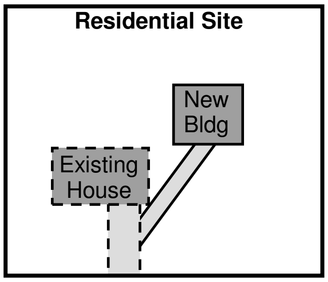
[1] *Maintenance* means those usual activities taken to prevent a decline, lapse, or cessation in the use of currently serviceable structures, facilities, equipment, or systems if there is no expansion of the structure, facilities, equipment, or system and there are no significant hydrologic impacts. Maintenance includes the repair or replacement of non-functional facilities and the replacement of existing structures with different types of structures, if the repair or replacement is required to meet current engineering standards or is required by one or more environmental permits and the functioning characteristics of the original facility or structure are not changed. For the purposes of applying this definition to the thresholds and requirements of this manual, DDES will determine whether the functioning characteristics of the original facility or structure will remain sufficiently unchanged to consider replacement as maintenance.

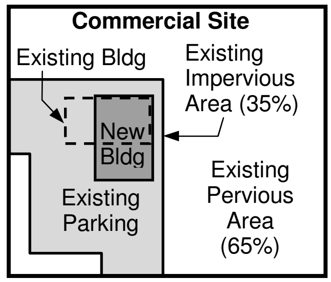
[2] *Development* means any activity that requires a permit or approval, including, but not limited to, a building permit, grading permit, shoreline substantial development permit, conditional use permit, special use permit, zoning variance or reclassification, subdivision, short subdivision, urban planned development, binding site plan, site development permit, or right-of-way use permit. "Development" does not include a Class I, II, III, or IV-S forest practice conducted in accordance with Chapter 76.09 RCW and Title 222 WAC or a class IV-G nonconversion forest practice, as defined in KCC 21A.06, conducted in accordance with Chapter 76.09 RCW and Title 222 WAC and a county approved forest management plan.

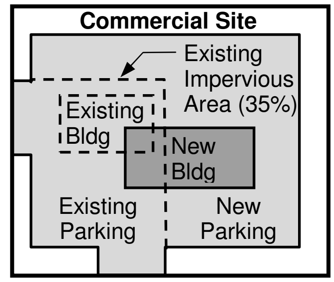
[3] *Subject to vehicular use* means the surface, whether paved or not, is regularly used by motor vehicles. The following surfaces are considered regularly used by motor vehicles: roads, unvegetated road shoulders, bike lanes within or not separated from the traveled lane of a roadway, driveways, parking lots, unfenced firelanes, diesel equipment storage yards, and airport runways. The following surfaces are not considered regularly used by motor vehicles: road shoulders primarily used for emergency parking, paved bicycle pathways, bicycle lanes adjacent to unpaved or paved road shoulders primarily used for emergency parking, fenced firelanes, and infrequently used maintenance access roads.

[4] *Erodible or leachable materials, wastes, or chemicals* are those substances that, when exposed to rainfall, measurably alter the physical or chemical characteristics of the rainfall runoff (examples include erodible soil, uncovered process wastes, manure, fertilizers, oily substances, ashes, kiln dust, garbage dumpster leakage, etc.).

[5] A covered parking area would be considered pollution-generating if runoff from uphill could regularly run through it, or if rainfall could regularly blow in and wet the pavement surface. The same parking area would not be included if it were enclosed by walls or if a low wall and berm prevented stormwater from being blown in or from running onto the covered area.







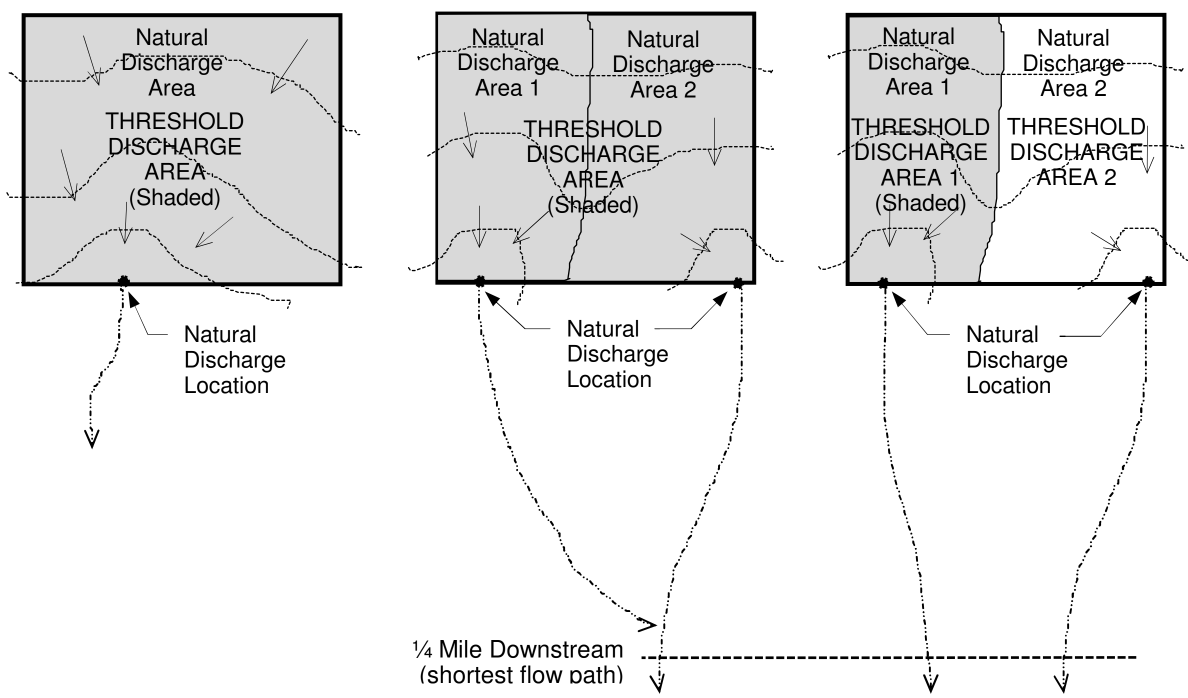
---

[6] *Finished floor area*, for the purposes of defining ***severe building flooding problem***, means any enclosed area of a building that is designed to be served by the building's permanent heating or cooling system.

[7] *Habitable building* means any residential, commercial, or industrial building that is equipped with a permanent heating or cooling system and an electrical system.

[8] *Roadway*, for the purposes of this definition, means the traveled portion of any public or private road or street classified as such in the *King County Road Standards*.

[9] *Sole access driveway* means there is no other unobstructed, flood-free route for emergency access to a habitable building.


Natural
Discharge
Area
THRESHOLD
DISCHARGE
AREA
(Shaded)
Natural
Discharge
Location
Natural
Discharge
Area 1
Natural
Discharge
Area 2
THRESHOLD
DISCHARGE
AREA
(Shaded)
Natural
Discharge
Location
Natural
Discharge
Area 1
Natural
Discharge
Area 2
THRESHOLD
DISCHARGE
AREA 1
(Shaded)
THRESHOLD
DISCHARGE
AREA 2
Natural
Discharge
Location
¼ Mile Downstream
(shortest flow path)

Guide to Using Section 1.1

The following steps are recommended for efficient use of Section 1.1:

1. Determine whether your proposed project is subject to the requirements of this manual by seeing if it meets any of the **thresholds for drainage review** specified in Section 1.1.1 (p. 1-9). Making this determination requires an understanding of the key terms defined at the beginning of this chapter.
2. If drainage review is required per Section 1.1.1, use the flow chart in Figure 1.1.2.A (p. 1-11) to determine what **type of drainage review** will be conducted by DDES. The type of drainage review defines the scope of drainage requirements that will apply to your project as summarized in Table 1.1.2.A (p. 1-12).
3. Check the more detailed threshold information in Section 1.1.2 (beginning on page 1-10) to verify that you have determined the correct type of drainage review.
4. After verifying the type of drainage review, use the information in Section 1.1.2 to determine which **core requirements** (found in Section 1.2) and which **special requirements** (found in Section 1.3) must be evaluated for compliance by your project. To determine how to comply with each applicable core and special requirement, see the more detailed information on these requirements contained in Sections 1.2 and 1.3 of this chapter.

Note: For Steps 2 through 4, it is recommended that you arrange a predesign meeting with DDES permit review staff to confirm the type of drainage review and scope of drainage requirements that apply to your proposed project.

King County Permits and Approvals

[10] The thresholds for ***new impervious surface*** and ***land disturbing activity*** shall be applied by ***threshold discharge area*** and in accordance with the definitions of these surfaces and activities.

[11] See Reference Section 3 for a list of ***Critical Drainage Areas***.

[12] This is the "project valuation" as declared on the permit application submitted to DDES. The dollar amount of this threshold is considered to be as of January 8, 2001 and may be adjusted on an annual basis using the local consumer price index (CPI). *Note: January 8, 2001 is the effective date of the ESA 4(d) Rule for Puget Sound Chinook salmon.*

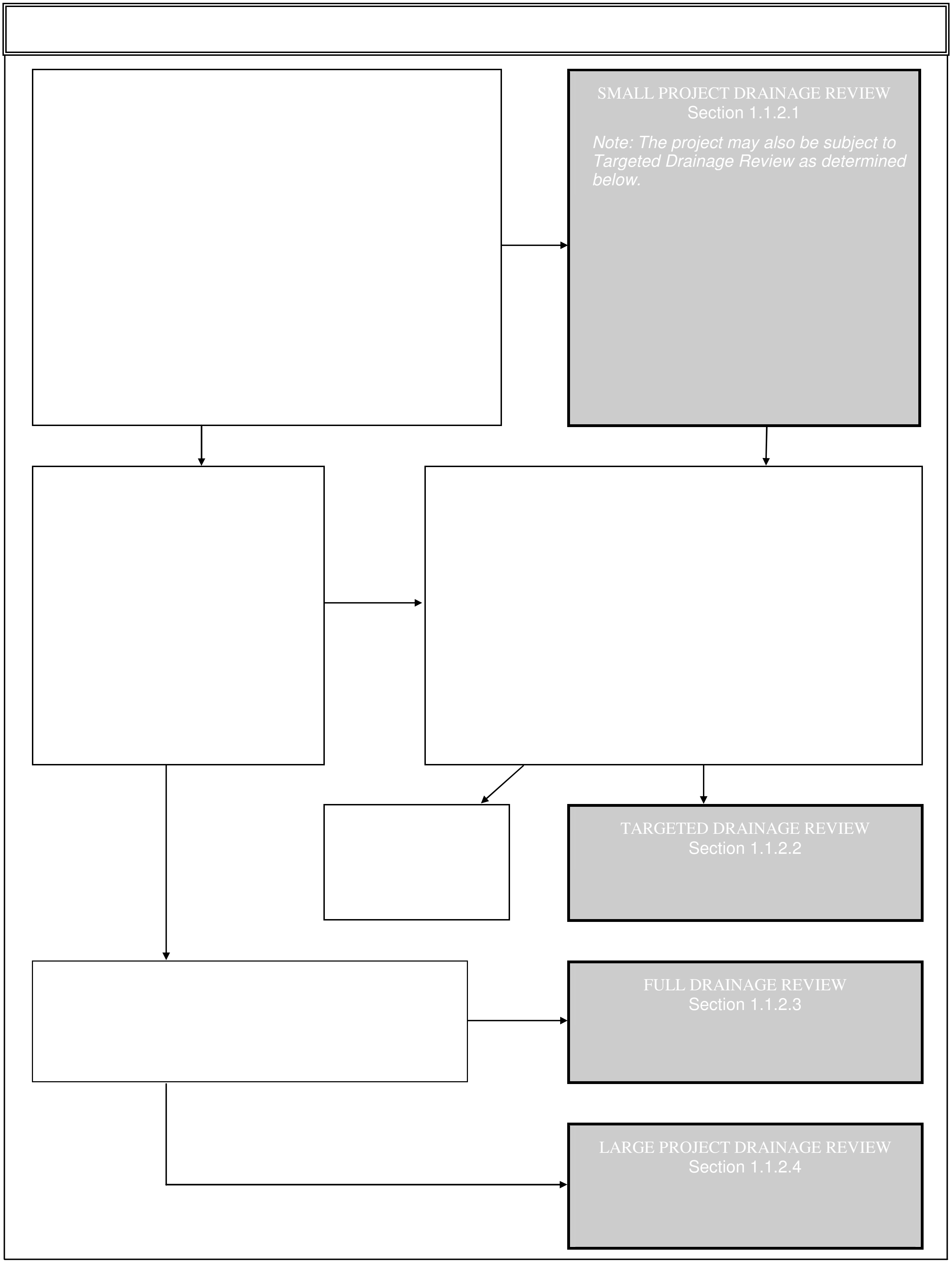

SMALL PROJECT DRAINAGE REVIEW
Section 1.1.2.1
Note: The project may also be subject to Targeted Drainage Review as determined below.
TARGETED DRAINAGE REVIEW
Section 1.1.2.2
FULL DRAINAGE REVIEW
Section 1.1.2.3
LARGE PROJECT DRAINAGE REVIEW
Section 1.1.2.4

TABLE 1.1.2.A REQUIREMENTS APPLIED UNDER EACH DRAINAGE REVIEW TYPE

T
H
R
E
S
H
O
L
D

R
E
Q
M
T
S

[13] The thresholds of 2,000, 10,000, 35,000, and 70,000 square feet of impervious or pervious surface shall be applied by ***threshold discharge area*** and in accordance with the definitions of these surfaces in Section 1.1. *Note: the calculation of total impervious surface added on after January 8, 2001 may exclude any such added impervious surface that is confirmed by DDES engineering staff to be already mitigated by a County approved and inspected flow control facility or BMP.*

THRESHOLD

REQMTS

REQUIREMENTS

REQUIREMENTS

REQUIREMENTS

THRESHOLD

REQMTS

[14] The thresholds of 2,000, 5,000, and 35,000 square feet of ***new impervious***, ***replaced impervious***, and ***new pervious surface*** shall be applied by ***threshold discharge area***.

T
H
R
E
S
H
O
L
D

R
E
Q
U
I
R
E
M
E
N
T
S

[15] *Hydraulically connected* means connected through surface flow or water features such as wetlands or lakes.

Agency	Permit/Approval

REQUIREMENT

16 Peak discharges for applying this requirement are determined using KCRTS with 15-minute time steps as detailed in Chapter 3.

[17] *Acceptable discharge point* means an enclosed drainage system (i.e., pipe system, culvert, or tightline) or open drainage feature (e.g., ditch, channel, swale, stream, river, pond, lake, or wetland) where concentrated runoff can be discharged without creating a significant adverse impact.

[18] For the purposes of applying this exception, the *developed conditions runoff volume* is the average annual runoff volume as computed with KCRTS per Chapter 3. Any areas assumed not to be cleared when computing the developed conditions runoff volume must be set aside in an open space tract or covenant in order for the proposed project to qualify for this exception. Preservation of existing forested areas in Landslide Hazard Drainage Areas is encouraged.

REQMT

[19] *Flow duration* means the aggregate time that peak flows are at or above a particular flow rate (e.g., the amount of time over the last 50 years that peak flows were at or above the 2-year flow rate). *Note: flow duration is not considered to be increased if it is within the tolerances specified in Chapter 3.*

[20] Increases in the project's contribution are considered to be prevented if sufficient onsite flow control and/or offsite improvements are provided as specified for ***severe flooding problems*** in Table 1.2.3.A (p. 1-29). For ***severe flooding problems*** located within the mapped 100-year floodplain of a ***major receiving water*** (see , p. 1-30) or the mapped 100-year floodplain of a major stream for which there is an adopted basin plan, increases in the project's contribution are considered negligible (zero) regardless of the flow control standard being applied, unless DDES determines there is a potential for increased flooding separate from that associated with the existing 100-year floodplain.

[21] *Existing flooding*, for the purposes of this definition, means flooding over all lanes of the roadway or driveway has occurred in the past and can be verified by County records, County personnel, photographs, or other physical evidence.

[22] *Sole access roadway* means there is no other flood-free route for emergency access to one or more dwelling units.

REQUIREMENT

R
E
Q
M
T

Guide to Applying the Area-Specific Flow Control Facility Requirement

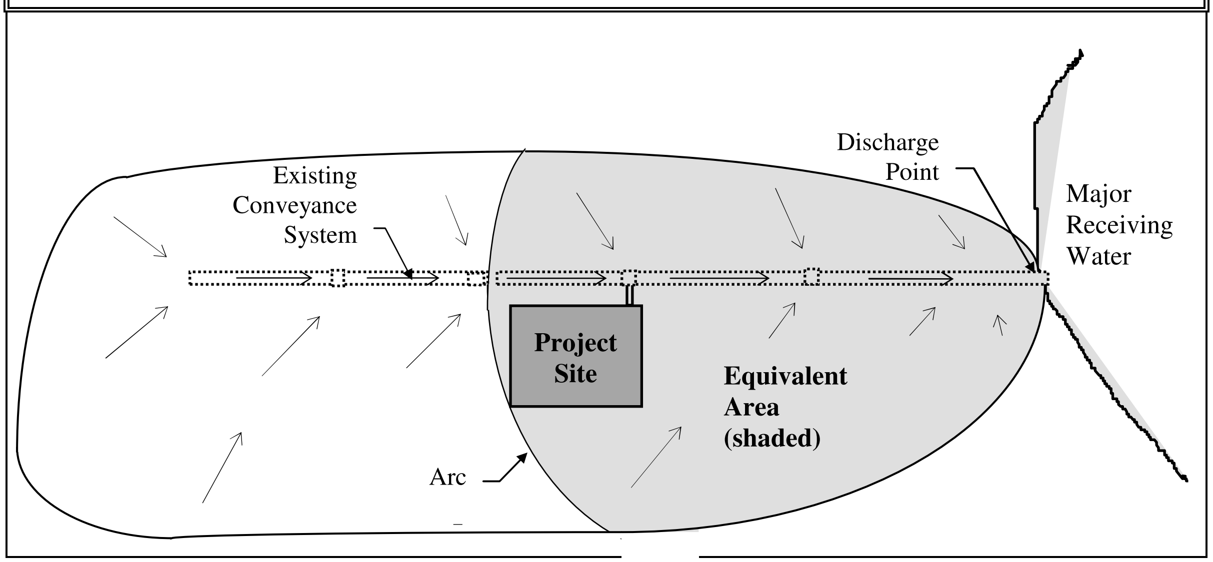
The flow control facility requirement varies across the county landscape according to the *flow control area* within which the project or a ***threshold discharge area*** of the project is located. Flow control areas are designated by the county to target the level of flow control performance to the broad protection needs of specific basins or subbasins. There are currently three such flow control areas, which are depicted on the Flow Control Applications Map adopted with this manual (see map pocket on inside of back cover). These are the **Basic Flow Control Areas**, **Conservation Flow Control Areas**, and **Flood Problem Flow Control Areas**. Each flow control area has an area-specific set of minimum flow control facility performance criteria, design assumptions, surfaces that must be mitigated, and exceptions. These provisions all comprise what is referred to as the "area-specific flow control facility requirement."

Note that the minimum required performance of the facility as specified by this requirement may need to be increased to ensure that downstream problems are not created or significantly aggravated as set forth in Section 1.2.2.2, "Problem-Specific Mitigation Requirements" (p. 1-25). Table 1.2.3.A (p. 1-29) provides a quick guide for selecting the flow control performance criteria necessary to meet both the area-specific flow control facility requirement and the problem-specific mitigation requirement. This is further explained in Step 4 below.

For efficient application of the flow control facility requirement, the following steps are recommended:

1. Check the Direct Discharge Exemption on Page 1-30 and the Impervious Surface Exemption on Page 1-31 to determine if and/or which portions of your project are exempt from the flow control facility requirement. If exempt from the flow control facility requirement, proceed to Step 6.
2. Use the Flow Control Applications Map to determine the flow control area in which your project is located. If this determination cannot be made from the map, a more detailed delineation of flow control areas is available on King County's Geographic Information System (GIS).
3. Consult the detailed requirement and exception language for the identified flow control area to determine if and how the flow control facility requirement applies to your project. This requirement and exception language is detailed on subsequent pages for each of the three flow control areas depicted on the Flow Control Applications Map. If a flow control facility is not applicable per the area-specific exceptions, proceed to Step 6.
4. If downstream problems were identified through offsite analysis per Core Requirement #2 and are proposed to be addressed through onsite flow control, use Table 1.2.3.A (p. 1-29) to determine if and what additional flow control performance is necessary to mitigate impacts (i.e., to prevent creation or aggravation of the identified problems).
5. Use Section 1.2.3.2 (p. 1-39) to identify the applicable requirements for implementing the flow control facility requirement. These requirements cover facility siting, analysis and design, unusual situations, and other site-specific considerations.
6. Use Section 1.2.3.3 (p. 1-44) to identify the flow control BMPs that must be applied to your ***project site*** regardless of whether a flow control facility is required.

TABLE 1.2.3.A
SUMMARY OF FLOW CONTROL PERFORMANCE CRITERIA ACCEPTABLE FOR IMPACT MITIGATION[1]



* *Projects discharging directly to the Sammamish River must infiltrate runoff to the extent feasible before discharge to the River.*

[23] *Direct discharge* means undetained discharge from a proposed project to a ***major receiving water***.

[24] *Note: If the conveyance system is an existing King County-owned system, the County may charge a special use fee.*

REQMT

[25] *Percent build-out* is calculated by dividing the number of existing residential dwelling units (including existing multifamily units) by the total potential number of residential dwelling units as determined from current base zoning. The total potential number of residential dwelling units is defined as the sum of (1) existing residential dwelling units, (2) existing vacant non-subdividable single family residential lots, (3) potential single family residential lots (net buildable area of subdividable parcels multiplied by the base zoning, and subtracting out any lots with existing residential dwelling units), and (4) potential multifamily dwelling units on vacant or subdividable multifamily-zoned parcels. Permanent open space areas (e.g., sensitive areas and buffers, recreational tracts) and those properties that are zoned commercial or industrial, or are publicly owned (e.g., parks, schools, arterial roadways, stormwater tracts) shall be excluded from these calculations.

R
E
Q
M
T

[26] *Note: Any **threshold discharge area** that appears to be located within a Conservation Flow Control Area according to the Flow Control Applications Map but drains entirely by non-erodible manmade conveyance to a **major receiving water** (listed on page 1-30) is considered to be located within a Basic Flow Control Area.*

R
E
Q
M
T

[27] The *participating portion* includes those properties that have agreements for use of the shared facility.

[28] *Non-native pervious surface* means a pervious surface that does not meet the definition of a ***native vegetated surface***.

TABLE 1.2.3.C FLOW CONTROL BMP FACILITY SIZING CREDITS(1)	

[29] Note: DDES may allow this distance to be extended beyond a quarter mile to the point where the ***project site*** area constitutes less than 15% of the tributary area.

R
E
Q
M
T

REQUIREMENT

[30] *New conveyance system elements* are those that are proposed to be constructed where there are no existing constructed conveyance elements.

[31] *Full build-out conditions* means the tributary area is developed to its full zoning potential except where there are existing sensitive areas, open space tracts, and/or native growth protection easements/covenants.

[32] For purposes of this requirement, the term *subdivision project* refers to any project that creates a short plat, plat, or binding site plan.

[33] Peak discharges shall be as computed using KCRTS as detailed in Chapter 3.

[34] *Natural onsite drainage feature* means a natural swale, channel, stream, closed depression, wetland, or lake.

[35] *Measured infiltration rate* shall be as measured by the EPA method or the Double Ring Infiltrometer Method (ASTM D3385). For some soils, an infiltration rate of less than 9 inches per hour may be assumed based on a soil texture determination rather than a rate measurement. For more details, see the "Groundwater Protection" requirements in Section 5.4.1.

[36] *Sensitive lake* is a designation applied by the County to lakes that are particularly prone to eutrophication from development-induced increases in phosphorus loading. Such lakes are identified on the Water Quality Applications Map adopted with this manual (see map pocket on inside of back cover).

[37] *Cation exchange capacity* shall be tested using EPA Laboratory Method 9081.

[38] *Organic content* shall be measured on a dry weight basis using ASTM D2974.

REQUIREMENT

REQMT

[39] *Note: King County does not assume maintenance of individual lot drainage systems or drainage stub-outs serving single family residential lot downspout, footing, or yard drains, nor does King County assume maintenance of the vegetated portions of water quality treatment facilities and flow control BMPs integrated into site landscaping.*

REQUIREMENT

R
E
Q
M
T

Guide to Applying Core Requirement #8

Core Requirement #8 requires that WQ treatment facilities be provided to remove pollutants from runoff discharging from a ***project site*** in accordance with one of the three area-specific WQ facility requirements found in Section 1.2.8.1 (p. 1-60). Each area-specific facility requirement applies to one of three geographic areas of unincorporated King County, called "WQ treatment areas." Such areas are designated by King County to tailor the levels of treatment to the protection needs of specific waterbodies and resources. The three areas are **Basic WQ Treatment Areas**, **Sensitive Lake WQ Treatment Areas**, and **Sphagnum Bog WQ Treatment Areas**. They are depicted on the WQ Applications Map adopted with this manual (see the map pocket inside the back cover).

The facility requirement for each WQ treatment area includes an area-specific menu of treatment facility options, the types of surfaces from which runoff must be treated ("target surfaces"), and any exceptions to the menu and surfaces requirements.

For efficient application of Core Requirement #8, the following steps are recommended:

1. Check the exemption language on page 1-58 to determine if or which ***threshold discharge areas*** of the ***project site*** must provide WQ treatment facilities per Core Requirement #8.
2. Use the WQ Applications Map and any necessary ***site***-specific information to determine the WQ treatment area in which your project is located. If this determination can not be made from the WQ Applications Map, a more detailed delineation of WQ treatment areas is available on King County's Geographic Information System. Because the basin boundaries of Sphagnum Bog WQ Treatment Areas are not delineated on the WQ Applications Map, you may find that your project is located in one of these as well as another WQ treatment area. If this happens, the requirements of the Sphagnum Bog WQ Treatment Area take precedence.
3. Comply with the requirements specified in Section 1.2.8.1 (p. 1-60) for the WQ treatment area you identified above.
4. Consult Section 1.2.8.2 (p. 1-67) for other design requirements, allowances, and flexible compliance provisions related to implementing water quality treatment.

[40] *Measured infiltration rate* shall be as measured by the EPA method or the Double Ring Infiltrometer Method (ASTM D3385). For some soils, an infiltration rate of less than 9 inches per hour may be assumed based on a soil texture determination rather than a rate measurement. For more details, see the "Groundwater Protection" requirements in Section 5.4.1.

[41] *Sensitive lake* is a designation applied by the County to lakes that are particularly prone to eutrophication from development-induced increases in phosphorus loading. Such lakes are identified on the Water Quality Applications Map adopted with this manual (see map pocket on inside of back cover).

[42] *Cation exchange capacity* shall be tested using EPA Laboratory Method 9081.

[43] *Organic content* shall be measured on a dry weight basis using ASTM D2974.

REQUIREMENT

REQUIREMENT

REQUIREMENT

[44] For evaluation purposes, typical concentrations of TSS in Seattle area runoff are between 30 and 100 mg/L (Table 1, "Water Quality Thresholds Decision Paper," King County Surface Water Management Division, April 1994).

[45] *Landscape management plan* means a King County approved plan for defining the layout and long-term maintenance of landscaping features to minimize the use of pesticides and fertilizers, and to reduce the discharge of suspended solids and other pollutants. Guidelines for preparing landscape management plans can be found in Reference Section 4-A. Submittal requirements are detailed in Section 2.3.1.4.

R
E
Q
U
I
R
E
M
E
N
T

[46] Phosphorus concentrations of between 0.10 and 0.50 mg/L are considered typical of Seattle area runoff (Table 1, "Water Quality Thresholds Decision paper," King County Surface Water Management Division, April 1994).

[47] *In series* means that the entire treatment water volume flows from one facility to the other in turn.

[48] *High infiltration rates* are those in excess of 9 inches per hour as measured by the EPA method or the Double Ring Infiltrometer method (ASTM D3385). These will typically be medium to coarse sand or gravel soil with low silt content. See Section 5.4.1 for information on measuring infiltration rates.

R
E
Q
M
T

[49] A *sphagnum bog wetland* is defined as a wetland dominated by sphagnum moss and which has an associated acid-loving plant community. A technical definition can be found in the "Definitions" section.

[50] The *size* of a sphagnum bog wetland is defined by the boundaries of the sphagnum bog plant community.

[51] Approximately 3% of wetlands in the 1990 sensitive areas inventory are either sphagnum bogs or include portions of a lake or wetland with bog characteristics.

[52] A *treatment train* is a combination of two or more treatment BMPs connected in series (i.e., the design water volume passes through each facility in turn).

[53] *High infiltration rates* are those in excess of 9 inches per hour as measured by the EPA method or the Double Ring Infiltrometer method (ASTM D3385). These will typically be medium to coarse sand or gravel soil with low silt content. See Section 5.4.1 for information on measuring infiltration rates.

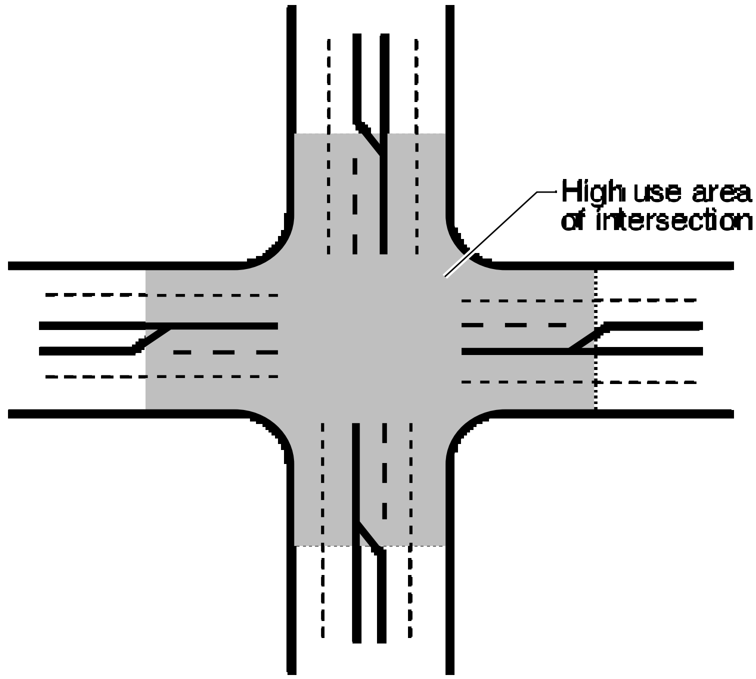

High use area
of intersection

TABLE 2.1.2.A DRAINAGE PLAN SUBMITTALS			
Type of Permit or Project		**Type of Drainage Review**	
SUBDIVISIONS, UPDs, AND BINDING SITE PLANS		Full or Targeted Drainage Review(2)	
		Large Project Drainage Review	
SHORT PLATS		Small Project Drainage Review	
		Small Project Drainage Review AND Targeted Drainage Review(2)	
		Full or Targeted Drainage Review(2)	
COMMERCIAL PERMITS		Full or Targeted Drainage Review	
SINGLE FAMILY RESIDENTIAL BUILDING PERMITS OR PERMITS FOR AGRICULTURAL PROJECTS		Small Project Drainage Review	
		Small Project Drainage Review AND Targeted Drainage Review(2)	
		Full or Targeted Drainage Review(2)	
OTHER PROJECTS OR PERMITS		Full or Targeted Drainage Review(2)	

2-6

Zoning Designation	Contour Intervals

[1] The specific level of required drainage analysis and design is usually determined during the preliminary drainage review of the plans submitted with the application. The overall plan review process may be expedited if the project is submitted with the appropriate level of detail.

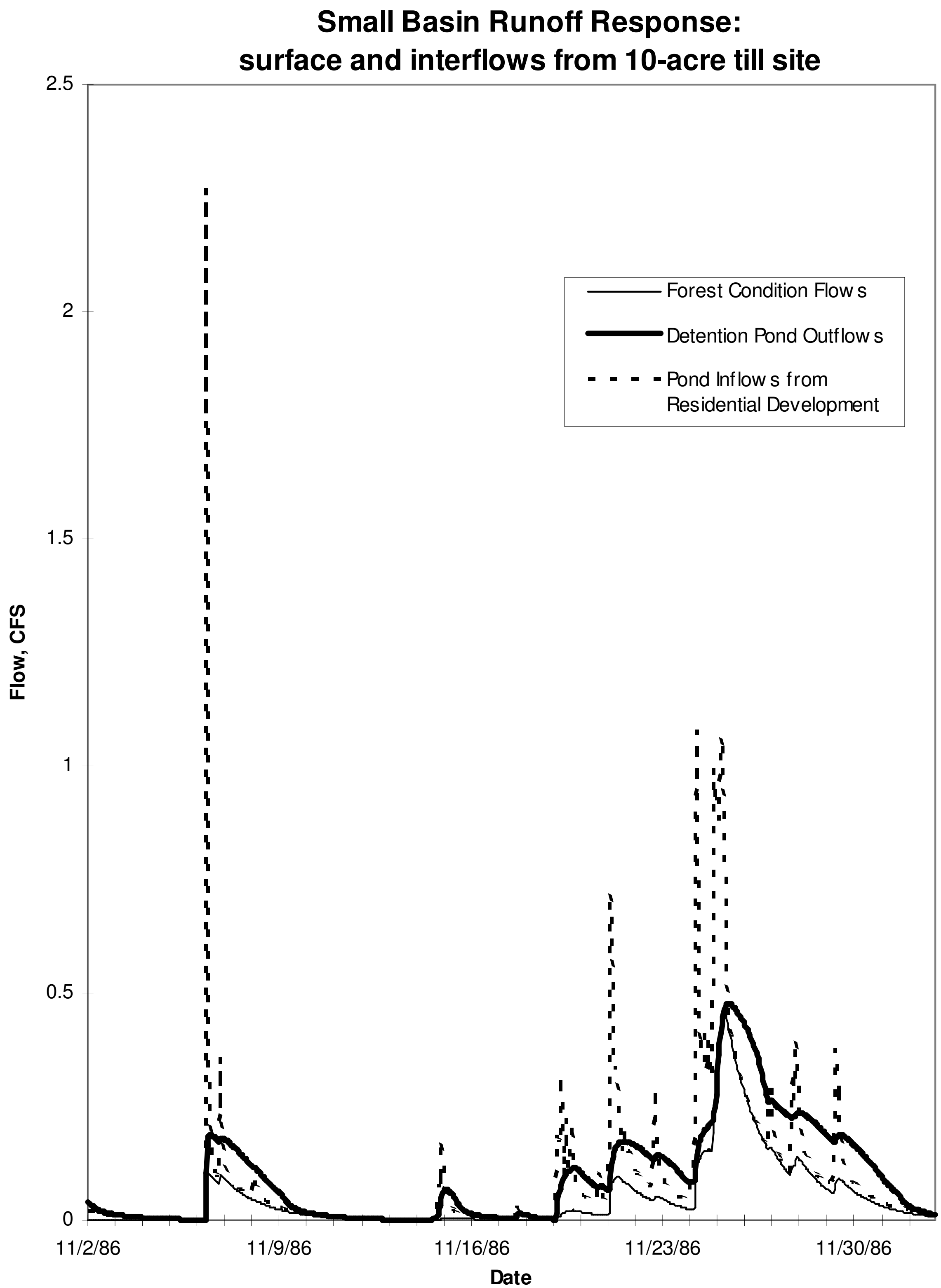
[2] *Note: drainage complaints that are more than 10 years old are not required for Level 1 downstream analysis.*

TABLE 2.3.1.A BASE MAP REQUIREMENTS

[3] *Relevant critical areas*, for the purposes of drainage review, include aquatic areas, wetlands, ***flood hazard areas***, ***erosion hazard areas***, ***landslide hazard areas***, ***steep slope hazard areas***, and ***critical aquifer recharge areas***.

[4] *Relevant critical areas*, for the purposes of drainage review, include aquatic areas, wetlands, ***flood hazard areas***, ***erosion hazard areas***, ***landslide hazard areas***, ***steep slope hazard areas***, and ***critical aquifer recharge areas***.

TABLE 2.3.2.A MINIMUM ENGINEERING PLAN ELEMENTS[(1)] FOR PROJECTS IN TARGETED DRAINAGE REVIEW


Small Basin Runoff Response:
surface and interflows from 10-acre till site
Flow, CFS
Date
Forest Condition Flows
Detention Pond Outflows
Pond Inflows from Residential Development
0
0.5
1
1.5
2
2.5
11/2/86
11/9/86
11/16/86
11/23/86
11/30/86

3-9

TABLE 3.2 ACCEPTABLE USES OF RUNOFF COMPUTATION METHODS

$(-b_R)$

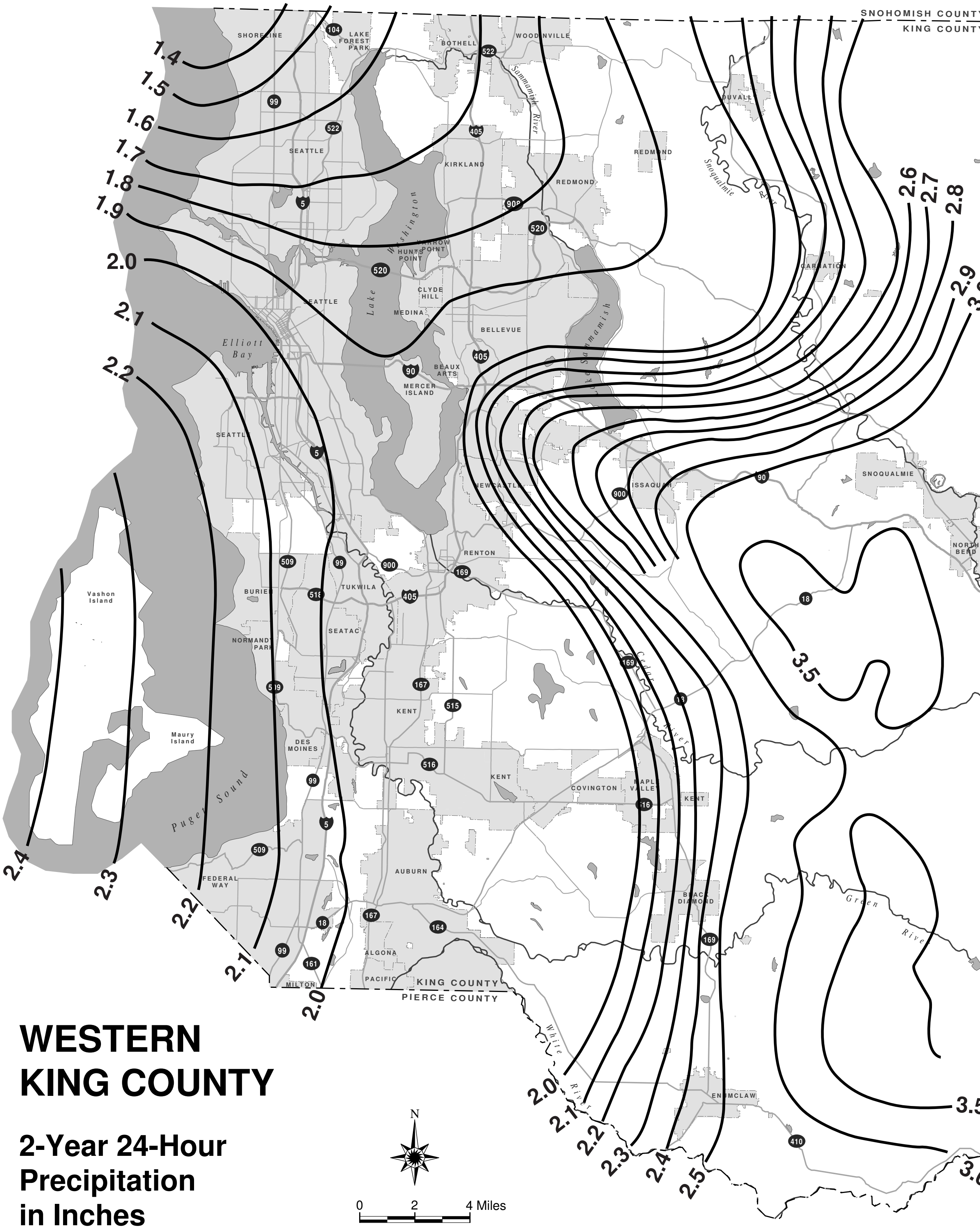
$$\frac{L}{60V}$$

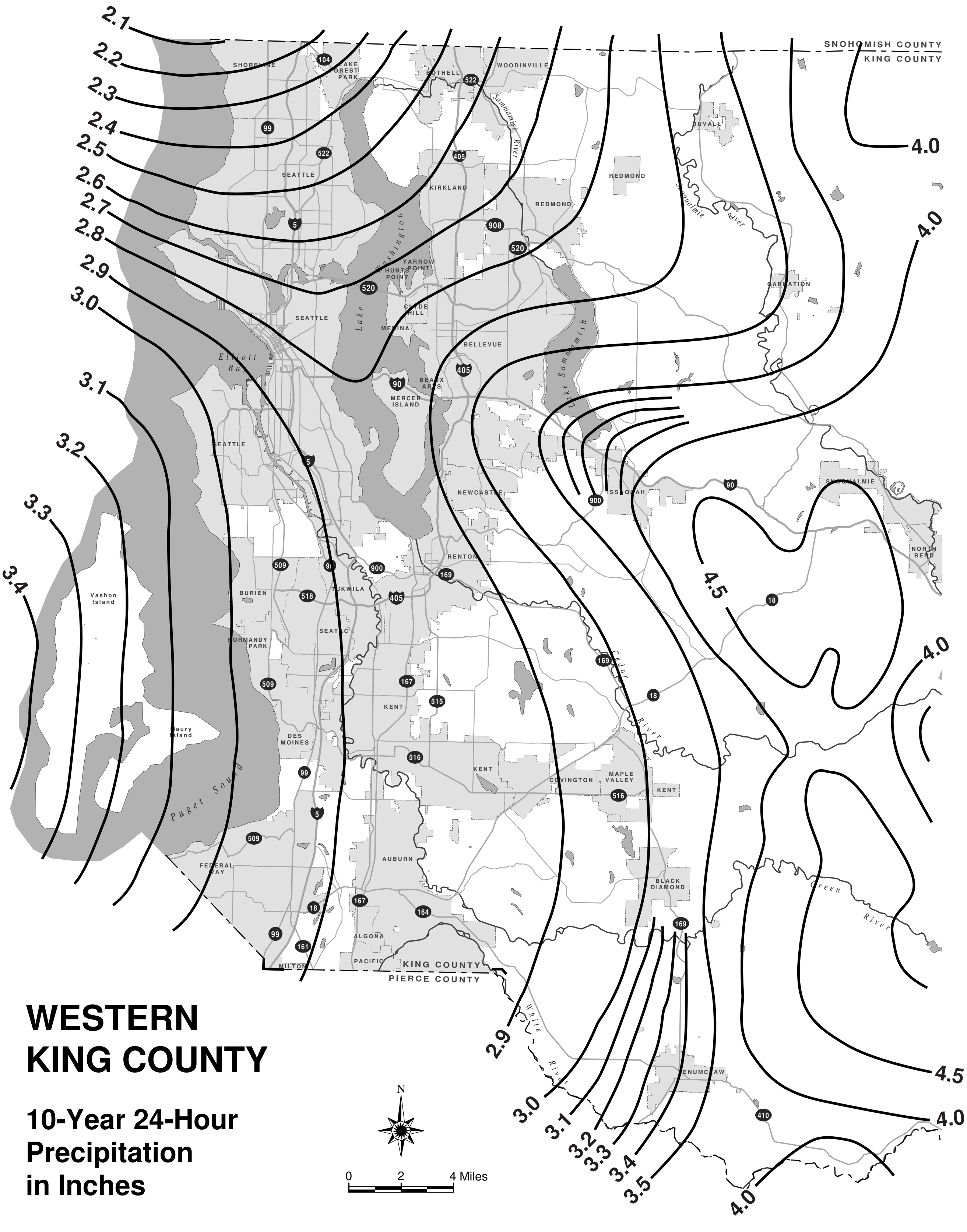
$\sqrt{s_o}$

TABLE 3.2.1.A RUNOFF COEFFICIENTS - "C" VALUES FOR THE RATIONAL METHOD

TABLE 3.2.1.B COEFFICIENTS FOR THE RATIONAL METHOD "i_R" EQUATION

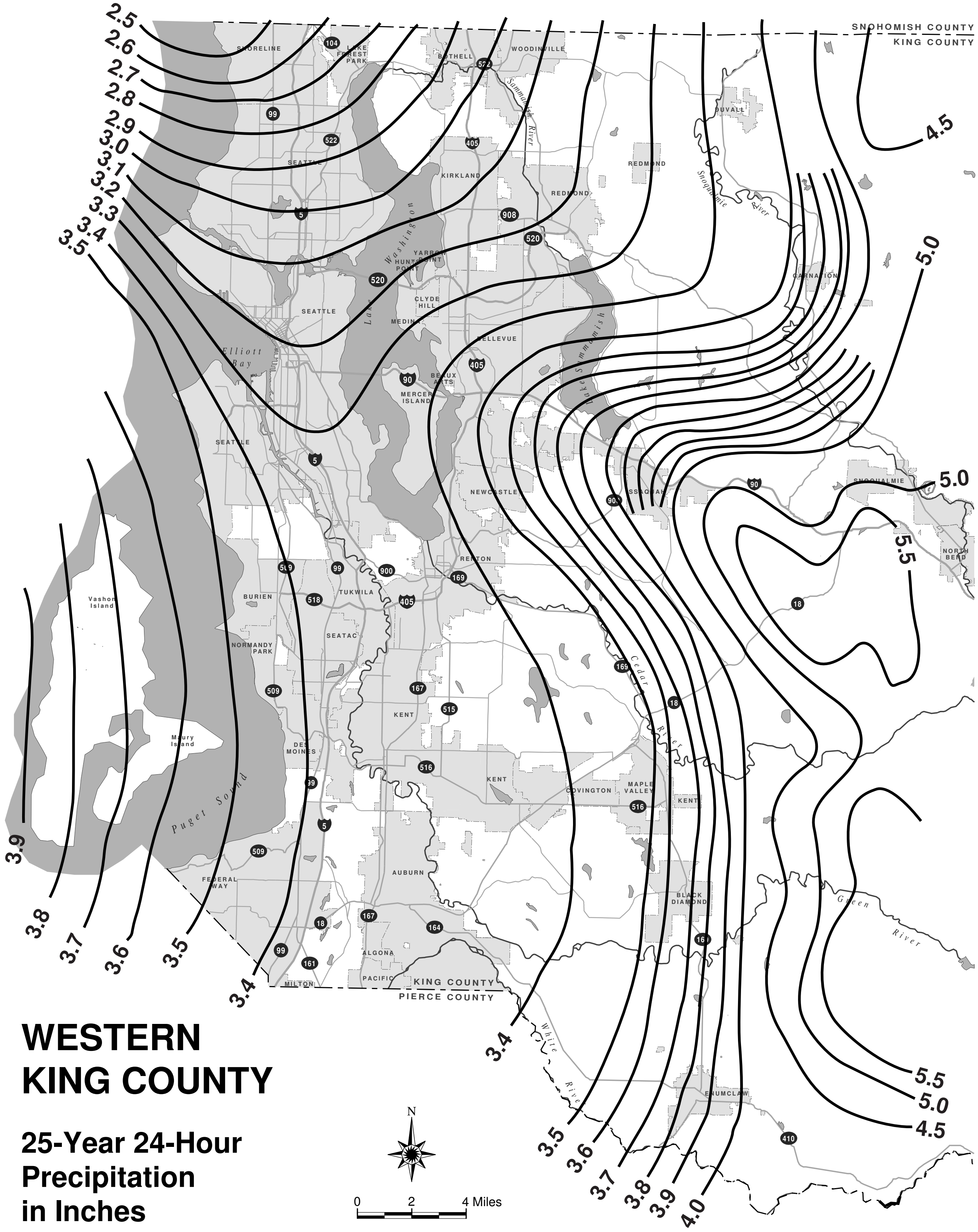
TABLE 3.2.1.C k_R VALUES FOR T_t USING THE RATIONAL METHOD

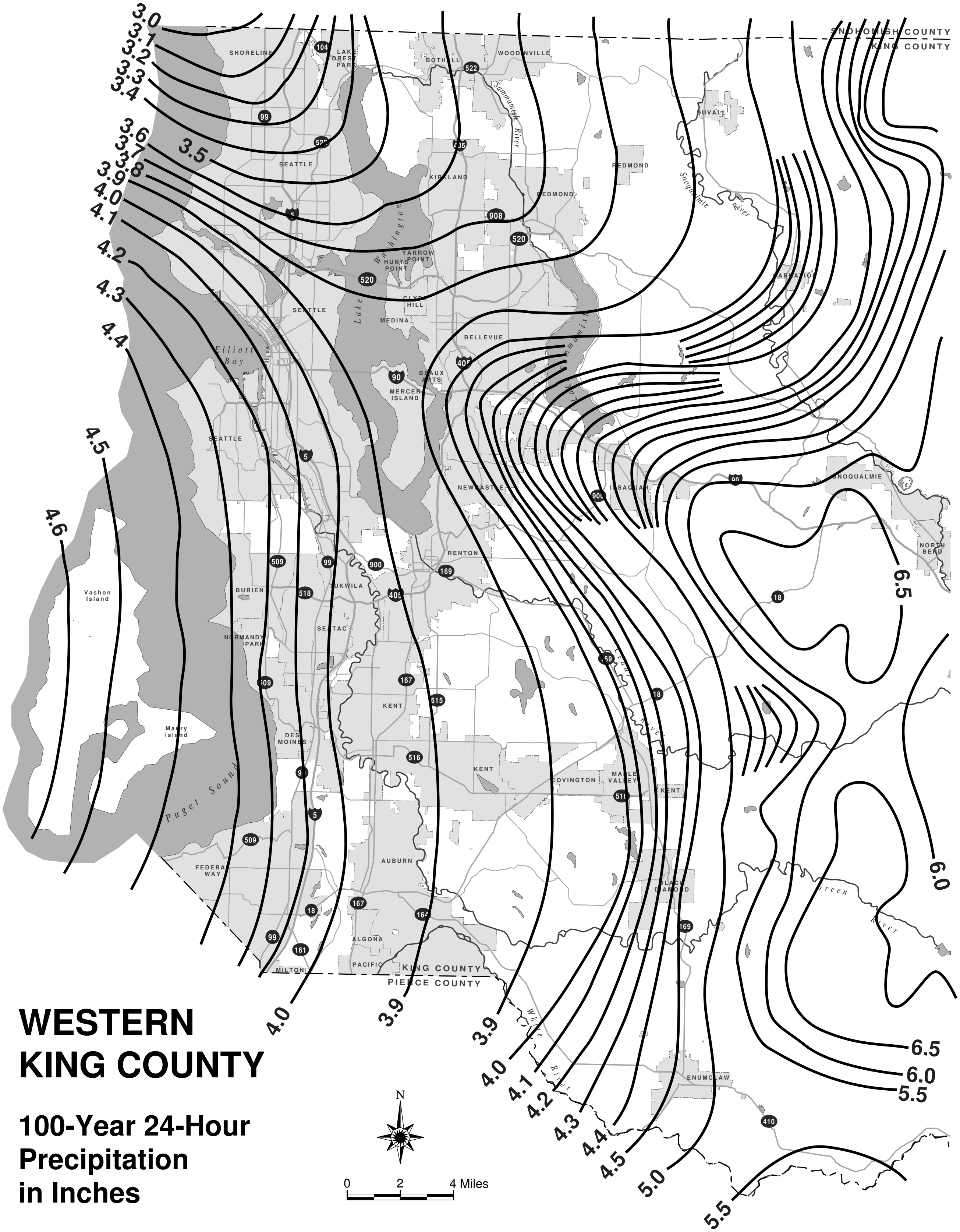

WESTERN
KING COUNTY
2-Year 24-Hour
Precipitation
in Inches
SNOHOMISH COUNTY
KING COUNTY
PIERCE COUNTY
N
0 2 4 Miles
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
3.0
3.5
SHORELINE
LAKE FOREST PARK
BOTHELL
WOODINVILLE
KIRKLAND
REDMOND
DUVALL
SEATTLE
CARNATION
CLYDE HILL
MEDINA
BELLEVUE
BEAUX ARTS
MERCER ISLAND
NEWCASTLE
ISSAQUAH
SNOQUALMIE
NORTH BEND
RENTON
TUKWILA
BURIEN
SEATAC
NORMANDY PARK
KENT
DES MOINES
COVINGTON
MAPLE VALLEY
FEDERAL WAY
AUBURN
BLACK DIAMOND
ALGONA
PACIFIC
MILTON
ENUMCLAW
Vashon Island
Maury Island
Elliott Bay
Puget Sound
Lake Washington
Lake Sammamish
Sammamish River
Snoqualmie River
Cedar River
Green River
White River



WESTERN KING COUNTY

10-Year 24-Hour Precipitation in Inches


WESTERN
KING COUNTY
25-Year 24-Hour
Precipitation
in Inches
SNOHOMISH COUNTY
KING COUNTY
PIERCE COUNTY
N
0 2 4 Miles
2.5
2.6
2.7
2.8
2.9
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
4.5
5.0
5.5
SHORELINE
LAKE FOREST PARK
BOTHELL
WOODINVILLE
DUVALL
REDMOND
KIRKLAND
SEATTLE
YARROW POINT
HUNTS POINT
CLYDE HILL
MEDINA
BELLEVUE
BEAUX ARTS
MERCER ISLAND
CARNATION
SNOQUALMIE
NORTH BEND
ISSAQUAH
NEWCASTLE
RENTON
TUKWILA
BURIEN
SEATAC
NORMANDY PARK
KENT
DES MOINES
COVINGTON
MAPLE VALLEY
BLACK DIAMOND
AUBURN
FEDERAL WAY
ALGONA
PACIFIC
MILTON
ENUMCLAW
Vashon Island
Maury Island
Puget Sound
Elliott Bay
Lake Washington
Lake Sammamish
Sammamish River
Snoqualmie River
Cedar River
Green River
White River


WESTERN
KING COUNTY
100-Year 24-Hour
Precipitation
in Inches
SNOHOMISH COUNTY
KING COUNTY
PIERCE COUNTY
SHORELINE
LAKE FOREST PARK
BOTHELL
WOODINVILLE
DUVALL
REDMOND
KIRKLAND
SEATTLE
YARROW POINT
HUNTS POINT
CLYDE HILL
MEDINA
BELLEVUE
BEAUX ARTS
MERCER ISLAND
Elliott Bay
Lake Washington
Sammamish River
Snoqualmie River
CARNATION
SNOQUALMIE
NORTH BEND
ISSAQUAH
NEWCASTLE
RENTON
TUKWILA
BURIEN
SEATAC
NORMANDY PARK
Vashon Island
Maury Island
Puget Sound
DES MOINES
KENT
COVINGTON
MAPLE VALLEY
BLACK DIAMOND
FEDERAL WAY
AUBURN
ALGONA
PACIFIC
MILTON
ENUMCLAW
Green River
White River
Cedar River
N
0
2
4 Miles
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
4.1
4.2
4.3
4.4
4.5
4.6
5.0
5.5
6.0
6.5

$$\frac{L_1}{60V_1} = \frac{L_1}{60(k_R\sqrt{s_1})} = \frac{300}{60(2.5\sqrt{0.08})}$$

$$\frac{L_2}{60V_2} = \frac{L_2}{60(k_R\sqrt{s_2})} = \frac{200}{60(2.5\sqrt{0.03})}$$

$$\frac{L_3}{60V_3} = \frac{L_3}{60(k_R\sqrt{s_3})} = \frac{1000}{60(15\sqrt{0.015})}$$

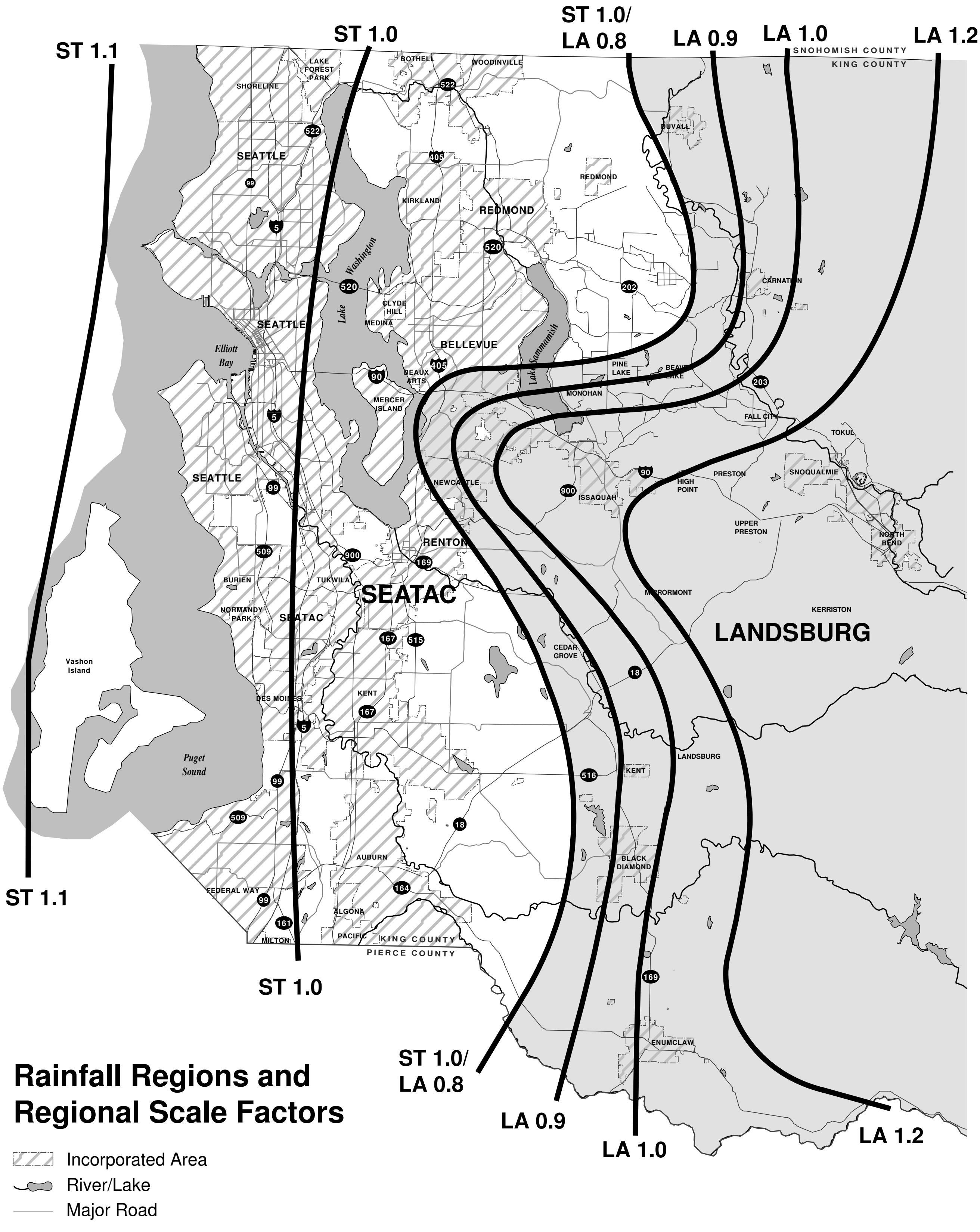

ST 1.1
ST 1.0
ST 1.0/
LA 0.8
LA 0.9
LA 1.0
LA 1.2
SNOHOMISH COUNTY
KING COUNTY
SEATTLE
SEATAC
LANDSBURG
BELLEVUE
REDMOND
KIRKLAND
RENTON
ISSAQUAH
CARNATION
DUVALL
SNOQUALMIE
NORTH BEND
KENT
AUBURN
FEDERAL WAY
BLACK DIAMOND
ENUMCLAW
Vashon Island
Puget Sound
Elliott Bay
Lake Washington
Lake Sammamish
KING COUNTY
PIERCE COUNTY
Rainfall Regions and
Regional Scale Factors
Incorporated Area
River/Lake
Major Road

TABLE 3.2.2.A SELECTION OF RUNOFF FILE TIME STEPS AND RECORD TYPES

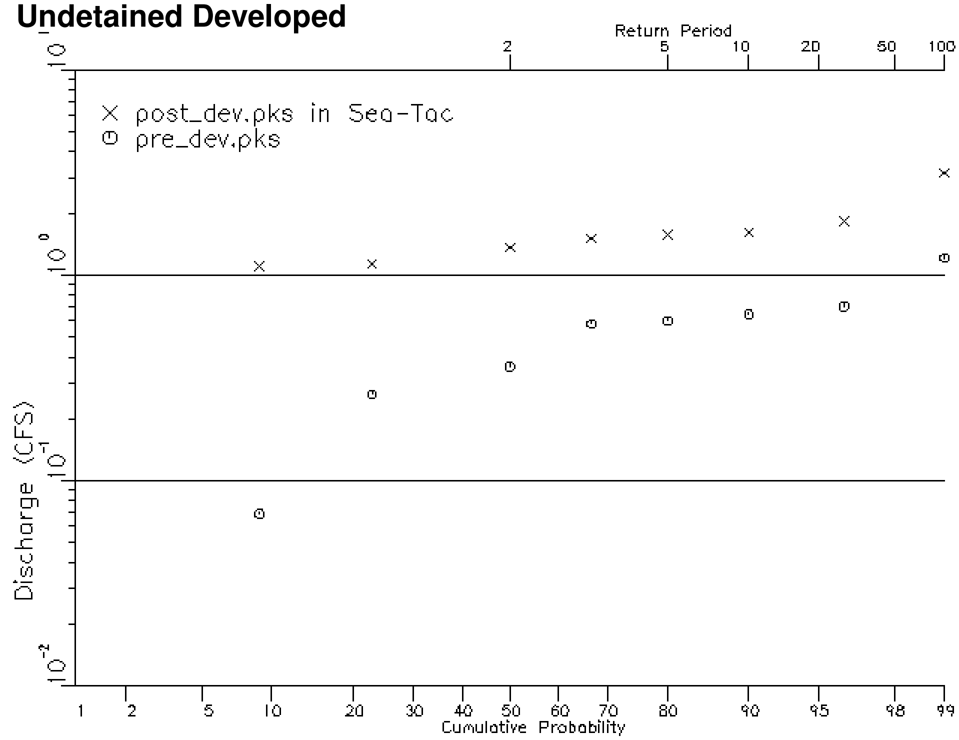
TABLE 3.2.2.B EQUIVALENCE BETWEEN SCS SOIL TYPES AND KCRTS SOIL TYPES

TABLE 3.2.2.C KCRTS COVER GROUPS AND AREAS OF APPLICATION

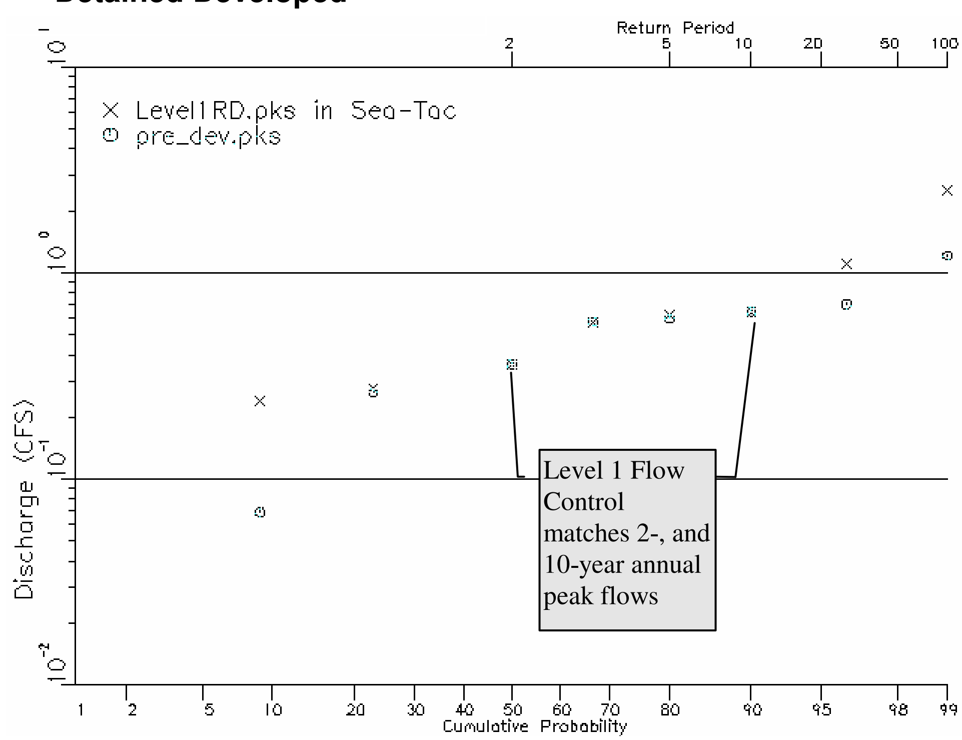
TABLE 3.2.2.D PERCENT IMPERVIOUS COVERAGE FOR EXISTING RESIDENTIAL AREAS

TABLE 3.2.2.E EFFECTIVE IMPERVIOUS FRACTION[(1)]

Undetained Developed

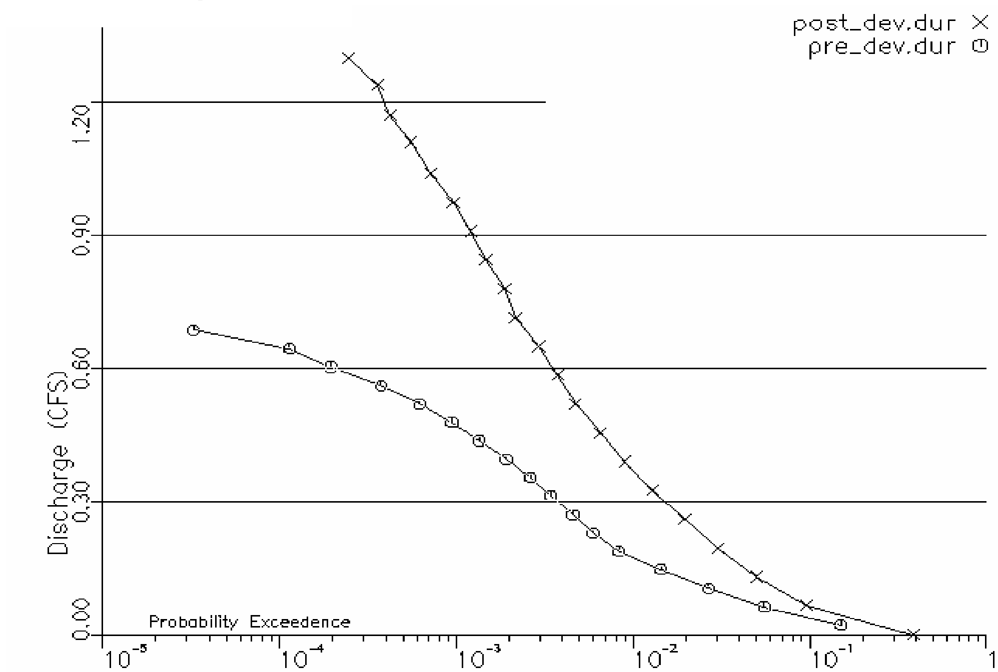


Detained Developed

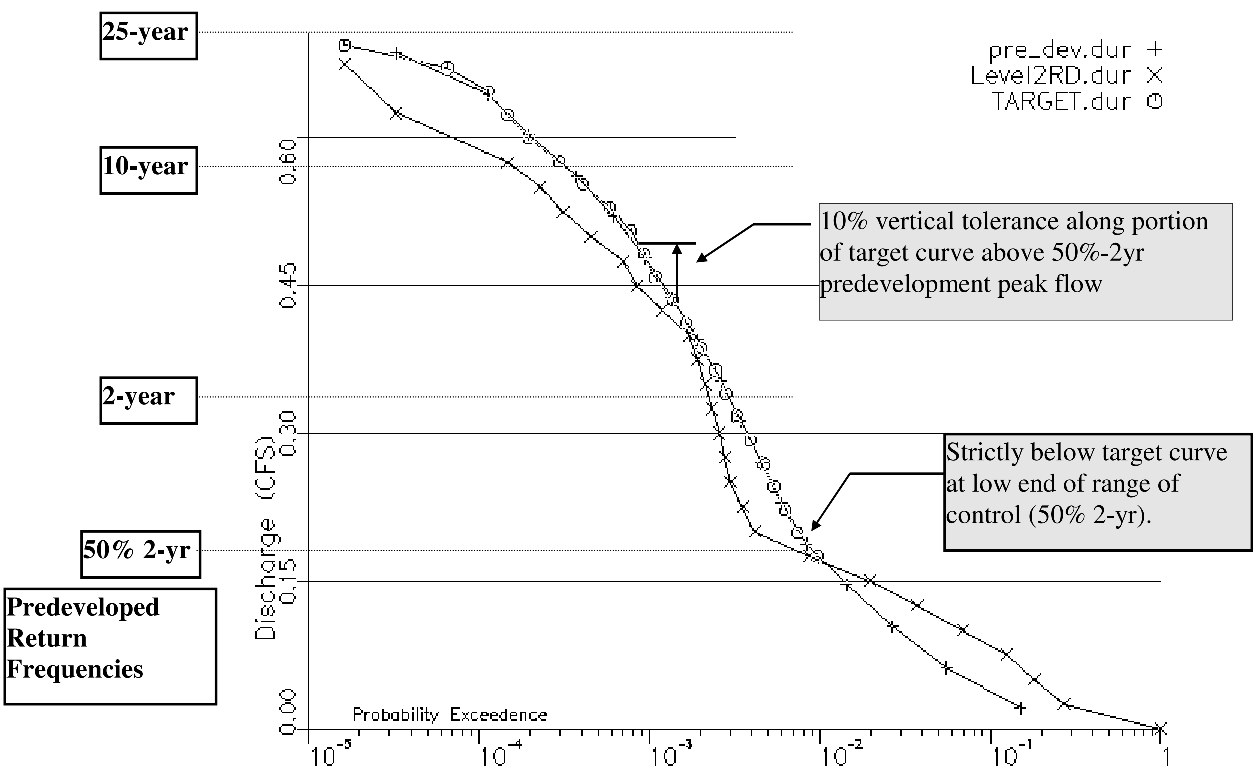


[1] Brief excursions may not result in more than 50% of the target duration curve being exceeded.

