◆					◆	
Symphoricarpus albus	Common Snowberry								◆				◆	
Taxodium distichum	Bald cypress										◆		◆	◆
Thuja plicata	Western Red Cedar										◆	◆		◆
Tsuga canadensis	Canadian hemlock										◆		◆	◆
Tsuga mertensiana	Mountain hemlock										◆		◆	◆
Tsuga sieboldii	Southern Japanese hemlock										◆		◆	◆
Veronica americana	American Speedwell													
Viburnum edule	Highbush Cranberry								◆			◆	◆	

FACILITY PLANTING ZONES

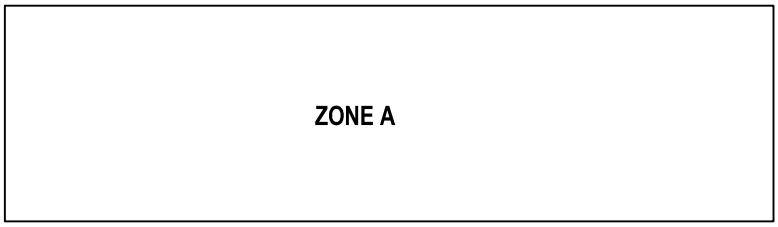
Zone A: Area of the facility defined as the bottom of the facility to the designated high water mark. This area has wet to moist soils and plants located here shall be tolerant of mild inundation.

Zone B: Area of the facility defined as the side slopes from the designated high water line up to the edge of the facility. This area typically has drier to moist soils with the moist soils being located farther down the side slopes. Plants here should be drought tolerant and help stabilize the slopes.

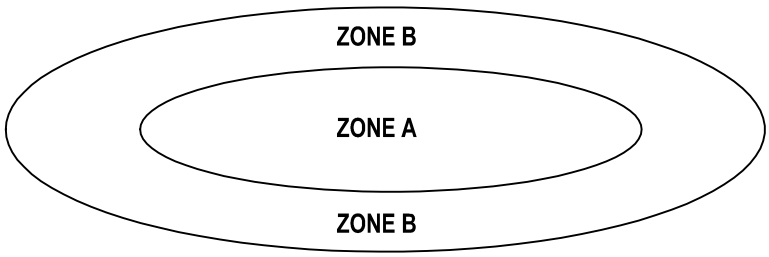
SWALE PLANTING ZONES



PLANTER PLANTING ZONES



RAIN GARDEN PLANTING ZONES



Eugene	CITY OF EUGENE, OREGON DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION	PLANTING ZONES	DATE 1/2/2014 SCALE NTS DRAWN BY SNG

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APPENDIX E

APPROVED PROPRIETARY STORMWATER TREATMENT TECHNOLOGIES

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APPENDIX E

APPROVED PROPRIETARY STORMWATER TREATMENT TECHNOLOGIES
City of Eugene
List Currently Approved as of November, 2013

OVERVIEW

This document is a list of proprietary stormwater treatment technologies (devices) approved for use to meet the pollution reduction requirements of the City of Eugene Stormwater Management Manual.

USE LEVEL DESIGNATIONS

Approved proprietary stormwater treatment technologies are those devices approved to meet the target treatment goal of **Basic Treatment or Pre Treatment** at the **General Use Level Designation (GULD)** as defined by the 2011 Washington State Department of Ecology Technology Assessment Protocol – Ecology (TAPE). Devices shall be sized using the treatment flow rates defined below. The sizing the requirements are based upon flow rates identified in each proprietary stormwater treatment technologies GULD decision from the Washington State DOE.

SUBMISSION OF ALTERNATE TECHNOLOGIES

Manufacturers or designers wishing to submit proprietary stormwater treatment technologies for approval shall submit those technologies to the Washington State Department of Ecology. The City of Eugene does not test pollution reduction treatment technologies. Proprietary manufactured stormwater treatment technologies are approved for use within the City of Eugene based on Washington Department of Ecology (WashDOE) General Use Level Designation (GULD). Please see the Washington Department of Ecology website for more information on submission guidelines for new technologies:

http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html

APPROVED TECHNOLOGIES FOR USE ON PRIVATE SYSTEMS

All units shall be sized using the Presumptive Method. Devices shall be sized using the treatment flows rates for each model below. Bypass flow rates shall be per the manufacturer's specifications.

Americast Filterra® System

Filterra® stormwater treatment systems shall be sized using a filter hydraulic conductivity of 35.46 inches per hour.

Aqua Shield Aqua-Swirl®
Aqua-Swirl® stromwater treatment systems shall be sized per manufactures maximum water quality design flow rates.

BaySaver Technologies, Inc. BayFilter®

- BayFilter Cartridge (BFC) is limited to 30 GPM (0.067 CFS) per cartridge (43 sf filter area)
- Enhanced Media Cartridge (EMC) is limited to 45 GPM (0.1 CFS) per cartridge for 30-inch diameter cartridges (90 sf filter area) and 75 GPM (0.17 CFS) per cartridge for 39 inch diameter cartridges (150 sf filter area).
- Media combinations or the BayFilter cartridges are limited to Silica Sand, Perlite, Zeolite and Activated Alumina.

Contech Engineered Solutions Media Filtration System (MFS)

- Filter media shall be Perlite
- The 12 inch filter cartridge is limited to a maximum water quality flow rate of 4.9 GPM per cartridge
- The 22 inch tall cartridge is limited to a maximum water quality flow rate of 9.0 GPM per cartridge

Contech Engineered Solutions Stormfilter using ZPG media

- The 12 inch filter cartridge is limited to a maximum water quality flow rate of 5.0 GPM per cartridge
- The 18 inch filter cartridge is limited to a maximum water quality flow rate of 7.5 GPM per cartridge
- The 27 inch filter cartridge is limited to a maximum water quality flow rate of 11.3 GPM per cartridge

Contech Engineered Solutions CDS® Stormwater Treatment System
CDS® stormwater treatment systems shall be sized per manufactures maximum water quality design flow rates.

Hydro International Downstream Defender
Downstream Defender® stormwater treatment systems shall be sized per manufactures Maximum Treatment flow Rates for 50 microns (MFTR-50).

Imbrium Stormcepter®
Stormceptor STC® stormwater treatment systems shall be sized in accordance with the following Table.

Imbrium Stormceptor®	
Model	Maximum Water quality treatment flow rate (CFS)
STC 450i	0.32
STC 900	0.64
STC 1200	0.64
STC 1800	0.64
STC 2400	1.06
STC 3600	1.06
STC 4800	1.77
STC 6000	1.77
STC 7200	2.48
STC 11000	3.53
STC 13000	3.53
STC 16000	4.95

Kristar Enterprises Flogard Perk Filter®

- Filter media shall be zeolite-perlite-carbon (ZPC) filter media as specified by Kristar
- The 12 inch filter cartridge is limited to a maximum water quality flow rate of 6.8 GPM per cartridge
- The 18 inch tall cartridge is limited to a maximum water quality flow rate of 10.2 GPM per cartridge

Royal Environmental Systems ecoStrom/ecoStorm *plus* Treatment Train
The ecostrom *plus* system must be used in conjunction with an upstream ecoStrom unit as a treatment train. ecoStrom plus units shall use the standard concrete filter. ecoStorm *plus* units shall be sized at a maximum water quality design flow rate of 180 GPM (0.40 CFS) per 5 foot diameter filter (19.63 square foot surface area)

The upstream ecoStrom unit shall be sized in accordance with the following Table.

Royal Environmental System ecoStorm		
Model	Diameter	Maximum Water quality treatment flow rate GPM (CFS)
0.5	4	377 (0.84)
0.75	5	588 (1.31)
1	6	848 (1.89)
1.5	7	1,153 (2.57)
2	8	1,508 (3.36)
3	10	2,356 (5.25)
4	12	3,393 (7.57)

APPROVED TECHNOLOGIES FOR USE IN THE PUBLIC RIGHT-OF-WAY

All units shall be sized using the Presumptive Method. Devices shall be sized using the minimum water quality treatment flows rates for each model below. All bypass flow rates shall be per the manufacturer's specifications.

Aquashield Aqua-Swirl®
Aqua-Swirl stromwater treatment systems shall be sized per manufactures maximum water quality design flow rates.

Contech CDS® System
CDS® stormwater treatment systems shall be sized per manufactures maximum water quality design flow rates.

Hydro International Downstream Defender®
Downstream Defender® stormwater treatment systems shall be sized per manufactures Maximum Treatment flow Rates for 50 microns (MFTR-50).

Imbrium Systems Stromcepter STC®
Stormceptor STC® stormwater treatment systems shall be sized in accordance with the following Table.

Imbrium Stormceptor®	
Model	Maximum Water quality treatment flow rate (CFS)
STC 450i	0.32
STC 900	0.64
STC 1200	0.64
STC 1800	0.64
STC 2400	1.06
STC 3600	1.06
STC 4800	1.77
STC 6000	1.77
STC 7200	2.48
STC 11000	3.53
STC 13000	3.53
STC 16000	4.95

APPENDIX F

FLOW CONTROL STRUCTURES AND OUTFALL SIZING

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APPENDIX F

CONTROL STRUCTURES FOR DETENTION SYSTEMS

This appendix presents the methods and equations for the design of flow control structures. It includes illustrations and equations for the design of orifices, rectangular sharp crested weirs and v-notch weirs.

Detention control structures shall be either weir structures or orifice structures. Weir structures may be enclosed in a catch basin, manhole, or vault, or may be installed in the open, provided they are accessible for maintenance and are not exposed to damage. Riser type restrictor devices also provide some incidental oil/water separation and spill control. Weir structures provide some oil/water separation when fitted with a baffle plate located upstream of the weir.

Orifices

- Orifices may be constructed on a pipe, "tee" riser, baffle, or other structure intended for conveyance.

- The minimum allowable diameter for an orifice used to control flows in a public facility is 2 inches. Private facilities may utilize a 1-inch diameter orifice if additional clogging prevention measures are implemented. The orifice diameter shall always be greater than the thickness of the orifice plate.

- Multiple orifices may be necessary to meet the flood control design storm performance for a detention system. However, extremely low flow rates may result in small orifices (< 2 inches) that are prone to clogging. In these cases, retention facilities that do not rely on orifice structures shall be used to the maximum extent practicable to meet flow control requirements. Large projects may also result in high flow rates that necessitate excessively large orifice sizes that are impractical to construct. In such cases, several orifices may be located at the same elevation to reduce the size of each individual orifice.

