

**Chapter 4**  
**STORMWATER**

**1. General**

- a. The standards established by this chapter are intended to represent the minimum standards for the design and construction of storm drainage facilities
- b. Drainage control and stormwater quality enhancement shall be provided on all developed property within the City of Port Townsend per these standards, the city's Drainage Ordinance, Stormwater Management Plan and the Environmentally Sensitive Areas Ordinance.
- c. The developer is responsible for obtaining all required local, state and federal permits related to stormwater.
- d. Erosion control requirements covered under Chapter 5 of these standards shall also be required and should be considered in conjunction with this section in designing drainage control.
- e. Every effort shall be made for surface water entering the subject property to be received at the naturally occurring location and surface water exiting the subject property shall be discharged at the naturally occurring location with adequate energy dissipaters to prevent erosion. The discharge rate of flow after development shall not exceed the rate of flow prior to development for the design storm(s).
- f. Surface water exiting the subject property shall be conveyed to the nearest established, stable drainage course by pipe or an approved swale in a manner that will not result in erosion or flooding. Sufficient downstream information and analysis shall be provided to enable the city to determine that this requirement is being met. Private easements will be required if conveyance must occur across private property.
- g. Rooftop drainage shall be addressed for all development projects. In all cases, the method selected will be subject to approval by the Public Works Department, with considerations given to site, soil types, slope conditions, and the nature of the development. The acceptable methods for disposal of rooftop drainage are:
  - i. Discharge to the site's storm drain system (private or public).
  - ii. Discharge to a suitable residential roof downspout on site disposal system.

**2. Minimum Requirements**

- a. All developments shall comply with the DOE *Stormwater Management Manual*, city engineering design standards, city stormwater master plan and adopted drainage basin plans for all clearing and grading activities, for erosion control during construction and for permanent drainage system improvements.
- b. Surface water entering the subject property shall be received at the naturally occurring locations and surface water exiting the subject property shall be discharged at the natural locations with adequate energy dissipaters within the subject property to minimize downstream damage.
- c. All developers shall do the necessary analysis and install the necessary mitigation

measures to insure that stormwater exiting their property is discharged at a safe location which will not impact other property owners.

- d. All structures shall be built such that finished floor elevations are in conformance with Section 1806.4.5 (Foundation elevation) of the Uniform Building Code.
- e. Building plans shall clearly show locations of drainage system and stormwater controls within property limits and any off-site drainage improvements.
- f. Waivers from the requirements of this section may be permitted only after a determination by the public works director, using the stormwater master plan and/or using the following criteria:
  - i. Sufficient capacity of downstream facilities under design conditions;
  - ii. Maintenance of the integrity of the receiving waters;
  - iii. Possibility of adverse effects of retention/detention
  - iv. Utility of regional retention/detention facilities
  - v. Capability of maintenance of the system; and
  - vi. Structural integrity of abutting foundations and structures.

Requests for waivers shall be filed in writing to the Director and shall adequately detail the basis for the request. All developers not providing permanent stormwater control facilities will be required to sign a no-protest agreement for future participation in a stormwater-related LID.

### **3. Drainage Plans - When Required and Content Required**

- a. All persons applying for any of the following permits and/or approvals shall provide a drainage plan for surface and pertinent subsurface water flows entering, flowing within and leaving the subject property both during and after construction:
  - i. Grading permits;
  - ii. Street development permits
  - iii. Substantial development permit required under Chapter 90.58 RCW (Shoreline Management Act);
  - iv. Subdivision approval;
  - v. Short subdivision approval;
  - vi. Construction upon or development of more than one lot of record;
  - vii. Commercial, industrial or multifamily site plan approval;
  - viii. Rezones;
  - ix. Conditional Use Permits;
  - x. Planned unit developments;
  - xi. Building permits, where the permit either: a) authorizes or is for new construction of 40 percent or more square feet of impervious developmental coverage within the property; or b) authorizes or is for new construction which, together with preexisting developmental coverage, would result in 40 percent or more square feet of impervious developmental coverage within the property, or c) is for development within an environmentally sensitive area or which has the possibility of adversely impacting an environmentally sensitive area;

- xii. All construction permits for development in critical flood, drainage, or erosion areas as specified in the ESA ordinance or as determined by the Public Works Director;
- xiii. All projects that involve roadway construction.
- b. All building permits will require that drainage be addressed in the building plans. There are four thresholds for submittals and plan requirements:
  - i. Low Impact Projects - impervious developmental coverage of less than 40 percent within the property not exceeding 5000 square feet impervious surface area,
  - ii. Medium Impact Projects - impervious developmental coverage greater than 40 percent within the property not exceeding 5000 square feet,
  - iii. High Impact Projects - impervious developmental coverage exceeding 5000 square feet or land disturbing activities exceeding one acre, and
  - iv. High Risk Land Uses, as defined below.
- c. Requirements for Submittals and Plans
  - i. Construction plans shall be submitted for review and approval for all storm drain work proposed. There are four categories as described above.
    - (1) Low Impact Projects (less than 40 percent impervious and less than 5000 sq. ft impervious) the following requirements apply:
      - (a) As part of the building permit application, include a scaled drawing showing discharge of roof downspouts, locations of on-site disposal facilities (if proposed), soil infiltration test results (if performed) description of soil amendments or landscaping where proposed for runoff mitigation. If roof downspout tightline discharge is proposed into the public right-of-way or into a public conveyance system, the drawing must clearly indicate outlet locations (from development into public system) and proposed outlet protection or connection.
    - (2) Medium Impact Projects (greater than 40 percent impervious and less than 5000 sq. ft.) the plan submittal requirements as described below in Section 5 Drainage Plans - Contents and Standard Procedures for Medium Impact Projects apply.
    - (3) High Impact Projects (greater than 5000 sq.ft. impervious or greater than one acre land disturbing activities) the following storm drain plan requirements apply:
      - (a) A topographical map shall be submitted by the developer which will indicate the natural drainage patterns of the proposed land development along with the surrounding area. Sufficient adjoining areas shall be included on the map to determine the existing stormwater inflow into the proposed development as well as the areas downstream that will be impacted by the development. The map shall indicate direction of flow, site acreage, tributary acreage,