Undetained Developed



Detained Developed

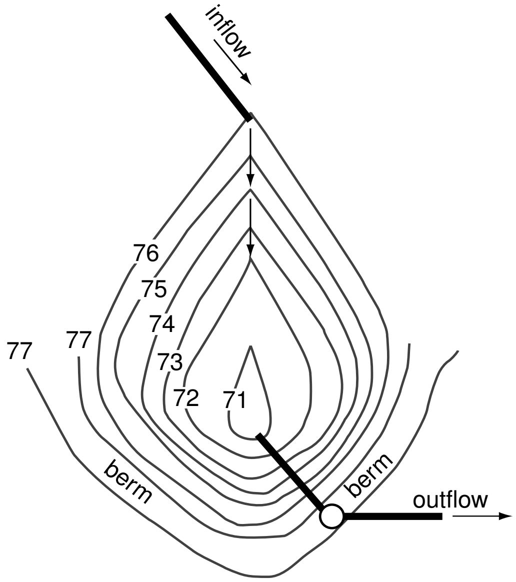


$$\left[\left(\frac{I_1 + I_2}{2}\right) - \left(\frac{O_1 + O_2}{2}\right)\right] = \frac{\Delta S}{\Delta t} = S_2 - S_1$$

$$\sqrt{A_b}$$

$$\frac{h}{3} \qquad \sqrt{A_t A_b}$$

$$\frac{600 + 4400}{2}$$



Area within each contour	
71	600 sq. ft.
72	4400 sq. ft.
73	8700 sq. ft.
74	11,400 sq. ft.
75	14,500 sq. ft.
76	19,000 sq. ft.

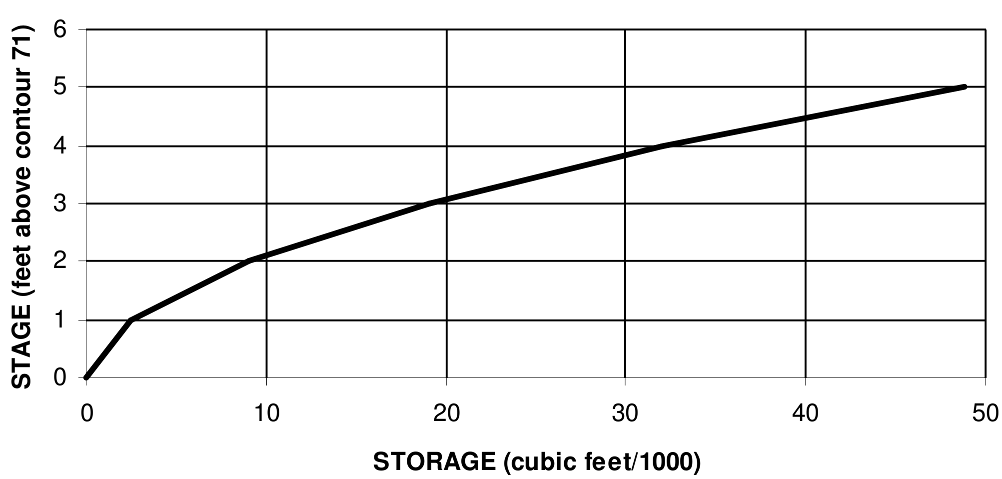
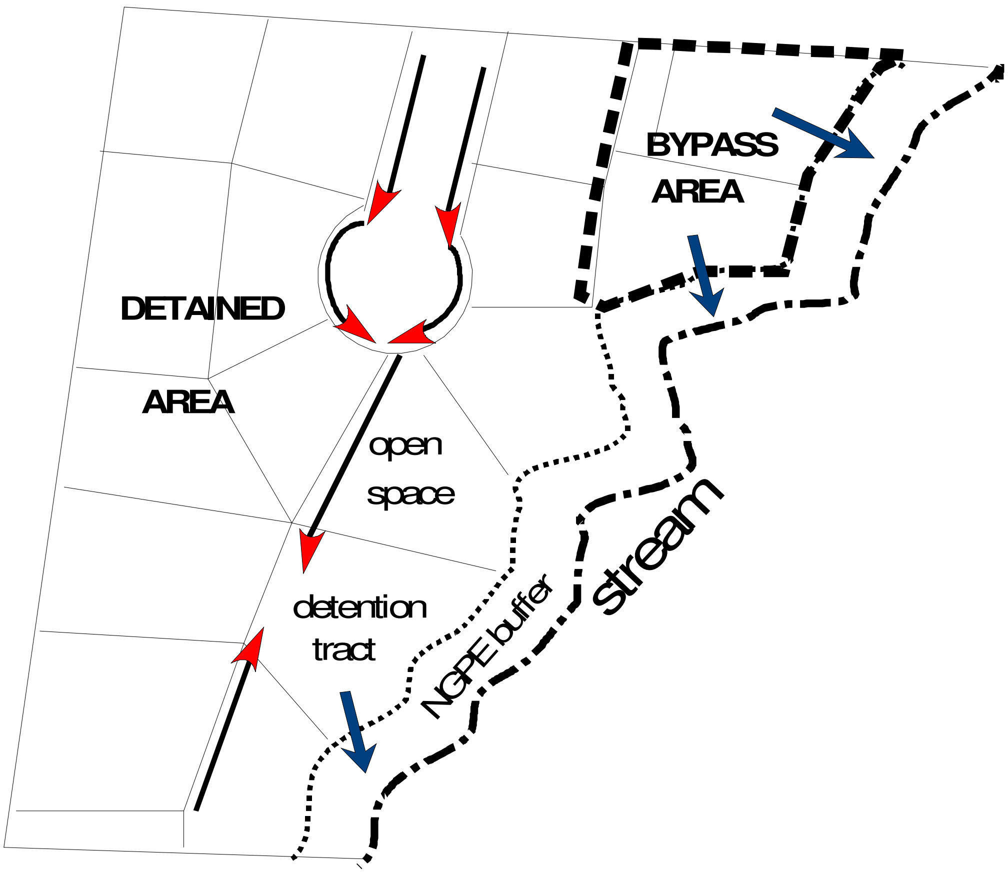


TABLE 3.3.2.A HYDROGRAPHS AND FLOW TARGETS FOR PRELIMINARY POND & ORIFICE SIZING				

[2] For small projects, the lower limit of the range of control is considered met with a minimum diameter (0.5 inches) lower orifice in a low head facility (maximum effective storage depth of 3 feet) where full duration control cannot be achieved at the lower limit. Predeveloped flow durations, within allowed tolerances, must be met for all flows above the best achievable lower limit.


BYPASS
AREA
DETAINED
AREA
open
space
detention
tract
NGPE buffer
stream

[3] *Not altered* means existing on- and offsite flows to the feature will remain unchanged and the feature will not be excavated or filled.

[1] *Major rivers* are defined in the King County Flood Hazard Reduction Plan.

TABLE 4.1 EASEMENT WIDTHS AND BUILDING SETBACK LINES

[2] Galvanized metals leach zinc into the environment, especially in standing water situations. High zinc concentrations, sometimes in the range that can be toxic to aquatic life, have been observed in the region. Therefore, use of galvanized materials should be avoided. Where other metals, such as aluminum or stainless steel, or plastics are available, they shall be used. If these materials are not available, asphalt coated galvanized materials may then be used.

[3] LCPE pipe and fittings shall be manufactured from high density polyethylene resin which shall meet or exceed the requirements of Type 111, Category 3, 4 or 5, Grade P23, P33 or P34, Class C per ASTM D1248. In addition, the pipe shall comply with all material and stiffness requirements of AASHTO M294.

[4] CPE pipe (single wall, fully corrugated) is allowed only for use in private storm sewer systems such as downspout, footing, or yard drain collectors on private property (smooth interior required in road right-of-way for drainage stub-outs or perforated as subgrade drain per *KCRS*).

[5] PVC pipe is allowed only for use in privately maintained drainage systems or as allowed in road right-of-way per *KCRS*. PVC pipe must be SDR 35 or thicker and meet the requirements of ASTM D3034.

[6] SWPE pipe is normally used outside of King County right-of-way, such as on steep slope installations (see Section 4.2.2, p. 4-29). Connections to King County road drainage systems are allowed for pipe diameters of 12” or greater. SWPE pipe shall comply with the requirements of Type III C5P34 as tabulated in ASTM D1248, shall have the PPI recommended designation of PE3408, and shall have an ASTM D3350 cell classification of 345534C. The pipe shall have a manufacturer's recommended hydrostatic design stress rating of 800 psi based on a material with a 1600 psi design basis determined in accordance with ASTM D2837-69. The pipe shall have a suggested design working pressure of 50 psi at 73.4^{o} F and SDR of 32.5.

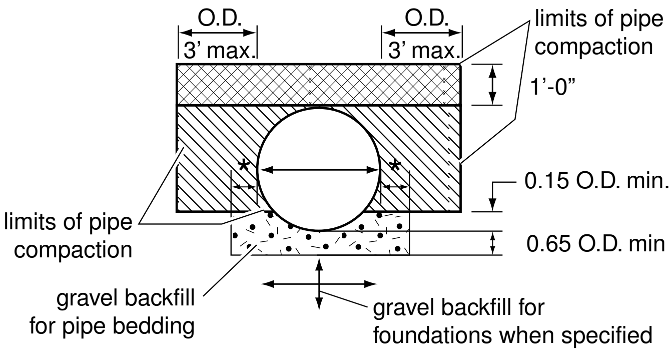
TABLE 4.2.1.A MAXIMUM PIPE SLOPES AND VELOCITIES

[7] Match point is at 80% of the pipe diameter, measured from the invert of the respective pipes.

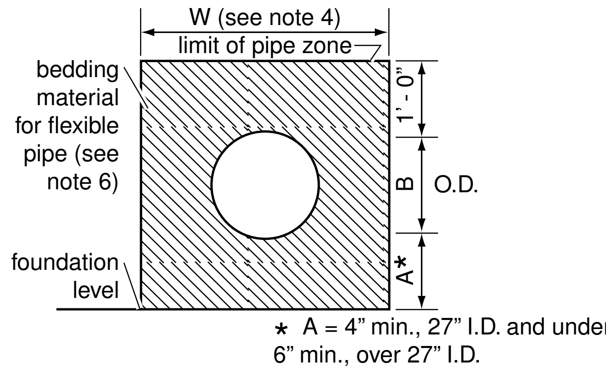
[8] Side laterals include any 8-inch or smaller pipe connected to the main conveyance system at a catch basin, or manhole, as allowed under this manual and/or the King County Road Standards. In addition, 12-inch and smaller pipes that serve a single inlet point (e.g., roadway simple inlets, footing drains, and lot stubouts including manifold systems serving multiple residential lots) are also included. Excluded from this definition are inlet pipes which contribute 30% or more of the total flow into a catch basin, or which collect or convey flows from a continuous source.

TABLE 4.2.1.B ALLOWABLE STRUCTURES AND PIPE SIZES

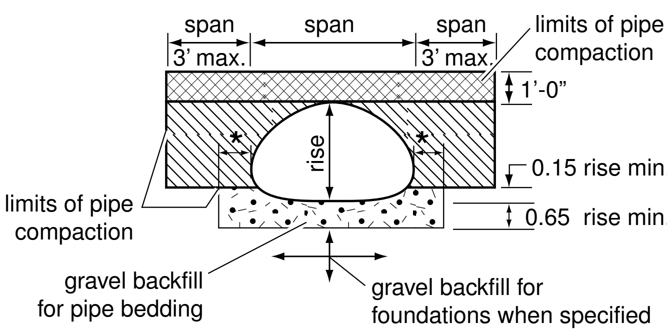
TABLE 4.2.1.C MAXIMUM COVER (FEET) FOR CONCRETE PIPE COMPACTION DESIGN A



A. Metal and Concrete Pipe



Bedding for Flexible Pipe



B. Pipe - Arch Installation

Rigid Pipe NOTES:

1. Pipe compaction limits shown on this plan are for pipe construction in an embankment. For pipe construction in a trench, the horizontal limits of the pipe compaction zone shall be the walls of the trench.
2. All steel and aluminum pipe and pipe-arches shall be installed in accordance with design A.
3. Concrete pipe with elliptical reinforcement shall be installed in accordance with design A.
4. Concrete pipe, plain or with circular reinforcement, shall be installed with design A.
5. O.D. is equal to the outside diameter of a pipe or the outside span of pipe-arch. The dimensions shown as O.D. with 3' maximum shall be O.D. until O.D. equals 3', at which point 3' shall be used.

* 1' -0" for diameters 12" through 42" and spans through 50". 2' -0" for diameters greater than 42" and spans greater than 50".

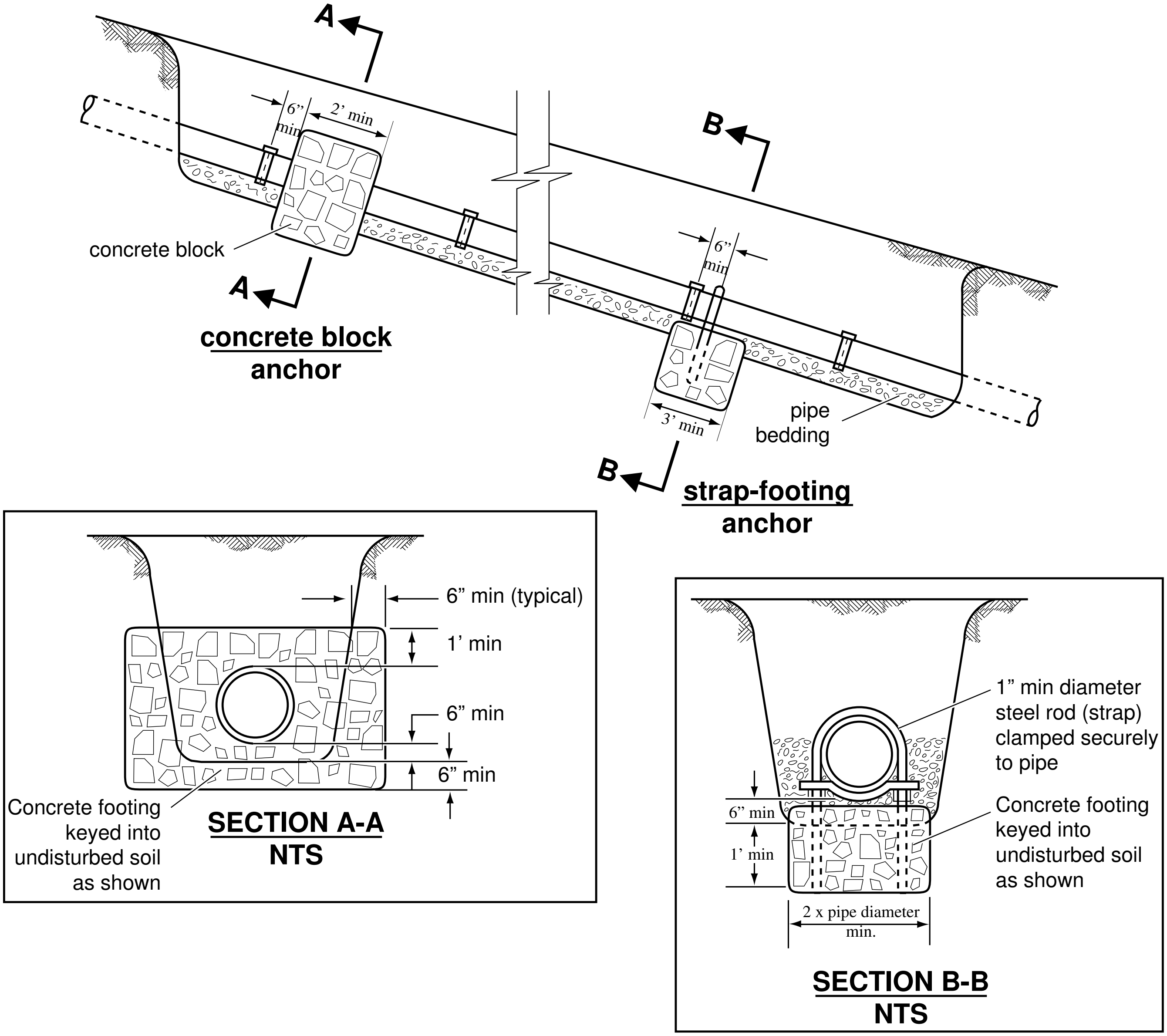
Flexible Pipe NOTES:

1. Provide uniform support under barrels.
2. Hand tamp under haunches.
3. Compact bedding material to 95% max. density; directly over pipe, hand tamp only.
4. See "Excavation and Preparation of Trench" in sanitary sewers section of the standard WSDOT/APWA specifications for trench width "W" and trenching options. The pipe zone will be the actual trench width. The minimum concrete width shall be 1 1/2 I.D. + 18".
5. Trench backfill shall conform to "Backfilling Sewer Trenches" in the sanitary sewers section of the WSDOT/APWA standard specifications, except that rocks or lumps larger than 1" per foot of pipe diameter shall not be used in the backfill material.
6. See "Bedding Material for Flexible Pipe" in aggregates section of the WSDOT/APWA standard specification for the material specifications.

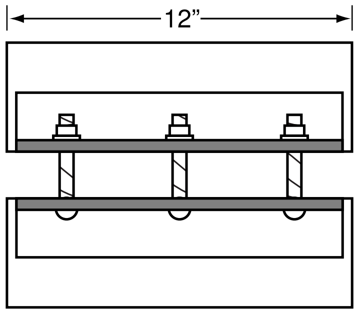
Backfill material placed in 0.5' loose layers and compacted to 95% maximum density.

Method B or C compaction (WSDOT/APWA standard specifications.)

Pipe	Size	Min. dist. between barrels
circular pipe conc., LCPE, CMP (diameter)	12" to 24"	12"
	30" to 96"	diam. ÷ 2
	102" to 180"	48"
pipe - arch metal only (span)	18" to 36"	12"
	43" to 142"	span. ÷ 3
	148" to 199"	48"



NOTE: For SWPE, pipe must be free to slide inside a 4’ long section of pipe one size diameter larger.



Smooth Coupling Band for Smooth Pipe

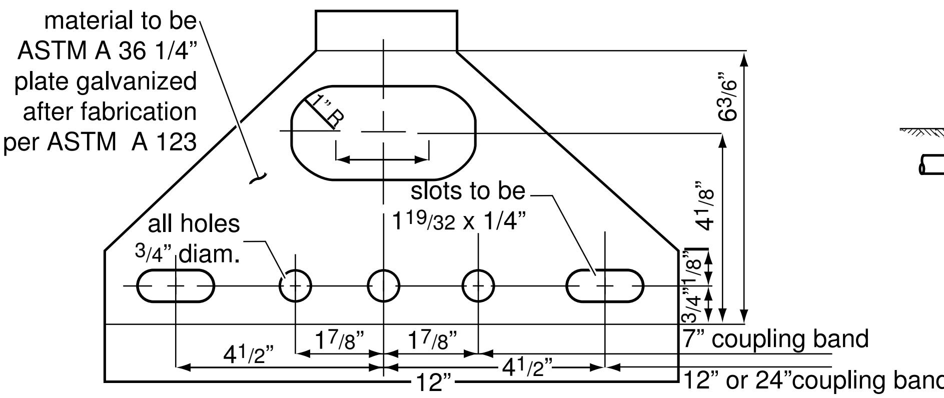
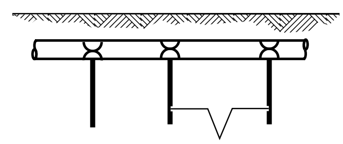
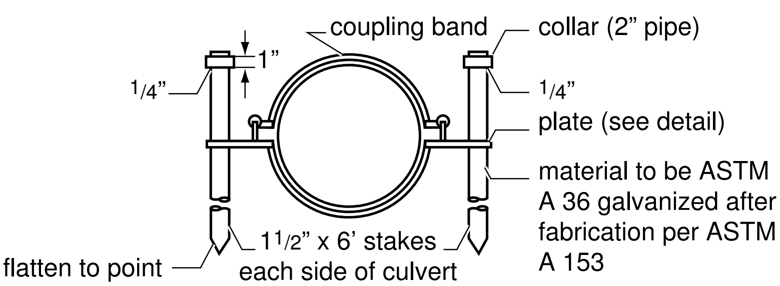


Plate Detail



pipe stakes

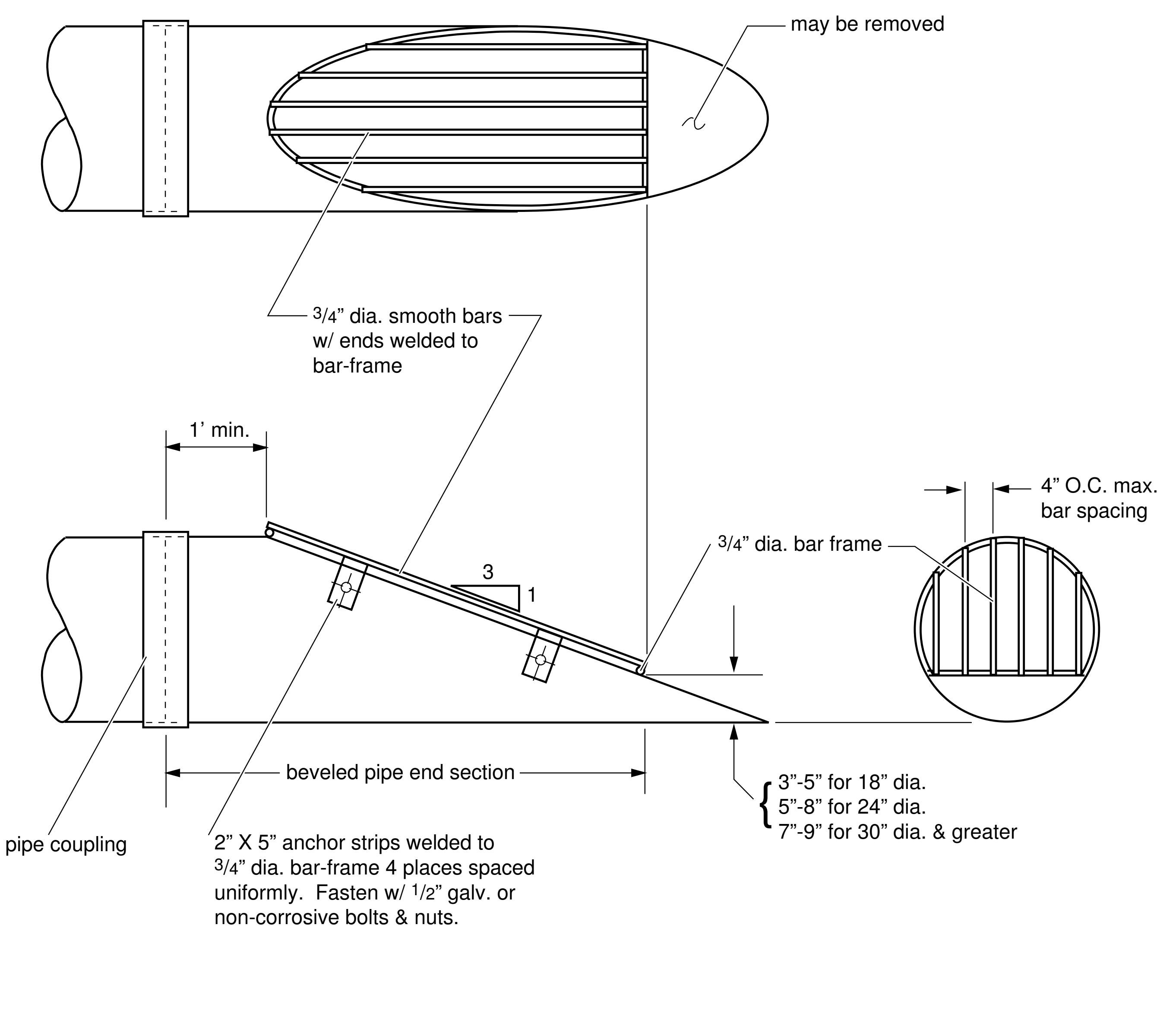


Anchor Assembly - Corrugated Metal Pipe

NOTES:

1. The smooth coupling band shall be used in combination with concrete pipe.
2. Concrete pipe without ball and spigot shall not be installed on grades in excess of 20%.
3. The first anchor shall be installed on the first section of the lower end of the pipe and remaining anchors evenly spaced throughout the installation.
4. If the pipe being installed has a manhole or catch basin on the lower end of the pipe, the first pipe anchor may be eliminated.
5. When CMP is used, the anchors may be attached to the coupling bands used to join the pipe as long as the specified spacing is not exceeded.
6. All pipe anchors shall be securely installed before backfilling around the pipe.

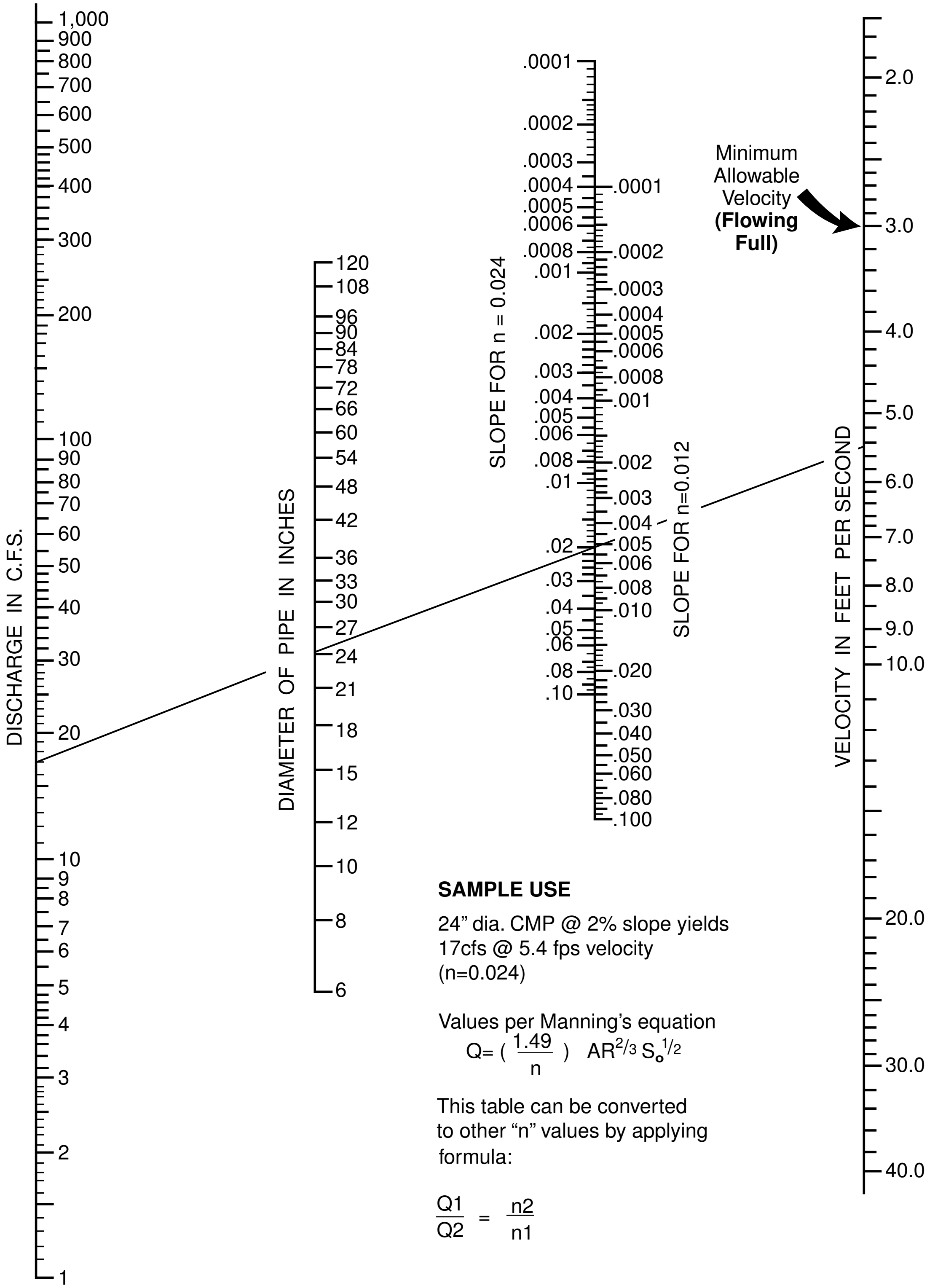
NOTES:
1. CMP or LCPE pipe end-section shown; for concrete pipe beveled end section, see KCRS drawing No. 2-001.
2. All steel parts must be galvanized and asphalt coated (treatment 1 or better).



$$\frac{1.49}{n}$$

$$\frac{1.49}{n}$$

TABLE 4.2.1.D MANNING'S "*n*" VALUES FOR PIPES



SAMPLE USE

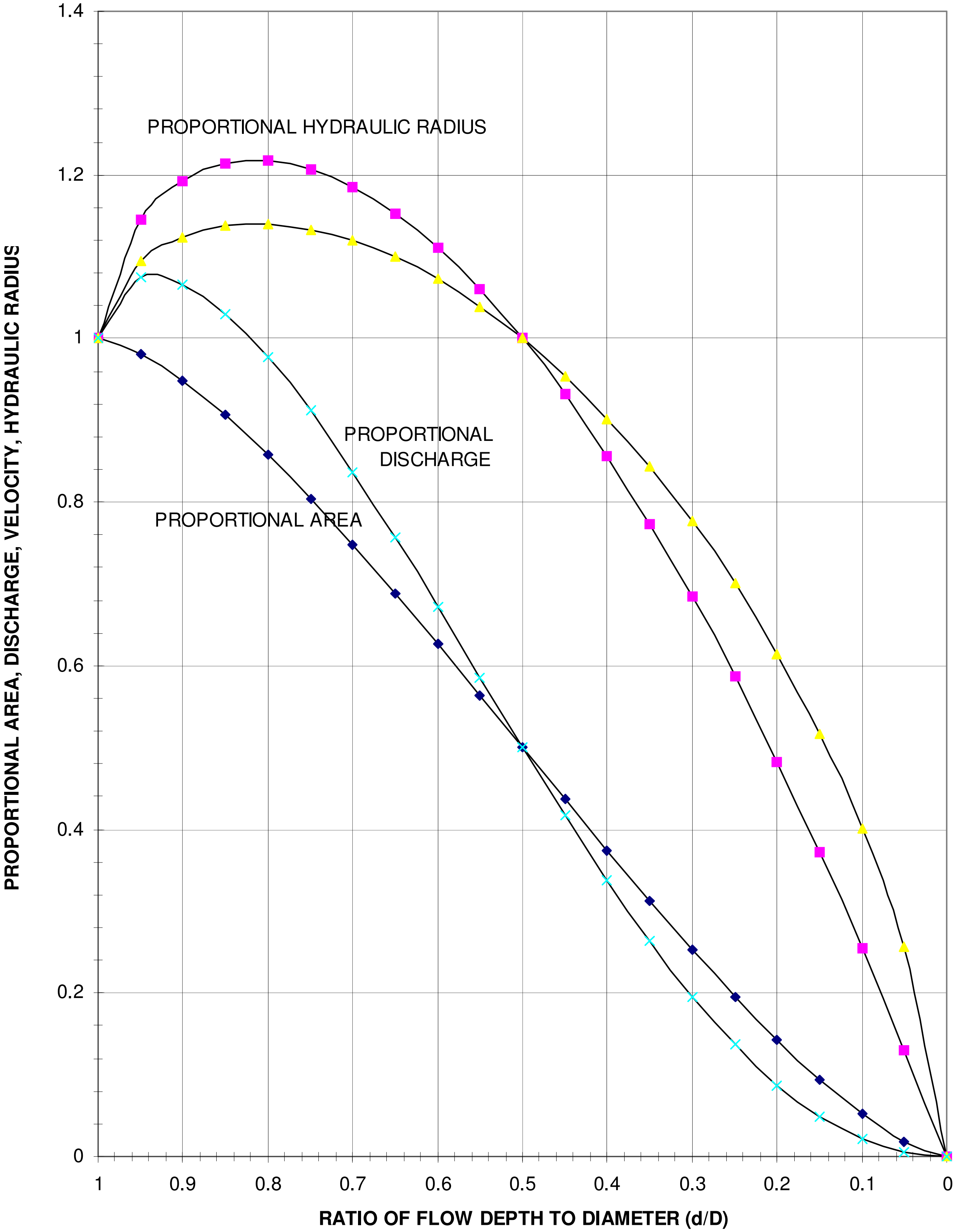
24” dia. CMP @ 2% slope yields 17cfs @ 5.4 fps velocity (n=0.024)

Values per Manning’s equation

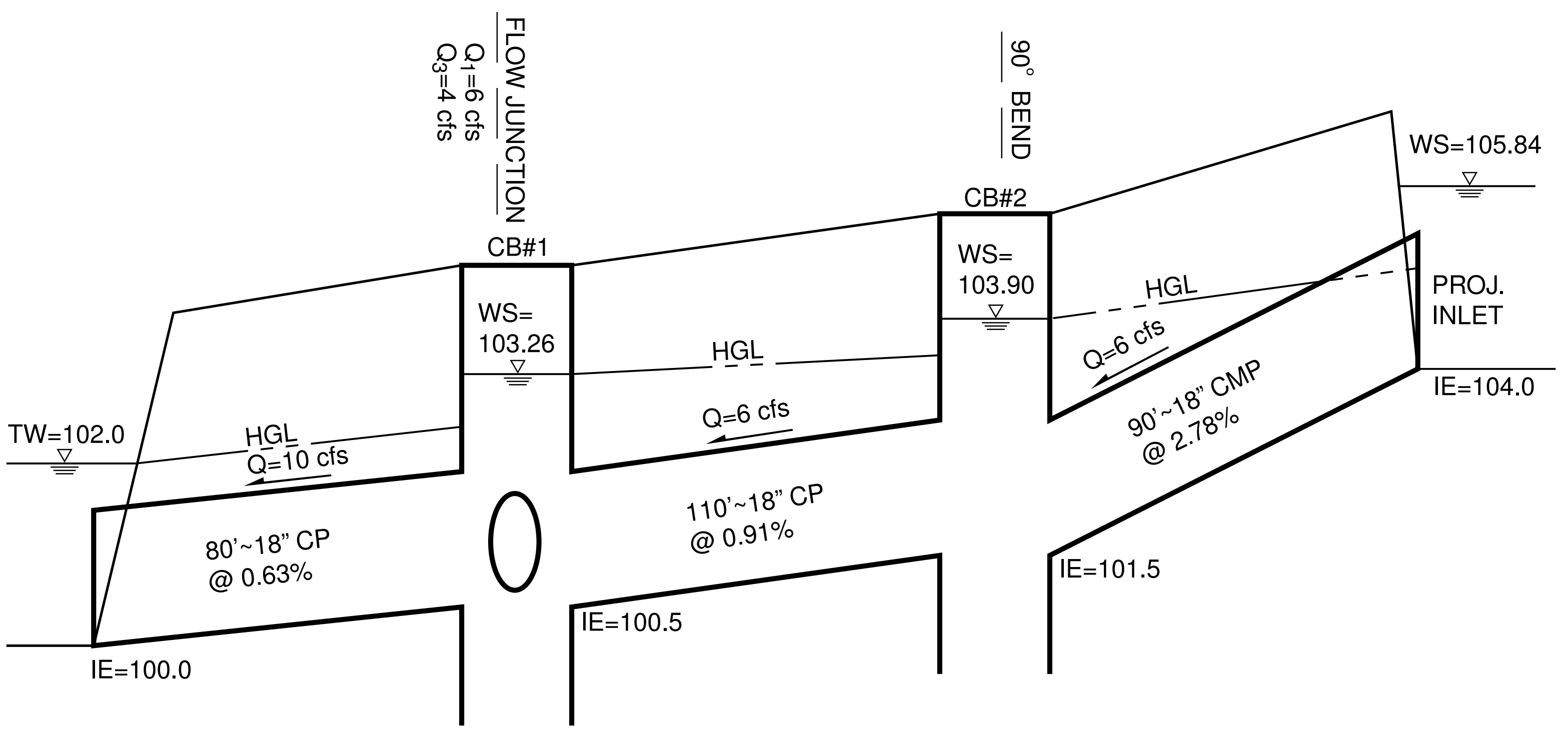
$$Q = \left(\frac{1.49}{n}\right) AR^{2/3} S_o^{1/2}$$

This table can be converted to other “n” values by applying formula:

$$\frac{Q1}{Q2} = \frac{n2}{n1}$$


PROPORTIONAL HYDRAULIC RADIUS
PROPORTIONAL DISCHARGE
PROPORTIONAL AREA
PROPORTIONAL AREA, DISCHARGE, VELOCITY, HYDRAULIC RADIUS
RATIO OF FLOW DEPTH TO DIAMETER (d/D)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

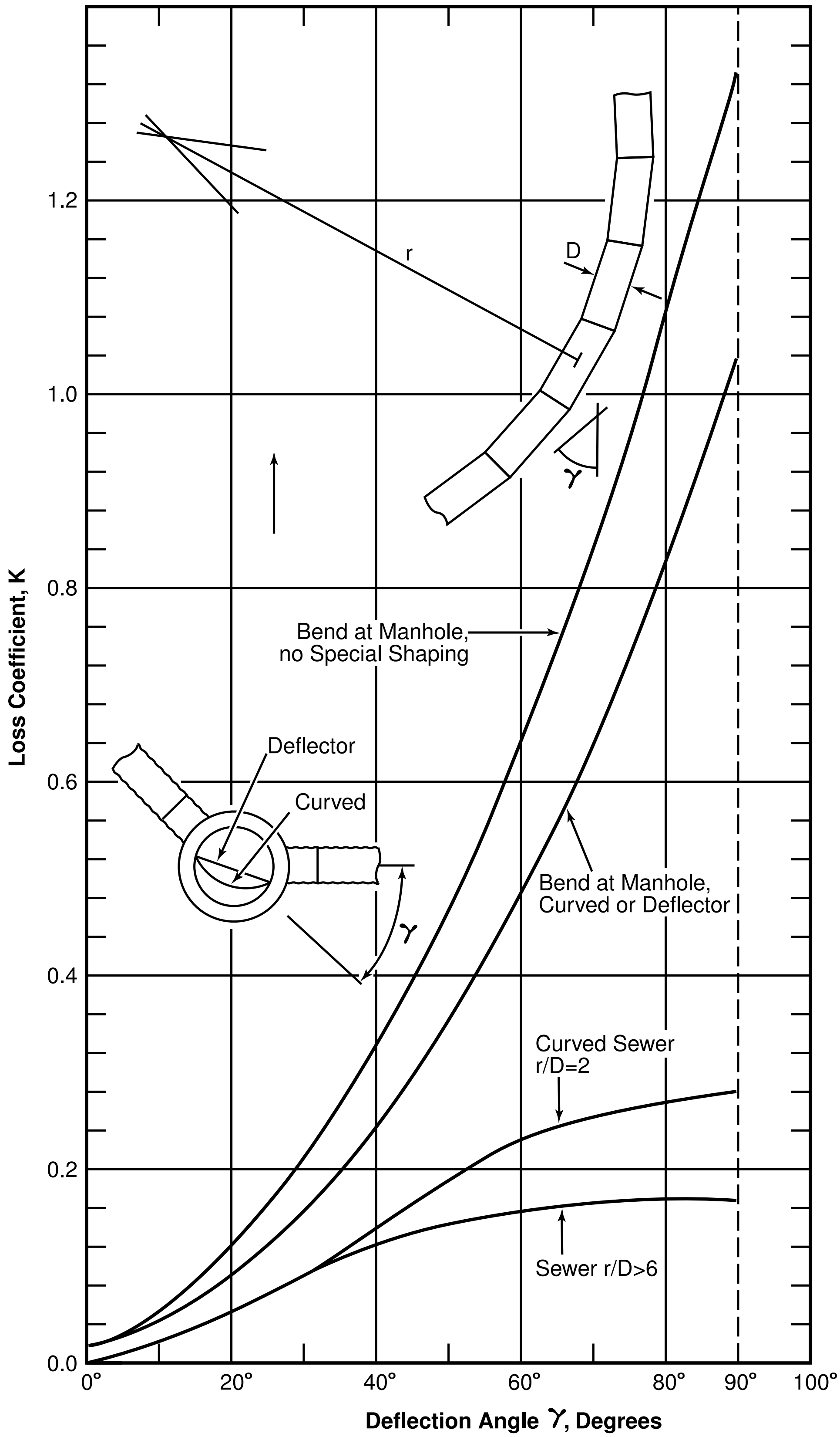
Pipe Segment CB to CB		(1) Q (cfs)	(2) Lngth (ft)	(3) Pipe Size	(4) "n" Value	(5) Outlet Elev (ft)	(6) Inlet Elev (ft)	(7) Barrel Area (sq. ft)	(8) Barrel Vel (fps)	(9) Barrel Vel Head (ft)	(10) TW Elev (ft)	(11) Fric- tion Loss (ft)	(12) Entr HGL Elev (ft)	(13) Entr Head Loss (ft)	(14) Exit Head Loss (ft)	(15) Outlt Cntrl Elev (ft)	(16) Inlet Cntrl Elev (ft)	(17) Appr Vel Head (ft)	(18) Bend Head Loss (ft)	(19) Junc Head Loss (ft)	(20) HW Elev (ft)



BACKWATER CALCULATION SHEET

Select the greater elevation

Pipe Segment CB to CB		(1) Q (cfs)	(2) Length (ft)	(3) Pipe Size	(4) "n" Value	(5) Outlet Elev (ft)	(6) Intlet Elev (ft)	(7) Barrel Area (sqft)	(8) Barrel Vel (fps)	(9) Barrel Vel Head (ft)	(10) TW Elev (ft)	(11) Friction Loss (ft)	(12) Entr HGL Elev (ft)	(13) Entr Head Loss (ft)	(14) Exit Head Loss (ft)	(15) Outlt Contr Elev (ft)	(16) Inlet Contr Elev (ft)	(17) Appr Vel Head (ft)	(18) Bend Head Loss (ft)	(19) Junc Head Loss (ft)	(20) HW Elev (ft)
Out fall	1	10	80	18"	0.012	100.00	100.50	1.77	5.65	0.50	102.00	0.62	102.62	0.25	0.50	103.37	102.75	-0.18	0.002	0.07	103.26
1	2	6	110	18"	0.012	100.50	101.50	1.77	3.39	0.18	103.26	0.31	103.57	0.09	0.18	103.84	102.95	-0.18	0.24	0.0	103.90
2	Inlet	6	90	18"	0.024	101.50	104.00	1.77	3.39	0.18	103.90	1.00	(104.9) 105.5	0.16	0.18	105.84	105.80	-0.0	0.0	0.0	105.84


Loss Coefficient, K
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0°
20°
40°
60°
80°
90°
100°
Deflection Angle γ, Degrees
r
D
γ
Bend at Manhole, no Special Shaping
Deflector
Curved
Bend at Manhole, Curved or Deflector
Curved Sewer r/D=2
Sewer r/D>6

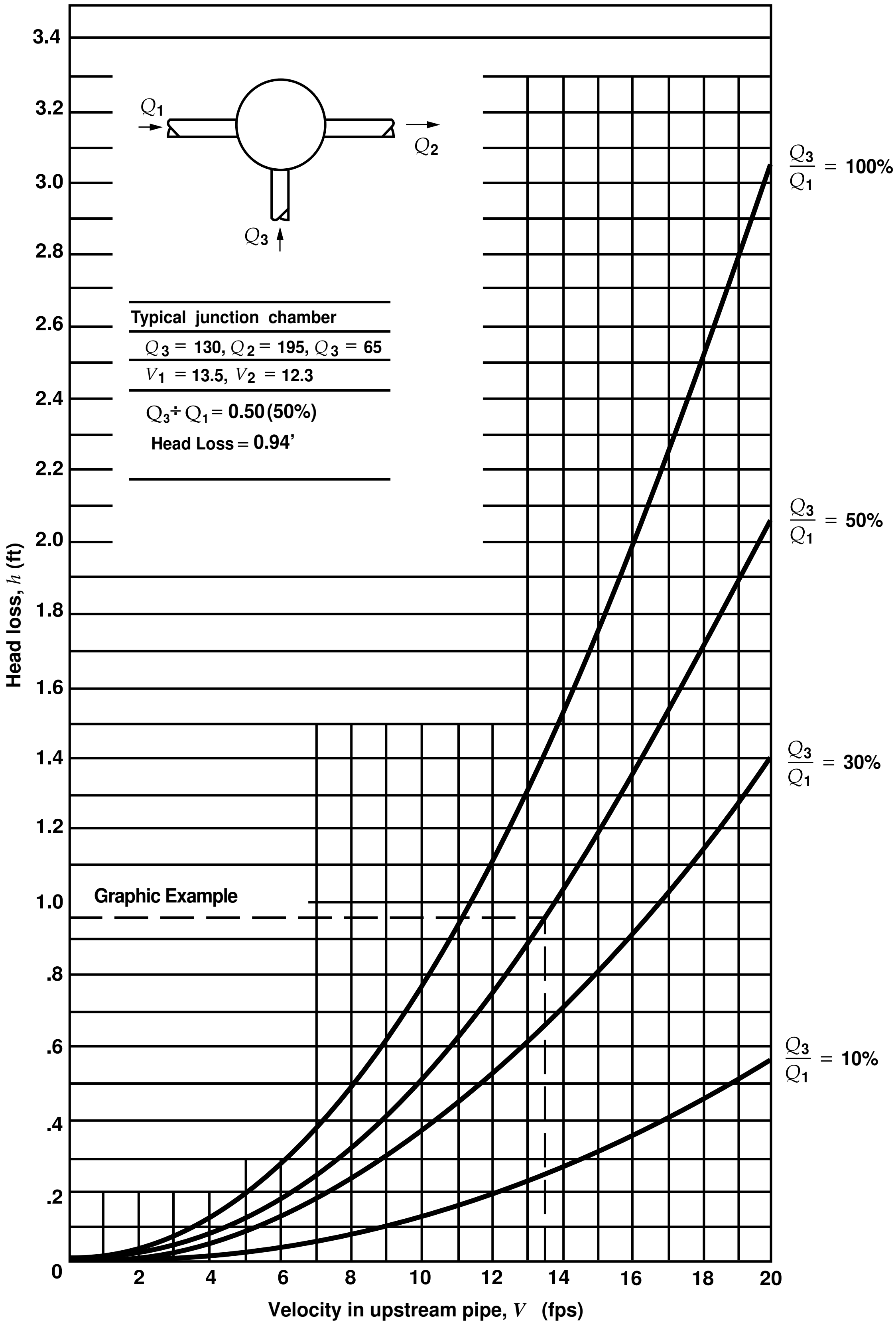
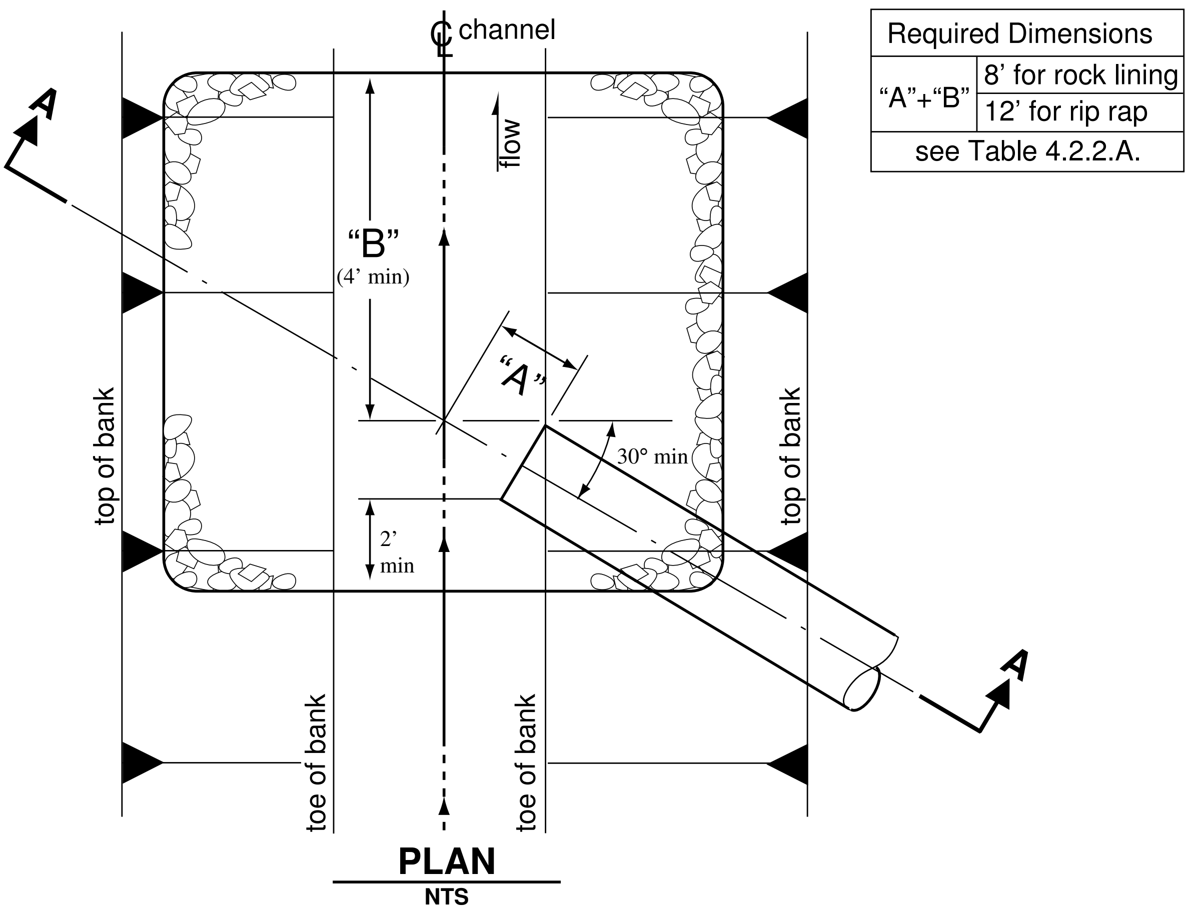
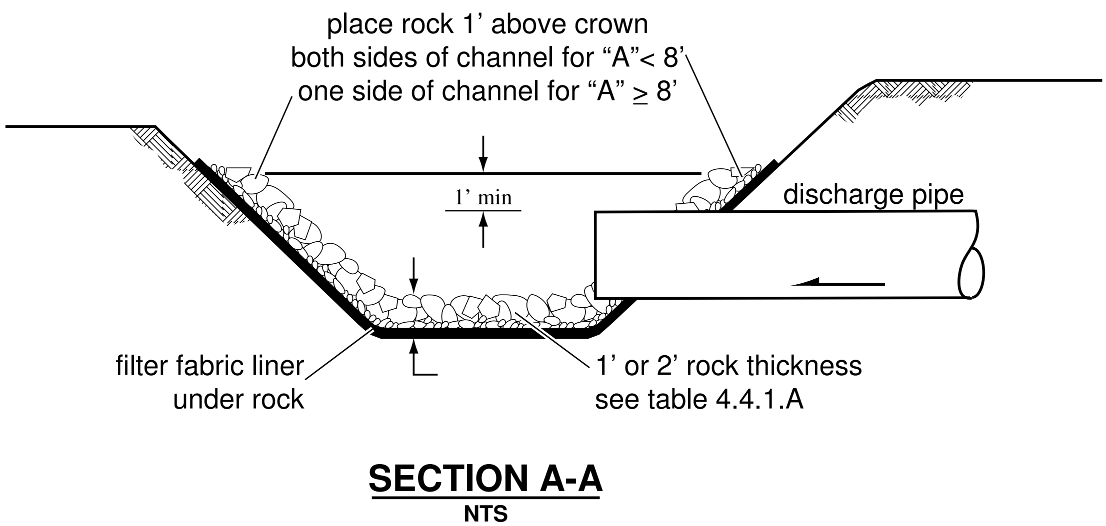

Head loss, h (ft)
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
.8
.6
.4
.2
0
2 4 6 8 10 12 14 16 18 20
Velocity in upstream pipe, V (fps)
Q_1
Q_2
Q_3
Typical junction chamber
Q_3 = 130, Q_2 = 195, Q_3 = 65
V_1 = 13.5, V_2 = 12.3
$Q_3 \div Q_1$ = 0.50 (50%)
Head Loss = 0.94'
Graphic Example
$\frac{Q_3}{Q_1}$ = 100%
$\frac{Q_3}{Q_1}$ = 50%
$\frac{Q_3}{Q_1}$ = 30%
$\frac{Q_3}{Q_1}$ = 10%

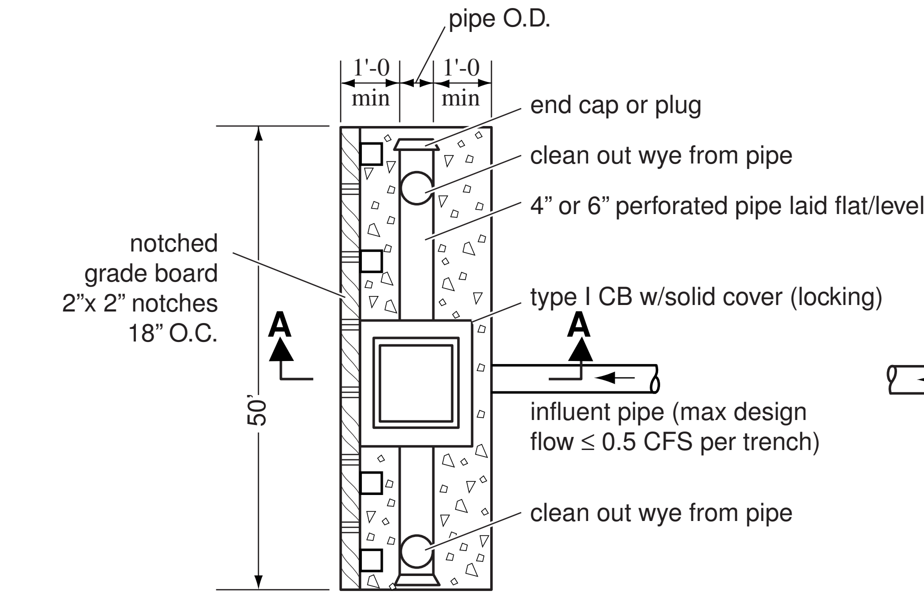
TABLE 4.2.2.A ROCK PROTECTION AT OUTFALLS



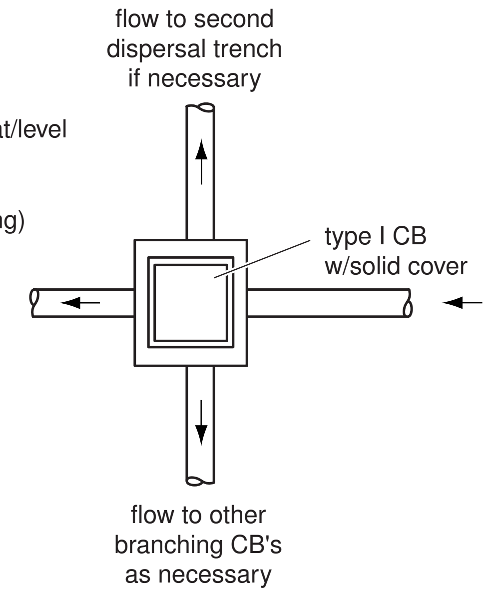
channel
Required Dimensions
"A"+"B"
8' for rock lining
12' for rip rap
see Table 4.2.2.A.
A
flow
"B"
(4' min)
"A"
30° min
2' min
top of bank
top of bank
toe of bank
toe of bank
A
PLAN
NTS

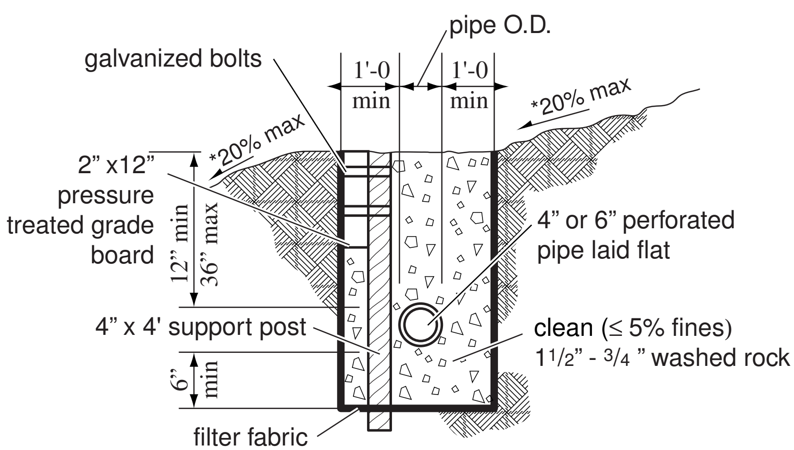


place rock 1' above crown
both sides of channel for "A"< 8'
one side of channel for "A" ≥ 8'
1' min
discharge pipe
filter fabric liner
under rock
1' or 2' rock thickness
see table 4.4.1.A
SECTION A-A
NTS



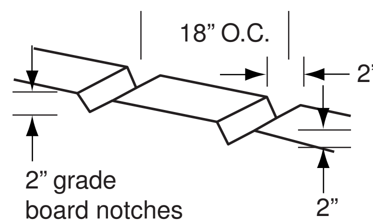
PLAN
NTS





*15% max for flow control/water quality treatment in rural areas.

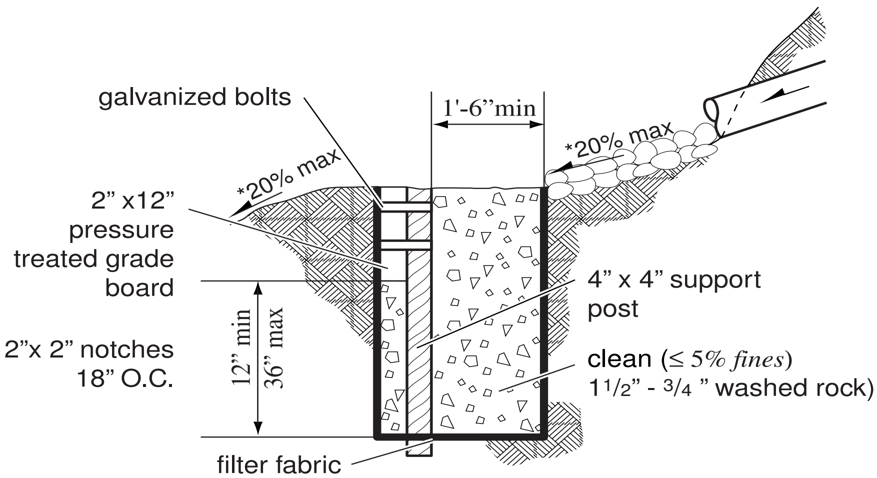
SECTION A-A
NTS



NOTES:

1. This trench shall be constructed so as to prevent point discharge and/or erosion.
2. Trenches may be placed no closer than 50 feet to one another. (100 feet along flowline)
3. Trench and grade board must be level. Align to follow contours of site.
4. Support post spacing as required by soil conditions to ensure grade board remains level.

Grade board shall be designed per detail in Figure 4.2.2.C

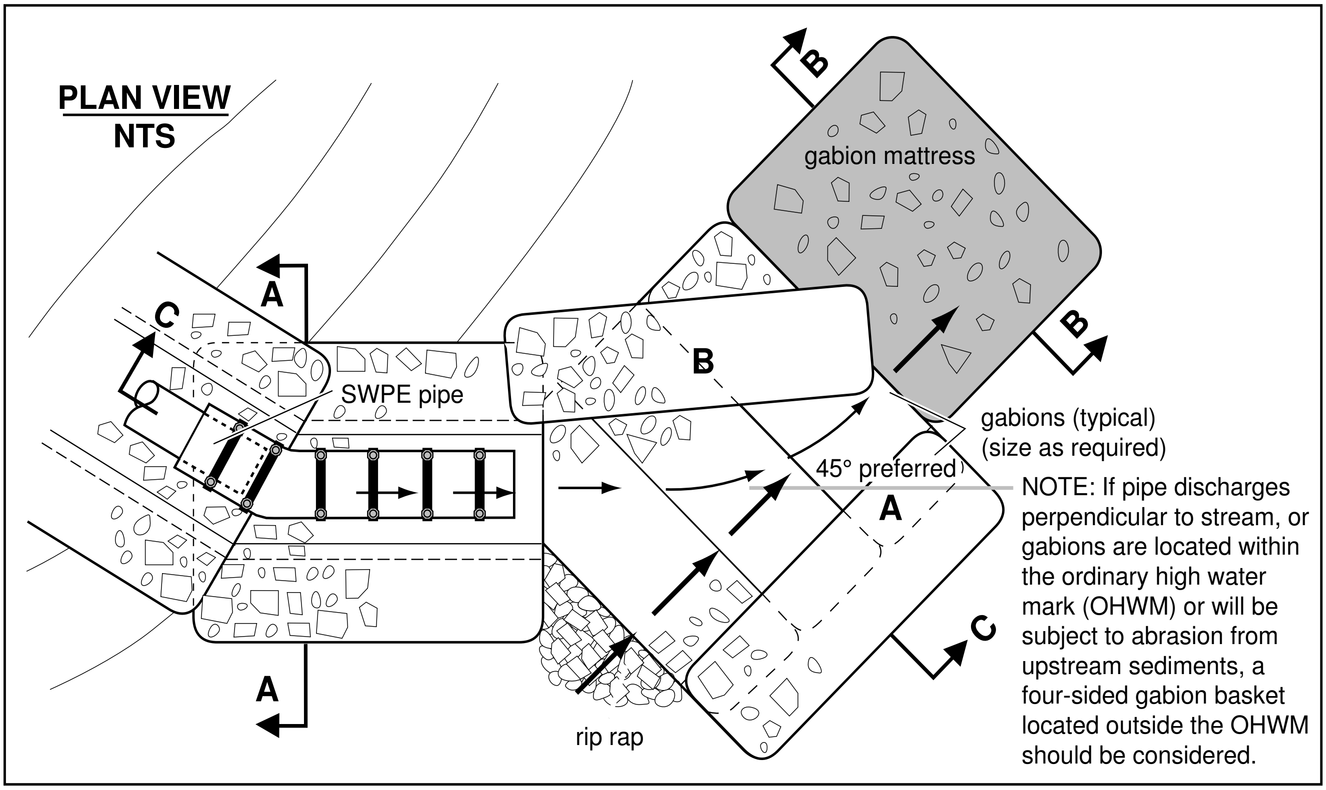


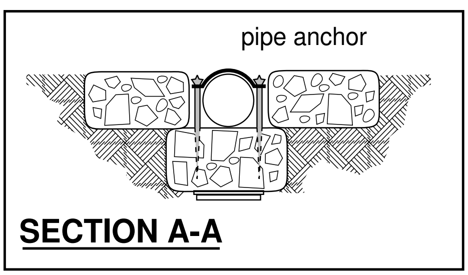
*15% max for flow control/water quality treatment in rural areas

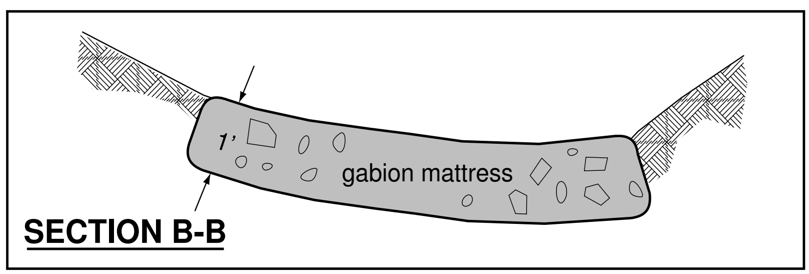
SECTION A-A
NTS

NOTES:

1. This trench shall be constructed so as to prevent point discharge and/or erosion.
2. Trenches may be placed no closer than 50 feet to one another. (100 feet along flowline)
3. Trench and grade board must be level. Align to follow contours of site.
4. Support post spacing as required by soil conditions to ensure grade board remains level.