Orifice Sizing Equation:

$$Q = C A \sqrt{2gh}$$

where:

Q = Orifice discharge rate, cfs
C = Coefficient of discharge, feet (suggested value = 0.60 for plate orifices)
A = Area of orifice, square feet
h = hydraulic head, feet
g = 32.2 ft/sec^2

The diameter of plate orifices is typically calculated from the given flow. The orifice equation is often useful when expressed as an equivalent orifice diameter in inches.

$$d = \sqrt{\frac{36.88\ Q}{\sqrt{h}}}$$

where:

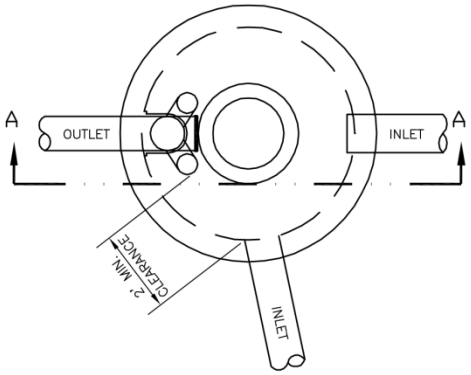
Q = flow, cfs
d = orifice diameter, inches
h = hydraulic head, feet

- Orifices shall be protected within a manhole structure, or by a minimum 18-inch-thick layer of 1½" to 3" evenly graded, washed rock. Orifice holes shall be externally protected by stainless steel or galvanized wire screen (hardware cloth) with a mesh of 3/4" or less. Chicken wire shall not be used for this application.

- Orifice diameter shall be greater than or equal to the thickness of the orifice plate (see diagram).

- If less than 3", the orifice shall not be made of concrete. A thin material (e.g., stainless steel, HDPE or PVC) shall be used to make the orifice plate; the plate shall be attached to the concrete or structure**.**

PLAN VIEW



NOTES:

1. EXCEPT AS SHOWN OR NOTED, UNITS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS FOR LARGER PRECAST CONCRETE MANHOLE PER STANDARD PLAN.

2. FOR DETAILS SHOWING GRADE RING, MANHOLES, AND TOP SLABS, SEE STANDARD PLAN.

3. PIPE SUPPORTS SHALL ANCHORED AT 3' MAX. SPACING BY 3/8 DIA. STAINLESS STEEL EXPANSION BOLTS EMBEDDED 2" IN WALL.

4. THE RESTRICTOR/SEPARATOR SHALL BE FABRICATED FROM SOLID WALL HDPE PIPE, OR APPROVED EQUAL.

5. OUTLET SHALL BE CONNECTED TO RESTRICTOR PIPE WITH A FLEXIBLE COUPLING.

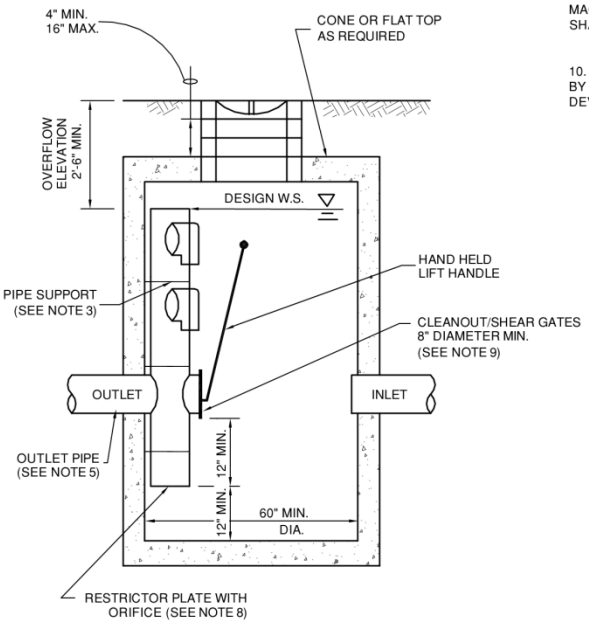
6. THE VERTICAL RISER STEM OF THE RESTRICTOR/ SEPARATOR SHALL BE THE SAME DIAMETER AS THE HORIZONTAL OUTLET PIPE, WITH A 10" MINIMUM DIAMETER.

7. MULTI-ORIFICE ELBOWS MAY BE LOCATED AS SHOWN OR ALL ON ONE SIDE OF RISER. SIZE OF ELBOWS AND PLACEMENT TO BE CLEARLY LABELED ON PLANS.

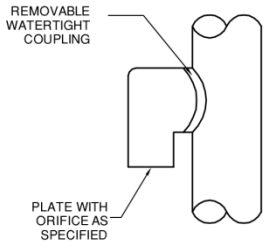
8. RESTRICTOR PLATE WITH ORIFICE AS SPECIFIED ON PLANS. SPECIFIED OPENING TO BE CUT ROUND AND SMOOTH.

9. CLEANOUT/SHEAR GATE: ALUMINUM ALLOY PER B-26-26-32E OR CAST IRON ASTM A48 CLASS 308 AS REQUIRED. LIFT HANDLE EITHER SOLID OR TUBING WITH ADJUSTABLE HOOK AS REQUIRED. NEOPRENE RUBBER GASKET REQUIRED BETWEEN RISER MOUNTING FLANGE AND GATE FLANGE. MATING SURFACES OF LID AND BODY TO BE MACHINED FOR PROPER FIT. FLANGE MOUNTING BOLTS SHALL BE 3/4" DIA. STAINLESS STEEL.

10. GATE SHALL NOT OPEN BEYOND THE CLEAR OPENING BY LIMITED HINGE MOVEMENT, STOP TABS, OR SOME OTHER DEVICE.



SECTION A-A



ELBOW DETAIL

CITY OF EUGENE
EXHIBIT DRAWING

ORIFICE LOCATION TEE RISER

	REVISIONS
DATE	DESCRIPTION

6/06

EXHIBIT 2-7

NOTES

1. EXCEPT AS SHOWN OR NOTED, UNIT SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS FOR LARGE PRE CAST CONCRETE MANHOLES.

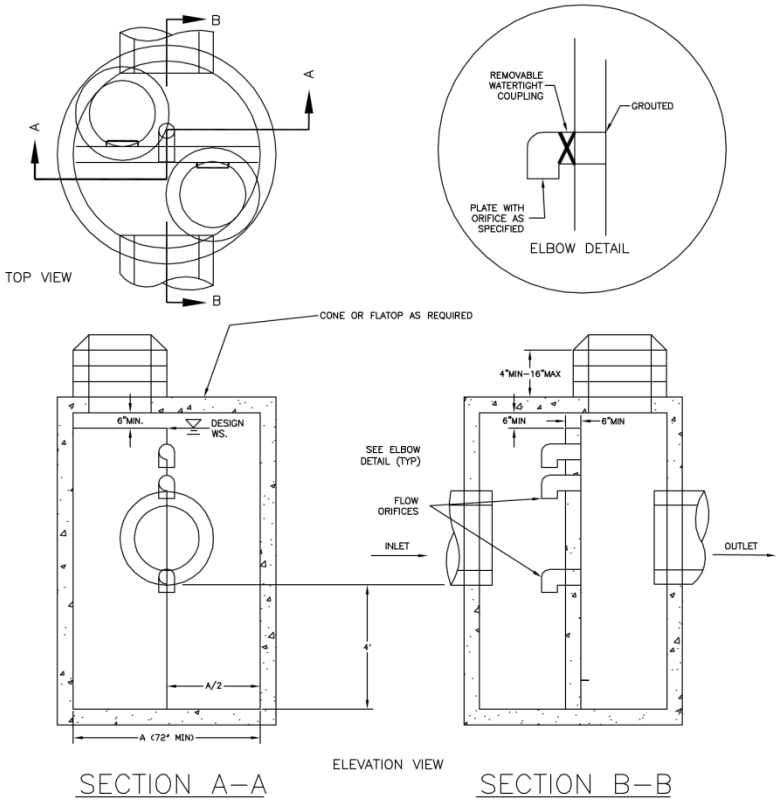
2. SEE PROJECT PLANS FOR SIZE AND LOCATION OF ORIFICES.

