City of Normandy Park

Small Project Drainage Requirements And Technical Guidance Manual

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Section I: Introduction

A drainage plan is a proposed method for managing stormwater on your property. The City of Normandy Park requires drainage plans to control any increase in the amount and rate of stormwater that runs off each property as a result of the development of that property. The drainage plan illustrates how stormwater runoff will be retained on the property so it does not drain onto neighboring properties.

In Normandy Park an approved drainage plan is required as a part of building permit submittals for either a new structure or for the enlargement of an existing structure. The plan must be approved by the City before a building permit will be issued.

Why Drainage Requirements?

Almost every form of development increases the amount of surface runoff that occurs following a heavy rainstorm. For example:

- Removing trees and other vegetation reduces the amount of rain and snow intercepted by the tree canopy and leaves and the amount of water absorbed by roots.
- Regrading the land eliminates natural depressions in the soil that slow runoff and hold water until it is absorbed into the soil.
- Covering ground with roofs, pavements, and similar impervious surfaces prevents the underlying soil from absorbing rainwater.
- Covering porous soil with comparatively impervious topsoil and lawn decreases the rate the soil can absorb water.
- Driving over the ground (both during and after construction) compacts the surface, decreasing the small voids in the soil that let the water filter into the ground.
- Placing plastic films under landscaped areas prevents percolation of water through the soil.

These and other factors combine to decrease the landscape's ability to absorb rainfall. To minimize the detrimental impacts of stormwater runoff associated with development, The City of Normandy Park requires appropriate management of that runoff. When properly designed and constructed, a drainage plan protects the environment, property owners, and neighboring properties from adverse impacts related to residential development.

Do I qualify for a Small Project Drainage Plan Review?

The drainage techniques outlined in this manual are for small-scale residential projects within the City that meet the requirements for a ***Small Project Drainage Plan*** review. For small scale projects, mitigation of runoff impacts can usually be achieved with a combination of the Best Management Practices (BMPs) outlined in this manual. These include practices such as preservation of native vegetation on site, protection of soil during construction, and creation of runoff management systems to store and absorb runoff from impervious areas. For projects with under 5000 square feet of existing and proposed impervious surfaces, Small Project drainage requirements may be met with plans prepared by contractors, architects, or homeowners <u>without the involvement of a licensed civil engineer</u>.

In general, a project will qualify for the ***Small Project Drainage Plan*** review if it meets all of the following criteria:

- The project is a single family residential project.
- Less than 10,000 square feet of total site impervious surface on the lot will result from the proposed project. However, on lots less than 1acre, if the amount of impervious surfaces such as asphalt, concrete, gravel driveways, buildings, or other relatively impervious surfaces exceeds either 25% of the total lot area or 5,000 square feet, whichever is greater, the City may require an engineered drainage plan designed to the adopted standard drainage manual.
- Less than 5,000 square feet of new or replaced paved area is included in the project.
- Less than one-half acre of clearing and grading will result from the proposed project.
- A site on your property is available for the proposed stormwater management system which does not conflict with any septic drainfield or reserve drainfield, structure foundations, or wells. As sites with slopes greater than 15% may pose problems with the design of a small project drainage plan, engineering is required for lots with moderate to steep slopes.
- Your soils must be sufficiently permeable to implement the proposed techniques. Soils which allow the use of either a conventional on-site sewage disposal system or a pressurized sewage disposal system are considered to be sufficiently permeable for most drainage systems included in this manual.

For projects meeting the above criteria, the techniques spelled out in this manual may be used to create a ***Small Project Drainage Plan*** for review.

For any project not meeting the above criteria, or for non-residential development, multi-family residential development, and development within 100 feet of critical areas such as floodplains, streams, wetlands, shorelines, or geologically hazardous areas, a drainage plan prepared by a civil engineer licensed in the State of Washington that complies with the current general drainage manual adopted by The City of Normandy Park and the City of Normandy Park Critical Areas Ordinance will be required.

These criteria are intended to simplify the screening of drainage plans by the City and are not necessarily all-inclusive. The City reserves the option to require submittal of an engineered drainage plan prepared by a licensed engineer for any development. The City will inform land development applicants of any additional drainage requirements for their project(s).

Definitions of Key Terms

Proper application of the small project drainage requirements in this manual requires an understanding of the following key terms and their definitions.

Best Management Practice (BMP) A practice or combination of practices that are the most effective and practicable means of managing stormwater runoff based on the best available science.

Bioretention area A vegetated depression, such as a rain garden, that is designed to collect, store and infiltrate runoff. Bioretention areas typically include amended soils and native vegetation.

Civil engineer A person licensed by the State of Washington as a professional engineer with experience in civil engineering.

Conveyance BMP A stormwater management technique that conveys stormwater to or from a runoff management BMP such as a rain garden or infiltration trench, and slows flows as stormwater travels across and from a developed site.

Critical areas The Washington State Growth Management Act, Chapter 36.70A RCW, requires the protection of the following areas in The City of Normandy Park: (a) wetlands; (b) areas with a critical recharging effect on aquifers used for potable water; (c) aquatic and wildlife habitat conservation areas; (d) frequently flooded areas; and (e) geologically hazardous areas. Use and management within these areas is subject to regulation by The City. Consult the Title 13 of The City of Normandy Park Code for details on The City of Normandy Park Critical Areas Code.

Discharge Any stormwater runoff that is not infiltrated or evaporated but instead flows from the conveyance or management BMPs onto adjacent land.

Dispersion Spreading stormwater runoff over vegetated pervious areas to slow runoff and aid in infiltration

Drainage easement A portion of the land set aside to assist in the management of stormwater runoff. Easements are permanent and are transferred with the title to the land.

End-of-line discharge BMP A stormwater management technique that disperses stormwater *on-site* from a runoff management or conveyance BMP in a slow and diffuse manner to prevent concentration and associated channeling.

Engineered drainage plan A plan designed by an engineer licensed in the State of Washington as a professional engineer.

Existing impervious surface Any existing hard or compacted surface like a roof, pavement, or gravel that does not allow water to soak into the ground. All impervious surfaces shall be included for the purposes of designing a small project drainage plan.

Hydrologic soil group Soils are classified by the Natural Resource Conservation Service into four Hydrologic Soil Groups based on the soil's runoff potential. Soil properties that influence runoff potential include depth to a seasonally high water table, intake rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The four Hydrologic Soils Groups are A, B, C and D. Type A soils generally have the smallest runoff potential and Type D soils have the greatest.

Impervious surface – total site impervious surface Any existing or proposed hard or compacted surface like a roof, pavement, or gravel that does not allow water to soak into the ground. All impervious surfaces shall be included for the purposes of designing a small project drainage plan.

Pervious surface A surface that allows water to enter the ground by virtue of is porous nature or by large spaces in the material. Due to compaction, gravel driveways and parking areas do not count as permeable surfaces unless specifically engineered to be pervious or porous.

Project type Project are separated into two types, new development and re-development. Redevelopment projects are projects which modify or add to existing impervious surfaces.

Runoff management BMP A stormwater management technique designed to capture, store, and absorb stormwater runoff from impervious surfaces such as roofs and driveways.

Single family residential project A dwelling unit detached from any other dwelling unit and intended for occupation by one family and including accessory improvements and uses.

Stormwater runoff Water which is not absorbed into the ground during and after a storm which then flows over the land.

Vegetated open space Native undisturbed areas, rehabilitation of previously disturbed areas. Active recreation areas and lawn shall not count towards vegetated open space.

Small Project Drainage Plan Requirements

Submittals

If you meet the criteria for a ***Small Project Drainage Plan*** Review and want to use it, the following must be submitted to the Department of Planning and Community Development:

- **Drainage Plan Submittal Form** which will guide you through the submittal requirements. Copies of the form are available from the Department of Planning and Community Development.
- **Drainage Plan**: a scale drawing of the individual site showing how stormwater runoff will be managed on the property. Consult Section II: Developing a Drainage Plan for guidance in preparing this plan.
- **Written Drainage Assessment**: a written overview of the proposed project that includes a description of the property, existing site conditions, proposed site improvements, and proposed stormwater management techniques. Further instructions are available on the Drainage Plan Submittal Form.
- **Erosion and Sedimentation Control Plan**: a scale drawing of the individual site showing how problems of erosion and sedimentation will be prevented. See appendix for details on erosion and sedimentation control methods and plans.
- **Operation and Maintenance Details**: written documentation of all applicable operation and maintenance that your system may require.

Implementation

After a proposed drainage plan is approved by the City it must then be installed, adhering to the approved plan. If you use a ***Small Project Drainage Plan***, you must install the system according to the guidelines in this manual.

Inspection

The drainage system must be inspected by the City prior to certifying the structure for occupancy. Do not backfill over any underground installation until it has been inspected. Drainage system inspections will be conducted only during regularly scheduled building inspections prior to the final inspection, and installation must be complete prior to the final inspection. The inspection requirements vary depending upon the type of system approved for your development. You can find out more about the inspection procedure when you obtain your permit.

Liability and Responsibility

You are responsible for damage caused by stormwater runoff due to your development. The City of Normandy Park's drainage requirements represent a good faith effort to address the potential problems associated with stormwater runoff due to development. However, the City has no control over the accuracy of information submitted and does not assume responsibility for damage which may occur due to stormwater runoff.

Operation and Maintenance Responsibility

The size, placement, and design of the drainage facilities as depicted by the drainage plan and approved by the The City of Normandy Park Department of Planning and Community Development must be maintained and may not be changed without written approval from The City of Normandy Park Department of Planning and Community Development. Maintenance of all required drainage facilities is the responsibility of the owner of the site/lot served by these facilities.

Erosion and Sediment Control

Appendix A: Small Project Erosion and Sediment Control includes the specifications for erosion and sediment control BMPs applicable to prevent transport of soils from a small project construction site. **The Erosion and Sediment Control BMPs listed in the Appendix may be used if less than one-half acre of soil will be disturbed by the project.** Additional measures may be required by The City of Normandy Park if these are insufficient for the project or fail to contain sediment on the project site. In all cases the erosion control plan shall meet the requirements of Volume II of the Stormwater Management Manual for Western Washington.

Pollution Source Control

All projects should include practices which prevent pollutants from entering stormwater. Pollutants include but are not limited to petroleum products, antifreeze, pesticides, herbicides, acids and bases, paints and stains, soaps and detergents, sewage, chlorine bleach, ammonia, or any other chemical not normally found in uncontaminated water. Pollution source control practices may include routine checking of equipment for oil and fuel leaks, shelters and containment systems for storage tanks, and special drains connected to sanitary sewers for contaminated water such as hot-tub and pool backwash and garbage storage areas (check with your sewer service provider for sewer connections).

Small project drainage planning process

The following pages contain planning guidelines to direct the reader through the small project drainage planning process. The first section (Developing a Drainage Plan, pages 10-15) deals with designing your site to minimize impacts to the landscape and outlines the required elements in a small project drainage plan. The final section of the manual (Small Project Drainage Plan Design BMPs, pages 16-47) describes the specific requirements, designs, and specifications of each BMP. The Appendices include examples of drainage plans and supporting documents needed for the development of an effective drainage plan.

Section II: Developing a Drainage Plan

The steps described below outline the process for development of a ***Small Project Drainage Plan***. For effective stormwater management, the project should minimize land disturbance and impervious surfaces such as roofs and driveways, and maximize protection of soil and vegetation. Projects which add or replace less than 2000 square feet of impervious surface may be able to use basic dispersion (splash blocks) for the runoff management portion of the plan; conveyance and end-of-line discharge BMPs may still be required.

1. Conduct a site inventory to determine existing patterns of water movement and vegetated areas on your site. Consider ways your proposed development can avoid impacts to them.

2. Obtain an accurate topographic map for the site to use as a basis for the drainage plan. This can be as simple as a map that denotes flat areas, sloped areas with approximate percent grade, and drainage paths. Topographic information for your site can be found on the King County IMAP website or at the City Planning and Community Development Department.

3. Find out the soil type on your project site in order to determine which stormwater management techniques will be applicable for your site. The assumed soil type contains silt (type C) and is not recommended for infiltration. Two areas in the City have type A or B soils suitable for infiltration. These areas are South of Normandy Road and East of 4th Avenue to Arrow Lake and areas South of Arrow Lake and East of Marine View Drive. Sites outside these areas may require a soils analysis by an approved professional to allow infiltration systems.

4. Use the drainage project planning charts on pages 12 and 13 to select options for managing roof water runoff, driveway runoff, conveyance areas, and end-of-line discharge areas.

5. Consult Section III of this manual for details on the design and applicability of each of the BMP options.

6. Use the sizing charts located in Section III to determine the required dimensions for each BMP based on the project type, i.e. new development or re-development.

7. Sketch your drainage plan. Pages 13-14 include a list of the required information to include in the plan.

Site Planning Tips

The following are tips for creating a development that minimizes the impact your construction project will have on the patterns of water flow and vegetated areas of the site and help facilitate stormwater infiltration on the property.

- Place structures as close to the public access point as possible to minimize road/driveway length. Minimize paved parking areas, and utilize porous paving options wherever possible.
- Slope paved areas to facilitate drainage to stormwater management areas.
- Reduce building footprints whenever possible. Utilize basements or taller structures with lofts or second stories to achieve square footage goals.
- Orient buildings on slopes with long-axis along topographic contours to reduce grading requirements.
- Set clearing limits that give maximum protection to soils and vegetation while allowing reasonable areas for equipment to maneuver on the site. Delineate the areas both on the construction plans and on the ground with temporary fencing or taping.

Elements of a Drainage Plan

The drainage plan must show the square footage of the impervious areas such as a roof and driveway, the technique for managing the runoff generated by the impervious surfaces and the drainage path of the runoff from source to and from a treatment area and end-of-line discharge method.

Runoff Management BMPs (Section III-A)

The **Runoff Management** section of this manual presents general guidelines for design of BMPs for managing runoff from impervious surfaces such as roofs and driveways. In a ***Small Project Drainage Plan*** there are many options to manage stormwater from roofs and paved areas.

For projects that add or replace less than 2000 square feet of impervious surface:

- Basic Dispersion i.e. splash blocks Note: other provisions may be required.

For projects that add or replace more than 2000 square feet of impervious surface, one or more of the following are required:

- Rain Gardens
- Rainwater Planters
- Rainwater Dispersion
- Infiltration Systems
- Runoff Filter Strips
- Porous Pavement
- Rainwater Collection

The runoff management section of this manual provides general design requirements for the BMPs listed above, as well as specific sizing requirements for each.

Stormwater Conveyance BMPs (Section III-B)

The stormwater conveyance section of this manual presents general guidelines for conveying stormwater on your site. The stormwater conveyance BMPs serve to both convey stormwater from, and if necessary to, a runoff management area such as a rain garden or infiltration trench, and to slow flows as they travel across and from a developed site. There are four options for the conveyance of stormwater on the site:

- Swales
- Conveyance Furrows
- Conveyance Gardens
- Gravel Trenches

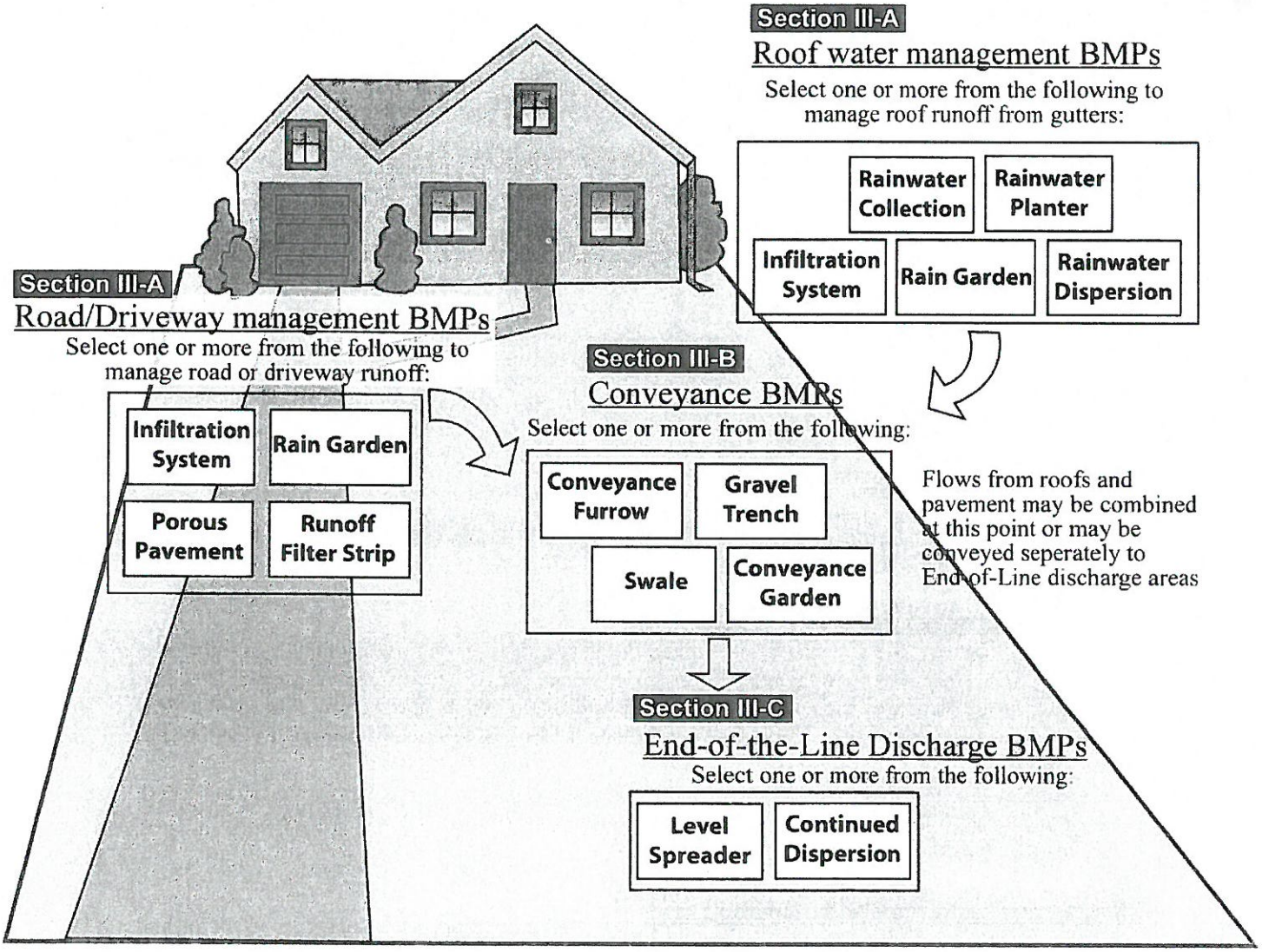
End-of-Line Discharge BMPs (Section III-C)

The discharge BMPs provide a means for stormwater from a developed lot to disperse in a slow and diffuse manner to prevent concentration and associated channeling. End-of-Line Discharge BMPs are designed to be used to disperse stormwater *on- site* and shall not be used to disperse stormwater outside the project property's boundaries. These options are outlined in the End-of-Line Discharge section of the manual. They include:

- Level Spreaders
- Quarry Spall Pads
- Continued Dispersion

Figure 1. Drainage Planning Flowchart

The following chart outlines the typical elements of a small project drainage system.