PLAN VIEW
NTS
gabion mattress
B
B
A
A
C
C
B
A
SWPE pipe
gabions (typical)
(size as required)
45° preferred
NOTE: If pipe discharges perpendicular to stream, or gabions are located within the ordinary high water mark (OHWM) or will be subject to abrasion from upstream sediments, a four-sided gabion basket located outside the OHWM should be considered.
rip rap


pipe anchor
SECTION A-A


1'
gabion mattress
SECTION B-B

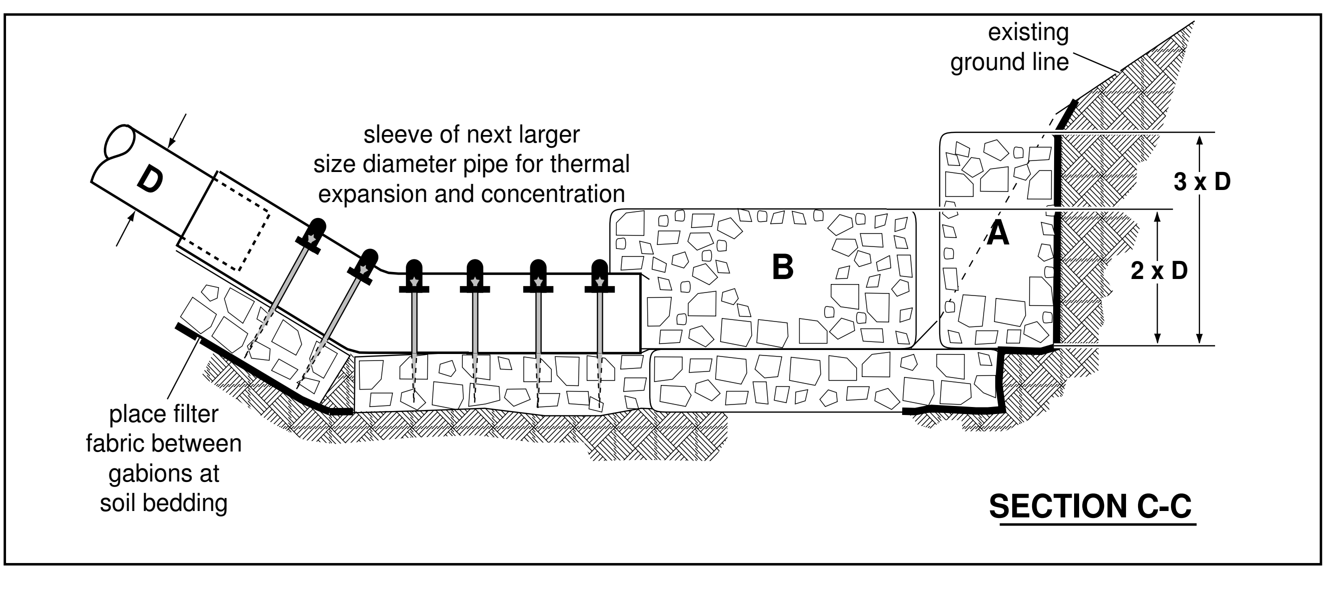
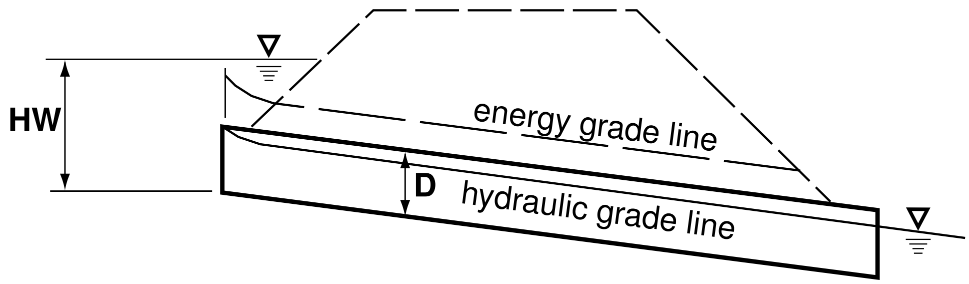
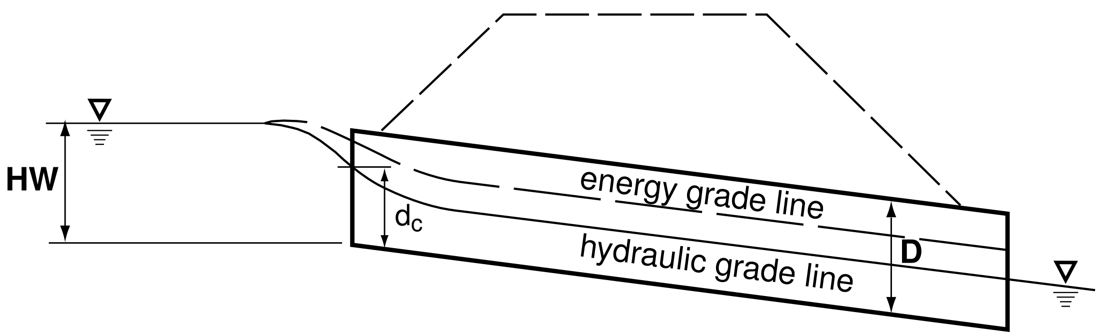

existing
ground line
sleeve of next larger
size diameter pipe for thermal
expansion and concentration
D
B
A
3 x D
2 x D
place filter
fabric between
gabions at
soil bedding
SECTION C-C

TABLE 4.3.1.A CONSTANTS FOR INLET CONTROL EQUATIONS*

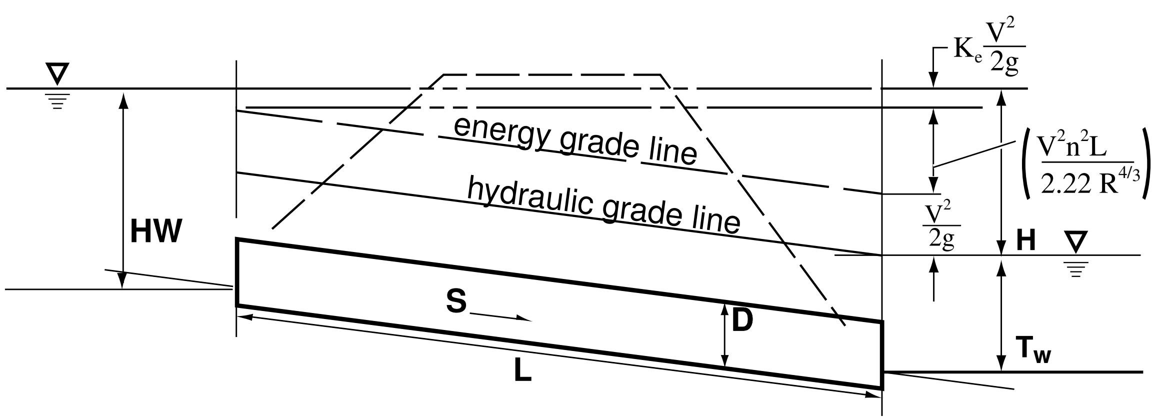
TABLE 4.3.1.B ENTRANCE LOSS COEFFICIENTS



Inlet Control - Submerged Inlet

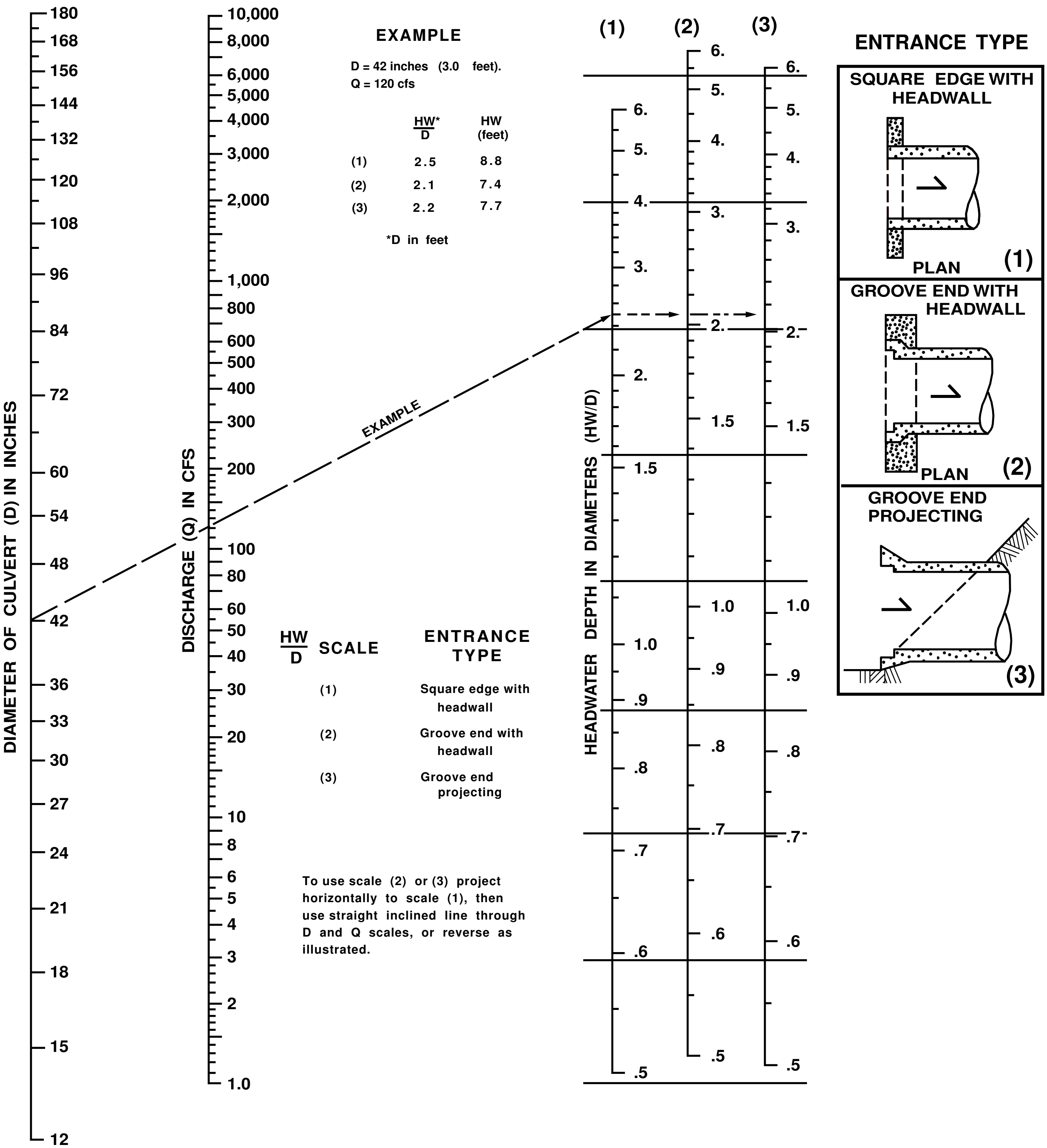


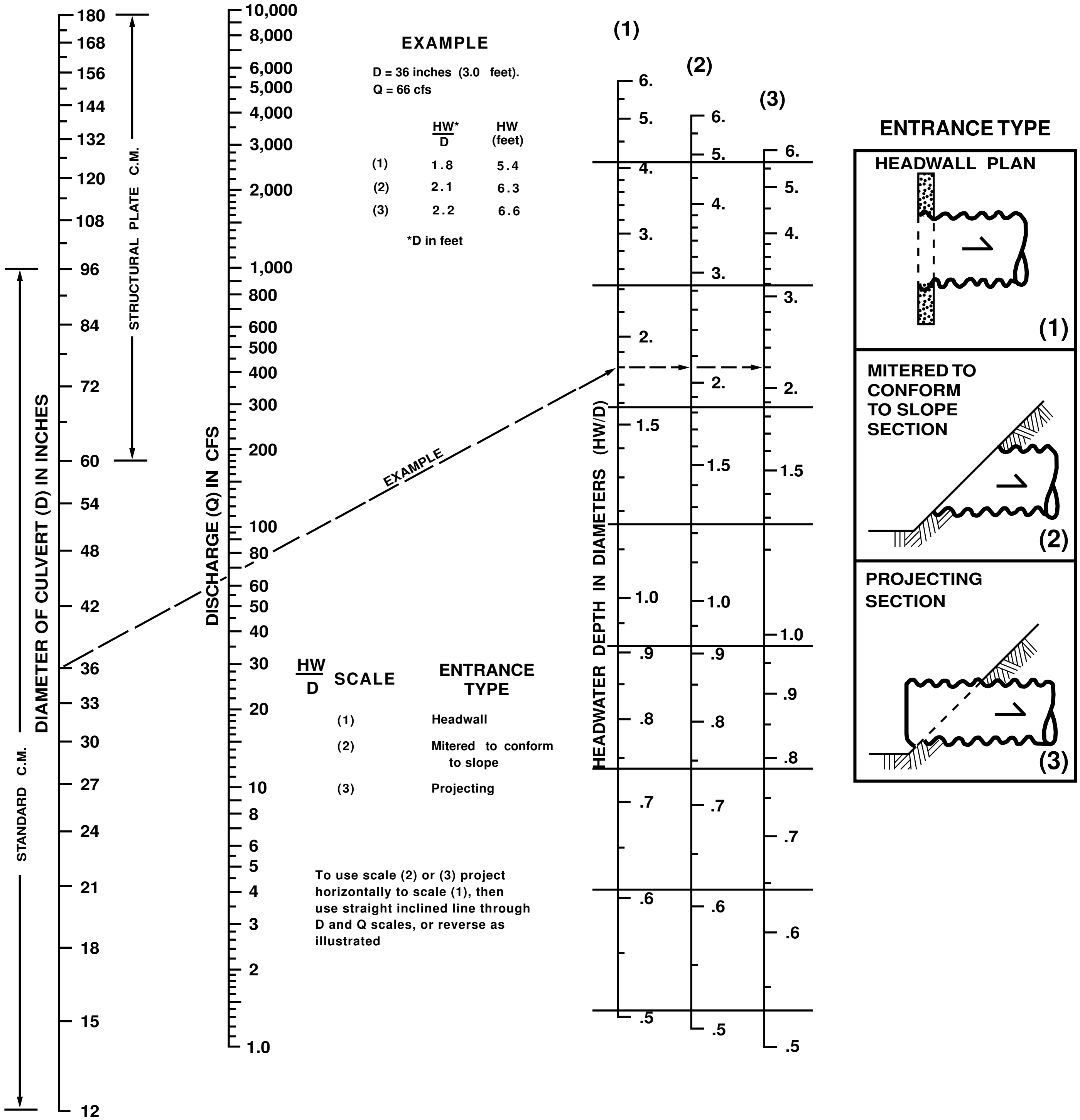
Inlet Control - Unsubmerged Inlet

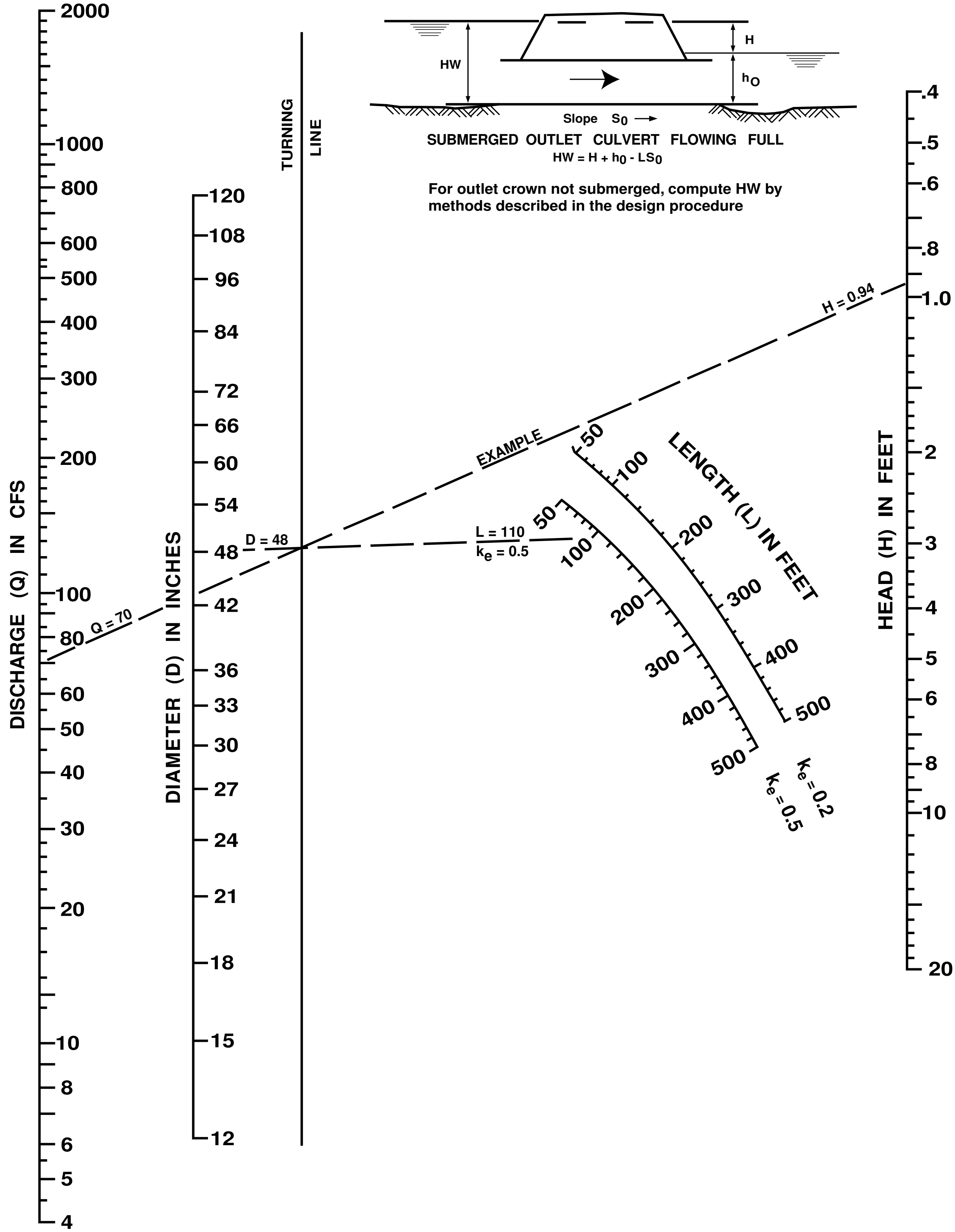


Outlet Control - Submerged Inlet and Outlet

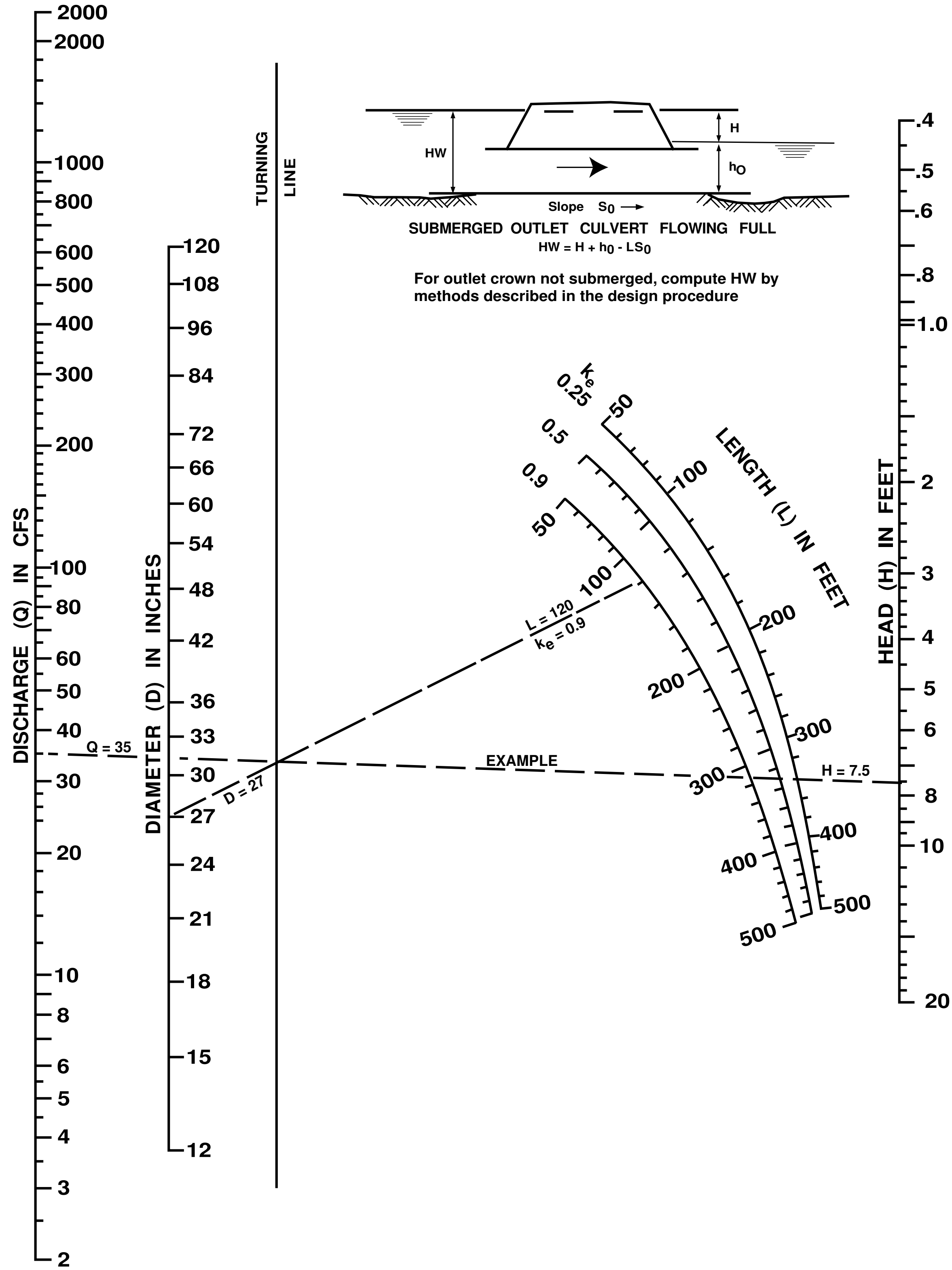
NOTE: See FHWA no. 5 for other possible conditions

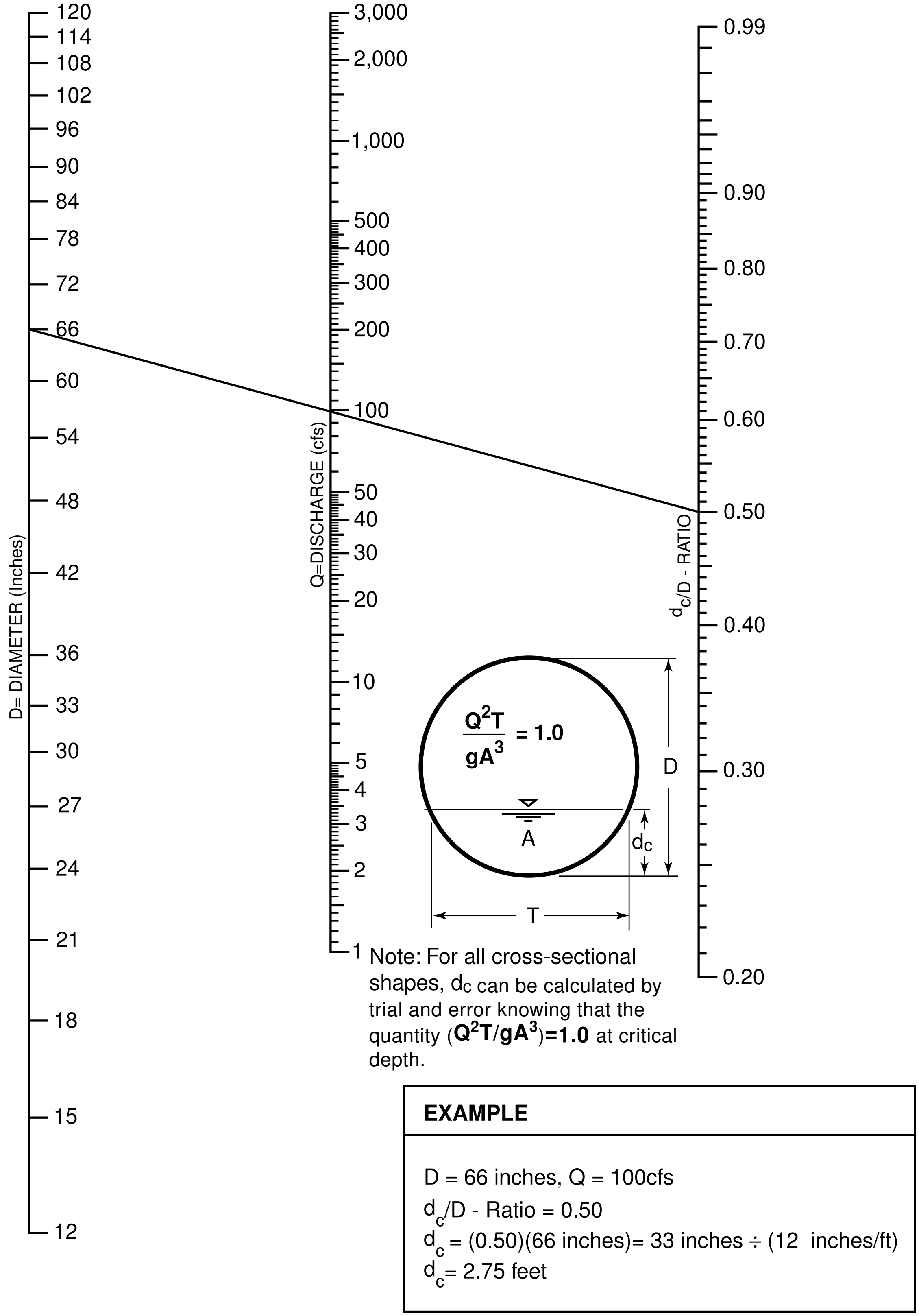

DIAMETER OF CULVERT (D) IN INCHES
180
168
156
144
132
120
108
96
84
72
60
54
48
42
36
33
30
27
24
21
18
15
12
DISCHARGE (Q) IN CFS
10,000
8,000
6,000
5,000
4,000
3,000
2,000
1,000
800
600
500
400
300
200
100
80
60
50
40
30
20
10
8
6
5
4
3
2
1.0
EXAMPLE
D = 42 inches (3.0 feet).
Q = 120 cfs
HW* / D
HW (feet)
(1) 2.5 8.8
(2) 2.1 7.4
(3) 2.2 7.7
*D in feet
EXAMPLE
HW / D SCALE
ENTRANCE TYPE
(1) Square edge with headwall
(2) Groove end with headwall
(3) Groove end projecting
To use scale (2) or (3) project horizontally to scale (1), then use straight inclined line through D and Q scales, or reverse as illustrated.
HEADWATER DEPTH IN DIAMETERS (HW/D)
(1)
(2)
(3)
6.
5.
4.
3.
2.
1.5
1.0
.9
.8
.7
.6
.5
ENTRANCE TYPE
SQUARE EDGE WITH HEADWALL
PLAN
(1)
GROOVE END WITH HEADWALL
PLAN
(2)
GROOVE END PROJECTING
(3)


EXAMPLE
D = 36 inches (3.0 feet).
Q = 66 cfs
HW*/D HW (feet)
(1) 1.8 5.4
(2) 2.1 6.3
(3) 2.2 6.6
*D in feet
DIAMETER OF CULVERT (D) IN INCHES
STRUCTURAL PLATE C.M.
STANDARD C.M.
DISCHARGE (Q) IN CFS
HEADWATER DEPTH IN DIAMETERS (HW/D)
EXAMPLE
HW/D SCALE
ENTRANCE TYPE
(1) Headwall
(2) Mitered to conform to slope
(3) Projecting
To use scale (2) or (3) project horizontally to scale (1), then use straight inclined line through D and Q scales, or reverse as illustrated
ENTRANCE TYPE
HEADWALL PLAN
(1)
MITERED TO CONFORM TO SLOPE SECTION
(2)
PROJECTING SECTION
(3)

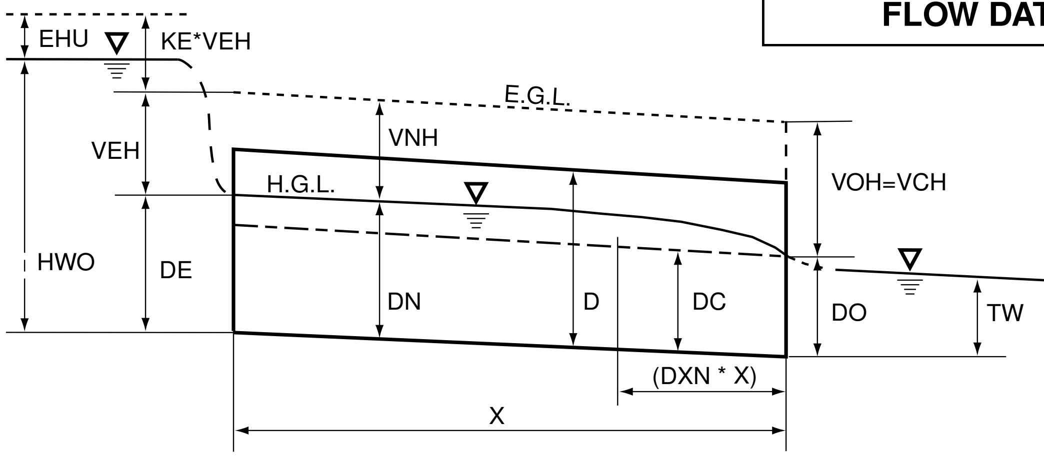


SUBMERGED OUTLET CULVERT FLOWING FULL
HW = H + h0 - LS0
Slope S0
HW
H
hO
For outlet crown not submerged, compute HW by methods described in the design procedure
TURNING LINE
DISCHARGE (Q) IN CFS
DIAMETER (D) IN INCHES
LENGTH (L) IN FEET
HEAD (H) IN FEET
EXAMPLE
Q = 70
D = 48
L = 110
ke = 0.5
H = 0.94
ke = 0.2
ke = 0.5
2000
1000
800
600
500
400
300
200
100
80
60
50
40
30
20
10
8
6
5
4
120
108
96
84
72
66
60
54
48
42
36
33
30
27
24
21
18
15
12
.4
.5
.6
.8
1.0
2
3
4
5
6
8
10
20


DISCHARGE (Q) IN CFS
DIAMETER (D) IN INCHES
TURNING LINE
HW
H
h_O
Slope S_0
SUBMERGED OUTLET CULVERT FLOWING FULL
HW = H + h_0 - LS_0
For outlet crown not submerged, compute HW by methods described in the design procedure
k_e
0.25
0.5
0.9
LENGTH (L) IN FEET
HEAD (H) IN FEET
L = 120
k_e = 0.9
Q = 35
D = 27
EXAMPLE
H = 7.5


D= DIAMETER (Inches)
120
114
108
102
96
90
84
78
72
66
60
54
48
42
36
33
30
27
24
21
18
15
12
Q=DISCHARGE (cfs)
3,000
2,000
1,000
500
400
300
200
100
50
40
30
20
10
5
4
3
2
1
d_c/D - RATIO
0.99
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
$\frac{Q^2T}{gA^3} = 1.0$
D
A
d_c
T
Note: For all cross-sectional shapes, d_c can be calculated by trial and error knowing that the quantity (Q^2T/gA^3)=1.0 at critical depth.
EXAMPLE
D = 66 inches, Q = 100cfs
d_c/D - Ratio = 0.50
d_c = (0.50)(66 inches)= 33 inches ÷ (12 inches/ft)
d_c= 2.75 feet

FLOW DATA


EHU
KE*VEH
E.G.L.
VNH
VEH
H.G.L.
VOH=VCH
HWO
DE
DN
D
DC
DO
TW
(DXN * X)
X

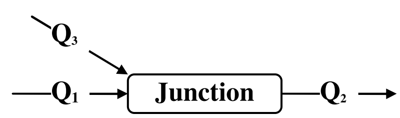
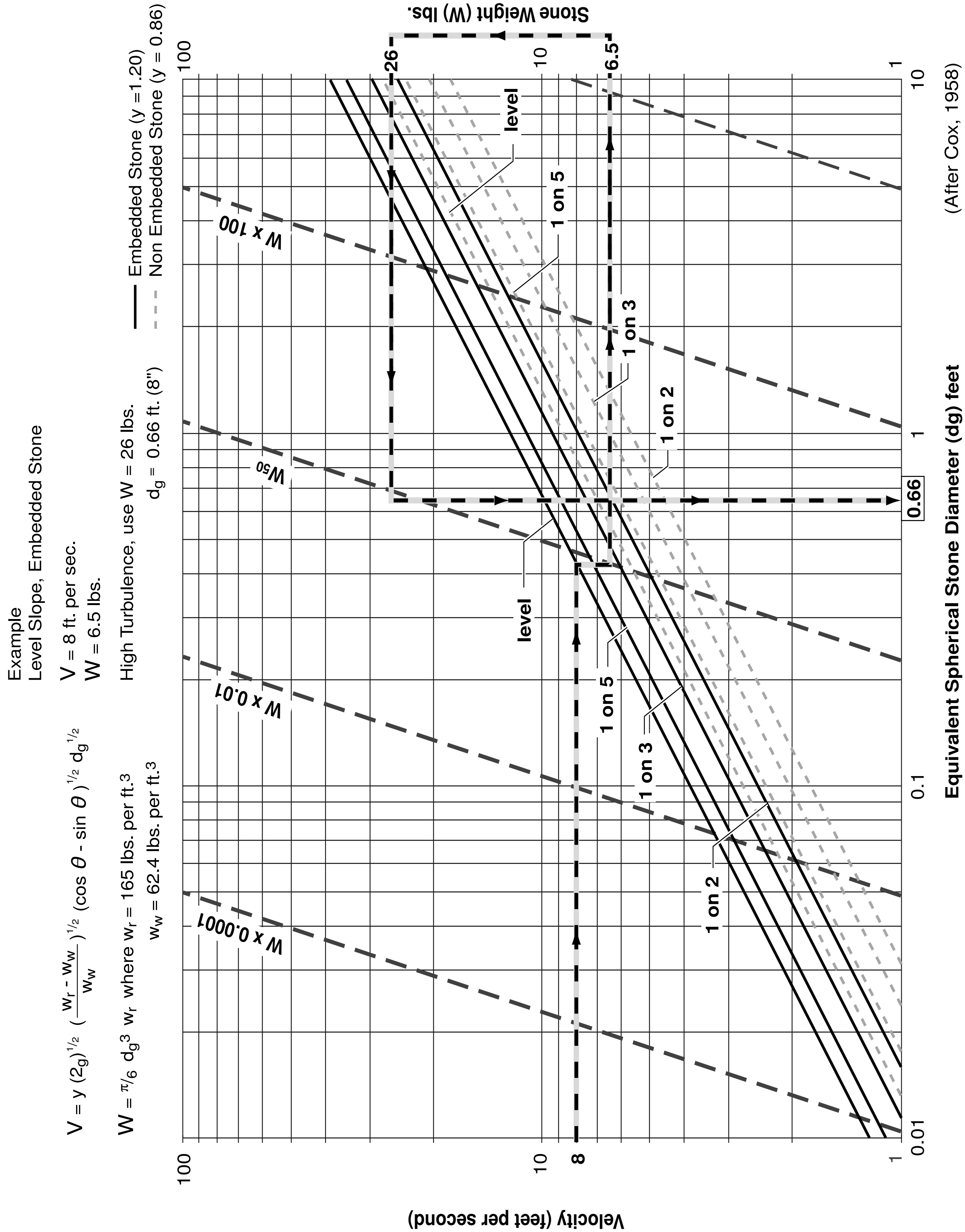

Q3
Q1
Junction
Q2

TABLE 4.3.2.A FISH PASSAGE DESIGN CRITERIA			

TABLE 4.4.1.A CHANNEL PROTECTION

[9] From a paper prepared by M. Schaefer, Dam Safety Section, Washington State Department of Ecology.



$V = y\,(2g)^{1/2}\left(\frac{w_r - w_w}{w_w}\right)^{1/2}(\cos\theta - \sin\theta)^{1/2}\,d_g^{1/2}$
$W = {}^{\pi}/_{6}\; d_g^3\; w_r$ where w_r = 165 lbs. per ft.^{3}
w_w = 62.4 lbs. per ft.^{3}
Example
Level Slope, Embedded Stone
V = 8 ft. per sec.
W = 6.5 lbs.
High Turbulence, use W = 26 lbs.
d_g = 0.66 ft. (8")
Embedded Stone (y = 1.20)
Non Embedded Stone (y = 0.86)
Stone Weight (W) lbs.
Velocity (feet per second)
Equivalent Spherical Stone Diameter (dg) feet
(After Cox, 1958)
W x 100
W_{50}
W x 0.01
W x 0.0001
level
1 on 5
1 on 3
1 on 2
26
6.5
8
0.66
100
10
1
0.01
0.1

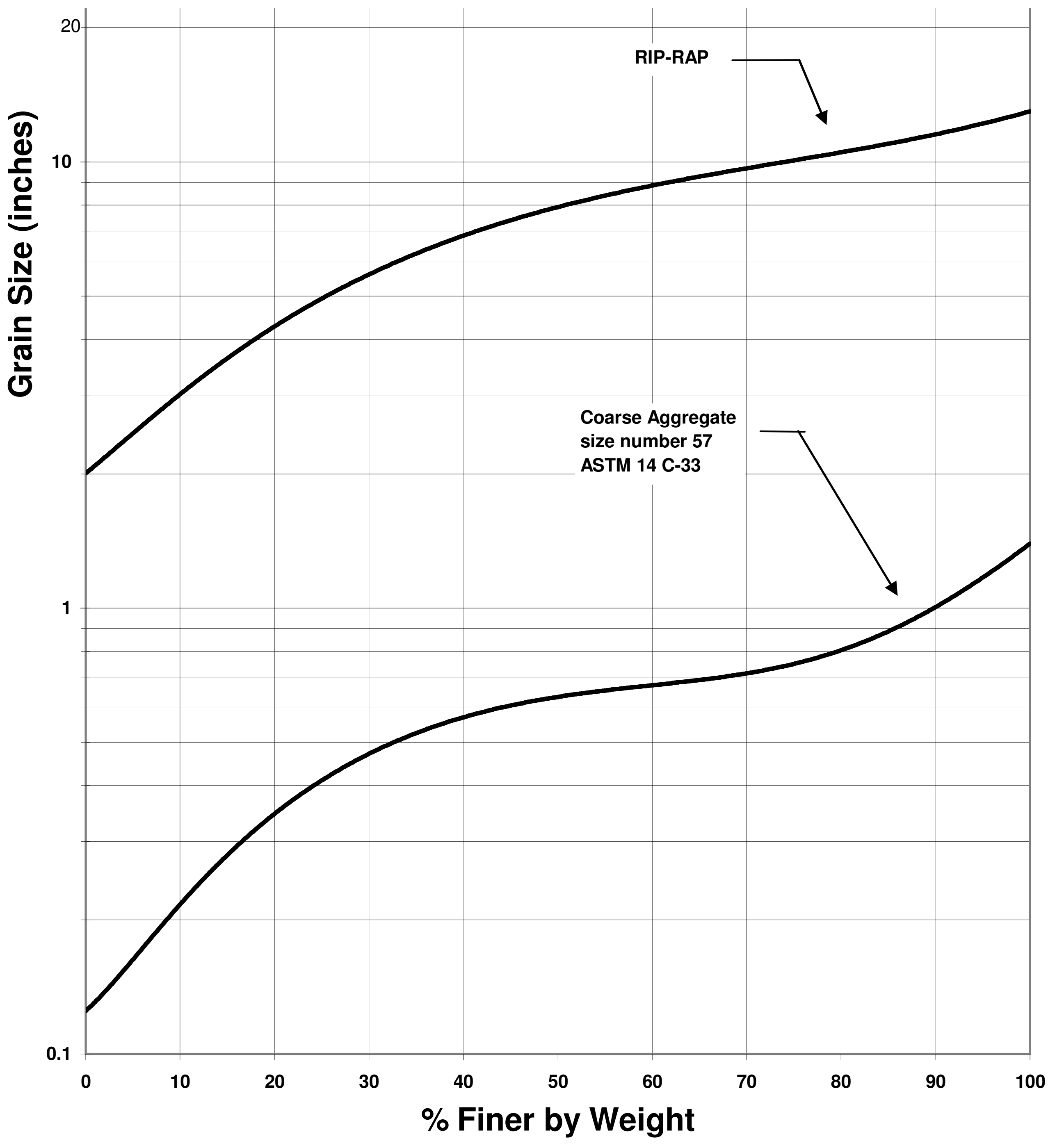
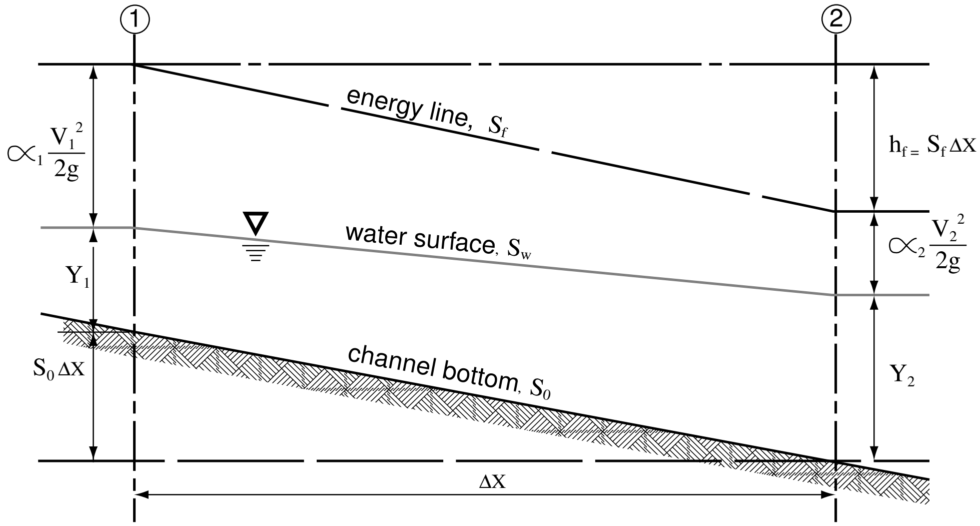
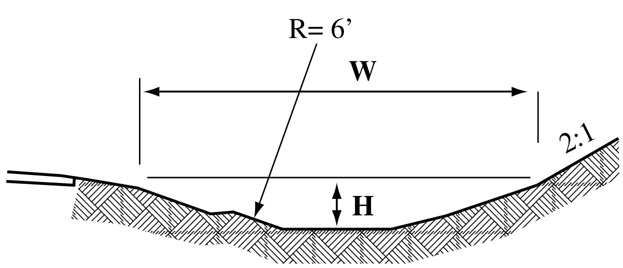

RIP-RAP
Coarse Aggregate
size number 57
ASTM 14 C-33
Grain Size (inches)
20
10
1
0.1
0
10
20
30
40
50
60
70
80
90
100
% Finer by Weight

TABLE 4.4.1.B VALUES OF ROUGHNESS COEFFICIENT "*n*" FOR OPEN CHANNELS

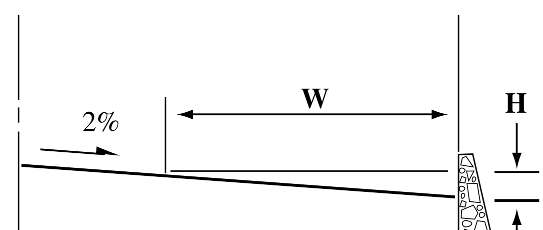


$$\alpha_1 \frac{V_1^2}{2g} \qquad \alpha_2 \frac{V_2^2}{2g}$$

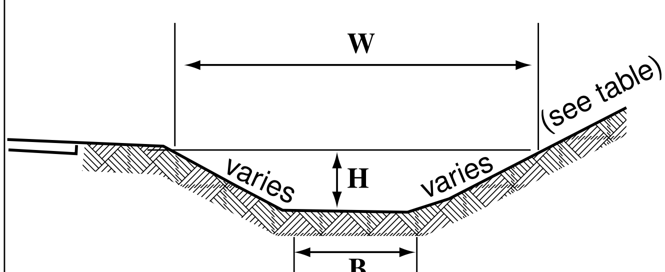
$$\alpha \frac{V^2}{2g}$$



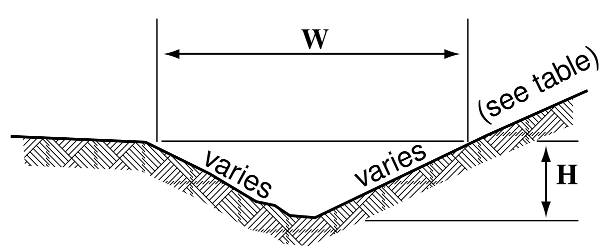
D-1 Segmental (parabolic)



D-1c Curbed crowned street



D-2, D-3, D-4, D-5 Trapezoidal

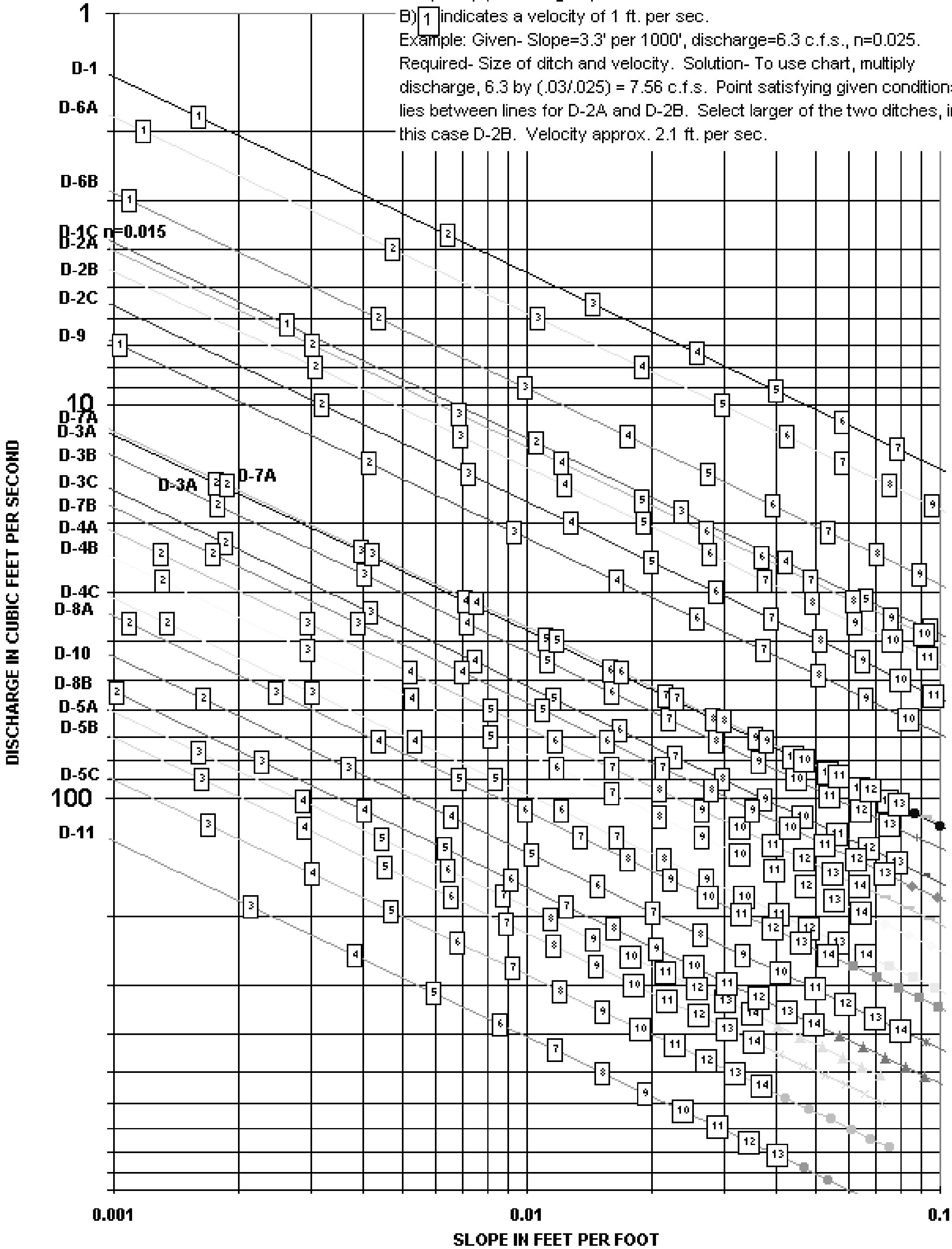


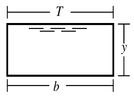
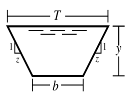
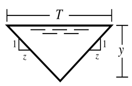
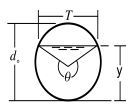
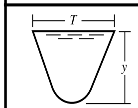
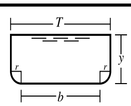
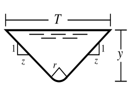
Isosceles triangular D-6 through D-11

NOTE: A) Chart based on Manning formula Q=1.49/n*A*R2/3*S1/2 with n=0.030, except D-1C which is based on n=0.015. For other values of n, multiply discharge by 0.030/n

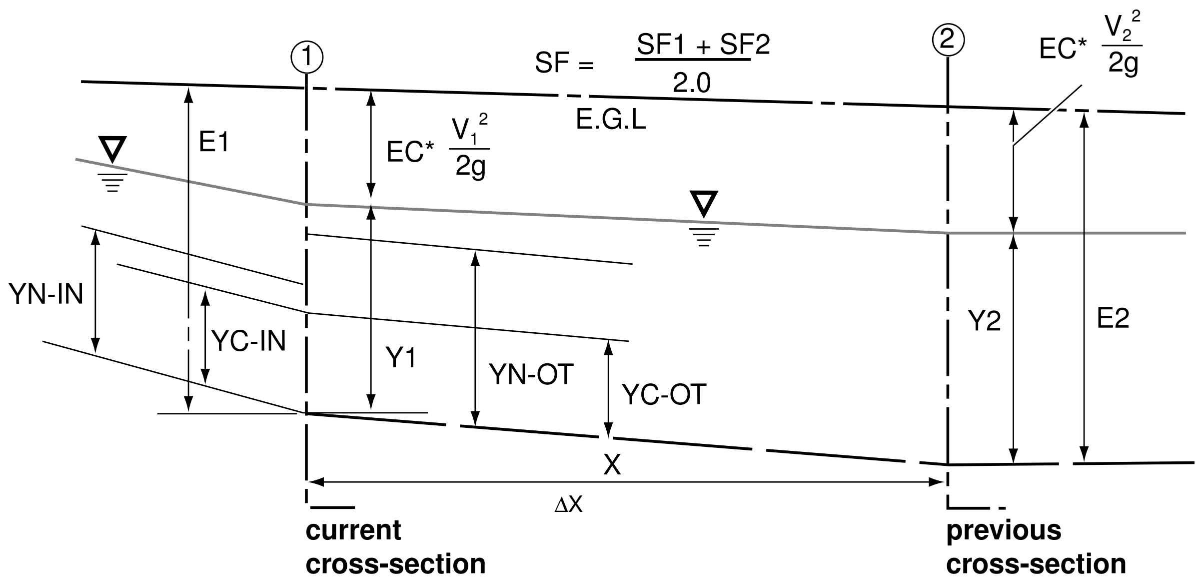
B) 1 indicates a velocity of 1 ft. per sec.

Example: Given- Slope=3.3' per 1000', discharge=6.3 c.f.s., n=0.025. Required- Size of ditch and velocity. Solution- To use chart, multiply discharge, 6.3 by (.03/.025) = 7.56 c.f.s. Point satisfying given conditions lies between lines for D-2A and D-2B. Select larger of the two ditches, in this case D-2B. Velocity approx. 2.1 ft. per sec.



Section	Area A	Wetted perimeter P	Hydraulic radius R	Top width W	Hydraulic depth D	Section factor Z
 Rectangle	by	$b + 2y$	$\frac{by}{b + 2y}$	b	y	$by^{1.5}$
 Trapezoid	$(b + zy)y$	$b + 2y\sqrt{1 + z^2}$	$\frac{(b + zy)y}{b + 2y\sqrt{1 + z^2}}$	$b + 2zy$	$\frac{(b + zy)y}{b + 2zy}$	$\frac{[(b + zy)y]^{1.5}}{\sqrt{b + 2zy}}$
 Triangle	zy^2	$2y\sqrt{1 + z^2}$	$\frac{zy}{2\sqrt{1 + z^2}}$	$2zy$	${}^1/_2 y$	$\frac{\sqrt{2}}{2} zy^{2.5}$
 Circle	${}^1/_8(\theta - \sin\theta)d_\circ^2$	${}^1/_2 \theta d_\circ$	${}^1/_4 (1 - \frac{\sin\theta}{\theta}) d_\circ$	$(\sin({}^1/_2\theta)d_\circ)$ *or* $2\sqrt{y(d_\circ - y)}$	${}^1/_8\left(\frac{\theta - \sin\theta}{\sin {}^1/_2\theta}\right)d_\circ$	$\frac{\sqrt{2}}{32}\frac{(\theta - \sin\theta)^{1.5}}{(\sin {}^1/_2\theta)^{0.5}} d_\circ^{2.5}$
 Parabola	${}^2/_3 Ty$	$T + \frac{8y^2}{3T}$ *	$\frac{2T^2 y}{3T^2 + 8y^2}$ *	$\frac{3A}{2y}$	${}^2/_3 y$	${}^2/_9\sqrt{6}Ty^{1.5}$
 Round-cornered Rectangle ($y>r$)	$(\frac{\pi}{2} - 2)r^2 + (b + 2r)y$	$(\pi - 2)r + b + 2y$	$\frac{(\frac{\pi}{2} - 2)r^2 + (b + 2r)y}{(\pi - 2)r + b + 2y}$	$b + 2r$	$\frac{(\frac{\pi}{2} - 2)r^2}{(b + 2r)} + y$	$\frac{[(\frac{\pi}{2} - 2)r^2 + (b + 2r)y]^{1.5}}{\sqrt{b + 2y}}$
 Round-bottomed Triangle	$\frac{T^2}{4z} - \frac{r^2}{z}(1 - z\cot^{-1}z)$	$\frac{T}{z}\sqrt{1 + z^2} - \frac{2r}{z}(1 - z\cot^{-1} z)$	$\frac{A}{P}$	$2[z(y - r) + r\sqrt{1 + z^2}]$	$\frac{A}{T}$	$A\sqrt{\frac{A}{T}}$

*Satisfactory approximation for the interval 0<x≤1, where x=4y/T. When x>1, use the exact expression $P = ({}^T/_2)\left[\sqrt{1 + x^2} + {}^1/_x \ln\left(x + \sqrt{1 + x^2}\right)\right]$



	$\left(Y1 + EC * V_1^2 / 2g\right)$

TABLE 4.4.2.A FLOODPLAIN/FLOODWAY STUDY THRESHOLDS AND REQUIREMENTS		

[10] *Engineering plan* means a site improvement plan, including supporting documentation, stamped by a ***licensed civil engineer***. In some instances, DDES engineering review staff may determine that the proposed project is sufficiently above the clearances specified in this exception and may not require an engineering plan. Typically, this is done for projects in Small Project Drainage Review that clearly exceed minimum clearances and otherwise would not require engineering design.

[11] Dinacola, 1990. U.S.G.S., Characterization and Simulation of Rainfall-Runoff Relations for Headwater Basins in Western King and Snohomish Counties, Washington.

TABLE 4.4.2.B DATUM CORRELATIONS

[1] Finlayson, 1990. Unpublished data from reconnaissance of Metro Park and Ride lot stormwater characteristics.

[2] *Local drainage system* means any natural or constructed drainage feature that collects and concentrates runoff from the ***site*** and discharges it downstream.

[3] ***Target impervious surface*** means that portion of a ***site's*** impervious surface from which runoff impacts are required to be mitigated by a particular set of drainage requirements—in this case, flow control BMP requirements. For projects **on large lots with low impervious surface coverage**, target impervious surface shall include all ***new impervious surface*** together with any existing impervious surface added on or after January 8, 2001 (the effective date of the Endangered Species Act "take prohibition" issued by the federal government to protect Puget Sound Chinook salmon). For projects **on large lots with high impervious surface coverage**, target impervious surface shall also include ***replaced impervious surface***. *Note: any impervious surface on the **site** other than target impervious surface may be mitigated by flow control BMPs in trade for not mitigating an equivalent-sized area of target impervious surface.*

[4] For projects subject to Small Project Drainage Review, and for any ***single family residential project*** subject to Full or Large Project Drainage Review, the design requirements and specifications in Appendix C, Section C.2.2 may be used for evaluation and design of full infiltration on individual lots. For all other projects, full infiltration must be evaluated and designed in accordance with the infiltration facility standards in Section 5.4.

5 *Recordable version* means one that meets King County's "Standard Formatting Requirements for Recording Documents" pursuant to RCW 36.18.010 and 65.04.045, available online at ftp://ftp.metrokc.gov/records/formatting_requirements.pdf or from the King County Recorder's Office. These requirements include specifications for such things as page size ($8^1/_2$" x 14" or smaller), font size (at least 8-point), and margin width (1" on all sides of every page if there is a standard cover sheet).

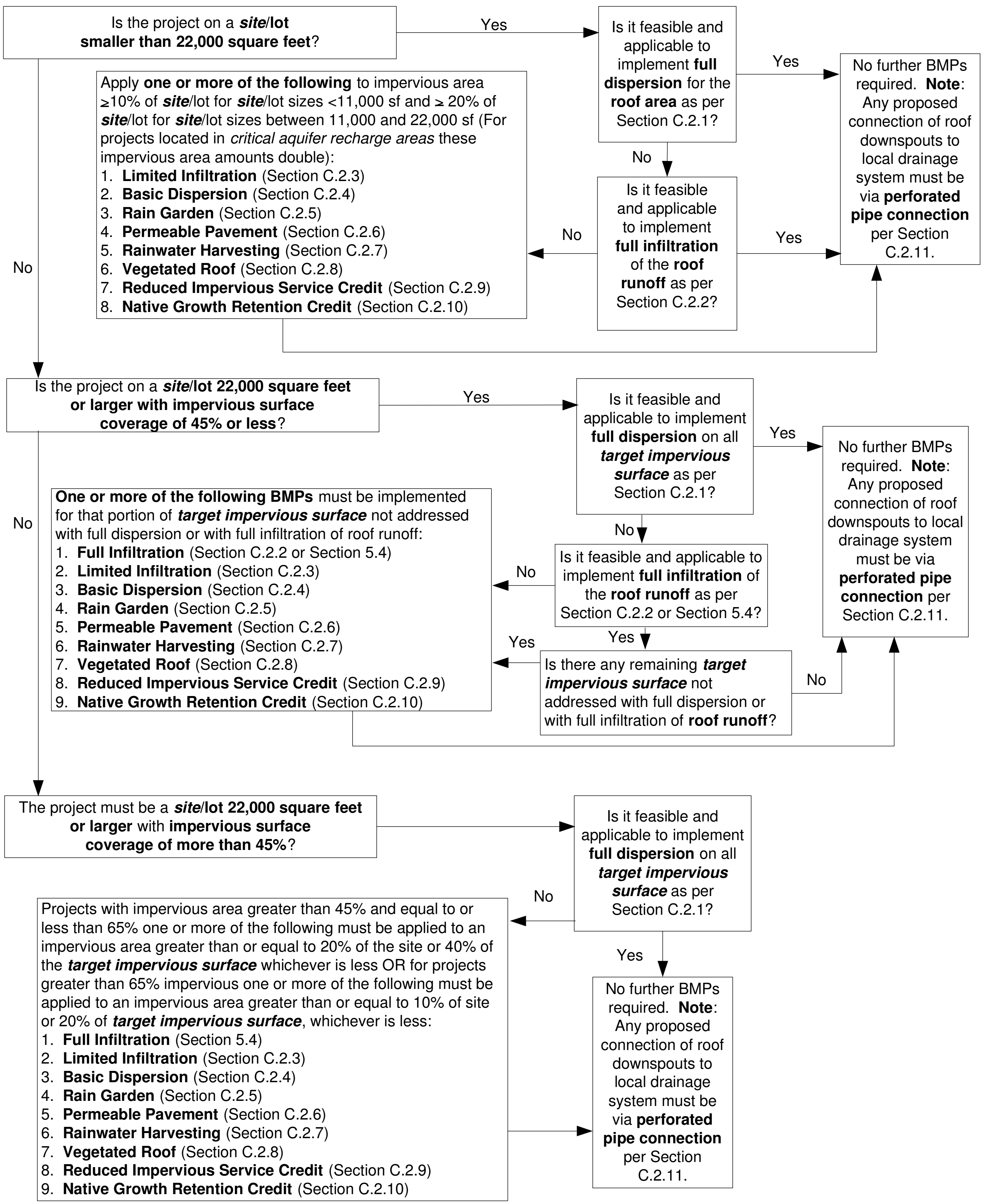

Is the project on a site/lot smaller than 22,000 square feet?
Yes
Is it feasible and applicable to implement full dispersion for the roof area as per Section C.2.1?
Yes
No further BMPs required. Note: Any proposed connection of roof downspouts to local drainage system must be via perforated pipe connection per Section C.2.11.
No
Is it feasible and applicable to implement full infiltration of the roof runoff as per Section C.2.2?
Yes
No
Apply one or more of the following to impervious area ≥10% of site/lot for site/lot sizes <11,000 sf and ≥ 20% of site/lot for site/lot sizes between 11,000 and 22,000 sf (For projects located in critical aquifer recharge areas these impervious area amounts double):
1. Limited Infiltration (Section C.2.3)
2. Basic Dispersion (Section C.2.4)
3. Rain Garden (Section C.2.5)
4. Permeable Pavement (Section C.2.6)
5. Rainwater Harvesting (Section C.2.7)
6. Vegetated Roof (Section C.2.8)
7. Reduced Impervious Service Credit (Section C.2.9)
8. Native Growth Retention Credit (Section C.2.10)
No
Is the project on a site/lot 22,000 square feet or larger with impervious surface coverage of 45% or less?
Yes
Is it feasible and applicable to implement full dispersion on all target impervious surface as per Section C.2.1?
Yes
No further BMPs required. Note: Any proposed connection of roof downspouts to local drainage system must be via perforated pipe connection per Section C.2.11.
No
Is it feasible and applicable to implement full infiltration of the roof runoff as per Section C.2.2 or Section 5.4?
No
One or more of the following BMPs must be implemented for that portion of target impervious surface not addressed with full dispersion or with full infiltration of roof runoff:
1. Full Infiltration (Section C.2.2 or Section 5.4)
2. Limited Infiltration (Section C.2.3)
3. Basic Dispersion (Section C.2.4)
4. Rain Garden (Section C.2.5)
5. Permeable Pavement (Section C.2.6)
6. Rainwater Harvesting (Section C.2.7)
7. Vegetated Roof (Section C.2.8)
8. Reduced Impervious Service Credit (Section C.2.9)
9. Native Growth Retention Credit (Section C.2.10)
Yes
Is there any remaining target impervious surface not addressed with full dispersion or with full infiltration of roof runoff?
Yes
No
No
The project must be a site/lot 22,000 square feet or larger with impervious surface coverage of more than 45%?
Is it feasible and applicable to implement full dispersion on all target impervious surface as per Section C.2.1?
No
Projects with impervious area greater than 45% and equal to or less than 65% one or more of the following must be applied to an impervious area greater than or equal to 20% of the site or 40% of the target impervious surface whichever is less OR for projects greater than 65% impervious one or more of the following must be applied to an impervious area greater than or equal to 10% of site or 20% of target impervious surface, whichever is less:
1. Full Infiltration (Section 5.4)
2. Limited Infiltration (Section C.2.3)
3. Basic Dispersion (Section C.2.4)
4. Rain Garden (Section C.2.5)
5. Permeable Pavement (Section C.2.6)
6. Rainwater Harvesting (Section C.2.7)
7. Vegetated Roof (Section C.2.8)
8. Reduced Impervious Service Credit (Section C.2.9)
9. Native Growth Retention Credit (Section C.2.10)
Yes
No further BMPs required. Note: Any proposed connection of roof downspouts to local drainage system must be via perforated pipe connection per Section C.2.11.

TABLE 5.2.2.A FLOW CONTROL BMP FACILITY SIZING CREDITS(1)	

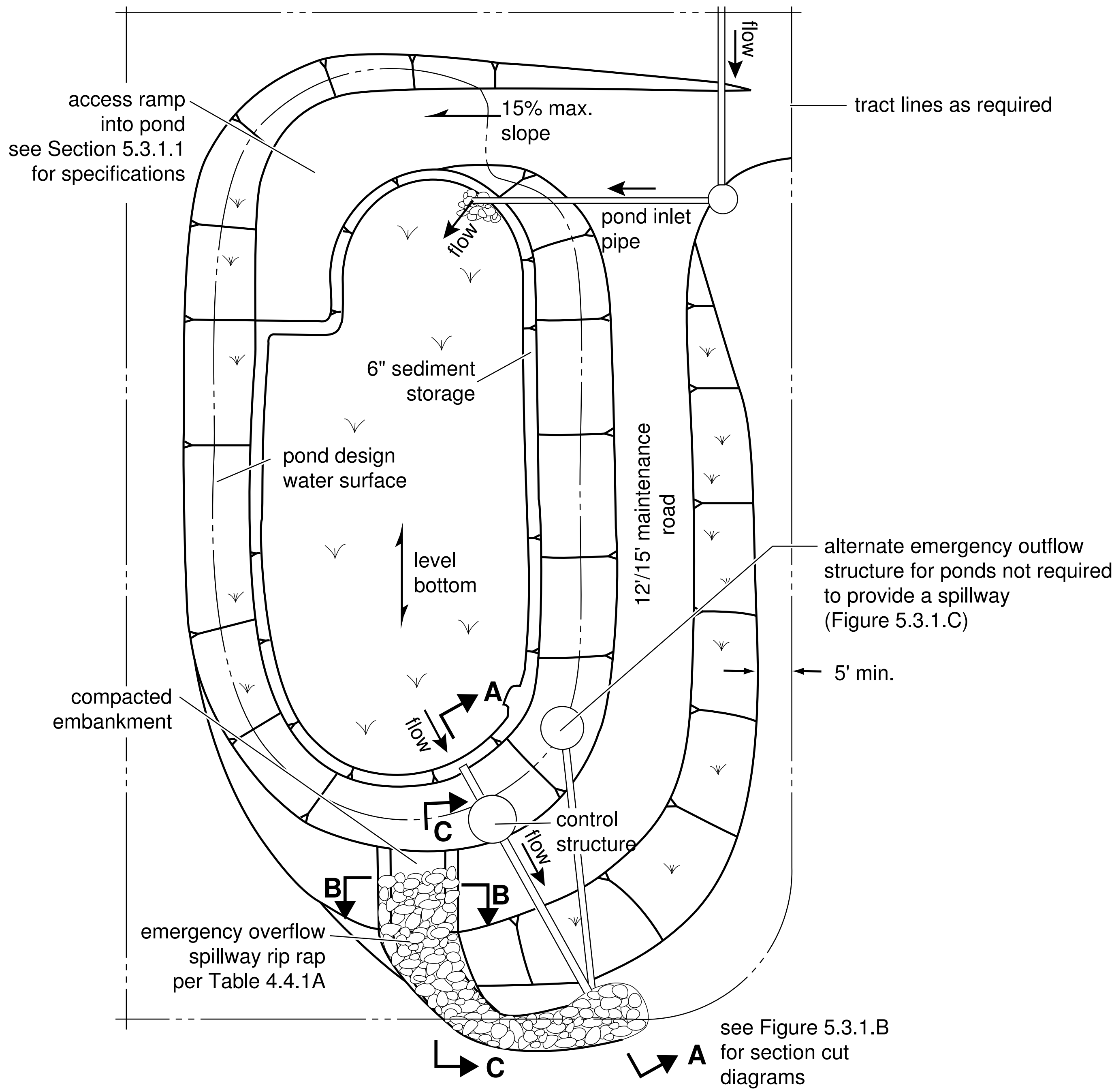
6 For purposes of applying flow control BMPs, the term *subdivision* or *subdivision project* refers to any project that is a short plat, plat, or binding site plan.

5-17

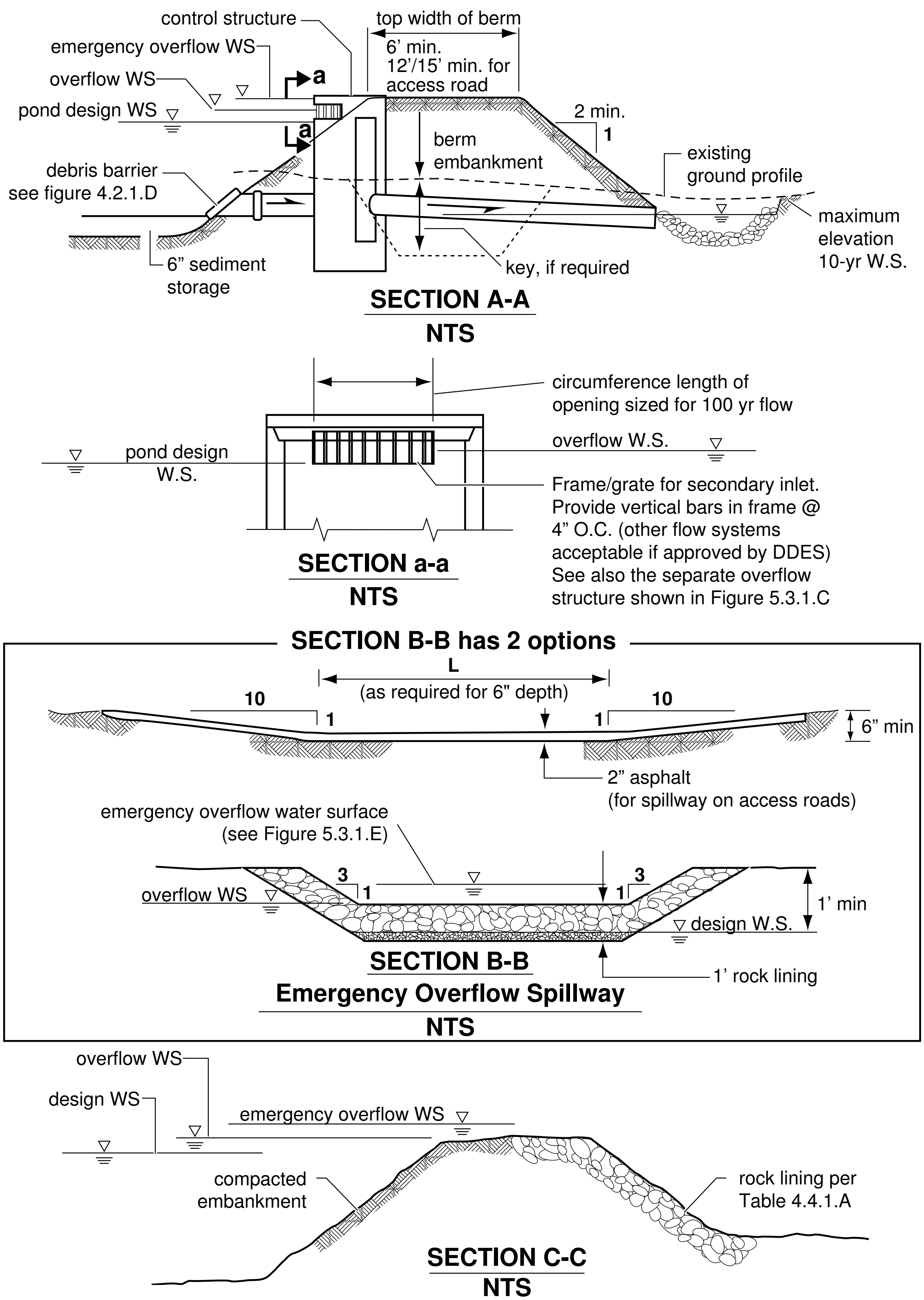
[7] Shredded wood mulch is made from shredded tree trimmings, usually from trees cleared onsite. It must be free of garbage and weeds and may not contain excessive resin, tannin, or other material detrimental to plant growth.

TABLE 5.3.1.A SMALL TREES AND SHRUBS WITH FIBROUS ROOTS

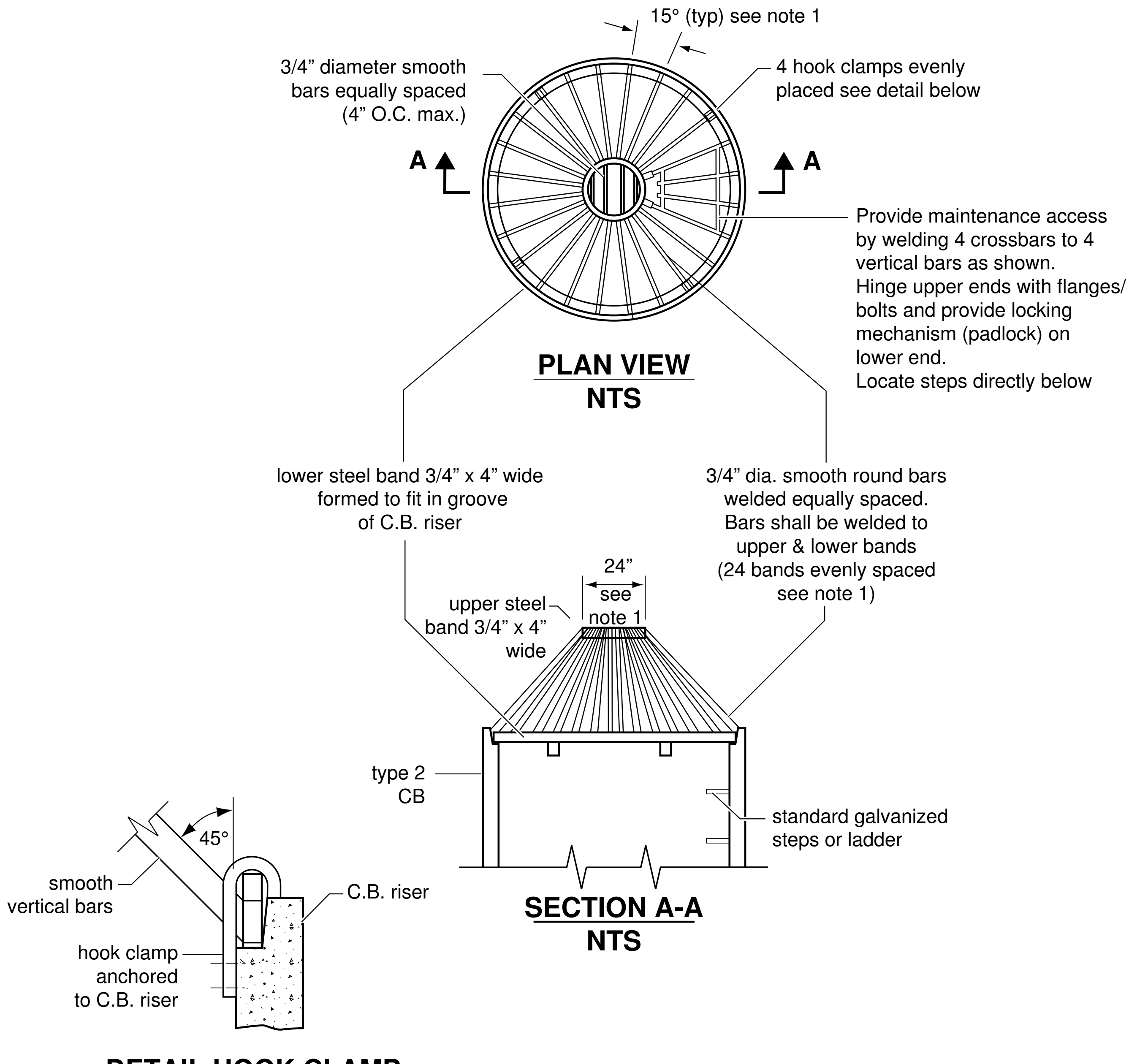
TABLE 5.3.1.B STORMWATER TRACT "LOW-GROW" SEED MIX	



NOTE:
This detail is a schematic representation only. Actual configuation will vary depending on specific site constraints and applicable design criteria.