3. PIPE SIZES, SLOPES AND ALL ELEVATIONS AS SHOWN IN THE PLANS.

4. BAFFLE WALL SHALL HAVE #4 BAR AT 12" SPACING EACH WAY.

5. PRE CAST BAFFLE WALL SHALL BE KEYED AND GROUTED IN PLACE.

6. ORIFICE PLATES TO BE 1/4" THICK MIN. HDPE OR APPROVED EQUAL AND ATTACHED WITH 1/2" STAINLESS STEEL BOLTS.



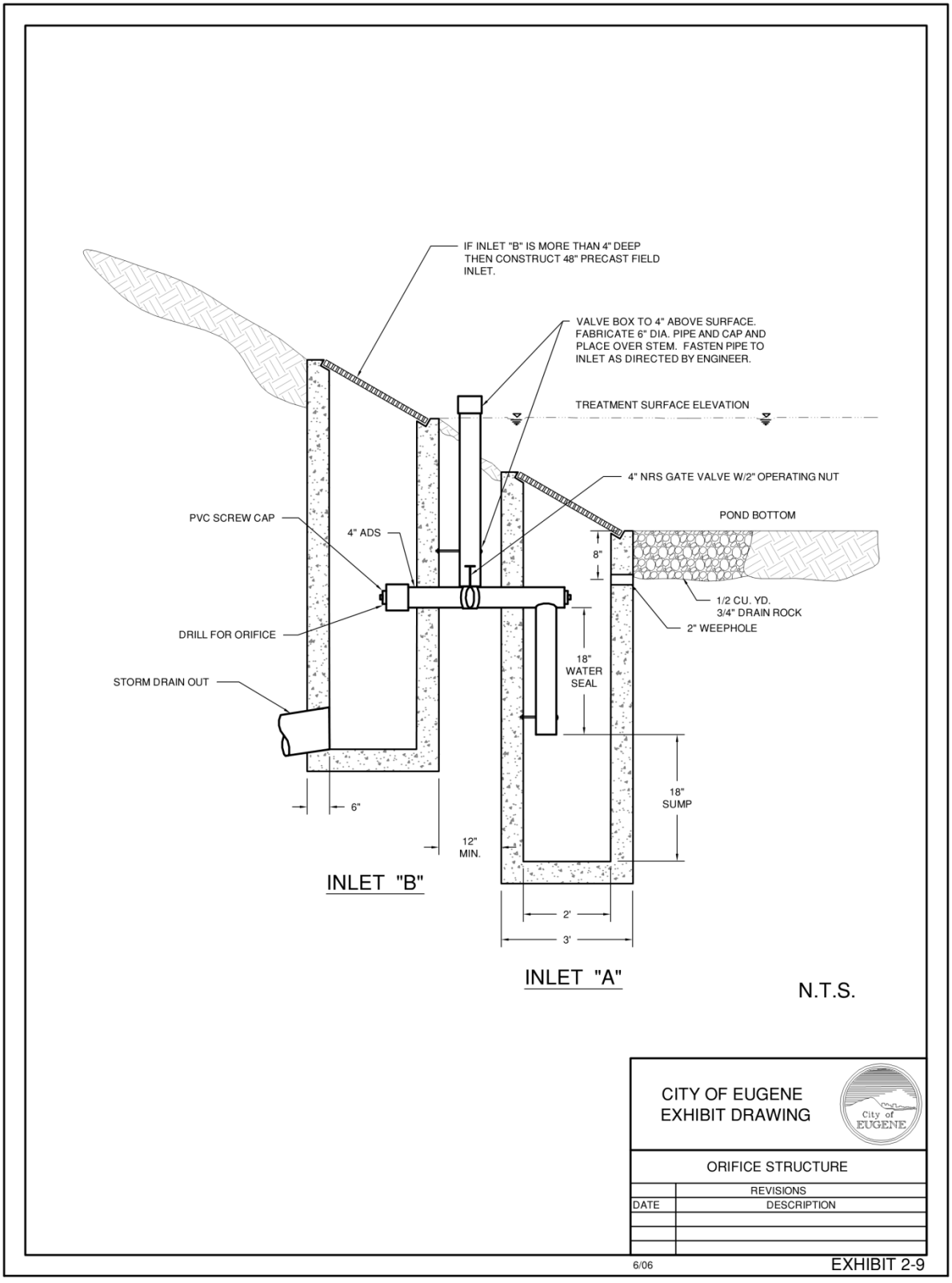
CITY OF EUGENE
EXHIBIT DRAWING

ORIFICE LOCATION BAFFLE RISER

	REVISIONS
DATE	DESCRIPTION

6/06

EXHIBIT 2-8


IF INLET "B" IS MORE THAN 4" DEEP
THEN CONSTRUCT 48" PRECAST FIELD
INLET.
VALVE BOX TO 4" ABOVE SURFACE.
FABRICATE 6" DIA. PIPE AND CAP AND
PLACE OVER STEM. FASTEN PIPE TO
INLET AS DIRECTED BY ENGINEER.
TREATMENT SURFACE ELEVATION
4" NRS GATE VALVE W/2" OPERATING NUT
POND BOTTOM
PVC SCREW CAP
4" ADS
8"
1/2 CU. YD.
3/4" DRAIN ROCK
2" WEEPHOLE
DRILL FOR ORIFICE
18"
WATER
SEAL
STORM DRAIN OUT
18"
SUMP
6"
12"
MIN.
INLET "B"
2'
3'
INLET "A"
N.T.S.
CITY OF EUGENE
EXHIBIT DRAWING
City of EUGENE
ORIFICE STRUCTURE
REVISIONS
DATE
DESCRIPTION
6/06
EXHIBIT 2-9

Rectangular Notched Sharp Crested Weir

$$Q = C\,(L - 0.2H) * H^{1.5}$$

Where:

Q=Weir discharge, cubic feet per second (cfs)
C = 3.27 + 0.40*H/P, feet
P = Height of weir bottom above downstream water surface, feet
H = Height from weir bottom to crest, feet
L = Length of weir, feet*

* For weirs notched out of circular risers, length is the portion of the riser circumference not to exceed 50 percent of the circumference.

V-Notched Sharp Crested Weir

$$Q = C_d\,(\text{Tan}\ \frac{\theta}{2})\ H^{\frac{5}{2}}$$

Where:

Q = Weir discharge, cfs
C_d = Contraction coefficient, feet (suggested value = 2.5 for 90 degree weir)
θ = Internal angle of notch, degrees
H = Height from weir bottom to crest, feet

ROCK PROTECTION AT OUTFALLS FOR PIPES GREATER THAN 6 INCHES IN DIAMETER

Discharge Velocity at Design Flow (fps)			REQUIRED PROTECTION Minimum Dimensions				
			Type	Depth*	Width	Length**	Height
0	To	5	Riprap*	2 x (max stone size)	Diameter + 6 ft.	As calculated	Crown + 1 ft.
6	To	10	Riprap*	2 x (max stone size)	Diameter + 6 ft. or 3x dia. which-ever is greater	As calculated	Crown + 1 ft.
11	To	20	Gabion or Riprap*	2 x (max stone size)	Diameter + 6 ft. or 4x dia. which-ever is greater	As calculated	Crown +1 ft.
Over 20			Engineered Energy Dissipater Required				

* Riprap size shall be determined using the following formulae*** and the City's *Standard Construction Specifications*

V = Average velocity (ft/s)
Do = Pipe diameter (ft)
ds = Riprap diameter (ft)
Lsp = Apron length (ft)
depth = Thickness (ft)
$Fo = V/(g*Do)^{0.5}$

*Riprap size ds=0.25*Do*Fo (6" minimum)
Depth=2*ds (1 foot minimum)
**Apron length Lsp= Do(8+17*Log Fo)

$g = 32.2\ ft/s^2$

***US Army Corps of Engineers design formulas from *Erosion and Riprap Requirements at Culvert and Storm Outlets*, January 1970

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APPENDIX G

INFILTRATION TESTING

APPENDIX G

INFILTRATION TESTING

To properly size and locate stormwater management facilities, it is necessary to characterize the soil infiltration conditions at the location of the proposed facility. All projects that propose onsite infiltration must evaluate existing site conditions and determine:

1. If the infiltration rate is adequate to support the proposed stormwater management facility (satisfied through presence of mapped NRCS Type A & B Soils or the Simplified Approach infiltration test) or;
2. The design infiltration rate prior to facility design (satisfied through the Presumptive Approach infiltration testing conducted by a qualified professional).

The following sections provide the approved standard infiltration testing specifications.

Simplified Approach Open Pit Infiltration Test

The purpose of the Simplified Approach is to provide a method which can be conducted by a nonprofessional for design of simple stormwater systems on small projects. The Simplified Approach open pit test is applicable only to projects on private property with less than 15,000 square feet of new or redeveloped impervious area. The results of infiltration testing must be documented on the Simplified Approach Form.

The Simplified Approach cannot be used to find a design infiltration rate. The intent of the open pit test is to determine whether or not the local infiltration rate is adequate (2 inches/hour or greater) for the predesigned stormwater facilities described in Chapter 2 (infiltration swales, basins, planters, drywells, and trenches). The Simplified Approach Infiltration Test does not need to be conducted by a licensed professional.

Simplified Approach Procedure

A simple open pit infiltration test is required for each facility designed through the Simplified Approach. The test should be where the facility is proposed or within the immediate vicinity.

Excavate a test hole to the depth of the bottom of the infiltration system, or otherwise to 4 feet. The test hole can be excavated with small excavation equipment or by hand using a shovel, auger, or post hole digger. If a layer hard enough to prevent further excavation is encountered, or if noticeable moisture/water is encountered in the soil, stop and measure this depth from the surface and record it on the Simplified Approach Form. Proceed with the test at this depth.

Fill the hole with water to a height of about 6 inches from the bottom of the hole, and record the exact time. Check the water level at regular intervals (every 1 minute for fast-draining soils to every 10 minutes for slower-draining soils) for a minimum of 1 hour or until all of the water has infiltrated. Record the distance the water has dropped from the top edge of the hole.

Repeat this process two more times, for a total of three rounds of testing. These tests should be performed as close together as possible to accurately portray the soil's ability to infiltrate at different levels of saturation. The **third test** provides the best measure of the saturated infiltration rate.

For each test pit required, submit all three testing results with the date, duration, drop in water height, and conversion into inches per hour.

If the results of the Simplified Approach open pit test show an infiltration rate greater than 2.0 inches per hour, the applicant can proceed with Simplified Approach facility design (where applicable). If the applicant would like to use an infiltration rate for design purposes, a Presumptive Infiltration Test must be conducted.

Presumptive Infiltration Testing

The Presumptive Approach must be used for all public and private developments where the Simplified Approach is not applicable. The qualified professional must exercise judgment in the selection of the infiltration test method. The three infiltration available testing methods used to determine a design infiltration rate are:

- Open pit falling head
- Encased falling head
- Double-ring infiltrometer

Where satisfactory data from adjacent areas is available that demonstrates infiltration testing is not necessary, the infiltration testing requirement may be waived. Waiver of the site specific testing is subject to approval by the City. Recommendation for foregoing infiltration testing must be submitted in a report which includes supporting data and is stamped and signed by the project engineer or geologist.

Testing Criteria

Testing must be conducted or overseen by a qualified professional. This professional must be a Professional Engineer, Registered Geologist, Soil Scientist or other professional testing service with equivalent training and experience in determining the permeability of soils.

The depth of the test must correspond to the facility depth. If a confining layer is observed during the subsurface investigation to be within 4 feet of the bottom of the planned infiltration system, the testing should be conducted within that confining layer.

Tests must be performed in the immediate vicinity of the proposed facility. Exceptions can be made to the test location provided the qualified professional can support that the strata are consistent from the proposed facility to the test location.

Infiltration testing should not be conducted in engineered or undocumented fill.

Minimum Number of Required Tests

The simplified Approach requires one infiltration test for every proposed facility. The Presumptive Approach requires one infiltration test for every proposed facility or one test for every 100 feet of proposed linear facility. Generalized soil infiltration rates may be used if facilities are proposed in areas of consistent topography and soil strata as outlined in a Geotechnical report.

Factor of Safety

A minimum factor of safety of 2 shall be applied to field obtained infiltration rates where infiltration of the flood control design storm is proposed.

Presumptive Infiltration Testing Instructions

Open Pit Falling Head Procedure

The open pit falling head procedure is performed in an open excavation and therefore is a test of the combination of vertical and lateral infiltration.

1. Excavate a hole with bottom dimensions of approximately 2 feet by 2 feet into the native soil to the elevation of the proposed facility bottom. Smooth excavations should be scratched and loose material removed.
2. Fill the hole with clean water a minimum of 1 foot above the soil to be tested, and maintain this depth of water for at least 4 hours (or overnight if clay soils are present) to presoak the native material. In sandy soils with little or no clay or silt, soaking is not necessary. If after filling the hole twice with 12 inches of water, the water seeps completely away in less than 10 minutes, the test can proceed immediately.
3. Determine how the water level will be accurately measured. The measurements should be made with reference to a fixed point.
4. After the presaturation period, refill the hole with water to 12 inches above the soil and record the time. Alternative water head heights may be used for testing provided the presaturation height is adjusted accordingly. Measure the water level at 10-minute intervals for a total period of 1 hour (or 20-minute intervals for 2 hours in slower soils) or until all of the water has drained. In faster draining soils (sands and gravels), it may be necessary to shorten the measurement interval in order to obtain a well defined infiltration rate curve. Constant head tests may be substituted for falling head tests at the discretion of the professional overseeing the infiltration testing.
5. Repeat the test. Successive trials should be run until the percent change in measured infiltration rate between two successive trials is minimal. The trial should be discounted if the infiltration rate between successive trials increases. At least three trials must be conducted. After each trial, the water level is readjusted to the 12 inch level.
6. The average infiltration rate over the last trial should be used to calculate the unfactored infiltration rate. The final rate must be reported in inches per hour.
7. For very rapidly draining soils, it may not be possible to maintain a water head above the bottom of the test pit. A rate based test may be used if the infiltration rate meets or exceeds the flow of water into the test pit.

Note that a maximum infiltration rate of 20 inches per hour can be used in stormwater system design.

Encased Falling Head Test

The encased falling head procedure is performed with a 6-inch casing that is embedded approximately 6 inches into the native soil. The goal of this field test is to evaluate the vertical infiltration rate through a 6-inch plug of soil, without allowing any lateral

infiltration. The test is not appropriate in gravelly soils or in other soils where a good seal with the casing cannot be established.