- the outline of the development, the length of travel and grade of the drainage courses.
- (b) Plans shall be on 24" x 36" sheets with a minimum scale of 1 inch equals 40 feet and may be combined on the plan sheet showing roadway or street improvements.
  - (c) Both plan and profile views of all storm drains must be included.
  - (d) All other utilities existing, or to be constructed, must be shown on plans in a lighter tone.
  - (e) All utility crossings are to be indicated in profile views.
  - (f) Notes must be provided that refer to specific city Standards for such things as catch basins, maintenance holes, grates, restrictors, etc.
  - (g) Plans must indicate elevations for all flow lines, tops of grates or lids, restrictor overflows, orifice sizes, etc.
  - (h) All easements must be shown on plans.
  - (i) General notes required on plans - The following maintenance statement and notes shall be included on site storm drainage plans:
    - (i) All work and materials shall conform to City of Port Townsend Standards and/or WSDOT/APWA Standard Specifications as applicable.
    - (ii) No part of the drainage system shall be covered, concealed or put into use until it has been tested, inspected and accepted by the city.
    - (iii) Approximate locations of existing utilities have been obtained from available records and are shown for convenience. The contractor shall be responsible for verification of locations and to avoid damage to any additional utilities not shown. If conflicts with existing utilities arise during construction, the contractor shall notify the Public Works inspector and any changes required shall be approved by the Public Works Director prior to commencement of related construction on the project.
  - (j) All storm drain work must be staked by survey for line and grade prior to starting construction.
- (4) High Risk Land Uses High risk land uses include practices that may have a significant concentrated effect on water quality. These land uses include but are not limited to fueling stations, auto stores, maintenance shops, car washes, car washes, auto dealerships and businesses that generate soapy or contaminated water as a result of business practices. Additional requirements for

on site treatment and control of stormwater as well as source control practices may apply and shall be determined on a case by case basis. All regulated activities and required designs shall be per the DOE Stormwater Management Manual.

**4. Sites Containing or Adjacent to Environmentally Sensitive Areas**

- a. Environmentally sensitive areas shall be protected and impact mitigated in accordance with Chapter 19 of the PTMC, the ESA manual, these standards, the conditions of final SEPA approval (if applicable), and the following specific requirements:
  - i. On-site stormwater runoff shall be treated by an approved method prior to discharging into a wetland, stream, river, lake, pond, or the Puget Sound.
  - ii. Surface drainage facilities, such as detention ponds, wetponds, vegetated swales, and infiltration basins, shall be located outside of the associated buffers of all wetlands, streams, rivers, lakes or ponds unless the applicant demonstrates (1) no practicable alternative exists and (2) the functions of the buffer or wetland are not adversely impacted.
  - iii. Naturally occurring or mitigation wetlands may not be used for detention of stormwater, greater than pre-development levels, unless the applicant demonstrates that such detention will have no significant effect on the functions and values of the wetland.
  - iv. Development of a site must not adversely affect the hydrology of wetlands located on or adjacent to the site. The quantity and rate of water entering wetlands must be determined for pre-development conditions. After the site is developed, a similar rate and quantity of roof drainage or treated runoff must continue to be discharged to the wetland(s). A characterization of the hydrology of the wetland(s) on or adjacent to this project that may be affected by the development of this site must be submitted to the Public Works Department for review.
  - v. Discharge of water to wetlands should mimic natural discharges as much as is feasible. Where point source discharges do not occur, this type of discharge should be avoided. Techniques that result in dispersed discharge, such as dispersion trenches or buried perforated pipe located at wetland buffer edges, can be used to mimic naturally occurring sheet flow into wetlands.
  - vi. The applicant may be required to submit a hydrologic study completed by a qualified professional demonstrating conformance with the above standards. The applicant may choose to have the City (or agent thereof) perform such a study and reimburse the City for such costs.
  - vii. Delineation of Environmentally Sensitive Areas shall be conducted so as to represent wet season conditions. Determinations where hydrology is the limiting factor may not occur in the dry season.

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**5. Drainage Plan - Contents and Standard Procedures for Medium Impact Projects**