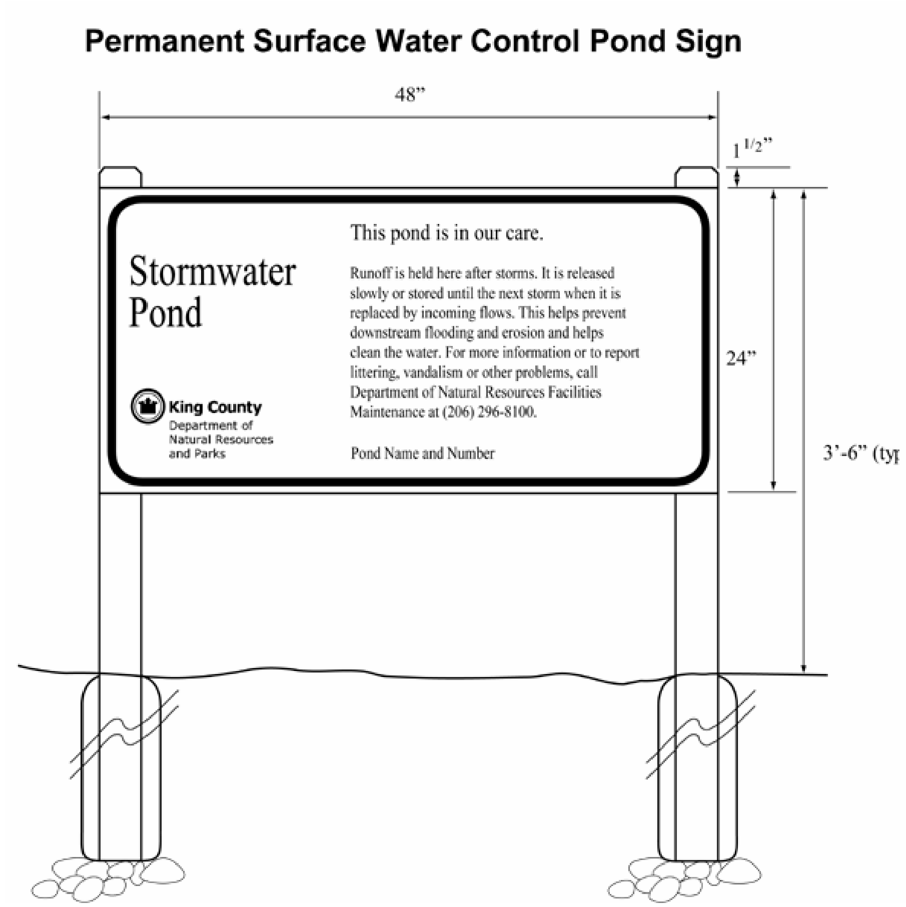
control structure
top width of berm
emergency overflow WS
6' min.
12'/15' min. for
access road
overflow WS
a
pond design WS
2 min.
1
a
berm
embankment
existing
ground profile
debris barrier
see figure 4.2.1.D
maximum
elevation
10-yr W.S.
6" sediment
storage
key, if required
SECTION A-A
NTS
circumference length of
opening sized for 100 yr flow
overflow W.S.
pond design
W.S.
Frame/grate for secondary inlet.
Provide vertical bars in frame @
4" O.C. (other flow systems
acceptable if approved by DDES)
See also the separate overflow
structure shown in Figure 5.3.1.C
SECTION a-a
NTS
SECTION B-B has 2 options
L
(as required for 6" depth)
10
1
1
10
6" min
2" asphalt
(for spillway on access roads)
emergency overflow water surface
(see Figure 5.3.1.E)
3
1
3
1
overflow WS
1' min
design W.S.
SECTION B-B
1' rock lining
Emergency Overflow Spillway
NTS
overflow WS
design WS
emergency overflow WS
compacted
embankment
rock lining per
Table 4.4.1.A
SECTION C-C
NTS



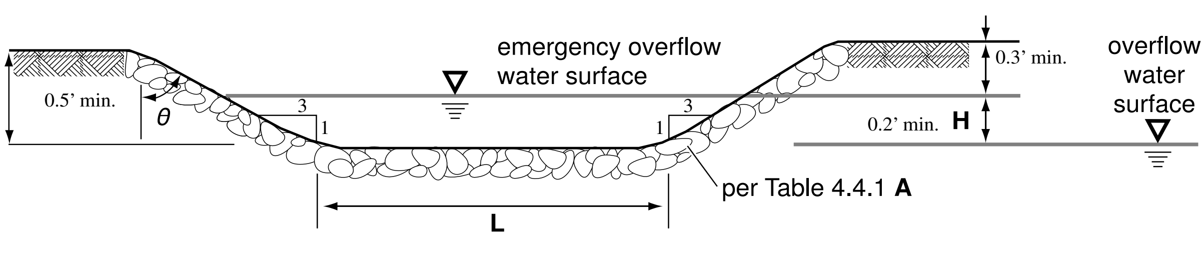
DETAIL HOOK CLAMP
NTS

NOTES:

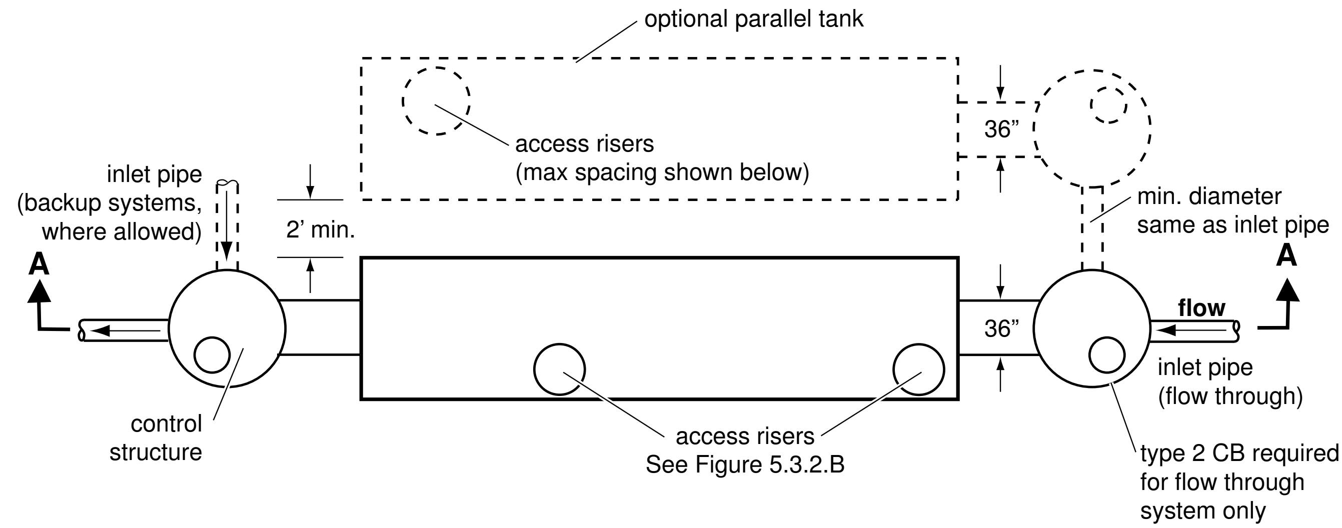
1. Dimensions are for illustration on 54” diameter CB For different diameter CB's adjust to maintain 45° angle on "vertical" bars and 7” o.c. maximum spacing of bars around lower steel band.
2. Metal parts must be corrosion resistant; steel bars must be galvanized.
3. This debris barrier is also recommended for use on the inlet to roadway cross-culverts with high potential for debris collection (except on type 2 streams)
4. This debris barrier is for use outside of road right-of-way only. For debris cages within road right-of-way, see Drawing 2-028 KCRS.



Permanent Surface Water Control Pond Sign
48”
1 1/2”
24”
3’-6” (ty
Stormwater
Pond
King County
Department of
Natural Resources
and Parks
This pond is in our care.
Runoff is held here after storms. It is released slowly or stored until the next storm when it is replaced by incoming flows. This helps prevent downstream flooding and erosion and helps clean the water. For more information or to report littering, vandalism or other problems, call Department of Natural Resources Facilities Maintenance at (206) 296-8100.
Pond Name and Number

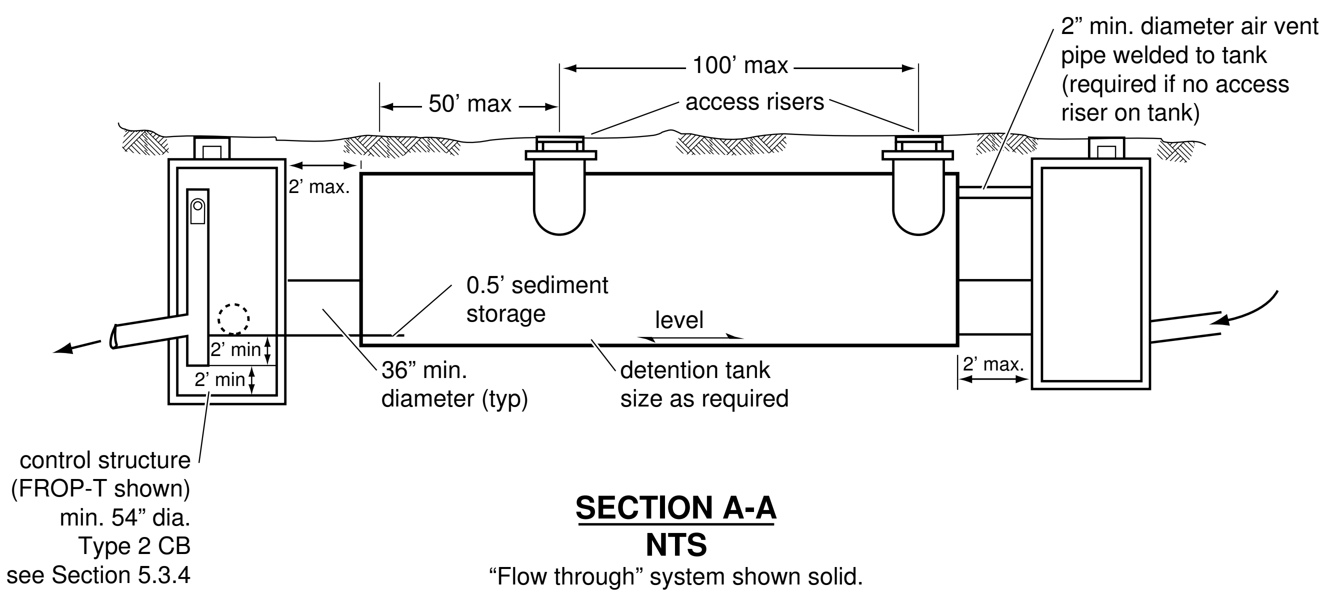

emergency overflow
water surface
0.5' min.
θ
3
1
3
1
0.3' min.
overflow
water
surface
0.2' min.
H
per Table 4.4.1 A
L

[8] Galvanized metals leach zinc into the environment, especially in standing water situations. High zinc concentrations, sometimes in the range that can be toxic to aquatic life, have been observed in the region. Therefore, use of galvanized materials should be avoided. Where other metals, such as aluminum or stainless steel, or plastics are available, they shall be used. If these materials are not available, asphalt coated galvanized materials may then be used.



PLAN VIEW
NTS

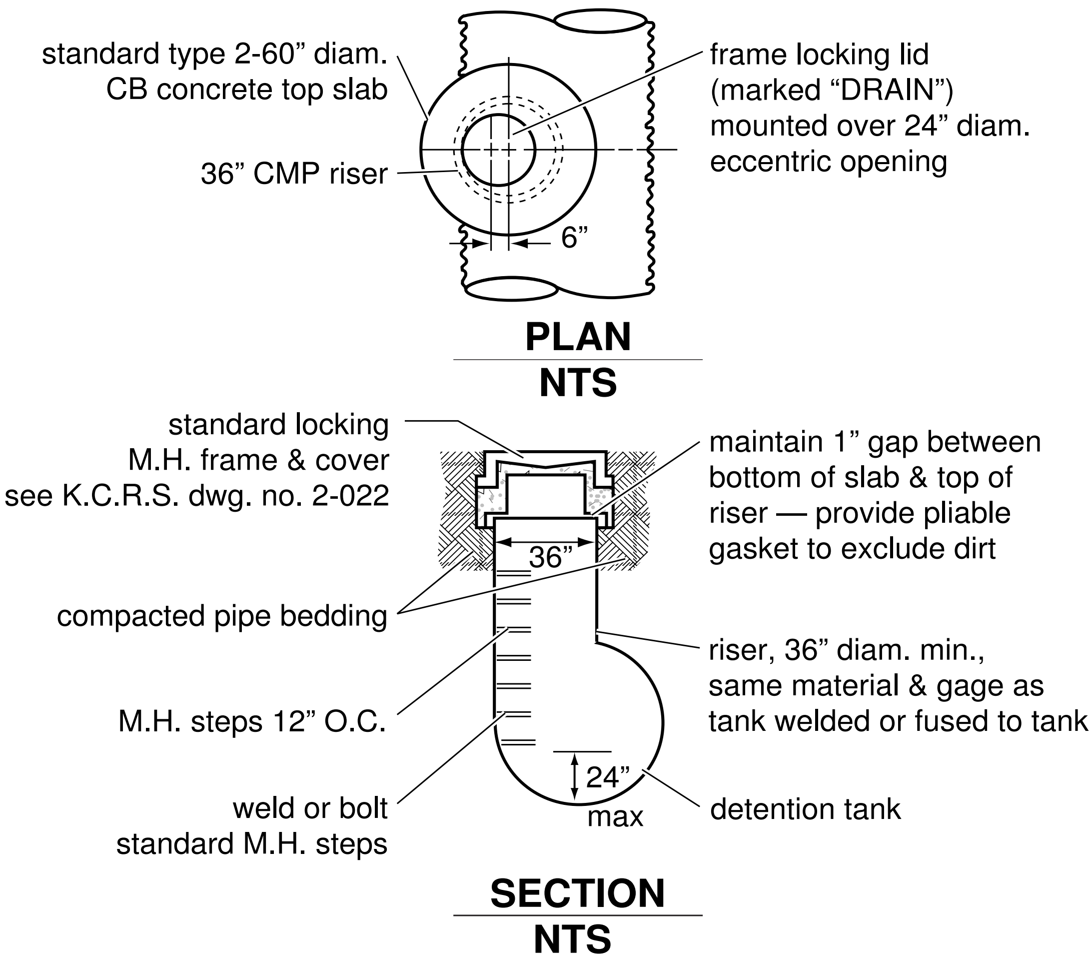
"Flow-through" system shown solid.
Designs for "flow backup" system and
parallel tanks shown dashed



SECTION A-A
NTS

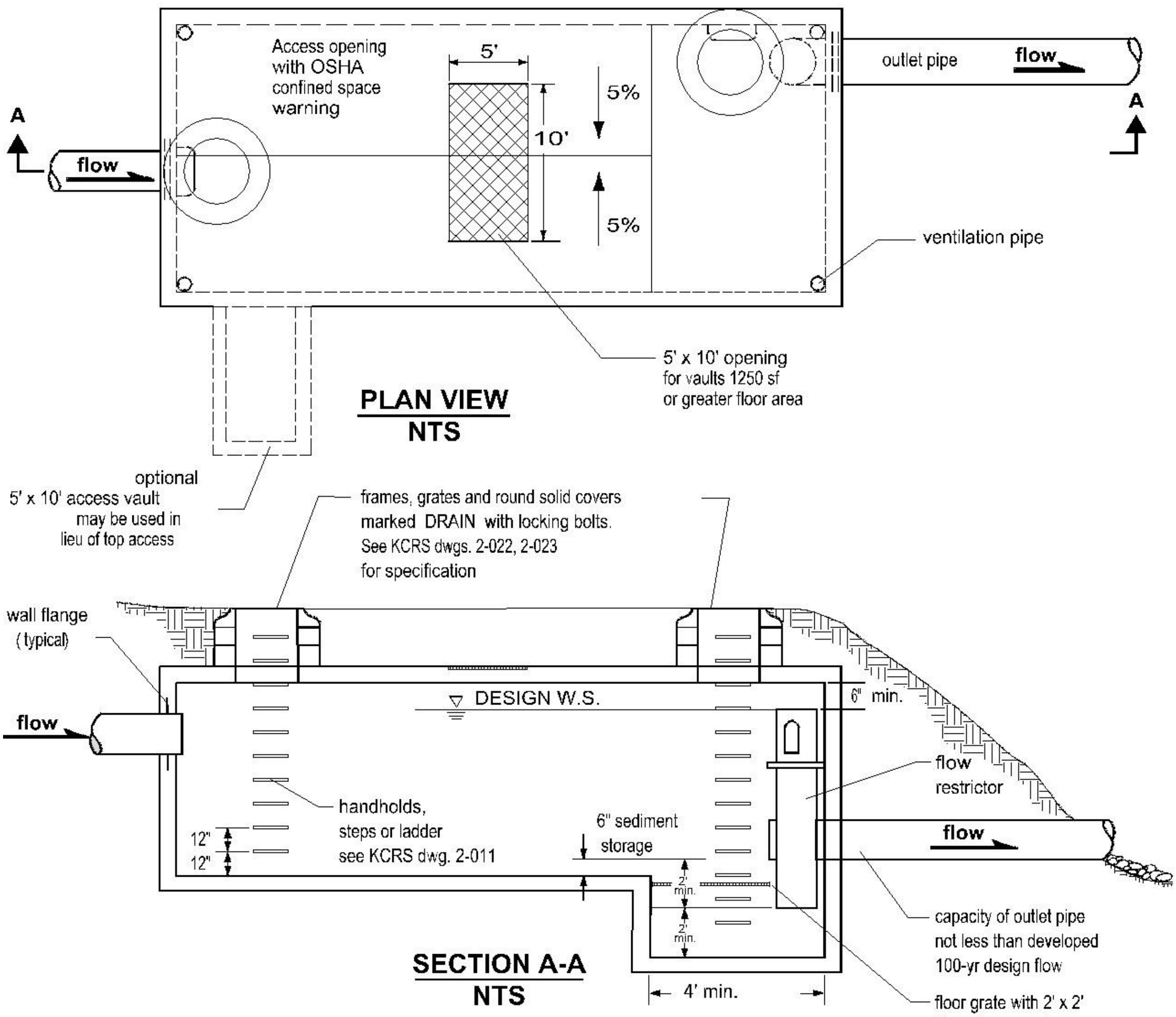
"Flow through" system shown solid.

NOTE:
All metal parts corrosion resistant.
Steel parts galvanized and asphalt
coated (Treatment 1 or better).



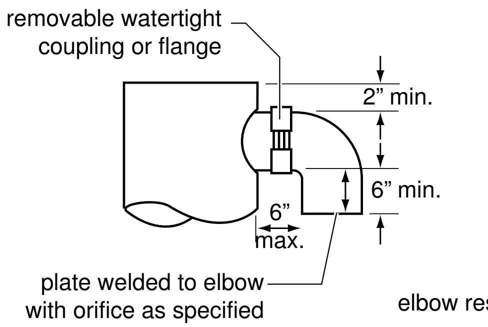
NOTES:
1. Use adjusting blocks as required to bring frame to grade.
2. All materials to be aluminum or galvanized and asphalt coated (Treatment 1 or better).
3. Must be located for access by maintenance vehicles.
4. May substitute WSDOT special Type IV manhole (RCP only).

NOTE: All vault areas must be within 50' of an access point

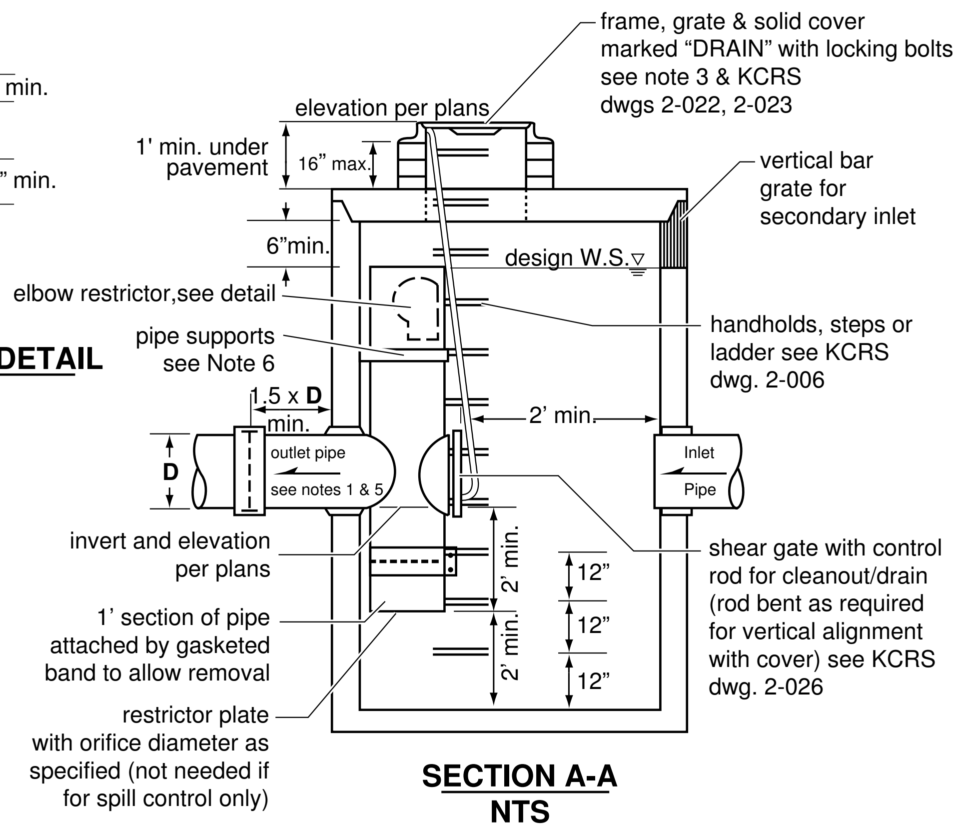


NOTES:

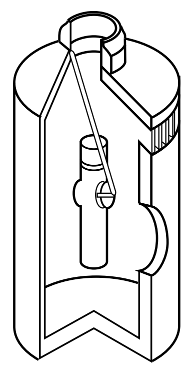
1. All metal parts must be corrosion resistant. If substitutes not available, steel parts must be galvanized and asphalt coated (Treatment I or better).
2. Provide water stop at all cast-in-place construction joints. Precast vaults shall have approved rubber gasket system.
3. Vaults < 10' wide must use removable lids.
4. Prefabricated vault sections may require structural modifications to support 5' x 10' opening over main vault. Alternatively, access can be provided via a side vestibule as shown.



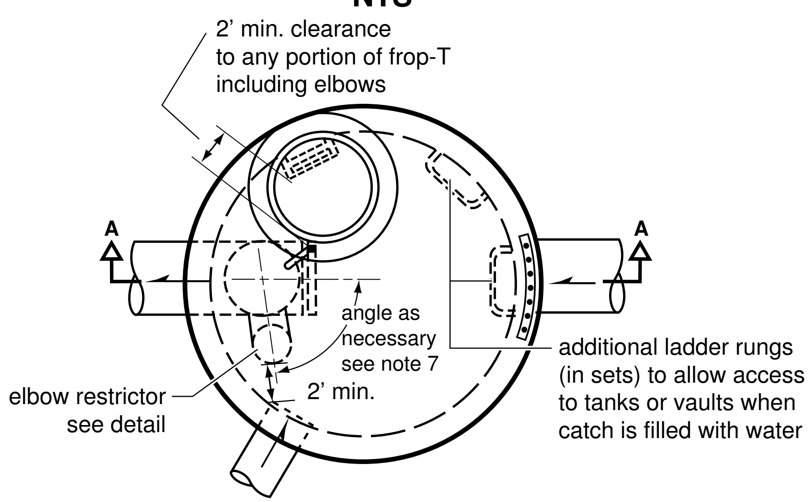
ELBOW RESTRICTOR DETAIL
NTS



SECTION A-A
NTS



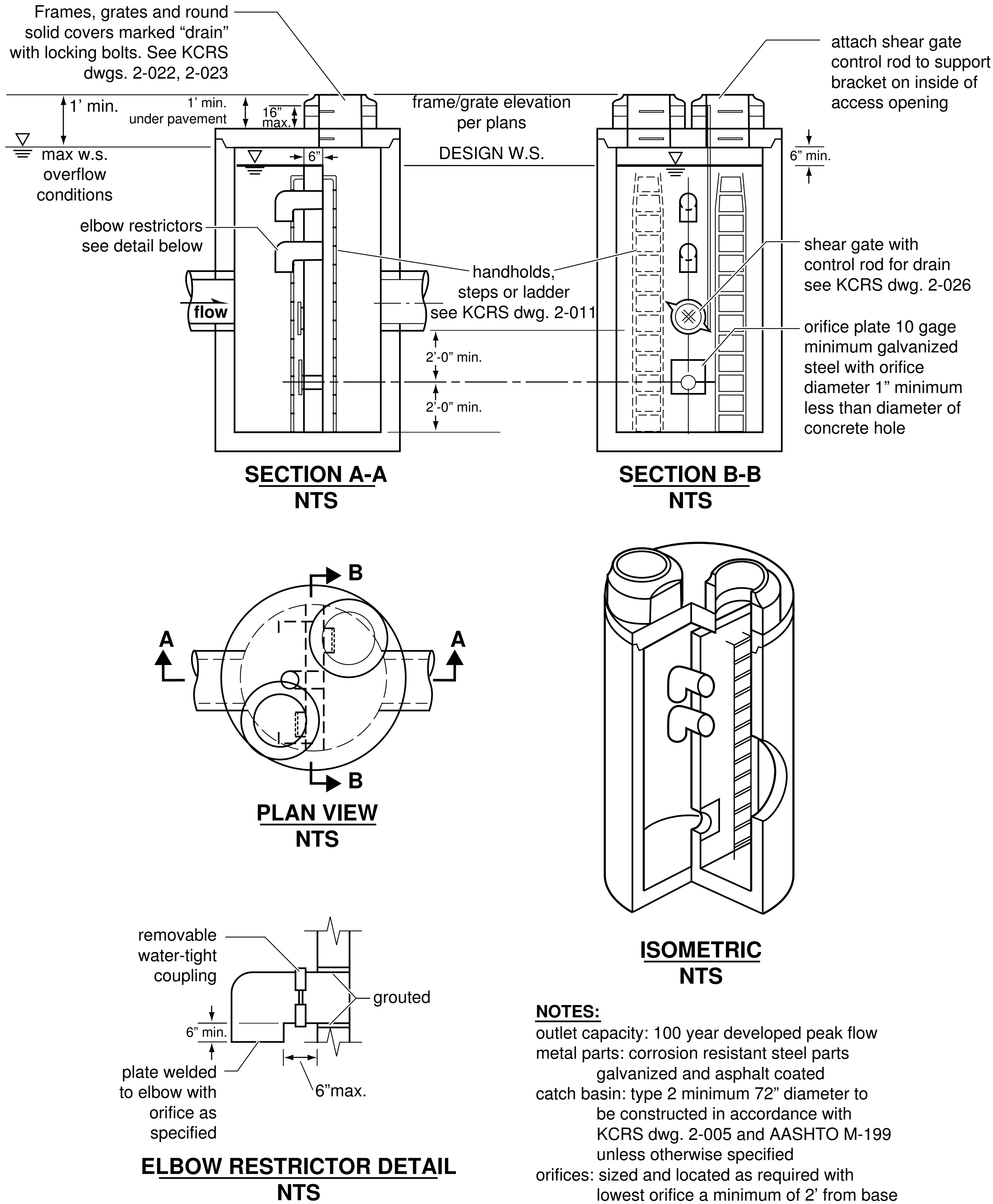
ISOMETRIC
NTS



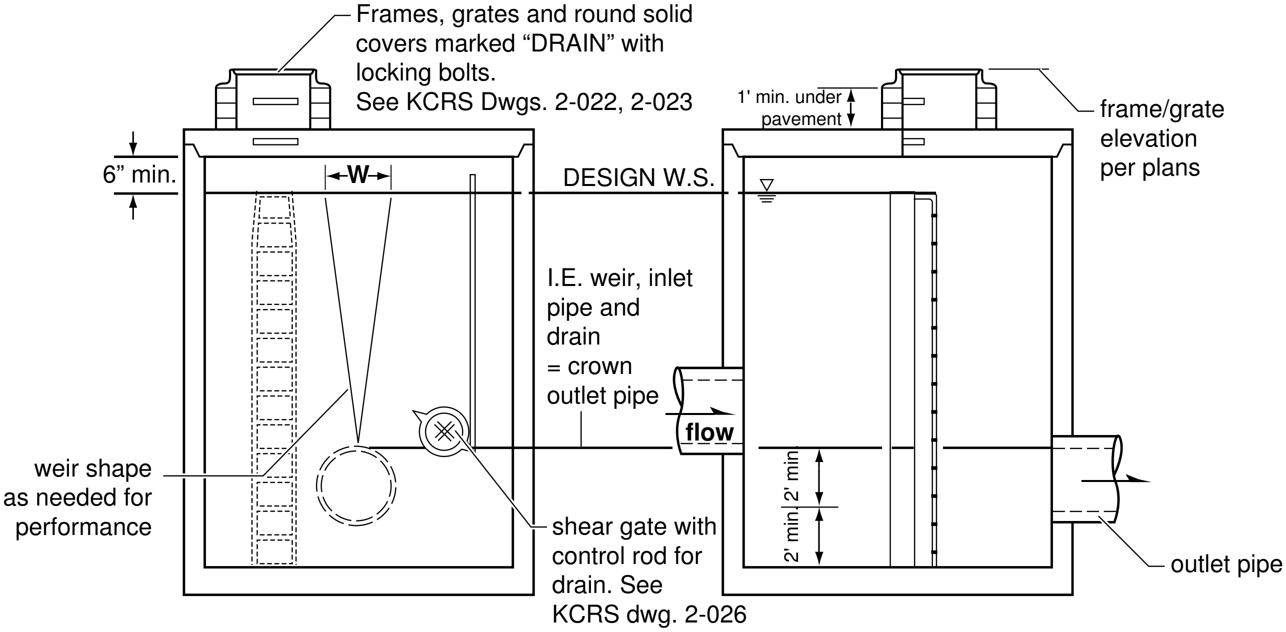
PLAN VIEW
NTS

NOTES:

1. Use a minimum of a 54" diameter type 2 catch basin.
2. Outlet Capacity: 100-Year developed peak flow.
3. Metal Parts: Corrosion resistant. Non-Galvanized parts perferred. Galvanized pipe parts to have asphalt treatment 1.
4. Frame and ladder or steps offset so:
   A. Cleanout gate is visible from top.
   B. Climb-down space is clear of riser and cleanout gate.
   C. Frame is clear of curb.
5. If metal outlet pipe connects to cement concrete pipe: outlet pipe to have smooth O.D. equal to concrete pipe I.D. less 1/4".
6. Provide at least one 3" X .090 gage support bracket anchored to concrete wall. (maximum 3'-0" vertical spacing)
7. Locate elbow restrictor(s) as necessary to provide minimum clearance as shown.
8. Locate additional ladder rungs in structures used as access to tanks or vaults to allow access when catch basin is filled with water.

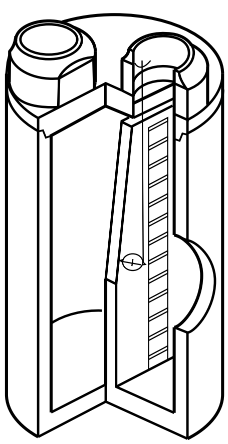


Frames, grates and round solid covers marked "drain" with locking bolts. See KCRS dwgs. 2-022, 2-023
1' min.
1' min. under pavement
16" max.
frame/grate elevation per plans
attach shear gate control rod to support bracket on inside of access opening
6" min.
max w.s. overflow conditions
6"
DESIGN W.S.
elbow restrictors see detail below
handholds, steps or ladder see KCRS dwg. 2-011
shear gate with control rod for drain see KCRS dwg. 2-026
flow
orifice plate 10 gage minimum galvanized steel with orifice diameter 1" minimum less than diameter of concrete hole
2'-0" min.
2'-0" min.
SECTION A-A
NTS
SECTION B-B
NTS
B
A
A
B
PLAN VIEW
NTS
ISOMETRIC
NTS
removable water-tight coupling
grouted
6" min.
plate welded to elbow with orifice as specified
6"max.
ELBOW RESTRICTOR DETAIL
NTS
NOTES:
outlet capacity: 100 year developed peak flow
metal parts: corrosion resistant steel parts galvanized and asphalt coated
catch basin: type 2 minimum 72" diameter to be constructed in accordance with KCRS dwg. 2-005 and AASHTO M-199 unless otherwise specified
orifices: sized and located as required with lowest orifice a minimum of 2' from base

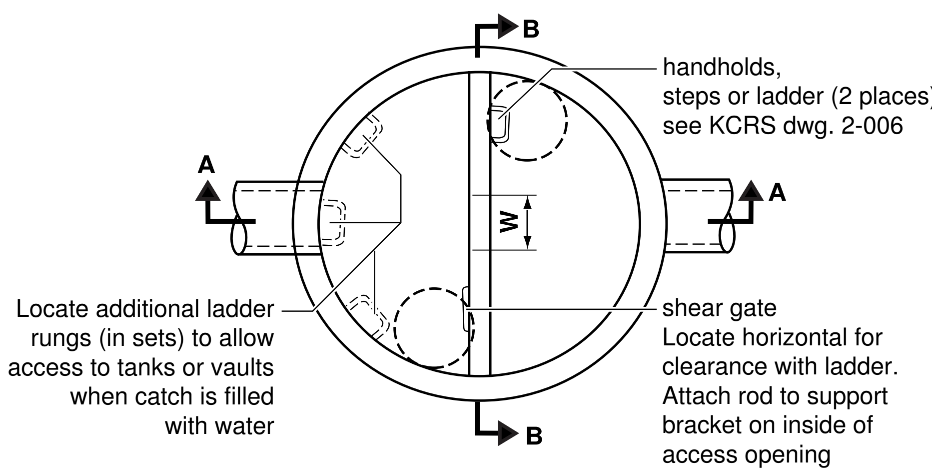


SECTION B-B
NTS

SECTION A-A
NTS



ISOMETRIC
NTS

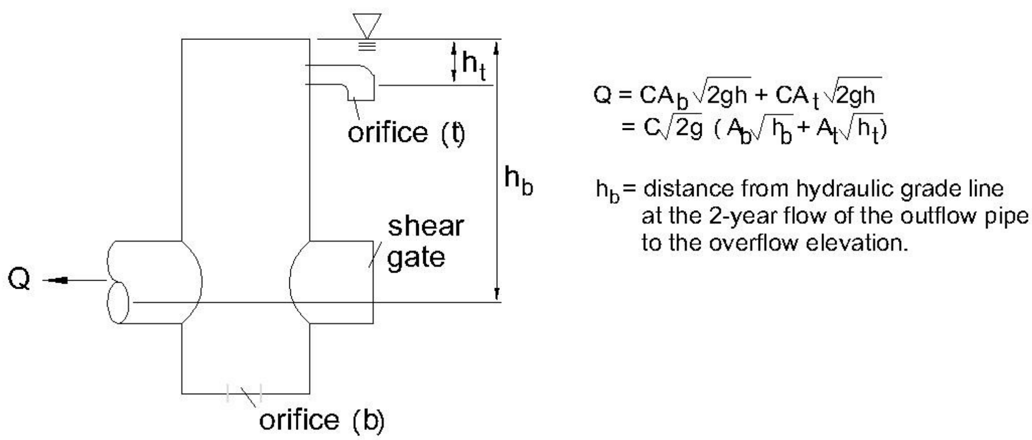


PLAN VIEW
NTS

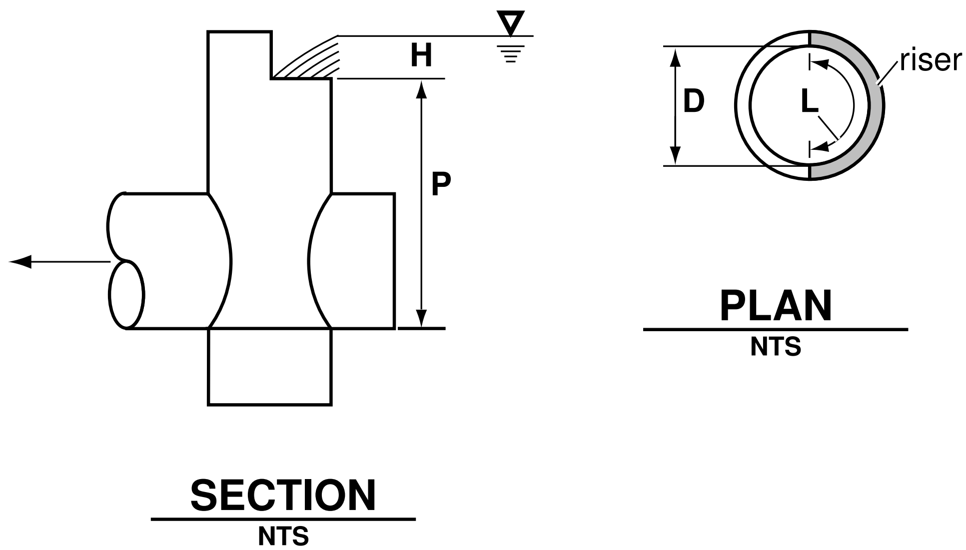
NOTES:

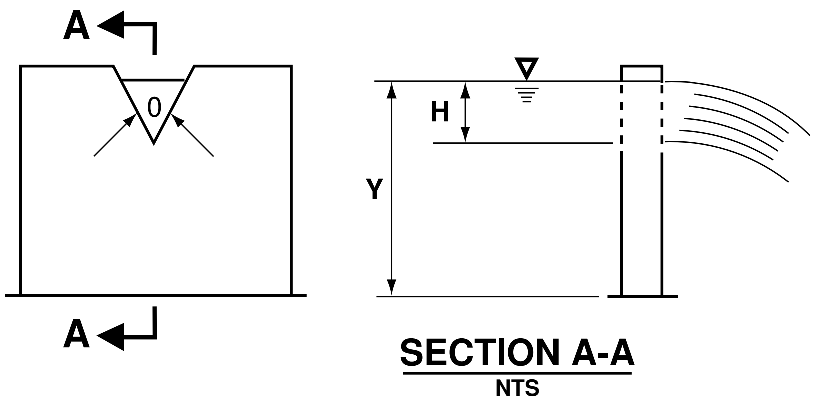
Outlet Capacity: 100-year developed peak flow.
Metal Parts: corrosion resistant steel parts galvanized and asphalt coated.
Catch Basin: type 2 Min. 72" diameter to be constructed in accordance with KCRS dwg 2-005 and AASHTO M-199 unless otherwise specified.
Baffle Wall: to be designed with concrete reinforcing as required.
Spill Control Requirements: see Section 4.2.

$$\sqrt{2gh}$$



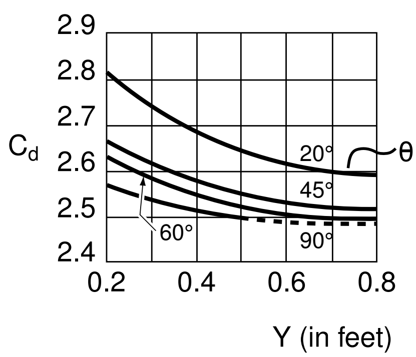
$$\sqrt{\frac{36.88Q}{\sqrt{h}}}$$

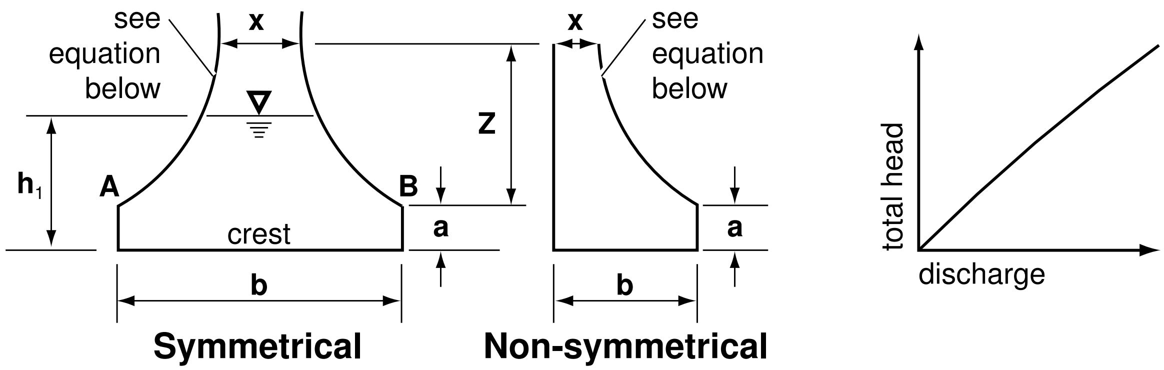

H
P
SECTION
NTS
D
L
riser
PLAN
NTS



$Q = C_d\,(\tan \theta/2)Y^{5/2}$, in cfs

Where values of C_d may be taken from the following chart:

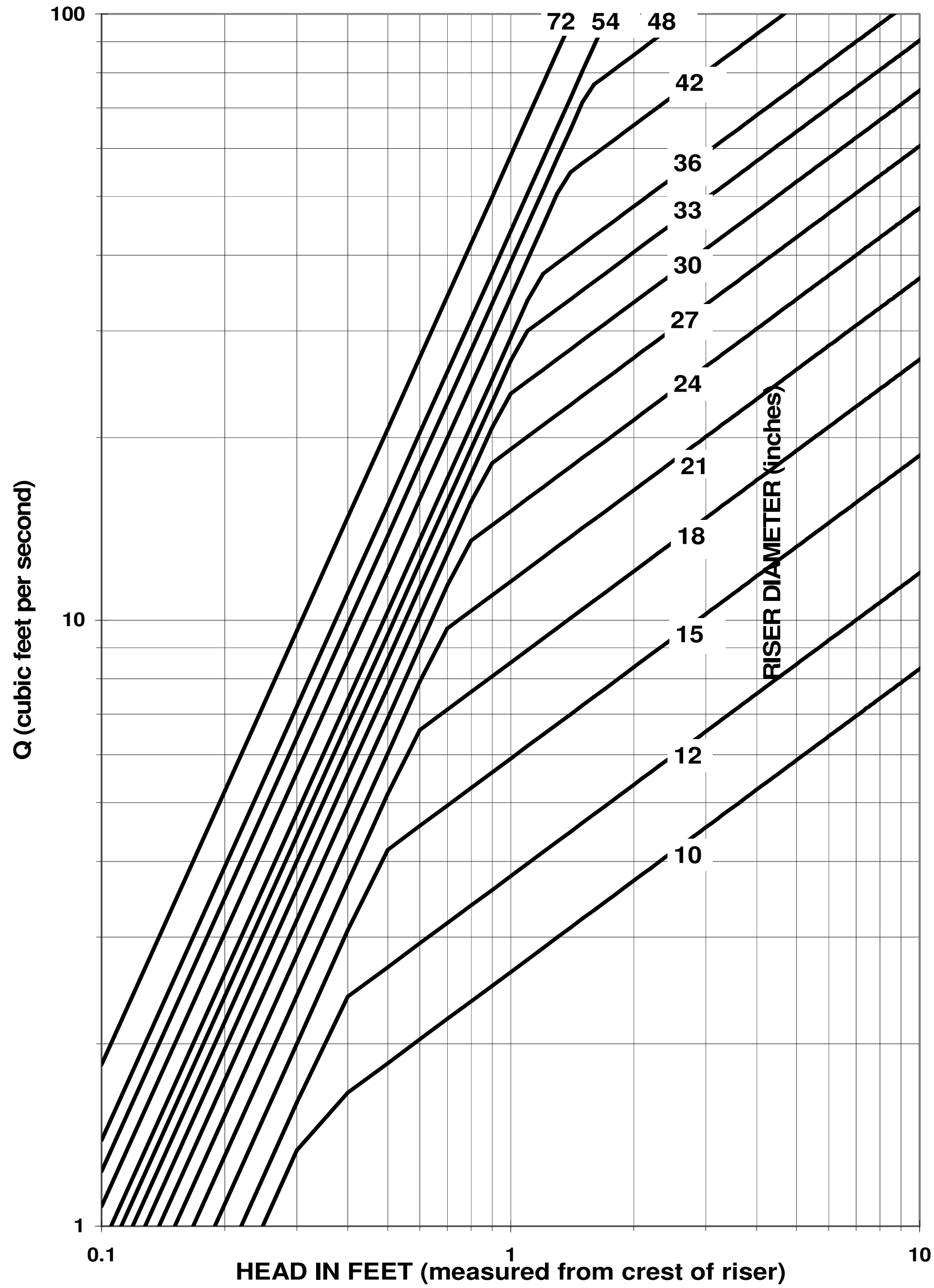




$$\frac{x}{b} \qquad \frac{2}{\pi} \qquad \sqrt{\frac{Z}{a}}$$

$$\sqrt{2ag}\left(h_1 - \frac{a}{3}\right)$$

TABLE 5.3.4.A VALUES OF C_d FOR SUTRO WEIRS

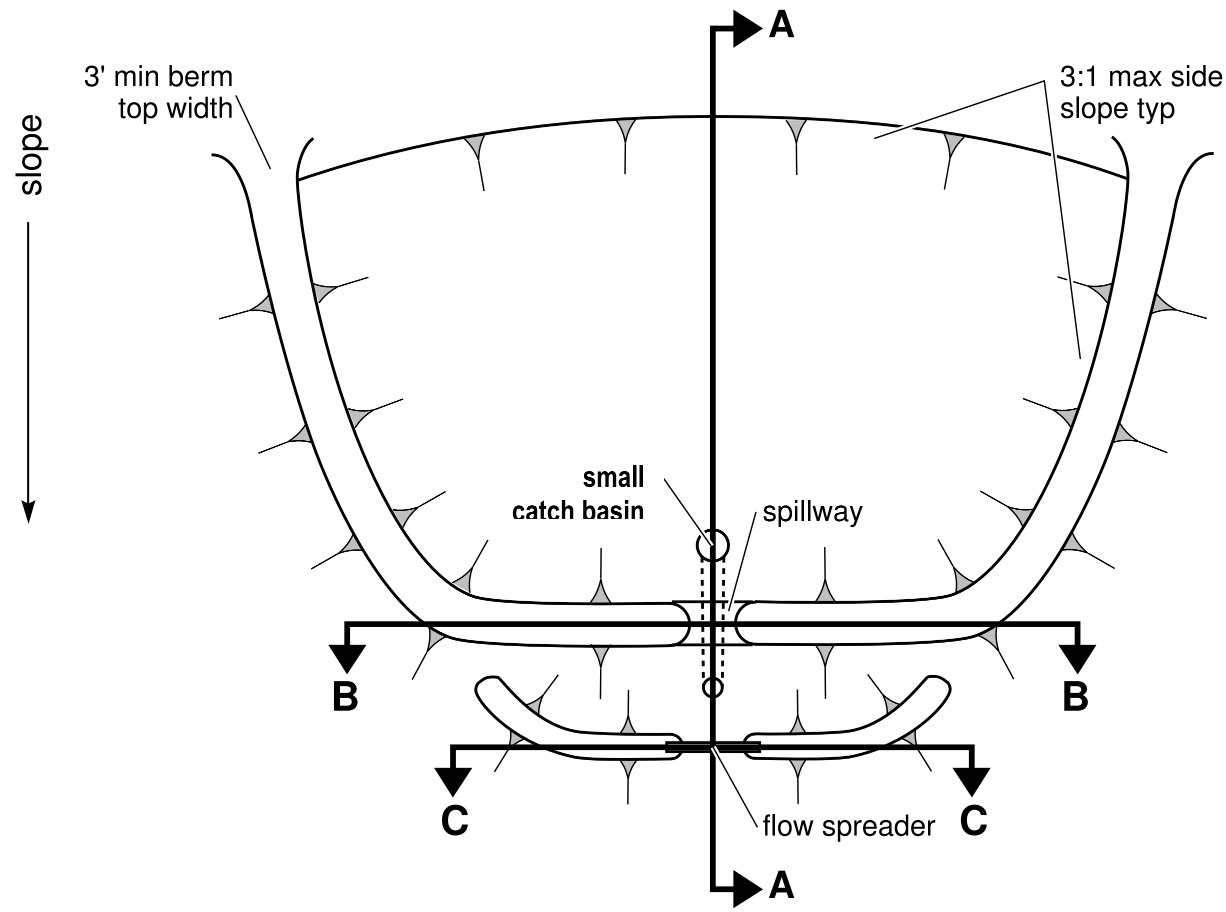


Q_{weir}=9.739 $DH^{3/2}$

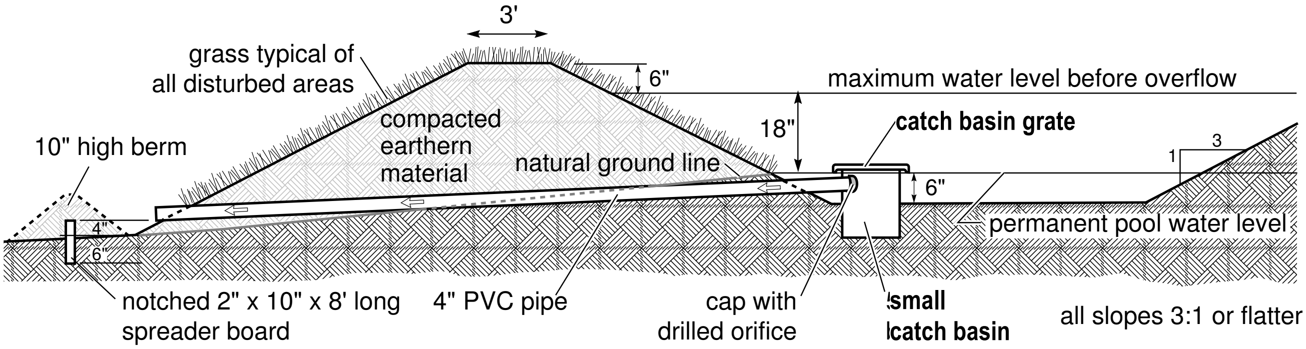
$Q_{orifice}$=3.782 $D^2H^{1/2}$

Q in cfs, D and H in feet

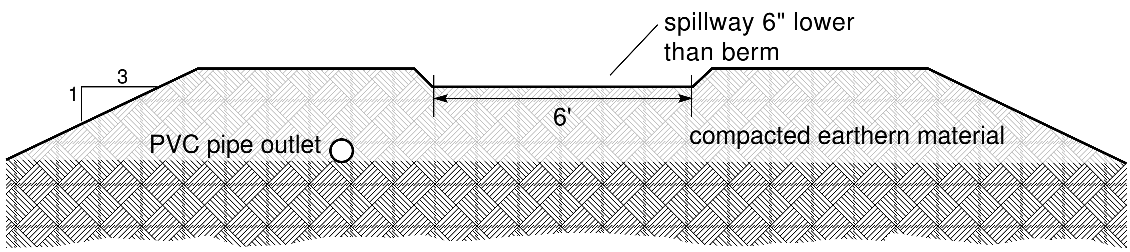
Slope change occurs at weir-orifice transition



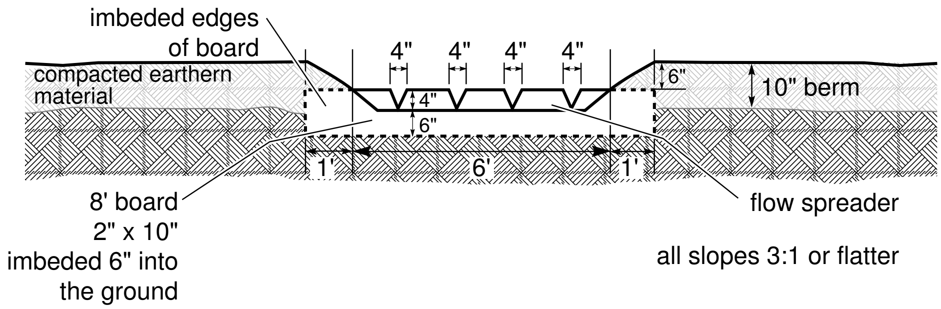
PLAN VIEW
NTS



SECTION A-A
NTS

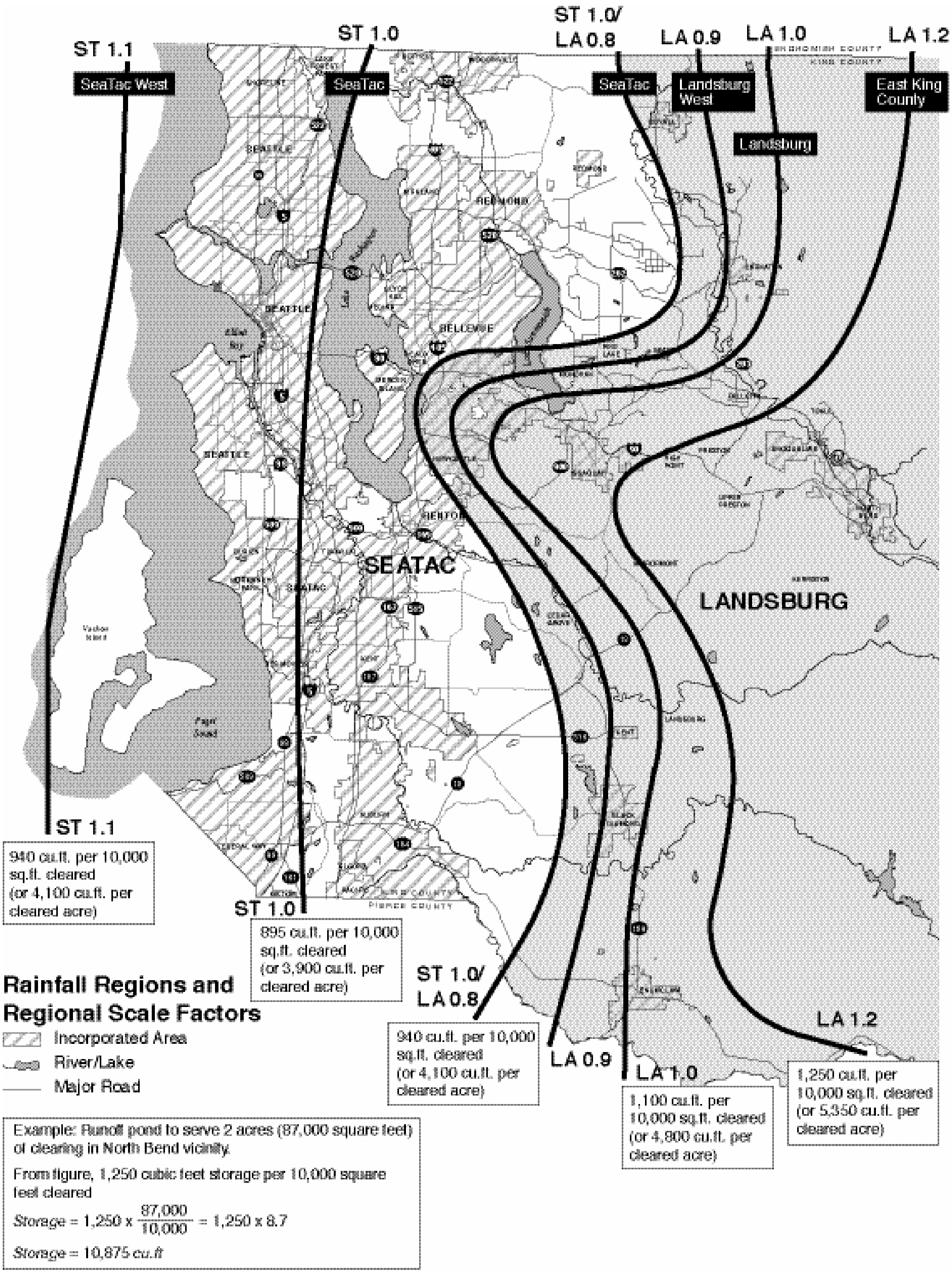


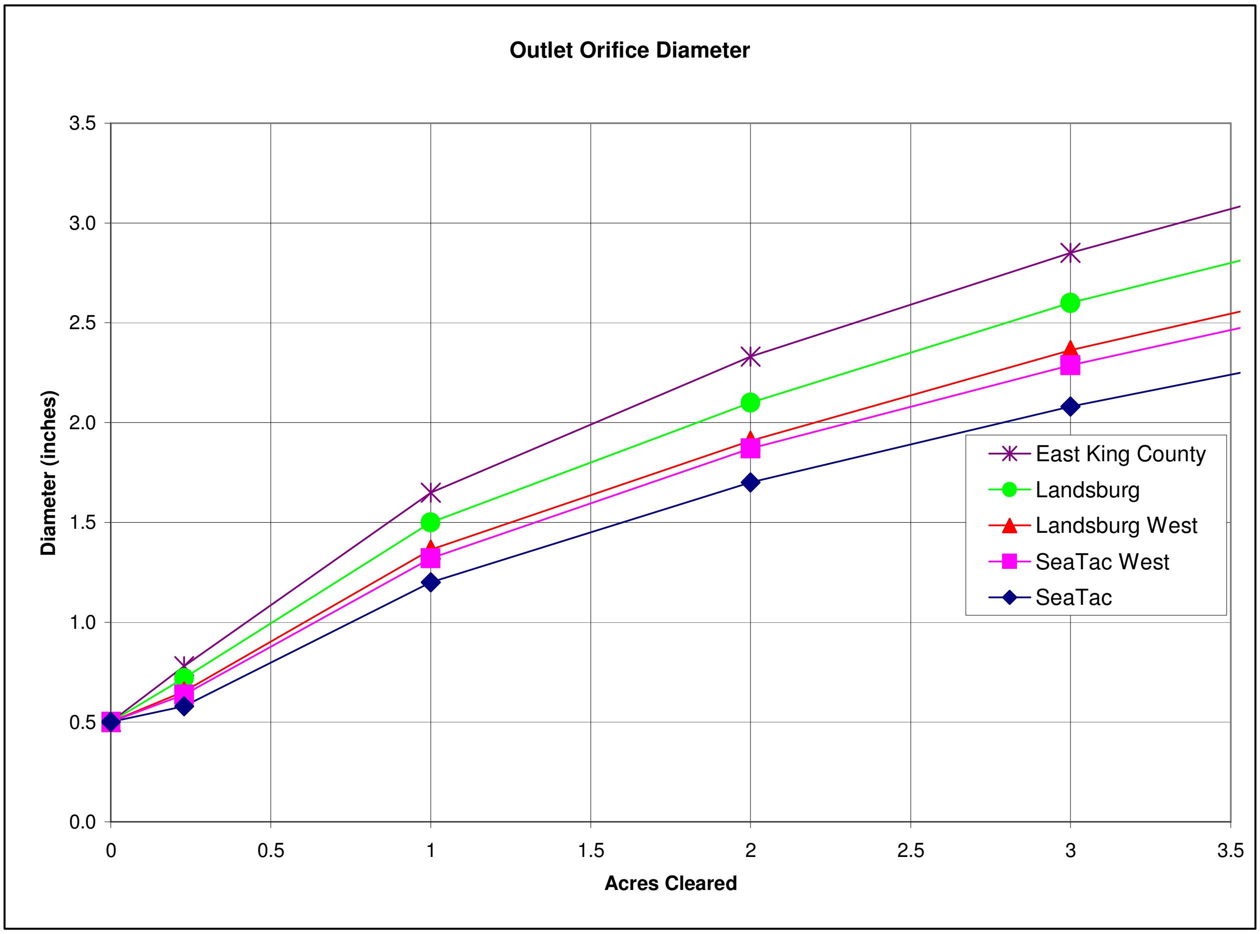
SECTION B-B
NTS



SECTION C-C
NTS

$$\frac{(A_w + A_b)}{2}$$


ST 1.1
ST 1.0
ST 1.0/
LA 0.8
LA 0.9
LA 1.0
LA 1.2
SeaTac West
SeaTac
SeaTac
Landsburg
West
Landsburg
East King
County
SNOHOMISH COUNTY
KING COUNTY
SEATTLE
REDMOND
BELLEVUE
RENTON
SEATAC
LANDSBURG
Vashon
Island
Puget
Sound
PIERCE COUNTY
ST 1.1
940 cu.ft. per 10,000
sq.ft. cleared
(or 4,100 cu.ft. per
cleared acre)
ST 1.0
895 cu.ft. per 10,000
sq.ft. cleared
(or 3,900 cu.ft. per
cleared acre)
ST 1.0/
LA 0.8
940 cu.ft. per 10,000
sq.ft. cleared
(or 4,100 cu.ft. per
cleared acre)
LA 0.9
LA 1.0
1,100 cu.ft. per
10,000 sq.ft. cleared
(or 4,800 cu.ft. per
cleared acre)
LA 1.2
1,250 cu.ft. per
10,000 sq.ft. cleared
(or 5,350 cu.ft. per
cleared acre)
Rainfall Regions and
Regional Scale Factors
Incorporated Area
River/Lake
Major Road
Example: Runoff pond to serve 2 acres (87,000 square feet)
of clearing in North Bend vicinity.
From figure, 1,250 cubic feet storage per 10,000 square
feet cleared
$Storage = 1{,}250 \times \frac{87{,}000}{10{,}000} = 1{,}250 \times 8.7$
$Storage = 10{,}875\ cu.ft$

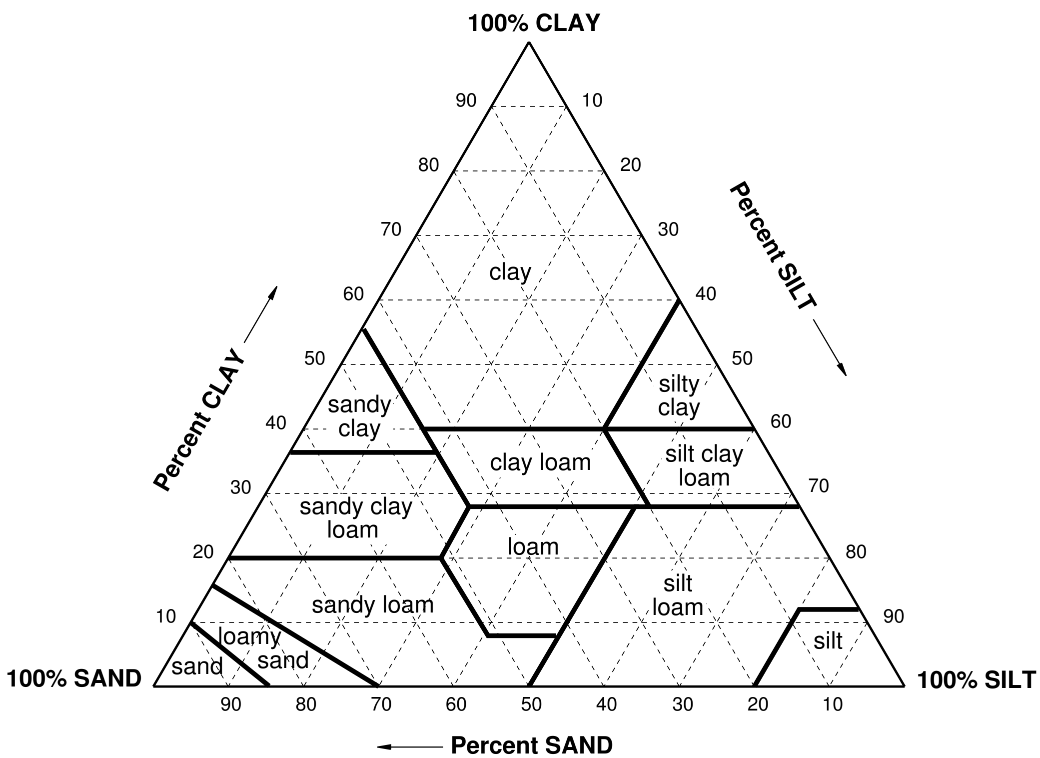

Outlet Orifice Diameter
Diameter (inches)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
0.5
1
1.5
2
2.5
3
3.5
Acres Cleared
East King County
Landsburg
Landsburg West
SeaTac West
SeaTac

[9] See discussion of the measured infiltration rate on page 5-58.

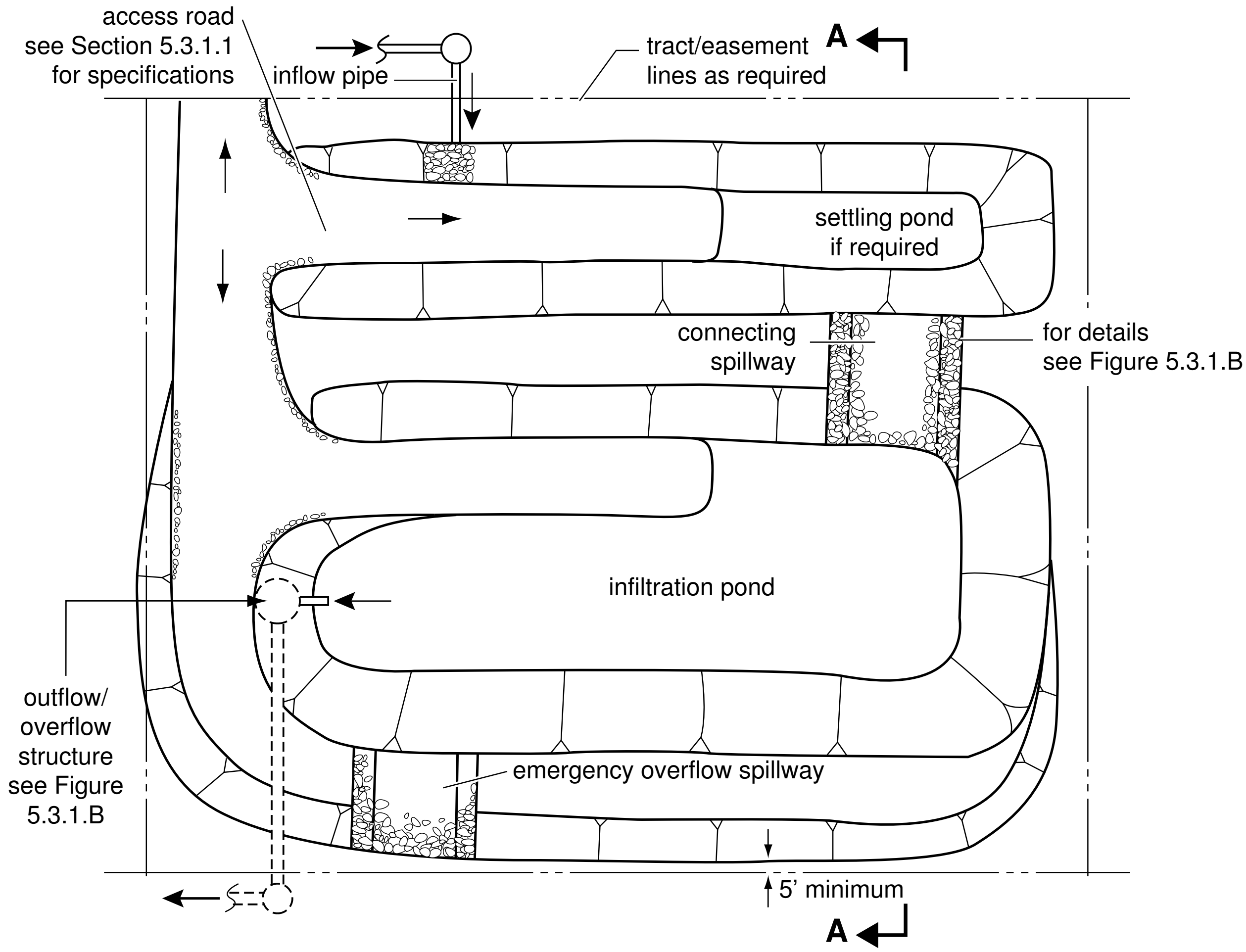
[10] Criteria (a) is based on the relationship between infiltration rates and soil texture. However, there are many other factors, such as high water table, presence of impervious strata or boulders close to the surface, etc., which also affect infiltration rate. When any such condition is suspected because soils are coarser than expected from the measured infiltration rate, a sieve analysis should be done to establish soil characteristics. The judgment of a geotechnical engineer, geologist or soil scientist shall determine whether a sieve analysis is warranted. The sieve analysis must meet Criteria (c) above to be considered protective.

[11] *Cation exchange capacity* shall be tested using EPA Laboratory Method 9081.

[12] *Organic content* shall be measured on a dry weight basis using method ASTM D2974 for the fraction passing the #40 sieve.

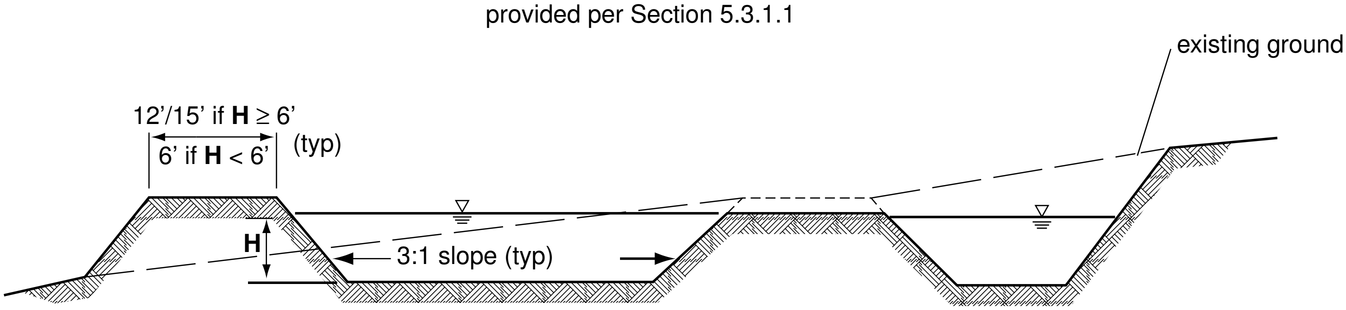


[13] Concerns regarding Criteria (a) and the correspondence between the measured infiltration rate and soil textures are the same as discussed for projects outside sole-source aquifer areas.