Embed a solid 6-inch diameter casing into the native soil at the elevation of the proposed facility bottom. Ensure that the embedment provides a good seal around the pipe casing so that percolation will be limited to the 6-inch plug of the material within the casing. This method can also be used when testing within hollow stem augers, provided the driller and tester are reasonably certain that a good seal has been achieved between the soil and auger.

Fill the pipe with clean water a minimum of 1 foot above the soil to be tested, and maintain this depth for at least 4 hours (or overnight if clay soils are present) to presoak the native material. Any soil that sloughed into the hole during the soaking period should be removed. In sandy soils with little or no clay or silt, soaking is not necessary. If after filling the hole twice with 12 inches of water, the water seeps completely away in less than 10 minutes, the test can proceed immediately.

To conduct the first trial of the test, fill the pipe to approximately 12 inches above the soil and measure the water level. Alternative water head heights may be used for testing provided the presaturation height is adjusted accordingly. The level should be measured with reference to a fixed point. Record the exact time.

Measure the water level at 10-minute intervals for a total period of 1 hour (or 20-minute intervals for 2 hours in slower soils) or until all of the water has drained. In faster draining soils (sands and gravels), it may be necessary to shorten the measurement interval in order to obtain a well defined infiltration rate curve. Constant head tests may be substituted for falling head tests at the discretion of the professional overseeing the infiltration testing. Successive trials should be run until the percent change in measured infiltration rate between two successive trials is minimal. The trial should be discounted if the infiltration rate between successive trials increases. At least three trials must be conducted. After each trial, the water level is readjusted to the 12 inch level.

The average infiltration rate over the last trial should be used to calculate the unfactored infiltration rate. Alternatively, the infiltration rate measured over the range of water head applicable to the project stormwater system design may be used at the discretion of the professional overseeing the testing. The final rate must be reported in inches per hour.

Double Ring Infiltrometer Test

The double-ring infiltrometer test procedure should be performed in accordance with ASTM 3385-94. The test is performed within two concentric casings embedded and sealed to the native soils. The outer ring maintains a volume of water to diminish the potential of lateral infiltration through the center casing. The volume of water added to the center ring to maintain a static water level is used to calculate the infiltration rate. The double-ring infiltrometer is appropriate only in soils where an adequate seal can be established.

Reporting Requirements

The following information should be included in the Infiltration Testing Report. The Infiltration Testing Report should be attached to the project's Stormwater Management Report:

1. Statement of project understanding (proposed stormwater system).
2. Summary of subsurface conditions encountered.
3. Summary of infiltration testing including location and number of tests and testing method used. Discussion of how the tests were performed (i.e. pipe type or diameter or test pit dimensions).
4. Infiltration testing results in inches per hour.
5. Recommended design infiltration rate including factors of safety.
6. Groundwater observations within exploration and an estimate of the depth to seasonal high groundwater.
7. Site plan showing location of infiltration tests.
8. Boring or test pit logs. The logs should include an associated soil classification consistent with ASTM D2488-00, Standard Practice for Classification for Description and Identification of Soils (Visual-Manual Procedure). The logs should also include any additional pertinent subsurface information, such as soil moisture conditions, depth and description of undocumented or engineered fill, soil color and mottling conditions, soil stiffness or density, and approximate depth of contact between soil types.
9. Infiltration Test Data

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APPENDIX H

STORMWATER ANALYSES REPORTS

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APPENDIX H

STORMWATER ANALYSIS REPORT REQUIREMENTS

A Stormwater Management Report is required for every site improvement where the Presumptive Approach is used. The report shall be prepared by a licensed Civil Engineer in the State of Oregon. The report should include the following information where applicable:

Cover Sheet

- Project name and owner
- Site address
- Associated permit numbers
- Engineer
- Firm
- Address
- Contact information
- Oregon Professional Engineer's registration stamp

Table of Contents

Project Overview and Description

- Size and location of project site (vicinity map)
- Type of development/proposed improvements
- Watershed description
- Permits required (local, state, federal)
- Existing vs. post-construction conditions

Methodology

- Drainage at existing site
- Potential impacts on the proposed site from existing conditions
- Potential impacts from the proposed site on existing drainage
- Techniques for mitigating potential conflicts or problems
- Infiltration testing results
- Narrative that defines the proposed stormwater management techniques, including discharge point(s) for runoff from private and public impervious areas
- Stormwater hierarchy category justification

Analysis

- Design Assumptions
- Design storms used
- Computation methods
- Software used
- Safety factors, curve numbers, and design coefficients
- Clarify variations from the norm
- PAC narrative form and printouts
- Conveyance requirements and design
- Table of impervious area treated (differentiates public vs. private and roof vs. pavement).
- Comparison table of the flow rates for pre and post construction. Table must show that the project meets the flow control requirements if applicable
- Determination of the flood control point of discharge and capacity of receiving system

Engineering Conclusions

- Based on compliance with Stormwater Management Manual
- How water quality, flow control, and flood control requirements are satisfied
- Stormwater Facility Details/Exhibits
- Contour maps of pre and post development
- Impervious area identification
- Watershed delineation
- Existing and new drainageways
- Point(s) of discharge
- Delineation of each catchment

Additional Forms

- Source Control Special Circumstances Installations (if applicable)
- Special Circumstances (if applicable)
- Other Reports (is applicable)

APPENDIX I

INFILTRATION LIMITED AREAS MAP AND NRCS SOIL GROUP MAP

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Infiltration Limited Areas

L E G E N D

- Eugene Urban Growth Boundary
- Storm Water Basins
- Rivers and Streams

Infiltration Limiting Criteria

- Depth to Bedrock less than 5 feet*
- Permeability less than 0.6 inches/hour*
- Depth to Groundwater less than 6 feet*
- Slopes greater than 15 percent

This map displays areas that are not likely to meet the City's proposed subsurface infiltration design requirements. Detailed site-specific information will be required for all proposed infiltration facilities whether required by the City or initiated by the property owner.

** from USDA Natural Resources Conservation Services*

Figure 1. Infiltration limited areas in Eugene

1 0.5 0 1 2 3 Miles

Map produced by City of Eugene PW Eng Info Team, May 25 2006 (ref# 0605-1467)

N

Map based on imprecise source data, subject to change

I - 5

River Rd

Hwy 99

Beltline Rd

Royal Ave

Coburg Rd

I - 105

W 11th

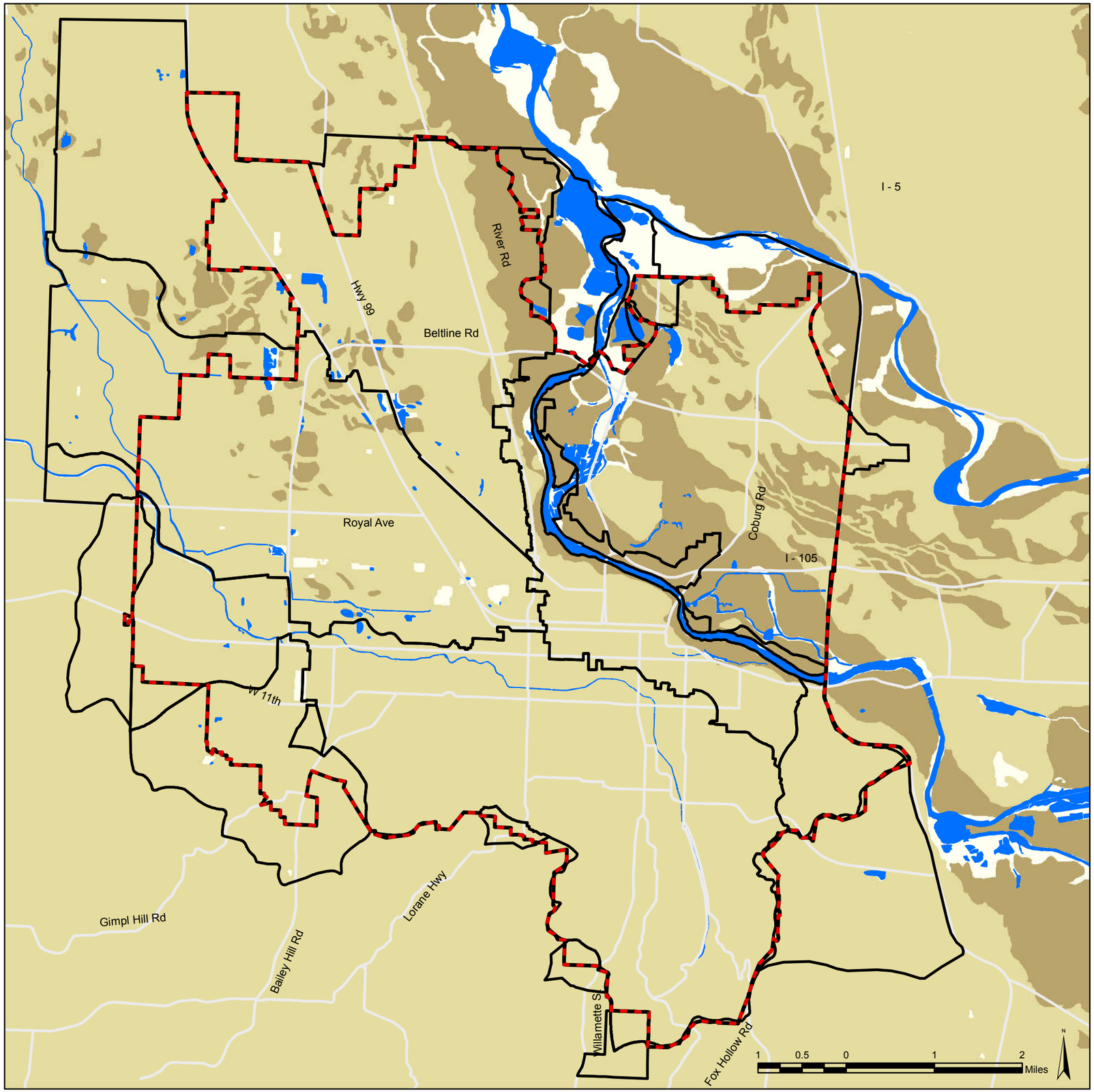
Gimpl Hill Rd

Bailey Hill Rd

Lorane Hwy

Willamette St

Fox Hollow Rd



Hydrologic Soil Groups

L E G E N D

Eugene Urban Growth Boundary

Storm Water Basins

Rivers and Streams

Hydrologig Group

A and B

C and D

Map based on imprecise
source data, subject to change

Map produced by City of Eugene PW Eng Info Team, February 2014 (ref# 0605-1467)