- a. Developments less than 5000 square feet impervious area may use the standard plans referenced in this section. If the project is located in a critical drainage area, in an environmentally sensitive area, or within a site presenting special problems, the plan must address the special circumstances and may require preparation by a licensed civil engineer.
- b. On slopes over 15%, use of infiltration trenches or runoff spreaders are prohibited. Saturation caused by infiltration of stormwater can cause instability and accelerated soil creep.
- c. Two alternative approaches to on site drainage control are available with the standard plans. One alternative uses an infiltration trench system, requiring an on-site perc test. (This perc test as described may be used to fulfill the requirements for Small Parcel submittals as well.) The other alternative uses an enclosed, subsurface detention system, discharging at an acceptable outfall location. Both approaches have several basic requirements in common.
  - i. Basic Requirements: For both approaches, the following requirements must be satisfied:
    - (1) Prepare a dimensioned site plan sketch of the entire property to scale; show north arrow and note scale.
    - (2) Show all locations where concentrated surface water enters the property, the present drainage route through the property, and present discharge from the property. A description of the type and magnitude of flow should be noted on the plan (for example, "intermittent flow during storms in shallow grass swale"). Show all other surface waters.
    - (3) Show locations of all existing and proposed buildings and other impervious surfaces and show their dimensions.
    - (4) For any route of concentrated flow which is to be changed, show the revised route and the type of channel to be provided. Structures are to be set back at least 10 feet from any closed drainage facility and 15 feet from the edge of any channel or pond. Note, also, that structures must be at least one-foot above the maximum water level in the channel. Stream changes require a State Hydraulic permit.
- d. Infiltration System
  - (1) Conduct at least one field perc test where each infiltration trench is to be located (see perc test instructions below). Show the location of the perc test(s) on the site plan, number each location, and note the design perc rate on the plans "Design Data" table.
  - (2) Use the following Table 1, to determine the required trench length(s) for each 1000 square feet of impervious surface and enter the length(s) in the "Design Data" table.
  - (3) Compute the impervious surface area which will drain to each infiltration trench and enter in the plan's "Design Data" table.

- (4) Compute the actual trench length required for the actual amount of impervious area draining to each infiltration trench and enter the numbers in the “Design Data” table.
  - (5) Add the proposed locations of infiltration trench(es) to the site plan. Dimension the trench(es) on the plan and draw them to scale and in the proper locations. The trenches are to be at least 10 feet from buildings and property lines. The trenches must be level, so they must generally follow the land contours. Trenches should generally be placed downslope from any existing or proposed buildings. Please consult Public Works if you have any questions regarding locations of trenches.
  - (6) Complete the plan by
    - (a) Show tight lines: from roof drains to the system catch basin(s); from the footing drains; and from any driveway drains. Roof drains may not be piped into footing drains.
    - (b) Adding any additional notes you want the builder to know.
    - (c) Filling in the title block with required information.
  - (7) Copy the plan and submit 3 copies with your application.
- i. Perc Test Procedure for Infiltration Systems
- (1) Dig a hole with an approximate diameter of 6 inches to a depth equivalent with the bottom of the proposed trench. The standard tool to use is the post-hole digger.
  - (2) After digging the hole, it is important to carefully scratch the bottom and sides of the hole to eliminate any smeared or sealed surfaces. Remove all loose material from the hole, and place two inches of course sand or fine gravel in the bottom. This is to prevent the bottom surface of the hole from being scoured when water is poured into it.
  - (3) Many soils will tend to swell and lose percolation capacity after being wetted for a period of time. The tendency for a soil to swell is dependent on the quantities of clays having a shrink-swell potential. Therefore, it is important that those soils be allowed to swell prior to performing the percolation test.
  - (4) If a soil is comprised almost entirely of sand (the majority of individual grains visible without magnification), soaking is not required.
  - (5) If the soil contains a significant amount of fine material, the hole must be soaked a minimum of 4 hours (continuous soaking for 24 hours is preferred). The soaking may require periodic addition of water. Percolation measurements are made 24 hours after the start of the soaking period.
  - (6) After soaking, the percolation rate is to be measured by one of the following methods:
    - (a) If water remains in the test hole, add or remove water so

- the water level is six inches above the gravel. Carefully measure the drop in water level over a 30 minute period. Use this data to calculate the perc rate in minutes per inch.
- (b) If no water remains in the hole after the soaking period, add water to six inches above the gravel. Measure the drop in water over a 30 minute period. Use this data to calculate the percolation rate in minutes per inch.
  - (c) If more than 2.5 inches of water drains out within 30 minutes, disregard the previous results. Retest by adding water to six inches above the gravel. Then measure the time it takes for the water to drop 2 inches and calculate the perc rate in minutes per inch.
- (7) It is important to use a six inch diameter hole for the perc tests. Other sizes need to be mathematically adjusted.

TABLE 1 INFILTRATION TRENCH LENGTH	
Perc Rate (minutes per inch)	Trench Length (feet) (Per 1000 square feet of contributing area)
1	15 (minimum)
2	18
3	21
4	24
5	26
6	28
7	29
8	30
9	31
10	32
11	33
12	34
13	34
14	35
15	35

e. Detention System

- (1) Add the proposed location of the underground detention pipe to the site plan (must be downhill from the impermeable surfaces which are to drain to it).
- (2) Select the outflow location (must be downhill from the detention pipe outlet):
  - (a) Where a well defined drainage channel drains the area to be developed, direct the outflow pipe to that channel provided the pipe and the channel at the discharge location are within the property.

- (b) Where a public storm drain or public drainage ditch is within or adjacent to the property, direct the outflow pipe to these facilities. Note that a catch basin is normally required where pipes connect.
  - (c) Where neither of the previous situations exists, perc tests must be performed to assess the feasibility of using the infiltration system. The infiltration system should be used where feasible. If this system is not feasible the detention system outflow must be dispersed over the natural discharge area(s) using runoff spreader(s).
- (3) Compute the impermeable surface area which will drain to the detention system and enter on the “Design Data” table.
  - (4) Choose a detention pipe diameter and find the required detention pipe length for impermeable surface area using Table 2. Enter the pipe diameter and length on the “Design Data” table.
  - (5) Find the required outlet orifice size for the impermeable surface area using Table 3. Enter the outlet orifice size on the “Design Data” table.
  - (6) Complete the plans by:
    - (a) Showing tight lines from roof drains to the system catch basin(s); from the footing drains; and from any driveway drains. Roof drains may not be piped into footing drains.
    - (b) Adding any additional notes you want the builder to know.
    - (c) Add either the runoff spreader detail or the system outlet detail, depending on which one is planned for use.
    - (d) Filling in the title block with required information.
  - (7) Copy the plan and submit 3 copies with your application.