Drainage plan requirements

The following information must be included in the *Drainage Plan Submittal Form,* visit The City of Normandy Park Department of Planning and Community Development for a copy of the form:

Identification

- ☐ Name, address, and phone number of applicant
- ☐ Parcel number
- ☐ Dimension of all property lines
- ☐ Street names and existing or proposed property address
- ☐ North arrow
- ☐ Legend if needed
- ☐ Scale—use a scale that clearly illustrates drainage features and BMPs/measures.
- ☐ Show at least 5-foot contours for all slopes steeper than 15%

Building and Site Development Features

- ☐ Footprint of all structures (existing and proposed)
- ☐ Future structures and planned improvements
    - If you wish to have drainage review waived for future structures/improvements on this parcel, you must show them (with dimensions) on the site plan and include them in calculations.
- ☐ Parking, roads, and driveways (existing and proposed)
- ☐ Sport courts, patios, pools and any other paved or impervious surfaces (existing and proposed)
- ☐ Total impervious surface land cover (existing and proposed)
- ☐ Location of any retaining walls and rockeries (existing and proposed)
- ☐ Existing or proposed septic system, including all system components and both primary and reserve drainfields
- ☐ Utility structures (poles, fire hydrants, etc.)
- ☐ Existing easements
- ☐ Existing wells or wells to be abandoned
- ☐ Newly created vegetated areas
- ☐ Remaining **vegetated open space** that will remain undisturbed

Natural Features and Critical Areas

For a map detailing the critical areas on your site, go to http://www.ci.normandy-park.wa.us/ or visit the permit counter at the Department of Planning and Community Development. *Development within a critical area or its buffer requires an engineered drainage plan designed by a Civil Engineer licensed in the State of Washington.*

- ☐ Existing natural features of the property (woods, pasture, brush)
- ☐ Existing hydrology - location of all existing and proposed ditches, swales, pipes, etc.
- ☐ Delineation of all streams, wetlands, lakes, closed depressions, or other water features (including any required buffer widths)
- ☐ Delineation of all critical areas on the property including flood hazard areas, erosion hazard areas, steep slope hazard areas, landslide hazard areas, and their buffers and building setback lines

Stormwater Management Information

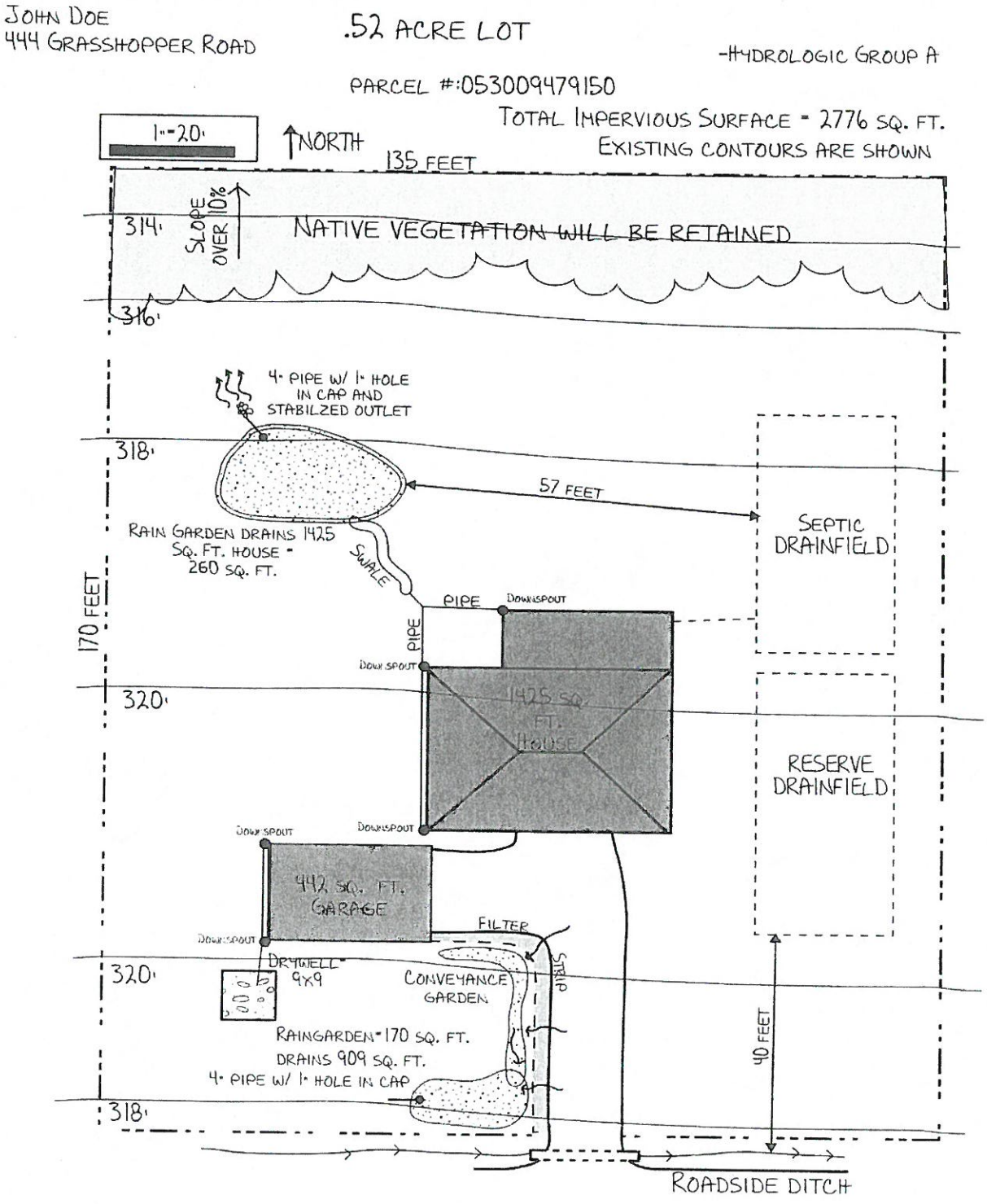
In addition to the general information listed above, the following additional information is required on drainage plans that include installation of stormwater BMPs:

- ☐ Identify the soil type(s) on your project site in order to determine which stormwater management techniques in this manual will be applicable for your site
    - Two areas in the City have type A or B soils suitable for infiltration. These areas are South of Normandy Road and East of 4th Avenue to Arrow Lake. Also areas South of Arrow Lake and East of Marine View Drive have type A or B soils suitable for infiltration systems. Areas outside these areas may require a soils analysis by an approved professional to allow infiltration systems. An approved professional may be a licensed engineer, geologist, or on-site wastewater treatment systems designer.
- ☐ Show delineation and dimensions of impervious surfaces and pervious surfaces, both existing and new
- ☐ Show location and dimensions of runoff management BMP methods such as but not limited to infiltration trenches, drywells, rain gardens, permeable pavements, rain water storage tanks for managing stormwater from all impervious surfaces
    - Use the drainage project planning chart on page 12 to select options for managing roof water runoff, driveway runoff, conveyance areas, and end-of-line discharge areas.
    - Consult Section III of this manual for details on the design and applicability of each of the BMP options. Use the sizing charts located in Section III to determine the required dimensions for each BMP based on the amount of impervious surface drainage to it.
- ☐ Show delineation and dimensions of the flowpath of stormwater through the site - from the runoff management BMPs, to conveyance BMPs, to end-of-line discharge BMPs
- ☐ Show setback lengths between stormwater management BMPs and any property line, structure, well, steep slope, stream, wetland, or septic system including drainfields.

Putting it all together

This manual along with some basic measuring and drawing tools should be sufficient for many people to complete an acceptable drainage plan; however, if your project is somewhat large or complex, it is suggested at this point to have a professional engineer design the plan and create the plan drawings for submittal. Below is an example of a drainage plan that can be developed from a site plan. Consult Appendix B for other examples of simple drainage plans that can be developed.

Figure 2. Example Drainage Plan



Section III: Small Project Drainage Plan Design BMPs

A drainage system collects, cleanses, infiltrates, and conveys stormwater to a natural drainage system or existing storm sewer. The following are guidelines for the design and implementation of a ***Small Project Drainage Plan***, including techniques for managing run-off from impervious surfaces, conveying stormwater on the property, and for properly discharging stormwater from your property.

BMPs have been adapted from King City, Washington *Surface Water Design Manual Appendix C: Small Project Drainage Requirements, 2005, City of Portland Stormwater Management Manual, Revision 3, 2004*, and SvR / City of Seattle *High Point Community Site Drainage Technical Standards, 2004.*

Section III-A

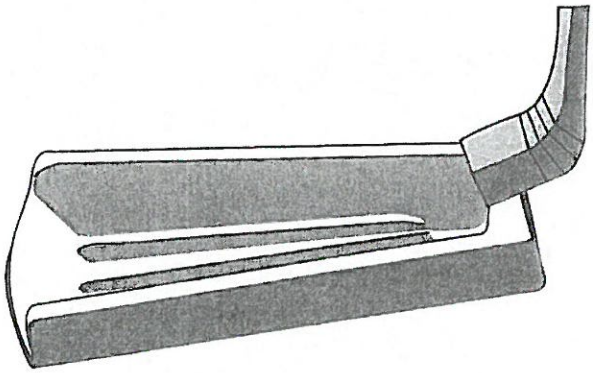
Runoff Management BMPs

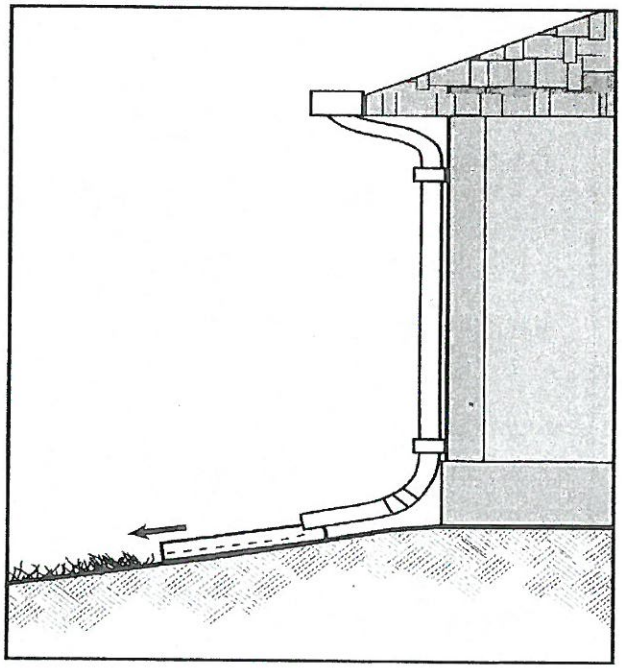
Runoff management is the main component of a small project drainage plan. This manual includes a basic dispersion option for projects under 2000 square feet of new and/or replaced impervious surfaces, and seven options to manage stormwater from roofs and paved areas on larger projects.

Basic Dispersion Runoff Management

Projects on level and gently sloping ground which create less than 2000 square feet of new and redeveloped impervious surfaces may use basic dispersion for runoff management. In general, if the ground is sloped away from the foundation, and there is adequate vegetation for effective dispersion, splash blocks will adequately disperse storm runoff into and or across the soil. If the ground is level, adding downspout extensions to move the discharge point further from the foundation may be a better choice. Conveyance and end-of-line discharge BMPs may be required. The following requirements apply to basic dispersion

- ☐ The developed lot area must be predominately flat to gently sloped, with slopes of no more than 10% in the path of the dispersed flows.
- ☐ When utilizing *Basic Dispersion*, no more than 700 square-feet of roof area may be drained to a single splash block. All existing, new, and replaced roof areas on the site are required to meet these requirements.
- ☐ When new or replaced pavement is included in the project, the design of the pavement shall disperse runoff evenly along at least one side of the driveway to the extent practical.
- ☐ A turf or other vegetated flowpath of at least 50 feet in length must be available along the path that runoff will follow upon discharge from the splash block to the nearest property line or a conveyance BMP and discharge BMP is required.





Standard Project Runoff Management

Projects adding more than 2000 square feet of new or replaced impervious surface must provide runoff management using one or more of the following options for the entire site. Projects which are redevelopments of existing developed lots may use the re-development design numbers included in the sizing tables. The main features and preferred application for each option are summarized below. Details of each option are explained in the following sections.

Rain Gardens

- Rain gardens are excavated basins in which runoff accumulates and slowly infiltrates or flows out through a small outlet opening.
- One of the most versatile options, rain gardens can be placed in any soil type and on most sites and should be the primary runoff management technique for most sites.

Rainwater Planters

- Rainwater planters are basins with raised sides of wood or concrete in which runoff accumulates and slowly infiltrates or flows out through small weep holes to surrounding surfaces.
- Planters are a good option where they can be installed near roof downspouts.

Rainwater Dispersion

- Dispersion emphasizes use of vegetated areas to receive dispersed stormwater.
- Requires at least 50% vegetated open space on site with a drainage easement.
- Best on slopes less than 10% where runoff is easily routed to vegetated areas.

Infiltration Systems: Trenches and Drywells

- Infiltration utilizes gravel-filled basins or trenches to infiltrate runoff into porous soil.
- Requires soil with sandy or gravelly texture without high water table. A list of suitable soils for infiltration techniques can be found in Appendix C.
- Infiltration systems may clog with sediment over time and require replacement.

Runoff Filter Strips

- Runoff filter strips are large roadside areas of sandy or gravelly soil covered with turf which allow filtering, storage and infiltration of paved area runoff.
- The filter strip area must be equal to that of the impervious paved area it is adjacent to (such as the driveway), excavated and filled with sand or gravel.

Porous Pavement

- Porous pavement allows rainwater to seep through the hardened surface through pores and spaces in the pavement.
- Porous pavement should be placed on slopes less than 5%.

Rainwater Collection

- Rain barrels and cisterns are containers in which roof runoff is collected for later use or release. These options have limitations on size and application.
- Rain barrels and cisterns can only collect roof runoff, and the collected water is suitable for non-potable uses only.
- Rain barrels and cisterns require careful management to control and manage overflow.

Rain Gardens

Rain gardens are excavated depressions lined with amended soil and planted with vegetation capable of thriving in wet soil in the winter and dry conditions in the summer. Rain gardens provide bioretention, a process in which storm runoff is temporarily captured in small vegetated basins, where physical and biological processes improve water quality and lessen flows before they enter public or other drainage systems.

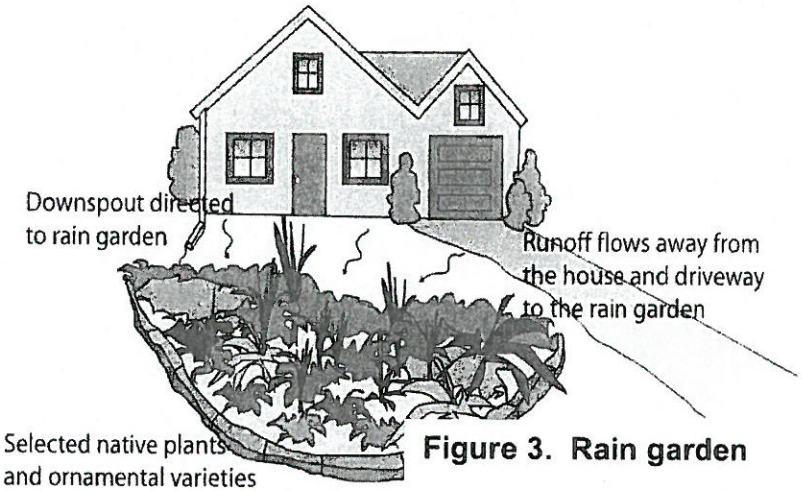


Figure 3. Rain garden

Rain gardens are the simplest, easiest to maintain, and most fool-proof option for runoff management and should be included as the primary runoff management option for most projects.

The table below serves as a guide to determine the surface area of the rain garden based on the amount of impervious surface area draining to the garden and type of development activity. For new development multiply the impervious area by 17%, for re-development multiply by 13%.

Square footage of impervious surface draining to rain garden									
		500	**1000**	**1500**	**2000**	**2500**	**3000**	**4000**	**5000**
Required Area of Rain Garden by Region (Sq. ft.)	**Re-development**	65	130	195	255	320	380	510	635
	New Development	85	170	255	340	425	510	680	850

Rain gardens have a minimum depth of 2 feet.

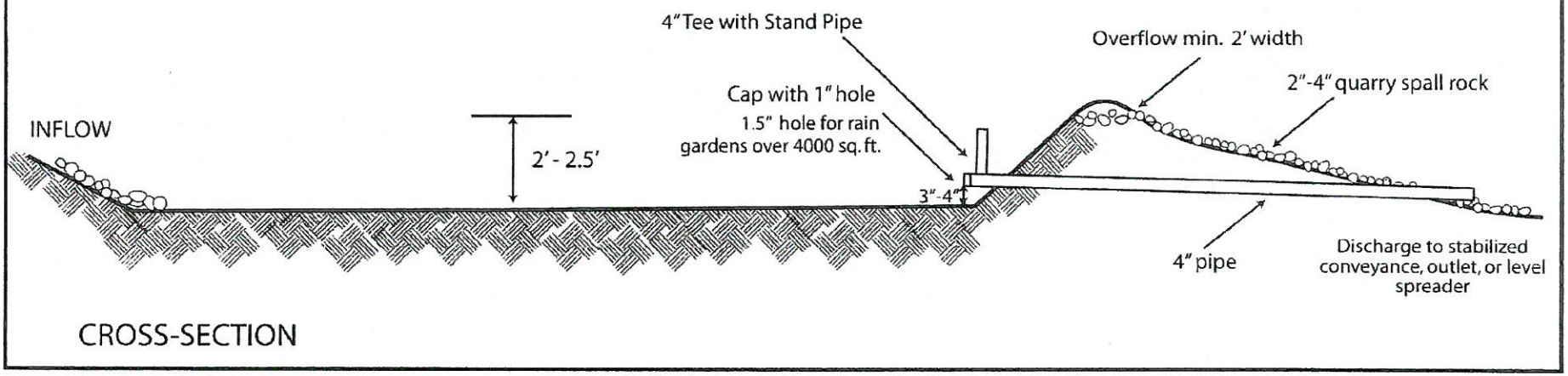
Example: A new 3,000 square foot house would require a rain garden with a surface area of 510 sq. feet.

If you utilize a rain garden to control stormwater runoff, you will need to follow the guidelines below:

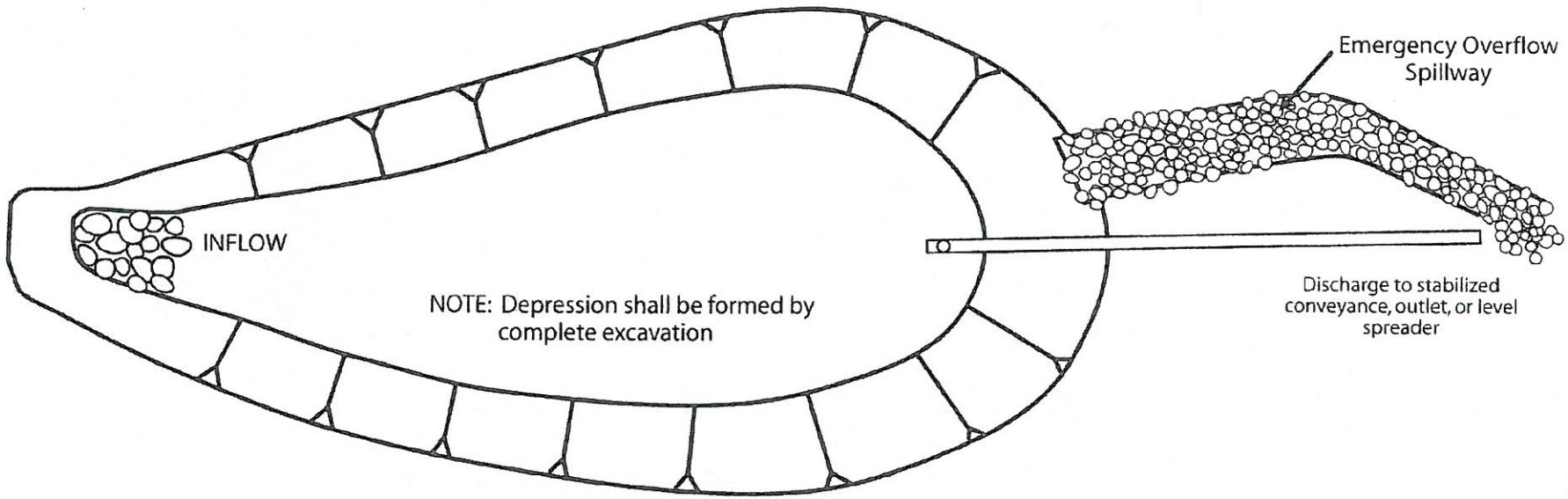
- ☐ Rain gardens should be located on level to gently sloped ground. Use caution in locating rain gardens on slopes greater than 10%.
- ☐ Rain gardens shall be built to the required size as shown in the sizing table above.
- ☐ Rain gardens shall have a minimum depth of 2 feet.
- ☐ Side slopes shall be 2 horizontal to 1 vertical or less.
- ☐ Rain gardens shall include outlets consisting of a 4" pipe with a cap with a 1" hole to meter the outflow. The hole in the cap should be increased to 1.5 inches for rain gardens with over 4000 sq. feet of impervious draining to them. A 4" tee and standpipe approximately 16" tall shall be installed to provide overflow to the drain line in the event of high water levels. This prevents overtopping of the rain garden.
- ☐ The rain garden shall include an additional overflow either by surface sheet flow or stabilized rock spillway to a level spreader, ditch or other stormwater dispersal system.
- ☐ The rain garden should be planted with vegetation appropriate for moist and seasonally dry conditions. See Appendix C for a list of recommended plants.