APPENDIX J

HEADWATERS STREAM MAP

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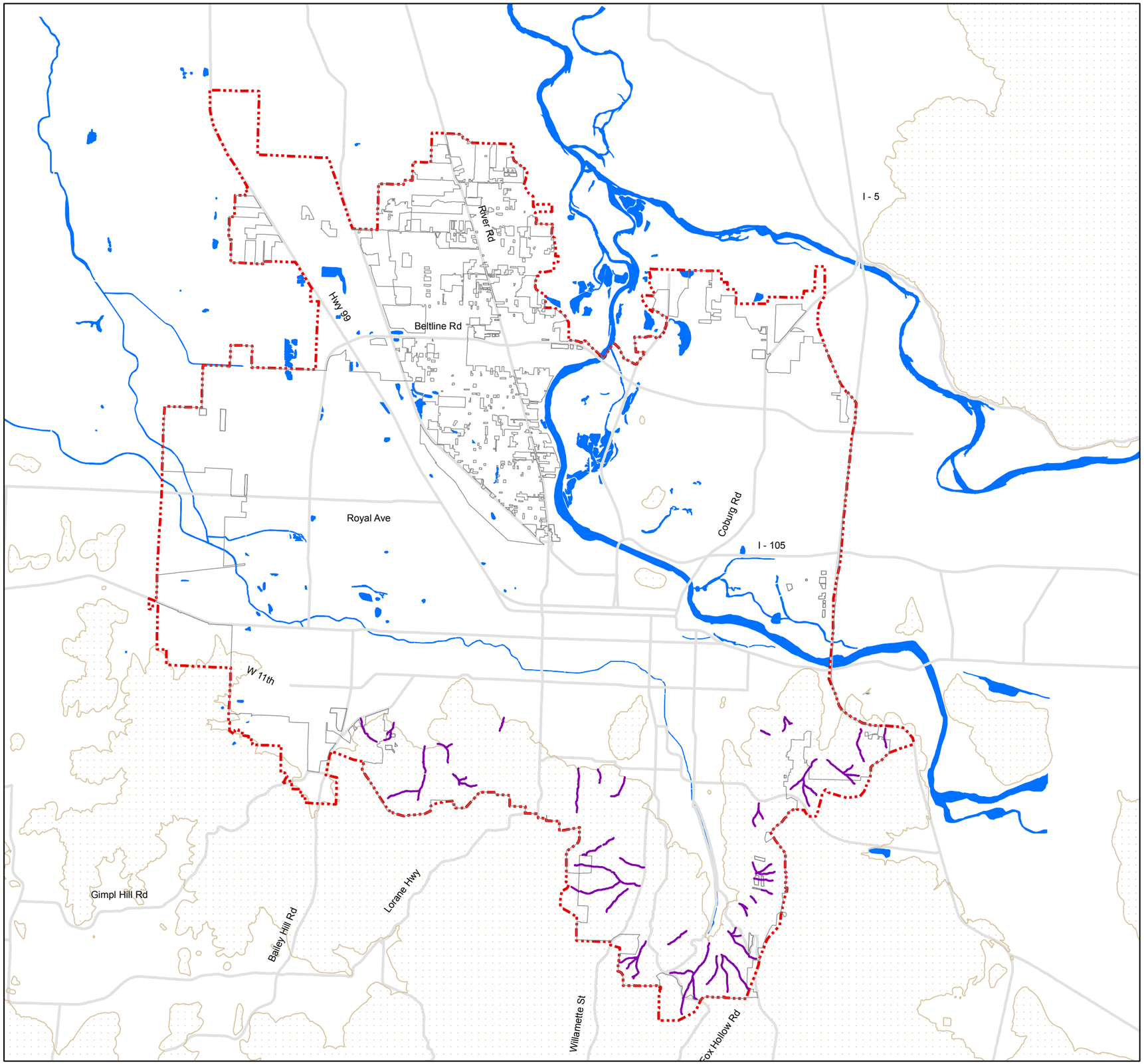
Headwaters Streams Map



L E G E N D

- Headwater Stream*
- Eugene Urban Growth Boundary
- City Limits
- 500 ft Elevation Line
- Rivers and Streams

Definition:

* Headwater Streams: a waterbody having a minimum length of 500 feet and provides a drainage area of 10 acres or more, and is identified on the City of Eugene's Sensitive Areas Map having all or a portion of its length greater than 10% slope and affected by highly erodible soils

1 0.5 0 1 2 3 Miles

Map produced by City of Eugene PW Eng Info Team, June 02 2006 (ref# 0605-1467)

N

Map based on imprecise source data, subject to change

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APPENDIX K

FLOOD CONTROL DESIGN STORM TABLES

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Table 3-1
Storm Recurrence Intervals for Planning and Design of Drainage Improvements

Drainage Area (acres)			Type of Drainage Improvement				Design Storm Recurrence Interval in Years
					Culverts and Bridges - Type of Roadway		
			Open Channel	Closed Pipe	Major Collectors and Neighborhood Collectors	Major Arterials and Minor Arterials	
<40	40 TO 640	>640	(a)	(b)	(c)	(d)	(e)
X				X			5/10 (h)
X			X		X	X	10 (f)
	X			X			10 (f)
	X		X		X		10 (f)
	X					X	25
		X	X	X(g)	X		25
		X				X	50
All improvements on waterways with FEMA 100-year floodplains							100

(a) Includes roadside ditches and drainage swales
(b) Storm sewer systems or a closed conduit whose length exceeds that of a normal culverted crossing of a single roadway
(c) Includes local or residential streets, local collectors, and any other roadways up to a major arterial
(d) Major arterial or better within the City's right-of-way maintenance
(e) Assuming ultimately planned development conditions (i.e., impervious cover) within the City's Urban Growth Boundary (UGB) and existing development conditions outside of the City's UGB
(f) The 5-year recurrence interval can be used in unusual situations involving sufficient topographical conditions that result in an exceptionally high cost differential between the 10-year and 5-year improvement design (e.g., 40%)
(g) Closed pipe systems should not be used on waterways draining more than 640 acres (i.e., 1 square mile)
(h) The 5-year storm may be used when the Rational Method is applied to calculate the design flow rate. The 10-year storm should be used for closed pipes with <40 acre drainage areas when using the City's SWMM modeling results or when extending the City's SWMM model using consistent methods and assumptions as used for the City's SWMM modeling work.

Table 3-2
Selected Design Events for Each Basin

Design Event	Amazon Creek	Willow Creek	Bethel Danebo	Laurel Hill	Willakenzie	Willamette River
10-Year	11/25/77	11/23/60	11/23/60	11/25/77	11/25/77	8/16/68 2/5/96
25-Year Summer	8/16/68	**	8/16/68	8/16/72	8/21/79	*
25-Year Winter	2/5/96	2/5/96	10/31/94	10/31/94	10/31/94	*
50-Year	5.76" SCS Type 1A	5.76" SCS Type 1A	5.76" SCS Type 1A	5.76" SCS Type 1A	5.76" SCS Type 1A	*
100-Year	6.48" SCS Type 1A	6.48" SCS Type 1A	6.48" SCS Type 1A	6.48" SCS Type 1A	6.48" SCS Type 1A	*

*For the Willamette basin, only the 10-year storm was needed for the evaluation because only selected portions of the basin were modeled.
**For the Willow Creek basin, an August storm was not evaluated as the short, high-intensity events were not as critical in this basin as the long duration, high-volume events.

Table 3-3
Design Events Characteristics

Design Event	Rainfall Volume (inches)	Maximum Intensity (in/hour)	Approximate Duration (hours)
11/23/60	7.36	0.67	114
8/16/68	1.36	1.14	10
8/16/72	1.38	0.92	5
11/25/77	2.09	0.66	7
8/21/79	1.82	1.11	3
10/31/94	4.05	0.70	32
2/5/96	7.24	0.66	51
50-Year SCS Type 1A	5.76	0.95	24
100-Year SCS Type 1A	6.48	1.06	24

The above information is based on NWS rain gage data.

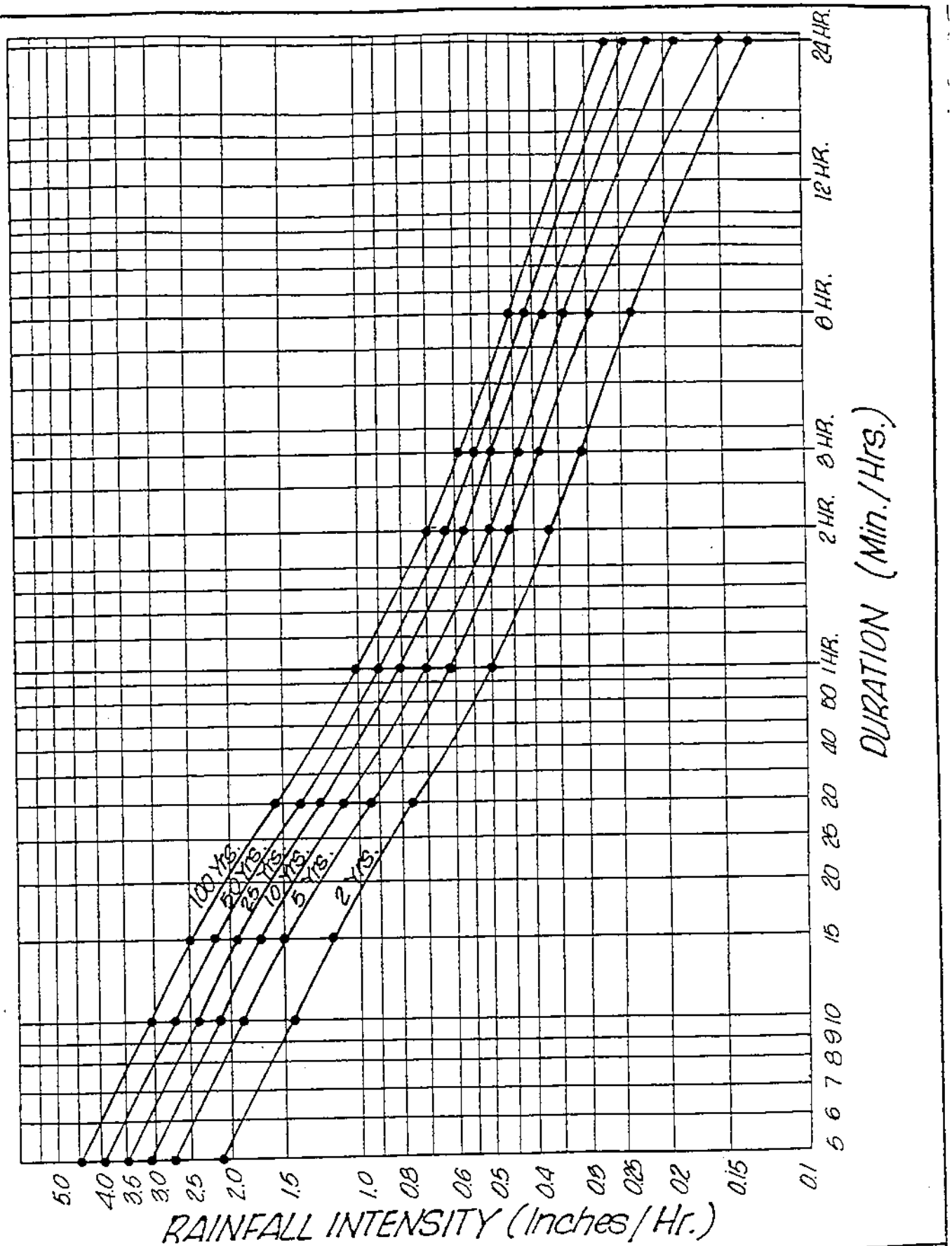

FIGURE 4.1
Rainfall Intensity, Duration and Frequency Curves for Eugene, Oregon

otak INC. ARCHITECTS, P.C.
incorporated
17355 S.W. Boones Ferry Rd. Lake Oswego OR 97035 (503) 635-3618
101 E. 8th Street, Vancouver WA 98660 (206) 695-0357
11058 Main Street #215, Bellevue WA 98004 (206) 455-5340

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APPENDIX L

WATER QUALITY DESIGN STORM DEVLOPMENT

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APPENDIX L

CITY OF EUGENE DEVELOPMENT STANDARDS MEMORANDUM #4
WATER QUALITY DESIGN STORM SELECTION

INTRODUCTION

In Development Standards Memorandum #2, the following four approaches for implementing stormwater quality requirements were considered:

1. Stormwater quality facilities are required to reduce pollutants in the stormwater runoff resulting from a specified amount of rainfall, or "water quality design storm"
2. Stormwater quality facilities are required to meet a specified performance threshold (e.g., 80% removal of TSS)
3. Specific stormwater quality facilities are required for specific land uses
4. In-lieu-of fees are allowed

Based on the advantages and disadvantages described for each of the four approaches, we decided to further evaluate Approach #1 – Stormwater quality facilities are required to reduce pollutants in the stormwater runoff resulting from a specified water quality design storm.