Table 2 Detention Pipe Lengths (in feet)						
Impermeable Area (sq. ft.)	Required Volume (cu. ft.)	Pipe Diameter				
		12"	15"	18"	24"	30"
2000	50		40	28	16	10
2500	62		50	35	20	13
3000	75		60	42	24	15
3500	87		70	49	28	18
4000	100		80	56	32	21
4500	112		90	63	36	23
5000	125		100	70	40	25

Outlet Orifice Sizes	
Impermeable Area (sq. ft.)	Outlet Orifice Diameter (inches)
2000	5/8
2500	5/8
3000	3/4
3500	3/4
4000	7/8
4500	7/8
5000	7/8

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**6. Drainage Plan Contents for High Impact Projects**

- a. For development creating more than 5000 sq. ft. of impervious surface area, or greater than one acre of disturbance, the minimum requirements as outlined in the DOE Stormwater Management Manual apply. Thresholds for new and redevelopment as described in the SWMM will be used to determine plan requirements. In general, the two major components of a large parcel drainage plan are an erosion and sediment control plan (see Chapter 5) and a Permanent Stormwater Quality Control Plan. All large parcels must conform to the DOE SWMM Minimum Requirements 2-11 (SWMM Chap I-2) for submittal of PSQAs.
- b. Stormwater Quantity Control Requirements for plan submittal. The City of Port Townsend will use the runoff control requirements as described in the DOE SWMM Minimum Requirement #5 Chap I-2.9 limiting discharge from the site for all large parcels. These requirements are discussed in the next section Design Standards for Large Parcels. In general, the following computations and information are required for submittal of a Large Parcel Drainage Plan.
  - i. Background computations for sizing drainage facilities:
    - (1) Depiction of the drainage area on a topographical map of approved scale and contour interval, with acreage of the site, development, and developmental coverage indicated.
    - (2) Indications of the peak discharge and volume of surface water currently entering and leaving the subject property due to the design storm.
    - (3) Indication of the peak discharge and volume of runoff which will be generated due to the design storm within the subject property if the development or proposed activity is allowed to proceed.
    - (4) Determination of the peak discharge and volume of water that will be generated by the design storm at various points on the subject property.
  - ii. Proposed measures for handling the computed runoff:
    - (1) The design storm peak discharge from the subject property may not be increased by the proposed development.
    - (2) Retention/detention facilities must be provided in order to maintain surface water discharge rates at or below the existing design storm peak discharge.
  - iii. Proposed measures for controlling runoff during construction:
    - (1) See Chapter 5 - Clearing, Grading and Erosion Control, for requirements.
- c. The following General Conditions and those in Chapter 1- Section 8 shall be included on any plans dealing with stormwater/storm drainage systems when a permit is required.
  - (1) All storm drain mains shall be high velocity cleaned and low pressure tested in accordance with WSDOT/APWA Specifications

- prior to final paving.
- (2) Prior to backfilling, all storm drains and appurtenances shall be inspected and approved by the city's inspector. Approval shall not relieve the owner and contractor for correction of any deficiencies and/or failure as determined by subsequent testing and inspections. It shall be the contractor's responsibility to notify the city for the required inspections.
  - (3) Special structures, oil/water separators and outlet controls shall be installed per plans and manufacturer's recommendations.
  - (4) The city construction inspector shall be notified a minimum of 48 hours in advance of a tap connection to an existing storm main. The inspector shall be present at the time of the tap.
- d. Common detention, water quality treatment and conveyance standards are included in the following section General Design Standards. This section is not meant to replace or supersede those requirements of the DOE SWMM. It is meant to aide the designer in completion of plans for the more common facilities. Should any of these standards conflict with those of the DOE SWMM, the Director of Public Works or his/her designee shall use their professional judgment in determining which standard shall prevail.

## 7. General Design Standards for High Impact Projects

- a. Design Storm Criteria
  - i. Stormwater Discharge Rates: The water runoff from the site shall be limited to the peak rate of runoff from the individual development sites to 50 percent of the existing 2-year, 24-hour design storm while maintaining the existing conditions peak runoff rate for the 10-year, 24-hour and 100-year, 24-hour design storms.
  - ii. Retention/Detention Facilities:
    - (1) Retention/detention facilities will be required as needed to achieve the discharge standards as described above.
    - (2) No retention/detention facility shall be located in an area that is used to satisfy an open space requirement, without prior approval. Facilities that enhance a recreational amenity or are located underground may be acceptable.
    - (3) Retention/detention facility design and volume calculation shall be in accordance with Chapter III-4 of the DOE Stormwater Management Manual. Retention/detention discussed in this chapter will be applied by the City Engineer on a case by case basis where water quantity control is required for streambank erosion control or inadequate downstream facilities.
  - iii. Stormwater Conveyance Systems: Stormwater or storm drainage conveyance systems shall be designed for a 25-year design storm event. (See DOE Stormwater Management Manual, Chapter III-2, for guidance)
    - (1) While the method of calculation and the responsibility for adequate

sizing of the facility rests with the engineer involved, the criteria that the city will use to judge the adequacy of the facility are based upon the minimum computational standards contained in Chapter III-1, Hydrologic Analysis, of the DOE Stormwater Management Manual.