An excellent handbook for rain garden construction produced by Washington State University is available at Normandy Park City Hall.

Figure 4. Rain garden



CROSS-SECTION



PLAN VIEW

Rain Garden Operation and Maintenance

Rain gardens are vegetated depressions that retain and filter stormwater from an area of impervious surface. The plant growth in the rain garden serves to filter the water and sustain infiltration. Depending on soil conditions, rain gardens may have water in them throughout the wet season and may overflow during major storm events.

- ☐ The size, placement, and design of the rain garden as depicted by the drainage plan must be maintained and shall not be changed without written approval from The City of Normandy Park Department of Planning and Community Development.
- ☐ Plant materials may be changed to suit tastes, but chemical fertilizers and pesticides must not be used.
- ☐ Additional mulch and compost should be added to the rain garden periodically.
- ☐ Rain gardens must be inspected annually by the property owner for physical defects.
- ☐ After major storm events, the rain garden should be checked to see that the overflow system is working properly and is not clogged.
- ☐ If erosion channels or bare spots are evident, they should be stabilized with soil, plant material, and mulch.
- ☐ A supplemental watering program may be needed the first year to ensure the long-term survival of the rain garden's vegetation.
- ☐ Vegetation should be maintained as follows:
  1) replace all dead vegetation as soon as possible;
  2) remove debris as needed;
  3) remove all noxious vegetation when discovered;
  4) manually weed without herbicides or pesticides;
  5) mulch to conserve moisture and inhibit weed germination.

Rainwater planters

Rainwater planters are much like raised, above ground rain gardens. Generally planters are used for runoff from roofs and are built so that downspouts empty directly into the planter. Planter sides may be constructed of treated wood, concrete, or brick. Planters may be constructed with open contact to the ground or with impervious bottoms with side weep holes of ½ to 1 inch in diameter. The bottom layer shall be clean gravel with a 1 foot minimum depth covered by a minimum of 1 foot of topsoil. The planter must include an overflow notch or pipe and be designed to drain to a conveyance BMP with a minimum 1 foot of water storage depth.

Sizing for rainwater planters is the same as for rain gardens (see sizing chart in the Rain Garden section). The rainwater planter should be planted with vegetation appropriate for moist and seasonally dry conditions. Trees and large shrubs are not recommended. See Appendix C for a list of recommended plants.

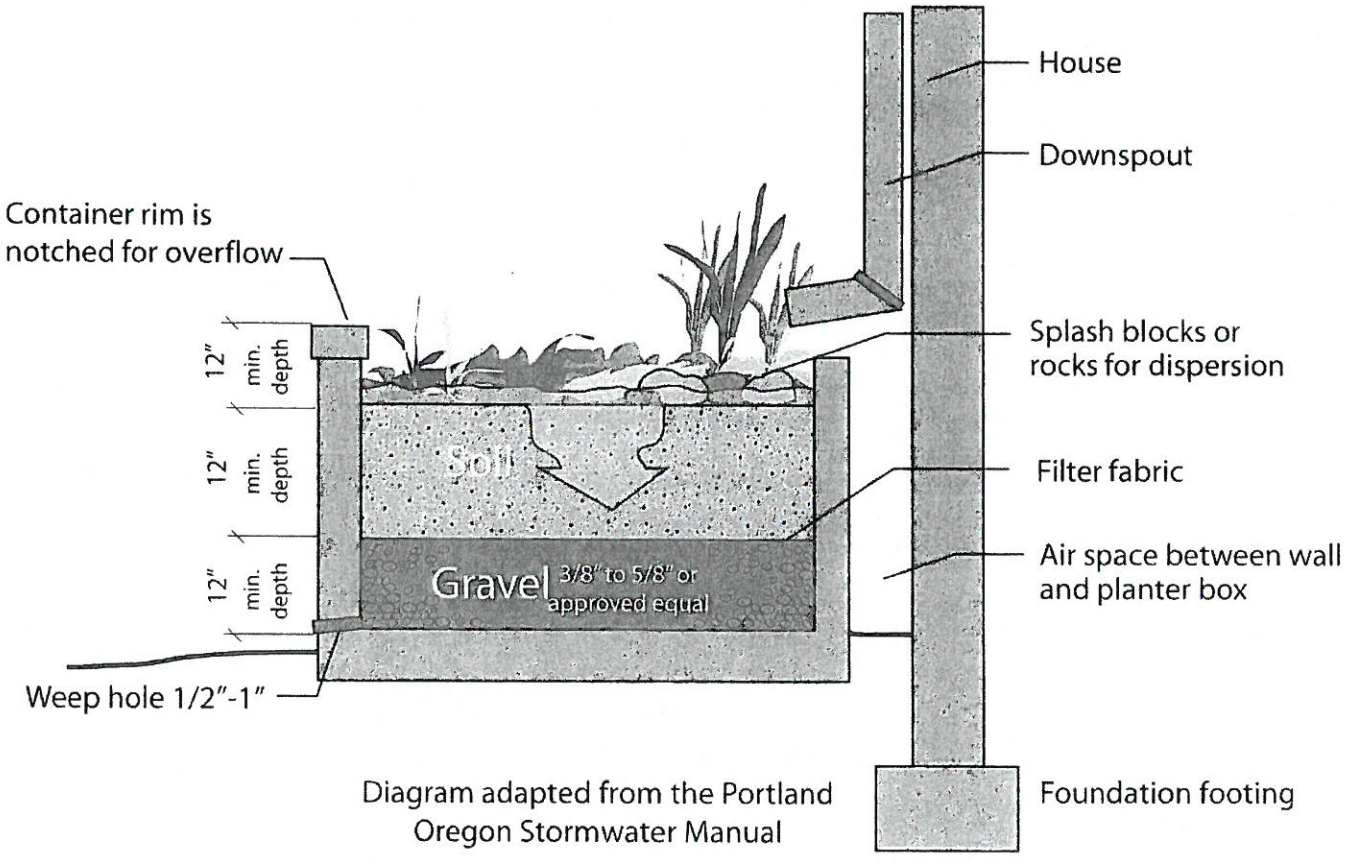


Figure 5. Rainwater Planter cross-section

Rainwater Planter Operation and Maintenance

Rainwater planters are containers designed to intercept rainfall that would normally fall on impervious surfaces and store and release the captured stormwater at a slower rate.

- ☐ The size, placement, and design of the rainwater planter as depicted by the drainage plan must be maintained and shall not be changed without written approval from the The City of Normandy Park Department of Planning and Community Development.
- ☐ Chemical fertilizers and pesticides must not be used.
- ☐ Additional mulch and compost should be added to the rainwater planter periodically.
- ☐ Rainwater planters must be inspected annually by the property owner for physical defects. Structural deficiencies in the planter including rot, cracks, and failure shall be repaired. Holes that are not consistent with the design and allow water to flow directly through the planter to the ground shall be plugged.
- ☐ After major storm events, the rainwater planter should be checked to see that the drainage system is working properly and is not clogged. If stormwater is not draining properly, the planter shall be excavated and cleaned, and gravel or soil shall be replaced to correct low infiltration rates.
- ☐ A supplemental watering program may be needed the first year to ensure the long-term survival of the rain garden's vegetation.
- ☐ Vegetation should be maintained as follows:
    1) replace all dead vegetation as soon as possible;
    2) remove debris as needed;
    3) remove all noxious vegetation when discovered;
    4) manually weed without herbicides or pesticides;
    5) mulch to conserve moisture and inhibit weed germination.

Rainwater Dispersion

Rainwater dispersion is a strategy that emphasizes minimization of impervious surfaces and evenly dispersing runoff into vegetated areas on your property. In order to utilize dispersion, a lot can not have more than 15% impervious surface and must maintain at least 50% of the lot area in vegetated open space protected by a conservation easement. Vegetated open space includes native undisturbed areas and rehabilitated previously disturbed areas. Active recreation areas and lawn shall not count towards vegetated open space.

Dispersion is a good option for large lots. The following basic requirements apply to sites utilizing rainwater dispersion; additional measures may be required if site conditions warrant:

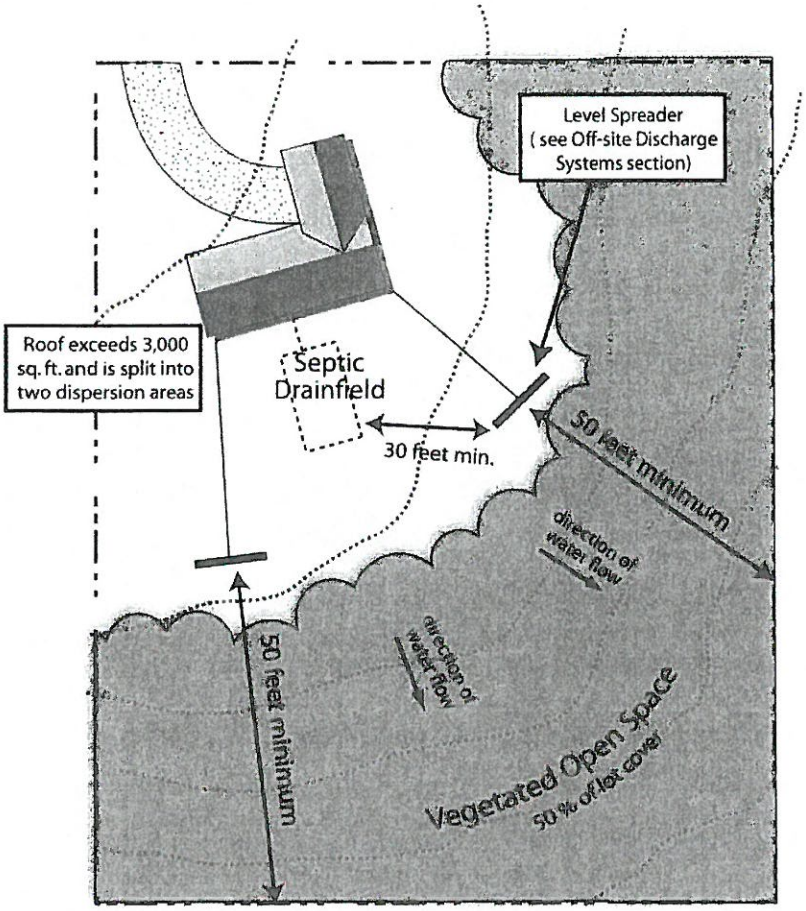


Figure 6. Rainwater Dispersion Example

- ☐ The developed lot area must be predominately flat with slopes of no more than 10%.
- ☐ Areas of vegetated open space should be delineated clearly on the drainage plan.
- ☐ The maximum lot impervious surface area is 15%.
- ☐ At least 50% of the total lot area shall be protected with an drainage easement granted to The City of Normandy Park or other appropriate entity such as the King Conservation District.
- ☐ A vegetated flowpath of at least 50 feet in length must be available along the path that runoff will follow upon discharge to the nearest property line.
- ☐ A minimum 100-foot vegetated buffer from the point of dispersion to a critical area or its buffer such as a stream or wetland.
- ☐ Dispersion areas must be at least 30 feet away from primary and reserve septic drainfields and shall not outlet directly upslope from a drainfield.
- ☐ Careful attention must be paid to spreading the stormwater properly. Runoff from each distinct impervious area should be dispersed to *different areas* and combining the flows from different areas should be kept to a minimum. **No more than 3,000 square feet of impervious surface shall be routed to one area for dispersion.**

Rainwater Dispersion Operation and Maintenance

Dispersion is a strategy for minimizing the area disturbed by development, retaining native vegetated areas and applying dispersion techniques that utilize the natural capacity of vegetation to mitigate the stormwater runoff quantity.

This flow control BMP has two primary components that must be maintained: (1) the dispersal flowpath and (2) the vegetated open space.

Dispersion Flowpath

- ☐ The size, placement, composition, and downstream flowpaths of these devices as depicted by the drainage plan must be maintained and shall not be changed without written approval from the The City of Normandy Park Department of Planning and Community Development.
- ☐ Dispersion devices such as splash blocks and level spreaders (See pg. 43 for a description of level spreaders) must be inspected annually by the property owner and after major storm events to identify and repair any physical defects..
- ☐ When native soil is exposed or signs of erosion are present, the sources of the erosion or concentrated flow shall be identified and mitigated. Bare spots should be re-vegetated with native vegetation. Concentrated flow can be mitigated by leveling the edge of the pervious area and/or replenishing the rock in the dispersion device, such as in gravel-filled trenches.

Vegetated Open Space

- ☐ **The vegetated surface required for dispersion should be delineated as "vegetation retention area" on the drainage plan.**
  - ☐ The trees, shrubs, ground cover, and soil conditions in this area shall not be disturbed, except as allowed by the following provisions:
    - Individual trees that have a structural defect due to disease or other defects, and which threaten to damage a structure, road, parking area, utility, or place of employment or public assembly, or block emergency access, may be topped, pruned, or removed as needed to eliminate the threat.
    - Dead or fallen trees, tree limbs within ten feet of the ground, and branches overhanging a residence may be removed to reduce the danger of wildfire.
    - Noxious weeds (i.e., plant species listed on the State noxious weed list in Chapter 16-750 WAC) and invasive vegetation (i.e., plant species listed as obnoxious weeds) shall be removed.
    - Passive recreation uses and related facilities, including pedestrian, equestrian and bicycle trails, nature viewing areas, fishing and camping areas, and other similar uses that do not require permanent structures, are allowed if clearing and soil compaction associated with these uses and facilities does not exceed 10 % percent of the vegetation retention area.

Infiltration Systems

Infiltration systems are BMPs that are designed to allow runoff to be absorbed into the ground. Soil conditions must be favorable enough to assure that the device used to soak water into the ground (e.g., infiltration trench, drywell, etc.) will perform as expected. Many locations in The City of Normandy Park have soils that are underlain by a compact layer of soil called glacial till or hardpan which severely limits infiltration capacity and causes water to accumulate at or near the soil surface during the wet season. This can make full infiltration of runoff impracticable, cost prohibitive, unreliable, or all three.

Two areas in the City have type A or B soils suitable for infiltration. These areas are South of Normandy Road and east of 4th Avenue to Arrow Lake, and areas South of Arrow Lake and East of Marine View Drive. Sites outside these areas may require a soils analysis by an approved professional to allow infiltration systems. Approved professionals include licensed engineers, geologists, and on-site wastewater treatment system designers.

If you plan to utilize infiltration trenches or drywells to control stormwater runoff, you will need to follow the guidelines listed below:

- ☐ In your drainage plan include locations of proposed drywells and trenches with their sizes. Indicate which roof areas will be routed into each.

- ☐ Runoff from paved areas including driveways and parking areas should flow through or across a vegetated strip or swale prior to infiltration.

- ☐ Infiltration systems must be appropriately sited with respect to the locations of septic drainfields, wells, and building foundations so as not to adversely affect them. Infiltration systems must be down gradient and at least 30 feet from the septic drainfield, at least 10 feet from foundations, and 100 ft. from wells. Infiltration systems shall be located on flat or gently sloped ground with grades of less than 15%.

- ☐ Infiltration systems must be filled with washed drain rock (1 ½" to 3" in diameter). The top and sides must be covered and wrapped with filter fabric so that the fine soils do not migrate into the voids of the drain rock. Landscaping cloth (generally available at hardware stores) works well for this purpose. A screen must be provided either at the outlet of the downspout or at the inlet to the drywell pipe to keep debris from entering the system.

- ☐ Connections between the infiltration system and the conveyance system such as swale, conveyance garden, or gravel trench should utilize one of the following:
    1. 3"-4" pipe buried not more than 6" below grade at least 2 feet in length.
    2. 8" wide x 8" deep gravel trench at least 2 feet in length
    3. Shallow earthen slot 4" deep and 4" wide

Consult the following pages for specifics on different infiltration techniques.

Infiltration Systems (cont.): Infiltration Trenches

Infiltration trenches are shallow gravel-filled trenches where runoff water is routed for storage and infiltration. Infiltration trenches work best in sandy or gravelly soil (generally hydrologic group A and B) and are not appropriate in some clayey soil types (hydrologic groups C and D).

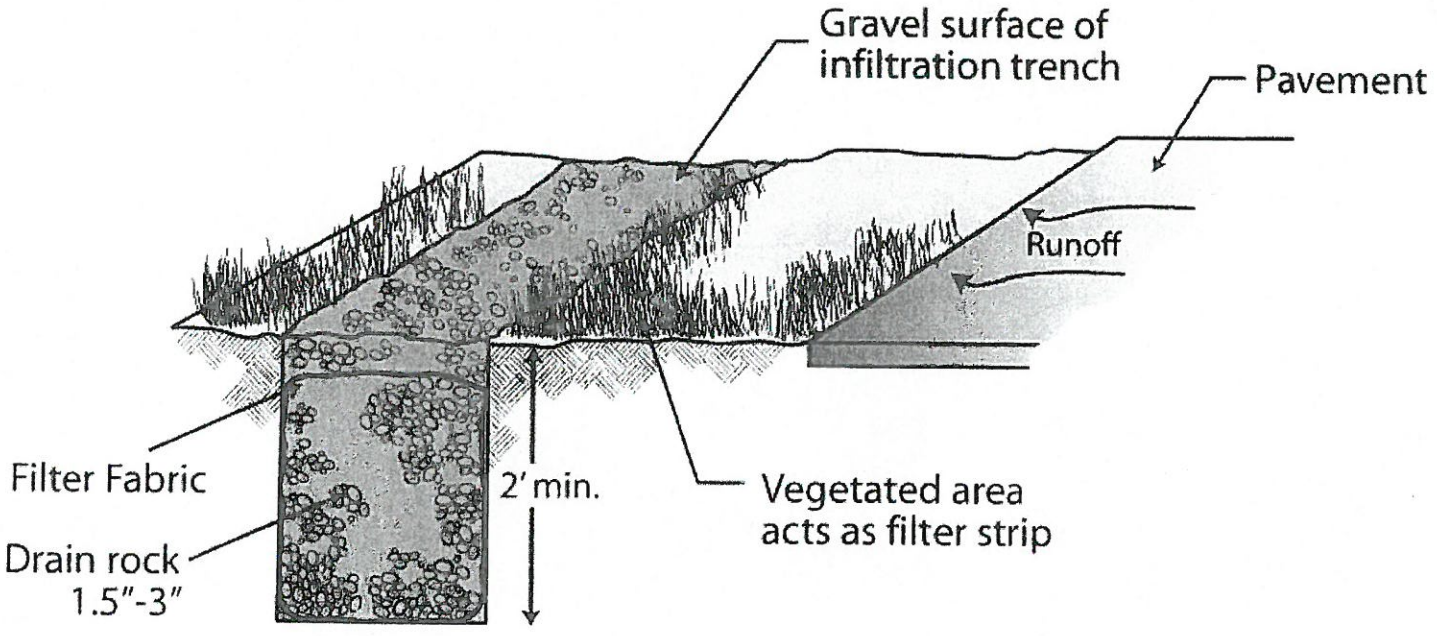
Runoff from paved areas including driveways and parking areas should flow through or across a vegetated strip or swale prior to infiltration.

Infiltration trenches are sized according to the amount of impervious surface and the type of development. The table below can be used to determine the surface area needed for an infiltration trench based on the type of project and the amount of stormwater draining to the trench. For new development multiply the impervious area by 30%, for re-development multiply by 22%.

Square Footage of Impervious Surface Draining to Infiltration Trench									
		500	**1000**	**1500**	**2000**	**2500**	**3000**	**4000**	**5000**
Required Surface Area of Trench by Region (Sq. ft.)	**Re-development**	115	230	340	450	560	675	900	1125
	New development	150	300	450	600	750	900	1200	1500

The Infiltration Trench should be a minimum of 2' deep.

Figure 9. Infiltration Trench



Infiltration Systems (cont.): Drywells

A drywell is a simple, gravel-filled hole with a bottomless catch basin in the center into which runoff from the downspouts and gutters is routed. Drywells give a limited storage space for runoff to infiltrate slowly into the surrounding soil. Individual drywells can be used to manage runoff from up to 1,500 square feet of impervious surface area. Multiple drywells may be needed to manage the stormwater runoff on your property. Drywells are appropriate for sandy or gravelly soil types (generally hydrologic group A and B).