Structural stormwater quality facilities (i.e., not site planning) can generally be divided into two groups based on different design requirements: detention facilities and flow-through facilities. Detention type facilities include dry ponds, wet ponds, and stormwater marshes. These facilities are designed to allow for the settling of particulates and other pollutants in stormwater by storing the stormwater runoff for a certain period. Therefore, the total rainfall (depth in inches) of the water quality design storm needs to be specified to determine the appropriate size of a detention type facility.

Flow-through facilities include vegetated swales and/or structural facilities with filter media such as sand or compost. These facilities remove particulates and other pollutants by mechanical means (e.g., baffles) or by passing the stormwater through a filtration media (e.g., vegetation, sand or compost). Since flow-through type facilities operate with little or no detention, these types of facilities are designed to treat a maximum flow rate rather than a total runoff volume. Therefore, the rainfall intensity (inches/hour) of the water quality design storm needs to be specified to determine the appropriate size of a flow-through based facility.

The purpose of this memorandum is to describe the methods used to select the water quality design storm parameters for detention type and flow-through type stormwater quality facilities. This memo contains the following information:

- Description of measured rainfall data sources

- Description of the rainfall analysis procedures
- A discussion of the conceptual design procedure for the preliminary capital projects
- Summary of the results of the water quality design storm analysis
- Comparison to other jurisdictions
- Recommendation for further evaluation

LONG-TERM RAINFALL DATA SOURCES

The parameters of the water quality design storm (i.e., total rainfall and rainfall intensity) are based on a statistical analysis of local long-term rainfall data. Hourly rainfall measurements are needed to determine the total rainfall volume for designing detention type facilities. For Eugene, long-term hourly precipitation data are available from a rain gage operated by the National Weather Service (NWS) at the Eugene Airport. Hourly precipitation data is available for this gauge location from 1948 to the present.

Shorter increment rainfall measurements (i.e., 5 to 15 minutes) are more appropriate for determining the rainfall intensity for designing flow-through type facilities. The City has operated several rain gauges within Eugene for the past six years that measure rainfall at 15-minute increments. The rainfall data collected at City gauge 11 (located in west Eugene on the Bertlesen Slough) and City gauge M2 (located in Amazon Park) were used in this analysis.

RAINFALL ANALYSIS PROCEDURES

The statistical analyses of the long-term hourly rainfall measurements collected by the NWS at the Eugene Airport were completed using the Synoptic Rainfall Data Analysis Program (SYNOP). SYNOP provides a summary and statistical analysis of storm event parameters (e.g., rainfall depths, storm intensity, storm duration) and of annual and monthly rainfall totals. The two key input variables in SYNOP are the inter-event time and minimum storm depth. The inter-event time represents the minimum length of dry period, in hours, beyond which additional rainfall measurements are considered to be separate storm events. It is used to separate a long-term continuous rainfall record into discrete, independent storm events. The minimum storm depth is applied to eliminate small storm events from the long-term record that are unlikely to produce measurable stormwater runoff. Storm events with a depth of 0.01 inches or less were eliminated from the long-term record as they are unlikely to produce measurable stormwater runoff. Additional analyses of the results from SYNOP were completed using Microsoft Excel.

CONCEPTUAL DESIGN OF PRELIMINARY CAPITAL PROJECTS

In order to develop conceptual designs for the preliminary capital projects identified during the basin planning process, a preliminary water quality design storm was needed. A SYNOP analysis was completed on the long-term hourly precipitation data from the NWS gage at the Eugene airport using an inter-event time of 6 hours and a minimum storm depth of 0.01 inches. The results of the SYNOP and spreadsheet

analyses are presented in Figure 1.

The plot in Figure 1 presents the average annual percentage of storm events (y axis) that are equal to or less than a specific design storm rainfall depth (x axis). For example, approximately 80% of the storm events have a rainfall depth of 1.4 inches or less. Therefore, if a detention type stormwater quality facility were designed to capture and treat the stormwater runoff from a site resulting from a 1.4 inch storm event, approximately 80% of the annual stormwater runoff from the site would be treated. This storm depth, 1.4 inches, was selected as the preliminary water quality design storm for completing the conceptual designs for the detention type stormwater quality capital projects.

WATER QUALITY DESIGN STORM ANALYSIS

Based on recent Department Advisory Committee meetings, it seems apparent that development standards for stormwater quality are recommended for portions of Eugene. Therefore, we completed a more detailed analysis of the NWS and City rainfall records to develop the specific parameters of the water quality design storm for implementing development standards. The total rainfall and rainfall distribution is required to design detention type stormwater quality facilities. The rainfall intensity is required to design flow-through type facilities (both off-line and on-line). The procedures used to obtain these water quality design storm parameters are described below.

Detention Type Water Quality Facilities

Long-term hourly precipitation data at the Eugene airport were analyzed to select the water quality design storm parameters for designing detention type stormwater quality facilities. The SYNOP analysis was conducted using an inter-event time of 6 hours and a minimum storm depth of 0.01 inches. Based on the results presented in Figure 1, a design storm rainfall depth of 1.4 inches is required to capture approximately 80% of the average annual runoff from a site. A design storm rainfall depth of 0.95 inches is required to capture approx mately 70% of the average annual runoff from a site. A design storm rainfall depth of 2.4 inches is required to capture 90% ofthe average annual runoff from a site.

The rainfall distribution describes the temporal distribution for the total rainfall. The U.S. Soil Conservation Service (SCS) developed a rainfall distribution for western Oregon and Washington referred to as SCS Type 1A. The duration of the SCS Type 1A storm event is typically specified as 24 hours. Based on our SYNOP analysis, the average storm durations for a 6-hr, 12-hr, and 24-hr inter-event time were 16 hours, 26 hours, and 46 hours, respectively. Therefore, a 24-hour rainfall distribution appears to be appropriate.

Flow-through Type Water Quality Facilities

Flow-through type facilities can be installed as off-line or on-line structures. With off-line facilities, an inlet control structure (e.g., flow control manhole) is installed to limit

the maximum allowable flow rate that can be treated by the stormwater quality facility. Stormwater flows that exceed the maximum allowable flow rate are bypassed around the facility. The off-line configuration minimizes the possibility that particulates and other pollutants previously trapped by the facility will be resuspended and transported downstream during higher flows.

For on-line facilities, the high flows are not bypassed around the stormwater quality facility. A typical example of this type of facility is a vegetated swale. Most vegetated swales are designed to treat the peak flow rate resulting from the water quality design storm but also convey the peak flow rate resulting from the flood control design storm. During high flows, the treatment effectiveness of an on-line facility is eliminated or greatly reduced. Furthermore, there is a risk that a portion of the particulates and other pollutants that were previously trapped by the on-line facility could be resuspended and transported downstream. Due to these concerns, for an equivalent drainage area, an on- line facility typically must be significantly larger than an off-line facility to provide an equivalent degree of water quality treatment. Therefore, two rainfall intensities need to be specified for designing these facilities: one for the design of on-line facilities and one for the design of off-line facilities.

QA/QC for the 15-Minute Rainfall Data Collected at City Gauges 11 and M2

The 15-minute rainfall data collected at City gauges 11 and M2 were used to determine the rainfall intensity for designing flow-through type facilities. The rainfall data were available from 11 and M2 from January 1995 to December 1999. A comparison of the rainfall data from the two gauges indicated that significant differences exist in the two data sets for some periods of record. Therefore, the 15-minute rainfall data collected at 11 and M2 were studied and analyzed for quality assurance and control purposes. The daily precipitation data collected from the NWS Rain Gauge at the Eugene Airport were also used in the data QA/QC process. The steps involved in data QA/QC are summarized below.

First we calculated daily precipitation at 11 and M2 from 1995 to 1999 by summing all the 15-minute rainfall data collected on each individual day. The daily precipitation at 11 and M2 were then compared with the daily precipitation data collected from the National Weather Service Rain Gauge at the Eugene Airport. One rainfall data file was developed from the two city data sets (i.e., the 11 and M2 rain gages) based on the following criteria:

- If the daily precipitation data for specific dates at one city gauge were significantly different from the daily rainfall data from the NWS gauge and the other city gauge, the data collected at this city gauge were excluded for those dates;
- If the daily precipitation data collected at the two city gauges were similar for a storm event but were quite different from the data collected from NWS, the city gauge that had the closer daily rainfall values to the NWS data were included in the combined data set;

- For certain days in a month that the daily rainfall data were different at all three rain gauges, data from the city gauge that was excluded the least frequently in that month was included in the combined data set.

The following periods of precipitation data were excluded altogether from the records due to the malfunctioning ofboth the I1 and M2 rain gages:

1. March 6, 1995 through March 31, 1995
2. September 1, 1999 through December 31, 1999.

The *QA/QC* results can be found in the spreadsheet files titled 1995.xls, 1996.xls, 1997.xls, 1998.xls and 1999.xls. The shaded areas in the spreadsheet represent the periods of record that were excluded. A new set of 15-minute rainfall data was developed by combining the 15-minute rainfall data collected at I1 and M2 from 1995 to 1999 as described above. A spreadsheet analysis was then performed on the combined data set to develop a frequency distribution of rainfall intensities for on-line and off-line flow-through water quality facilities. Descriptions of the spreadsheet analysis for both off-line and on-line flow-through facilities are provided in the following sections.