PLAN VIEW

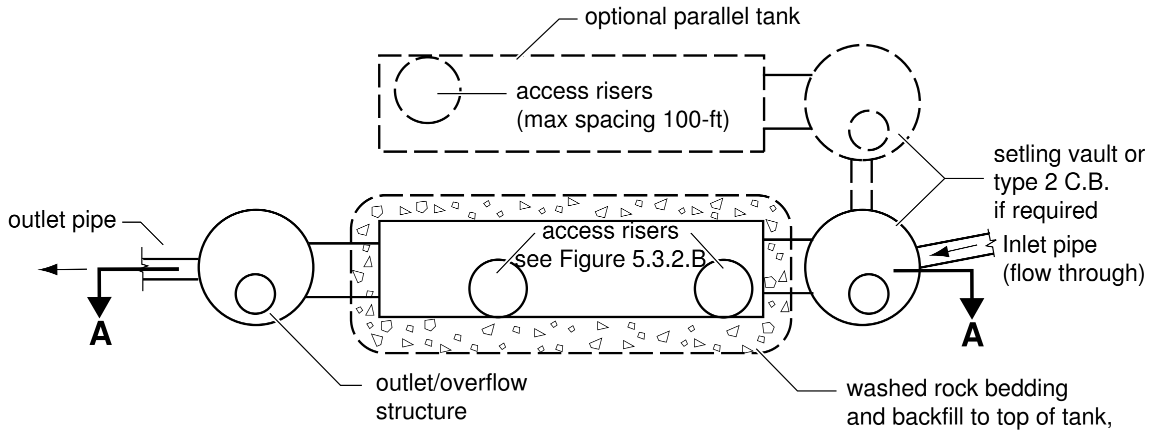
overflow/emergency overflow
provided per Section 5.3.1.1



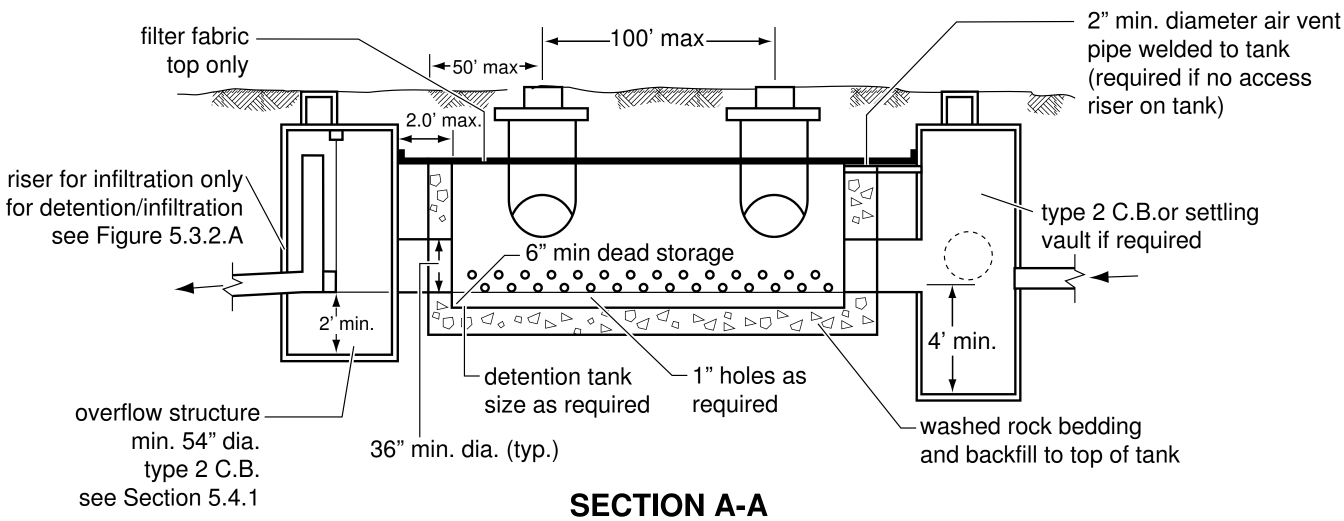
SECTION A-A

NTS

NOTE:
Detail is a schematic representation only. Actual configuration will vary depending on specific site constraints and applicable design criteria.



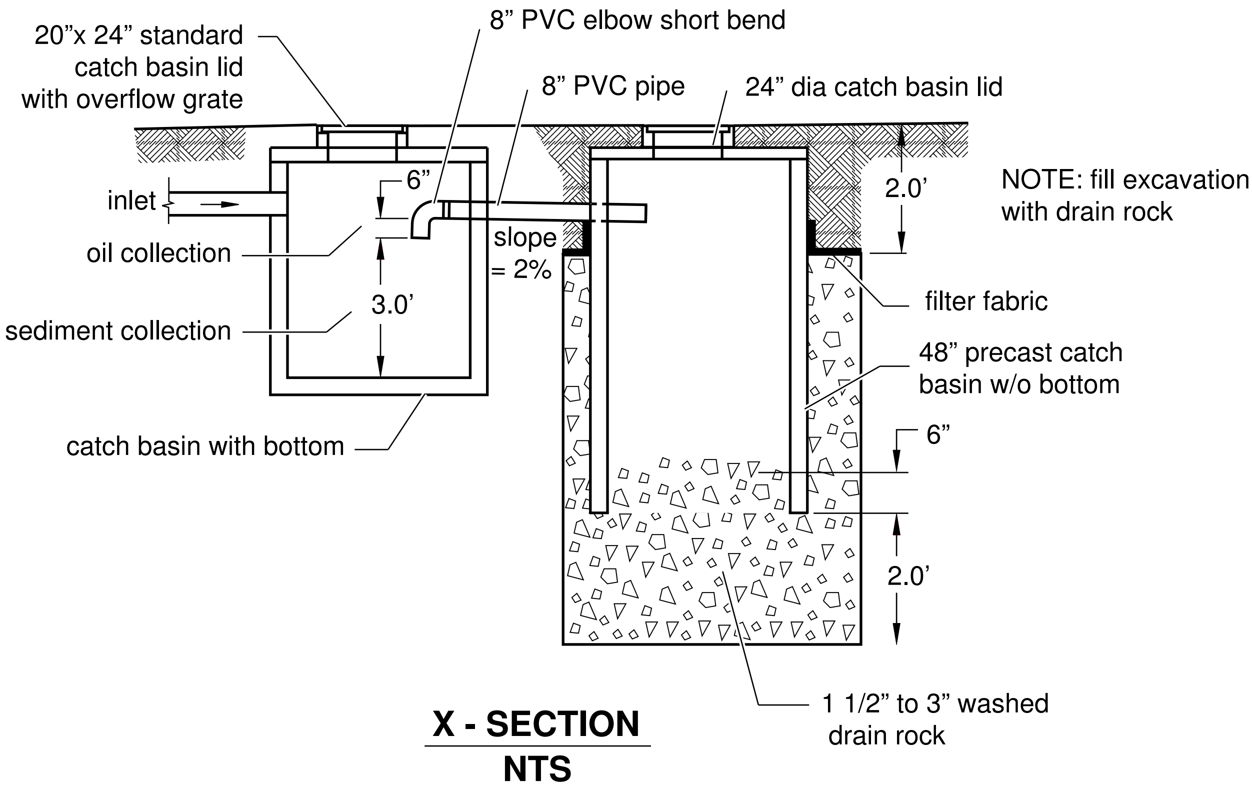
PLAN VIEW
NTS
optional design for parallel tank shown dashed



SECTION A-A
NTS

NOTES:

- All metal parts corrosion resistant. Steel parts galvanized and asphalt coated (treatment 1 or better).
- Filter fabric to be placed over washed rock backfill.



20"x 24" standard
catch basin lid
with overflow grate
8" PVC elbow short bend
8" PVC pipe
24" dia catch basin lid
inlet
6"
2.0'
NOTE: fill excavation
with drain rock
oil collection
slope
= 2%
filter fabric
3.0'
sediment collection
48" precast catch
basin w/o bottom
catch basin with bottom
6"
2.0'
1 1/2" to 3" washed
drain rock
X - SECTION
NTS

6-1

Guide to Applying Water Quality Menus

1. Determine the WQ treatment area in which your project is located by consulting the Water Quality (WQ) Applications map (back pocket). If this determination cannot be made from the map, a more detailed delineation of WQ treatment areas is available on King County's Geographic Information System. The map also lists some of the inventoried sphagnum bog wetlands using the numbering convention of the King County wetlands inventory.
2. Read Core Requirement #8 to determine if any exemptions apply to your project.
3. If the map indicates your project is within a Sensitive Lake WQ Treatment Area or a Sphagnum Bog WQ Treatment Area and no exemptions apply, determine if the ***project site*** will actually drain to the sensitive lake or bog. For instance, projects near drainage boundaries, especially in areas with underground storm drains, may drain in a direction different from the surface topography. If the ***project site*** does not drain to the sensitive lake or bog, it is located within the Basic WQ Treatment Area.
4. Check the detailed threshold and exceptions information in Section 1.2.8.1 to determine which WQ menu applies to all or part of your project. On some ***sites***, more than one menu may apply depending on proposed land cover, soil characteristics, and how runoff from developed surfaces will be collected.
5. Find the WQ menu in this section that applies to your project. Each menu presents two or more water quality treatment options; **select one**. Since all options are sized to provide equivalent removal of the target pollutant, the choice will depend only on the constraints and opportunities of your ***site***. (If detention requirements apply, it will usually be most economical to use the combined WQ/detention pond option). Detailed facility designs for the option selected are given in Sections 6.3 (p. 6-39), 6.4 (p. 6-69), and 6.5 (p. 6-103). Information about non-structural options is included in the menu itself.
6. Read the implementation requirements in Chapter 1 (Section 1.2.8.2) that address pollution-generating pervious surfaces. For some WQ menus, and in some situations, the facility requirements for these surfaces are eased.
7. Determine if your project fits the definition of a ***high-use site*** (see Special Requirement #5 in Chapter 1). If it does, or if you elect to provide enhanced oil pollution control, choose one of the options presented in the High-Use menu, Section 6.1.5. Detailed designs for oil control facilities are given in Section 6.6 (p. 6-139).
8. General water quality facility requirements (see Section 6.2, p. 6-17) apply to all menus and may affect the placement of facilities on your ***site***.

[1] This goal assumes the project generates a typical level of TSS (between 30 and 100 milligrams per liter (mg/L). For projects expected to generate a higher level of TSS, such as a sand and gravel operation, a higher treatment goal may be appropriate.

[2] The mean annual storm is derived from dividing the annual rainfall (in inches) by the number of storms per year.

TABLE 6.1.1.A SELECTION OF BIOFILTRATION SWALE TYPE APPROPRIATE FOR SITE

[3] The Enhanced Basic WQ menu targets different pollutants than the lake or bog protection menus. It does not necessarily provide a higher level of treatment except for the target pollutant, metal contaminants.

[4] This goal assumes total zinc concentrations for untreated runoff are between 0.10 and 0.25 milligrams per liter (m/L). For projects that are expected to generate higher levels of metals, such as a mining operation, a higher treatment goal may be appropriate.

TABLE 6.1.2.A PAIRED FACILITIES FOR ENHANCED BASIC TREATMENT TRAIN, OPTION 3	

[5] Typical TP concentrations in untreated Seattle-area runoff are considered to be between 0.10 and 0.50 mg/L. For projects that are expected to generate higher levels of TP, such as animal husbandry operations, a higher treatment goal may be appropriate.

TABLE 6.1.3.A PAIRED FACILITIES FOR LAKE PROTECTION TREATMENT TRAIN, OPTION 3	

TABLE 6.1.3.B WATER QUALITY CREDIT FOR PHOSPHORUS CONTROL

[6] The Bog Protection menu targets a different set of pollutants than the Sensitive Lake or Enhanced Basic menus. Since the targeted pollutants are more difficult to remove, use of larger and/or additional treatment facilities is required.

[7] A *sphagnum bog wetland* is defined as a wetland having a predominance of sphagnum moss creating a substrate upon which a distinctive community of acid-loving plants is established (see "Definitions" for more detail). There are several classification schemes for wetlands dominated by sphagnum moss, and a successional series from conventional wetlands to fens to sphagnum bog is recognized by most ecologists. Some biologists use water chemistry and plant community composition to determine where in this successional series a wetland should be placed. In these classification schemes, the sphagnum wetlands defined in this manual would be bogs. Others base the wetland type on the source of water, in which case most King County sphagnum wetlands would be fens. This manual has adopted the classification scheme based on water chemistry and plant communities and hence refers to these wetlands as bogs rather than fens.

[8] The *size* of a sphagnum bog wetland is defined by the boundaries of the sphagnum bog plant community.

TABLE 6.1.4.A FACILITY COMBINATIONS FOR BOG PROTECTION TREATMENT TRAIN, OPTION 4		

[9] Finlayson, 1990. Unpublished data from reconnaissance of Metro Park and Ride lot stormwater characteristics.

[10] The Department of Ecology WQ design flow is based on the flow predicted by the SBUH model for 64% of the 2-year 24-hour precipitation. This is roughly equivalent to the WQ design flows given here for the KCRTS model.

[11] Available data on the quality of roof runoff was examined. Although there are instances of polluted roof runoff, they tend to be related to galvanized roofing materials or industrial processes. There is also data that suggests the pollutant concentration of atmospheric fallout decreases with vertical elevation. See "Water Quality Thresholds Decision Paper," April 1994, King County Surface Water Management Division (now Water and Land Resources Division).

TABLE 6.2.2.A WATER QUALITY FACILITY PLACEMENT IN RELATION TO DETENTION

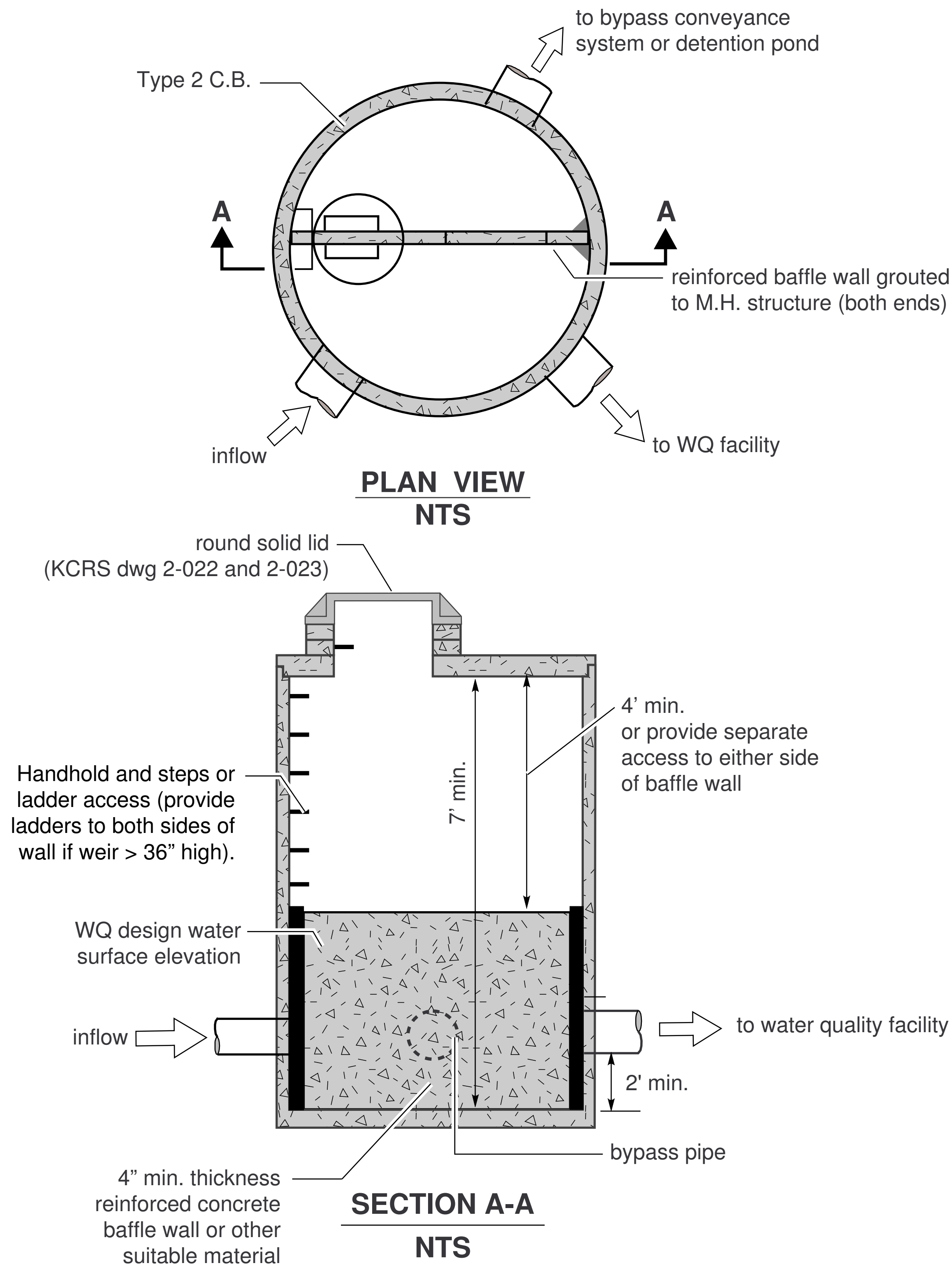
TABLE 6.2.3.A SETBACK REQUIREMENTS *

[12] Infiltration rates can either be measured in the field using methods given in Chapter 5 or inferred from the USDA soil textural triangle (shown in Section 5.4.1). If inferred, the measured infiltration rate is assumed less than 9 inches per hour for all soil texture classes except sand and loamy sand.

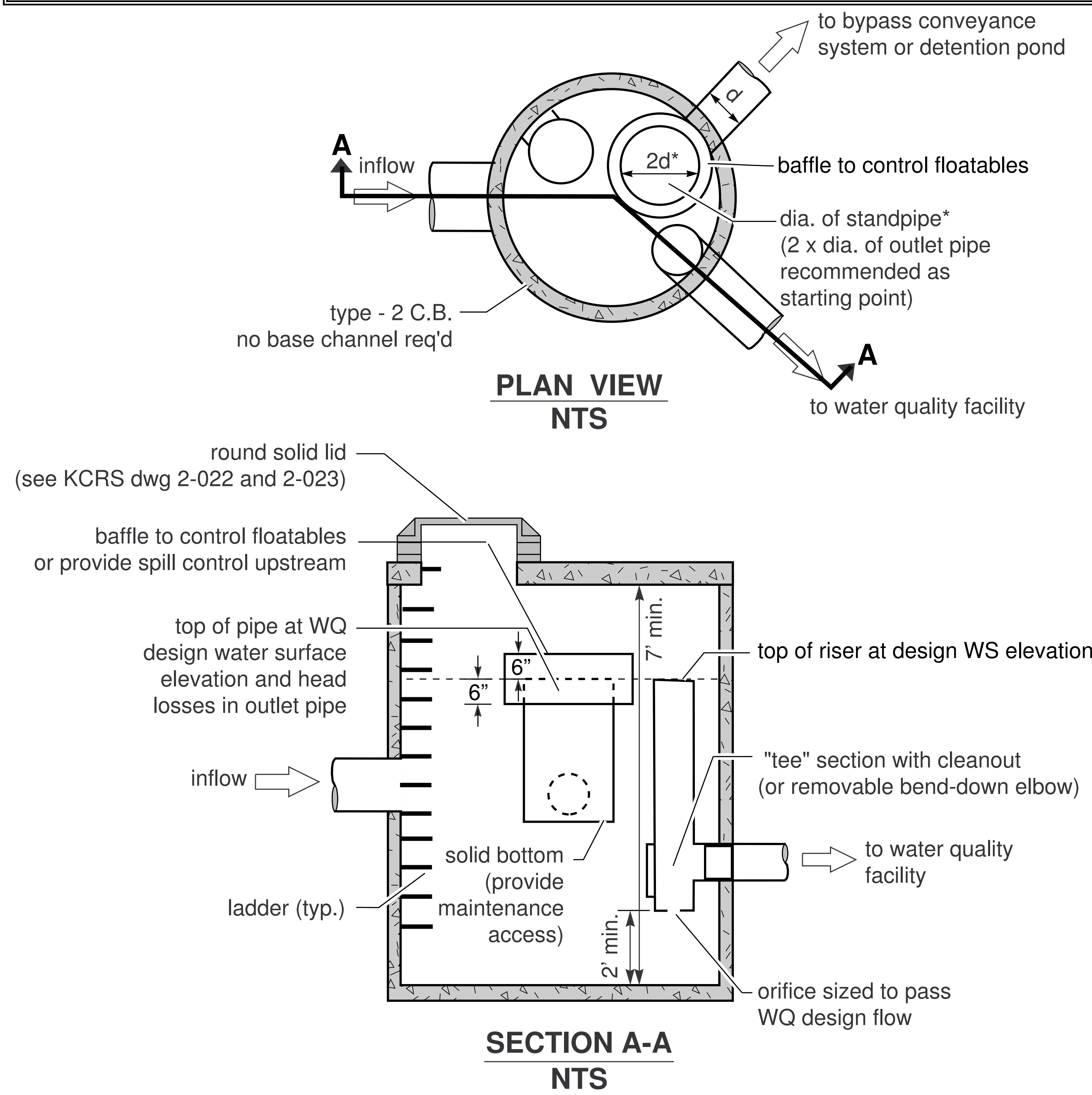
TABLE 6.2.4.A LINING TYPES FOR WQ FACILITIES		

6-27

[13] An exception is the linear sand filter which does not require a soil top dressing to the liner.



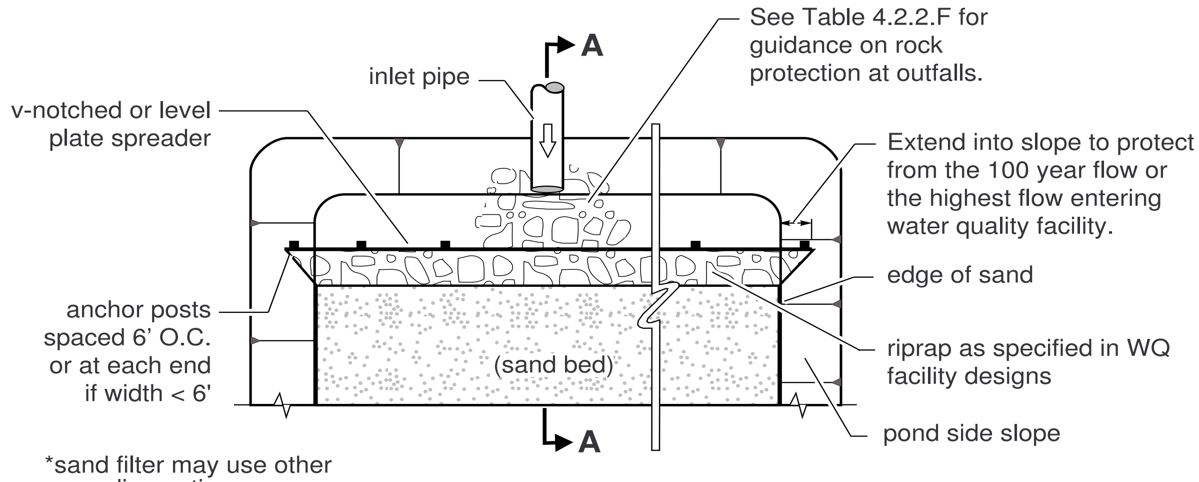
Note: The water quality discharge pipe may require an orifice plate be installed on the outlet to control the height of the design water surface (weir height). The design water surface should be set to provide a minimun headwater/diameter ratio of 2.0 on the outlet pipe.



* **NOTE:** Diameter (d) of standpipe should be large enough to minimize head above WQ design WS and to keep WQ design flows from increasing more than 10% during 100-year flows.

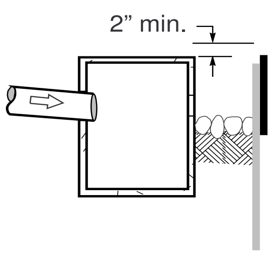
6-33

Example of anchored plate used with a sand filter* (may also be used with other water quality facilities).

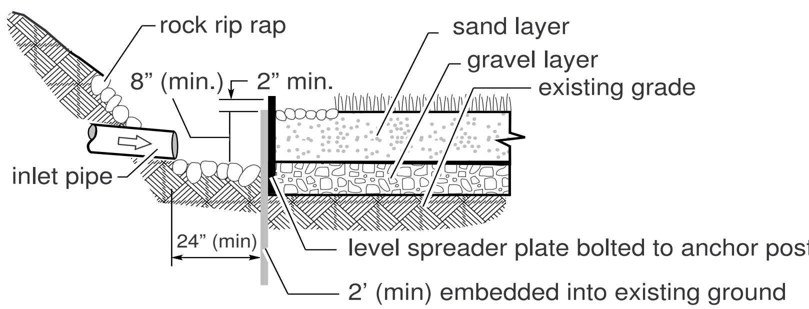


*sand filter may use other spreading options

PLAN VIEW
NTS

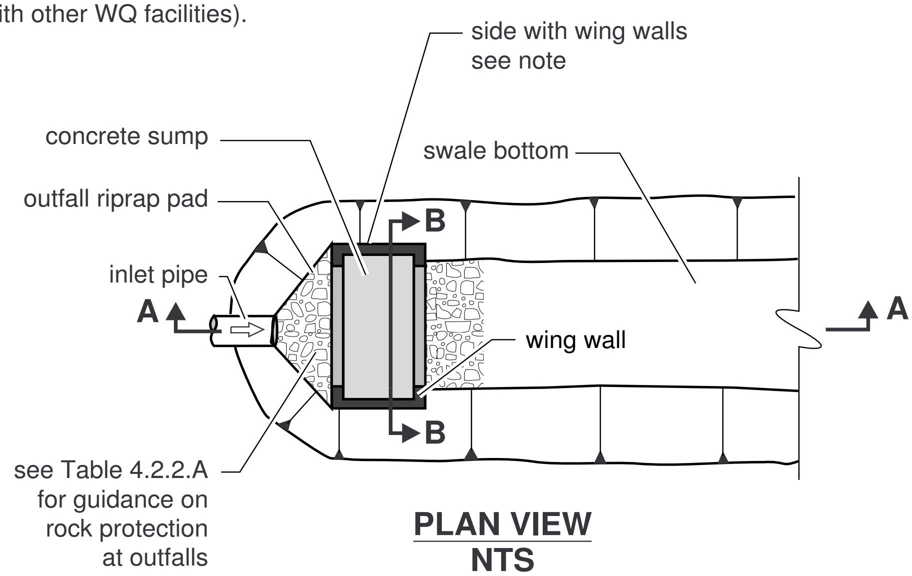


Alternative Design
Catch basin recommended for higher flow situations (generally for inflow velocities of 5 fps or greater for 100 year storm).

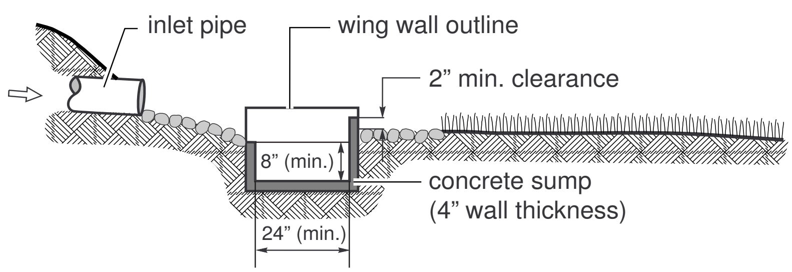


SECTION A-A
NTS

Example of a concrete sump flow spreader used with a biofiltration swale (may be used with other WQ facilities).

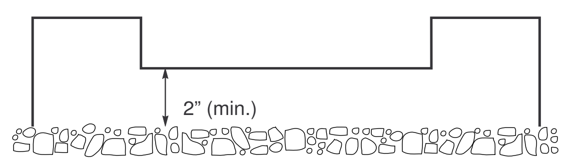


PLAN VIEW
NTS

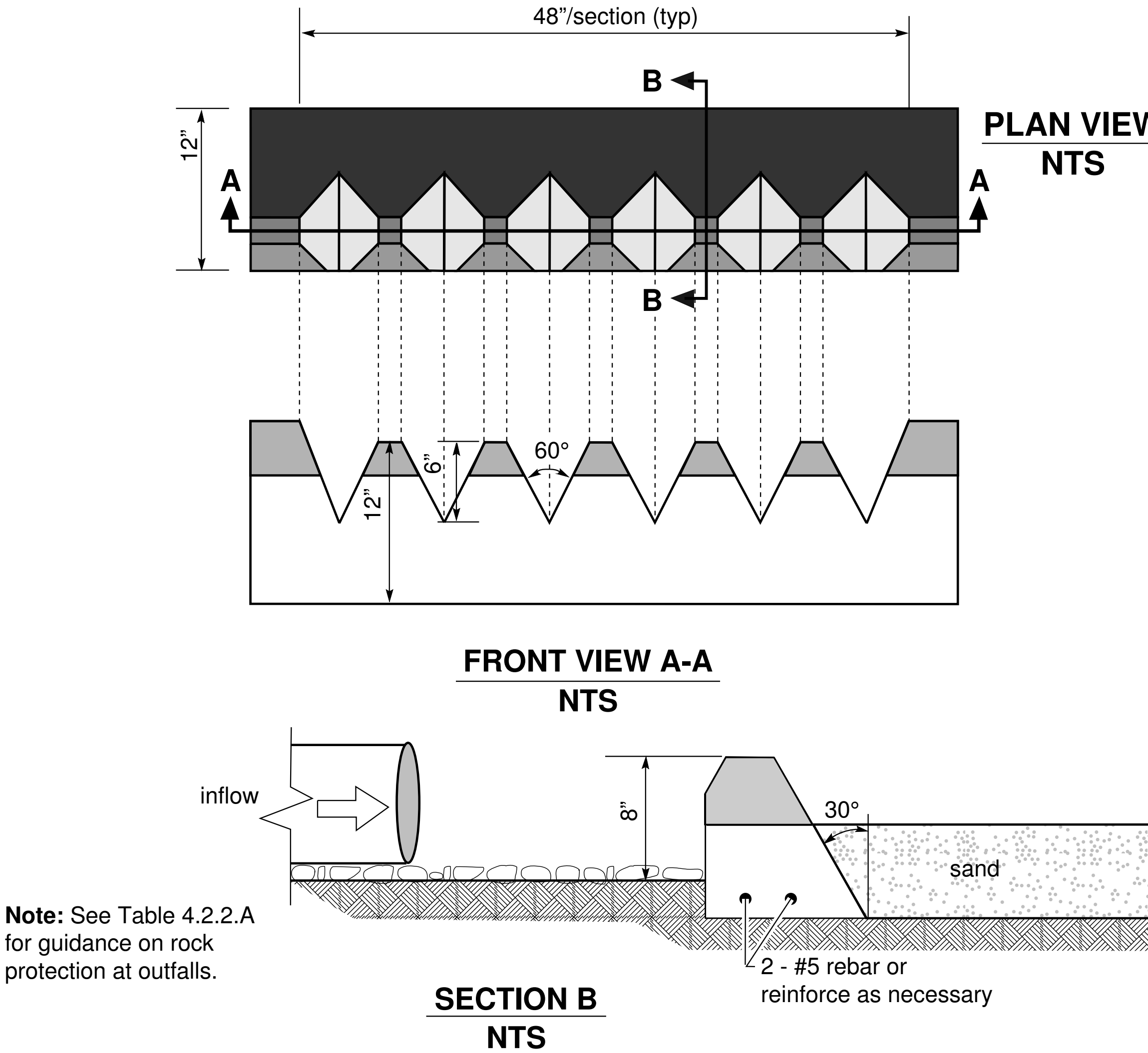


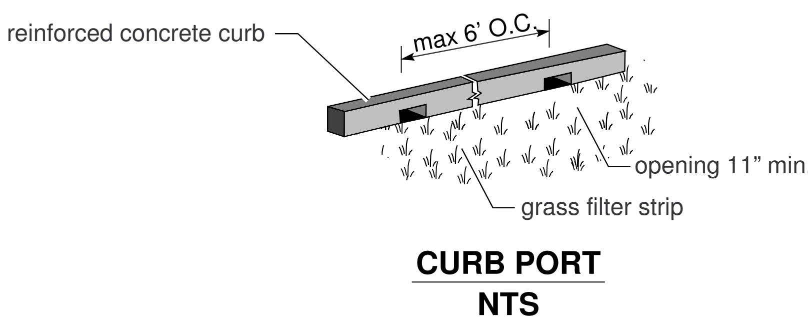
Note: Extend sides into slope. Height of side wall and wing walls must be sufficient to handle the 100-year flow or the highest flow entering the facility.

SECTION A-A
NTS



SECTION B-B
NTS


48"/section (typ)
B
B
A
A
12"
PLAN VIEW
NTS
60°
6"
12"
FRONT VIEW A-A
NTS
inflow
8"
30°
sand
Note: See Table 4.2.2.A for guidance on rock protection at outfalls.
2 - #5 rebar or reinforce as necessary
SECTION B
NTS


reinforced concrete curb
max 6' O.C.
opening 11" min.
grass filter strip
CURB PORT
NTS

6-39

$$\frac{1.49}{n} AR^{0.67} s^{0.5}$$

$$\frac{Q_{wq} n_{wq}}{1.49 y^{1.67} s^{0.5}}$$

$$\left(\frac{Q_{wq} n_{wq}}{1.49 s^{0.5} b}\right)^{3/5}$$

$$\frac{Q_{wq}}{A_{wq}}$$

$$\frac{A_{top}}{(b_f + b_{slope})}$$

[14] Experience with biofiltration swales shows that when the width exceeds about 10 feet it is difficult to keep the water from forming low-flow channels. It is also difficult to construct the bottom level and without sloping to one side. Biofilters are best constructed by leveling the bottom after excavating, and after the soil is amended. A single-width pass with a front-end loader produces a better result than a multiple-width pass.

[15] Soil bioengineering techniques may be used as an alternative to a rockery or structural retaining wall.

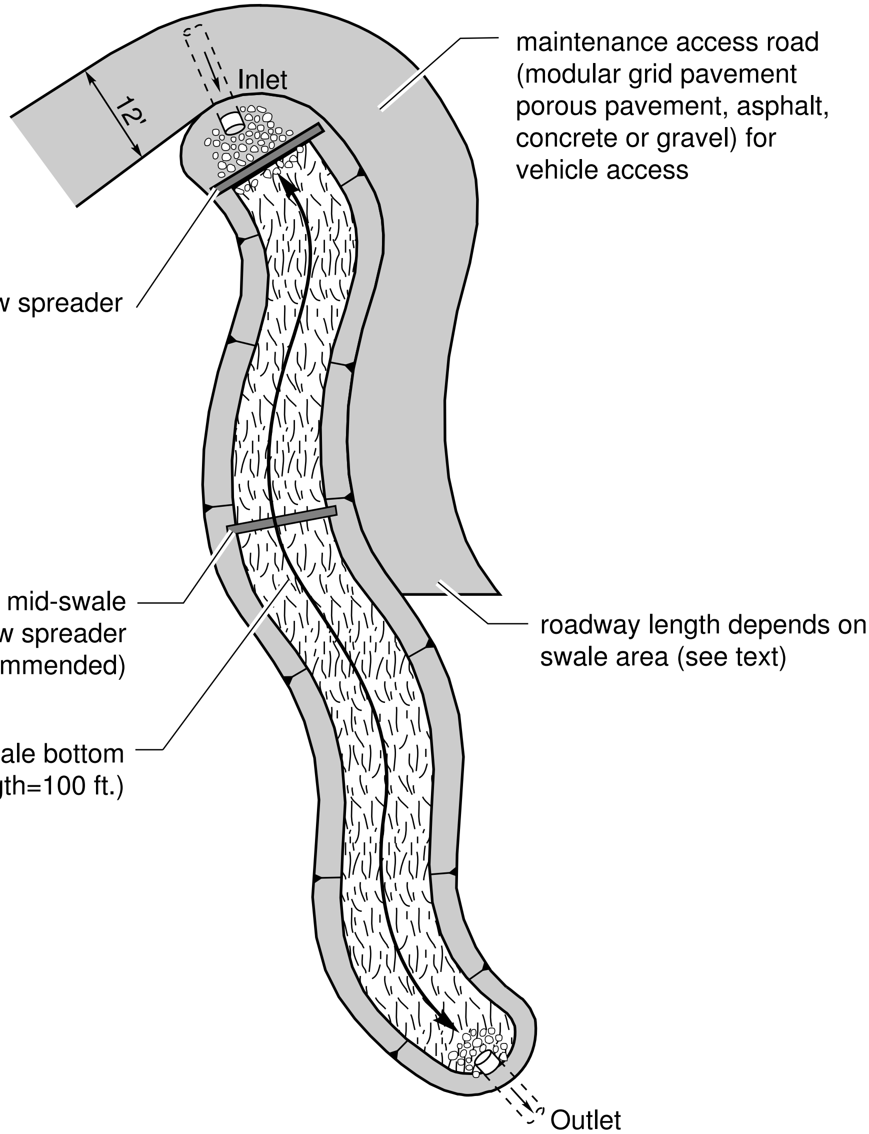
TABLE 6.3.1.A GEOTEXTILE MATERIAL MINIMUM REQUIREMENTS

TABLE 6.3.1.B REQUIREMENTS FOR BIOFILTRATION SWALE ACCESS ROAD	

TABLE 6.3.1.C GRASS SEED MIXES SUITABLE FOR BIOFILTRATION SWALE TREATMENT AREAS			

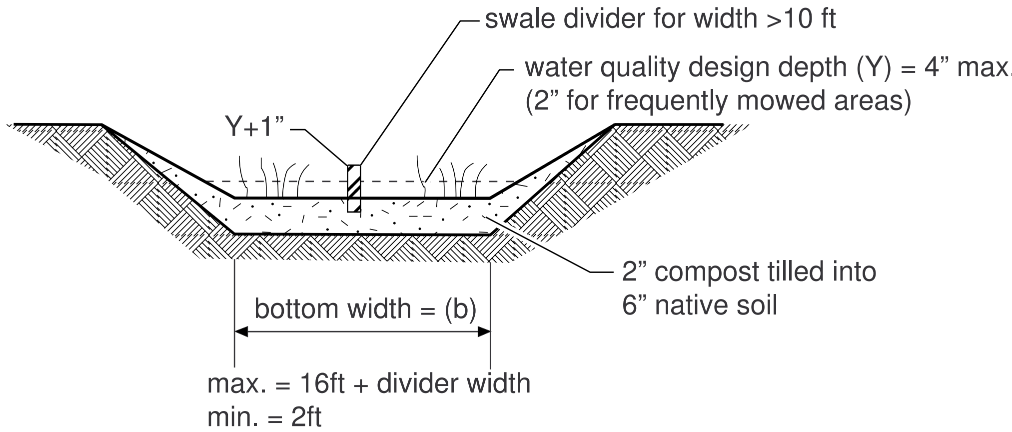
TABLE 6.3.1.D FINELY-TEXTURED PLANTS TOLERANT OF FREQUENT SATURATED SOIL CONDITIONS OR STANDING WATER			

TABLE 6.3.1.E GROUNDCOVERS AND GRASSES SUITABLE FOR THE UPPER SIDE SLOPES OF A BIOFILTRATION SWALE

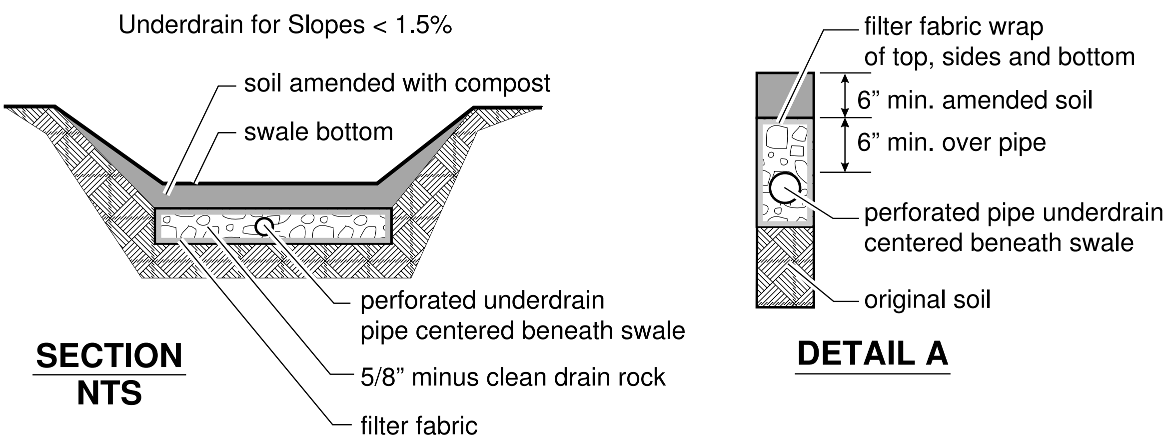


NOTE: Longitudinal slope 1-6%.
Provide underdrain for slopes < 1.5%.

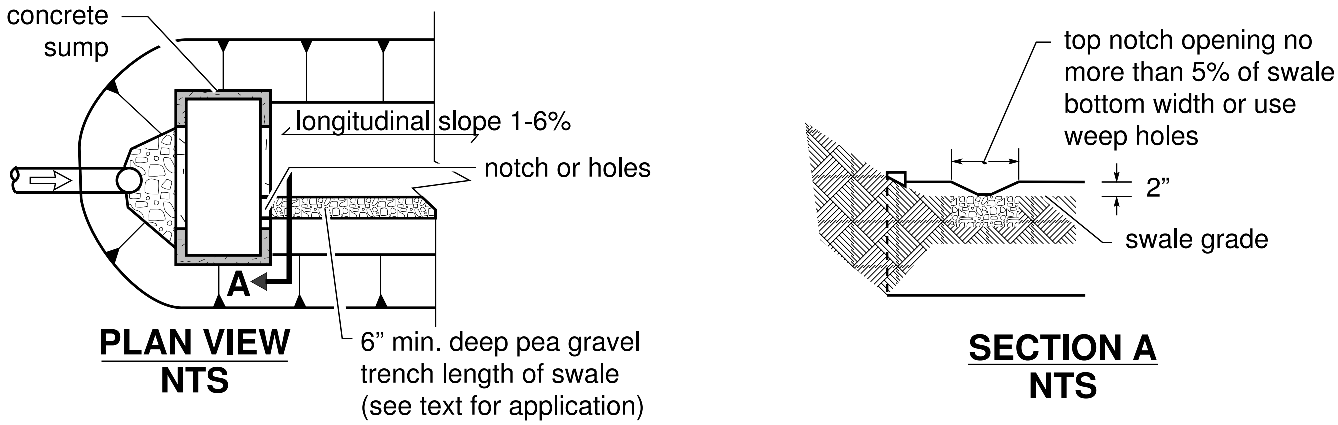
PLAN
NTS

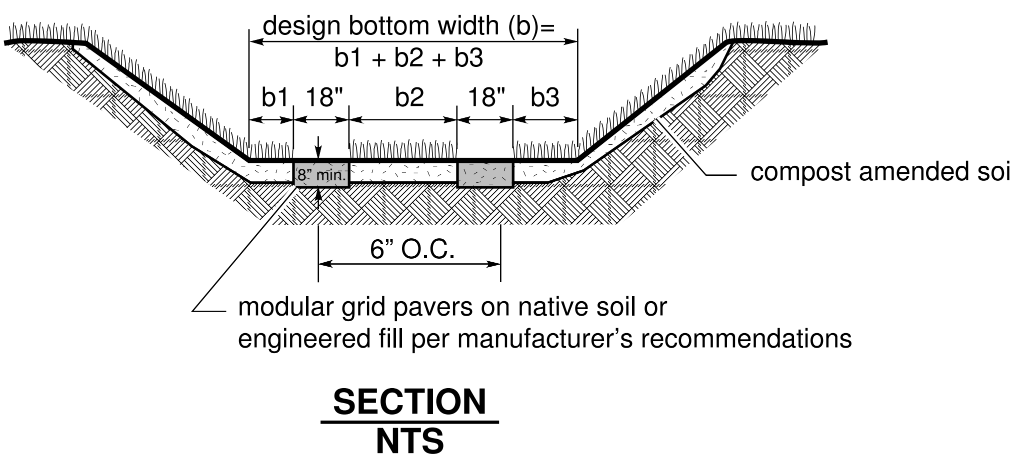


TYPICAL SWALE SECTION
NTS



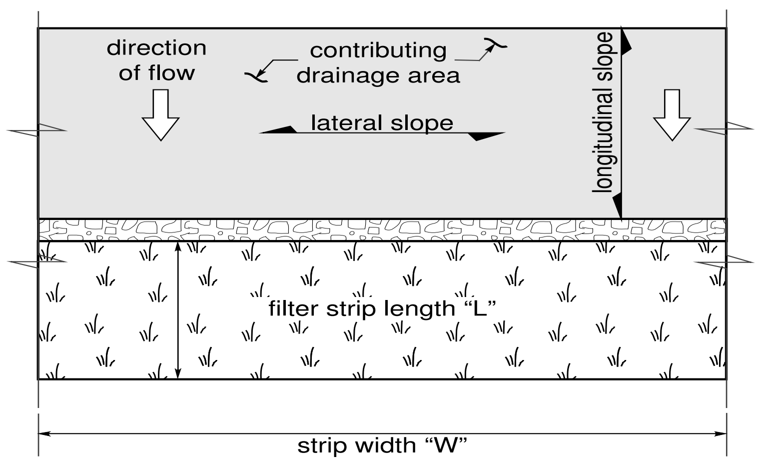
NOTE: Underdrain must infiltrate or drain freely to an acceptable discharge point.


concrete
sump
longitudinal slope 1-6%
notch or holes
A
PLAN VIEW
NTS
6" min. deep pea gravel
trench length of swale
(see text for application)
top notch opening no
more than 5% of swale
bottom width or use
weep holes
2"
swale grade
SECTION A
NTS


design bottom width (b)=
b1 + b2 + b3
b1
18"
b2
18"
b3
8" min.
compost amended soil
6" O.C.
modular grid pavers on native soil or
engineered fill per manufacturer's recommendations
SECTION
NTS

[16] Unlike grass, wetland vegetation will not quickly regain an upright attitude after being laid down by high flows. New growth, usually from the base of the plant, often taking several weeks, is required to regain its upright form.

TABLE 6.3.2.A RECOMMENDED PLANTS FOR WET BIOFILTRATION SWALE

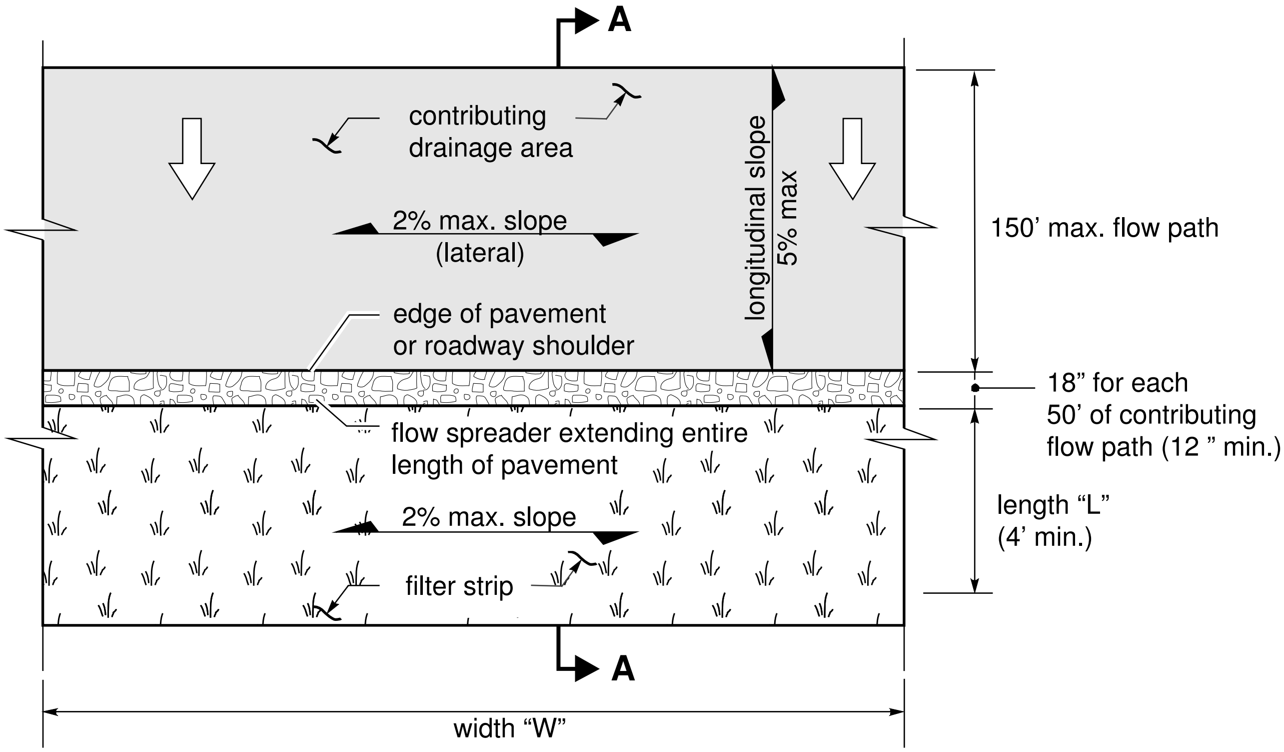


[17] Ree, W.O., F.L. Wimberley, and F.R. Crow. 1977. Manning *n* and the overland flow equation. Transactions of the American Society of Agricultural Engineers 20 (89).

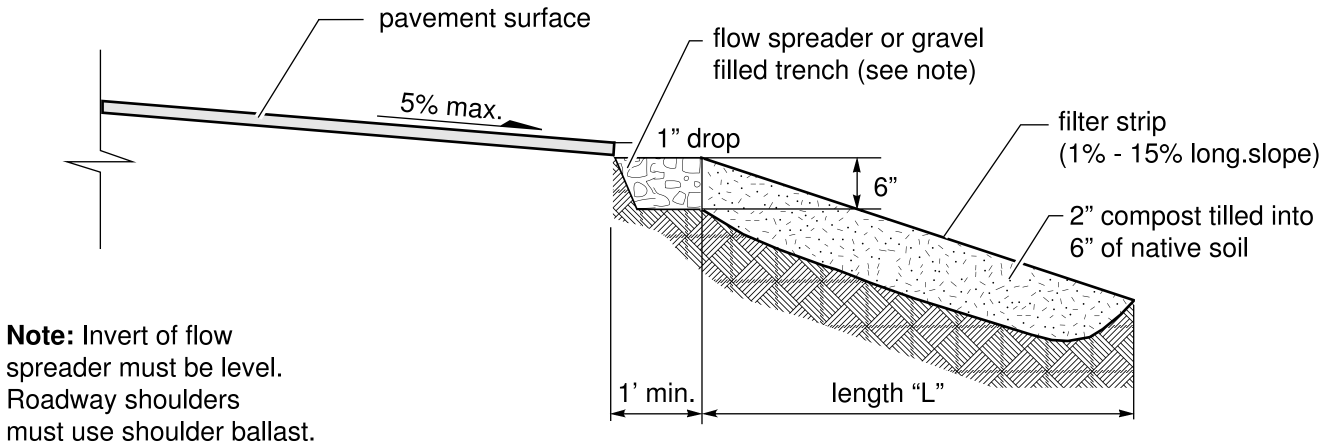
$$\frac{1.49}{n_{wq}} W d_f^{1.67} s^{0.5}$$

$$\left(\frac{Q_{wq} n_{wq}}{1.49 W s^{0.5}} \right)^{0.6}$$

$$\frac{Q_{wq}}{W d_f}$$



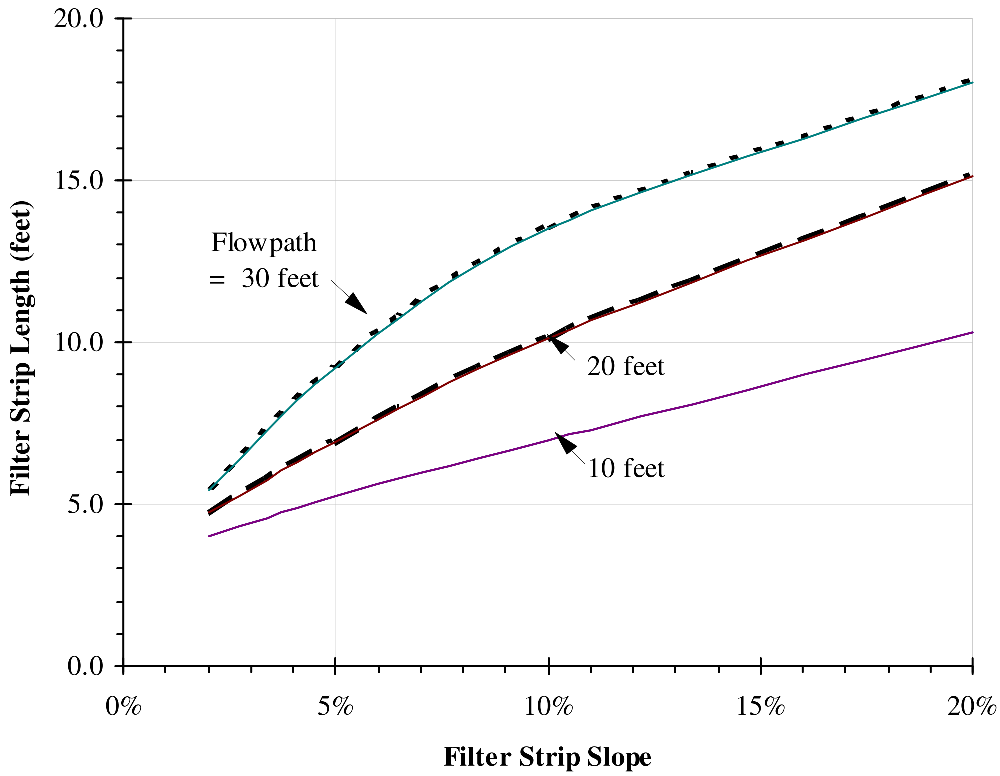
PLAN VIEW
NTS



SECTION A-A

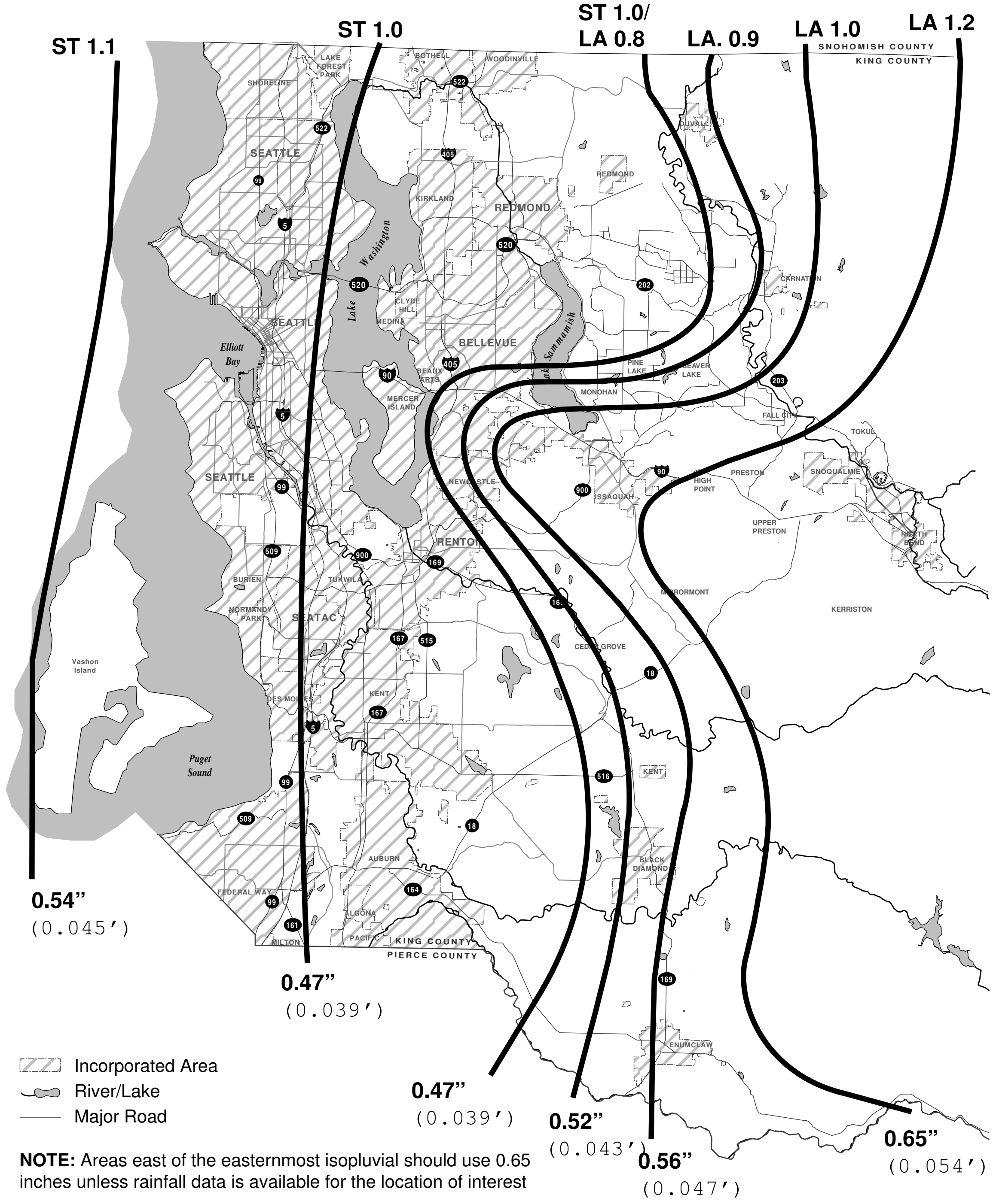
[18] This narrow area filter strip design method is included here because technical limitations exist in the basic design method that result in filter strips which are proportionately longer as the contributing drainage becomes narrower (a result that is counter-intuitive). Research by several parties is underway to evaluate filter strip design parameters. This research may lead to more stringent design requirements that would supersede the design criteria presented here.

[19] The filter strip length requirements reflected in Figure 6.3.5.A are scaled from dimensions of biofiltration swale treatment areas for the same slope and flow rate conditions.



Note: minimum allowable filter strip length is 4 feet

[20] The *mean annual storm* is a statistically derived rainfall event defined by the U.S. Environmental Protection Agency in "Results of the Nationwide Urban Runoff Program," 1986. It is defined as the annual rainfall divided by the number of storm events in the year. The NURP studies refer to pond sizing using a V_b/V_r ratio: the ratio of the pond volume V_b to the volume of runoff from the mean annual storm V_r. This is equivalent to using a volume factor f times V_r.



NOTE: Areas east of the easternmost isopluvial should use 0.65 inches unless rainfall data is available for the location of interest

[24] The mean annual storm is a conceptual storm found by dividing the annual precipitation by the total number of storm events per year

$$\frac{h(A_1 + A_2)}{2}$$

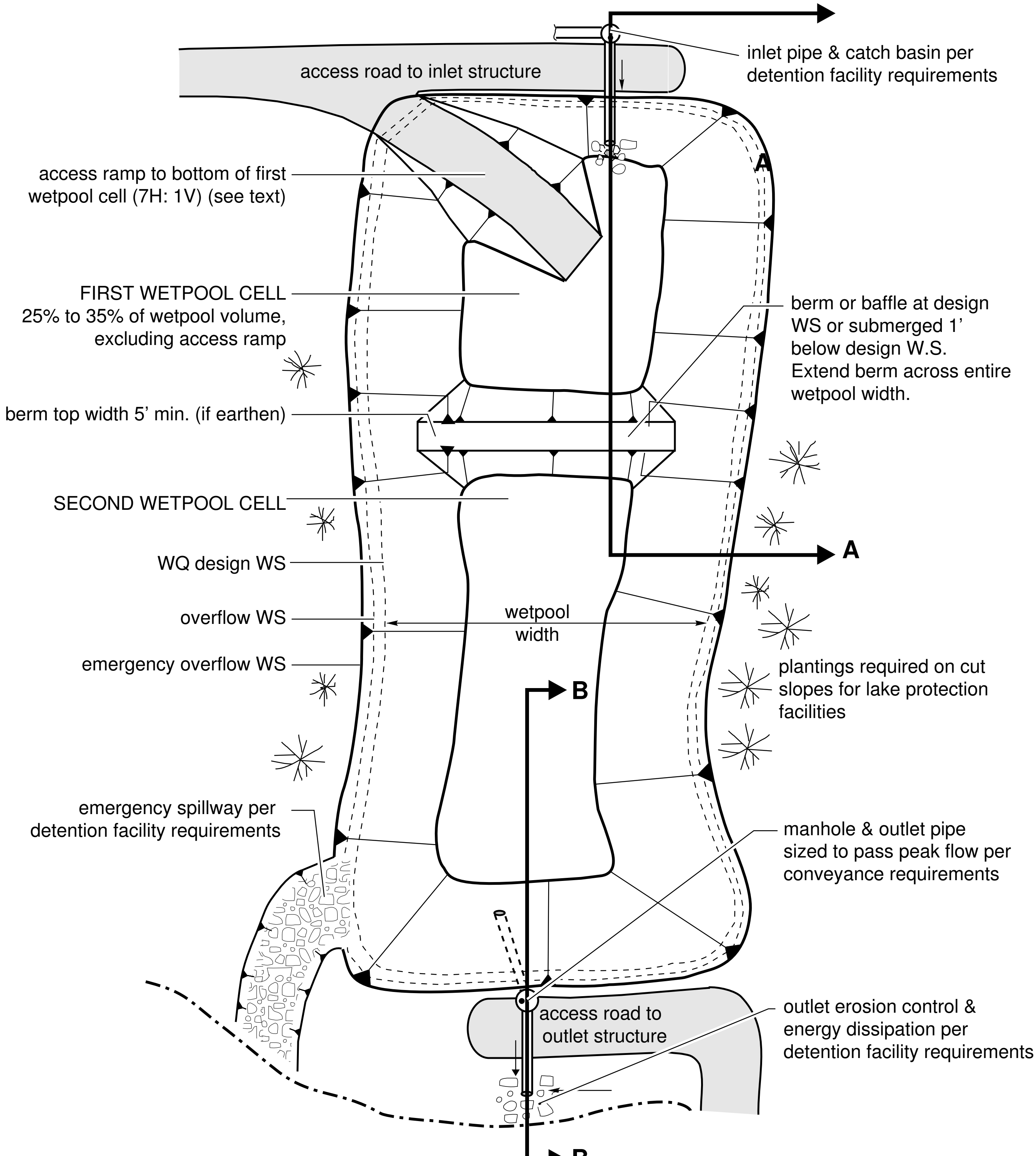
[21] As used here, the term *baffle* means a vertical divider placed across the entire width of the pond, stopping short of the pond bottom. A berm is a vertical divider typically built up from the bottom, or if in a vault, connects all the way to the bottom.

[22] The geotechnical analysis must address situations in which one of the two cells is empty while the other remains full of water. These situations can occur, for example, during pump down of either cell for sediment removal, or when water from the second unlined cell percolates into the ground.

[23] Waterfowl are believed to limit use of areas where their view of predator approach paths is blocked. Some suitable native shrubs include vine maple, Indian plum, bitter cherry, red osier dogwood, cascara, and red elderberry. Ornamental hedge plants such as English laurel, privet and barberry are also good choices.

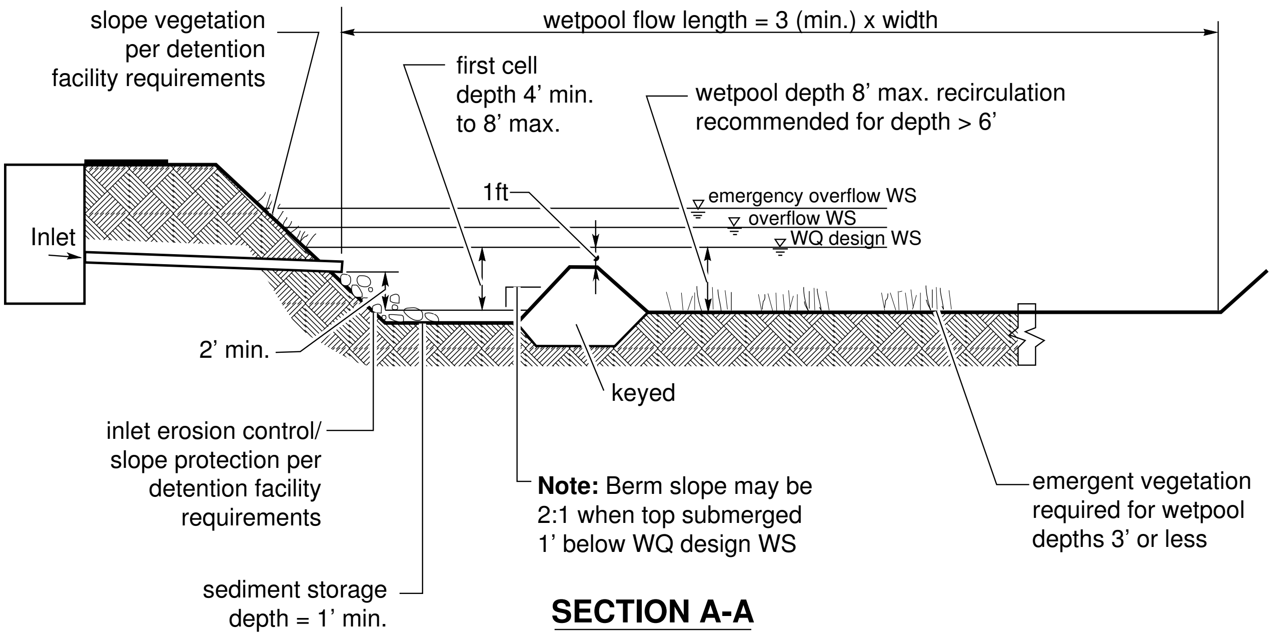
TABLE 6.4.1.A EMERGENT WETLAND PLANT SPECIES RECOMMENDED FOR WETPONDS

[24] Wind moving over the surface of standing water can often induce some mixing of surface and near-surface water, replenishing oxygen and reducing stagnant conditions. If the pond is aligned with the prevailing wind direction, this effect can be maximized.

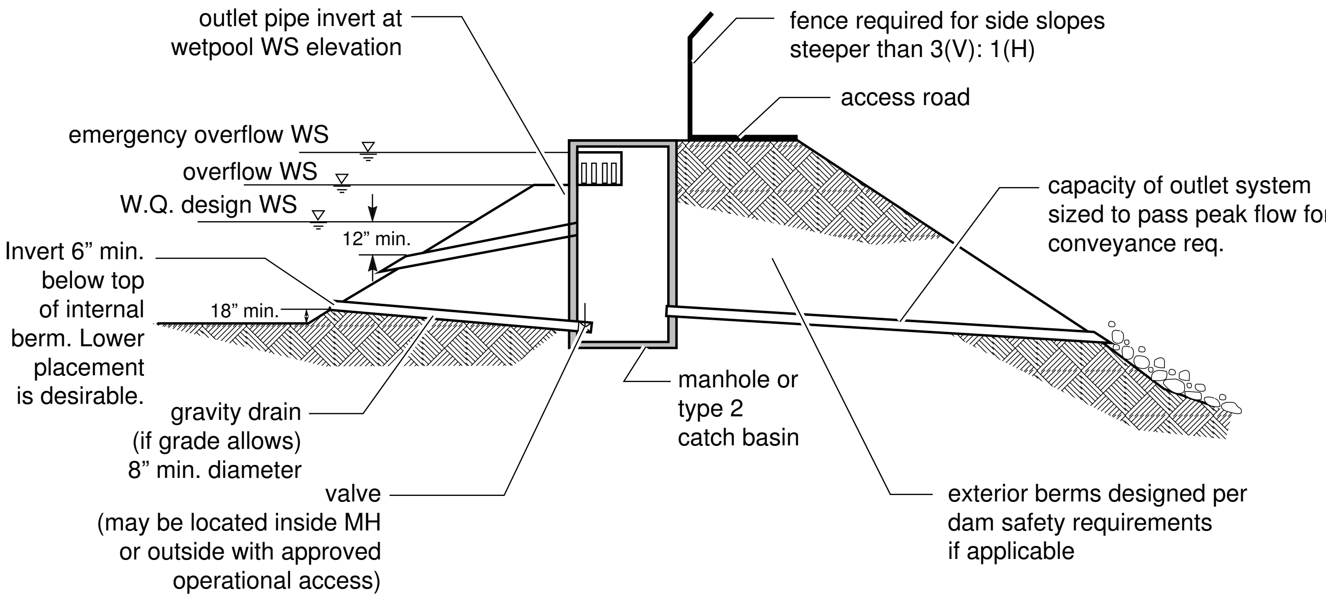


NOTE: Berm not required for ponds with length to width ratio 4:1 or if volume less than 4000 c.f.