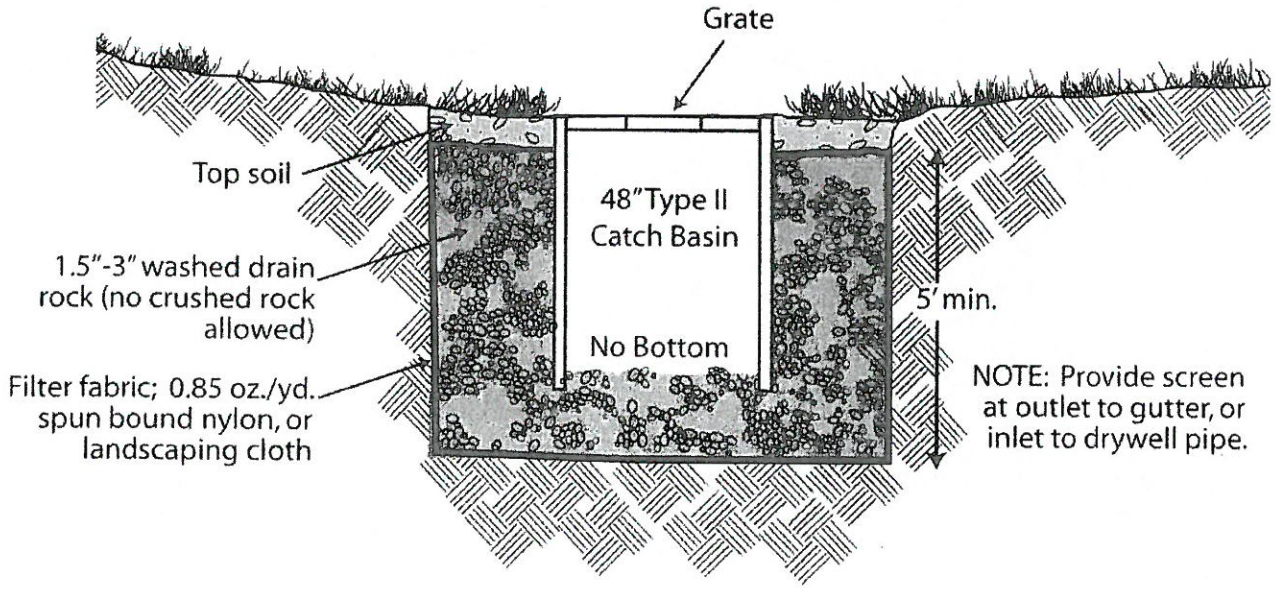
Drywells are sized according to the the amount of impervious surface and the type of development. The table below can be used to determine the necessary size for the drywell based on the type of project and the amount of stormwater draining to the drywell.

Square footage of impervious surface draining to drywell						
		500	**750**	**1000**	**1250**	**1500** (max. area allowed)
Required size of dry well by region	**Re-development**	8'x8'	10'x10'	12'x12'	13'x13'	14'x14'
	New development	9'x9'	11'x11'	13'x13'	14'x14'	15'x15'
	Required catch basin size*	Type 1	Type 1L	2-Type1-L	1-48" Type II	1-54" Type II

*Catch basins may be purchased from local concrete distributors.

☐ The drywell should be a minimum of 5 feet deep.

Figure 10. Drywell cross-section



Infiltration Systems Operation and Maintenance

Infiltration systems are designed to absorb runoff from impervious area (such as paved areas and roofs) into the ground. To be successful, the soil condition around the infiltration device must be reliably able to soak water into the ground.

- ☐ The size, placement, and composition of these devices as depicted by the drainage plan must be maintained and shall not be changed without written approval from the The City of Normandy Park Department of Planning and Community Development.
- ☐ Infiltration systems must be inspected annually by the property owner and after major storm events to identify and repair any physical defects.
- ☐ Maintenance and operation of the system should focus on ensuring the system's viability by preventing sediment-laden flows from entering the device. Excessive sedimentation will result in a plugged or non-functioning facility. If the infiltration device has a catch basin, sediment accumulation must be removed on a yearly basis or more frequently if necessary. Annual inspection should be conducted to ensure system has not become clogged.
- ☐ Prolonged ponding around or atop a device may indicate a plugged facility. If the device becomes plugged, it must be replaced.
- ☐ Keep the areas that drain to infiltration devices well swept and clean to enhance the longevity of these devices. For roofs, frequent cleaning of gutters will reduce sediment loads to these devices.

Runoff Filter Strips

Runoff filter strips are lawn areas underlain by 1 to 1.5 feet of sand or gravel that are adjacent to driveways or parking areas. The turf and sand filter pollutants from runoff and allow stormwater to slowly infiltrate into the underlying soil.

Runoff filter strips shall encompass an area equal to or larger than half the impervious surface area that drains to them. For paved areas of 2,000 square feet or less, no other runoff management option is required. For paved areas larger than 2,000 square feet, additional runoff management may be required. Recommended additional runoff management options for larger paved areas should be designed at one-third the standard sizing for regular impervious areas. For example, a runoff filter strip half the size of the impervious surface area along with a rain garden 1/3 the size of the rain garden sizing chart recommendation would fulfill the runoff management needed for paved areas larger than 2,000 square feet.

Examples:

- A 1,500 square foot paved driveway would require a filter strip totaling an area of 750 square feet. No additional runoff management is needed for the paved area.

- A 2,500 square foot paved driveway would require a filter strip with a surface area of 1,250 square feet *in combination with*:
    - A rain garden with a surface area of 141 sq feet, which is 1/3 of 425 square feet needed according to the rain garden sizing chart on pg. 18 for 2,500 square feet of impervious surface.

    - **OR** an infiltration trench with a surface area of 250 square feet, which is 1/3 of 750 square feet needed according to the infiltration trench sizing chart on pg. 26 for 2,500 square feet of impervious surface.

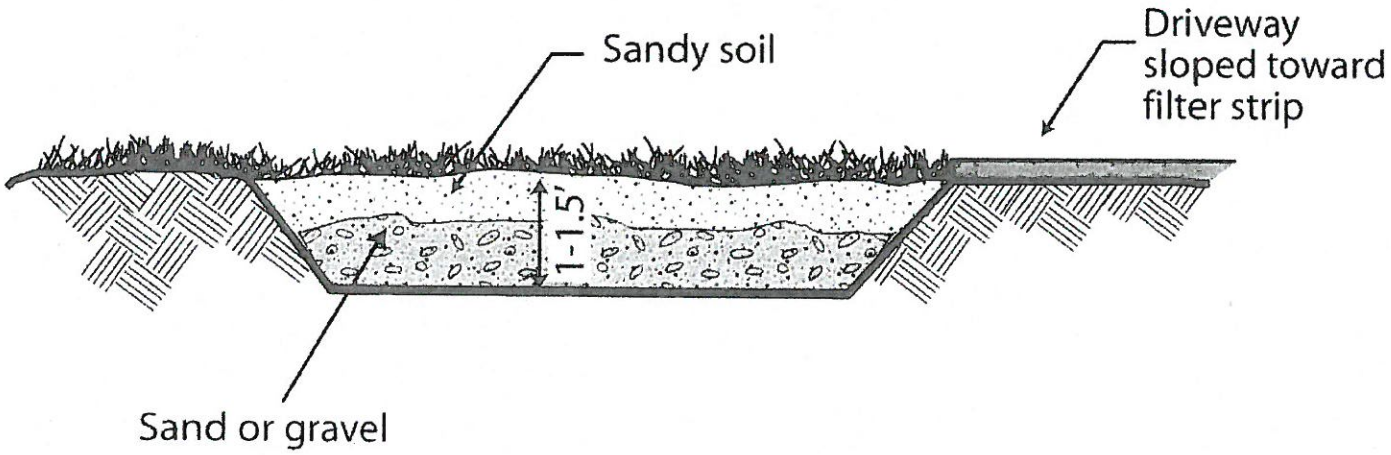


Figure 11. Runoff Filter Strip

Runoff Filter Strip Operation and Maintenance

Runoff filter strips are lawn areas that stormwater runoff is directed to flow and filter through. Pollutants are removed through infiltration and sedimentation.

- ☐ The size, placement, and composition of the filter strips as depicted by the drainage plan must be maintained and shall not be changed without written approval from the The City of Normandy Park Department of Planning and Community Development.
- ☐ Keep the areas that drain to the filter strip well swept and clean to enhance the longevity of the strip. For roofs, frequent cleaning of gutters will reduce sediment loads to these devices.
- ☐ Sources of erosion damage shall be identified and controlled when soil is exposed or erosion channels are forming.
- ☐ Sediment build-up in the filter strip that exceeds 2" in depth shall be removed.
- ☐ If the filter strip does not drain within 48 hours, it shall be regraded and reseeded.

Porous Pavement

Porous pavements are designed to accommodate vehicle and pedestrian traffic, while allowing infiltration, stormwater treatment, and limited stormwater storage. Porous pavement can be used in many standard pavement applications. For paved areas of 2,000 square feet or less, no other run-off management option is required. For areas larger than 2,000 square feet, additional run-off management may be required. Recommended additional run-off management options for porous paved areas exceeding 2,000 square feet should be designed at one-third the standard sizing for regular impervious areas. For example, a filter strip 1/6 the width of the driveway would fulfill the additional runoff management requirement.

Porous pavement is constructed above a gravel base of generally 1 to 1.5 inches of compacted, washed angular gravel with finer material or sand on top. A variety of types are available including porous asphalt and concrete, pavers, and concrete or plastic cellular paving systems. As most porous pavements have standard specifications, follow the manufacturers' recommendations.

- ☐ Use of porous pavement is restricted to sandy or gravelly soil types (hydrologic group A and B). Two areas in the City have type A or B soils suitable for porous pavement. These areas are South of Normandy Road and east of 4th Avenue to Arrow Lake, and areas South of Arrow Lake and East of Marine View Drive. Sites outside these areas may require a soils analysis by an approved professional to allow use of porous pavement. Approved professionals include licensed engineers, geologists, and on-site wastewater treatment system designers.
- ☐ A minimum depth to seasonal ground water of 2 feet is required to utilize porous pavement.
- ☐ Porous pavement should be used on flat to gently sloped ground with a maximum slope of 5%.
- ☐ The type and location of porous pavement shall be marked on the drainage plan.
- ☐ Porous pavements should be used in low-speed applications only, i.e. walkways, driveways, fire lanes, overflow parking, etc. Plastic cellular paving systems with turf shall be restricted to low-use applications such as overflow parking, shoulders, etc.
- ☐ Porous pavement should be designed with adequate drainage to prevent water from remaining in pavement or base material for over 24 hours.
- ☐ Engineering consultation is recommended for all systems.

Hollywood Driveway

A Hollywood driveway, a driveway constructed with a center grass strip, is a simple and effective way to reduce impervious surface. When a Hollywood driveway is constructed with a permeable gravel base and sand under the sod and soil layers, it shall be considered a porous pavement option.

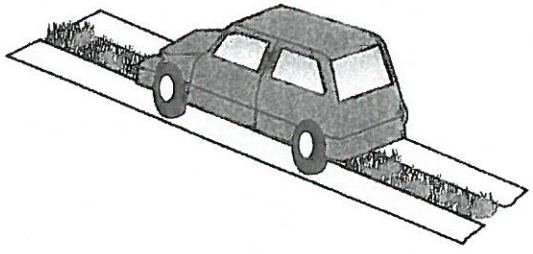


Figure 12. Hollywood Driveway

Porous Pavement Operation and Maintenance

Porous pavements reduce the amount of rainfall that becomes runoff by allowing water to seep through the pavement into a free-draining gravel or sand bed, where it can be infiltrated into the ground.

- ☐ The area covered by porous pavement as depicted by the drainage plan must be maintained as porous pavement and shall not be changed without written approval from the The City of Normandy Park Department of Planning and Community Development.
- ☐ Porous pavements must be inspected after major storms by the property owner to make sure it is working properly. Prolonged ponding or standing water on the pavement surface is a sign that the system is defective and may need to be replaced.
- ☐ To help extend the useful life of the system, the surface of the porous pavement should be kept clean and free of leaves, debris, and sediment through regular sweeping or vacuum sweeping.
- ☐ The owner is responsible for the repair of all ruts, deformation, and/or broken paving units.

A typical porous pavement system has a life expectancy of approximately 25 years.

Rainwater Collection

Rainwater can be collected off of roofs and routed to containers such as rain barrels or cisterns for storage and later use. Up to 2,500 square feet of impervious surface may be mitigated by the use of rainwater catchment. Small systems of up to 2,200 gallons with water use restricted to non-potable outdoor uses can be incorporated into a drainage plan without engineered designs, although engineering consultation is strongly recommended for all systems. **Rainwater catchment systems are subject to Department of Ecology rules.**

The table shown below shows the minimum size of storage required for the roof area draining to the cistern.

		250	500	1000	1500	2000
Required Cistern Volume (Gallons)	**All Development**	500	1100	2200	3300	4400

Shaded cells indicate rainwater catchment systems over 2,200 gallons that require an engineered design.

Rainwater catchment can be used as the sole runoff management option for roofs up to 1,250 square feet and for up to 50% credit for additional roof areas. To receive credit for roof areas routed to cisterns or rain barrels, the storage volume must equal or exceed the amounts required in the sizing table above.

In order for rainwater catchment to aid in reducing flows from developed areas, it is important to manage overflow during storms. Ideally, spigots should be shut off during stormy periods, and overflow routed to additional BMPs such as a rain garden or infiltration trench. Storage levels should be kept to less than ¾ full by slowly lowering levels during dryer weather by irrigating lawns or gardens or very slowly draining to conveyance areas. Larger clean-out valves should not be used to lower water levels especially during winter months. Water from the cistern should be drained prior to freezing weather.

If you plan to utilize a cistern or rain barrels to collect stormwater runoff, follow the guidelines below:

- ☐ Containers should be placed on a concrete or brick footing on firm ground.
- ☐ Container capacity shall meet or exceed the size specified in the sizing chart for the roof area draining to it.
- ☐ Containers storing less than 1,000 gallons shall use an outlet spigot of ½", larger containers shall utilize spigots of ¾". The spigot should drain to a hose or pipeline that can outlet to a conveyance BMP.
- ☐ Containers must have an overflow pipe located below the top of the tank which is directly routed to a conveyance BMP.
- ☐ The water collected from the gutter shall be filtered with a fine screen prior to discharging to the storage container.
- ☐ The container should have a valve of at least 2" in diameter to flush sediment out of the tank. This larger valve should not be used to drain the tank because of the rapid rate of draining.
- ☐ The effectiveness of rainwater collection systems is highly dependant on the ability to monitor the system closely for maintenance and needed adjustments.
- ☐ Engineering consultation is strongly recommended for all systems.

Rainwater Collection Systems Operation and Maintenance

Rainwater collection is a means of managing runoff through storage of roof runoff for irrigation use. Rainwater collection systems include a collection area, a filtering system, a storage device, and an outflow device.

- ☐ The size, components, and configuration of the rainwater system as depicted by the site plan and design details must be maintained and shall not be changed without written approval from the The City of Normandy Park Department of Planning and Community Development.
- ☐ The collection area (e.g., roof) should be routinely inspected by the property owner for debris and other material that could impede the entrance and/or exit of surface flows.
- ☐ The filtering system should be periodically inspected by the property owner for effectiveness and replaced or replenished as recommended by the manufacturer.
- ☐ Consulting with an engineer on the Operations and Maintenance of these systems is strongly recommended.

Section III-B

Stormwater Conveyance BMPs

The stormwater conveyance BMPs collect and convey runoff on the site. When well implemented, conveyance BMPs can slow flows and allow some infiltration of stormwater as it travels across a developed site. To achieve these benefits, at least one-third of the flow path distances from various impervious surfaces to the edge of the property shall consist of an open conveyance BMP, thus limiting the use of pipes and narrow ditches. The four options for conveyance of stormwater consist of swales, furrows, gardens, and gravel-filled trenches. This section of the manual presents general guidelines for design of the following conveyance BMPs for small projects:

- Swales
- Conveyance Furrows
- Conveyance Gardens
- Gravel Trenches

Swales

Swales are broad, shallow ditches with gentle slopes. They are generally grassed and designed for easy mowing. Swales should be used on level or gentle sloped ground with grades less than 5%.

- ☐ The bottom width of a swale should be at least 2 feet. However, if the swale serves over 5,000 square feet of impervious surface, the bottom should be at least 3 feet wide.

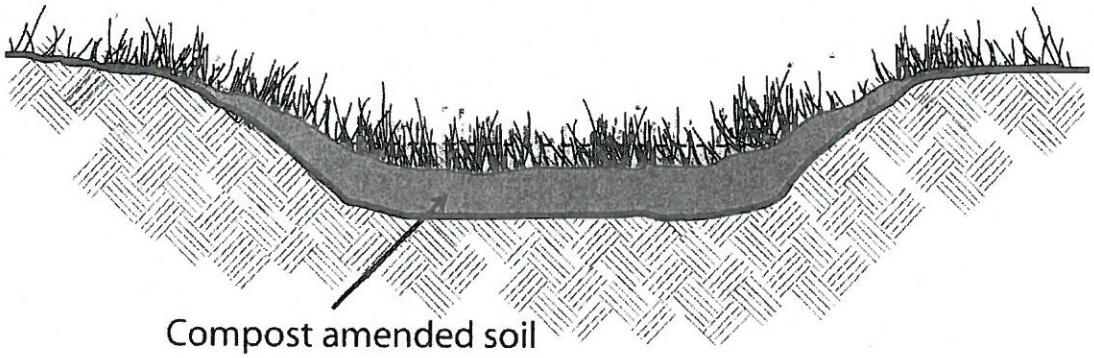


Figure 13. Grassy swale

Swale Operation and Maintenance

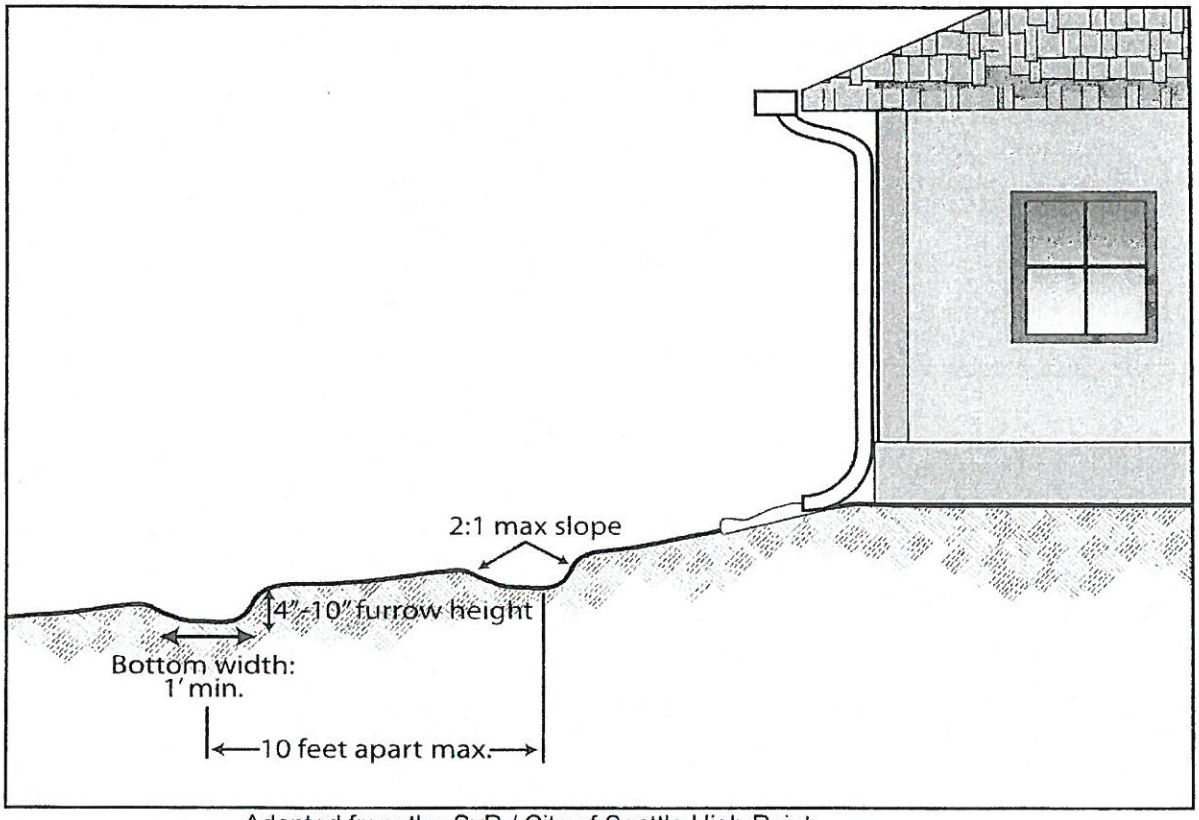
Swales are planted or grassed open channels that trap pollutants by filtering and slowing flows, allowing particles to settle out.