- (2) The infiltration rate shall be based upon soils investigation and analysis for the proposed infiltration area. Any testing shall be conducted so as to represent antecedent saturated soil conditions. Test results shall accompany storm calculations. Such testing shall be performed by a qualified engineer or septic system designed certified by Jefferson County. (See DOE Stormwater Management Manual Chapter III-3, for guidance)

iv. Closed Depression Analysis:

- (1) The analysis of closed depressions requires careful assessment of the existing hydrologic performance in order to evaluate the impacts a project may have. The design of facilities within a closed depression shall conform to the DOE SWMM III-1.5
- (2) More stringent standards for conveyance, retention/detention and off-site analysis may be required on a case by case basis.
- (3) Typical event simulation models used in hydrologic analysis may not be adequate to assess the impacts of development within a closed depression. The Director may determine that a continuous simulation model is required to fully assess the impacts of the development. The applicant may employ the option of having the City (or an agent thereof) complete the study and reimburse the City for such costs.

## 8. Easements

- a. When a closed system is used to handle drainage within the subject property, all structures must be a minimum of 10 feet from the system.
- b. There shall be a minimum drainage easement of 15 feet in width for publicly maintained open channel or closed system installations.
- c. No structures shall be erected within any drainage easement. Construction of a fence across an easement is allowed provided a 15-foot wide access gate is provided.
- d. All easements, except for special circumstances, shall be located to run within single lots rather than being split by a lot line.
- e. The minimum width of an access way from an established city street to a drainage facility shall be 15 feet.

## 9. Drainage Facilities

- a. General Requirements
  - i. Drainage facilities include those facilities designed to provide stormwater conveyance, quantity control, and/or water quality enhancement. These

- facilities can be surface facilities, or underground facilities.
  - ii. All surface drainage and stormwater quality enhancement facilities (including detention ponds, wetponds, vegetated swales, and infiltration basins) shall be landscaped so as to provide slope stability and a pleasant appearance by utilizing sodding and/or seeding. Under no circumstances shall the use of materials that may be eroded or floated easily (such as beauty bark) be permitted in surface ponds or basins, or vegetated swale interiors. Trees and/or shrubbery shall not be planted on detention or wetpond raised berms, but are acceptable for the upper slopes of excavated ponds (below ground level).
- b. Topsoil Requirements
- i. Topsoil used in constructing drainage facilities such as vegetated swales and wetponds shall meet the Standard for Topsoil A, as specified in WSDOT/APWA Standard Specifications Section 9-14.1(1) with the following modifications: 100% of the topsoil shall pass through a 1/2 inch sieve.
  - ii. The following are important excerpts from WSDOT/APWA Standard Specifications Section 9-14.1(1), with city modification.
  - iii. Topsoil shall be free from materials toxic to plant growth, noxious weeds, rhizomes, roots, subsoil, stones, and other debris.
  - iv. Topsoil Type A shall consist of a sandy clay loam, sandy loam, loam, clay loam, silty clay loam, or silt loam soil. The mix may not be more than 50% sand or 20% clay. Total organic matter shall be 1% to 10%. A maximum of 20% of the mix volume may be retained on a 1/4" sieve.
- c. Fencing Requirements
- i. The City of Port Townsend prefers designs which minimize the need for fencing around stormwater facilities. Ponds and basins with a maximum design depth of water greater than three feet will not require perimeter fencing if one of the following conditions is met:
    - (1) The facility is designed and constructed with a 10 foot wide safety bench for every three feet of depth, the interior side slopes are no greater than 3 horizontal to 1 vertical and the perimeter is planted with rosebush or another natural hedge to discourage entry into the pond; or
    - (2) The facility is designed and constructed so that the maximum water depth of the facility does not exceed 3 feet during a 2 year, twenty-four hour storm nor exceed 3 feet during a twenty-five year, twenty-four hour storm for a maximum of 4 hours; the maximum side slope of the facility does not exceed three horizontal to one vertical; and the perimeter is planted with rosebush or another natural hedge to discourage entry into the pond; or
    - (3) The city council reviews a proposed facility designed and approved by a licensed engineer or architect which meets neither

the requirements of the above two conditions herein and exercising its discretion makes a policy determination that either no fencing will be required or fencing less than 6 feet in height will be required. Issues considered by the council when making this determination include but are not limited to: (1) reasons why the proponent does not want to construct a fence 6 feet in height; (2) purpose(s) the facility is to serve; (3) design considerations of the facility; (4) safety considerations of the facility without the fencing or with fencing reduced in height; and (5) such additional issues as the council feels are appropriate.

- ii. Surface ponds and infiltration basins with a maximum depth of 3 feet or less will not require fencing provided the maximum interior side slope of the pond does not exceed three horizontal to one vertical. A natural hedge of rosebushes or other shrub should be planted to discourage entry into the pond.
  - iii. All ponds or basins determined not to require fencing will require signage warning the public against swimming and ice skating as well as flood conditions.
  - iv. All ponds or basins with a maximum depth of water greater than three feet that do not meet one of the above conditions will require a six foot high perimeter fence. When fencing is required around a facility to be dedicated to and/or maintained by the city, the fence shall be a 6 foot high chain link fence with thermally bonded, not sprayed or dipped on, polyvinyl chloride (PVC) coating. The PVC coating shall not be subject to fading, cracking, peeling, or shrinkage and shall be brown, black, or some shade of natural green (such as pine, forest, or olive). The fence manufacturer shall provide a 15 year (minimum) warranty on the chainlink fence and the PVC coating.
  - v. Fencing slats will be allowed, subject to the same color restrictions as the PVC coating, if the slats proposed are non-brittle, crack-resistant, locked in place in a bottom retaining channel, and non-fading.
  - vi. The chainlink fence shall meet all applicable specifications set forth in the WSDOT/APWA Standard Specifications.
- d. Berm Requirements
- i. All berms or embankments constructed for surface ponds and basins shall be compacted to at least 95% of the maximum relative density in lifts not to exceed 6 inches in depth.
  - ii. Berm soils shall consist of material conforming to the following gradation:
 