PLAN VIEW
NTS

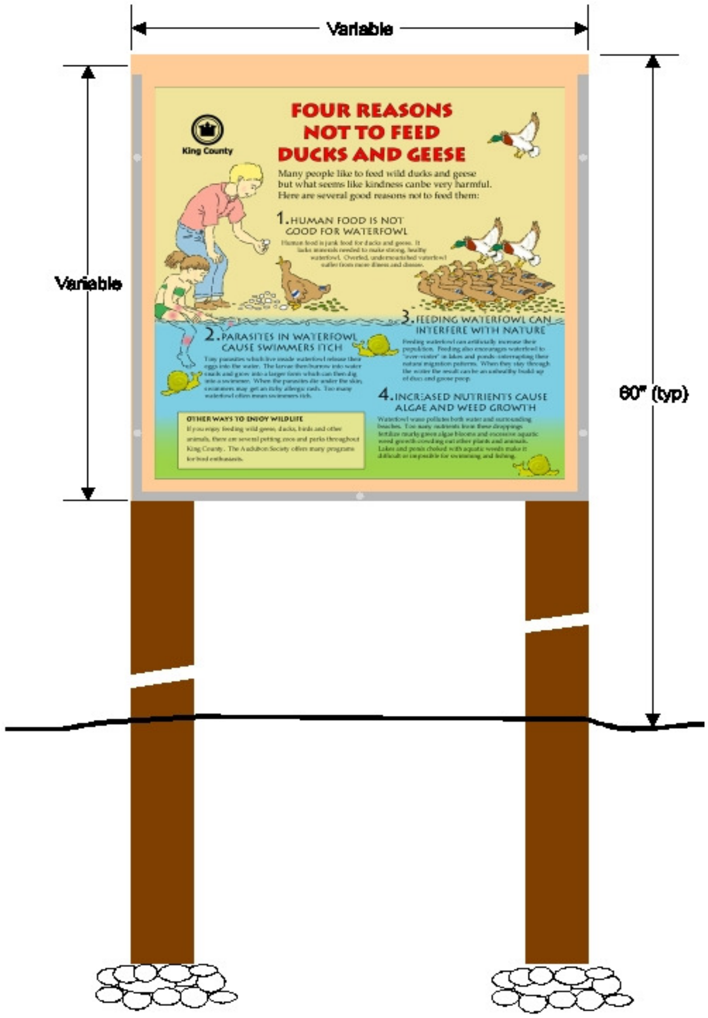


SECTION A-A
NTS



SECTION B-B
NTS

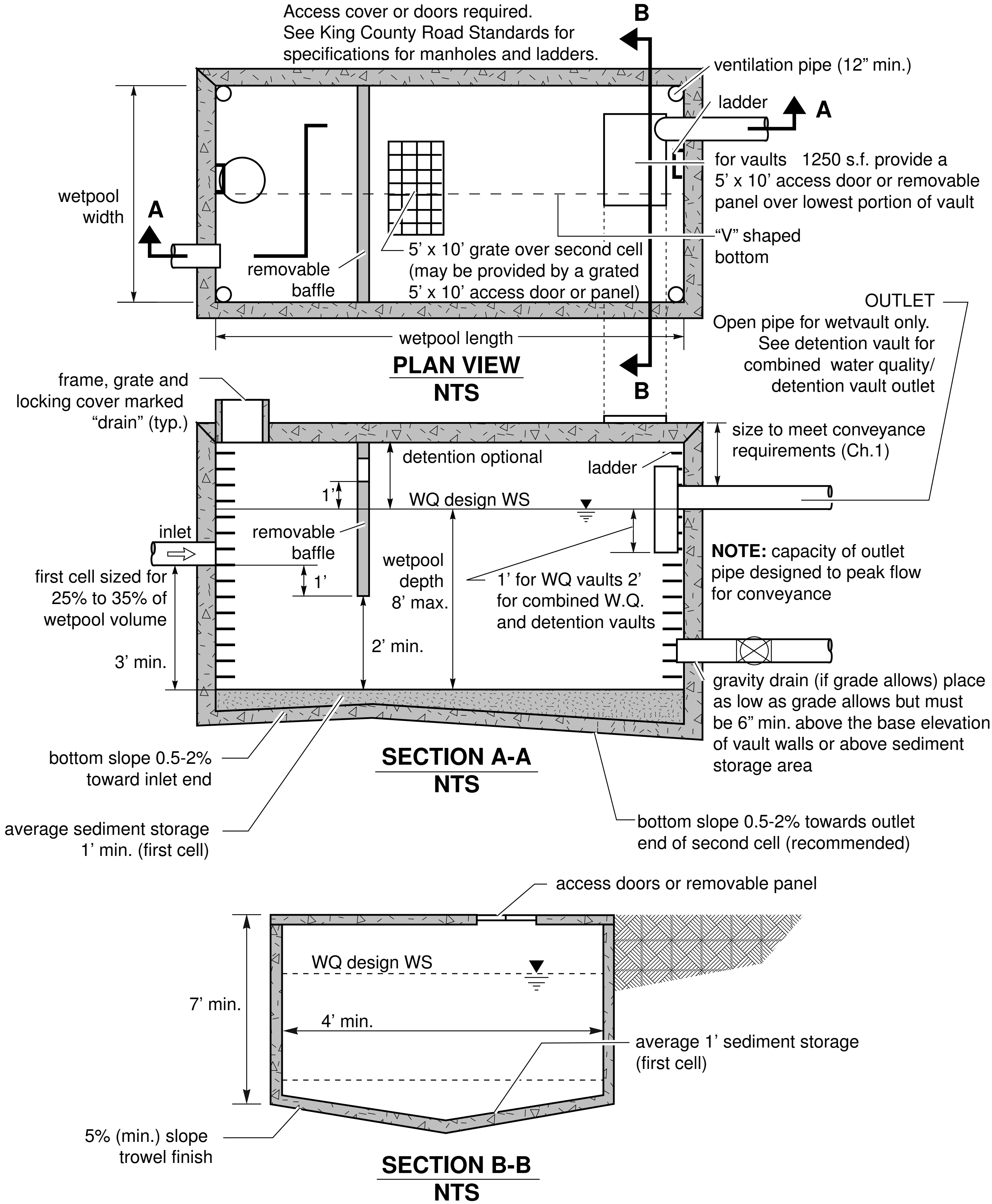
NOTE: See detention facility requirements for location and setback requirements.



Variable
Variable
60" (typ)
FOUR REASONS NOT TO FEED DUCKS AND GEESE
King County
Many people like to feed wild ducks and geese but what seems like kindness canbe very harmful. Here are several good reasons not to feed them:
1. HUMAN FOOD IS NOT GOOD FOR WATERFOWL
2. PARASITES IN WATERFOWL CAUSE SWIMMERS ITCH
3. FEEDING WATERFOWL CAN INTERFERE WITH NATURE
4. INCREASED NUTRIENTS CAUSE ALGAE AND WEED GROWTH
OTHER WAYS TO ENJOY WILDLIFE

[25] U.S. Environmental Protection Agency, *Results of the Nationwide Urban Runoff Program*, 1986.

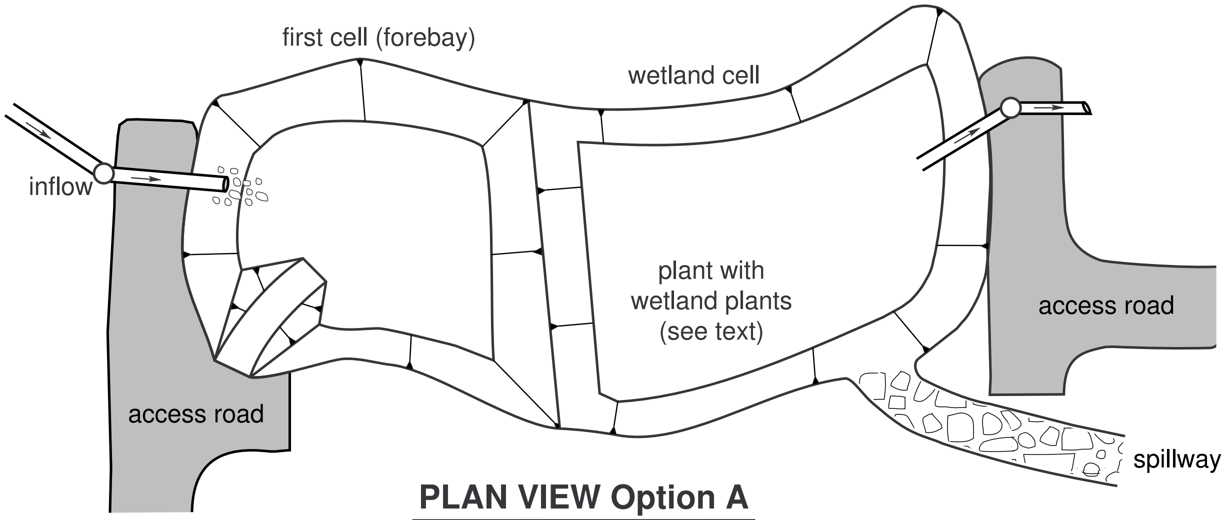
[26] As used here, the term *baffle* means a divider that does not extend all the way to the bottom of the vault, or if a bottom baffle, does not extend all the way to the top of the water surface. A *wall* is used here to mean a divider that extends all the way from near the water surface to the bottom of the vault.


Access cover or doors required.
See King County Road Standards for
specifications for manholes and ladders.
B
ventilation pipe (12” min.)
ladder
A
for vaults 1250 s.f. provide a
5’ x 10’ access door or removable
panel over lowest portion of vault
wetpool
width
A
“V” shaped
bottom
5’ x 10’ grate over second cell
(may be provided by a grated
5’ x 10’ access door or panel)
removable
baffle
OUTLET
Open pipe for wetvault only.
See detention vault for
combined water quality/
detention vault outlet
wetpool length
PLAN VIEW
NTS
B
frame, grate and
locking cover marked
“drain” (typ.)
size to meet conveyance
requirements (Ch.1)
detention optional
ladder
1’
WQ design WS
inlet
removable
baffle
wetpool
depth
8’ max.
NOTE: capacity of outlet
pipe designed to peak flow
for conveyance
first cell sized for
25% to 35% of
wetpool volume
1’
1’ for WQ vaults 2’
for combined W.Q.
and detention vaults
2’ min.
3’ min.
gravity drain (if grade allows) place
as low as grade allows but must
be 6” min. above the base elevation
of vault walls or above sediment
storage area
bottom slope 0.5-2%
toward inlet end
SECTION A-A
NTS
average sediment storage
1’ min. (first cell)
bottom slope 0.5-2% towards outlet
end of second cell (recommended)
access doors or removable panel
WQ design WS
7’ min.
4’ min.
average 1’ sediment storage
(first cell)
5% (min.) slope
trowel finish
SECTION B-B
NTS

[27] Richardson, C. 1987. "Mechanisms controlling phosphorus retention capacity in freshwater wetlands," *Science*, 228: 1424.

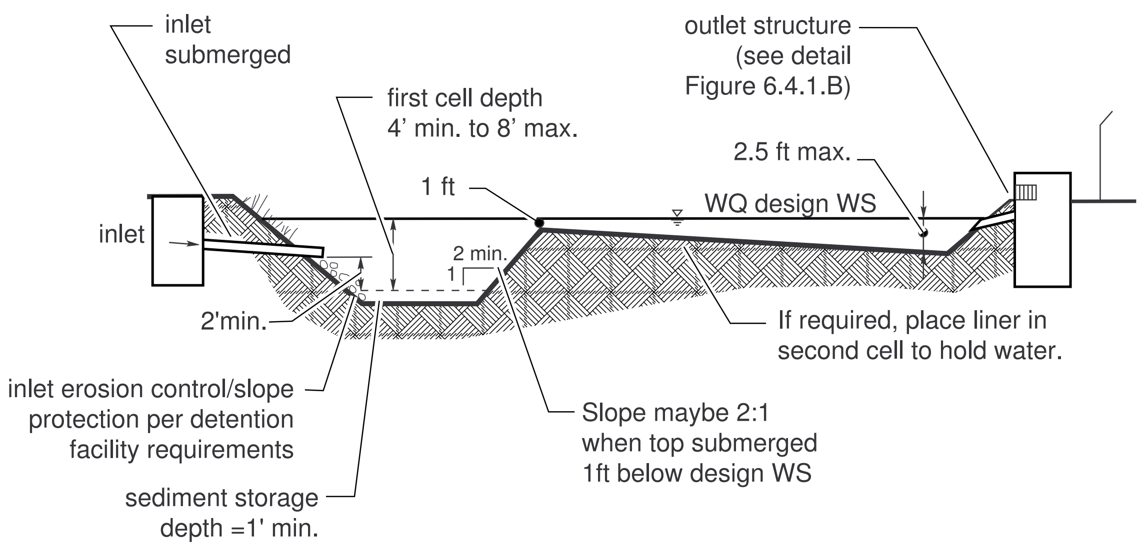
[28] If the berm is at the water surface, then for safety reasons, its slope must be no greater than 3:1, just as the pond banks must be 3:1 if the pond is not fenced. A steeper slope (2:1 rather than 3:1) is allowed if the berm is submerged in 1 foot of water. If submerged, the berm it is not considered accessible, and the steeper slope is allowed.

TABLE 6.4.3.A DISTRIBUTION OF DEPTHS IN WETLAND CELL			



PLAN VIEW Option A

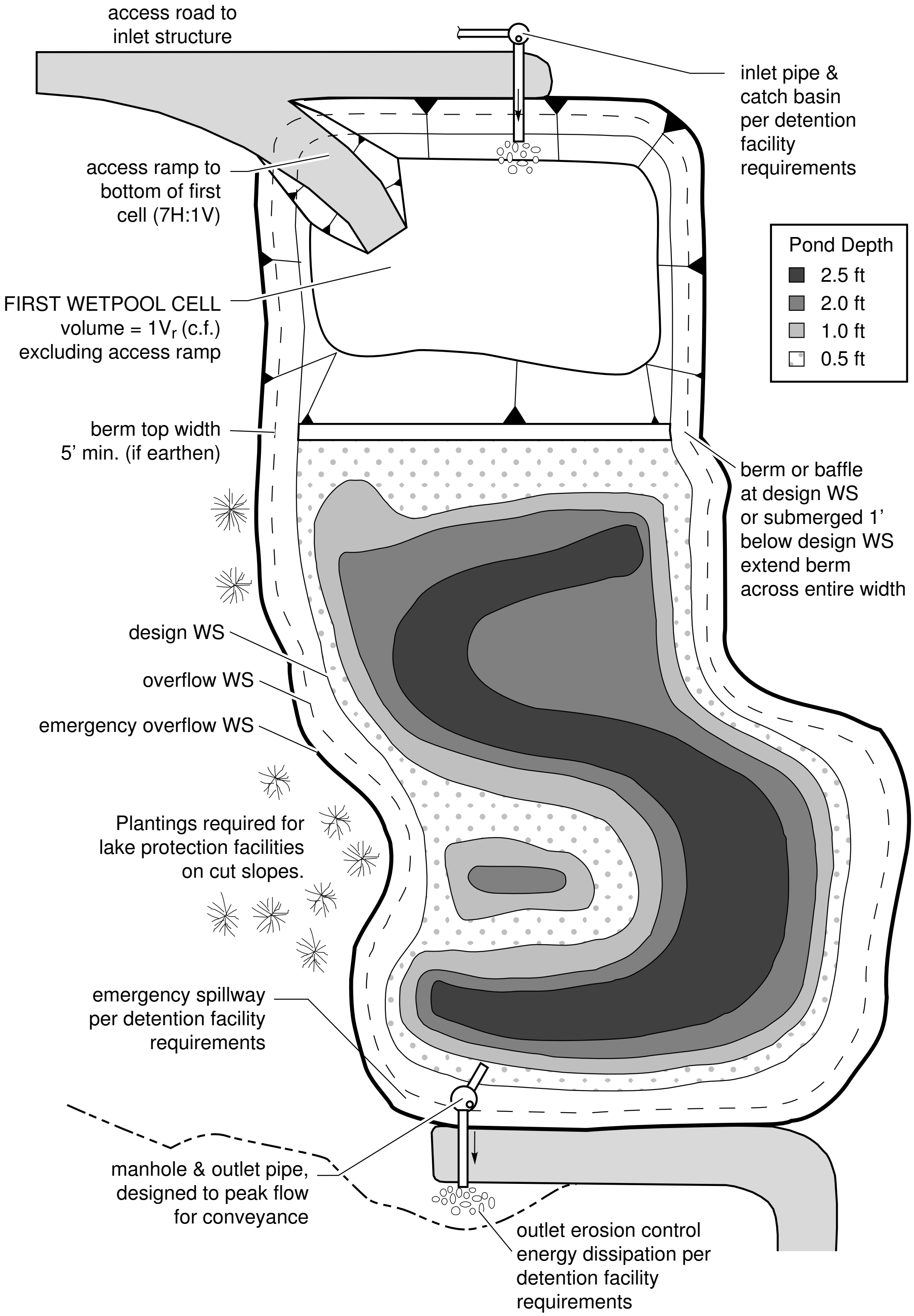
NTS



SECTION VIEW Option A

NTS

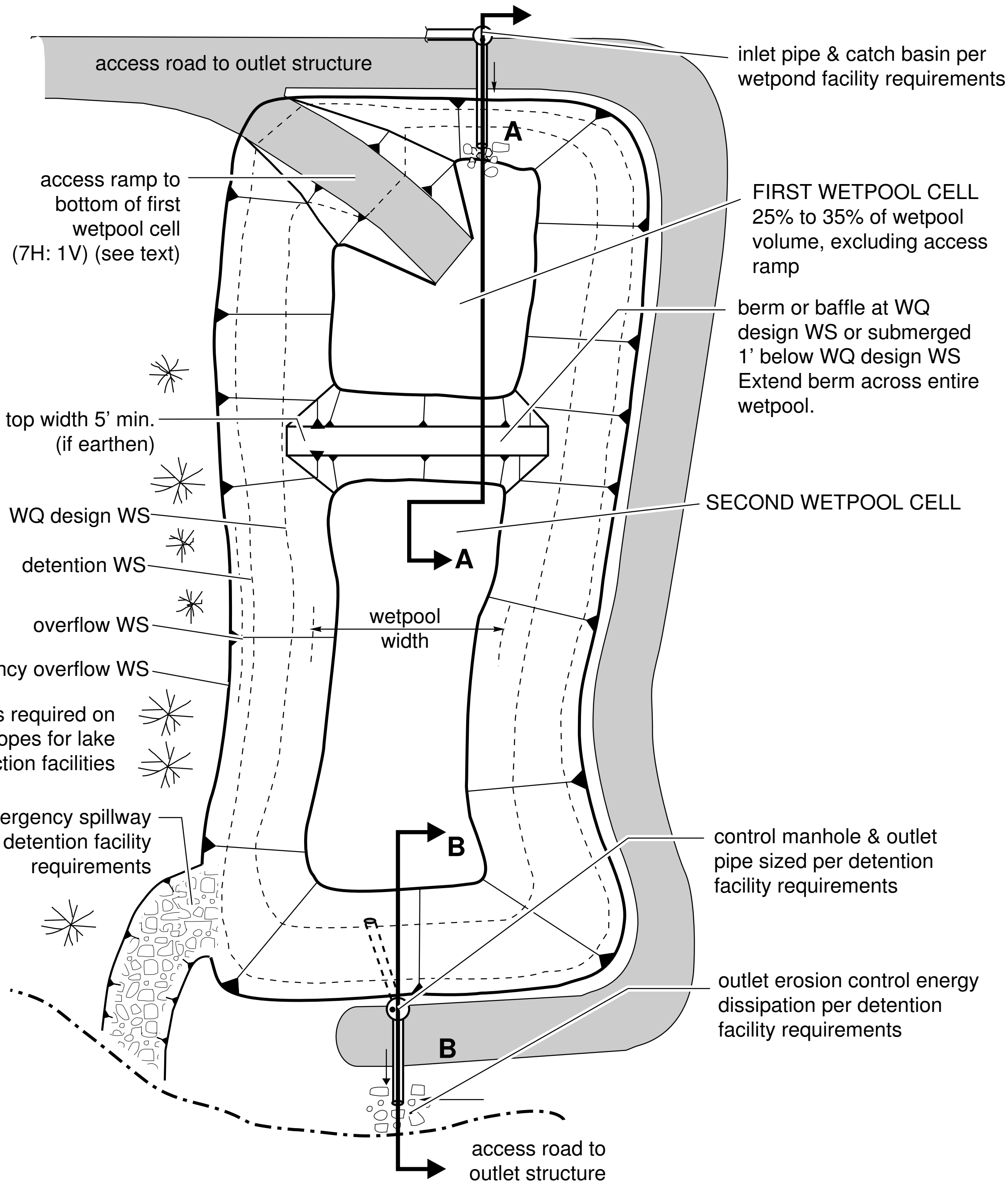
Note: See detention facility requirements for location and setback requirements.



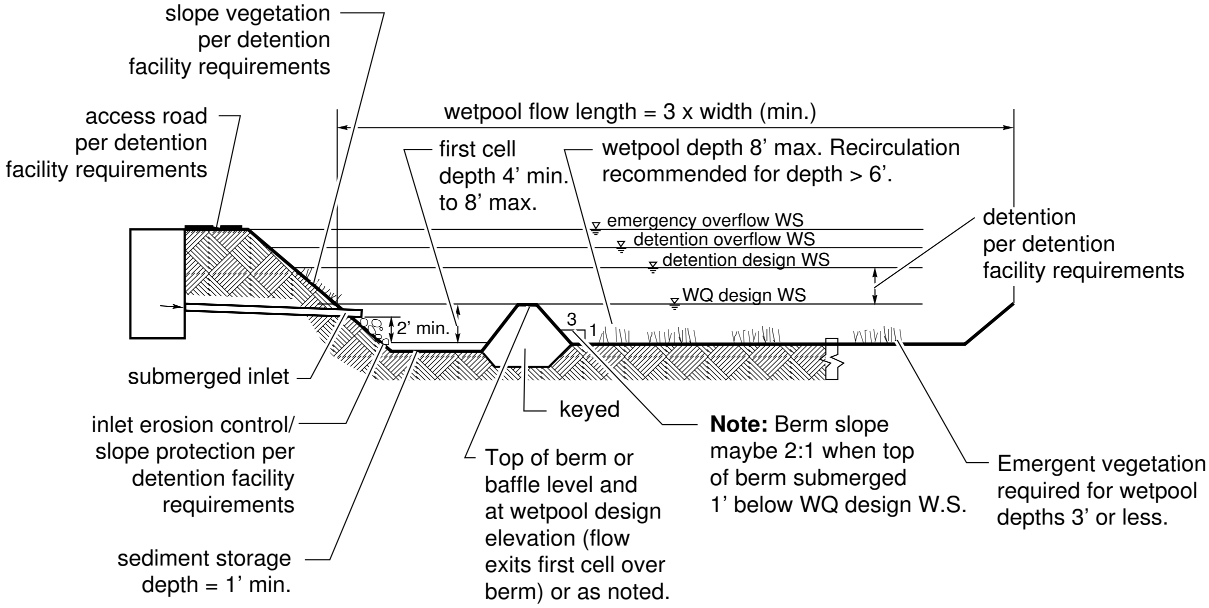
PLAN VIEW Option B

NTS

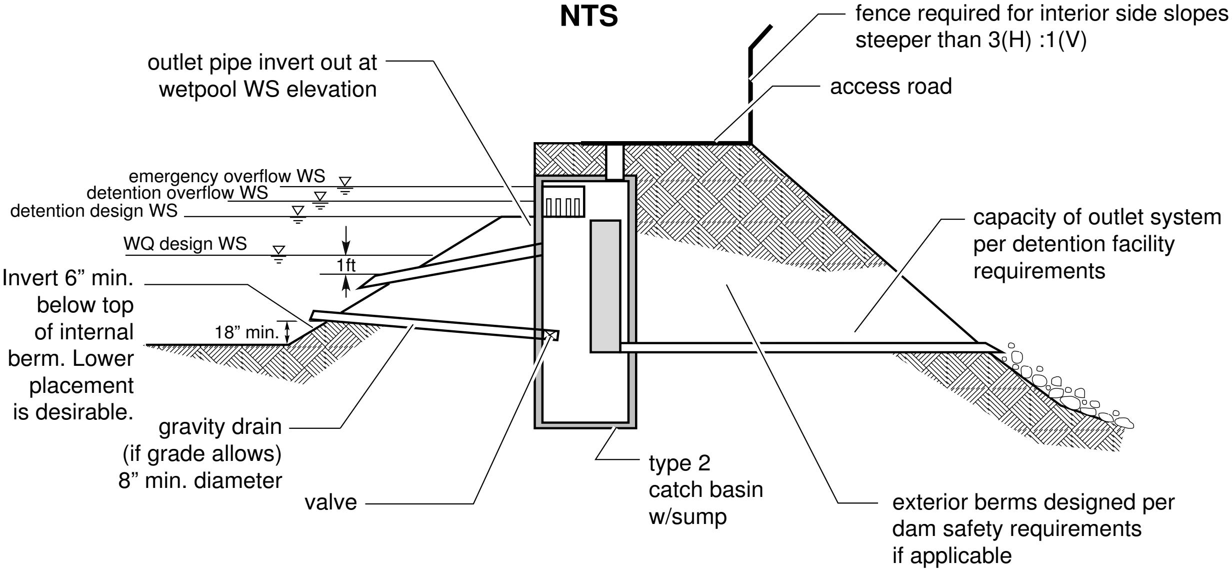
[29] Many of the ponds studied in the Nationwide Urban Runoff Program were combined ponds.



PLAN VIEW
NTS

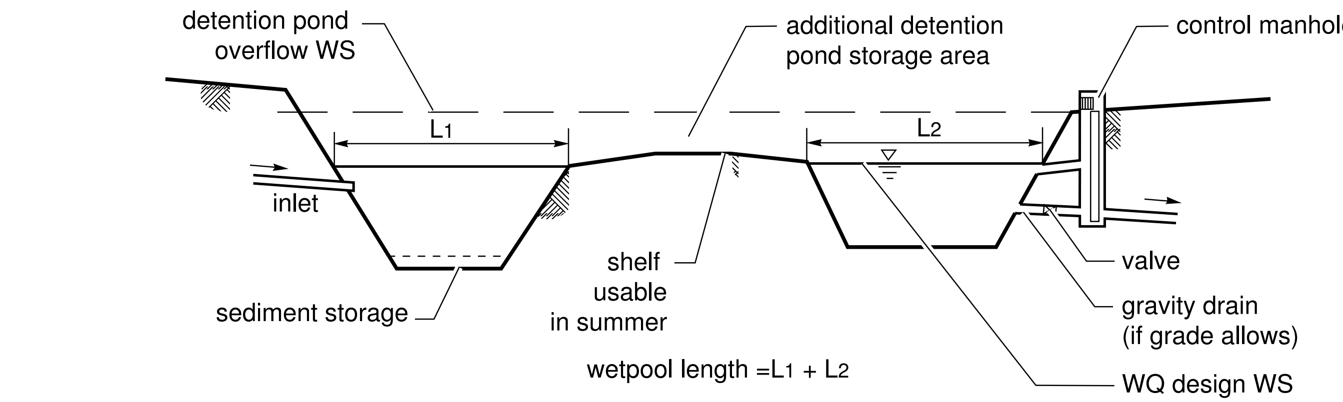


SECTION A-A
NTS

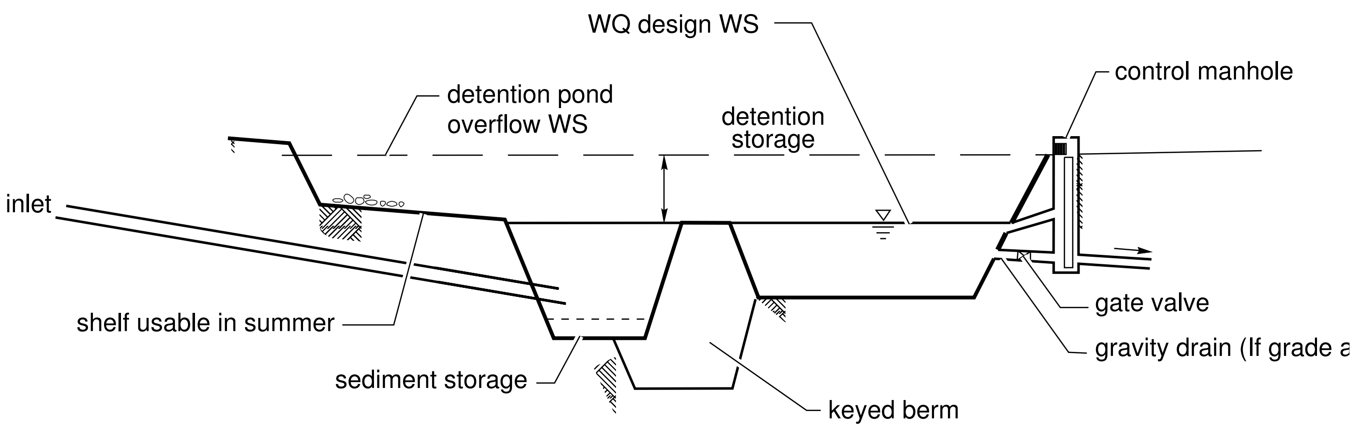


Note: See detention facility requirements for location, interior & exterior sideslopes, and setback requirements.

SECTION B-B
NTS



SECTION VIEW
NTS



SECTION VIEW
NTS

Note: These examples show how the combined detention/wetpool can be configured to allow for "shelves" for joint use opportunities in dry weather. Other options may also be acceptable.

6-103

$$\frac{h+l}{l}$$

[30] These flows are roughly equivalent to the WQ design flows used by the Dept. of Ecology in it's 1992 stormwater management manual. The Ecology design flow is based on the peak flow predicted by the SBUH event model for 64% of the 2-year 24-hour rainfall.

[31] King County has tested various sand mixes conditioned with simulated stormwater to establish realistic design standards. Tests were conducted under falling head conditions in columns containing 18 inches of sand underlain with a 2-inch layer of washed drain gravel containing a section of 2-inch perforated PVC pipe to simulate the underdrain system. Details are given in Koon, John, "Determination of infiltration rate and hydraulic conductivity for various sand filter media." January 1996.

TABLE 6.5.2.A SAND FILTER AREA INCREMENTS FOR VARIOUS SOIL AND COVER TYPES

[32] The values in Table 6.5.2.A were derived as follows. Flows were estimated using the KCRTS model for one acre of the cover types selected in the table. Darcy's law ($Q = Ki\ A$) was then used to determine sand filter area using this flow Q, the hydraulic gradient i for the various ponding depths given, and a hydraulic conductivity k of 2.3 X 10^{-5} fps (1 inch/hr). The hydraulic gradient i was calculated as $(h+l)/\ l$, where h = the average depth of water above the filter, taken to be the ponding depth $d/2$, and l = the thickness of the sand layer, which is 1.5 feet. The hydraulic conductivity represents a partially plugged sand condition found by bench-scale testing using successive trials with turbid water.

[33] For sand filters, the volume to be treated to meet the Basic menu goal is only 90% (rather than 95%) of the total runoff volume. This is because the sand filter has been documented to provide better than 80% TSS removal, and thus exceeds the treatment goal of the Basic WQ menu. Therefore, less runoff volume can be treated and still meet the basic water quality goal.

[34] Instructions for creating the time series are summarized as follows: **Select** "CREATE a new time series" at the main menu. Enter rainfall region and scale factor (see Figure 3.2.2.A), soil and land cover areas, time step, and data type (reduced record). **Select** "COMPUTE total area." Enter a name for the inflow time series. **Select** "COMPUTE time series." Press F10 to view information created; press "ENTER" to return to main menu. At the main menu, **select** "ENTER Analysis TOOLS module." **Select** "COMPUTE volume discharge," and enter the inflow time series name. Enter start date and end date for time series. **Select** "EXTRACT discharge volume." This is the total runoff volume in the time series. **Select** "CONTINUE," and then **select** "RETURN to previous menu."

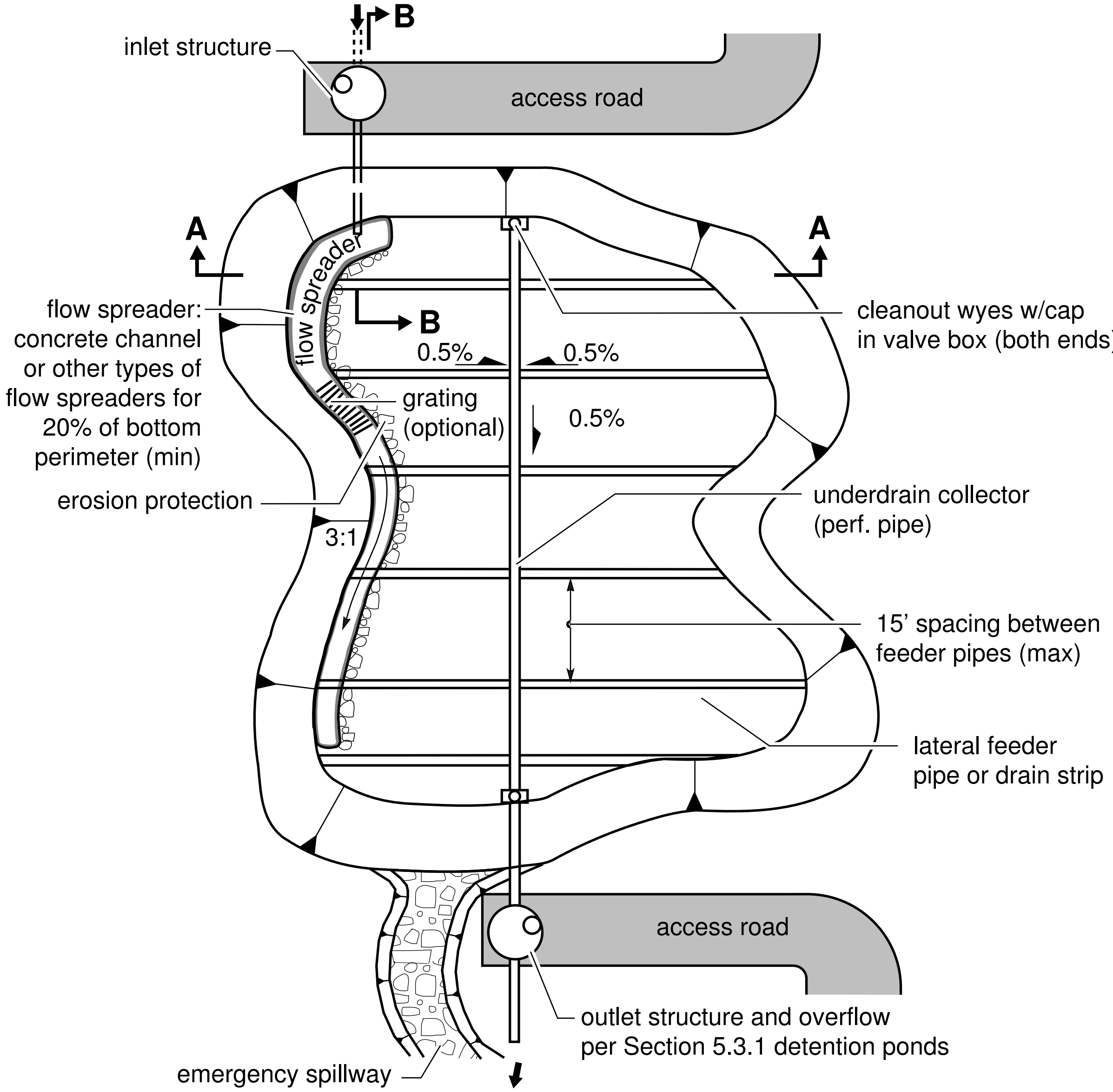
TABLE 6.5.2.B SAND FILTER DESIGN PARAMETERS						

[35] Whether a WQ facility is designed as on-line (all flow going through the facility) or off-line (high flows bypassing the facility) is a choice made by the designer. Section 6.2.5 (p. 6-29) contains information on flow splitters for WQ facilities.

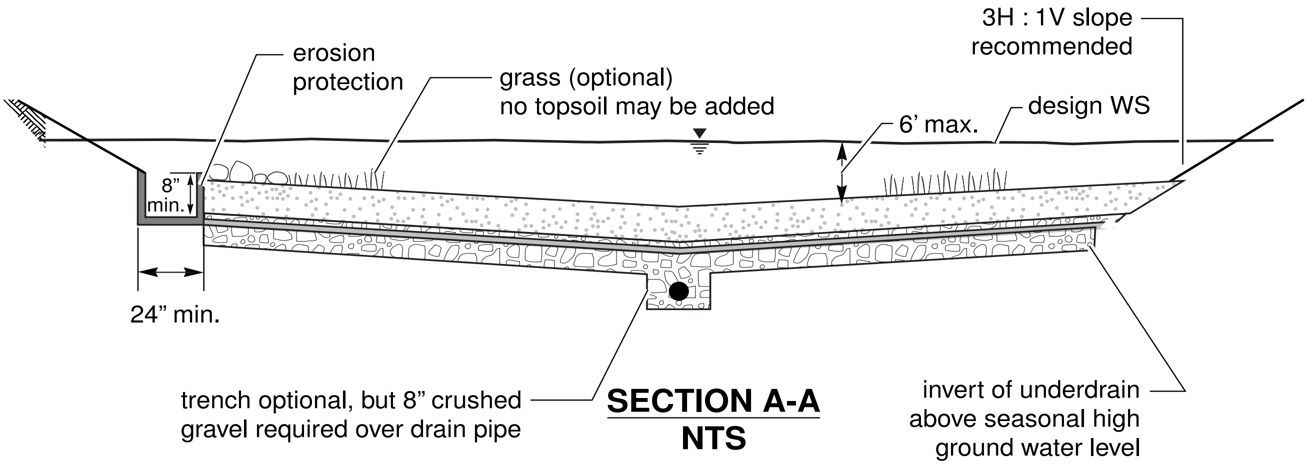
TABLE 6.5.2.C SAND MEDIA SPECIFICATIONS	

TABLE 6.5.2.D GEOTEXTILE SPECIFICATIONS		

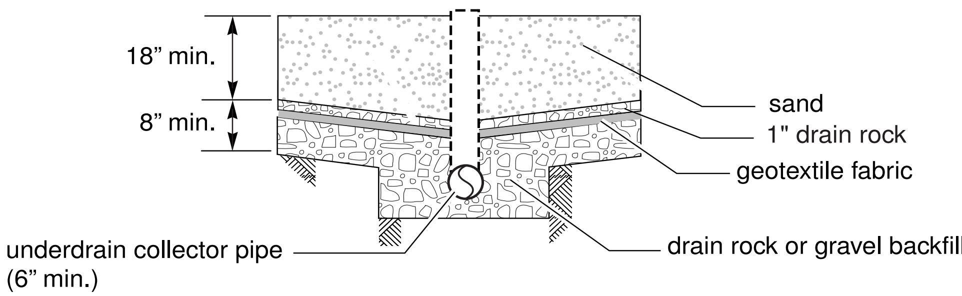
TABLE 6.5.2.E RECOMMENDED PLANTS FOR SATURATED AREAS	



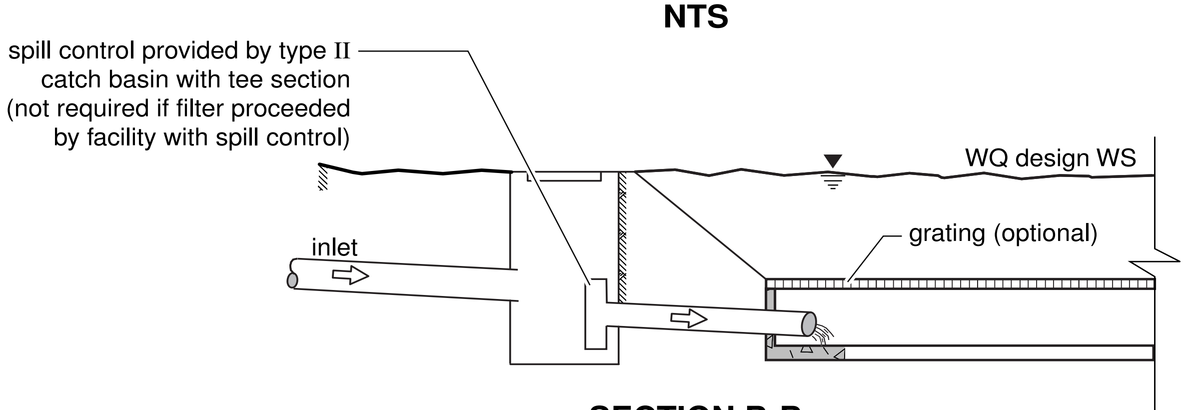
PLAN VIEW
NTS



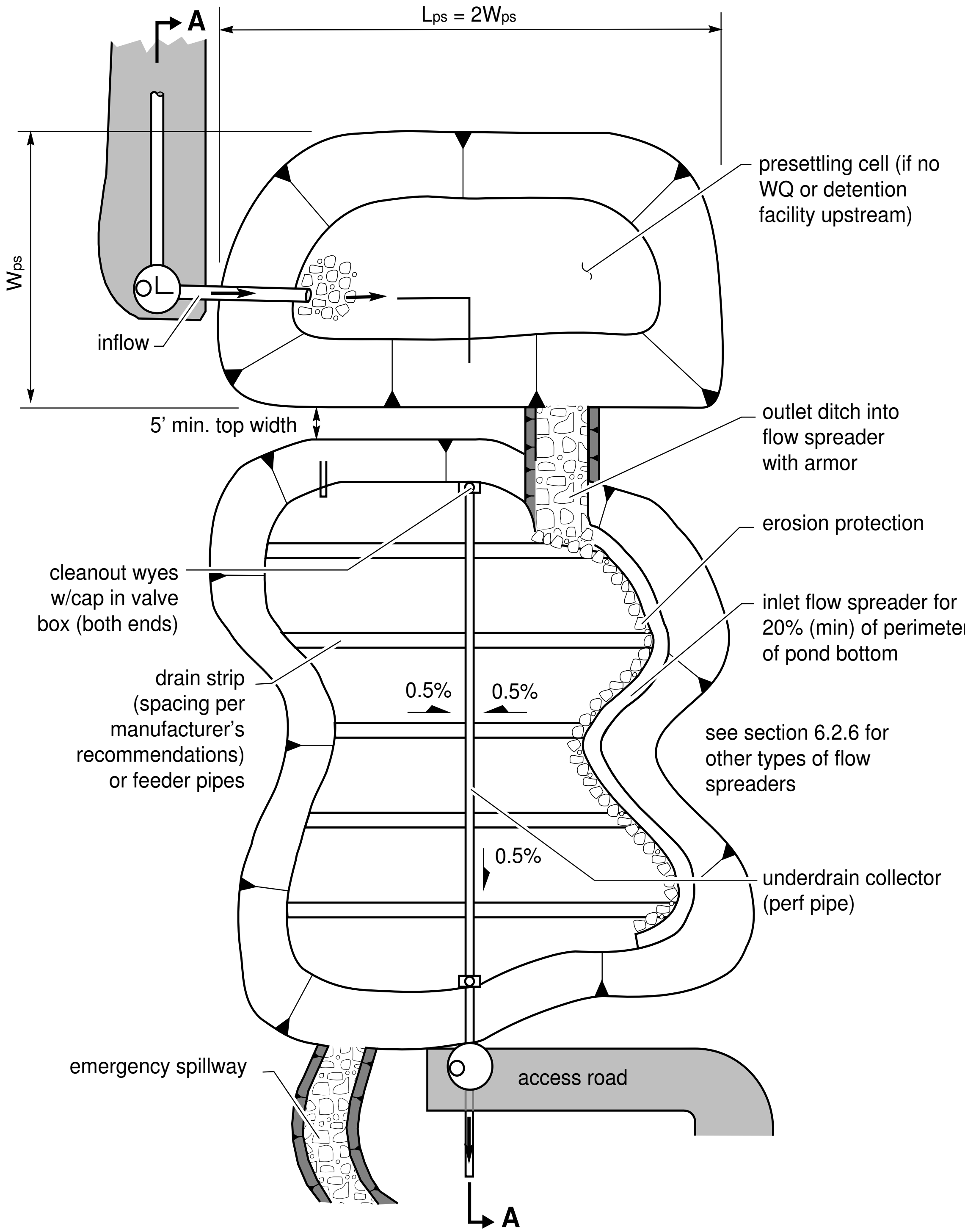
SECTION A-A
NTS



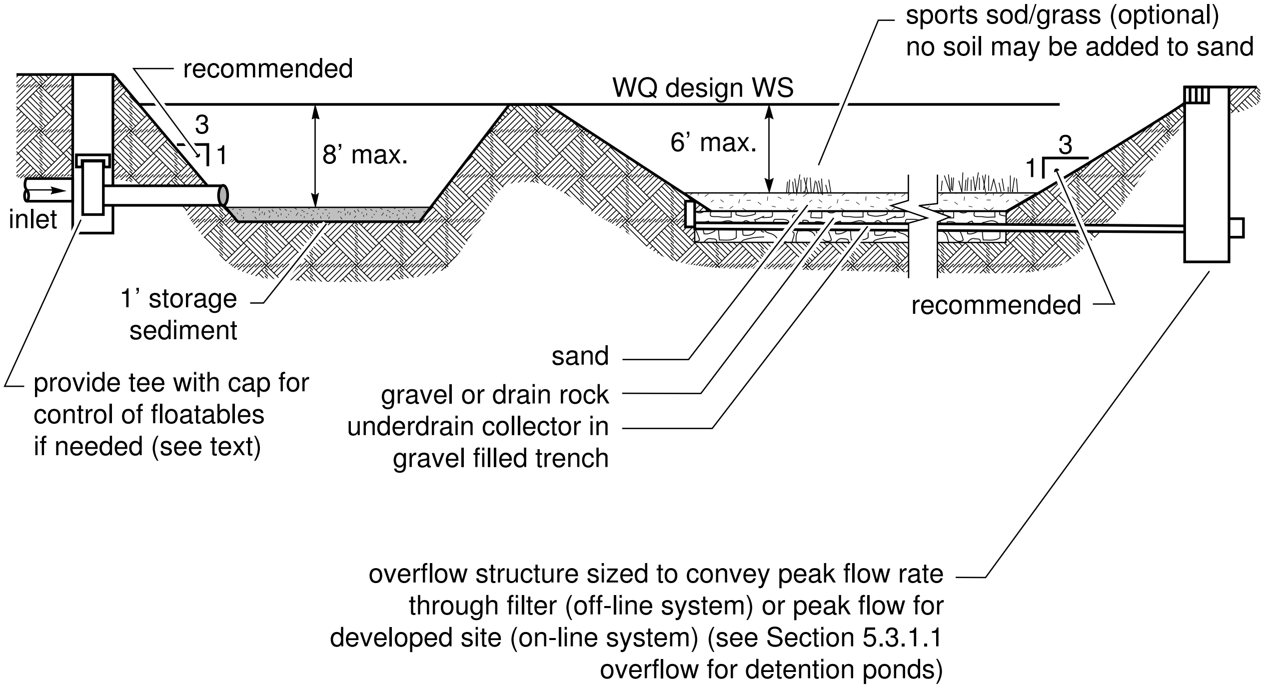
TRENCH DETAIL
NTS



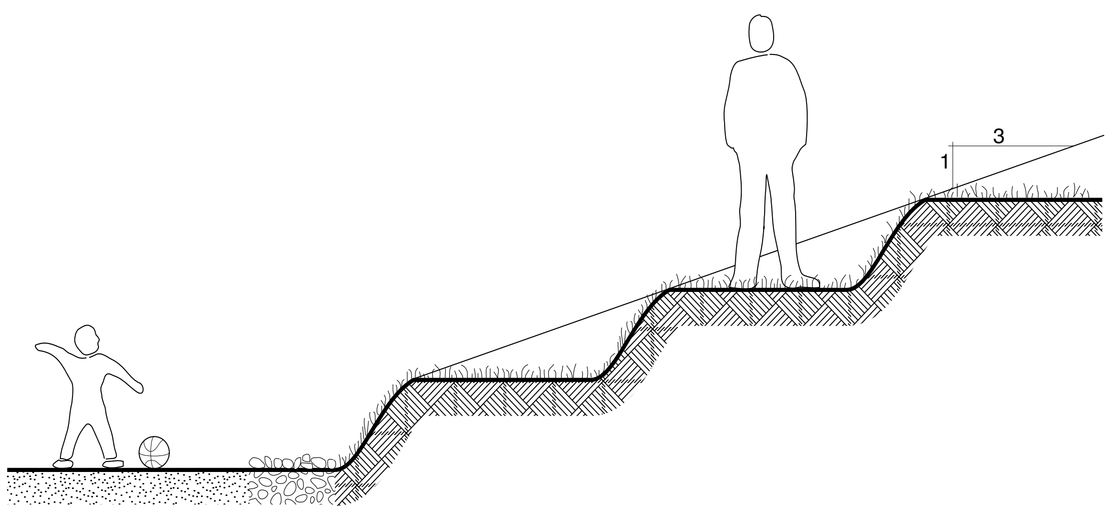
SECTION B-B
NTS



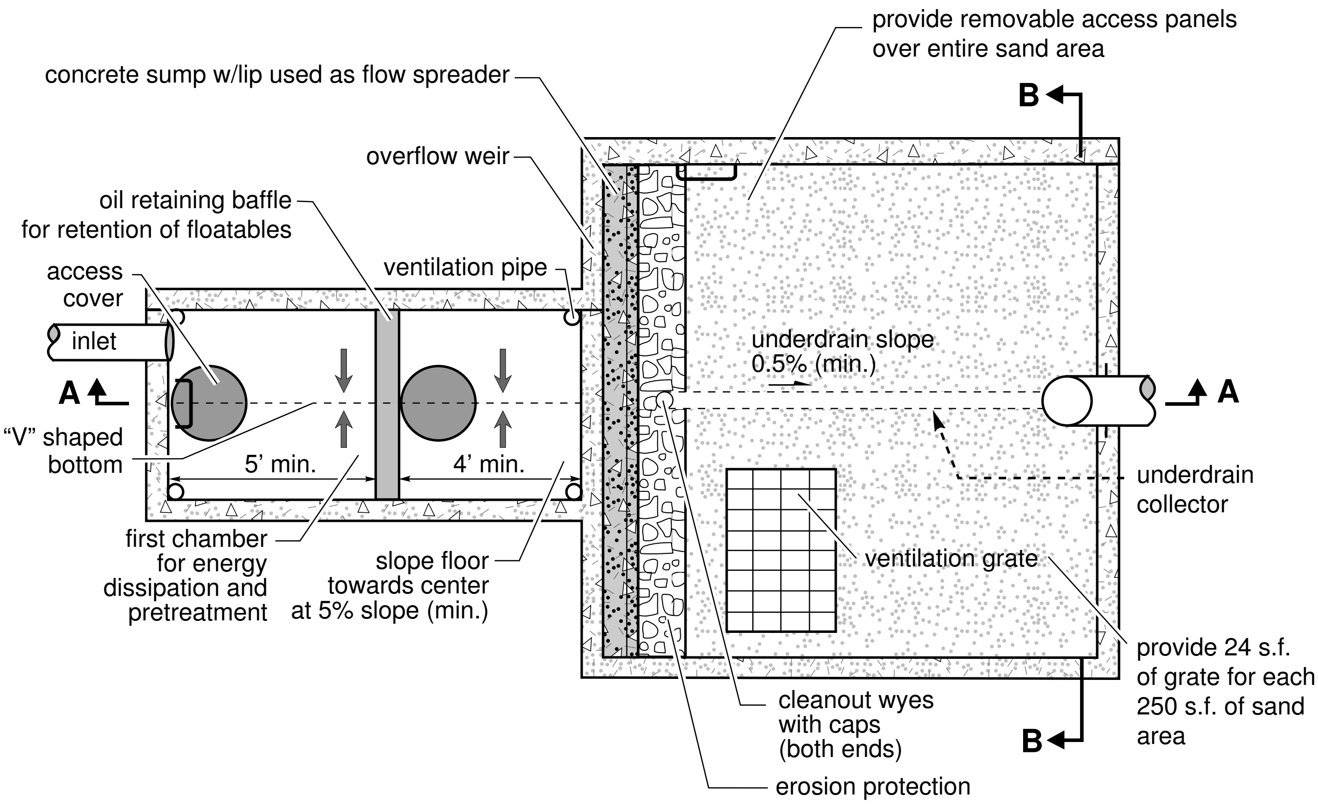
PLAN VIEW
NTS



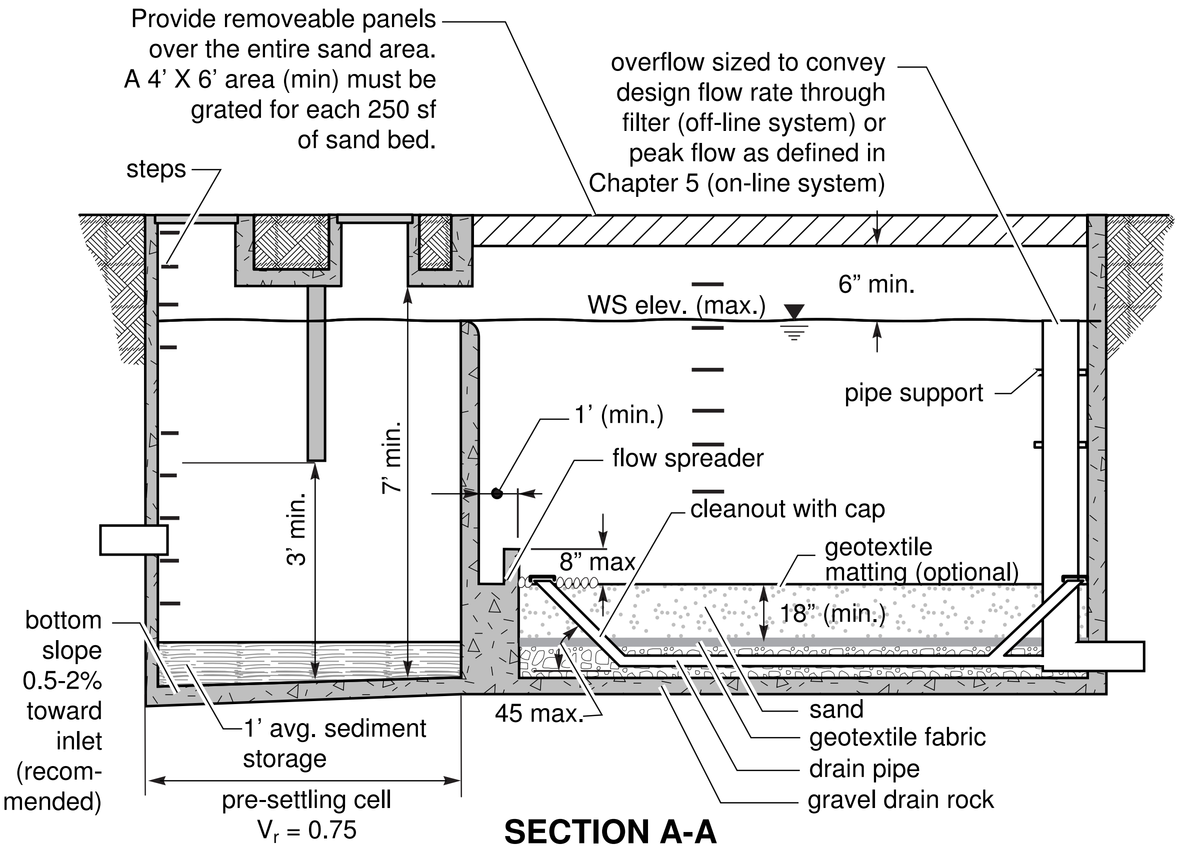
SECTION A-A
NTS



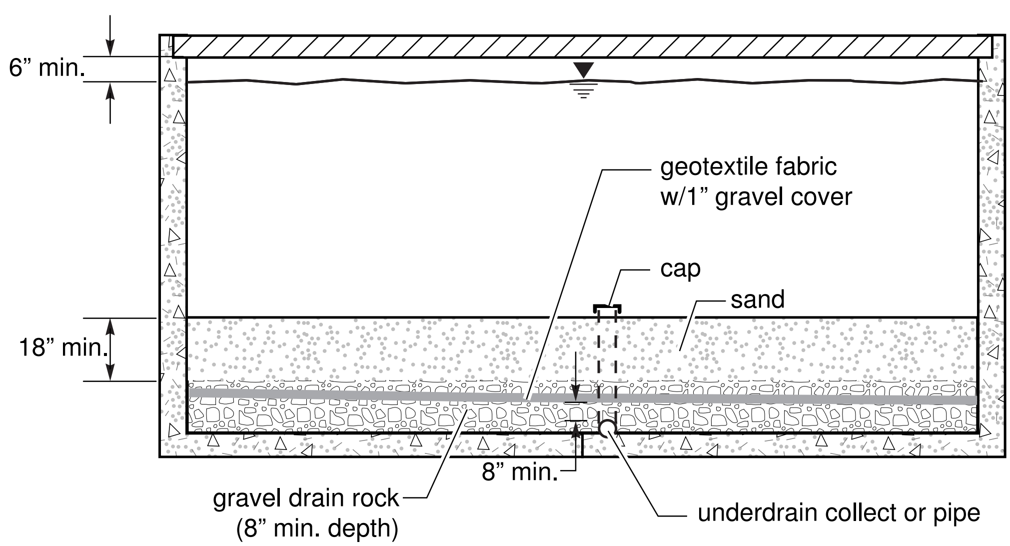
SECTION
NTS



PLAN VIEW
NTS



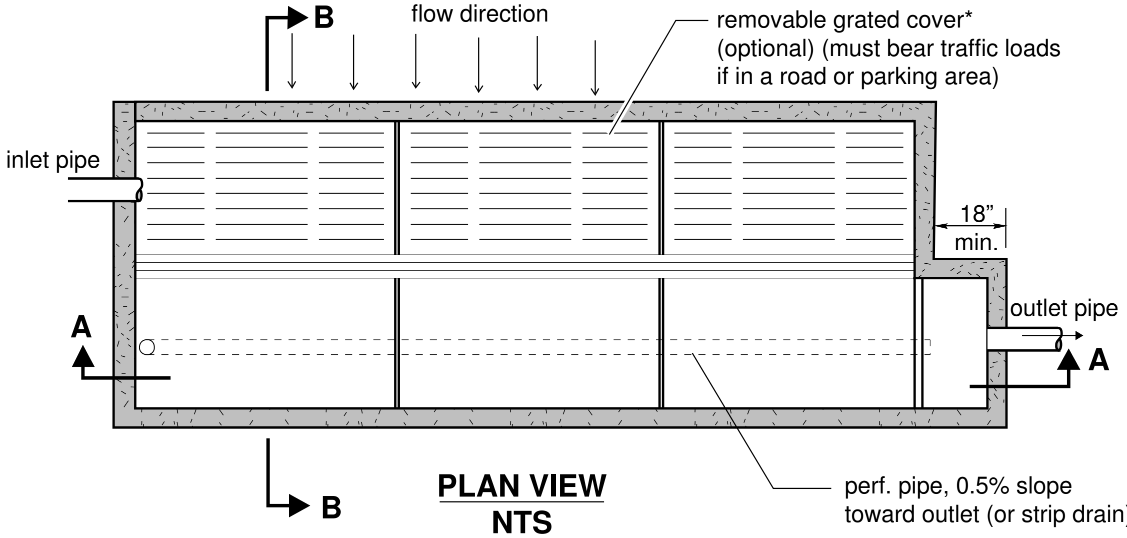
SECTION A-A
NTS



SECTION B-B
NTS

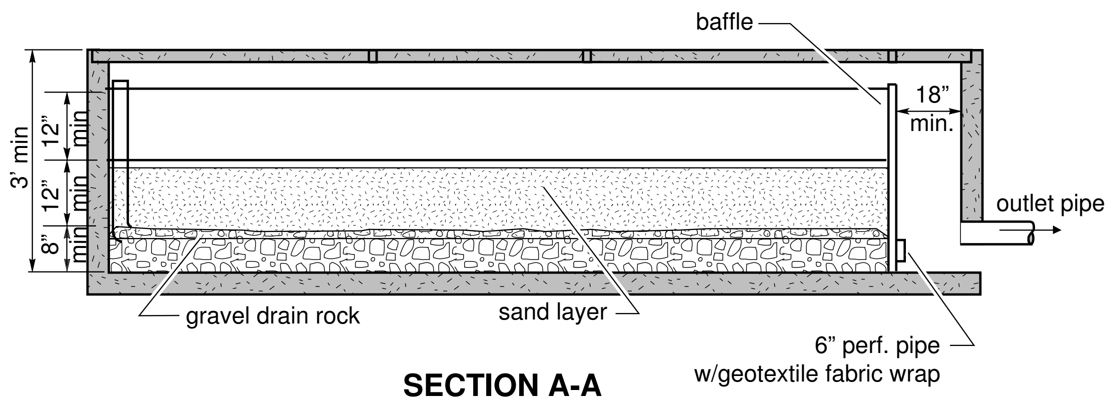
TABLE 6.5.4.A LINEAR SAND FILTER AREA INCREMENTS FOR SEA-TAC AND LANDSBURG				

TABLE 6.5.4.B SEDIMENT CELL WIDTH, LINEAR SAND FILTER	

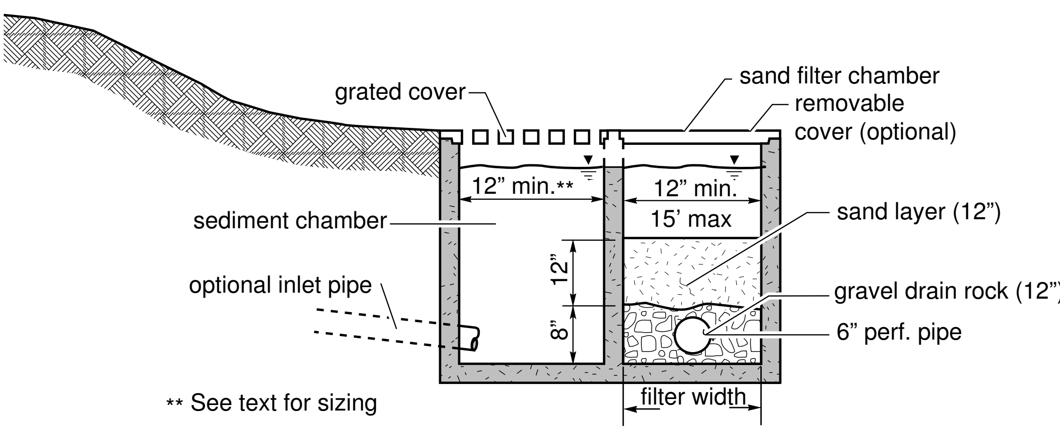


PLAN VIEW
NTS

*cover may be solid with piped inlet



SECTION A-A
NTS



SECTION B-B
NTS

TABLE 6.5.5.A TYPICAL PRECAST FILTER VAULT SIZES BASED ON DESIGN FLOW	

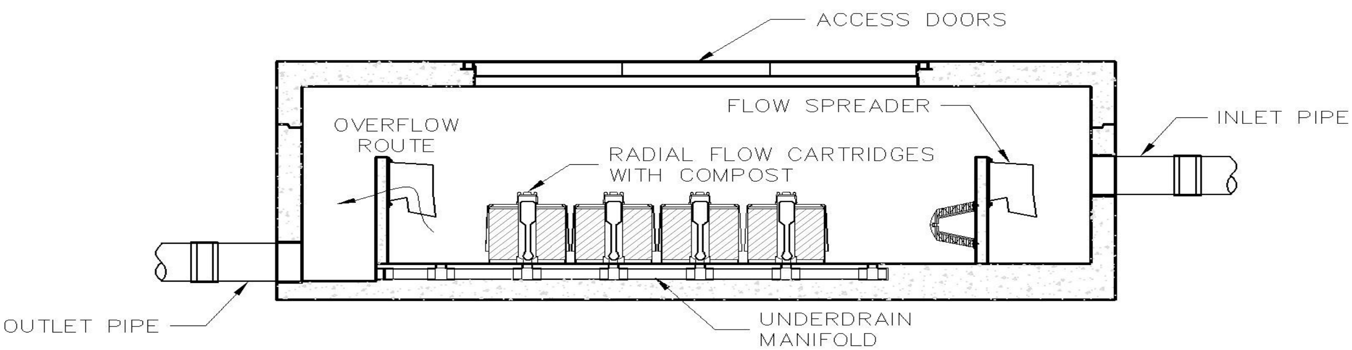
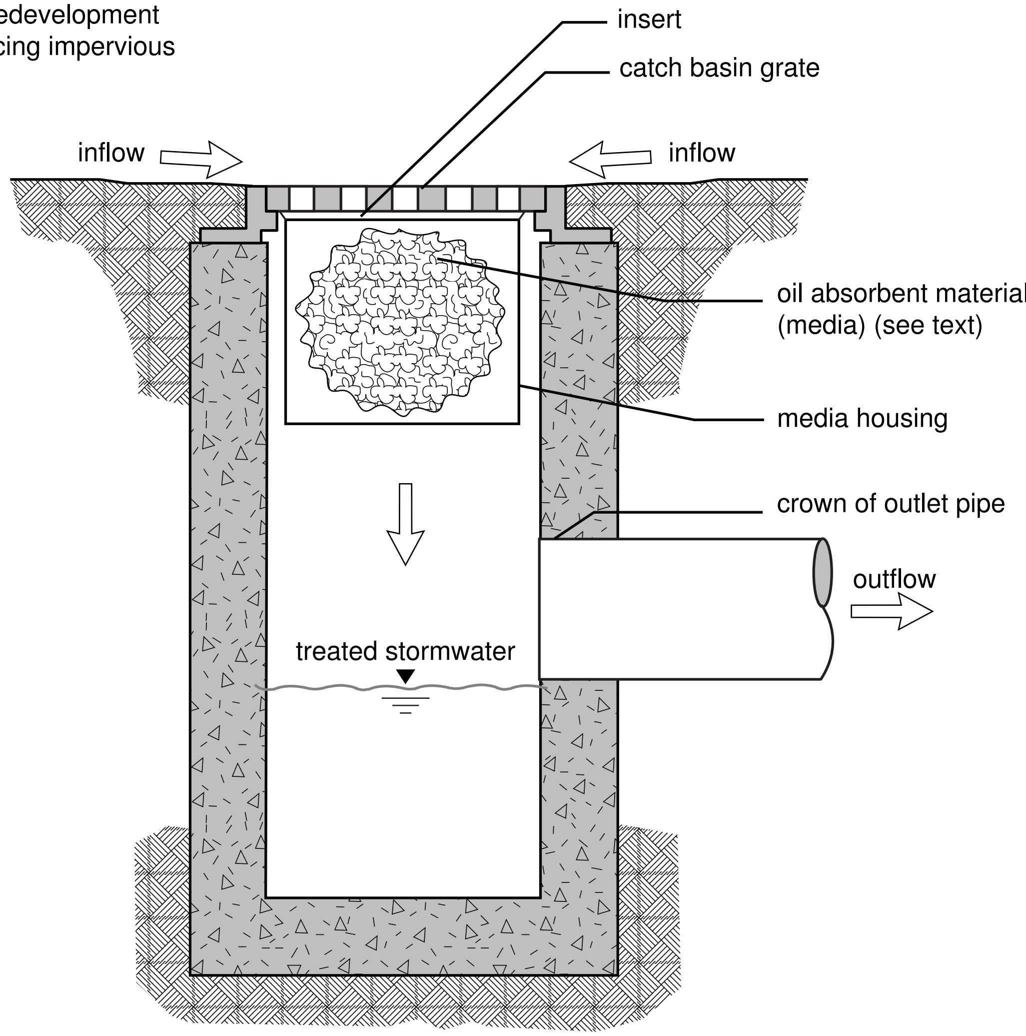

ACCESS DOORS
FLOW SPREADER
INLET PIPE
OVERFLOW
ROUTE
RADIAL FLOW CARTRIDGES
WITH COMPOST
OUTLET PIPE
UNDERDRAIN
MANIFOLD

TABLE 6.6.1.A
PERFORMANCE CRITERIA AND EVALUATION METHODS FOR CATCH BASIN INSERTS

[36] Testing by King County indicates that few of the devices tested could continue to meet treatment requirements at flow rates in excess of about 20 gpm. In addition, due to the very short contact time and potential for flushing previously trapped materials, treatment would be compromised at higher flow rates.

[37] Criteria used for acceptable absorbent materials are that a completely oil-saturated sample of the material does not release more than 10 mg/L of total petroleum hydrocarbon in any two minute period when flushed with tap water (running at a rate of 0.3 to 0.5 gpm) for 10 consecutive minutes.

Tributary area ≤ 5000 s.f.
(7000 s.f. if redevelopment
project replacing impervious
surface).