- ☐ The size, placement, composition, and flowpaths of the swales as depicted by the drainage plan must be maintained and shall not be changed without written approval from the The City of Normandy Park Department of Planning and Community Development.
- ☐ Swales must be inspected annually by the property owner and after major storm events to identify and repair any physical defects.
- ☐ When soil is exposed or erosion channels are present, the sources of the erosion or concentrated flow shall be identified and mitigated. Bare spots should be re-vegetated.
- ☐ Sediment accumulation shall be hand-removed with minimum damage to vegetation. Sediment shall be removed if it is more than 4" thick or so thick as to damage or kill vegetation.
- ☐ Inlet shall be cleared when conveyance capacity is plugged. Sources of sediment and debris shall be identified and corrected.
- ☐ Annual or semi-annual tilling shall be implemented if compaction or clogging occurs.

Conveyance Furrow

Conveyance furrows are a series of parallel troughs and berms perpendicular to the slope that runoff water flows across from one to another. Conveyance furrows should follow the contour of the land, being straight or curved, and may be vegetated with various ground covers or grass. When considered in site development plans, furrows can be graded and planted to be an amenity to the residence.
This option is best for slopes from 15% or more.

- ☐ At a minimum one furrow should be constructed for each foot of vertical drop, with a maximum spacing of 10 feet between furrows along the flow path.
- ☐ The total relief of the furrows should be 4 to 10 inches from bottom of trough to top of berm.
- ☐ To prevent concentration the furrows must be level and run along the contour of the land. Conveyance furrows and berms should be earth or drain rock.
- ☐ The furrows should be vegetated with grass or vegetation appropriate for moist and seasonally dry conditions. See Appendix E for a list of recommended plants.
- ☐ Conveyance furrows must be long enough to intercept all runoff generated from impervious sources.
- ☐ The bottom of the troughs should be a minimum of 1foot wide.



Adapted from the SvR / City of Seattle High Point
Community Site Drainage Technical Standards, 2004.

Figure 14. Conveyance Furrow

Conveyance Furrow Operation and Maintenance

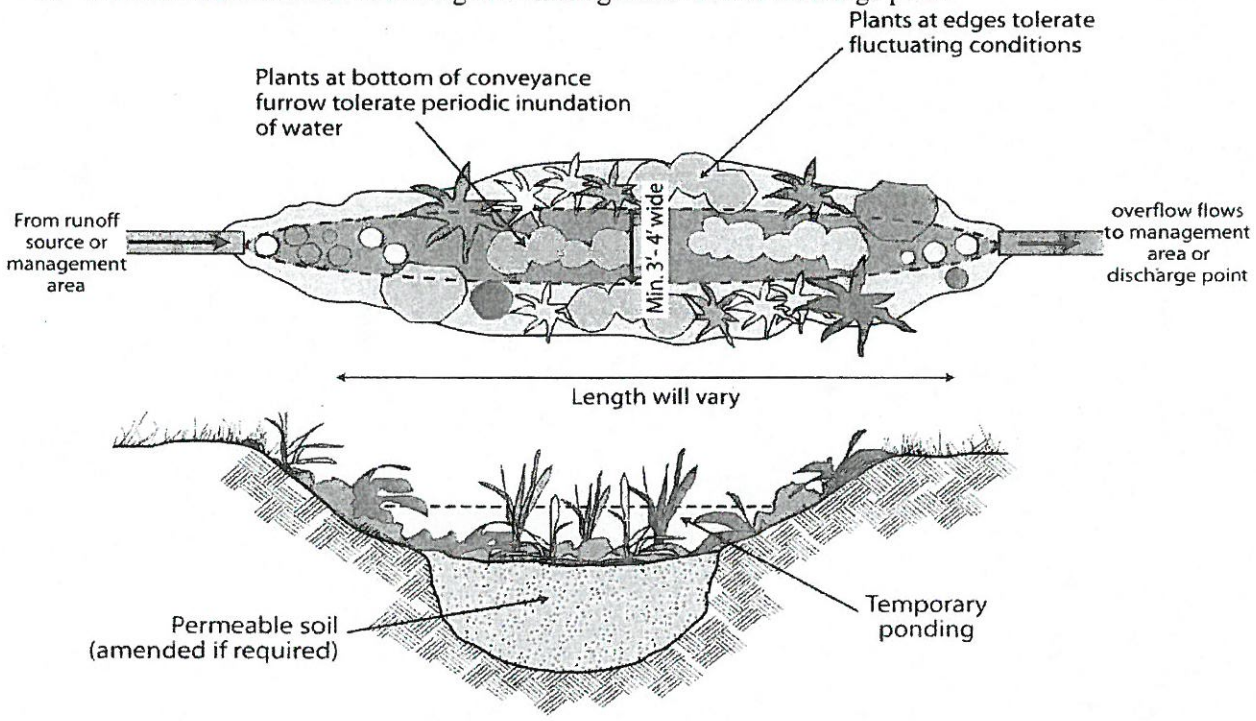
Conveyance furrows are a series of parallel troughs and berms perpendicular to the slope that runoff water flows across from one to another that can be planted with vegetation grass, or filled with gravel.

- ☐ The size, placement, and design of the conveyance furrow as depicted by the drainage plan must be maintained and shall not be changed without written approval from the The City of Normandy Park Department of Planning and Community Development.
- ☐ Chemical fertilizers and pesticides must not be used.
- ☐ Conveyance furrows must be inspected annually by the property owner for physical defects.
- ☐ After major storm events, the conveyance furrows should be checked to see that the flow path has not been clogged with debris.
- ☐ If erosion channels or bare spots within the furrows are evident, they should be stabilized with soil, plant material, and mulch.
- ☐ If planted with grass or other vegetation, a supplemental watering program may be needed the first year to ensure the long-term survival of the conveyance furrows' vegetation.
- ☐ If planted, vegetation should be maintained as follows:
  1) replace all dead vegetation as soon as possible;
  2) remove fallen leaves and debris as needed;
  3) remove all noxious vegetation when discovered;
  4) manually weed without herbicides or pesticides;
  5) mulch to conserve moisture and inhibit weed germination.

Conveyance Garden

Conveyance gardens are similar to rain gardens but are smaller, narrower and part of a continuous ditch or ditch-pipe system.

- ☐ Existing and replacement soil shall be uncompacted to increase infiltration.
- ☐ If the site soil has low permeability, the soil in the bottom of the garden can be replaced or amended with a more permeable soil or amended with compost.
- ☐ Conveyance gardens should be located on level to gently sloped ground. Use caution in locating conveyance gardens on slopes greater than 10%.
- ☐ The bottom of a conveyance garden should be 6 to 12 inches below the grade of the outlet pipe or ditch.
- ☐ The bottom width of a conveyance garden should taper from the inlet ditch up to a minimum of 3 feet, then taper down to the width of the outlet pipe or ditch.
- ☐ Conveyance gardens serving over 5,000 square feet of impervious surface should have a minimum width of 4 feet at their widest point.
- ☐ The conveyance garden should be planted with vegetation appropriate for moist and seasonally dry conditions. See Appendix C for a list of recommended plants.
- ☐ Overflow shall connect to a designated management area or discharge point.



Adapted from the SvR / City of Seattle High Point Community Site Drainage Technical Standards, 2004

Figure 15. Conveyance Garden Plan View and Cross-section

Conveyance Garden Operation and Maintenance

Conveyance gardens are linear depressions that collect, infiltrate, and convey stormwater from an area of impervious surface to an end-of-line system such as a level spreader.

- ☐ The size, placement, and design of the conveyance garden as depicted by the drainage plan must be maintained and shall not be changed without written approval from the The City of Normandy Park Department of Planning and Community Development.
- ☐ Chemical fertilizers and pesticides must not be used.
- ☐ Additional mulch and compost should be added to the soil of the conveyance garden periodically over time.
- ☐ Conveyance gardens must be inspected annually by the property owner for physical defects.
- ☐ After major storm events, the conveyance garden should be checked to see that the overflow system is working properly and is not clogged.
- ☐ If erosion channels or bare spots are evident, they should be stabilized with soil, plant material, and mulch.
- ☐ A supplemental watering program may be needed the first year to ensure the long-term survival of the conveyance garden's vegetation.
- ☐ Vegetation should be maintained as follows:
  1) replace all dead vegetation as soon as possible;
  2) remove fallen leaves and debris as needed;
  3) remove all noxious vegetation when discovered;
  4) manually weed without herbicides or pesticides;
  5) mulch to conserve moisture and inhibit weed germination.

Gravel Trenches

Gravel trenches are excavated trenches filled with loose gravel intended to convey runoff from the runoff management zone to an end-of-line discharge technique such as a level spreader (See Section III-C for a description of level spreaders). Gravel trenches should be used on gently sloped ground with grades less than 5%.

- ☐ The bottom width of a trench should be at least 2 feet. Gravel trenches serving over 5,000 square feet of impervious surface should be at least 3 feet wide at the bottom.
- ☐ The trench should be a minimum of 1 foot deep.

Gravel Trench Operation and Maintenance

- ☐ The size, placement, and composition of gravel trenches as depicted by the drainage plan must be maintained and shall not be changed without written approval from the The City of Normandy Park Department of Planning and Community Development.
- ☐ Gravel trenches must be inspected annually by the property owner and after major storm events to identify and repair any physical defects.
- ☐ Maintenance and operation of the trench should focus on ensuring the system's viability by preventing sediment-laden flows from entering the device. Excessive sedimentation will result in a plugged or non-functioning facility.
- ☐ Prolonged ponding around the gravel trench may indicate it has become blocked. The existing gravel in the trench should be excavated and replaced.

Section III-C

End-of-Line Discharge BMPs

After stormwater has traveled through a Runoff Management BMP such as a rain garden, rainwater planter, or infiltration system, it is conveyed through an open conveyance BMP to a discharge point. This point should be at or near the point where water naturally flowed from the site before the permitted development. In order to eliminate or minimize any impacts associated with the discharge of stormwater from a site, stormwater shall be dispersed utilizing either a level spreader, continued dispersion or conveyance furrows (see Section III-B for a description of conveyance furrows). This section of the manual presents general guidelines for design of the following discharge BMPs for small projects:

- Quarry Spall Pads
- Level Spreaders
- Continued Dispersion

Quarry Spall Pads

For areas draining less than 1000 square feet, a splash pad constructed of 4" quarry spalls may be used. The pad shall measure at least 4 feet by 4 feet and meet the property line setback requirements for level spreaders.

Level Spreaders

Level spreaders are structures that are designed to convert small concentrated stormwater flows to sheet flows over a large area. Level spreaders come in many forms but all designs follow the same principle:
1. Concentrated flow enters the spreader through a pipe, ditch or swale.
2. The flow is slowed and energy is dissipated.
3. The flow is distributed throughout a long linear shallow trench or behind a low berm or board.
4. Water then rises and is dispersed over the level spreader.

Two main types of level spreader may be used to disperse flows: level board spreaders and gravel spreader trenches. The key to either type is for the edge of the spreader to be even and level.

A spreader shall have a minimum length of 10 feet for every 1,000 feet of directly tied impervious surface. For example, to adequately disperse flows from an impervious surface (such as a driveway) that measures 1,500 square feet, a level spreader 15 feet long would be needed.

For the outflow of a BMP such as a rain garden, or planter, 2,000 square feet of impervious surface may be routed for every 10 feet of width of the level spreader. For example, a rain garden receiving the runoff from a 4,000 square foot surface should have an overflow leading to a level spreader 20 feet in length.

The maximum length of one level spreader shall be 30 feet. For areas larger than 3,000 square feet of impervious surface that are drained directly by a level spreader, more than one level spreader should be used. When used in conjunction with runoff management and conveyance BMPs such as a rain garden or

conveyance furrow, impervious surfaces larger than 6,000 should incorporate more than one level spreader.

For directly tied impervious areas, a turf or other vegetated flowpath of at least 50 feet in length must be available along the path that runoff will follow upon discharge from the spreader to the nearest property line. For outflows from a BMP such as a rain garden, or planter, a turf or other vegetated flowpath of at least 20 feet in length must be available along the path that runoff will follow upon discharge from the spreader to the nearest property line. Spreaders discharging to a public roadside ditch may be located as close as 5 feet from the property line.

The level spreader should be at least 100 feet from a critical area such as a stream, wetland or geologically hazardous area, and shall meet the requirments of the Normandy Park Critical Areas Code.

Level Board Spreaders

Boards are installed in a trench and serve as the downstream lip so that water can flow out of the level spreader more uniformly. The boards should be stabilized by rebar driven into the ground at regular intervals along the trench. Joints between boards can be constructed by wrapping cloth around both ends of the board.

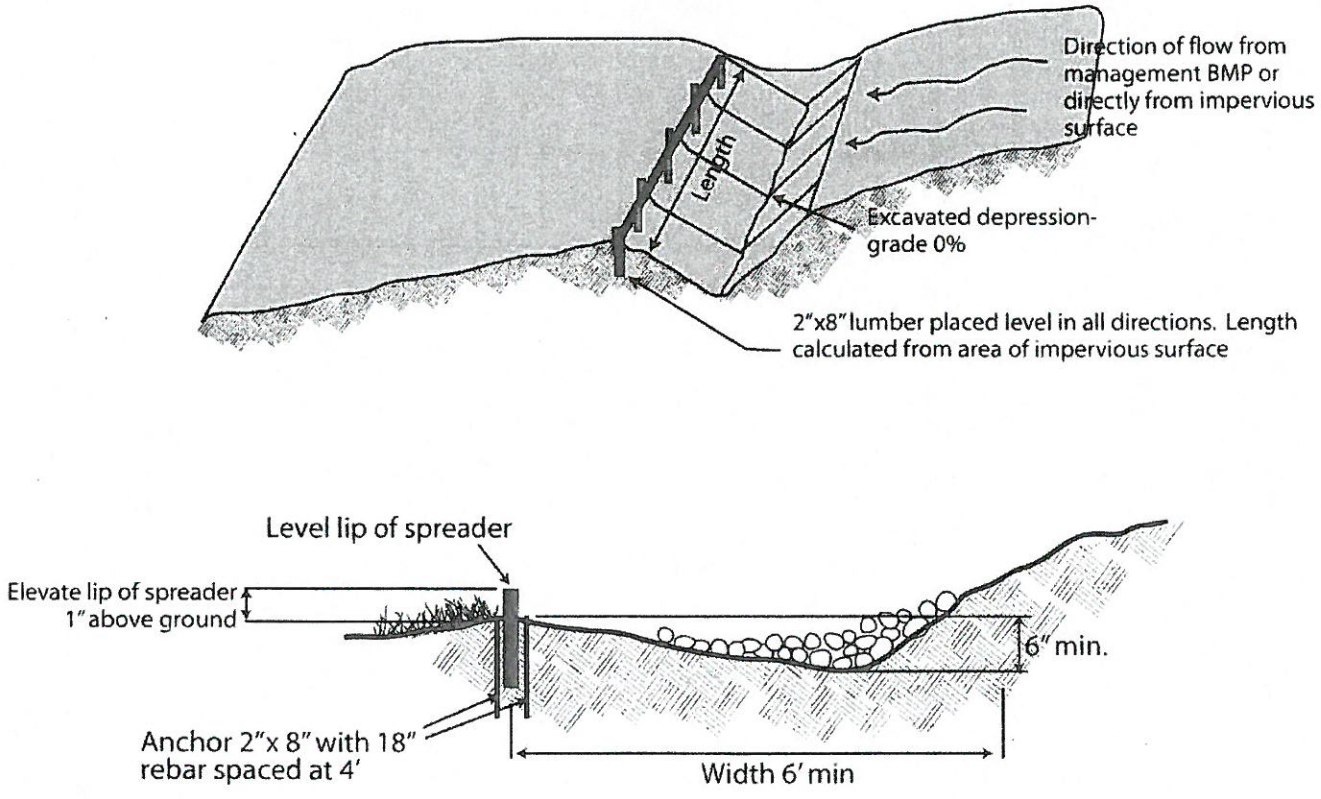


Figure 16. Level Board Spreader

Gravel Spreader Trenches

A gravel spreader trench is a gravel filled channel with a level downslope edge. Water pools in the channel, rises up and flows evenly over the edge of the channel as dispersed sheet flow. The channel should be dug along an elevation contour, which helps make the downstream lip "level." Landscape fabric should be used to underlay the channel and protect the downslope lip. A disadvantage of this type of spreader is that it is very hard to get the lip truly level and keep it that way.

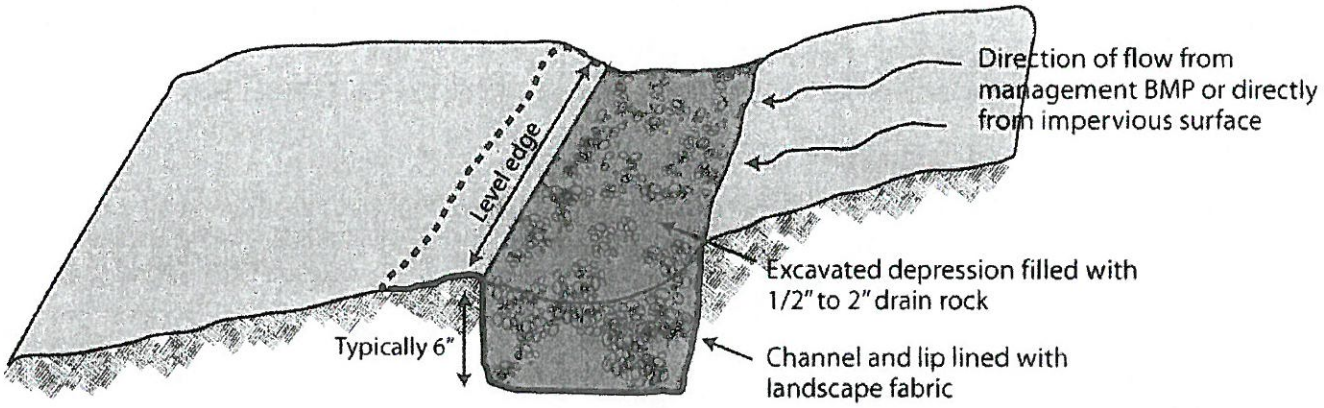


Figure 16. Gravel Spreader

Level Spreader Operation and Maintenance

- ☐ The size, placement, and composition of level spreaders as depicted by the drainage plan must be maintained and shall not be changed without written approval from the The City of Normandy Park Department of Planning and Community Development.
- ☐ Level spreaders must be inspected annually by the property owner and after major storm events to identify and repair any physical defects.
- ☐ Maintenance and operation of the trench should focus on ensuring the system's viability by preventing sediment-laden flows from entering the device. Excessive sedimentation will result in a plugged or non-functioning facility.
- ☐ When soil is exposed or erosion channels are present, it may mean the level edge of the spreader is no longer level. The level spreader should be regraded to eliminate the problem.

Continued Dispersion

Continued dispersion from level ground, a level spreader, conveyance furrows, filter strip or porous pavement is an appropriate discharge option where at least 100 feet of flow path through on-site native vegetation allows stormwater to naturally infiltrate and disperse. In some instances, this option may be limited or not allowed if City staff identify conditions that may concentrate stormwater flows and create downstream problems for public or private properties.

Continued Dispersion Operation and Maintenance

- ☐ The dispersion flowpath as depicted by the drainage plan must be maintained and shall not be changed without written approval from the The City of Normandy Park Department of Planning and Community Development.
- ☐ When soil is exposed or erosion channels are present, the sources of the erosion or concentrated flow shall be identified and mitigated. Bare spots should be re-vegetated with native vegetation.
- ☐ **The vegetated surface required for dispersion should be delineated as "vegetation retention area" on the drainage plan.**
  - ☐ The trees, shrubs, ground cover, and soil conditions in this area shall not be disturbed, except as allowed by the following provisions:
    - Individual trees that have a structural defect due to disease or other causes, and which threaten to damage a structure, road, parking area, utility, or place of employment or public assembly, or block emergency access, may be topped, pruned, or removed as needed to eliminate the threat.
    - Dead or fallen trees, tree limbs within ten feet of the ground, and branches overhanging a residence may be removed to reduce the danger of wildfire
    - Noxious weeds (i.e., plant species listed on the State noxious weed list in Chapter 16-750 WAC) and invasive vegetation (i.e., plant species listed as obnoxious weeds) may be removed.
    - Passive recreation uses and related facilities, including pedestrian, equestrian community and bicycle trails, nature viewing areas, fishing and camping areas, and other similar uses that do not require permanent structures, are allowed if clearing and soil compaction associated with these uses and facilities does not exceed eight percent of the native growth retention area.