Off-line Flow-through Type Facilities

A spreadsheet analysis of the combined 15-minute rainfall data collected at City gauges I1 and M2 was completed to summarize the occurrence of rainfall intensities for off-line facilities. The results are presented in Figure 2. The results are based on the assumption that all stormwater runoff would be treated if the measured rainfall intensity was equal to or less than the design storm intensity. If the measured rainfall intensity exceeded the design storm intensity, then the percentage ofthe storm that could be treated was set equal to the ratio of the design storm intensity to the actual storm intensity. For example, if the facility is designed to treat storm events with a maximum intensity of 0.2 in/hr, then all the runoff from storm events with intensities less than or equal to 0.2 in/hr can be treated. However, if the rainfall intensity is 0.3 in/hr, then only 2/3 (or 66%) of the runoff generated this storm event would get treated.

Based on these assumptions, 80% of the average annual runoff volume would be treated ifthe off-line facility is designed using a rainfall intensity of 0.13 in/hr. Approximately 70% of the average annual runoff volume would be treated using a rainfall intensity of 0.08 in/hr, and 90% would be treated using a rainfall intensity of 0.19 in/hr.

On-line Flow-through Type Facilities

A spreadsheet analysis of the combined 15-minute rainfall data collected at City gauges I1 and M2 was also completed to summarize the occurrence of rainfall intensities for on- line facilities. The results are presented in Figure 2. The results for on-line facilities are based on a different set of assumptions than for off-line facilities. Similar to off-line facilities, if the measured rainfall intensity was less than or equal to the design storm

intensity, then all ofthe stormwater runoff would be treated. However, if the measured rainfall intensity exceeded the design storm intensity, the results are based on the assumption that all of the stormwater runoff from that event would not receive treatment.

Based on these assumptions, 80% of the average annual runoff volume would be treated if the off-line facility is designed using a rainfall intensity of 0.22 in/hr. Approximately 70% of the average annual runoff volume would be treated using a rainfall intensity of 0.17 inlhr, and 90% would be treated using a rainfall intensity of 0.34 in/hr.

COMPARISON WITH OTHER JURISDICTIONS

Several other regional jurisdictions have recently adopted development standards for water quality. The following table presents the water quality requirements for Portland, Gresham, and the Unified Sewerage Agency with proposed requirements in Eugene.

Jurisdiction	Average Annual Rainfall (in)	Water Quality Design Storm			
		Detention Type Facilities		Flow-through Facilities	
		Total Rainfall (in)	Storm Duration	Off-line Facilities	On-Line Facilities
Portland	34	0.83	24-hr duration	Not Specified	Not Specified
Gresham	34	1.2	12-hr duration	0.11 in/hr	0.20 in/hr
USA	40	0.36	4-hr duration	Not Specified	Not Specified
Eugene	45	1.4	24-hr duration	0.13 in/hr	0.22 in/hr

RECOMMENDATION

Based on the above analysis, we recommend that preliminary capital project designs and example site designs (for the DAC) incorporate the use of the following design storm specifications:

- For detention type facilities: required storage volume is equal to the stormwater runoff resulting from a 1.4 inch, 24-hour duration design storm
- For off-line flow-through type facilities: treat the peak flow rate resulting from a design storm with a rainfall intensity of 0.13 inlhr
- For on-line flow-through type facilities: treat the peak flow rate resulting from a design storm with a rainfall intensity of 0.22 inlhr

For the development of design tools (Task 400B1) and development of the BMP manual (Task 400B3), we recommend further analysis of the proposed design storms. Specifically, we recommend designing some example facilities to meet these requirements and running the **lon**g-term rainfall record through the facilities to ensure 80% capture of runoff.

Figure 1

Occurrence of Storm Events Based on an Analysis of the 50-year NWS Rainfall Record from the Eugene Airport (inter-event time = 6 hrs, minimum storm volume = 0.01 in)

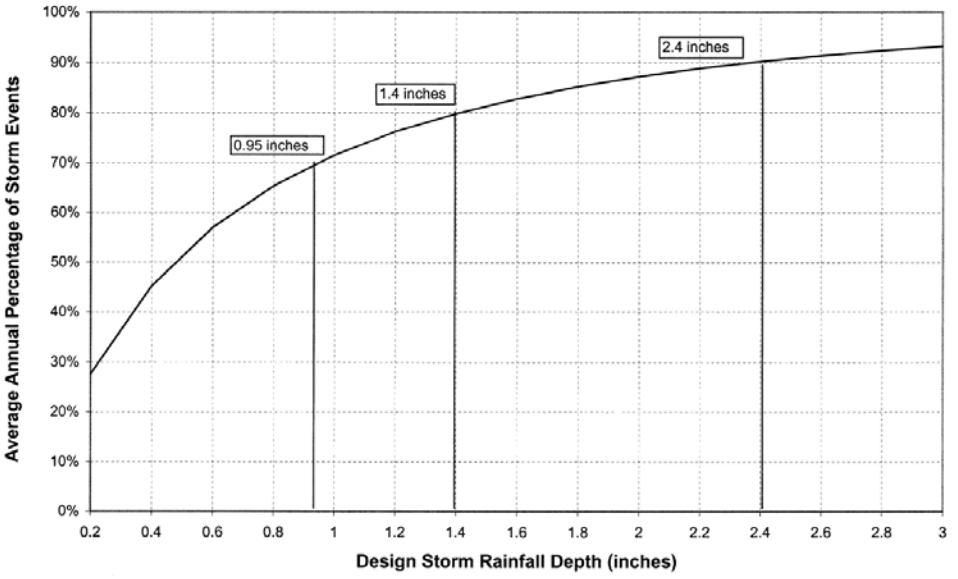
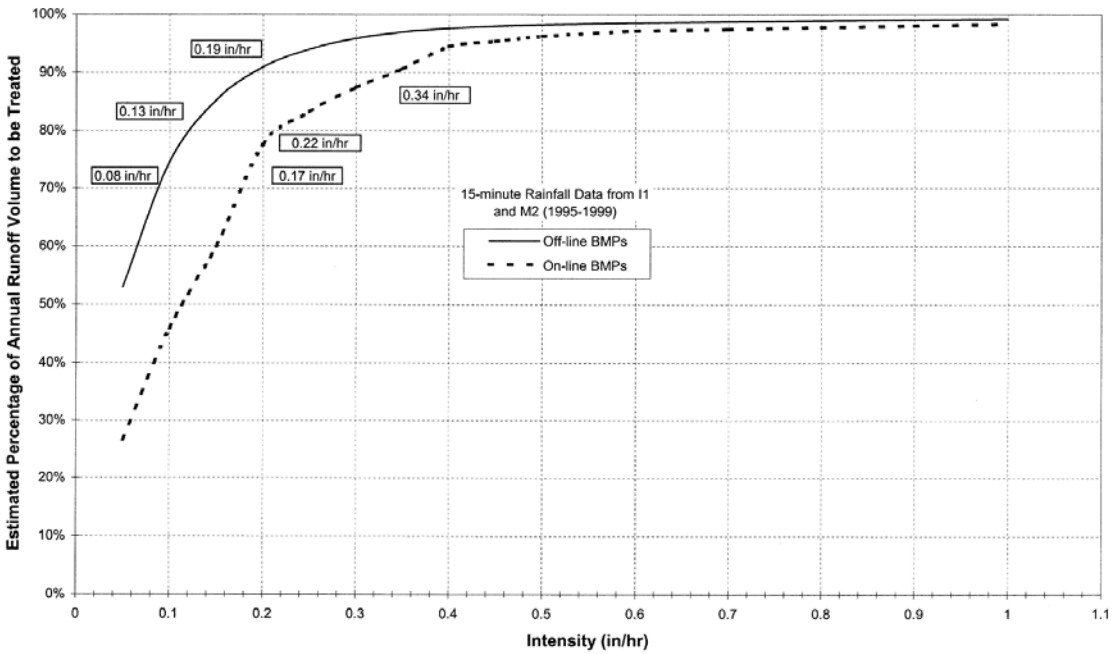


Figure 2

Eugene Stormwater Program
Potential Water Quality Design Storms for Flow-Through Type Facilities



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APPENDIX M

SANTA BARBARA UNIT HYDROGRAPH METHOD

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APPENDIX M

SANTA BARBARA URBAN HYDROGRAPH METHOD

Introduction

The Santa Barbara Urban Hydrograph (SBUH) method was developed by the Santa Barbara County Flood Control and Water Conservation District to determine a runoff hydrograph for an urbanized area. It is a simpler method than some other approaches, as it computes a hydrograph directly without going through intermediate steps (i.e., a unit hydrograph) to determine the runoff hydrograph.

The SBUH method is a popular method for calculating runoff, since it can be done with a spreadsheet or by hand relatively easily. The SBUH method is the method approved by the City of Eugene for determining runoff when doing flow control calculations.

Elements Of The SBUH Method

The SBUH method depends on several variables:

- Pervious (A_p) and impervious (A_{imp}) land areas
- Time of concentration (T_c) calculations
- Runoff curve numbers (CN) applicable to the site
- Design storm

These elements shall all be presented as part of the submittal process for review by staff. In addition, maps showing the pre-development and post-development conditions shall be presented to help in the review.

Land Area

The total area, including the pervious and impervious areas within a drainage basin, shall be quantified in order to evaluate critical contributing areas and the resulting site runoff. Each area within a basin shall be analyzed separately and their hydrographs combined to determine the total basin hydrograph. Areas shall be selected to represent homogenous land use/development units.

Time of Concentration

Time of concentration, T_c, is the time for a theoretical drop of water to travel from the furthest point in the drainage basin to the facility being designed. (In this case, T_c is derived by calculating the overland flow time of concentration and the channelized flow time of concentration.) T_c depends on several factors, including ground slope, ground roughness, and distance of flow. The following formula for determining T_c is:

Formulas

$T_c = T_{t1} + T_{c2} + T_{c3} + \ldots + T_{cn}$

$T_t = L/60V$ (Conversion of velocity to travel time)

$T_t = \frac{0.42\ (nL)^{0.8}}{1.58(s)^{0.4}}$ (Manning's kinematic solution for sheet flow less than 300 feet)

Shallow concentrated flow for slopes less than 0.005 ft/ft.:

$V = 16.1345(s)^{0.5}$ (Unpaved surfaces)

$V = 20.3282(s)^{0.5}$ (Paved surfaces)

Where,

T_t = travel time, minutes
T_c = total time of concentration, minutes (minimum T_c = 5 minutes)
L = flow length, feet
V = average velocity of flow, feet per second
n = Manning's roughness coefficient for various surfaces
s = slope of the hydraulic grade line (land or watercourse slope), feet per foot

When calculating T_c, the following limitations apply:

- Overland sheet flow (flow across flat areas that does not form into channels or rivulets) shall not extend for more than 300 feet.

- For flow paths through closed conveyance facilities such as pipes and culverts, standard hydraulic formulas shall be used for establishing velocity and travel time.
- Flow paths through lakes or wetlands may be assumed to be zero (i.e. $T_c = 0$).

Runoff Curve Numbers

Runoff curve numbers were developed by the Natural Resources Conservation Service (NRCS) after studying the runoff characteristics of various types of land. Curve numbers (CN) were developed to reduce diverse characteristics such as soil type, land usage, and vegetation into a single variable for doing runoff calculations. The runoff curve numbers approved for water quantity/quality calculations are included as Table C-2 of this appendix.