<u>Sieve Size</u>	<u>% Passing</u>
3"	100
#4	65-90
#200	12-20

**10. Wetponds**

- a. General
  - i. The City of Port Townsend prefers wetponds to dryponds as they provide both detention and water quality treatment. The term “wet” pond comes from the fact that the bottom of the pond of standing water in a wetpond. In addition to this permanent storage volume in the wetpond, the outlet from the pond is typically restricted to provide additional live storage for shorter term treatment during storms.
  - ii. Wetponds shall be designed in accordance with these standards and the DOE Stormwater Management Manual, and shall be prepared by a licensed engineer.
  - iii. Wetponds shall be designed to have at least two cells. At the inlet to the wetpond, a deep water area, called the open water cell, is provided to encourage settling of sediments associated with stormwater. From the open water cell, the water flows to a shallow area planted with wetland vegetation called the wetland treatment cell. See Standard Details for illustration. As an alternative to providing an open water cell, an equivalent volume of water may be provided as dead storage in a wet vault. This alternative has the advantage of requiring less surface area, results in a more pleasing pond appearance, and often eliminates the need for fencing.
- b. Design Criteria
  - i. Wetponds shall be sized in accordance with the DOE SWMM requirements.
  - ii. A flow restricting device at the wetpond outlet shall be provided so that the discharge rate from the pond is at a rate no higher than predevelopment levels.
  - iii. Pretreatment shall be provided upstream of the wet pond.
  - iv. A planting schedule for the wetland treatment cell shall be provided for approval by the city.
- c. Construction requirements
  - (1) Over-excavate the wetland treatment cell by a minimum of 6 inches as compared to final grade. After the treatment cell area has been graded, roughen the bottom and sides of the treatment cell by raking and place topsoil (a minimum of 6 inches) to bring the bottom elevation to final design grade.
  - (2) Sod or hydroseed the treatment cell banks immediately after the topsoil has been placed. If sod is used, lay sod to a minimum of 1 foot of vertical depth above the bottom of the treatment cell. Lay the sod pieces with their long axis perpendicular to the direction of flow in the cell and stagger the pieces to avoid a continuous longitudinal seam in the bottom of the cell.
  - (3) To plant the required wetland vegetation, punch holes in the sod with a bar or stake approximately equivalent to the diameter of the

plants' root wads. Insert the plants in the holes and tamp the sod and earth down around the plants. Locate the plants in the bottom of the treatment cell only and in a staggered pattern - not in a straight line.

- d. Approval of Wetpond Design Calculations
  - i. The following information shall be submitted for review and approval of wetpond design:
    - (1) Wetpond sizing calculations, including calculation of wetpond design volume, wetpond permanent volume, and design volumes for the wetland treatment cell and open water cell.
    - (2) Orifice sizing calculations.
    - (3) Stage-storage relationship of the pond.
    - (4) Results of routing the design storm through the pond, showing at a minimum the inflow hydrograph, outflow hydrograph, and the storage volume required.
    - (5) The wetland treatment cell planting schedule.
    - (6) The type of vegetation to be planted in the wetland treatment cell, the planting locations of different species, the density of the plantings, and the total number of plants needed.
    - (7) Location of fence, if required, and gates for access to the pond.
  - ii. Restrictor Design
    - (1) Restrictors for detention systems shall be constructed and installed per the Standard Details. Multiple orifice restrictors will be required where the detention system is designed based on a pre-development storm return frequency of 5 years or greater, or on large sites.

## 11. Vegetated Swales

- a. General
  - i. Vegetated swales may be used for treatment and conveyance.
  - ii. Two classes of vegetated swale shall be defined according to the slope of the swale. A swale with a slope of 2-4% is designated a grass swale. A swale with a slope of less than 2% is designated an emergent swale.
  - iii. Vegetated swales shall not be located where they will be subject to heavy and prolonged shading.
  - iv. Swale design shall be in conformance with the DOE Stormwater Management Manual or Biofiltration Swale Performance, Recommendations, and Design Considerations (Municipality of Metropolitan Seattle, 1992) and plans shall be prepared by a licensed engineer and submitted to the City for review and approval.
- b. Design Criteria
  - i. Vegetated swales shall be designed to provide a minimum hydraulic residence time of 9 minutes for the peak runoff flow rate from the 2 year, 24-hour storm.