Appendix A:
Small Project Erosion and Sediment Control

The intent of erosion and sedimentation control measures is to prevent the erosion and transport of soils from a construction site. Eroded soil is a major pollutant to streams and wetlands and can have harmful impacts to private property by silting up drainage ways. Preventing construction site erosion can help prevent harm to salmon spawning beds, maintain good water quality, and safeguard public drainage infrastructure.

Erosion control is the most effective and inexpensive method to reduce the impacts associated with construction activities. These practices primarily involve the protection of site vegetation and soils, the trapping of eroded or tracked soils, and the reestablishment of vegetation after construction has been completed. The proper installation and maintenance of selected erosion control options to a large degree determines their effectiveness. Avoidance of land disturbance during the winter months, when erosion control is the most difficult is encouraged, and may be required as a part of the permitting of your project. It is important to remember that it is easier to prevent erosion than it is to trap it once it has been mobilized.

This section presents the specifications for erosion and sediment control BMPs applicable **for small projects. These measures may be used if less than one-half acre of soil will be disturbed by the project.** Additional measures may be required by City of Normandy Park if these are insufficient for the project or fail to contain sediment on the project site. A complete description of erosion and sediment control measures can be found in the *Stormwater Management Manual for Western Washington, Volume II, Construction Stormwater Pollution Prevention, February 2005, Department of Ecology Publication No. 05-10-30.* Projects that disturb 1/2 acre or more of soil require an Erosion and Sediment Control plan developed by a civil engineer.

This section has been adapted from Kitsap County's *Residential Builder's Guide to Small Site Erosion Control and Stormwater Management*, 1999 and the *Washington Department of Ecology Stormwater Management Manual for Western Washington, Volume II Construction Stormwater Pollution Prevention, 2005.*

Limit site disturbance

The protection and management strategies discussed in this section are designed to protect vegetation and soil necessary for maintaining functioning hydrologic conditions on the site.

Equipment activity on construction sites can severely compact soil. Soil compaction is a leading cause of death or decline of mature trees in developed areas. Most tree roots are located within 3 feet of the ground surface and the majority of the fine roots necessary for water and nutrient absorption are within 18 inches. Roots can extend 2 to 3 times beyond the diameter of the crown. In addition to soil compaction, several other direct and indirect impacts can influence vegetation health during land development including:

- Direct loss of roots from trenching, foundation construction, and other grade changes
- Application of fill material
- Damage to trunks or branches from construction equipment and activities
- Exposure of forest interior areas to new stresses of forest edges as land is cleared
- Changes in surface and subsurface water flow patterns

Vegetation Protection

Leaving native vegetation intact is the single most effective method for reducing erosion on the construction site. Well marked clearing limits prevent disturbance to vegetation and soils in critical areas, buffers, and protected conservation and lot perimeter zones.

Vegetation Protection Guidelines:

- ❑ Map native soil and vegetation retention areas on all plans to protect soils and vegetation from construction damage.
- ❑ Clearing limits must be well marked with highly visible fencing or wire and tape and should be at least 3 feet high.
- ❑ Fencing for vegetation retention areas should be located at a minimum of 3 feet beyond the existing tree canopy along the outer edge of the tree stand.
- ❑ Individual trees that are to be preserved should be marked and the areas within the drip line protected from disturbance.
- ❑ Equipment operators should be informed of clearing limits prior to commencement of grading work. Walk property with equipment operators to clarify construction boundaries and limits of disturbance.
- ❑ Prohibit the stockpiling or disposal of excavated or construction materials in the vegetation retention areas to prevent contaminants from damaging vegetation and soils.
- ❑ Avoid excavation or changing the grade near trees that have been designated for protection.
- ❑ In areas of wildfire risk, utilize Firewise principles for developing a vegetation protection and planting plan. Consult the Firewise website (http://www.firewise.org/), the Washington State Department of Natural Resources, or your local fire department for details on Firewise recommendations.

Topsoil Conservation and Protection

Stockpiling topsoil for reuse during final site stabilization saves money by reducing the amount of soil to be imported and exported.

- ❑ Stockpile soil removed during grading.
- ❑ Cover stockpiled soil with mulch (preferred), plastic sheeting or temporary grass seeding (for stockpiles that may remain for several months) to prevent erosion.
- ❑ Surround stockpiles with silt fence.

Control Sediment and Flows On-site

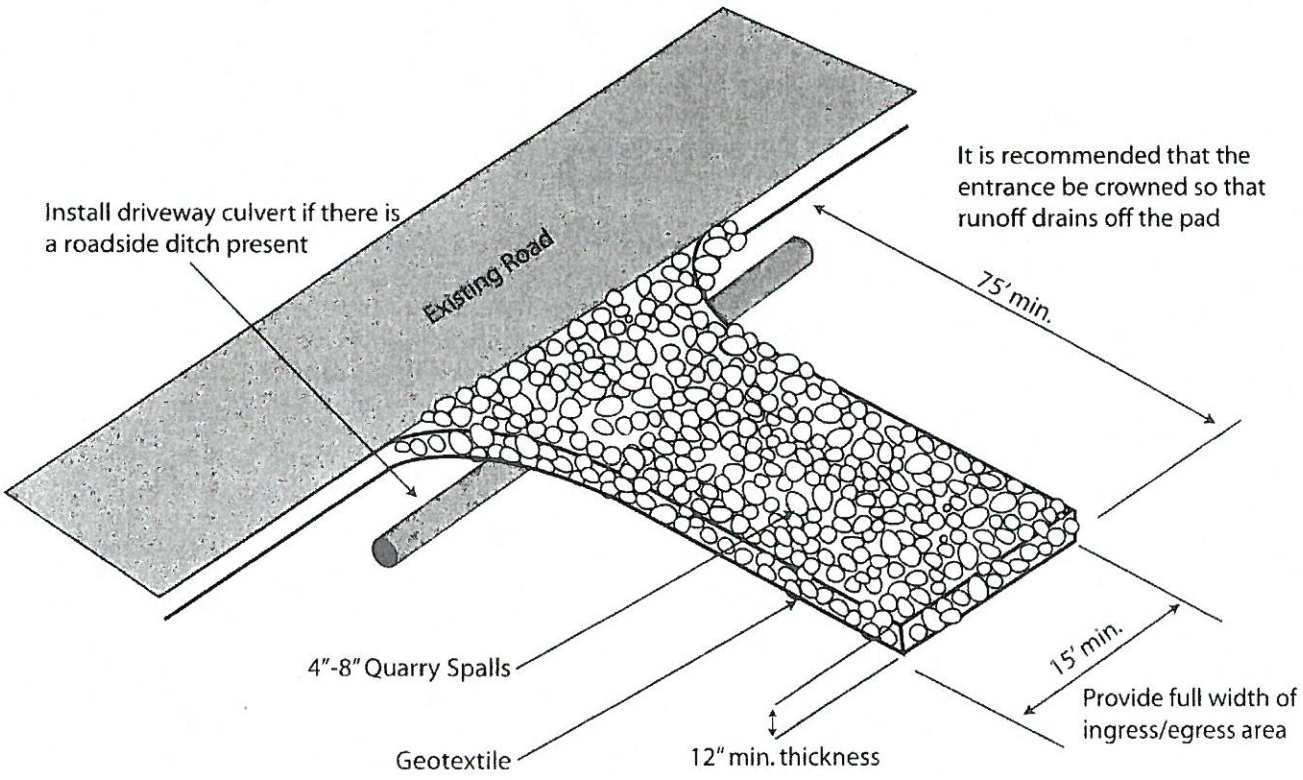
Most often some soil on a construction site will be mobilized. BMPs such as a stabilized entrance, silt fencing and sediment traps can capture and contain soil on site, reducing the amount of sediment and associated pollutants which can enter nearby waterways and wetlands.

Stabilize the Construction Entrance

Vehicles and heavy equipment can track mud offsite where it washes off the roads into ditches and waterways. A stabilized construction entrance is a stone pad located at the vehicular access point to the site that minimizes the amount of sediment and mud tracked offsite by construction site traffic.

- ❑ Stabilized entrance should use 4" to 8" angular quarry spalls
- ❑ Dimensions should be 75' minimum length, 15' foot minimum width, 1' depth
- ❑ If site soils are clayey, filter fabric should be placed under the stone pad to prevent soil from working into the rock material
- ❑ Install driveway culvert if roadside ditch is present
- ❑ Crown the entrance so runoff does not drain onto roadway
- ❑ Limit site access to one route
- ❑ Install fencing as necessary to restrict traffic to stabilized entrance
- ❑ Remove any mud or gravel that is tracked onto roadway by sweeping or shoveling it back onto site

Figure A-1. Stabilized Construction Entrance



Silt fences

Silt fencing, also known as filter fencing, is a temporary physical barrier to intercept sediment that has been mobilized on site. Silt fences are usually placed around the perimeter of a construction site, and can be used for both retaining sediment and demarking clearing limits on the site.

- ❑ The fabric at the bottom of a silt fence must be firmly anchored into the soil by burying it in a "J" configuration in a trench that is backfilled.
- ❑ A wire mesh fence can be placed behind a silt fence to prevent collapse where soil may pile up against the silt fence.
- ❑ Follow manufacturer's instructions on proper installation of filter fabric.
- ❑ Choose filter fabric with proper porosity and ability to trap sediments for the soil type on site.
- ❑ Do not install across streams or ditches.
- ❑ Do not attach to existing trees
- ❑ Construct trench to follow natural contour of land to ensure best protection.
- ❑ Inspect fencing on a regular basis throughout construction.

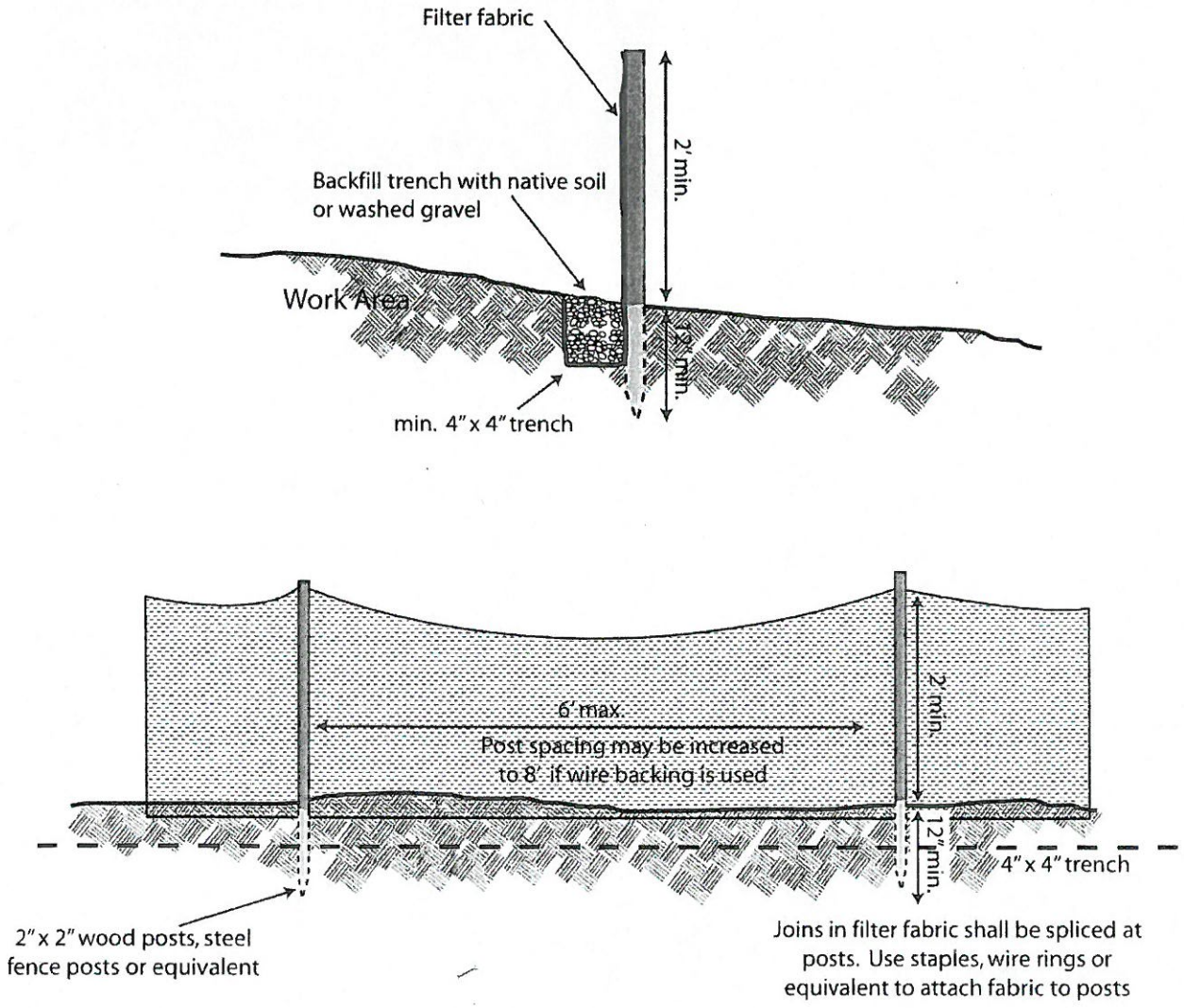


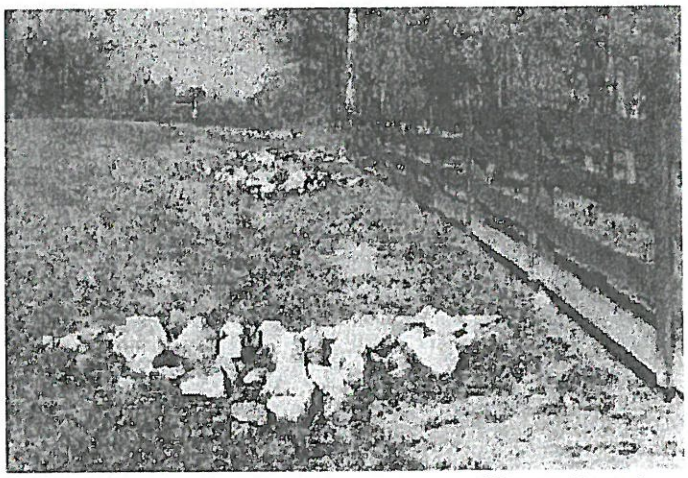
Figure A-2. Silt Fence diagram

Sediment barriers

Sediment barriers are used to impede the flow of water in small channels and ditches and allow sediment to settle out. Barriers are the last defense against sediment leaving a site and should be implemented as a secondary measure. Barriers may be constructed of sand or gravel bags, gravel or rock berms, manufactured silt dikes, straw bales, or brush waddles. In order to function, the barrier must be dense and allow water to back up behind it and flow across a low spot near the center of the barrier. A Check Dam is an example of an effective barrier.

Check Dams

A check dam is a small rock dam constructed across a path of water that slows concentrated flows and filters sediment.



Kitsap County

- ❑ Dam should be constructed of rock or pea-gravel filled sandbags
- ❑ Dam should be placed perpendicular to flow of water
- ❑ The maximum spacing between the dams shall be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam
- ❑ Construct so that center of the dam is at least 12 inches lower than the outer edges
- ❑ Side slopes should be 2:1 or less
- ❑ Maximum height should be 2 feet at center of dam
- ❑ Whatever material is used, dam should form a triangle when viewed from side
- ❑ Line area under check dam with filter fabric
- ❑ Seed and mulch area beneath check dam immediately after removal

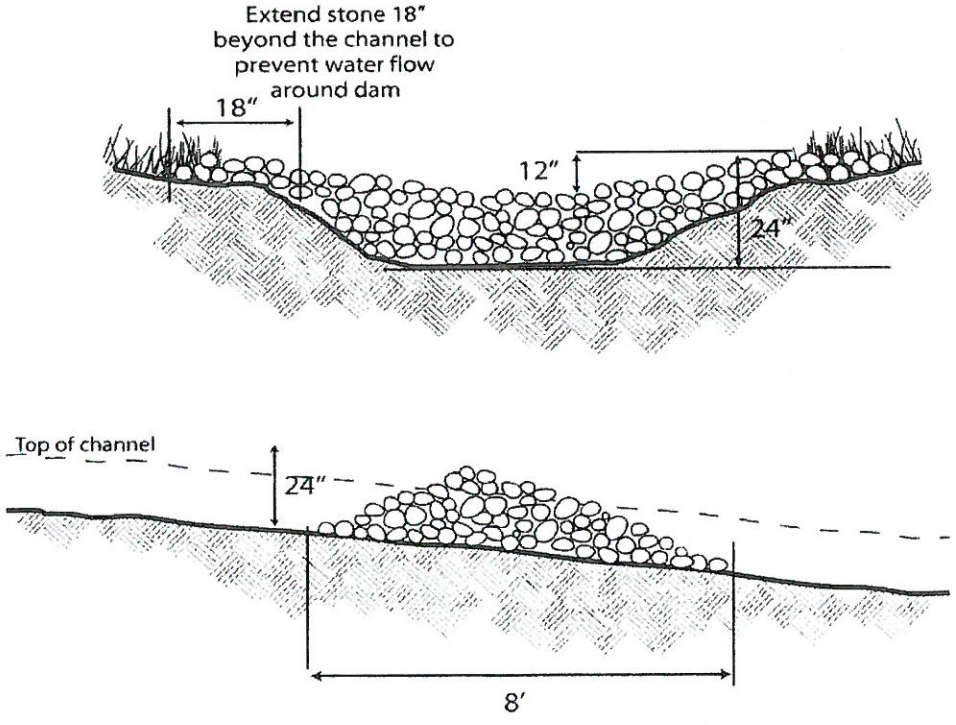


Figure A-3. Check Dam Sections

Stabilize Soils

Covering disturbed areas with mulch, woven materials, plastic sheeting or temporary seeding prevents soil erosion on disturbed areas and soil stockpiles. If the final stabilization of the site will not occur for more than 30 days, additional measures may be needed to protect the site soil.

Mulching

Mulching provides immediate temporary protection from erosion. Common mulch materials include straw, compost, and wood chips. Mulch is a temporary measure that should be followed up by seeding or other permanent landscape implementation. Mulch may be covered with a loose weave net to protect it from wind and water exposure.

Type of mulch	Thickness of Application
Straw	2"-3" thick; 5 bales per 1000 sq. ft.
Hydromulch	25-30 pounds per 1000 sq. ft.
Composted mulch and compost	2" minimum
Chipped on-site vegetation	2" minimum
Wood-based mulch	2" minimum

Temporary Seeding

Seeding is intended to reduce erosion by stabilizing exposed soils. A well-established vegetative cover is one of the most effective methods of reducing erosion. Seeding can be temporary or permanent. Seeding may be used throughout the project on disturbed areas that have reached final grade or that will remain unworked for more than 30 days.

- ❑ Install all surface runoff control measures before seeding
- ❑ Mulch is required at all times because it protects seeds from heat, moisture loss, and transport due to runoff.
- ❑ All disturbed areas shall be reviewed in late August to early September and all seeding should be completed by the end of September. Otherwise, vegetation will not establish itself enough to provide adequate winter cover.
- ❑ The optimum seeding windows for western Washington are April 1 through May 31st and September 1 through October 1.

Temporary Erosion Control Seed Mix

Grass type	% by Weight
Chewings fescue *Festuca rubra var. commutata*	40
Perennial rye -*Lolium perenne*	50
Redtop or colonial bentgrass - *Agrostis alba* or *Agrostis tenuis*	5
White Dutch clover - *Trifolium repens*	5

Application rate of erosion control seed mix is 120 pounds per acre.

Appendix B: Sample Drainage Plans

The following pages include sample drainage plans from development situations likely to be encountered. While each drainage plan should be site specific and address the unique conditions found on the site, these sample plans can be used as general examples for managing stormwater on residential sites.

- Large Lot with Full Dispersion
- Small Lot Dispersion
- Small Lot with Poorly Draining Soils
- Large Lot with Well-Drained Soils
- Large Lot with Poorly Draining Soils

Note: The following plans are intended as examples only. Each drainage plan should be designed to meet the specific conditions of the site.

Example A: Full Dispersion on Large Lot

A single family residential project with a roof area of 2,400 square-feet and a garage with a roof area of 970 square-feet on a 2.5 acre lot.

Step 1: Conduct Site inventory

A thorough inventory of the site is the initial step for developing and implementing an effective site design and drainage plan.