SECTION VIEW
NTS

$$\frac{g\left(d_p - d_c\right)D_o^2}{18\mu}$$

$$\frac{V}{Q}$$

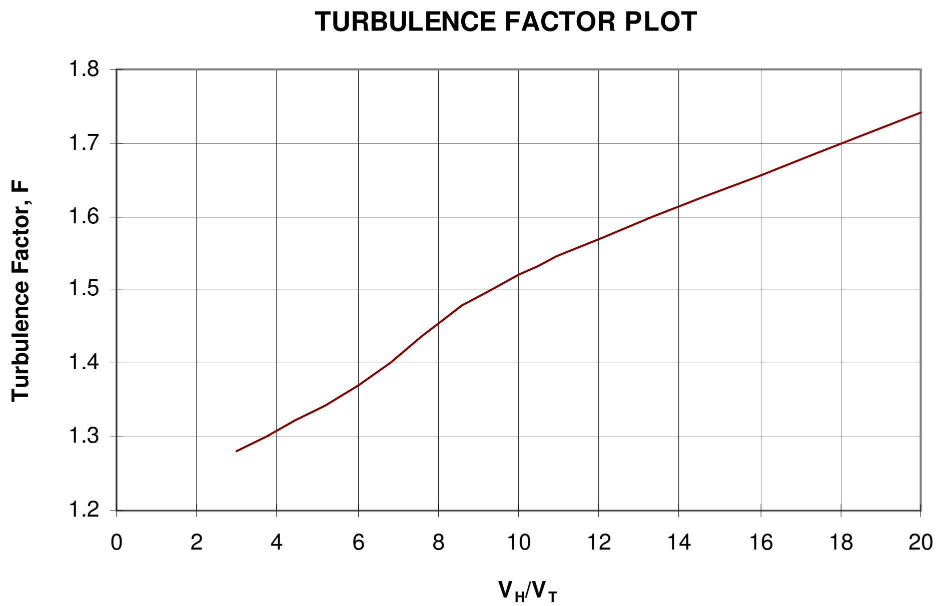
$$\frac{H}{V_T}$$

$$\frac{Q}{A_s}$$

$$\frac{Q}{V_H}$$

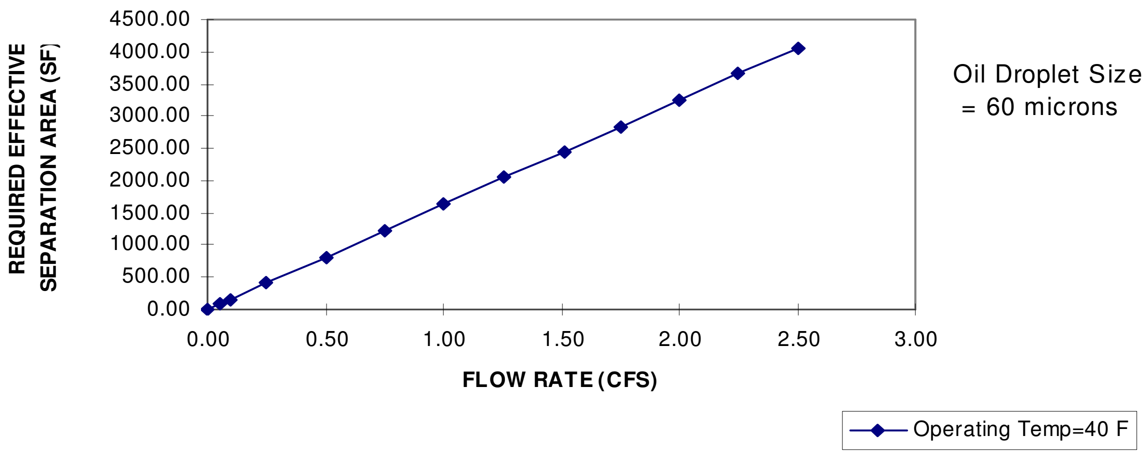
$$\frac{A_c}{W}$$

$$\left(\frac{V_H}{V_T}\right)$$



$$\left(\frac{1.65Q}{0.00055}\right)$$

$$\frac{60Q}{0.00386\left(\frac{S_w - S_o}{\mu}\right)}$$



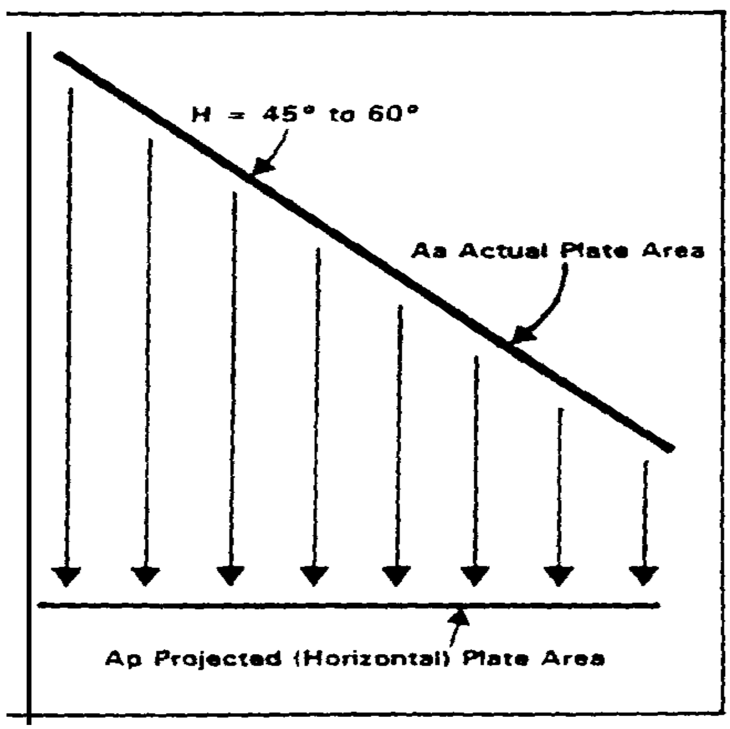
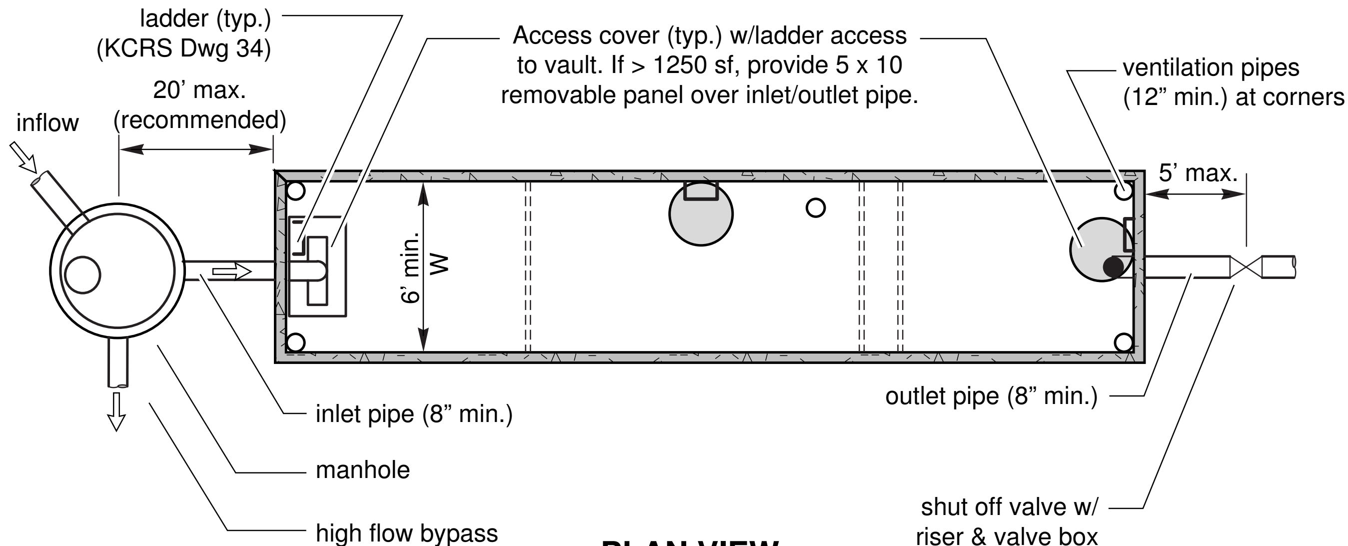
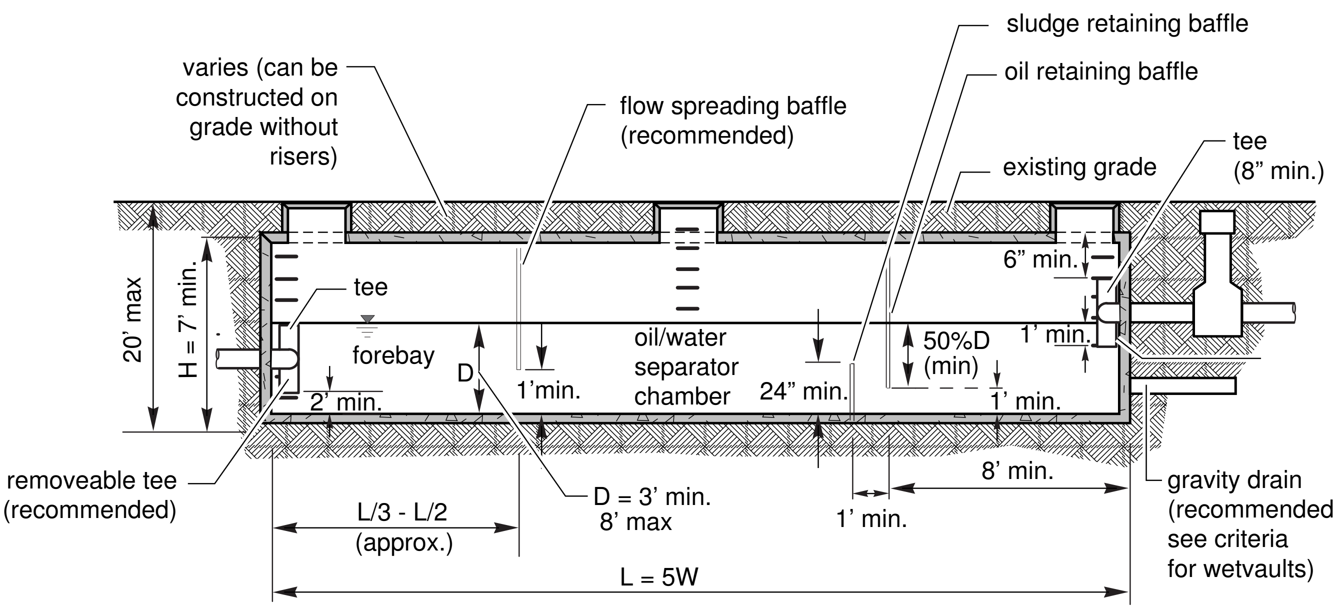

H = 45° to 60°
Aa Actual Plate Area
Ap Projected (Horizontal) Plate Area

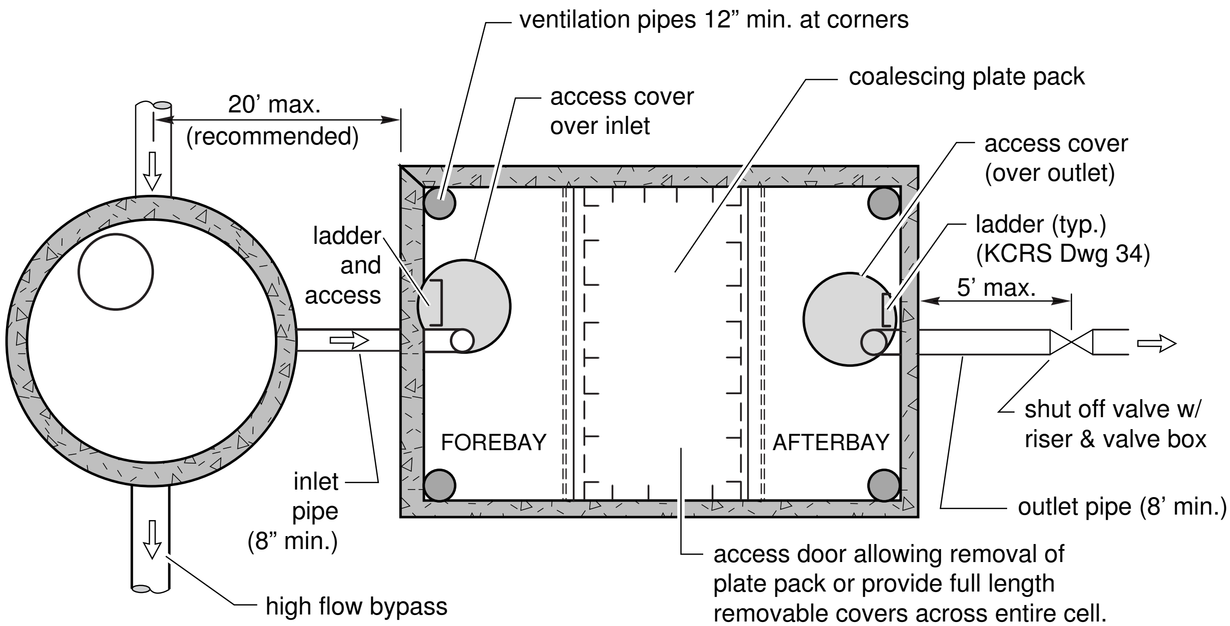
TABLE 6.6.2.A
APPROXIMATE COALESCING PLATE OIL/WATER SEPARATOR VAULT DIMENSIONS*



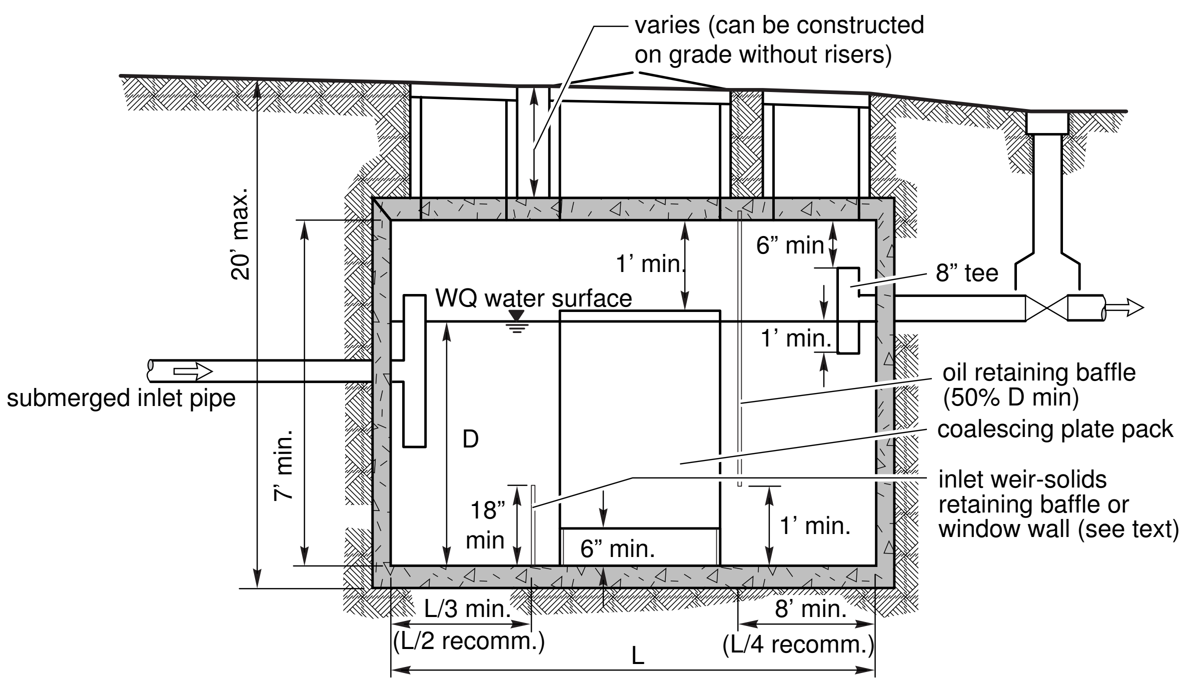
PLAN VIEW
NTS



SECTION VIEW
NTS



PLAN VIEW
NTS



SECTION VIEW
NTS

MAINTENANCE REQUIREMENTS FOR FLOW CONTROL, CONVEYANCE, AND WQ FACILITIES

NO. 1 – DETENTION PONDS

Maintenance Component	Defect or Problem	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Any trash and debris which exceed 1 cubic foot per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size office garbage can). In general, there should be no visual evidence of dumping.	Trash and debris cleared from site.
	Poisonous Vegetation or Noxious Weeds	Any poisonous or nuisance vegetation which may constitute a hazard to County personnel or the public.	No danger of poisonous vegetation where County personnel or the public might normally be. Coordination with Seattle-King County Health Department
	Contaminants and Pollution	Oil, gasoline, or other contaminants of one gallon or more, or any amount found that could: 1) cause damage to plant, animal, or marine life; 2) constitute a fire hazard; or 3) be flushed downstream during rain storms.	No contaminants present other than a surface film. (Coordination with Seattle/King County Health Department)
	Unmowed Grass/Ground Cover	If facility is located in private residential area, mowing is needed when grass exceeds 18 inches in height. In other areas, the general policy is to make the pond site match adjacent ground cover and terrain as long as there is no interference with the function of the facility.	When mowing is needed, grass/ground cover should be mowed to 2 inches in height. Mowing of selected higher use areas rather than the entire slope may be acceptable for some situations.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes or other causes.	Rodents destroyed and dam or berm repaired. (Coordination with Seattle/King County Health Department)
	Insects	When insects such as wasps and hornets interfere with maintenance activities. Mosquito complaints accompanied by presence of high mosquito larvae concentrations (aquatic phase).	Insects destroyed or removed from site. Mosquito control: Swallow nesting boxes or approved larvicide applied.
	Tree Growth	Tree growth threatens integrity of berms acting as dams, does not allow maintenance access, or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are a threat to berm integrity or not interfering with access, leave trees alone.	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood).

NO. 1 – DETENTION PONDS

Maintenance Component	Defect or Problem	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes should be stabilized by using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion.
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
	Liner Damage (If Applicable)	Liner is visible and has more than three ¼-inch holes in it.	Liner repaired or replaced.
Pond Berms (Dikes)	Settlement	Any part of berm that has settled 4 inches lower than the design elevation. Settling can be an indication of more severe problems with the berm or outlet works. A licensed civil engineer should be consulted to determine the source of the settlement.	Dike should be built back to the design elevation.
Emergency Overflow/Spillway and Berms over 4 feet in height.	Tree Growth	Tree growth on emergency spillways create blockage problems and may cause failure of the berm due to uncontrolled overtopping. Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed civil engineer should be consulted for proper berm/spillway restoration.
Emergency Overflow/Spillway	Rock Missing	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway. Rip-rap on inside slopes need not be replaced.	Replace rocks to design standards.

NO. 2 – INFILTRATION FACILITIES

Maintenance Component	Defect or Problem	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
Infiltration Pond General	Trash & Debris	See "Detention Ponds" Table No. 1	See "Detention Ponds" Table No. 1
	Poisonous Vegetation or Noxious Weeds	See "Detention Ponds" Table No. 1	See "Detention Ponds" Table No. 1
	Contaminants and Pollution	See "Detention Ponds" Table No. 1	See "Detention Ponds" Table No. 1
	Unmowed Grass/Ground Cover	See "Detention Ponds" Table No. 1	See "Detention Ponds" Table No. 1
	Rodent Holes	See "Detention Ponds" Table No. 1	See "Detention Ponds" Table No. 1
	Insects	See "Detention Ponds" Table No. 1	See "Detention Ponds" Table No. 1
Infiltration Pond Side Slopes	Erosion	See "Detention Ponds" Table No. 1	See "Detention Ponds" Table No. 1
Infiltration Pond Emergency Overflow Spillway and Berms over 4 feet in height.	Tree Growth	See "Detention Ponds" Table No. 1	See "Detention Ponds" Table No. 1
Infiltration Pond Emergency Overflow Spillway	Rock Missing	See "Detention Ponds" Table No. 1	See "Detention Ponds" Table No. 1
Infiltration Facility Storage Area	Sediment	A percolation test pit (ponds) or test of facility indicates facility is only working at 90% of its designed capabilities. If two inches or more sediment is present, remove.	Sediment is removed and/or facility is cleaned so that infiltration system works according to design. Ponds are reseeded if necessary to control erosion.
Infiltration Facility Rock Filters (If Applicable)	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Replaced gravel in rock filter.
Infiltration Facility Sump	Sump Filled with Sediment and Debris (If Applicable)	Any sediment and debris filling vault to 10% of depth from sump bottom to bottom of outlet pipe or obstructing flow into the connector pipe.	Clean out sump to design depth.
Infiltration Facility Filter Bags (If Applicable)	Filled with Sediment and Debris	Sediment and debris fill bag more than $^1/_2$ full.	Replaced filter bag or redesign system.
Infiltration Facility Pre-settling Ponds and Vaults	Sediment	Remove when 6" or more.	Sediment cleaned out to designed pond shape and depth or sediment is removed from vault. Ponds are reseeded if necessary to control erosion.

Note: Sediment accumulation of more than 0.25 inches per year may indicate excessive erosion is occurring upstream of the facility or that conveyance systems are not being properly maintained. The contributing drainage area should be checked for erosion problems or inadequate maintenance of conveyance systems if excessive sedimentation is noted in an infiltration facility.

Check twice a year during first 2 years of operation; once a year thereafter. Clean manholes/catch basins, repair damaged inlets/outlets, clean trash racks.

NO. 3 – DETENTION TANKS AND VAULTS

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Storage Area	Plugged Air Vents	One-half of the cross section of a vent is blocked at any point with debris and sediment.	Vents free of debris and sediment
	Debris and Sediment	Accumulated sediment depth exceeds 10% of the diameter of the storage area for ½ length of storage vault or any point depth exceeds 15% of diameter. Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than ½ length of tank.	All sediment and debris removed from storage area.
	Joints Between Tank/Pipe Section	Any crack allowing material to be transported into facility.	All joint between tank/pipe sections are sealed
	Tank Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape.	Tank/pipe repaired or replaced to design.
Vault Structure	Damage to Wall, Frame, Bottom, and/or Top Slab	Cracks wider than ½-inch and any evidence of soil particles entering the structure through the cracks, or maintenance inspection personnel determines that the vault is not structurally sound.	Vault replaced or repaired to design specifications.
	Damaged Pipe Joints	Cracks wider than ½-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than ½ inch of thread (may not apply to self-locking lids.)	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying 80lbs of lift. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
	Ladder Rungs Unsafe	King County Safety Office and/or maintenance person judges that ladder is unsafe due to missing rungs, misalignment, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Large access doors/plate	Gaps, Doesn't Cover Completely	Large access doors not flat and/or access hole not completely covered. NOTE however that grated doors are acceptable.	Doors closes flat and covers access hole completely.
	Lifting Rings Missing, Rusted	Lifting rings not capable of lifting weight of door or lid.	Lifting rings sufficient to remove lid.

NO. 4 – CONTROL STRUCTURE/FLOW RESTRICTOR

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris (Includes Sediment)	Distance between debris build-up and bottom of orifice plate is less than 1.5 feet.	All trash and debris removed.
	Structural Damage	Structure is not securely attached to manhole wall and outlet pipe structure should support at least 1,000 lbs of up or down pressure.	Structure securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
		Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes—other than designed holes—in the structure.	Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
		Gate is rusted over 50% of its surface area.	Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	See “Detention Tanks and Vaults”	See “Detention Tanks and Vaults” Table No. 3	See “Detention Tanks and Vaults” Table No. 3

NO. 5 – CATCH BASINS

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris (Includes Sediment)	Trash or debris of more than ½ cubic foot which is located immediately in front of the catch basin opening or is blocking capacity of the basin by more than 10%.	No Trash or debris located immediately in front of catch basin opening.
		Trash or debris (in the basin) that exceeds $^1/_3$ the depth from the bottom of basin to invert the lowest pipe into or out of the basin.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than $^1/_3$ of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
		Deposits of garbage exceeding 1 cubic foot in volume.	No condition present which would attract or support the breeding of insects or rodents.
	Structure Damage to Frame and/or Top Slab	Corner of frame extends more than ¾ inch past curb face into the street (If applicable).	Frame is even with curb.
		Top slab has holes larger than 2 square inches or cracks wider than ¼ inch (intent is to make sure all material is running into basin).	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than ¾ inch of the frame from the top slab.	Frame is sitting flush on top slab.
	Cracks in Basin Walls/Bottom	Cracks wider than ½ inch and longer than 3 feet, any evidence of soil particles entering catch basin through cracks, or maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Cracks wider than ½ inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	No cracks more than $^1/_4$ inch wide at the joint of inlet/outlet pipe.
	Settlement/ Misalignment	Basin has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards.
	Fire Hazard	Presence of chemicals such as natural gas, oil and gasoline.	No flammable chemicals present.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than 6 inches tall and less than 6 inches apart.	No vegetation or root growth present.
	Pollution	Nonflammable chemicals of more than ½ cubic foot per three feet of basin length.	No pollution present other than surface film.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed
	Locking Mechanism Not Working	Mechanism cannot be opened by on maintenance person with proper tools. Bolts into frame have less than ½ inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying 80 lbs. of lift; intent is keep cover from sealing off access to maintenance.	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.

NO. 5 – CATCH BASINS

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
Metal Grates (If Applicable)	Unsafe Grate Opening	Grate with opening wider than $^{7}/_{8}$ inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

NO. 6 – DEBRIS BARRIERS (E.G., TRASH RACKS)

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed.
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier clear to receive capacity flow.
Metal	Damaged/Missing Bars.	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than ¾ inch.
		Bars are missing or entire barrier missing.	Bars in place according to design.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Repair or replace barrier to design standards.

NO. 7 – ENERGY DISSIPATERS

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed.
External:			
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Replace rocks to design standards.
Dispersion Trench	Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed so that it matches design.
	Not Discharging Water Properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a “sheet flow” of water along trench). Intent is to prevent erosion damage.	Trench must be redesigned or rebuilt to standards.
	Perforations Plugged.	Over ½ of perforations in pipe are plugged with debris and sediment.	Clean or replace perforated pipe.
	Water Flows Out Top of “Distributor” Catch Basin.	Maintenance person observes water flowing out during any storm less than the design storm or its causing or appears likely to cause damage.	Facility must be rebuilt or redesigned to standards.
	Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Internal:			
Manhole/Chamber	Worn or Damaged Post. Baffles, Side of Chamber	Structure dissipating flow deteriorates to ½ or original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Replace structure to design standards.

NO. 8 – FENCING

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Missing or Broken Parts	Any defect in the fence that permits easy entry to a facility.	Parts in place to provide adequate security.
	Erosion	Erosion more than 4 inches high and 12-18 inches wide permitting an opening under a fence.	No opening under the fence that exceeds 4 inches in height.
Wire Fences	Damaged Parts	Post out of plumb more than 6 inches.	Post plumb to within 1½ inches.
		Top rails bent more than 6 inches.	Top rail free of bends greater than 1 inch.
		Any part of fence (including post, top rails, and fabric) more than 1 foot out of design alignment.	Fence is aligned and meets design standards.
		Missing or loose tension wire.	Tension wire in place and holding fabric.
		Missing or loose barbed wire that is sagging more than 2½ inches between posts.	Barbed wire in place with less than ¾ inch sag between post.
		Extension arm missing, broken, or bent out of shape more than 1½ inches.	Extension arm in place with no bends larger than ¾ inch.
	Deteriorated Paint or Protective Coating	Part or parts that have a rusting or scaling condition that has affected structural adequacy.	Structurally adequate posts or parts with a uniform protective coating.
	Openings in Fabric	Openings in fabric are such that an 8-inch diameter ball could fit through.	No openings in fabric.

NO. 9 – GATES

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Damaged or Missing Members	Missing gate or locking devices.	Gates and Locking devices in place.
		Broken or missing hinges such that gate cannot be easily opened and closed by a maintenance person.	Hinges intact and lubed. Gate is working freely.
		Gate is out of plumb more than 6 inches and more than 1 foot out of design alignment.	Gate is aligned and vertical.
		Missing stretcher bar, stretcher bands, and ties.	Stretcher bar, bands, and ties in place.
	Openings in Fabric	See “Fencing” Table No. 8	See “Fencing” Table No. 8

NO. 10 – CONVEYANCE PIPES AND DITCHES

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Pipes	Sediment & Debris	Accumulated sediment that exceeds 20% of the diameter of the pipe.	Pipe cleaned of all sediment and debris.
	Vegetation	Vegetation that reduces free movement of water through pipes.	All vegetation removed so water flows freely through pipes.
	Damaged	Protective coating is damaged; rust is causing more than 50% deterioration to any part of pipe.	Pipe repaired or replaced.
		Any dent that decreases the cross section area of pipe by more than 20%.	Pipe repaired or replaced.
Open Ditches	Trash & Debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet of ditch and slopes.	Trash and debris cleared from ditches.
	Sediment	Accumulated sediment that exceeds 20% of the design depth.	Ditch cleaned/flushed of all sediment and debris so that it matches design.
	Vegetation	Vegetation that reduces free movement of water through ditches.	Water flows freely through ditches.
	Erosion Damage to Slopes	See “Detention Ponds” Table No. 1	See “Detention Ponds” Table No. 1
	Rock Lining Out of Place or Missing (If Applicable).	Maintenance person can see native soil beneath the rock lining.	Replace rocks to design standards.

NO. 11 – GROUNDS (LANDSCAPING)

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Weeds (Nonpoisonous, not noxious)	Weeds growing in more than 20% of the landscaped area (trees and shrubs only).	Weeds present in less than 5% of the landscaped area.
	Safety Hazard	Any presence of poison ivy or other poisonous vegetation.	No poisonous vegetation present in landscaped area.
	Trash or Litter	Paper, cans, bottles, totaling more than 1 cubic foot within a landscaped area (trees and shrubs only) of 1,000 square feet.	Area clear of litter.
Trees and Shrubs	Damaged	Limbs or parts of trees or shrubs that are split or broken which affect more than 25% of the total foliage of the tree or shrub.	Trees and shrubs with less than 5% of total foliage with split or broken limbs.
		Trees or shrubs that have been blown down or knocked over.	Tree or shrub in place free of injury.
		Trees or shrubs which are not adequately supported or are leaning over, causing exposure of the roots.	Tree or shrub in place and adequately supported; remove any dead or diseased trees.

NO. 12 – ACCESS ROADS

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet (i.e., trash and debris would fill up one standards size garbage can).	Roadway free of debris which could damage tires.
	Blocked Roadway	Debris which could damage vehicle tires (glass or metal).	Roadway free of debris which could damage tires.
		Any obstruction which reduces clearance above road surface to less than 14 feet.	Roadway overhead clear to 14 feet high.
		Any obstruction restricting the access to a 10- to 12-foot width for a distance of more than 12 feet or any point restricting access to less than a 10-foot width.	Obstruction removed to allow at least a 12-foot access.
Road Surface	Settlement, Potholes, Mush Spots, Ruts	When any surface defect exceeds 6 inches in depth and 6 square feet in area. In general, any surface defect which hinders or prevents maintenance access.	Road surface uniformly smooth with no evidence of settlement, potholes, mush spots, or ruts.
	Vegetation in Road Surface	Weeds growing in the road surface that are more than 6 inches tall and less than 6 inches tall and less than 6 inches apart within a 400-square foot area.	Road surface free of weeds taller than 2 inches.
	Modular Grid Pavement	Build-up of sediment mildly contaminated with petroleum hydrocarbons.	Removal of sediment and disposal in keeping with Health Department recommendations for mildly contaminated soils or catch basin sediments.
Shoulders and Ditches	Erosion Damage	Erosion within 1 foot of the roadway more than 8 inches wide and 6 inches deep.	Shoulder free of erosion and matching the surrounding road.
	Weeds and Brush	Weeds and brush exceed 18 inches in height or hinder maintenance access.	Weeds and brush cut to 2 inches in height or cleared in such a way as to allow maintenance access.

NO. 13 – BASIC BIOFILTRATION SWALE

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
Swale Section	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches	Remove sediment deposits on grass treatment area of the bioswale. When finished, swale should be level from side to side and drain freely toward outlet. There should be no areas of standing water once inflow has ceased.
	Standing Water	When water stands in the swale between storms and does not drain freely.	Any of the following may apply: remove sediment or trash blockages, improve grade from head to foot of swale, remove clogged check dams, add underdrains or convert to a wet biofiltration swale.
	Constant Baseflow	When small quantities of water continually flow through the swale, even when it has been dry for weeks, and an eroded, muddy channel has formed in the swale bottom.	Add a low-flow pea-gravel drain the length of the swale or bypass the baseflow around the swale.
	Poor Vegetation Coverage	When grass is sparse or bare or eroded patches occur in more than 10% of the swale bottom.	Determine why grass growth is poor and correct that condition. Re-plant with plugs of grass from the upper slope: plant in the swale bottom at 8-inch intervals, or re-seed into loosened, fertile soil.
	Defective Vegetation	When the grass becomes excessively tall (greater than 10 inches) or when nuisance weeds and other vegetation starts to take over.	Mow vegetation or remove nuisance vegetation so that flow not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.
	Excessive Shading	Grass growth is poor because sunlight does not reach swale.	If possible, trim back over-hanging limbs, remove brushy vegetation on adjacent slopes.
	Trash and Debris Accumulation	Trash and debris accumulated in the bioswale.	Remove trash and debris from bioswale.
	Erosion/Scouring	Eroded or scoured swale bottom due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. The grass will creep in over the rock in time. If bare areas are large, generally greater than 12 inches wide, the swale should be re-graded and re-seeded. For smaller bare areas, overseed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8-inch intervals.
Inlet/Outlet	Sediment and Debris	Inlet/outlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area.
Flow Spreader	Concentrated Flow	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire swale width.	Level the spreader and clean so that flows are spread evenly over entire swale width.

NO. 14 – WET BIOFILTRATION SWALE

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
Swale Section	Sediment Accumulation	Sediment depth exceeds 2 inches in 10% of the swale treatment area.	Remove sediment deposits in treatment area.
	Water Depth	Water not retained to a depth of about 4 inches during the wet season.	Build up or repair outlet berm so that water is retained in the wet swale.
	Defective Wetland Vegetation	Vegetation becomes sparse and does not provide adequate filtration, OR vegetation is crowded out by very dense clumps of cattail which do not allow water to flow through the clumps.	Determine cause of lack of vigor of vegetation and correct. Replant as needed. For excessive cattail growth, cut cattail shoots back and compost offsite. *Note: normally wetland vegetation does not need to be harvested unless die-back is causing oxygen depletion in downstream waters.*
	Trash and Debris Accumulation	Trash and debris accumulated in the wet swale.	Remove trash and debris from wet swale.
	Erosion/Scouring	Swale has eroded or scoured due to flow channelization, or higher flows.	Check design flows to assure swale is large enough to handle flows. Bypass excess flows or enlarge swale. Replant eroded areas with fibrous-rooted plants such as *Juncus effusus* (soft rush) in wet areas or snowberry (*Symphoricarpos albus*) in dryer areas.
Inlet/Outlet	Sediment and Debris	Inlet/outlet area clogged with sediment and/or debris.	Remove clogging or blockage in the inlet and outlet areas.

NO. 15 – FILTER STRIP

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
Grass Strip	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits, re-level so slope is even and flows pass evenly through strip.
	Defective Vegetation	When the grass becomes excessively tall (greater than 10 inches) or when nuisance weeds and other vegetation starts to take over.	Mow grass, control nuisance vegetation such that flow not impeded. Grass should be mowed to a height between 3-4 inches.
	Trash and Debris Accumulation	Trash and debris accumulated on the filter strip.	Remove trash and debris from filter.
	Erosion/Scouring	Eroded or scoured areas due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. The grass will creep in over the rock in time. If bare areas are large, generally greater than 12 inches wide, the filter strip should be re-graded and re-seeded. For smaller bare areas, overseed when bare spots are evident.
Flow Spreader	Concentrated Flow	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire filter width.	Level the spreader and clean so that flows are spread evenly over entire filter width.

NO. 16 – WETPOND

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
Pond Area	Water Level	First cell empty, doesn't hold water.	Line the first cell to maintain at least 4 feet of water. Although the second cell may drain, the first cell must remain full to control turbulence of the incoming flow and reduce sediment resuspension.
	Defective Vegetation	Vegetation such as grass and weeds need to be mowed when it starts to impede aesthetics of pond. Mowing is generally required when height exceeds 18 inches. Mowed vegetation should be removed from areas where it could enter the pond, either when the pond level rises, or by rainfall runoff.	Vegetation should be mowed to 4 to 5 inches in height. Trees and bushes should be removed where they are interfering with pond maintenance activities; that is, at the inlet, outlet and near engineered structures.
	Algae Mats	When algae mats develop over more than 10% of the water surface, they should be removed. Also remove mats in the late summer before fall rains, especially in Sensitive Lake Protection Areas. Excessive algae mats interfere with dissolved oxygen content in the water and pose a threat to downstream lakes if excess nutrients are released.	Algae mats that cover more than 10% of the surface of any cell should be removed. A rake or mechanical device should be used to remove the algae. Removed algae can be left to dry on the pond slope above the 100-year water surface.
	Trash and Debris	Accumulation that exceeds 1 cubic foot per 1000 square foot of pond area.	Trash and debris removed from pond.
	Sediment Accumulation	Sediment accumulations in pond bottom that exceeds the depth of sediment zone plus 6 inches, usually in the first cell.	Removal of sediment from pond bottom.
	Oil Sheen on Water	Prevalent and visible oil sheen.	Remove oil from water by use of oil-absorbent pads or by vactor truck. Refer problem to locate source and correct. If chronic low levels of oil persist, plant wetland plants such as *Juncus effusus* (soft rush) which can uptake small concentrations of oil.
	Erosion	Erosion of the pond's side slopes and/or scouring of the pond bottom, that exceeds 6 inches, or where continued erosion is prevalent.	Slopes should be stabilized by using proper erosion control measures, and repair methods.
Pond Dike/Berm	Settlement	Any part of these components that has settled 4 inches or lower than the design elevation, or inspector determines dike/berm is unsound.	Dike/berm is repaired to specifications.
Internal Berm	Concentrated Flow	Berm dividing cells should be level.	Build up low areas of berm or lower high areas so that the berm surface is level and water flows evenly over the entire length of the berm from the first cell to the second.
Inlet/Outlet Pipe	Sediment and Debris	Inlet/Outlet pipe clogged with sediment and/or debris material.	No clogging or blockage in the inlet and outlet piping.
Overflow Spillway	Rock Missing	Rock is missing and soil is exposed at top of spillway or outside slope.	Replace rocks to specifications.

NO. 17 – WETVAULT

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
Vault Area	Trash/Debris Accumulation	Trash and debris accumulated in vault (includes floatables and non-floatables).	Remove trash and debris.
	Sediment Accumulation	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6 inches.	Remove sediment from vault.
	Ventilation	Ventilation area blocked or plugged	Remove or clear blocking material from ventilation area. A specified % of the vault surface area must provide ventilation to the vault interior (see p. 6-82 for required %).
Vault Structure	Damage to Wall, Frame, Bottom, and/or Top Slab	Cracks wider than ½-inch and any evidence of soil particles entering the structure through the cracks, or maintenance inspection personnel determines that the vault is not structurally sound.	Vault replaced or repaired to design specifications.
	Damaged Pipe Joints	Cracks wider than ½-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.
Baffles	Damaged/Defective	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection staff.	Repair or replace baffles to specifications.
Inlet/Outlet	Damaged Pipes	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Trash/Debris Accumulation	Trash and debris accumulated in pipe or inlet/outlet (includes floatables and non-floatables).	Remove trash and debris.
Access Cover	Damaged/Not Working	Cover cannot be opened or removed, especially by one person.	Pipe repaired or replaced to proper working specifications.
Access Ladder	Damaged	Ladder is corroded or deteriorated, not functioning properly, missing rungs, has cracks and/or misaligned. Confined space warning sign missing.	Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel. Replace sign warning of confined space entry requirements.

NO. 18 – SAND FILTER POND

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
Pond Area	Sediment Accumulation on top layer	Sediment depth exceeds ½-inch.	No sediment deposit on grass layer of sand filter that would impede permeability of the filter section.
	Trash and Debris Accumulation	Trash and debris accumulated on sand filter bed.	Trash and debris removed from sand filter bed.
	Defective Vegetation (*Note: grass is optional*)	When the grass becomes excessively tall (greater than 6 inches) or when nuisance weeds and other vegetation starts to take over.	Mow vegetation and/or remove nuisance vegetation.
	Erosion Damage to Slopes	Erosion over 2 inches deep where cause of damage is prevalent or potential for continued erosion is evident.	Slopes should be stabilized by using proper erosion control measures.
Clean-Outs	Sediment/Debris	When the clean-outs become full or partially plugged with sediment and/or debris.	Sediment removed from the clean-outs.
Sand Filter Media	Plugging	Drawdown of water through the sand filter media, takes longer than 24 hours, and/or flow through the overflow pipes occurs frequently.	Usually requires scraping of top several inches of sand. May occasionally require replacement of entire sand filter depth, depending on extent of plugging. A sieve analysis is helpful to determine if the lower sand has too high a proportion of fine material.
	Prolonged flows	Sand is saturated for prolonged periods of time (several weeks) and does not dry out between storms due to continuous base flow or prolonged flows from detention facilities.	Limit the low, continuous flows to a small portion of the facility by using a low wooden divider or slightly depressed sand surface.
	Short Circuiting	When flows become concentrated over one section of the sand filter rather than dispersed.	Flow and percolation of water through the sand filter is uniform and dispersed across the entire filter area.
Rock Pad	Missing or Out of Place	Soil beneath the rock is visible.	Replace or rebuild the rock pad to design specifications.
Flow spreader	Concentrated Flow	Flow spreader uneven or clogged so that flows are not uniformly distributed across sand filter.	Level the spreader and clean so that flows are spread evenly over sand filter.
Pipes	Damaged	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired or replaced.

NO. 19 – SAND FILTER VAULT

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
Sand Media Section	Sediment Accumulation	Sediment depth exceeds ½-inch.	Remove sediment deposits on sand filter section, which would impede permeability of the filter section.
	Trash/Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet (floatables and non-floatables)	Trash and debris removed from vault, and inlet/outlet piping.
	Short Circuiting	When seepage/flow occurs along the vault walls and corners. Sand eroding near inflow area.	Sand filter media section re-laid and compacted along perimeter of vault to form a semi-seal. Add erosion protection to dissipate force of incoming flow and curtail erosion.
Pre-Settling Section	Sediment Accumulation	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6 inches.	Remove sediment deposit in the first chamber of the vault.
Drain Pipes/Cleanouts	Sediment Accumulation	When drain pipes, cleanouts become full with sediment and/or debris.	Remove the material from the facilities.
Inlet/Outlet Pipes	Trash/Debris Accumulation	Trash and debris accumulated in inlet/outlet pipes (floatables and non-floatables)	Trash and debris removed from vault, and inlet/outlet piping.
	Damaged	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
Vault Structure	Damaged to Walls, Frame, Bottom and/or Top Slab.	Cracks wider than ½-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound.	Vault replaced or repaired to design specifications.
	Damaged Pipe Joints	Cracks wider than ½-inch at the joints of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.
	Ventilation	Ventilation area blocked or plugged	Remove or clear blocking material from ventilation area. A specified % of the vault surface area must provide ventilation to the vault interior (see p. 6-122 for required %).
Baffles/Internal Walls	Damaged	Baffles or walls corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Repair or replace baffles or walls to specifications.
Access Cover	Damaged/Not Working	Cover cannot be opened, corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
Access Ladder	Damaged	Ladder is corroded or deteriorated, not functioning properly, missing rungs, cracks, and misaligned.	Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel.

NO. 20 – STORMFILTER®

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
Media Section	Sediment Accumulation on Media.	Sediment depth exceeds 0.25 inches.	No sediment deposits that would impede permeability of the compost media.
	Trash/Debris Accumulation	Trash and debris accumulated on compost filter bed.	Trash and debris removed from the compost filter bed.
First Chamber	Sediment Accumulation	Sediment depth exceeds 6 inches in first chamber.	No sediment deposits in vault bottom of first chamber.
Drain Pipes Clean-Outs	Sediment Accumulation	When drain pipes, clean-outs, become full with sediment and/or debris.	Remove the accumulated material from the facilities.

NO. 21 – STORMFILTER® (CARTRIDGE TYPE)

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
Compost Media	Plugged	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.	Replace media cartridges.
	Short Circuiting	Flows do not properly enter filter cartridges.	Replace filter cartridges.
Pipes	Damaged	Any part of the pipes that are crushed, damaged due to corrosion and/or settlement.	Pipe repaired and/or replaced.
Access Cover	Damaged/Not Working	Cover cannot be opened, one person cannot open the cover, corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
Vault Structure	Damage to Wall, Frame, Bottom, and/or Top Slab	Cracks wider than ½-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound.	Vault replaced or repaired to design specifications.
	Damaged Pipe Joints	Cracks wider than ½-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.
Baffles	Damaged	Baffles corroding, cracking warping, and/or showing signs of failure as determined by maintenance/inspection person.	Repair or replace baffles to specification.
Access Ladder	Damaged	Ladder is corroded or deteriorated, not functioning properly, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

NO. 22 – BAFFLE OIL/WATER SEPARATOR

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed.
Vault Area	Monitoring	Inspection of discharge water for obvious signs of poor water quality.	Effluent discharge from vault should be clear with out thick visible sheen.
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6 inches in depth.	No sediment deposits on vault bottom which would impede flow through the vault and separation efficiency.
	Trash and Debris Accumulation	Trash and debris accumulation in vault (floatables and non-floatables).	Trash and debris removed from vault, and inlet/outlet piping.
	Oil Accumulation	Oil accumulations that exceed 1 inch, at the surface of the water	Extract oil from vault by vactoring. Disposal in accordance with state and local rules and regulations.
Vault Structure	Damage to Wall, Frame, Bottom, and/or Top Slab	Cracks wider than ½-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound.	Vault replaced or repaired to design specifications.
	Damaged Pipe Joints	Cracks wider than ½-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.
Baffles	Damaged	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Repair or replace baffles to specifications.
Inlet/Outlet Pipes	Trash and Debris Accumulation	Trash and debris accumulation in inlet/outlet (floatables and non-floatables).	Trash and debris removed from vault, and inlet/outlet piping.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired or replaced.
Access Cover	Damaged/Not Working	Cover cannot be opened. Corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
Access Ladder	Damaged	Ladder is corroded or deteriorated, not functioning properly, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

NO. 23 – COALESCING PLATE OIL/WATER SEPARATOR

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Vault Area	Monitoring	Inspection of discharge water for obvious signs of poor water quality.	Effluent discharge from vault should be clear with no thick visible sheen.
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6 inches in depth and/or visible signs of sediment on plates.	No sediment deposits on vault bottom and plate media, which would impede flow through the vault and separation efficiency.
	Trash and Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.
	Oil Accumulation	Oil accumulation that exceeds 1 inch at the water surface.	Extract oil from vault by vactoring methods. Clean coalescing plates by thoroughly rinsing and flushing. Should be no visible oil depth on water.
Coalescing Plates	Damaged	Plate media broken, deformed, cracked and/or showing signs of failure.	Replace that portion of media pack or entire plate pack depending on severity of failure.
Vault Structure	Damage to Wall, Frame, Bottom, and/or Top Slab	Cracks wider than ½-inch and any evidence of soil particles entering the structure through the cracks, or maintenance inspection personnel determines that the vault is not structurally sound.	Vault replaced or repaired to design specifications.
	Damaged Pipe Joints	Cracks wider than ½-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.
Baffles	Damaged	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Repair or replace baffles to specifications.
Inlet/Outlet Pipes	Trash and Debris Accumulation	Trash and debris accumulation in inlet/outlet (floatables and non-floatables).	Trash and debris removed from vault, and inlet/outlet piping.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired or replaced.
Access Cover	Damaged/Not Working	Cover cannot be opened. Corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
Access Ladder	Damaged	Ladder is corroded or deteriorated, not functioning properly, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

NO. 24 – CATCHBASIN INSERT

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Catch Basin	Inspection	Inspection of media insert is required.	Effluent water from media insert is free of oils and has no visible sheen.
	Sediment Accumulation	When sediment forms a cap over the insert media of the insert and/or unit.	No sediment cap on the insert media and its unit.
	Trash and Debris Accumulation	Trash and debris accumulates on insert unit creating a blockage/restriction.	Trash and debris removed from insert unit. Runoff freely flows into catch basin.
Media Insert	Water Saturated	Catch basin insert is saturated with water, which no longer has the capacity to absorb.	Remove and replace media insert
	Oil Saturated	Media oil saturated due to petroleum spill that drains into catch basin.	Remove and replace media insert.
	Service Life Exceeded	Regular interval replacement due to typical average life of media insert product.	Remove and replace media at regular intervals, depending on insert product.

[1] *Critical area* includes the following types of hazard or habitat areas defined and regulated in KCC 21A: coal mine hazard area, erosion hazard area, flood hazard area, landslide hazard area, seismic hazard area, steep slope hazard area, volcanic hazard area, aquatic area, wetland, wildlife habitat conservation area, wildlife habitat network, and critical aquifer recharge area.

TABLE C.1.1.A QUESTIONNAIRE/FLOW CHART FOR DETERMINING REQUIREMENTS			
No.	Question	If YES	If NO

[2] *DDES* means the King County Department of Development and Environmental Services, which is the department responsible for conducting drainage review of proposed projects that are subject to a King County development permit or approval. Applicants for a permit or approval should contact DDES permit review staff prior to submittal to determine/confirm that drainage review is required, and if so, what type of drainage review is appropriate. Applicants may also arrange a predesign meeting with DDES permit review staff to confirm the type of drainage review and scope of drainage requirements that apply to the proposed project.

TABLE C.1.1.A QUESTIONNAIRE/FLOW CHART FOR DETERMINING REQUIREMENTS			
No.	Question	If YES	If NO

[3] *Base flood elevation* is the elevation of the 100-year floodplain, at the ***project site***, that has been determined in accordance with the standards in KCC 21A.24.230.

[4] *Channel migration zone* means those areas within the lateral extent of likely stream channel movement that are subject to risk due to stream bank destabilization, rapid stream incision, stream bank erosion and shifts in the location of stream channels, as shown on King County's Channel Migration Zone maps. The channel migration zone includes two additional components, the *severe channel migration hazard area*, which includes the present channel width plus the area at greatest risk of lateral movement, and the *moderate channel migration hazard area*, which is the remaining portion of the channel migration zone.

TABLE C.1.1.A QUESTIONNAIRE/FLOW CHART FOR DETERMINING REQUIREMENTS			
No.	Question	If YES	If NO

TABLE C.1.1.A QUESTIONNAIRE/FLOW CHART FOR DETERMINING REQUIREMENTS			
No.	Question	If YES	If NO

[5] *Closed depression* means an area greater than 5,000 square feet at overflow elevation that is low-lying and that has no or such a limited surface water outlet that the area acts as a stormwater retention facility. The primary loss of water volume from a closed depression is through evapotranspiration and discharge into the ground rather than surface flow.

[6] *Note: for **single family residential permits** and permits for **agricultural projects**, DDES may waive the requirement for floodplain delineation on the site plan, provided the plan notes that a floodplain exists and indicates the base flood elevation.*

[7] *Land surveyor* means a person licensed by the State of Washington as a professional land surveyor.

[8] *Point discharge* means a concentrated flow from a pipe, ditch, or other similar drainage feature.

[9] *Tightline* means a continuous length of pipe that conveys water from one point to another (typically down a steep slope) with no inlets or collection points in between.

[10] *Critical aquifer recharge area* is the critical area designation, defined and regulated in KCC 21A, that is applied to areas where extra protection of groundwater quantity and quality is needed because of known susceptibility to contamination and importance to drinking water supply. Such areas are delineated on the *King County Critical Aquifer Recharge Area Map* available at DDES or on the County's Geographic Information System (GIS). See the definition of this term in KCC 21A.06 for more details.

[11] *Local drainage system* means any natural or constructed drainage feature that collects and concentrates runoff from the ***site*** and discharges it downstream.

Is the project on a ***site*/lot** **smaller than 22,000 square feet**?

Yes

Is it feasible and applicable to implement **full dispersion** for the **roof area** as per Section C.2.1?

Yes

No further BMPs required. **Note**: Any proposed connection of roof downspouts to local drainage system must be via **perforated pipe connection** per Section C.2.11.

No

Is it feasible and applicable to implement **full infiltration** of the **roof runoff** as per Section C.2.2?

Yes

No

Apply **one or more of the following** to impervious area ≥10% of ***site***/lot for ***site***/lot sizes <11,000 sf and ≥ 20% of ***site***/lot for ***site***/lot sizes between 11,000 and 22,000 sf (For projects located in *critical aquifer recharge areas* these impervious area amounts double):

1. **Limited Infiltration** (Section C.2.3)
2. **Basic Dispersion** (Section C.2.4)
3. **Rain Garden** (Section C.2.5)
4. **Permeable Pavement** (Section C.2.6)
5. **Rainwater Harvesting** (Section C.2.7)
6. **Vegetated Roof** (Section C.2.8)
7. **Reduced Impervious Service Credit** (Section C.2.9)
8. **Native Growth Retention Credit** (Section C.2.10)

Notes:
No flow control BMPs are required for ***new pervious surfaces***.
Water quality impacts are adequately addressed with the above flow control BMPs.

No

The project must be a ***site*/lot** **greater than or equal to 22,000 square feet**?

Is it feasible and applicable to implement **full dispersion** on all ***target impervious surface*** as per Section C.2.1?

Yes

No further BMPs required. **Note**: Any proposed connection of roof downspouts to local drainage system must be via **perforated pipe connection** per Section C.2.11.

No

Is it feasible and applicable to implement **full infiltration** of the **roof runoff** as per Section C.2.2?

No

One or more of the following BMPs must be implemented for ***target impervious surface*** not addressed with full dispersion or with full infiltration of roof runoff:

1. **Full Infiltration** (Section C.2.2)
2. **Limited Infiltration** (Section C.2.3)
3. **Basic Dispersion** (Section C.2.4)
4. **Rain Garden** (Section C.2.5)
5. **Permeable Pavement** (Section C.2.6)
6. **Rainwater Harvesting** (Section C.2.7)
7. **Vegetated Roof** (Section C.2.8)
8. **Reduced Impervious Service Credit** (Section C.2.9)
9. **Native Growth Retention Credit** (Section C.2.10)

Yes

Is there any remaining ***target impervious surface*** not addressed with full dispersion or with full infiltration of **roof runoff**?

Yes

No

Note:
Flow control BMPs are required for all ***new pervious surface*** when it exceeds 35,000 sf. Flow control BMPs must be applied in the following order of preference:

1. The feasibility and applicability of **full dispersion** as detailed in Section C.2.1 must be evaluated for all new pervious surfaces.
2. For those pervious surfaces not addressed in Requirement 1 above, **one or more of the following BMPs** must be implemented:
   Basic Dispersion (Section C.2.4)
   Rain Garden (Section C.2.5)

Note:
The following **extra water quality provisions must be implemented** if the project results in 5,000 sf or more of additional ***pollution generating impervious surface*** from which runoff is not fully dispersed in accordance with Section C.2.1:

1. Reduce existing or proposed pollution generating impervious surface so that the 5,000 sf threshold is not triggered.
2. Provide water quality facilities designed by a **licensed civil engineer** in accordance with Section 1.2.8 of the SWDM.

[12] *Recordable version* means one that meets King County's "Standard Formatting Requirements for Recording Documents" pursuant to RCW 36.18.010 and 65.04.045, available online at ftp://ftp.metrokc.gov/records/formatting_requirements.pdf or from the King County Recorder's Office. These requirements include specifications for such things as page size ($8^1/_2$" x 14" or smaller), font size (at least 8-point), and margin width (1" on all sides of every page if there is a standard cover sheet).

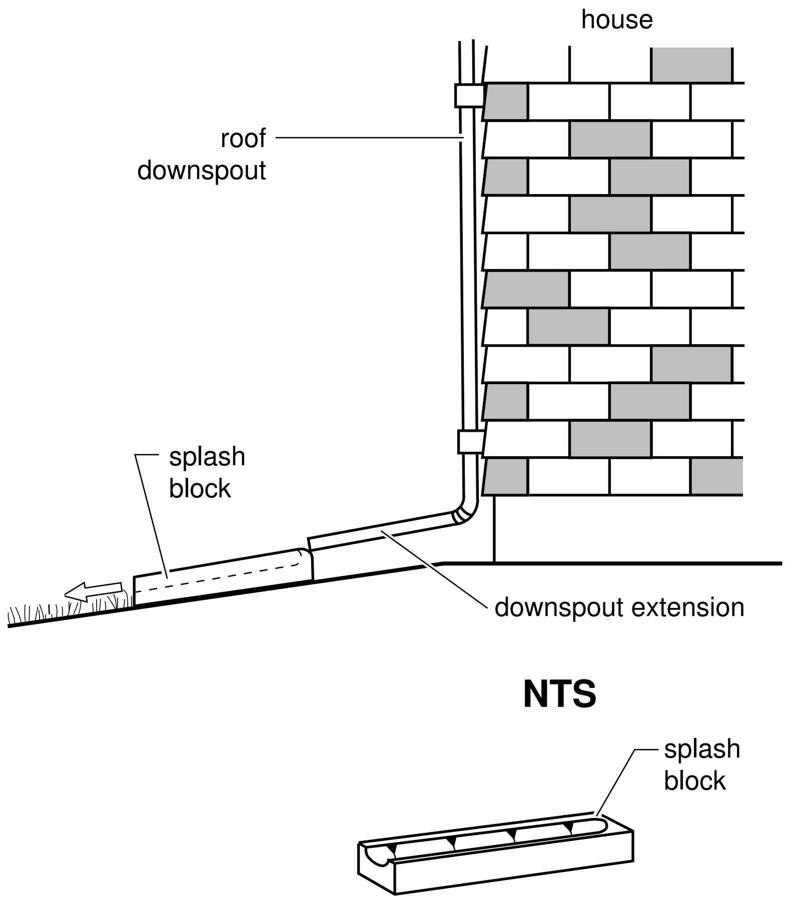
[13] *Structural engineer* means a person licensed by the State of Washington as a professional civil engineer specializing in structural engineering.

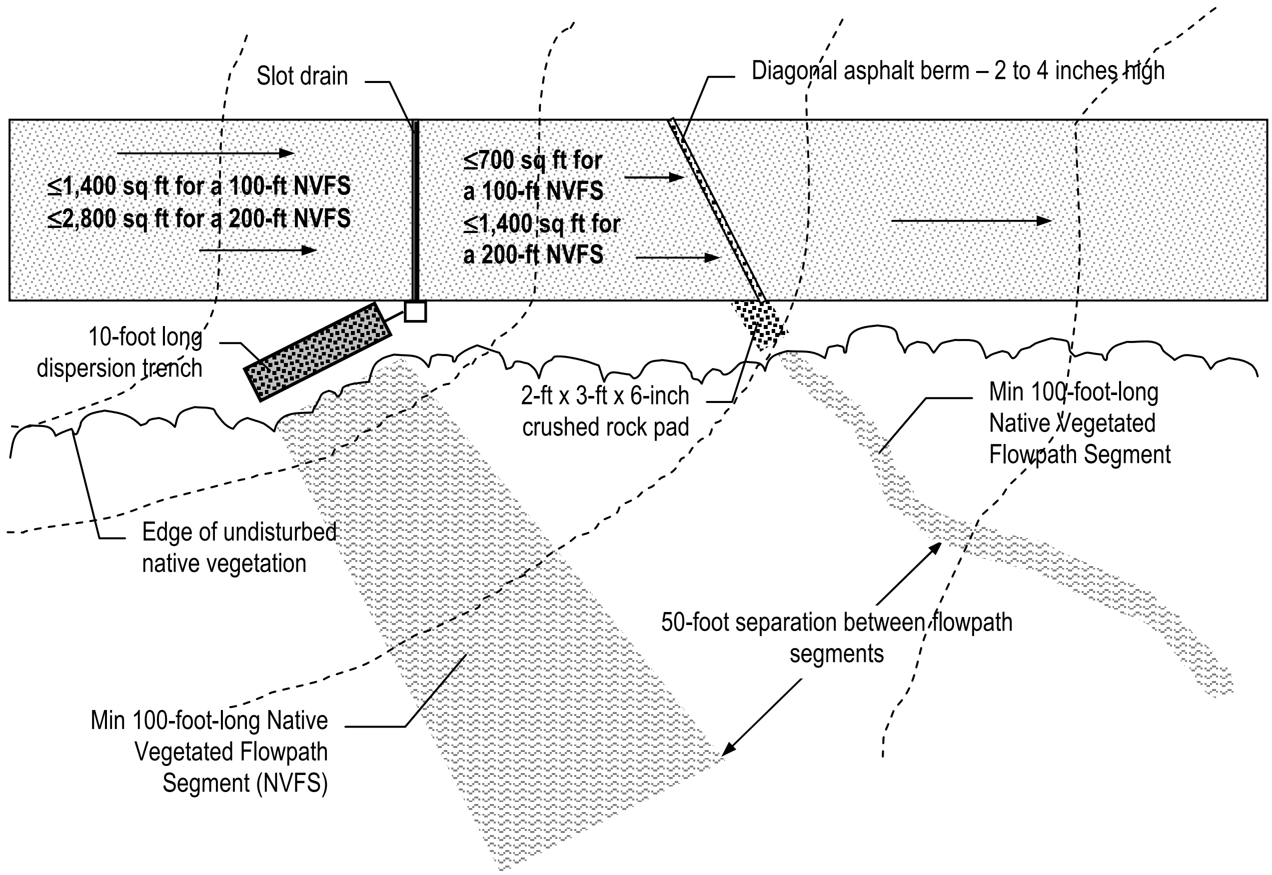
[14] *Non-native pervious surface* means a pervious surface that does not meet the definition of a ***native vegetated surface*** and is not a natural water body or critical area.

[15] *Unsubmerged* means outside the ordinary high water mark of streams, lakes, and wetlands.

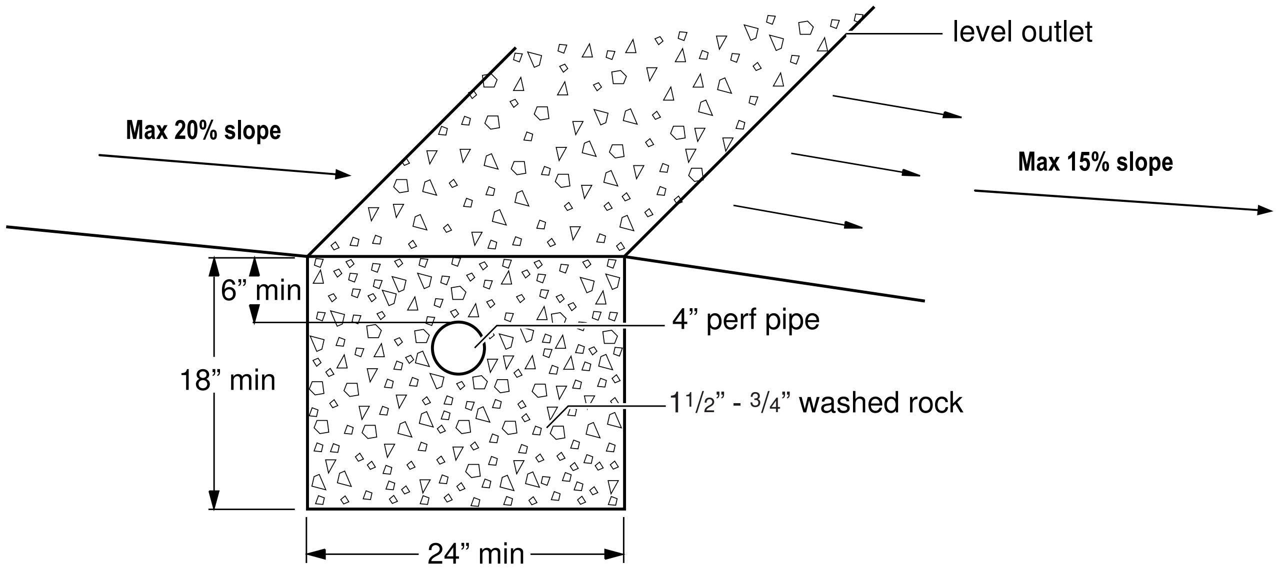
TABLE C.2.1.A SUMMARY OF DISPERSION DEVICE FLOWPATH LENGTHS & CAPACITIES

[16] *Width* is measured in the general direction that runoff flows across the area of non-native pervious surface. For irregular-shaped areas, the width may be an average of distances along multiple paths of runoff across the non-native pervious surface.

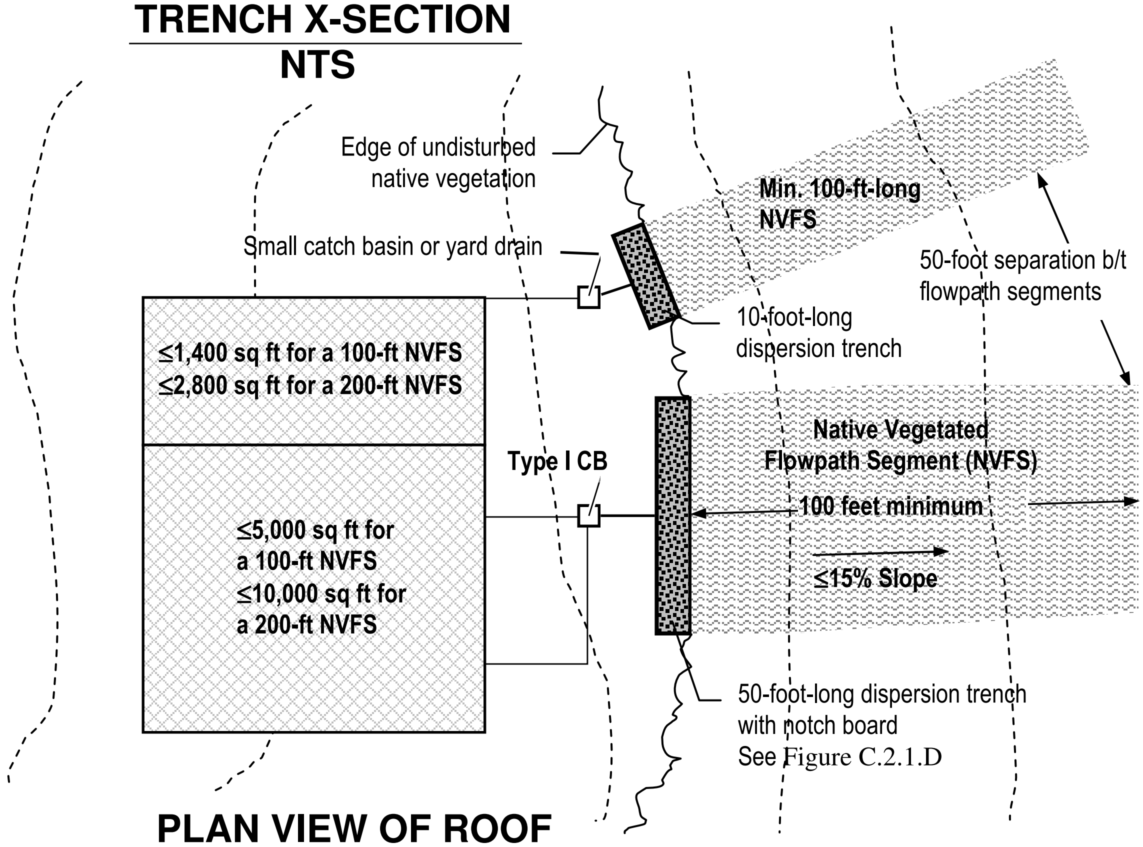

house
roof
downspout
splash
block
downspout extension
NTS
splash
block



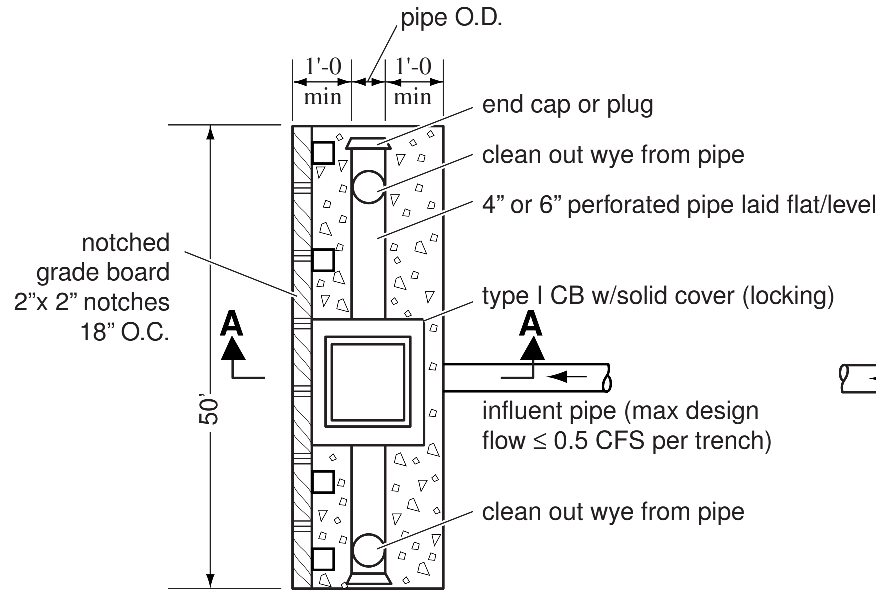
PLAN VIEW OF DRIVEWAY
NTS



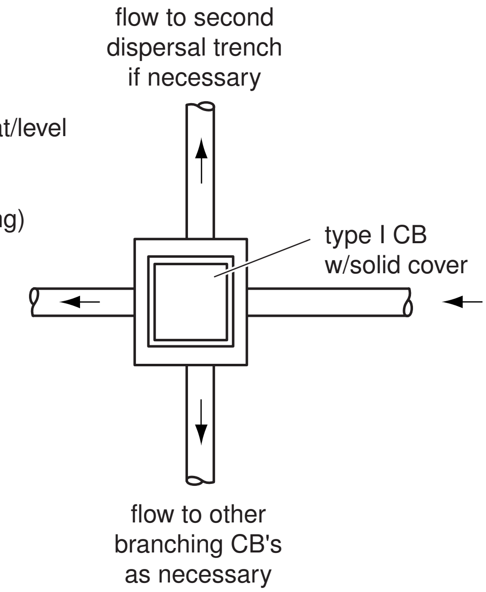
TRENCH X-SECTION
NTS

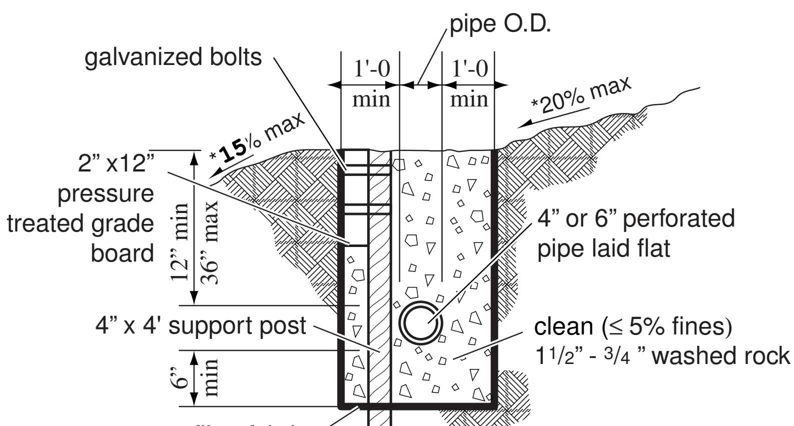


PLAN VIEW OF ROOF
NTS

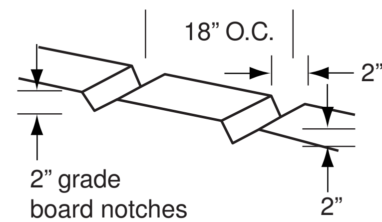


PLAN
NTS



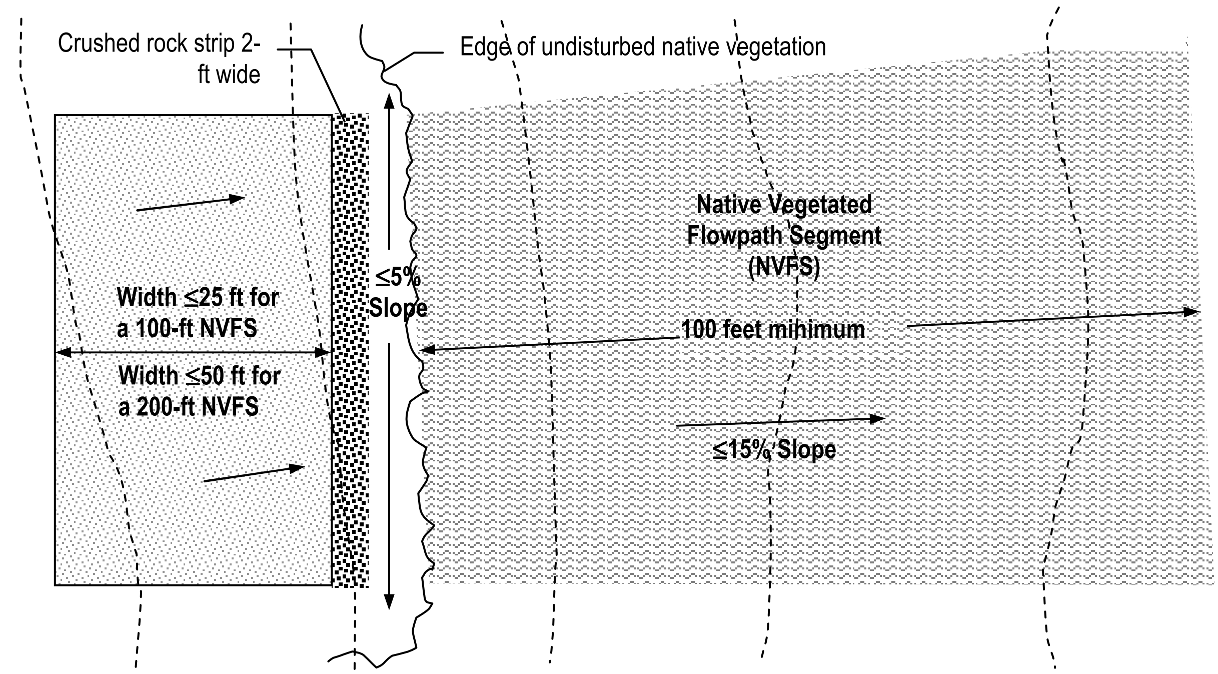


SECTION A-A
NTS



NOTES:

1. This trench shall be constructed so as to prevent point discharge and/or erosion.
2. Trenches may be placed no closer than 50 feet to one another. (100 feet along flowline)
3. Trench and grade board must be level. Align to follow contours of site.
4. Support post spacing as required by soil conditions to ensure grade board remains level.