- ii. Swales shall be designed and constructed with a trapezoidal cross section. Bottom widths shall range from 1 to 8 feet, and the sides of the swale shall have a maximum slope of 3:1 (horizontal:vertical).
  - iii. The maximum allowable velocity in vegetated swales shall be 0.9 feet per second.
  - iv. The maximum allowable longitudinal slope for vegetated swales shall be 4%.
  - v. The swale inlet shall be designed to provide energy dissipation and to uniformly distribute flow at the head of the swale.
  - vi. Swales located in the public right-of-way, parallel to roadways, shall have a minimum bottom width of 2 feet and shall have side slopes no steeper than 5:1 (horizontal:vertical).
  - vii. Vegetated swales shall be designed and constructed with a minimum of 0.5 feet of free-board above the maximum design depth.
  - viii. The entire associated side slope of the swale, from the bottom of the swale to the top of the adjacent bank, shall have a maximum slope of 3:1 (horizontal:vertical) unless rockeries or retaining walls are used.
  - ix. Neither rockeries nor retaining walls shall be designed to provide the required swale free-board depth. Therefore, for a swale with 3:1 side slopes, a retaining wall or the base of a rockery must be a minimum of 1.5 feet (horizontal distance) beyond the high water mark in the swale.
- c. Planting Requirements for Vegetated Swales
- i. A cover material shall be established in both grass and emergent swales and shall be over-seeded with the seed mix as recommended in the DOE SWMM or Metro Study. Five pounds of seed shall be applied per every 1,000 square feet of swale bottom.
  - ii. Emergent swales shall be planted with wetland vegetation. The species to be used are recommended in the DOE SWMM or the Metro study. Four separate species shall be planted, at a frequency of 25 plants of each species per every 100 square feet of swale (for an overall density of one plant per square foot of swale bottom). Weedy and invasive species such as cattail, purple loosestrife, reed canarygrass and giant reed should be avoided.

**Seed Mix for Grass and Emergent Swales**

<u>Grass Species</u>	<u>Percentage by Weight</u>
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**Option 1**

Meadow Foxtail ( <i>Alopecurus pratensis</i> )	40%
Alta Fescue ( <i>Festuca pratensis</i> )	25%
Redtop Bent Grass	20%

( <i>Agrostis alba</i> )	
Red Fescue	10%
( <i>Festuca rubra</i> )	
Birdsfoot Trefoil	5%
( <i>Lotus corniculatus</i> )	

**Option 2** (from Municipality of Metropolitan Seattle, Biofiltration Swale Performance, Recommendations, and Design Considerations, Publication 657, October 5, 1992)

Tall fescue	67%
Seaside bentgrass	16%
Meadow foxtail	9%
Alsike clover	6%
Marshfield bit trefoil	1%
Inert matter	1.5%
Weed seed	0.5%

d. Vegetated Swale Construction

i. General Considerations

- (1) Vegetated swales should be constructed early in the construction sequence in order to give vegetation a chance to establish before the swales are necessary as a part of the permanent storm drainage system. As a general rule, silt-laden construction runoff should not be routed through completed vegetated swales.
- (2) If vegetated swales are used as a component of the temporary erosion control plan, they shall be graded to final specification and sodded before receiving construction runoff. After construction on the site has been completed, all dead or dying sod, or sod covered with silt, shall be removed and replaced. If construction ends in the winter, when newly planted sod would not be expected to survive, accumulated sediment can be hand removed from the swale and dead and dying sod replaced at the beginning of the growing season. Wetland plants required for emergent swales should not be planted in the swale until the swale has been re-sodded after construction ends.
- (3) To prevent the swale from becoming a sediment source, it must be stabilized immediately after it has been graded. The recommended method for providing immediate swale stabilization and pollutant removal ability is to sod the swale per the construction requirements below. Alternatively, swales may be seeded during the summer months, May 15 to September 15. The proponent will be responsible for establishment of sufficient cover vegetation to provide for erosion control.

- (4) Wetland plants ideally should be planted between October 15 and March 15. A bond may be required from the contractor to ensure the viability of the plants.
  - (5) Provide irrigation as necessary to assure establishment of planting.
- e. Maintenance Requirements
- i. Swales may require irrigation during dry summer months and during establishment of vegetation, especially emergent swales.
  - ii. Viable vegetation is important to the function of the swale and dead or unhealthy vegetation shall be replaced as necessary. Appropriate maintenance shall be performed to ensure healthy vegetation. Accumulations of sediment in the bottom of swales that cover vegetation or reduce the swale's capacity shall be removed. Accumulated sediments shall be removed by hand, with a flat bottom shovel, during summer months. Bare areas shall be re-seeded immediately.
  - iii. Regular mowing for grass lined swales is important for both the viability of the vegetation and for water quality treatment. Grass height should be maintained above the design flow level. Grass clippings shall be removed from the swale.
- f. Approval of Vegetated Swale Design Calculations
- i. The following information shall be submitted for review and approval of vegetated swale design calculations and plans:
    - (1) Design flow calculations
    - (2) Velocity and flow depth calculations
    - (3) The hydraulic residence time in each vegetated swale.
    - (4) Bypass sizing calculations
    - (5) A copy of site plan showing the contributing area
    - (6) The proposed seed mix and wetland plant list.
    - (7) The vegetated swale construction.
    - (8) Elevations in the bottom of the swale at the head of the swale, at the swale outlet, and at approximately 50-foot intervals along the length of the swale.

## 12. Piping

- a. General
- i. All pipe joints shall be rubber gasketed. Culverts which flow under driveways from one open ditch to another, with a maximum length of 100 lineal feet may be mortar joint pipe.
  - ii. The minimum velocity in any pipe or culvert carrying the design storm flow shall be 2 feet per second, except for pipe installed as equalizers or a direct part of the detention system.
  - iii. The maximum allowable velocity in concrete pipe shall be 30 feet per second.
  - iv. A catch basin or maintenance hole will be required at all changes in storm drain diameters and changes in grade or alignment.