- The site is gently sloping with 5-7% slopes.
- There are no seeps, springs or visible drainage paths on-site.
- There are no environmental critical areas (e.g. wetlands, streams, geologic hazard areas) on the site.
- The forested portions of the site have native vegetated areas of trees and shrubs and cover more than 50% of the site.
- The site utilizes an on-site septic system.

Step 2: Site Design

Using the information gathered in the Inventory, align the roads and structures on the site to maximize the preservation of vegetation and retain the existing flow of water on the site to the greatest possible extent.

- Building envelope and access point are identified.
- Clearing limits are marked on construction plans.

Step 3: Determine Soil Type

- Determine the type of soil on the site. The example site is outside the areas that have type A or B soils suitable for infiltration. But as the lot is large with more than half the site in vegetated open-space, dispersion is an option.

Step 4: Drainage Plan Design

A drainage plan is developed using the project planning chart and the details in the Small Project Drainage Plan Design Elements section to select options for managing roof water runoff, driveway runoff, conveyance areas, and discharge areas. The sizing chart for each drainage element determines the required dimensions based on the amount of impervious surface draining to it. The following page shows the runoff, conveyance and discharge locations illustrated on the drainage plan for the site. The connection to the community drainage system is shown.

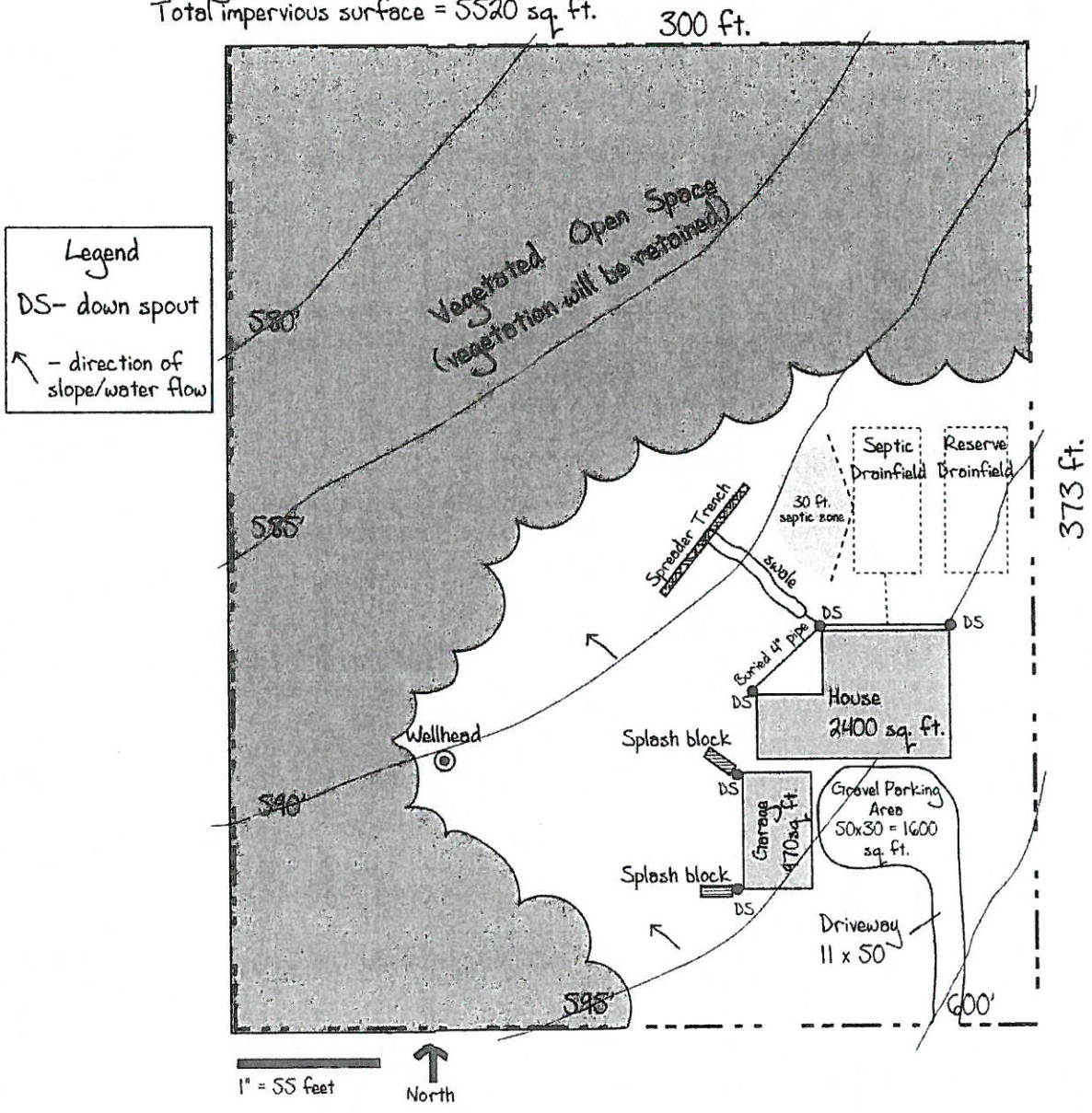
- ❑ Full dispersion of the roof runoff is possible because of the size of the lot, small building envelope and the existing vegetated open space is more than 50% of the lot cover.
- ❑ The house roof runoff is routed through downspouts, pipes and a swale to a spreader trench that is used to disperse the stormwater evenly.
- ❑ Splash blocks in combination with gutters and downspouts are used to disperse garage roof runoff.
- ❑ Runoff from the gravel driveway is dispersed into the surrounding lawn areas.

Example A: Full Dispersion on Large Lot

Applicant: John Doe

Parcel number: 083001232900
Project Address: 7543 Greenfields Lane

Acreage = 2.5 acres
Total impervious surface = 5520 sq. ft.



Example B: Basic Dispersion

An existing single family residential project with a roof area of 2,040 square-feet, a 1,180 square- foot driveway/parking area and a proposed garage with a roof area of 936 square-feet on a 0.62 acre lot. As the projects adds less than 2000 square feet of new impervious basic dispersion may be an option.

Step 1: Conduct Site inventory

A thorough inventory of the site is the initial step for developing and implementing an effective site design and drainage plan.

- The site is nearly level and there are no seeps, springs or visible drainage paths on site.
- There are no critical areas on the site.
- The site is a former hayfield and has no existing native vegetated areas but does have an intact ground cover layer of pasture grasses.
- The site utilizes an on-site septic system.

Step 2: Site Design

Using the information gathered in the Inventory, align the roads and structures on the site to maximize the preservation of vegetation and retain the existing flow of water on the site to the greatest possible extent.

- Building Envelope and Access Point are identified.
- Clearing limits are marked on construction plans.

Step 3: Determine Soil Type

- The example site is within the areas identified as having soils suitable for infiltration having type A or B soils. This soil type is ideal for basic dispersion.

Step 4: Drainage Plan Design

A drainage plan is developed using the project planning chart and the details in the Small Project Drainage Plan Design Elements section to select options for managing roof water runoff, driveway runoff, conveyance areas, and discharge areas. The following page shows the runoff, conveyance and discharge locations illustrated on the drainage plan for the site.

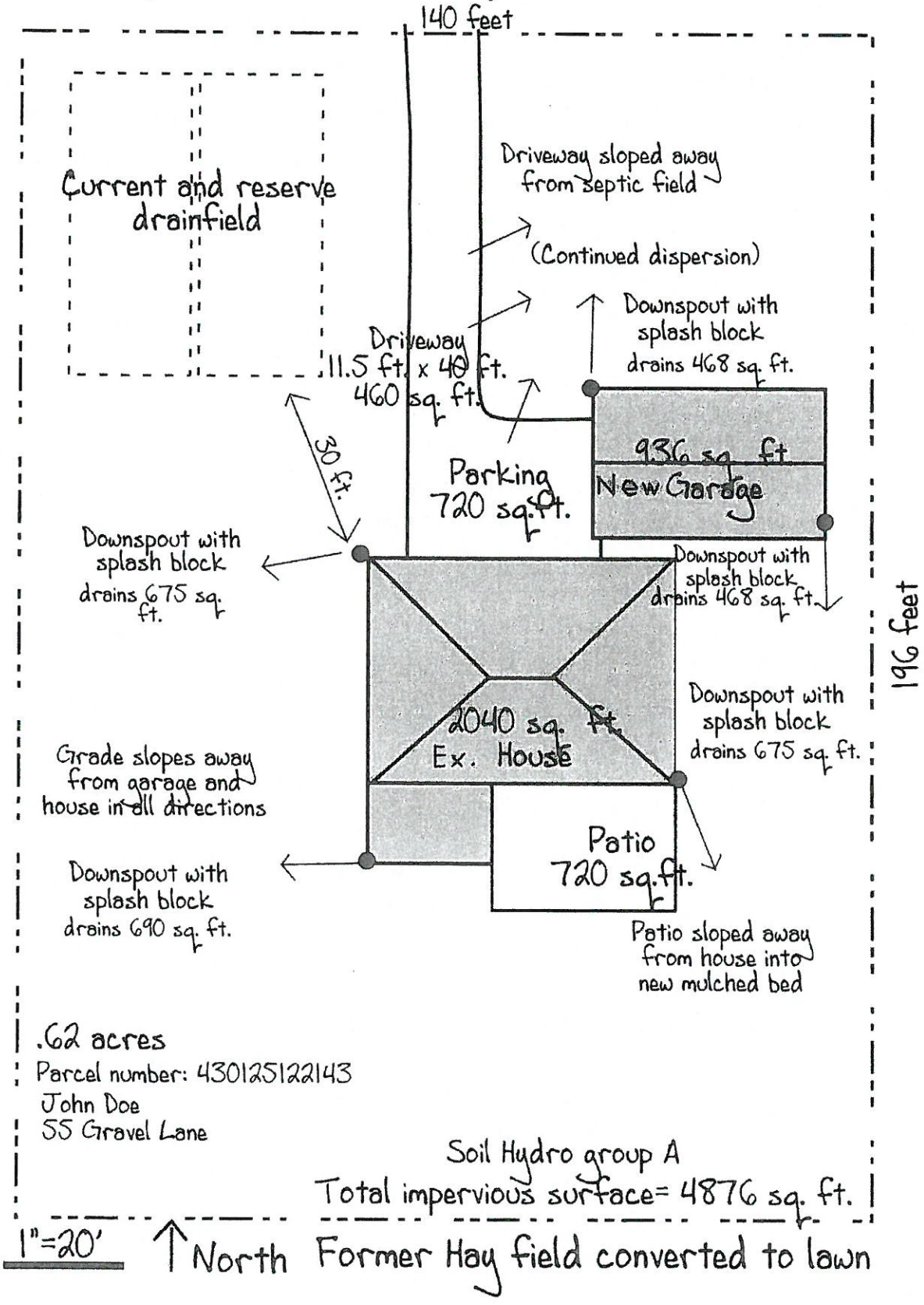
- ☐ Because this lot is eligible for *Basic Dispersion*, the roof runoff from the house may be managed with downspouts and splash blocks. Note: conveyance and end-of-line discharge BMP's may still be required.

- ☐ No more than 700 square feet of roof area is drained to a single splash block. Size of drainage area is indicated for each dispersion site.

- ☐ A vegetated flowpath of at least 50 feet in length is available along the paths that runoff will follow upon discharge from the splash blocks to the nearest property line.

- ☐ Runoff from the driveway is dispersed into surrounding lawn area.

Example B: Small Lot Dispersion



Example C: Small Lot with Poorly Draining Soils

This example depicts a single family residential project with a roof area of 1,854 square-feet, a 945 square-foot driveway, and a garage with a roof area of 528 square-feet on a 9,000 square-foot lot.

Step 1: Conduct Site inventory

A thorough inventory of the site is the initial step for developing and implementing an effective site design and drainage plan.

- The site is nearly level and there are no seeps, springs or visible drainage paths on site.
- There are no critical areas on the site.
- The site is former pasture land and has no existing native vegetated areas.
- The site has access to public sewer and water systems.

Step 2: Site Design

Using the information gathered in the Inventory, align the roads and structures on the site to maximize the preservation of vegetation and retain the existing flow of water on the site to the greatest possible extent.

- Building Envelope and Access Point are identified.
- Site was pre-cleared so defining clearing limits on plan is not an option.

Step 3: Determine Soil Type

- This example site lies outside of the areas identified as having soils suitable for infiltration. A soils test was performed by a licensed engineer confirming the site soils are type C, not recommended for infiltration.

Step 4: Drainage Plan Design

A drainage plan is developed using the project planning chart and the details in the Small Project Drainage Plan Design BMP's (Section III) to select options for managing roof water runoff, driveway runoff, conveyance areas, and discharge areas. The sizing chart for each drainage element determines the required size of each BMP based on the amount of impervious surface draining to it. The following page shows the runoff, conveyance and discharge locations illustrated on the drainage plan for the site.

- ☐ The roof runoff from the house is managed with gutters and downspouts that are piped to a rain garden. The surface area of the rain garden is sized at 405 sq. ft. to handle the 2,382 square foot total of roof area (house and garage) according to the sizing table on page 19. The overflow of the rain garden is routed to the existing community drainage system.

- ☐ The roof runoff from the garage is routed through a conveyance garden to slow and infiltrate some water and to provide an amenity along the backside of the house. The overflow of the conveyance garden is piped to the rain garden at the front of the house.

- ☐ The 945 sq. ft. driveway is paved. Because the driveway is less than 2,000 square feet, filter strips are all that is needed to manage the driveway runoff. The filter strip areas are at least half the width of the driveway.

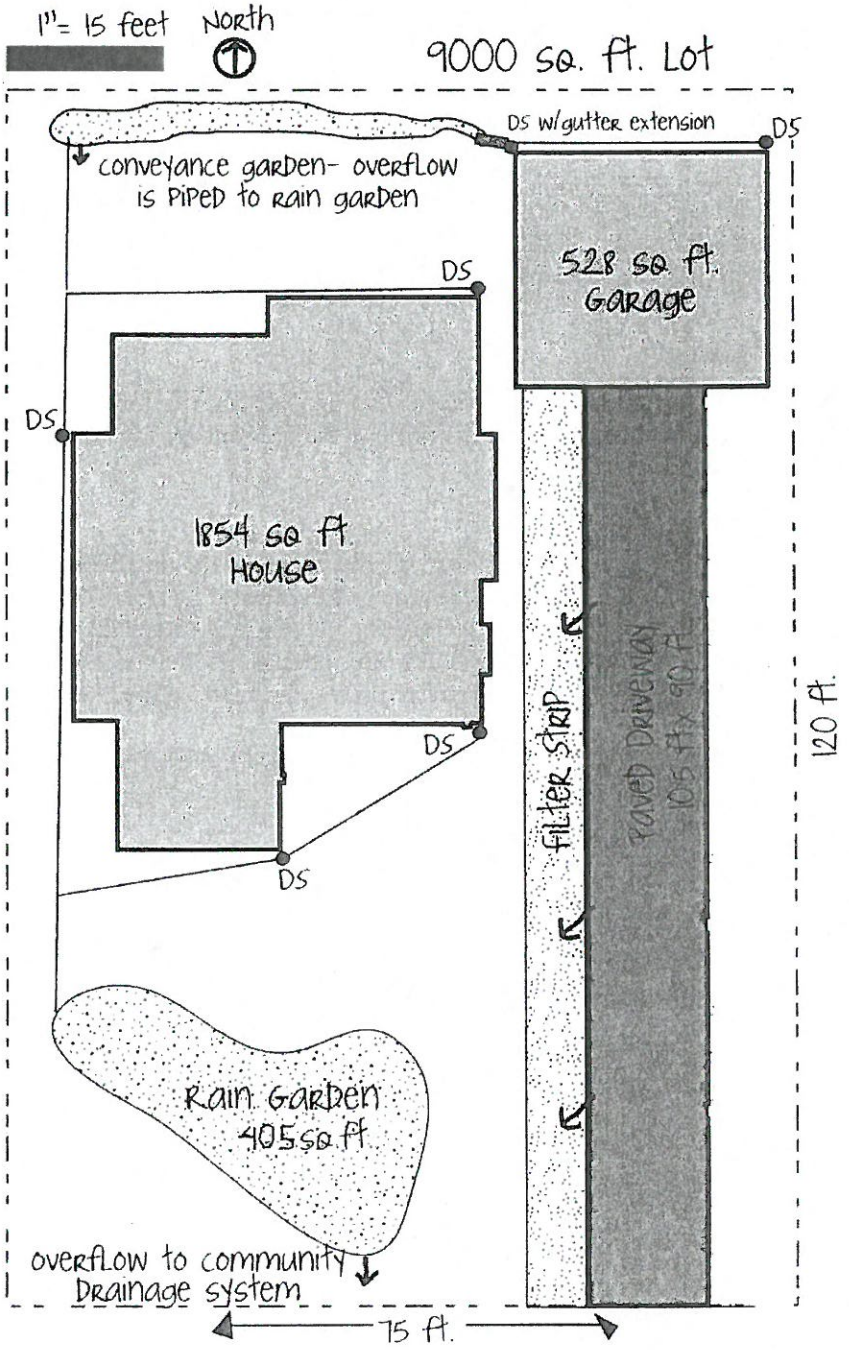
- ☐ The connection to the community drainage system is shown.

Example C: Small Lot with Poorly Draining Soils

PROJECT ADDRESS: 435 Z Street

Acreage = 0.2 acres

Total impervious surface of house and garage = 2382 sq. ft.



Example D: Large Lot with Well-Drained Soils

This example shows a single family residential project with a roof area of 3,281 square-feet and a garage with a roof area of 1,875 square-feet on a one-acre lot.

Step 1: Conduct Site inventory

A thorough inventory of the site is the initial step for developing and implementing an effective site design and drainage plan.

- The site slopes gently to the north with 5% slopes or less.
- There are no seeps, springs or visible drainage paths on-site.
- There are no critical areas on the site.
- The site has little native vegetation remaining.
- The site utilizes an on-site septic system.

Step 2: Site Design

Using the information gathered in the Inventory, align the roads and structures on the site to maximize the preservation of vegetation and retain the existing flow of water on the site to the greatest possible extent.

- Building Envelope and Access Point are identified.
- Clearing limits are marked on construction plans.

Step 3: Determine Soil Type

- The example site is located within the area identified as having soils suitable for infiltration.

Step 4: Drainage Plan Design

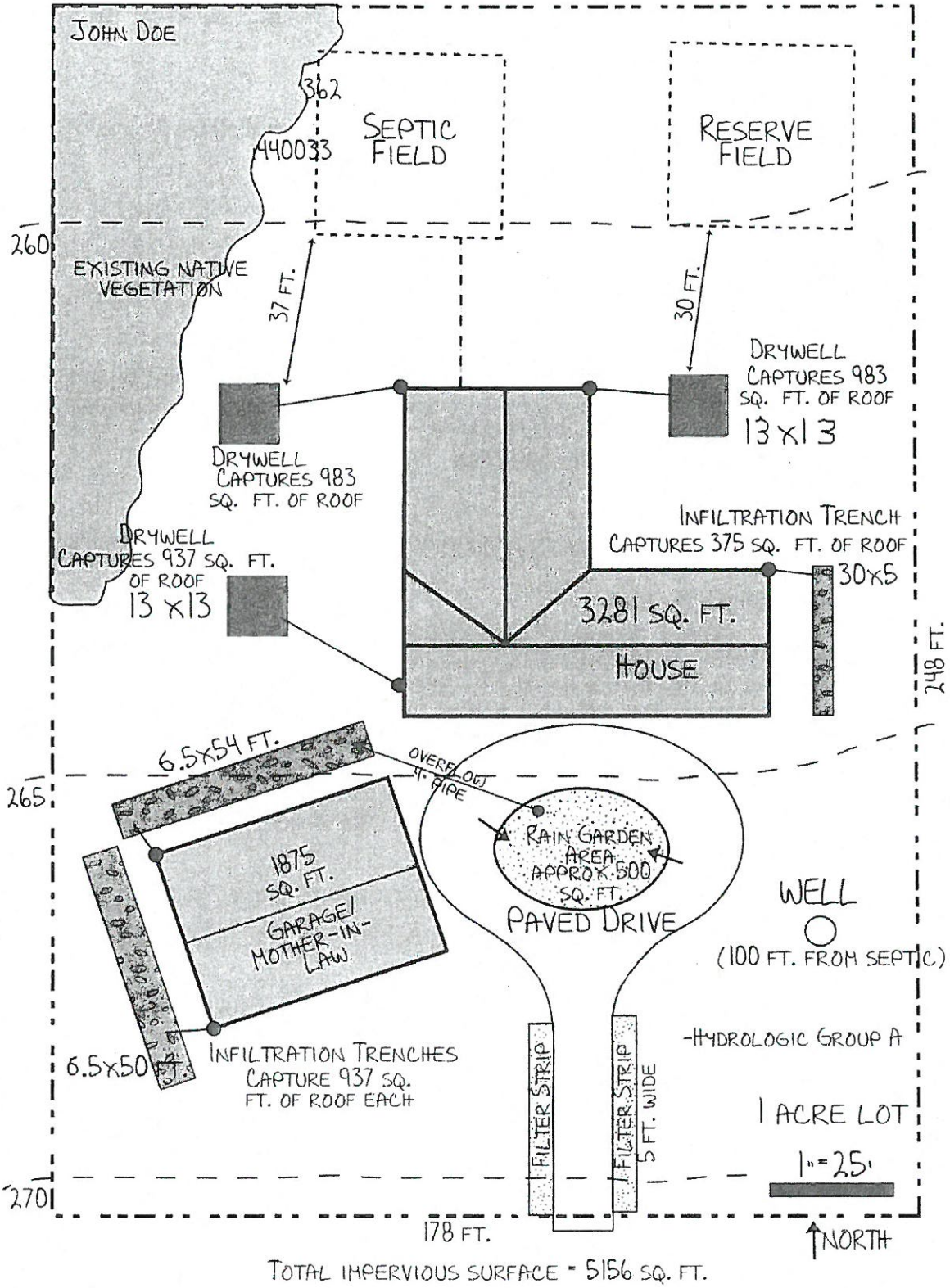
A drainage plan is developed using the project planning chart and the details in the Small Project Drainage Plan Design BMP's (section III) to select options for managing roof water runoff, driveway runoff, conveyance areas, and discharge areas. The sizing chart for each drainage element determines the required dimensions based on the amount of impervious surfaces draining to them. The following page shows the runoff, conveyance and discharge locations illustrated on the drainage plan for the site.