The curve numbers presented in Table C-2 are for *wet* antecedent moisture conditions. Wet conditions assume previous rainstorms have reduced the capacity of soil to absorb water. Given the frequency of rainstorms in this area, wet conditions are most likely, and give conservative hydrographic values.

Design Storm

The SBUH method also requires a design storm to perform the runoff calculations. For flow control calculations, use NRCS Type 1A 24-hour storm distribution. This storm is shown in Figure C-1 and Table C-4. The depth of rainfall for the 2 through 100-year storm events is shown below in Table C-1.

Table C-1
24-HOUR RAINFALL DEPTHS

Recurrence Interval, Years	2	5	10	25	100
Flood Control, Destination: 24-Hour Depths, Inches	3.12	3.6	4.46	5.18	6.48
Pollution Reduction: 24-Hour Depths, 1.4 Inches					

Table C-2
RUNOFF CURVE NUMBERS

Runoff curve numbers for urban areas*

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area	A	B	C	D
Open space (lawns, parks, golf courses, cemeteries, etc.):					
Poor condition (grass cover <50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82

Runoff curve numbers for other agricultural lands*

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range-continuous forage for grazing					
<50% ground cover or heavily grazed with no mulch	Poor	68	79	86	89
50 to 75% ground cover and not heavily grazed	Fair	49	69	79	84
>75% ground cover and lightly or only occasionally grazed	Good	39	61	74	80
Meadow-continuous grass, protected from grazing and generally mowed for hay	-	30	58	71	78
Brush--weed-grass mixture with brush as the major element					
<50% ground cover	Poor	48	67	77	83
50 to 75% ground cover	Fair	35	56	70	77
>75% ground cover	Good	30	48	65	73
Woods-grass combination (orchard or tree farm)	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79

Runoff curve numbers for other agricultural lands*

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Woods					
Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.	Poor	45	66	77	83
Woods are grazed but not burned, and some forest litter covers the soil.	Fair	36	60	73	79
Woods are protected from grazing, and litter and brush adequately cover the soil.	Good	30	55	70	77

Runoff curve numbers for Simplified Approaches**

Cover description		Curve numbers for hydrologic soil group			
Simplified Approaches	Hydrologic condition	A	B	C	D
Eco-roof	Good	n/a	61	n/a	n/a
Roof Garden	Good	n/a	48	n/a	n/a
Contained Planter Box	Good	n/a	48	n/a	n/a
Infiltration & Flow-Through Planter Box	Good	n/a	48	n/a	n/a
Pervious Pavement	-	76	85	89	n/a
Trees					
New and/or Existing Evergreen	-	36	60	73	79
New and/or Existing Deciduous	-	36	60	73	79

n/a - Does not apply, as design criteria for the relevant mitigation measures do not include the use of this soil type.
*Soil Conservation Service, *Urban Hydrology for Small Watersheds*, Technical Release 55, pp. 2.5-2.8, June 1986.
**CNs of various cover types were assigned to the Proposed Simplified Approaches with similar cover types as follows:

Eco-roof – assumed grass in good condition with soil type B.
Roof Garden – assumed brush-weed-grass mixture with >75% ground cover and soil type B.
Contained Planter Box – assumed brush-weed-grass mixture with >75% ground cover and soil type B.
Infiltration & Flow-Through Planter Box – assumed brush-weed-grass mixture with >75% ground cover and soil type B.
Pervious Pavement – assumed gravel.
Trees – assumed woods with fair hydrologic conditions.

Note: To determine hydrologic soil type, consult local USDA Soil Conservation Service Soil Survey.

TABLE C-3
NRCS HYDROLOGIC SOIL GROUP DESCRIPTIONS

NRCS Hydrologic Soil Group	**Description**
Group A	Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.
Group B	Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
Group C	Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine texture or fine texture. These soils have a slow rate of water transmission.
Group D	Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a fragipan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Figure C-1 - NRCS 24-Hour Type 1A Hyetograph

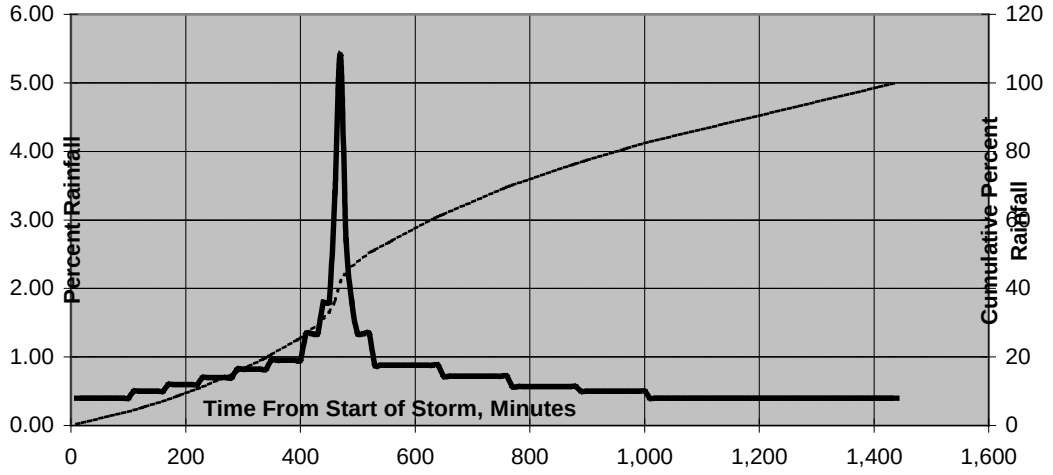

Table C-3 - NRCS Type 1A Hyetographic Distrubution - For Use In Water Quality/Quantity Design

Time From Start of Storm, Minutes	% Rainfall	Cumulative % Rainfall	Time From Start of Storm, Minutes	% Rainfall	Cumulative % Rainfall	Time From Start of Storm, Minutes	% Rainfall	Cumulative % Rainfall	Time From Start of Storm, Minutes	% Rainfall	Cumulative % Rainfall
0 - 10	0.40	0.40	360 - 370	0.95	22.57	720 - 730	0.72	67.40	1080 - 1090	0.40	86.00
10 - 20	0.40	0.80	370 - 380	0.95	23.52	730 - 740	0.72	68.12	1090 - 1100	0.40	86.40
20 - 30	0.40	1.20	380 - 390	0.95	24.47	740 - 750	0.72	68.84	1100 - 1110	0.40	86.80
30 - 40	0.40	1.60	390 - 400	0.95	25.42	750 - 760	0.72	69.56	1110 - 1120	0.40	87.20
40 - 50	0.40	2.00	400 - 410	1.34	26.76	760 - 770	0.57	70.13	1120 - 1130	0.40	87.60
50 - 60	0.40	2.40	410 - 420	1.34	28.10	770 - 780	0.57	70.70	1130 - 1140	0.40	88.00
60 - 70	0.40	2.80	420 - 430	1.34	29.44	780 - 790	0.57	71.27	1140 - 1150	0.40	88.40
70 - 80	0.40	3.20	430 - 440	1.80	31.24	790 - 800	0.57	71.84	1150 - 1160	0.40	88.80
80 - 90	0.40	3.60	440 - 450	1.80	33.04	800 - 810	0.57	72.41	1160 - 1170	0.40	89.20
90 - 100	0.40	4.00	450 - 460	3.40	36.44	810 - 820	0.57	72.98	1170 - 1180	0.40	89.60
100 - 110	0.50	4.50	460 - 470	5.40	41.84	820 - 830	0.57	73.55	1180 - 1190	0.40	90.00
110 - 120	0.50	5.00	470 - 480	2.70	44.54	830 - 840	0.57	74.12	1190 - 1200	0.40	90.40
120 - 130	0.50	5.50	480 - 490	1.80	46.34	840 - 850	0.57	74.69	1200 - 1210	0.40	90.80
130 - 140	0.50	6.00	490 - 500	1.34	47.68	850 - 860	0.57	75.26	1210 - 1220	0.40	91.20
140 - 150	0.50	6.50	500 - 510	1.34	49.02	860 - 870	0.57	75.83	1220 - 1230	0.40	91.60
150 - 160	0.50	7.00	510 - 520	1.34	50.36	870 - 880	0.57	76.40	1230 - 1240	0.40	92.00
160 - 170	0.60	7.60	520 - 530	0.88	51.24	880 - 890	0.50	76.90	1240 - 1250	0.40	92.40
170 - 180	0.60	8.20	530 - 540	0.88	52.12	890 - 900	0.50	77.40	1250 - 1260	0.40	92.80
180 - 190	0.60	8.80	540 - 550	0.88	53.00	900 - 910	0.50	77.90	1260 - 1270	0.40	93.20
190 - 200	0.60	9.40	550 - 560	0.88	53.88	910 - 920	0.50	78.40	1270 - 1280	0.40	93.60
200 - 210	0.60	10.00	560 - 570	0.88	54.76	920 - 930	0.50	78.90	1280 - 1290	0.40	94.00
210 - 220	0.60	10.60	570 - 580	0.88	55.64	930 - 940	0.50	79.40	1290 - 1300	0.40	94.40
220 - 230	0.70	11.30	580 - 590	0.88	56.52	940 - 950	0.50	79.90	1300 - 1310	0.40	94.80
230 - 240	0.70	12.00	590 - 600	0.88	57.40	950 - 960	0.50	80.40	1310 - 1320	0.40	95.20
240 - 250	0.70	12.70	600 - 610	0.88	58.28	960 - 970	0.50	80.90	1320 - 1330	0.40	95.60
250 - 260	0.70	13.40	610 - 620	0.88	59.16	970 - 980	0.50	81.40	1330 - 1340	0.40	96.00
260 - 270	0.70	14.10	620 - 630	0.88	60.04	980 - 990	0.50	81.90	1340 - 1350	0.40	96.40
270 - 280	0.70	14.80	630 - 640	0.88	60.92	990 - 1000	0.50	82.40	1350 - 1360	0.40	96.80
280 - 290	0.82	15.62	640 - 650	0.72	61.64	1000 - 1010	0.40	82.80	1360 - 1370	0.40	97.20
290 - 300	0.82	16.44	650 - 660	0.72	62.36	1010 - 1020	0.40	83.20	1370 - 1380	0.40	97.60
300 - 310	0.82	17.26	660 - 670	0.72	63.08	1020 - 1030	0.40	83.60	1380 - 1390	0.40	98.00
310 - 320	0.82	18.08	670 - 680	0.72	63.80	1030 - 1040	0.40	84.00	1390 - 1400	0.40	98.40
320 - 330	0.82	18.90	680 - 690	0.72	64.52	1040 - 1050	0.40	84.40	1400 - 1410	0.40	98.80
330 - 340	0.82	19.72	690 - 700	0.72	65.24	1050 - 1060	0.40	84.80	1410 - 1420	0.40	99.20
340 - 350	0.95	20.67	700 - 710	0.72	65.96	1060 - 1070	0.40	85.20	1420 - 1430	0.40	99.60
350 - 360	0.95	21.62	710 - 720	0.72	66.68	1070 - 1080	0.40	85.60	1430 - 1440	0.40	100.00