- v. Storm drain pipes installed in easements shall be constructed as nearly as possible in the center of the easement, but in no case shall the pipe be within 5 feet of any structure or property line.
  - vi. Any closed storm drain system collecting runoff from paved areas in the public right-of-way or private property shall provide for floatable material separation prior to discharge to the main storm drain system in the public right-of-way unless otherwise approved by the Public Works Director.
- b. Pipe Materials
- i. Pipe materials, joints and protective treatments shall conform to the requirements set forth in WSDOT/APWA Standard Specifications Section 9-05. The pipe materials and specifications included below are for conveyance systems installed for development and construction in the City of Port Townsend. The use of other pipe materials on private property that are not part of the drainage system requirements are not excluded from use provided they are installed and maintained by the private property owner.
  - ii. Pipe materials that are allowed for use in storm drainage systems in the City of Port Townsend are as follows:
    - (1) Plain concrete pipe (12 inches diameter only and used only for driveway culvert).
    - (2) Reinforced concrete pipe.
    - (3) Ductile iron pipe.
    - (4) Galvanized corrugated iron or steel pipe, treatment 1 through 6.
    - (5) PVC pipe (SDR35, ASTM D3034 with minimum 3 feet of cover).
    - (6) Corrugated high density polyethylene pipe, with smooth interior.
  - iii. Coupling bands shall be of the same material as the pipe. Gaskets will be required for all underground detention systems.
- c. Sizing
- i. No storm drain pipe between catch basins or maintenance holes in the public right-of-way shall be less than 12 inch diameter, with the exception that an 8 inch culvert may be used between inlets and catch basins in runs of 50 feet or less. Storm drainage pipe in the public right-of-way will be sized for a 10 year storm. In areas of high potential for flooding on private property, a 25 year design storm shall be used.
  - ii. Debris barriers (trash racks) may be required on culvert inlets, when in the opinion of the Public Works Director circumstances warrant the elimination of miscellaneous flowing debris.

### **13. Maintenance Holes, Inlets, and Catch Basins**

- a. Description
  - i. This work shall consist of constructing maintenance holes, inlets and catch basins of the types and sizes designated in accordance with the plans, these specifications, the Standard Plans, and WSDOT/APWA Standard Specifications Section 7-05.

b. Materials

i. Materials shall meet the requirements of the following sections of the WSDOT/APWA Standard Specifications:

<u>Item</u>	<u>Section</u>
Concrete	6-02
Rubber Gaskets	9-04.4
Metal Castings	9-05.15
Reinforcing Steel	9-07
Masonry Units	9-12

ii. Maintenance holes, catch basins and inlets shall be constructed of pre-cast units in accordance with the Standard Details.

iii. Construction Requirements

- (1) The cover or grating of a maintenance hole or catch basin shall not be grouted to final grade until the final elevation of the pavement, gutter, ditch, or sidewalk in which it is to be placed has been established, and until permission thereafter is given by the engineer to grout the cover or grating in place. Covers shall be seated properly to prevent rocking.
- (2) The maximum spacing between catch basins shall not exceed 300 feet. For roadways wider than 48 feet, the spacing shall not exceed 200 feet. Catch basin spacing based on percent of roadway grade is as follows:

<u>Percent Grade</u>	<u>Maximum Spacing</u>
0.5-1.5	150 feet
1.5-3.0	200 feet
3.0-8.0	300 feet
8.0-12.0	200 feet
12.0-20.0	150 feet

- (3) Concrete inlets shall not be used where discharge pipe goes directly into main storm drain system. In cases where direct discharge into storm drain system is called for, a floatable material separator will be required.
- (4) Except as otherwise approved, all manholes, catch basins, or inlets more than 5-1/2 feet of depth from the pipe invert to the grate shall be provided with a ladder.
- (5) Storm drain maintenance holes and Type 2 catch basins functioning exclusively as access structures shall be equipped with round 24 inch covers and frames. Round lids on all storm drain structures shall have "Drain" cast into the lid.
- (6) All catch basins and maintenance holes not in a paved area shall be equipped with locking frames and lids or grates.
- (7) All PVC connections to catch basins or maintenance holes shall be made by grouting in an approved maintenance hole adapter into

- which the PVC pipe is inserted.
- (8) In conditions when the effectiveness of a normal grate installation would be limited, an open grate face inlet frame and grate shall be furnished and installed. These conditions usually occur due to high likelihood of clogging from leaf fall, especially in sag vertical curves; when the inlet is a surface drainage end point, such as a cul-de-sac and when the road grade is such that normal inlet grates are passed over during storms. The use of open curb face frame and grates must be approved by the Public Works Director.
  - (9) All Type 2 catch basins and all maintenance holes with catches shall be supplied with locking lids or grates.
- iv. Maintenance
- (1) Accumulated sediments shall be removed from maintenance holes and catch basins when accumulated sediment reaches a depth of 6 inches or more.

#### **14. Trash Racks**

- a. General
  - i. Trash racks are provided on pipe inlets and outlets to and from surface drainage facilities to prevent plugging of the opening with debris and to provide safety to the public. In the City of Port Townsend, all such pipes 12 inches in diameter or larger shall be equipped with a trash rack for public safety. Smaller pipes shall be equipped with trash racks when plugging with debris is perceived to be a potential problem.
- b. Design Criteria
  - i. A net area of trash rack not less than 20 to 40 times the area of the outlet shall be provided for outlets with a 6 inch or less diameter.
  - ii. For outlets 24 inches in diameter or larger, a net area of trash rack not less than four times the area of the outlet shall be provided.
  - iii. The spacing between the openings of the trash rack shall be 6 inches or less, or smaller than the smallest dimension of the outlet.
  - iv. All trash racks shall be sloped at 30 to 50 degrees above the horizontal.
  - v. A 4 to 6 inch horizontal opening at the bottom of the trash rack may be provided on larger outlets to allow smaller debris to flush straight through.