- ☐ Roof runoff is handled by 3 different drywells and an infiltration trench to avoid exceeding the 1,250 sq. ft. drainage area limit to a single drywell. The size of the drywells and trench and the area it drains is noted on the plan.

- ☐ Infiltration trenches are used to manage the garage roof runoff. The infiltration trenches are sized for the drainage area draining to them, according to directions on page 26-29. The size of the trenches and the area they drain are noted on the plan.

- ☐ Runoff from the gravel driveway is handled by filter strips and a rain garden. The circular drive is graded to drain to the rain garden.

Example D: Large Lot with Well-Drained Soils



TOTAL IMPERVIOUS SURFACE = 5156 SQ. FT.

Example E: Large Lot with Poorly Draining Soils

A single family residential project with a roof area of 2,496 square-feet with a outbuilding with a roof area of 576 square-feet on a two-acre lot.

Step 1: Conduct Site inventory

A thorough inventory of the site is the initial step for developing and implementing an effective site design and drainage plan.

- The site has slopes over 15% draining to the northwest.
- There is a seep/ wet area along the hillside of the property that seasonally drains to the north.
- There are no critical areas on the site.
- The site was logged and has little native vegetation remaining.
- The site utilizes an on-site septic system and well.

Step 2: Site Design

Using the information gathered in the Inventory, align the roads and structures on the site to maximize the preservation of vegetation and retain the existing flow of water on the site to the greatest possible extent.

- Building Envelope and Access Point are identified.
- Clearing limits are marked on construction plans.

Step 3: Determine Soil Type and Stormwater Region

- This example site lies outside of the areas identified as having soils suitable for infiltration. A soils test was performed by a licensed on-site wastewater treatment system designer confirming the site soils are type C, not recommended for infiltration.

Step 4: Drainage Plan Design

A drainage plan is developed using the project planning chart and the details in the Small Project Drainage Plan Design BMP's (section III) to select options for managing roof water runoff, driveway runoff, conveyance areas, and discharge areas. The sizing chart for each drainage element determines the required dimensions based on the impervious surfaces draining to them. The following page shows the runoff, conveyance and discharge locations illustrated on the drainage plan for the site.

- ☐ Roof runoff of the house is handled by a rain garden sized for the impervious area of the house (according to the sizing information on page 19. The size of the rain garden and the area that it drains is noted on the plan.

- ☐ Swales and pipes are used to convey the roof runoff to the rain garden. A gravel spreader trench is used as end-of- the line discharge.

- ☐ Roof runoff from the outbuilding is managed by a downspout with a splash block that drains to 3 conveyance furrows on the northern slope.

- ☐ The gravel driveway utilizes a Runoff from the gravel driveway is dispersed into the surrounding lawn area.

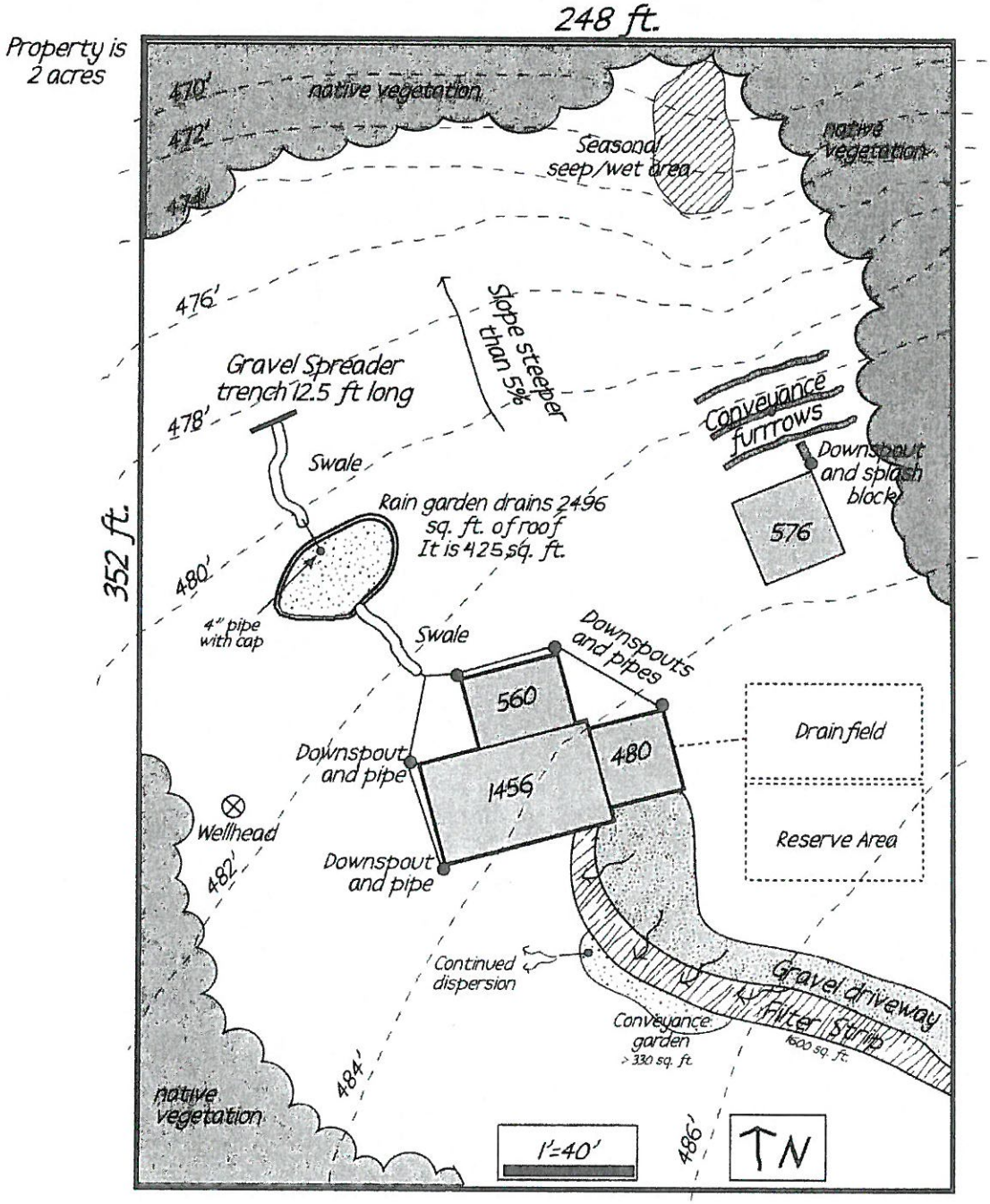
Example E: Large Lot with Poorly Draining Soils

Applicant: Jane Housebuilder *Project Address: 56 Foothills Crt.*

Soil- Group C

Parcel number: 053029732220

Total impervious surface = 3072 sq. ft buildings, 2944 sq. ft. gravel driveway



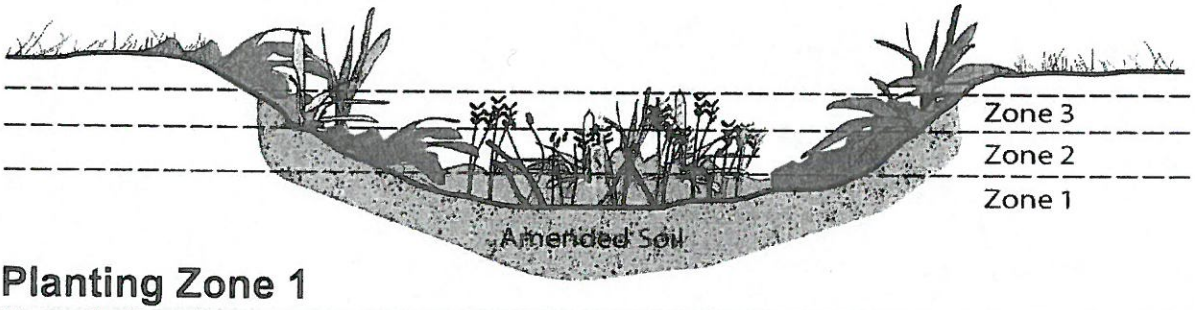
Appendix C: Recommended Plant List for Bioretention Areas

Adapted from *Low Impact Development: Technical Guidance Manual for Puget Sound*, Puget Sound Action Team and Washington State University Pierce County Extension, January 2005

The following native and non-native plants are recommended for use in Rain Gardens, Rainwater Planters, and Conveyance Gardens. Plants utilized in the bioretention areas should be adapted to withstand periods of dryness, but be able to tolerate saturated soil periodically. Conditions in the stormwater management areas will change from very dry during months with little or no rain, to wet or saturated soil following a storm event. The deeper areas of the Rain Garden and Conveyance Garden will be saturated more frequently than the sloping sides. The plants in the Rainwater Planter are at a more uniform depth, but soil moisture within the planter will vary seasonally.

The following list is arranged beginning with plants that thrive in wetter conditions to ones that prefer the slightly drier and higher sides of the Rain Garden or Conveyance Garden. Rainwater Planters should utilize plants from Zone 1 and Zone 2.

Zone 1: Areas of frequent inundation or standing water.
Zone 2: Periodically moist or saturated during larger storms.
Zone 3: Drier soils with infrequent inundation. Transition zone to existing landscape.



Planting Zone 1

Zone 1: Shrubs

Scientific Name	Common Name	Exposure	Mature Size/ Spread
Cornus sericea	Red-osier dogwood	Sun/part shade	to 15 feet
Cornus sericea 'Kelsey'	Dwarf dogwood	Sun	to 1.5 feet
Cornis sericea 'Flaviramea'	Yellow dogwood	Sun/part shade	6-8 feet
Physicarpus capitatus	Pacific ninebark	Sun-part shade	6-13 feet
Spirea douglasii	Douglas spirea	Sun/part shade	4-7 feet
Rubus spectablis	Salmonberry	Shade	5-10 feet

Zone 1: Perennials

Scientific Name	Common Name	Exposure	Mature Size/ Spread
Carex obnuta	Slough sedge	Sun/part shade	1-5 feet
Carex stipata	Sawbeak sedge	Part shade	10 inches-3 feet
Juncus effusus	Common rush	Sun/part shade	1-2 feet
Juncus ensipoluos	Daggerleaf rush	Sun	12-18 inches
Scirpus microcarpus	Small-fruited bulrush	Sun/shade	2-4 feet

Planting Zone 2

Zone 2: Shrubs

Scientific Name	Common Name	Exposure	Mature Size/ Spread
Acer circinatum	Vine Maple	Part shade	to 25 feet
Hammamelis intermedia 'Diane'	Diane Witchhazel	Sun/part shade	10-20 feet/ 10 foot spread
Oemleria cerasiformis	Indian plun	Sun/part shade	5-15 feet
Symphoricarpos albus	Snowberry	Sun/shade	2-6 feet
Rosa nutkana	Nootka rose	Sun/part shade	6-10 feet

Zone 2: Perennials

Scientific Name	Common Name	Exposure	Mature Size/ Spread
Aquilegia formosa	Western Columbine	Sun/part shade	1-3 feet
Asarum caudatum	Wild Ginger	Shade	to 10 inches
Aster subspicatus	Douglas aster	Sun	.5-2.5 feet
Iris douglasiana	Pacific Coast Iris	Sun/part shade	1-2 feet
Tellima grandiflora	Fringecup	Shade	1-3 feet
Hemerocallis fulva	Day Lily	Sun/part shade	1-4 feet
Heuchera micrantha	Purple Palace Heuchera	Sun/part shade	1-2 feet
Geranium sanguineum	Cranesbill	Sun/part shade	1.5 feet

Planting Zone 3

Zone 3: Shrubs

Scientific Name	Common Name	Exposure	Mature Size/ Spread
Arbutus unedo 'Compacta'	Compact strawberry tree	Sun/part shade	to 10 feet
Holodiscus discolor	Oceanspray	Sun/part shade	to 15' feet
Mahonia aquifolium	Tall Oregon Grape	Sun/part shade	6-8 feet
Philadelphus lewis	Mock Orange	Sun/part shade	5-10 feet
Potentilla fruitcosa	Shrubby Cinqufoil	Sun	4 feet
Ribes sanguineum	Red-flowering current	Sun/part shade	8-12 feet
Rhododendron 'PJM'	PJM Rhododendron	Sun/part shade	4 feet
Vaccinium ovatum	Evergreen huckleberry	Part shade/shade	3-15 feet

Zone 3: Perennials and Grasses

Scientific Name	Common Name	Exposure	Mature Size/ Spread
Achillea millefolium	Western Yarrow	Sun	4 inches-2.5 feet
Dicentra formosa	Pacific bleeding-heart	Sun/shade	6-20 inches
Festuca ovina 'Glauca'	Blue fescue	Sun/part shade	to 10 inches
Lupinus spp.	Lupine	Sun	3- 5 feet
Polystichum munitum	Sword Fern	Part shade/shade	2-4 feet
Rudbeckia hirta	Black-eyed Susan	Sun/part shade	3-4 feet
Smilacina racemosa	False Solomon's Seal	Par t shade	1-3 feet

Normandy Park Public Works Department
801 SW 174th Street Normandy Park WA, 98166
(206) 248-8269 fax (206) 439-8674

Small Project Drainage Plan Submittal

Information

Please print. Leave no blank lines.

Landowner	Tax Parcel #
Phone	Prepared By (Agent)
Address	Address
City, ST ZIP Code	City, ST ZIP Code
Nearest County Road	Phone
	Short Plat Name

Driveway:
____ Not on public Road
____ Submitting permit now for driveway approach onto public road
____ Existing driveway approach onto public road

Block: ____ Lot: ____
Volume ____ Page: ____
Acreage: ____ Soils: ____

Regarding pre-approval for additional/future structures: Locations and dimensions must be shown on this site plan for future drainage review to be waived.

Signature of Owner/ Owner's Agent

Date

Requirements: The following are required as part of small project drainage plan submittal

- ☐ Drainage Plan (must be plotted to scale, with all significant dimensions given. Use attached sheet or attach a separate sheet, no smaller than 11x17. See checklist for required information.
- ☐ Written Drainage Assessment
- ☐ Recorded Declaration of Covenant – Private Stormwater System

Submit the completed forms to the Normandy Park Department of Planning and Community Development. Incomplete information can delay processing of the drainage evaluation.

Drainage Plan

DRAINAGE PLAN CHECKLIST:

The following information must be included on all small project drainage plans:

Identification

- ☐ Name, address, and phone number of applicant
- ☐ Parcel number
- ☐ Dimension of all property lines
- ☐ Street names and existing or proposed property address
- ☐ North arrow
- ☐ Legend if needed
- ☐ Scale—use a scale that clearly illustrates drainage features and BMPs/measures
- ☐ Slope details, show at least 5-foot contours for all slopes steeper than 15% .

Building and Site Development Features

- ☐ Footprint of all structures (existing and proposed)
- ☐ Future Structures and Improvements planned.
    - If you wish to have drainage review waived for future structures/improvements on this parcel, you must show them (with dimensions) on the site plan.
- ☐ Parking, roads, and driveways (existing and proposed)
- ☐ Sport courts, patios, pools and any other paved or impervious surfaces (existing and proposed)
- ☐ Total Impervious surface land cover (existing and proposed)
- ☐ Location of any retaining walls and rockeries (existing and proposed)
- ☐ Existing or proposed septic system, including all system components and both primary and reserve drainfields.
- ☐ Utility structures (poles, fire hydrants, etc.)
- ☐ Existing easements
- ☐ Existing wells or wells to be abandoned.
- ☐ Newly created vegetated areas.
- ☐ Remaining **vegetated open space** that will remain undisturbed.

Natural Features and Critical Areas

For a map detailing the critical areas on your site, visit the permit counter at the Department of Community Development. *Development within 200 feet of a critical area may require an engineered drainage plan.*

- ☐ Existing natural features of the property (woods, pasture, brush).
- ☐ Existing hydrology- Location of all existing and proposed ditches, swales, pipes, etc.
- ☐ Delineation of all streams, wetlands, lakes, closed depressions, or other water features (including any required buffer widths)
- ☐ Delineation of all flood hazard areas, erosion hazard areas, steep slope hazard areas, landslide hazard areas, and their buffers and building setback lines.

Stormwater Management Information

In addition to the general information listed above, the following additional information is required on drainage plans that include installation of stormwater BMPs:

- ☐ Show delineation and dimensions of impervious surfaces and pervious surfaces, both existing and new.
- ☐ Show location and dimensions of runoff management BMP methods such as, detention ponds and vaults, infiltration trenches, drywells, rain gardens, permeable pavements, rain water storage tanks for managing stormwater from all impervious surfaces.
- ☐ Show delineation and dimensions of the flowpath of stormwater through the site- from the runoff management BMPs, to conveyance BMPs, to end-of-line discharge BMPs.
- ☐ Show setback lengths between stormwater management BMPs and any property line, structure, well, steep slope, stream, wetland, or septic system including drainfields.

Written Drainage Assessment

The written drainage assessment is a supporting document of the small project drainage plan and includes the following information:

- ☐ Property and Project Description:
  - **Property Description**: Describe the natural features of the parcel (i.e. woods, pasture, brush) and give the approximate area covered by those features.
  - **Existing Structures/ Improvements**: List any existing buildings, driveways (dirt, gravel, etc.), sidewalks, etc. and their area size in square feet or acres.
  - **New Structures/ Improvements:** List new buildings and their sizes along with any size changes in existing driveways, parking areas, landscaped areas, etc.
  - **Future Structures/ Improvements Planned**: If you wish to have drainage review waived for future structures/improvements on this parcel, you must list them (with dimensions) in this section. Show their locations on the plot plan.
  - **Remaining Undisturbed Land**: List and provide the size of the land (woods, pasture) not covered by buildings or improvements.
- ☐ Proposed Drainage Plan Narrative: A description of proposed stormwater management BMPs shown on the drainage plan and how they were selected with rationale. Please include details on the impervious surface draining to each BMP, and how each BMP was sized (by table or % coverage). Also include information on the end-of-line discharge and conveyance BMPs used with rationale for their selection.

Declaration of Covenant – Private Stormwater System

A signed and notarized Declaration of Covenant for recording is required for all projects requiring a drainage plan.

Parcel Number:	
Description	**Area (sq.ft.)**
Property description: (wooded, pasture, etc.)	
Existing Structures/ Improvements:	
New Structures and Improvements:	
Future Structures and Improvements:	
Sketch of Proposed Drainage Plan (separate full-sized plan required):	

I hereby certify the information provided above and on the attached plot plan is true and accurate to the best of my knowledge and represents the planned development of the parcel.

Signature of Owner/ Owner's Agent

Date