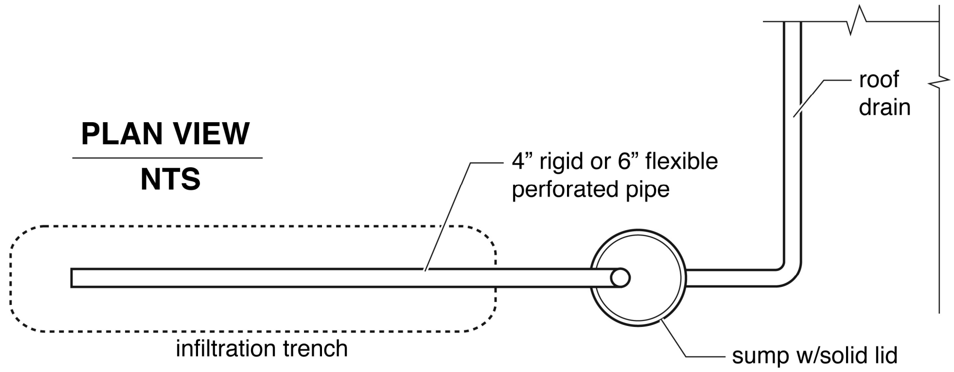


PLAN VIEW
NTS

TABLE C.2.1.B SELECTED NATIVE VEGETATION, SIZE, AND SPACING REQUIREMENTS

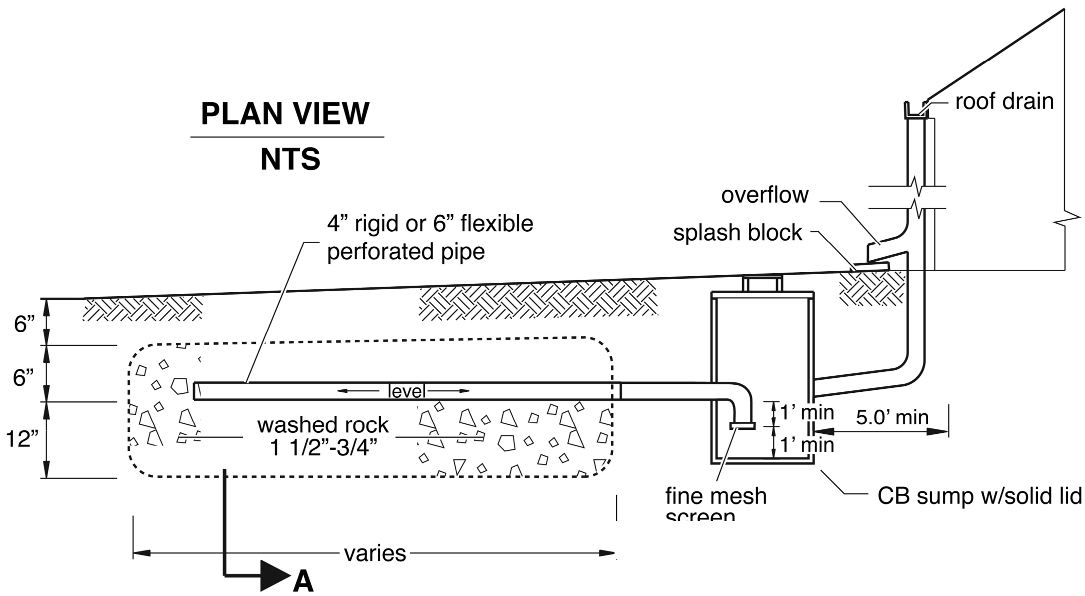
PLAN VIEW

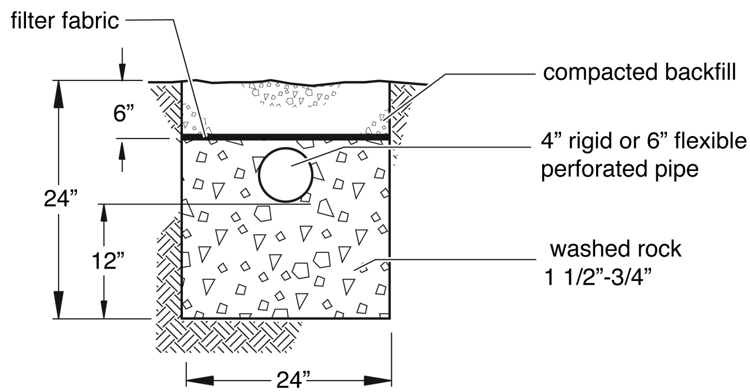
NTS



PLAN VIEW

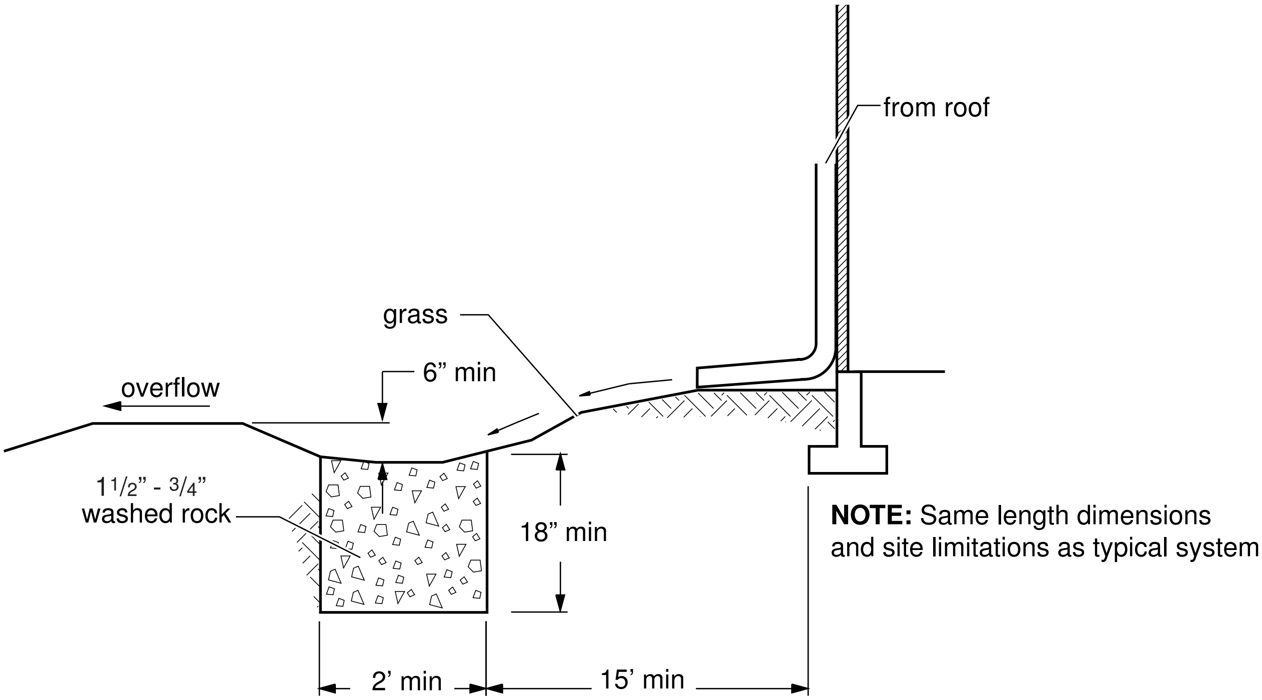
NTS



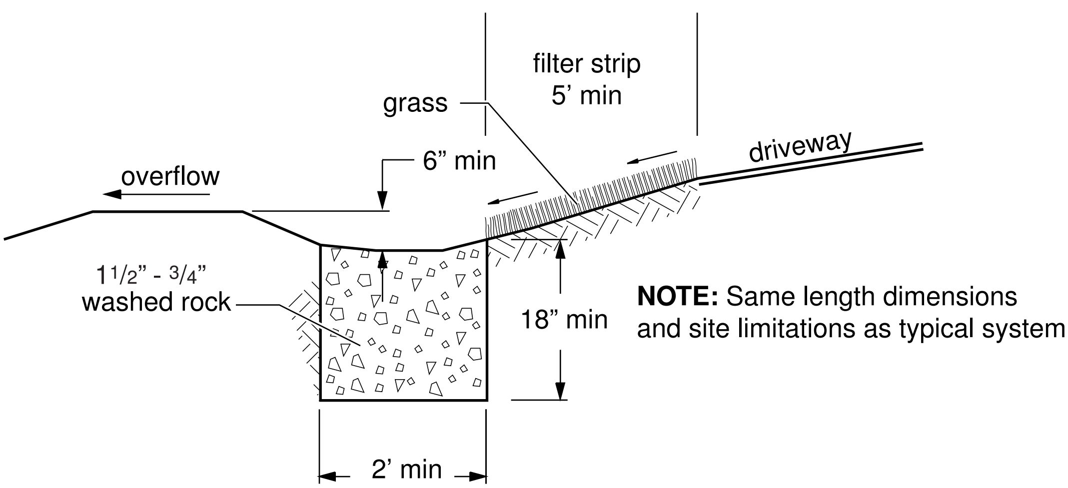


SECTION A

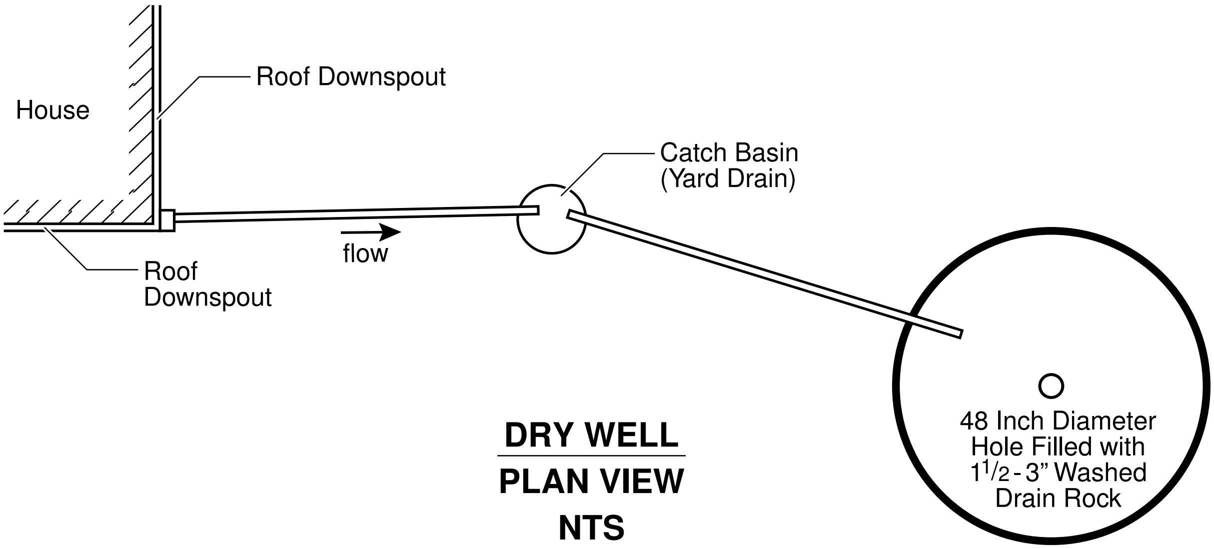
NTS



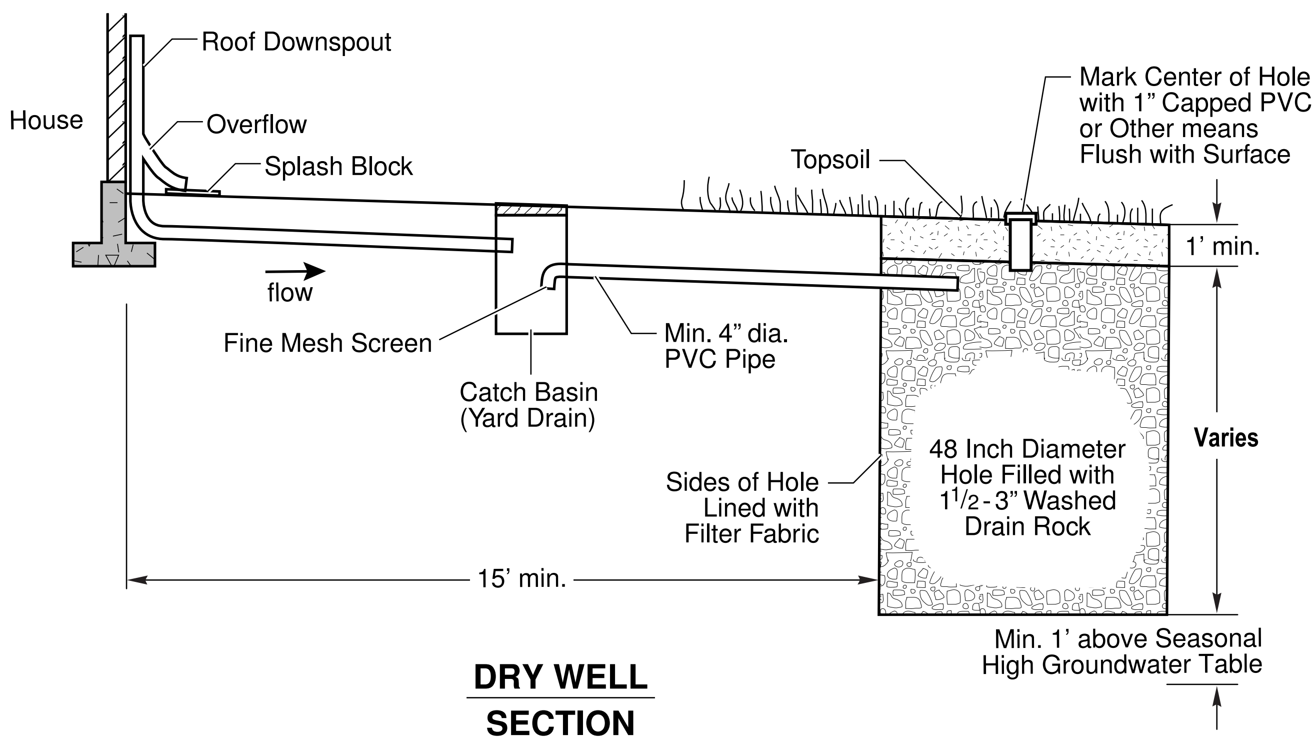
X-SECTION
NTS



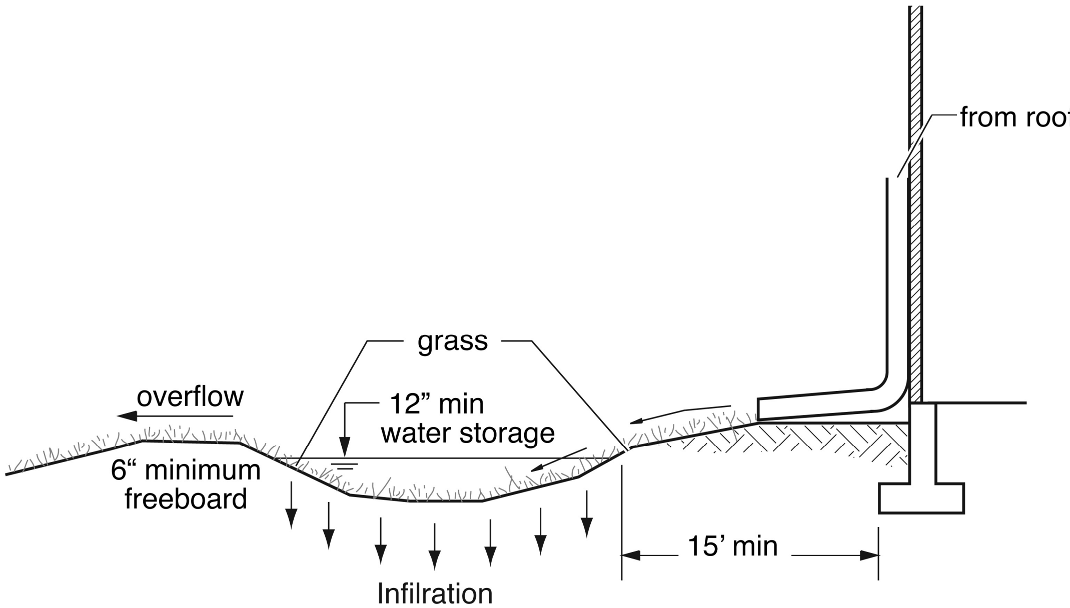
X-SECTION
NTS



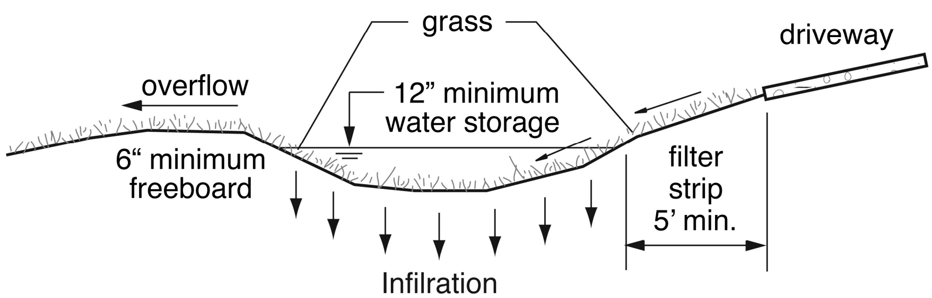
DRY WELL
PLAN VIEW
NTS



DRY WELL
SECTION
NTS

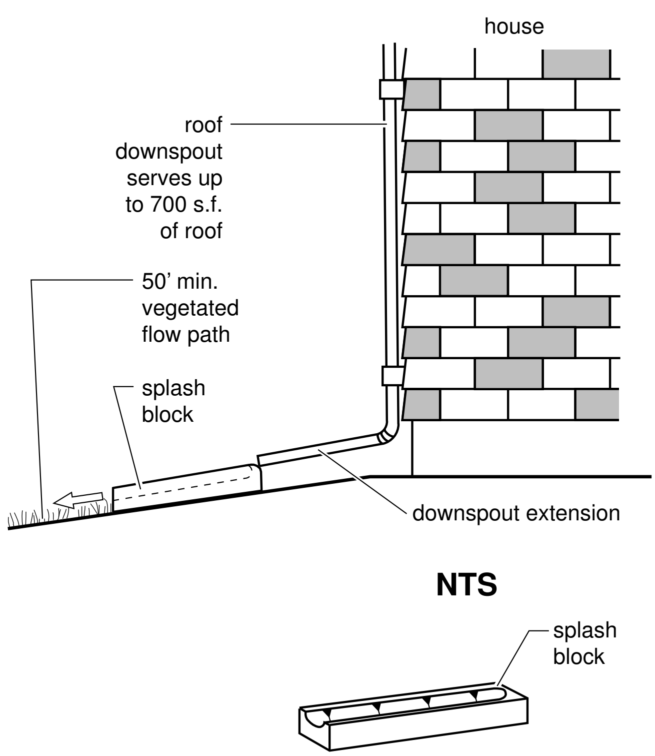


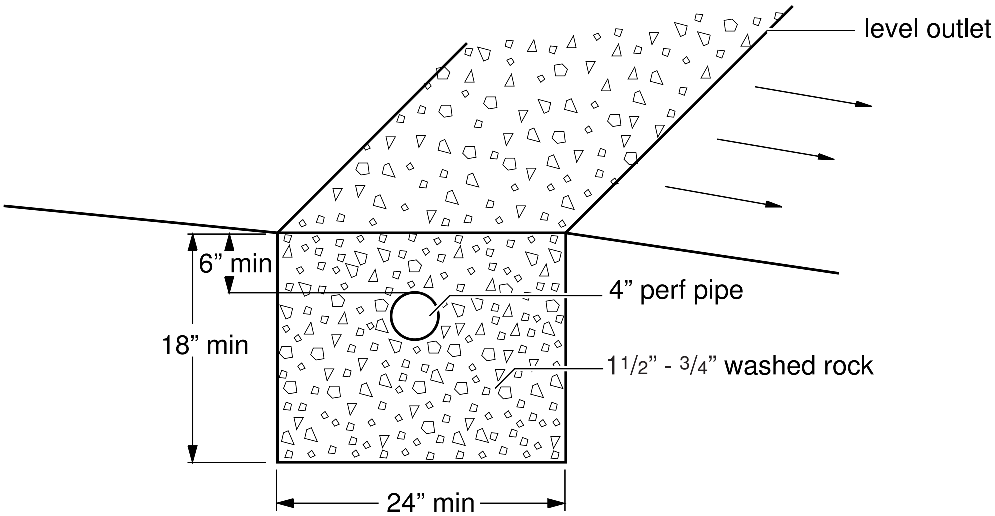
X-SECTION
NTS



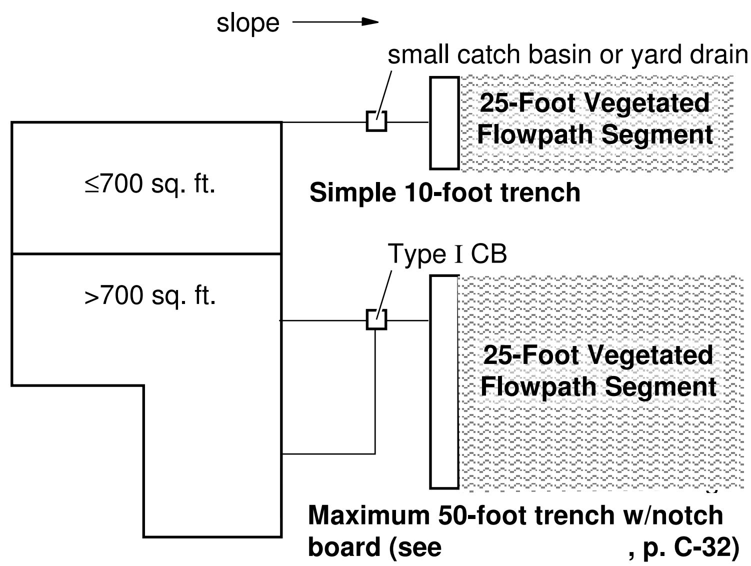
X-SECTION
NTS

[17] *Reverse slope sidewalk* is one that slopes away from rather than onto the roadway it abuts as required by County road standards. If this technique is proposed within County right-of-way, a Road Variance will be required for its use.

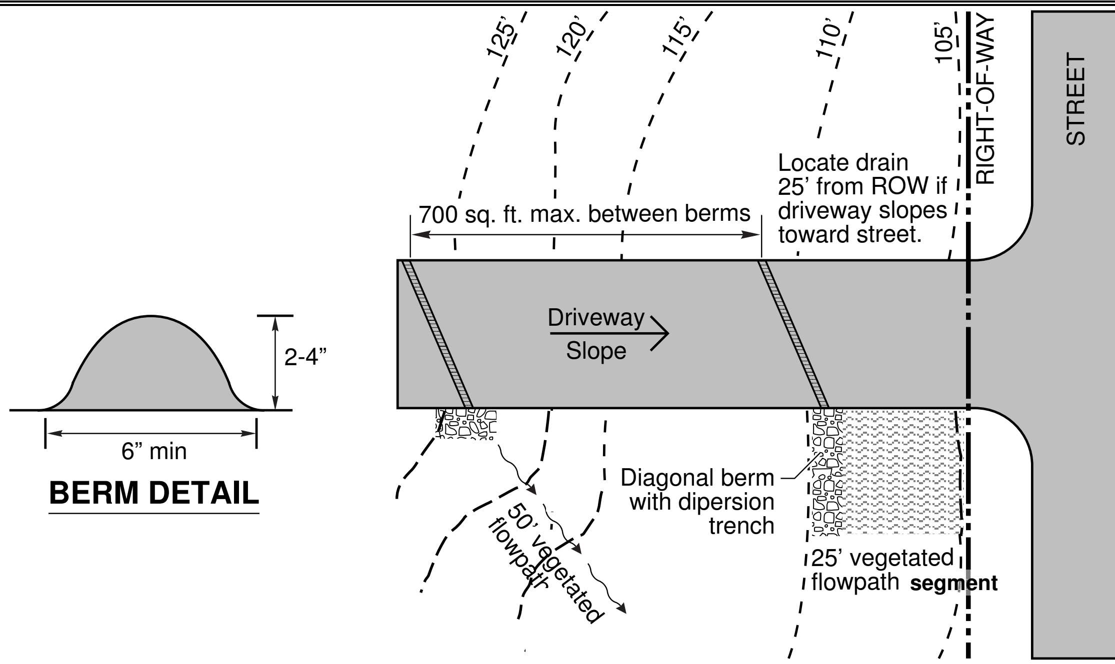

house
roof downspout serves up to 700 s.f. of roof
50' min. vegetated flow path
splash block
downspout extension
NTS
splash block



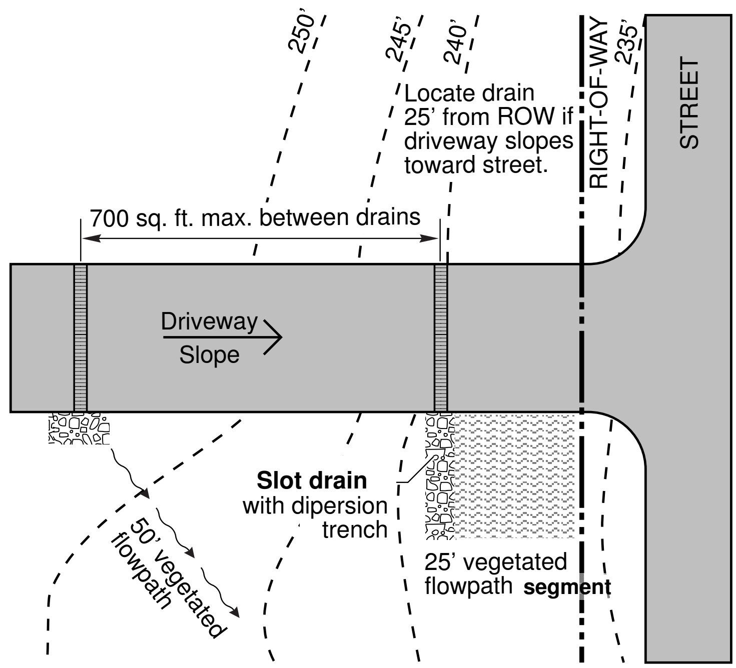
TRENCH X-SECTION
NTS



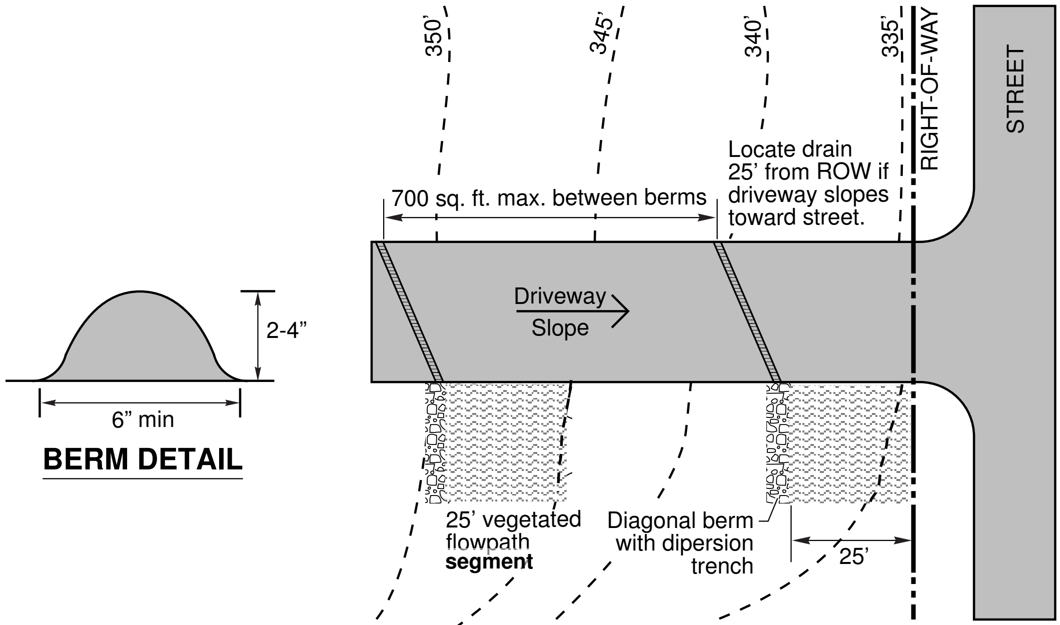
PLAN VIEW OF ROOF
NTS



PLAN
Steep Driveway with Diagonal Berms

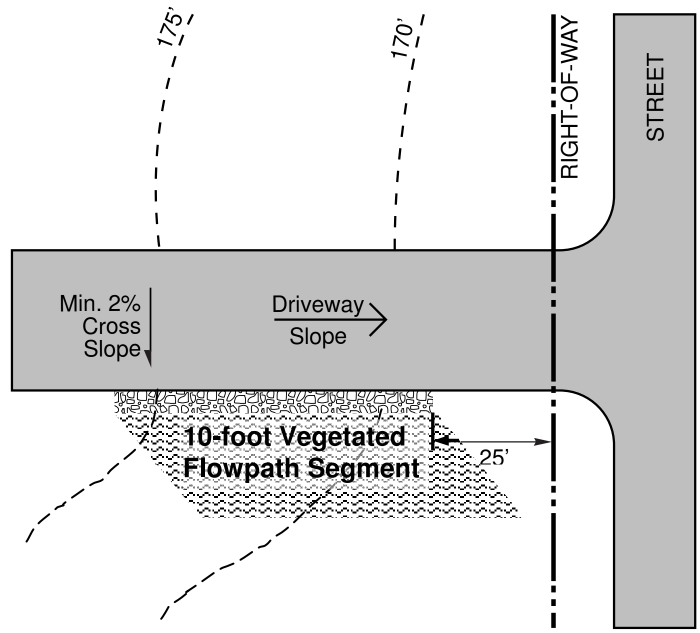


PLAN
Steep Driveway with Slotted Drains



PLAN

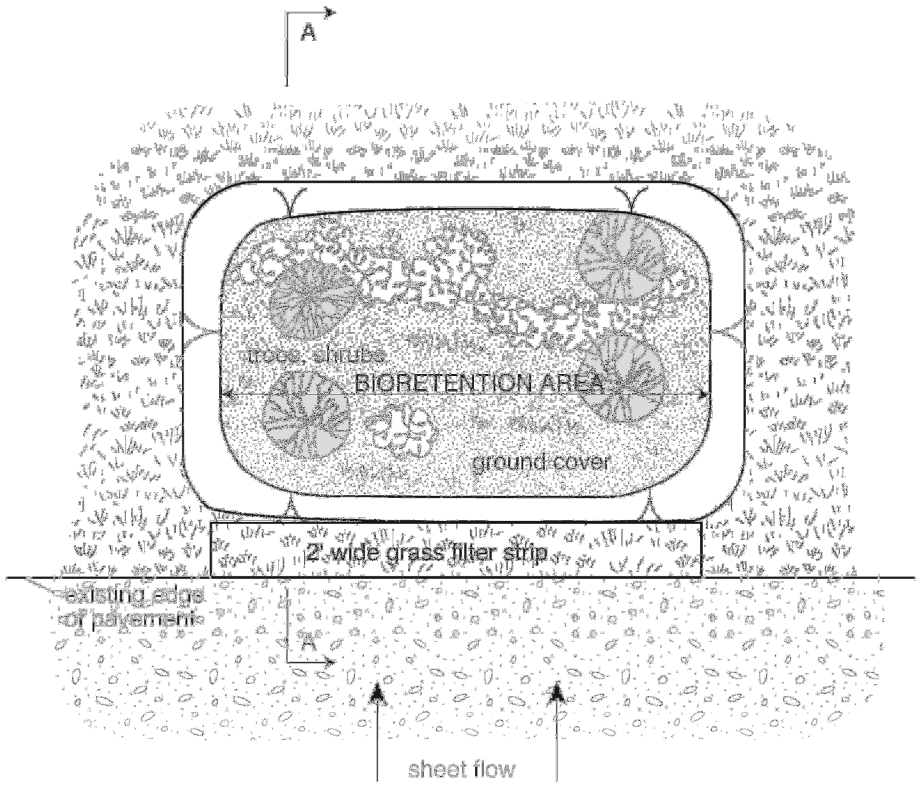
Driveway Dispersion Trench
Driveway Slope Varies and Slopes Toward Street



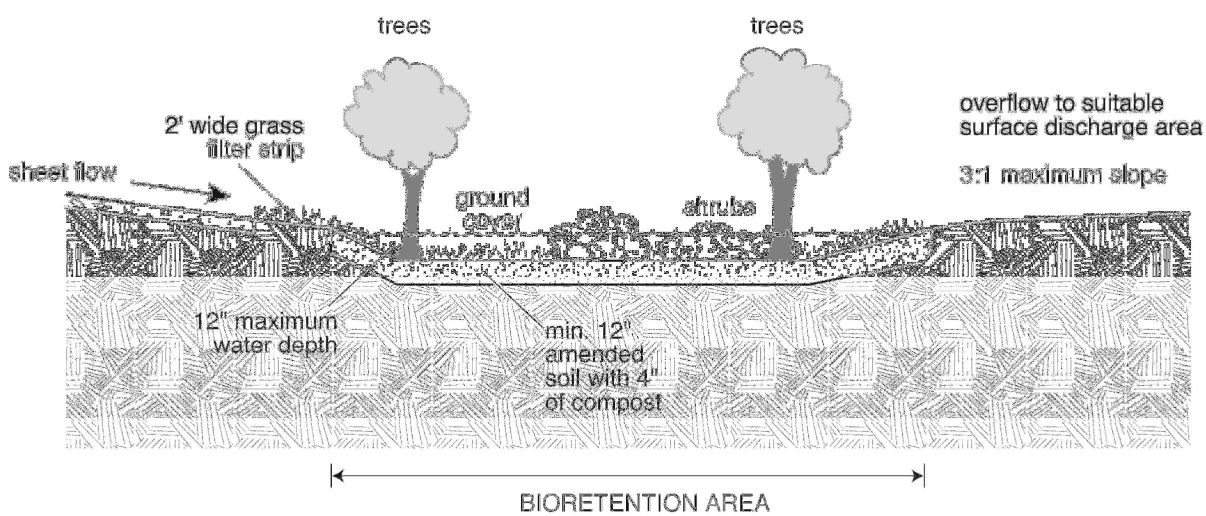
PLAN

Sheet Flow Dispersion from a Driveway
Flat to Moderately Sloping Driveways

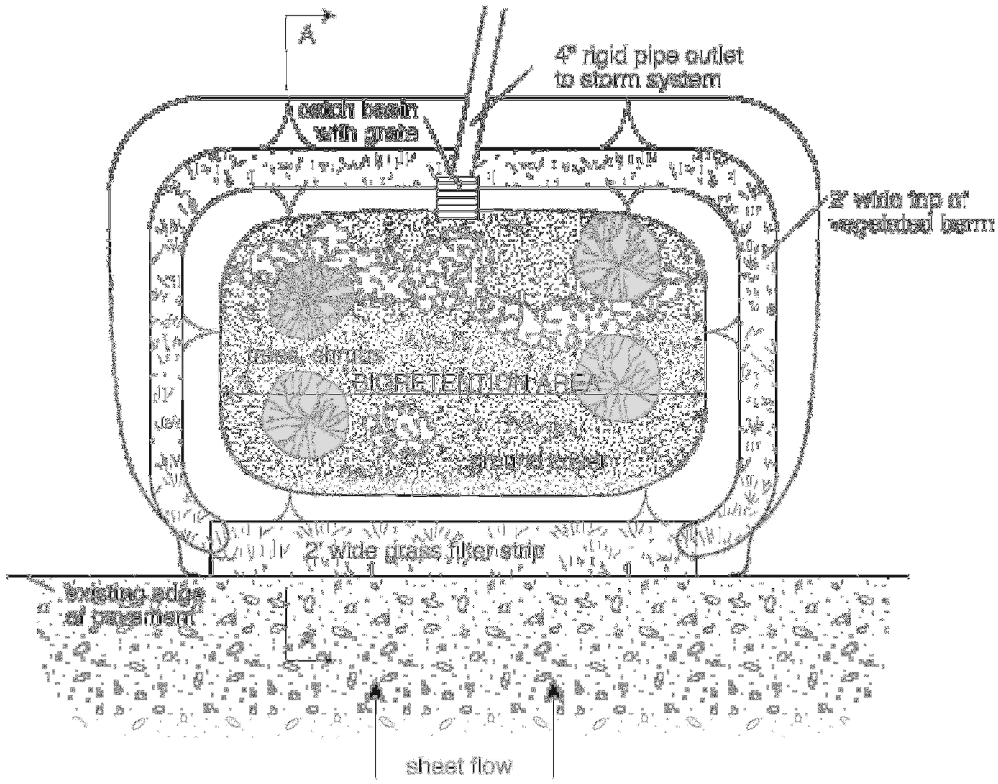
TABLE C.2.5.A WATER TOLERANT PLANTS		



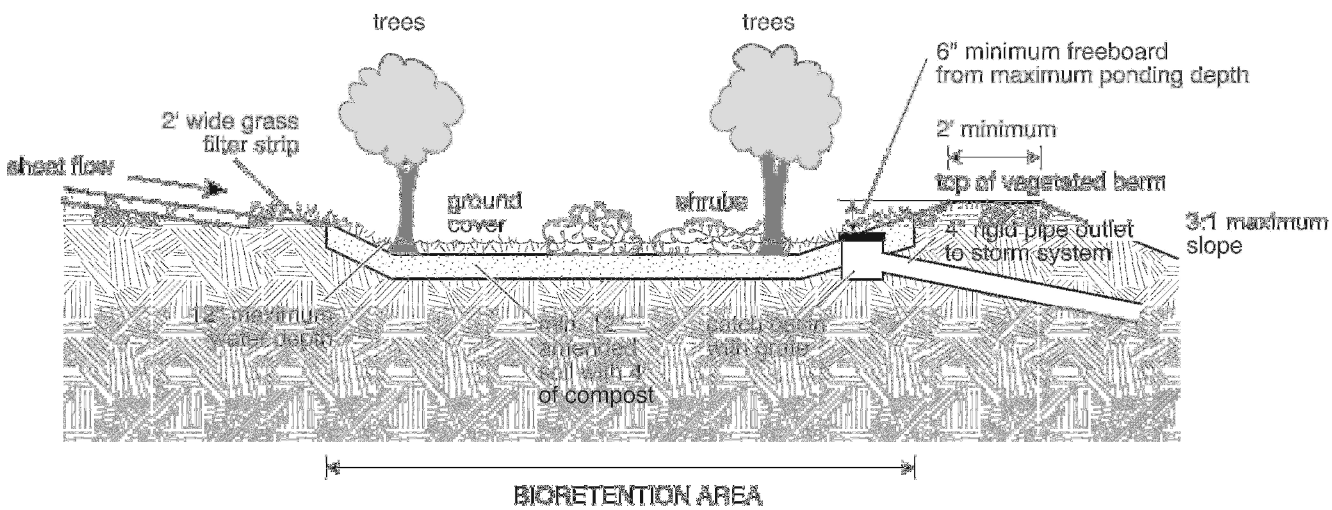
PLAN VIEW (not to scale)



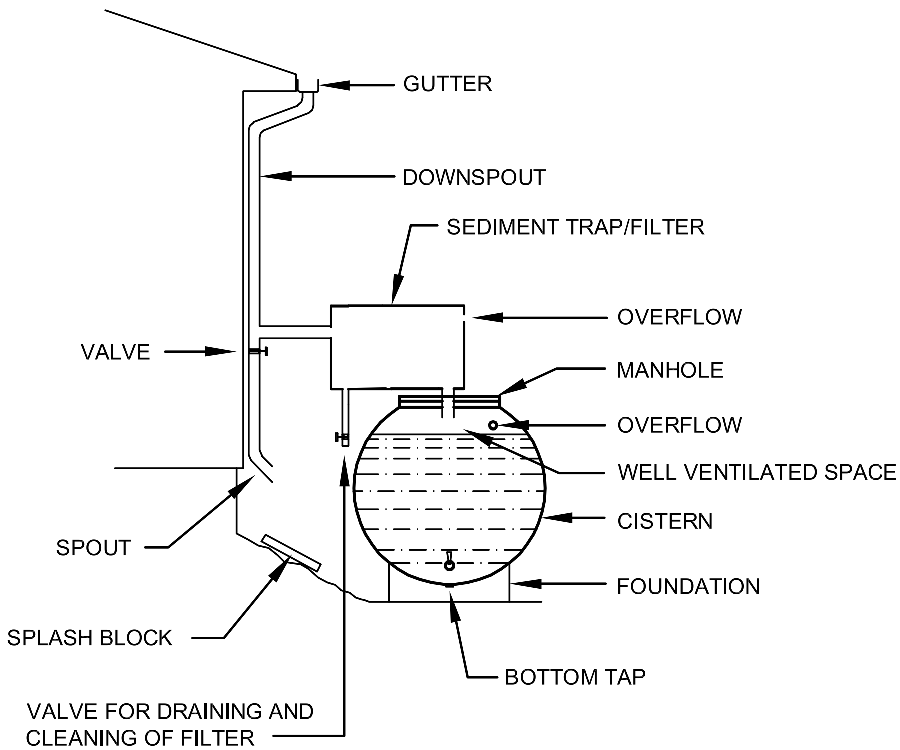
SECTION VIEW A-A (not to scale)

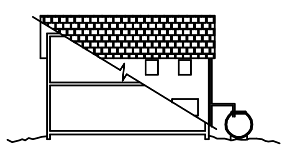


PLAN VIEW (not to scale)

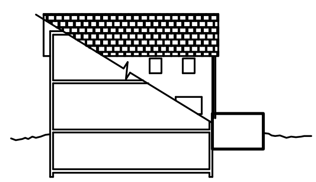


SECTION VIEW A-A (not to scale)

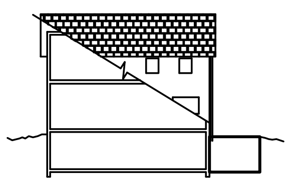




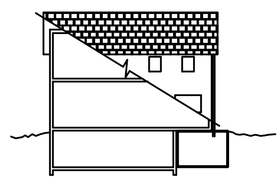
RESERVOIR ABOVE GROUND
(INSULATE IF NECESSARY)



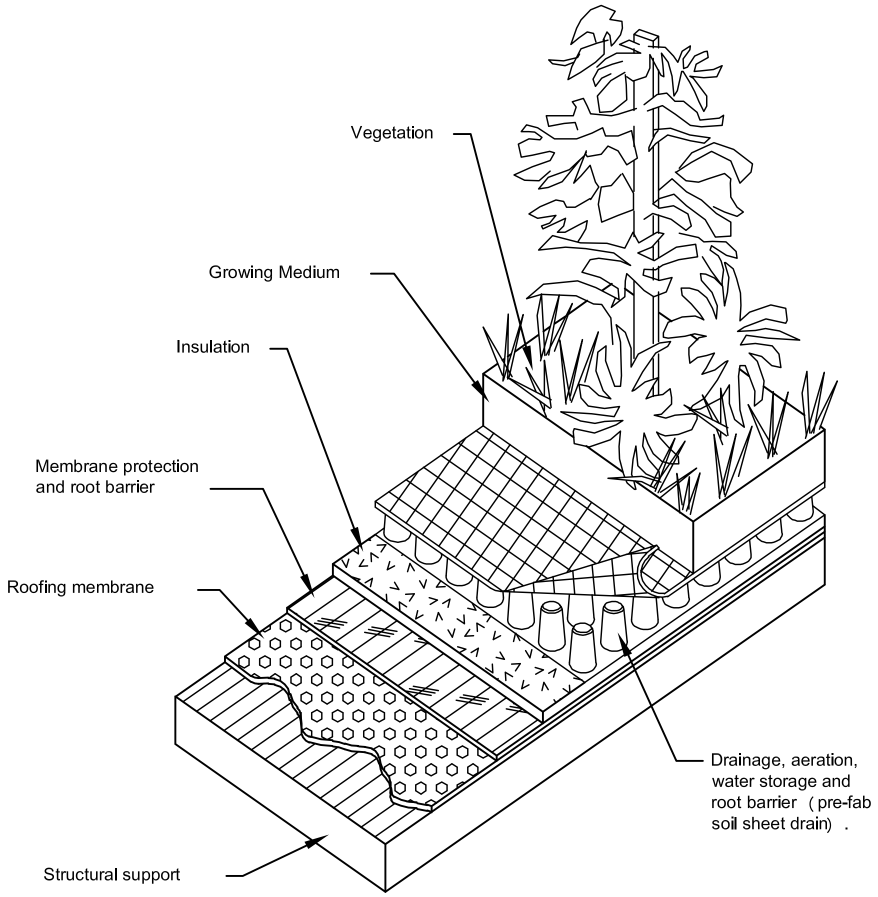
PARTIALLY BURIED RESERVOIR



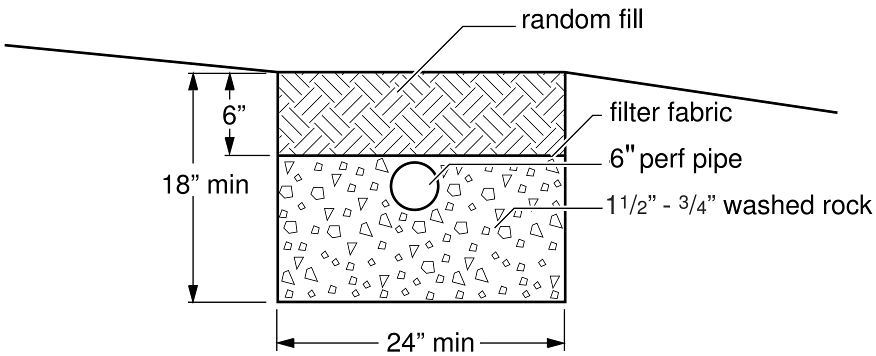
RESERVOIR BURIED OUTSIDE
BASEMENT



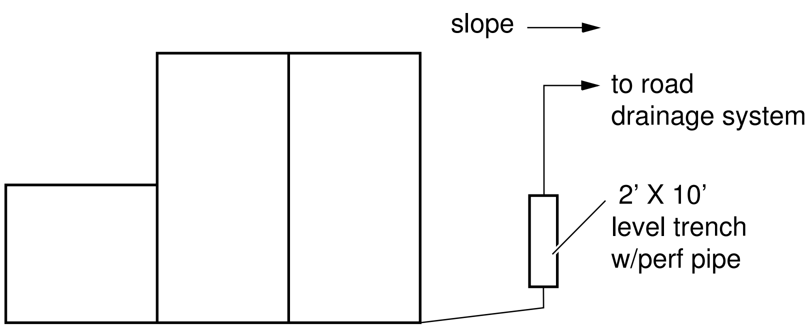
RESERVOIR IN BASEMENT



Note:
This example shows a two-part prefabricated soil sheet drain and protection board.



TRENCH X-SECTION
NTS



PLAN VIEW OF ROOF
NTS

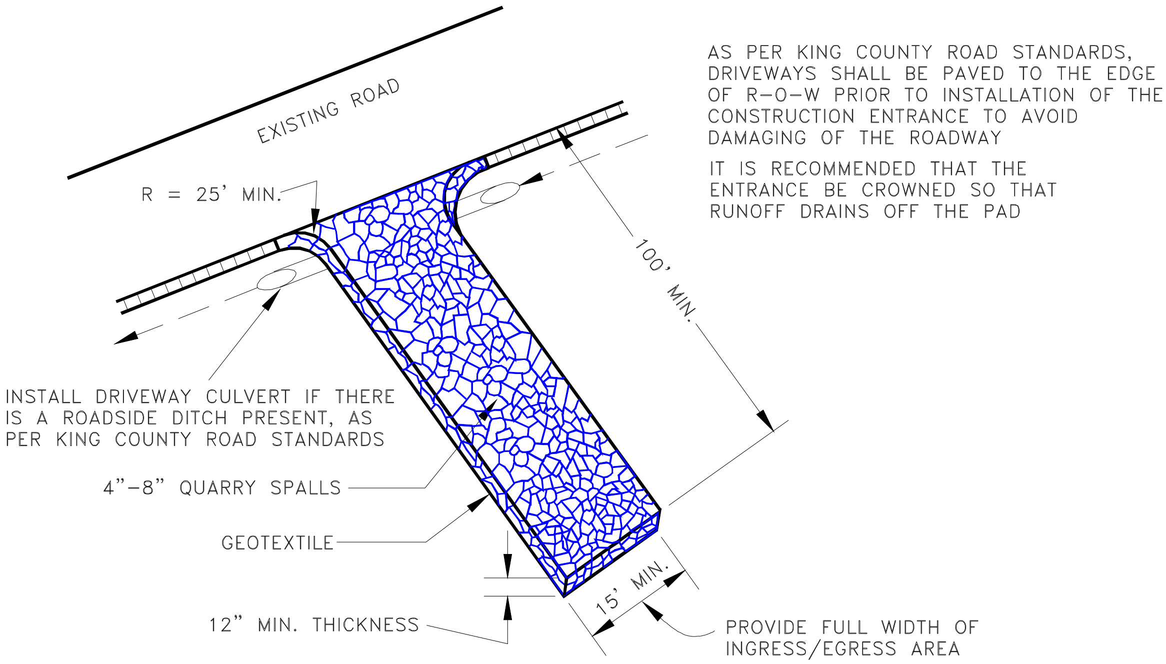
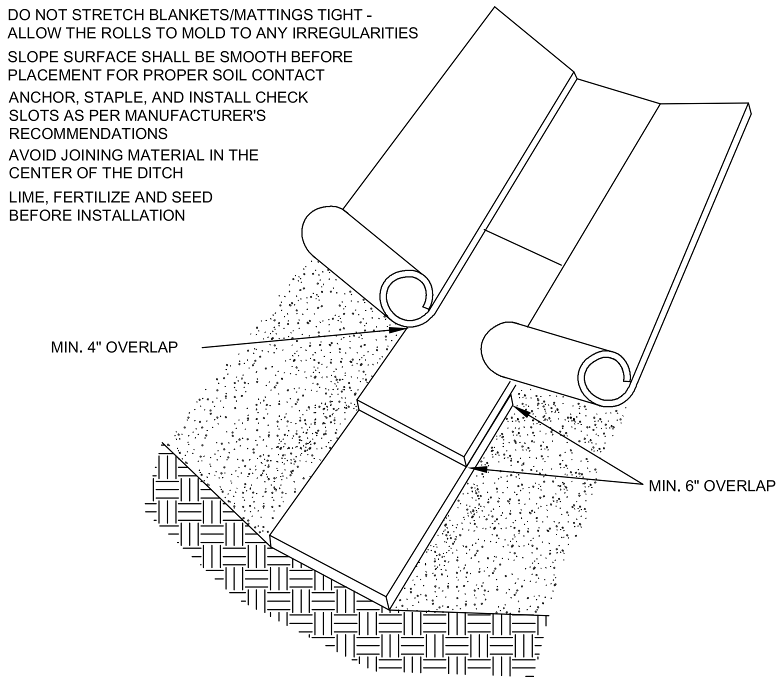
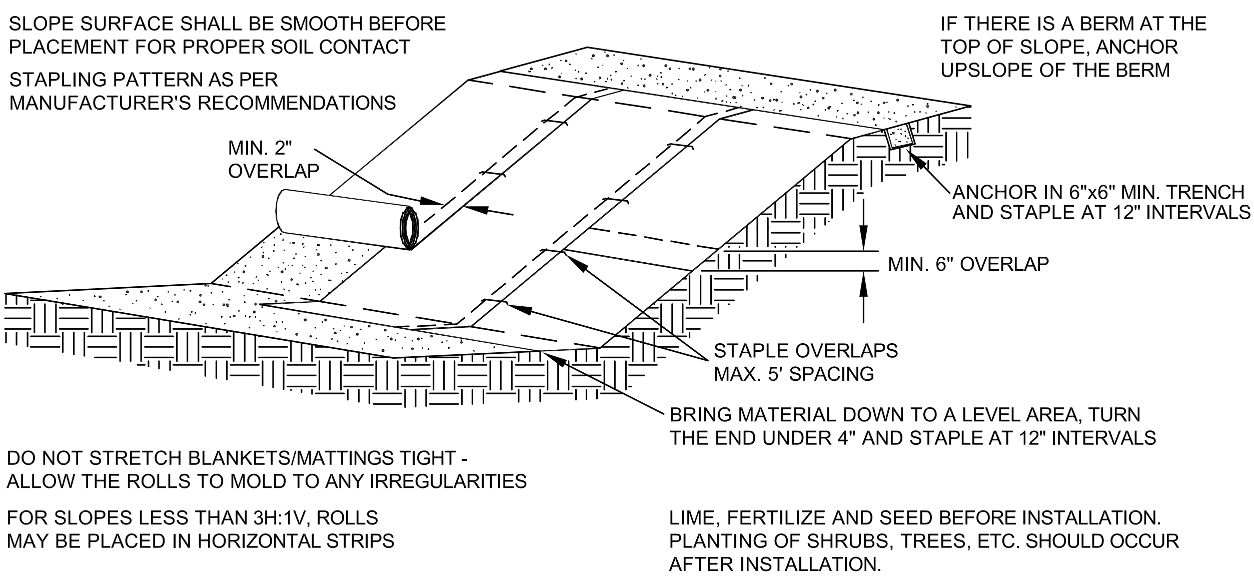
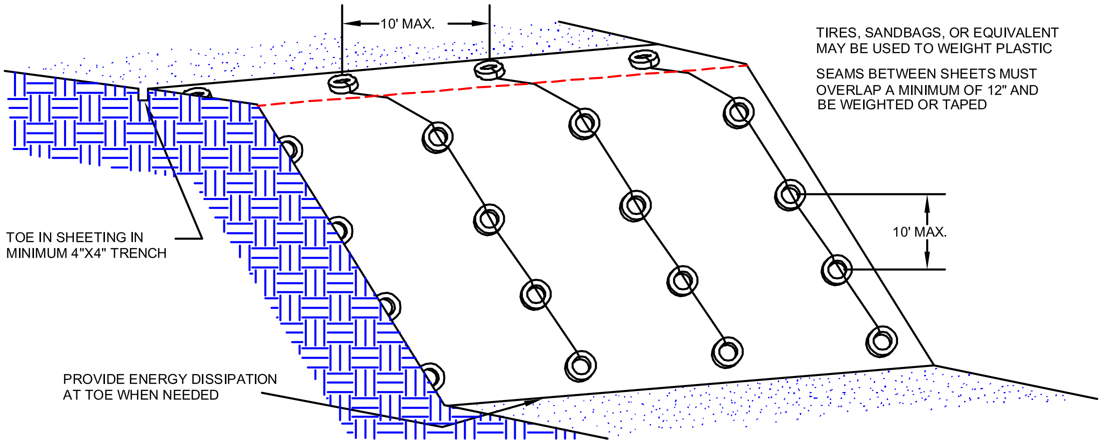
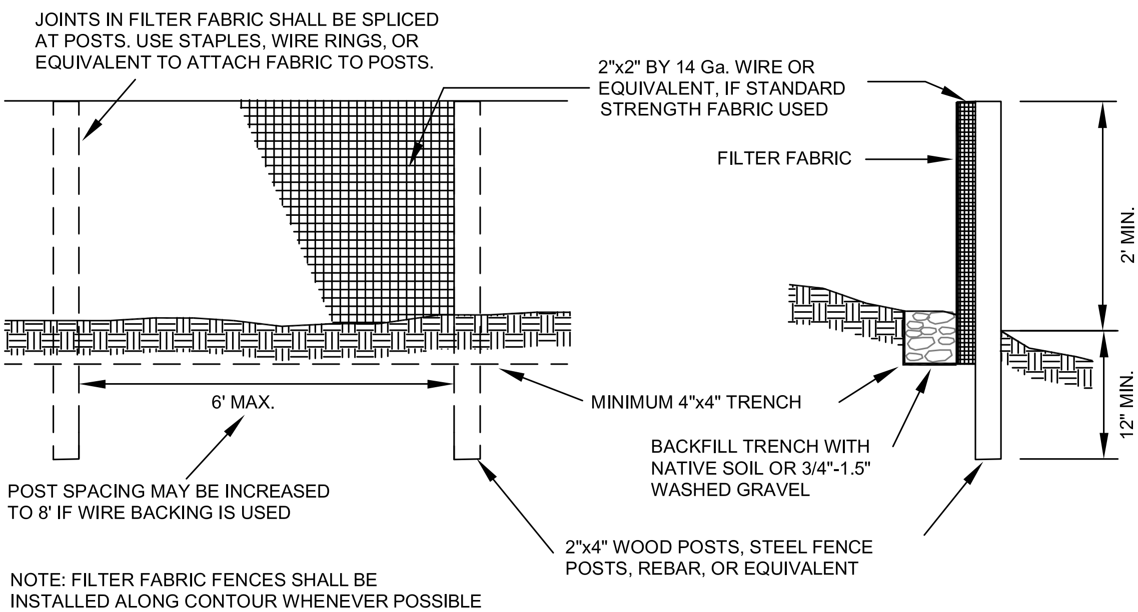

EXISTING ROAD
AS PER KING COUNTY ROAD STANDARDS, DRIVEWAYS SHALL BE PAVED TO THE EDGE OF R-O-W PRIOR TO INSTALLATION OF THE CONSTRUCTION ENTRANCE TO AVOID DAMAGING OF THE ROADWAY
IT IS RECOMMENDED THAT THE ENTRANCE BE CROWNED SO THAT RUNOFF DRAINS OFF THE PAD
R = 25' MIN.
100' MIN.
INSTALL DRIVEWAY CULVERT IF THERE IS A ROADSIDE DITCH PRESENT, AS PER KING COUNTY ROAD STANDARDS
4"-8" QUARRY SPALLS
GEOTEXTILE
12" MIN. THICKNESS
15' MIN.
PROVIDE FULL WIDTH OF INGRESS/EGRESS AREA

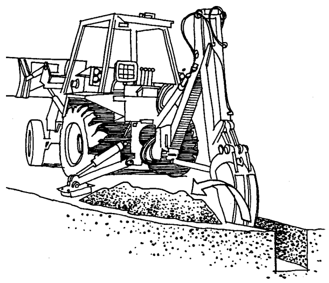
TABLE C.3.1.A MULCH STANDARDS AND GUIDELINES			


DO NOT STRETCH BLANKETS/MATTINGS TIGHT - ALLOW THE ROLLS TO MOLD TO ANY IRREGULARITIES
SLOPE SURFACE SHALL BE SMOOTH BEFORE PLACEMENT FOR PROPER SOIL CONTACT
ANCHOR, STAPLE, AND INSTALL CHECK SLOTS AS PER MANUFACTURER'S RECOMMENDATIONS
AVOID JOINING MATERIAL IN THE CENTER OF THE DITCH
LIME, FERTILIZE AND SEED BEFORE INSTALLATION
MIN. 4" OVERLAP
MIN. 6" OVERLAP


SLOPE SURFACE SHALL BE SMOOTH BEFORE PLACEMENT FOR PROPER SOIL CONTACT
STAPLING PATTERN AS PER MANUFACTURER'S RECOMMENDATIONS
MIN. 2" OVERLAP
IF THERE IS A BERM AT THE TOP OF SLOPE, ANCHOR UPSLOPE OF THE BERM
ANCHOR IN 6"x6" MIN. TRENCH AND STAPLE AT 12" INTERVALS
MIN. 6" OVERLAP
STAPLE OVERLAPS MAX. 5' SPACING
BRING MATERIAL DOWN TO A LEVEL AREA, TURN THE END UNDER 4" AND STAPLE AT 12" INTERVALS
DO NOT STRETCH BLANKETS/MATTINGS TIGHT - ALLOW THE ROLLS TO MOLD TO ANY IRREGULARITIES
FOR SLOPES LESS THAN 3H:1V, ROLLS MAY BE PLACED IN HORIZONTAL STRIPS
LIME, FERTILIZE AND SEED BEFORE INSTALLATION. PLANTING OF SHRUBS, TREES, ETC. SHOULD OCCUR AFTER INSTALLATION.

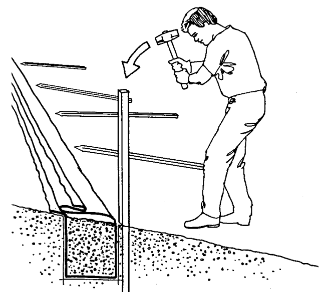

10' MAX.
TIRES, SANDBAGS, OR EQUIVALENT MAY BE USED TO WEIGHT PLASTIC
SEAMS BETWEEN SHEETS MUST OVERLAP A MINIMUM OF 12" AND BE WEIGHTED OR TAPED
10' MAX.
TOE IN SHEETING IN MINIMUM 4"X4" TRENCH
PROVIDE ENERGY DISSIPATION AT TOE WHEN NEEDED


JOINTS IN FILTER FABRIC SHALL BE SPLICED AT POSTS. USE STAPLES, WIRE RINGS, OR EQUIVALENT TO ATTACH FABRIC TO POSTS.
2"x2" BY 14 Ga. WIRE OR EQUIVALENT, IF STANDARD STRENGTH FABRIC USED
FILTER FABRIC
2' MIN.
12" MIN.
6' MAX.
MINIMUM 4"x4" TRENCH
BACKFILL TRENCH WITH NATIVE SOIL OR 3/4"-1.5" WASHED GRAVEL
POST SPACING MAY BE INCREASED TO 8' IF WIRE BACKING IS USED
2"x4" WOOD POSTS, STEEL FENCE POSTS, REBAR, OR EQUIVALENT
NOTE: FILTER FABRIC FENCES SHALL BE INSTALLED ALONG CONTOUR WHENEVER POSSIBLE

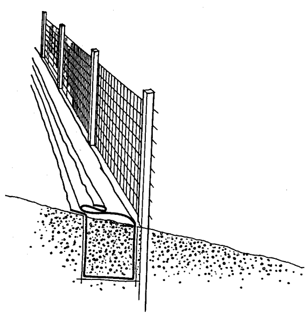


Dig trench

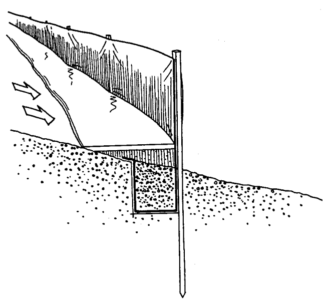
Toe-in-fabric



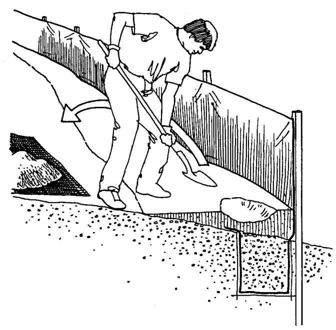
Stake



Reinforce

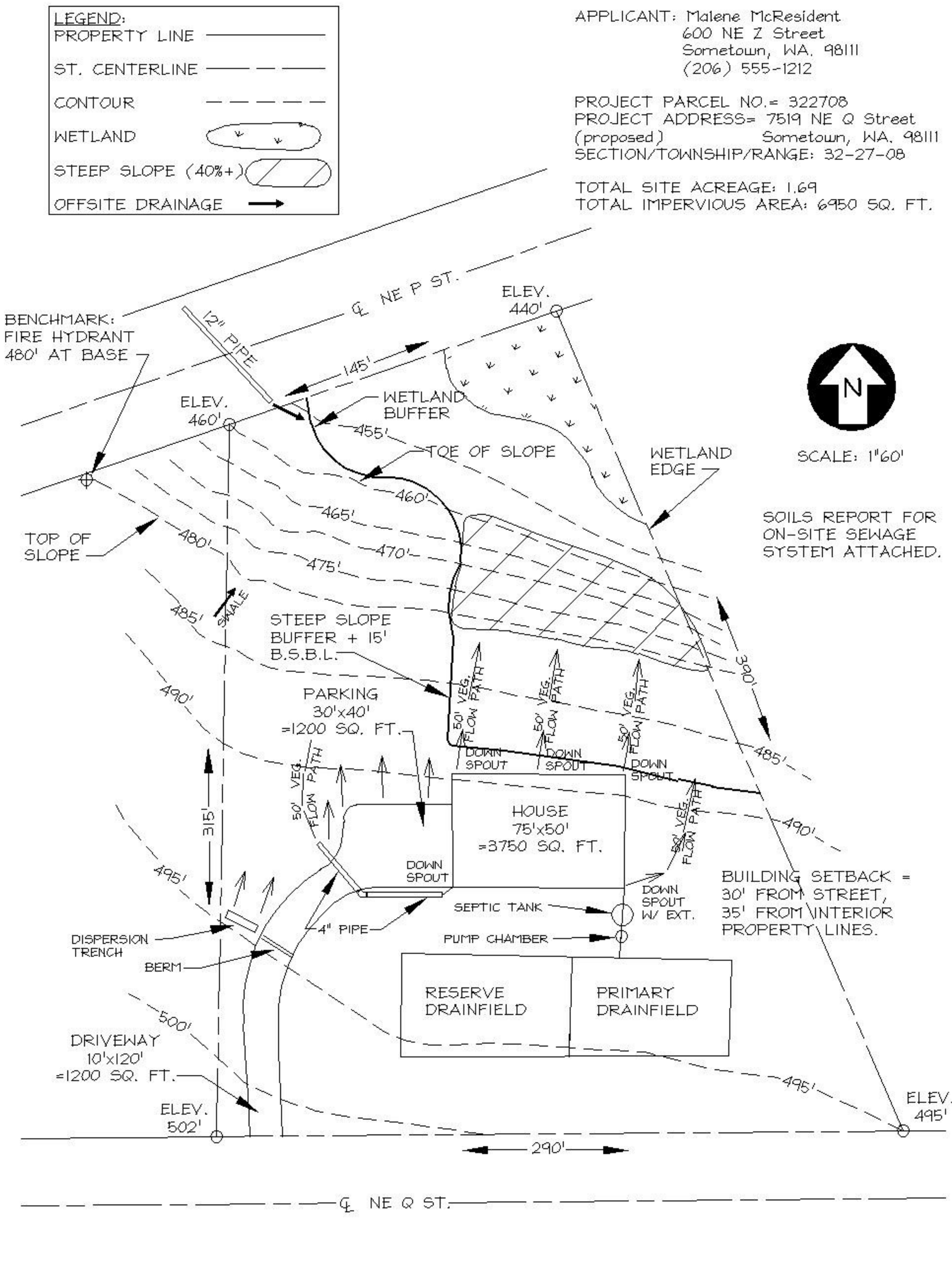


Monitor

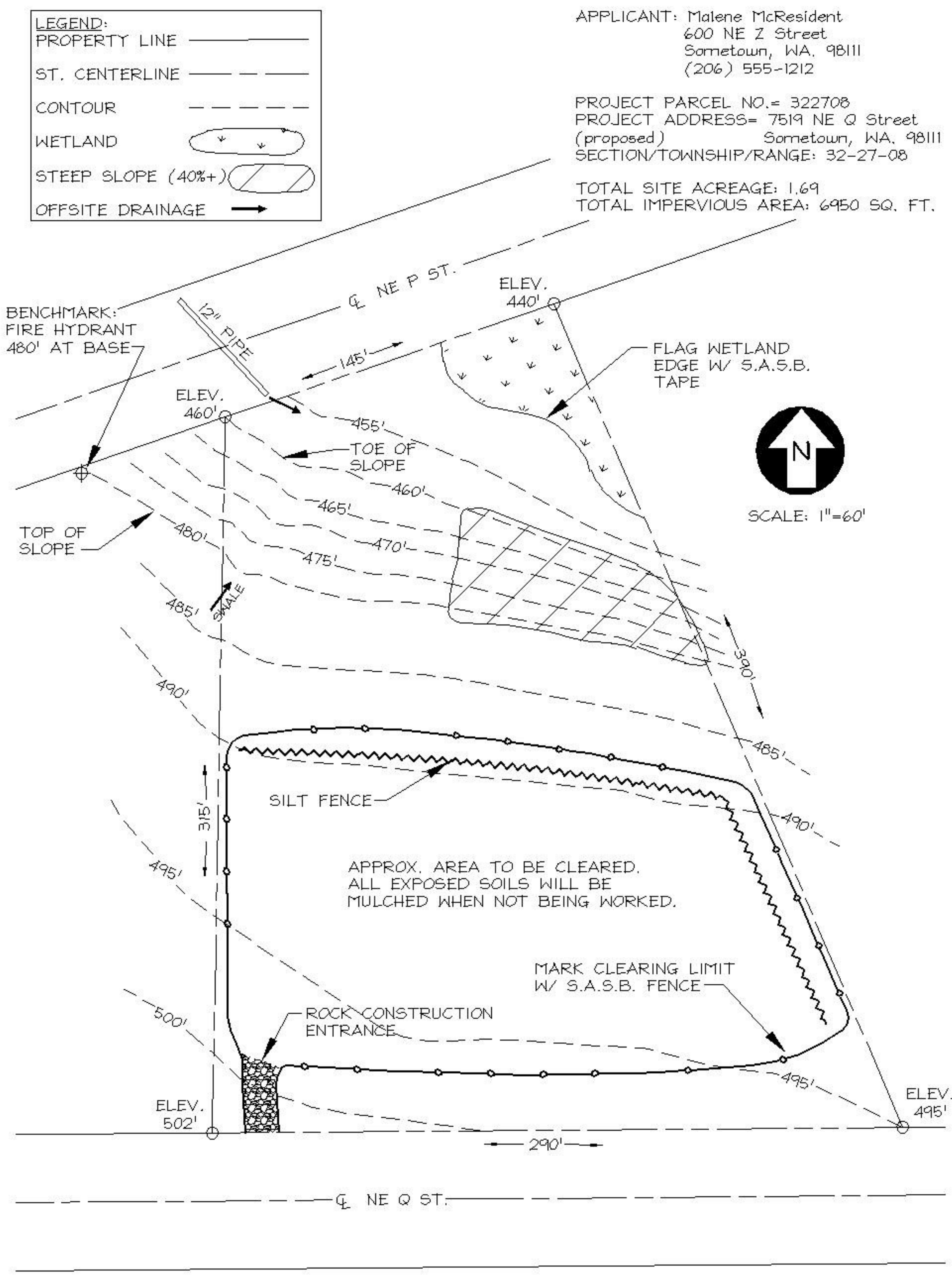


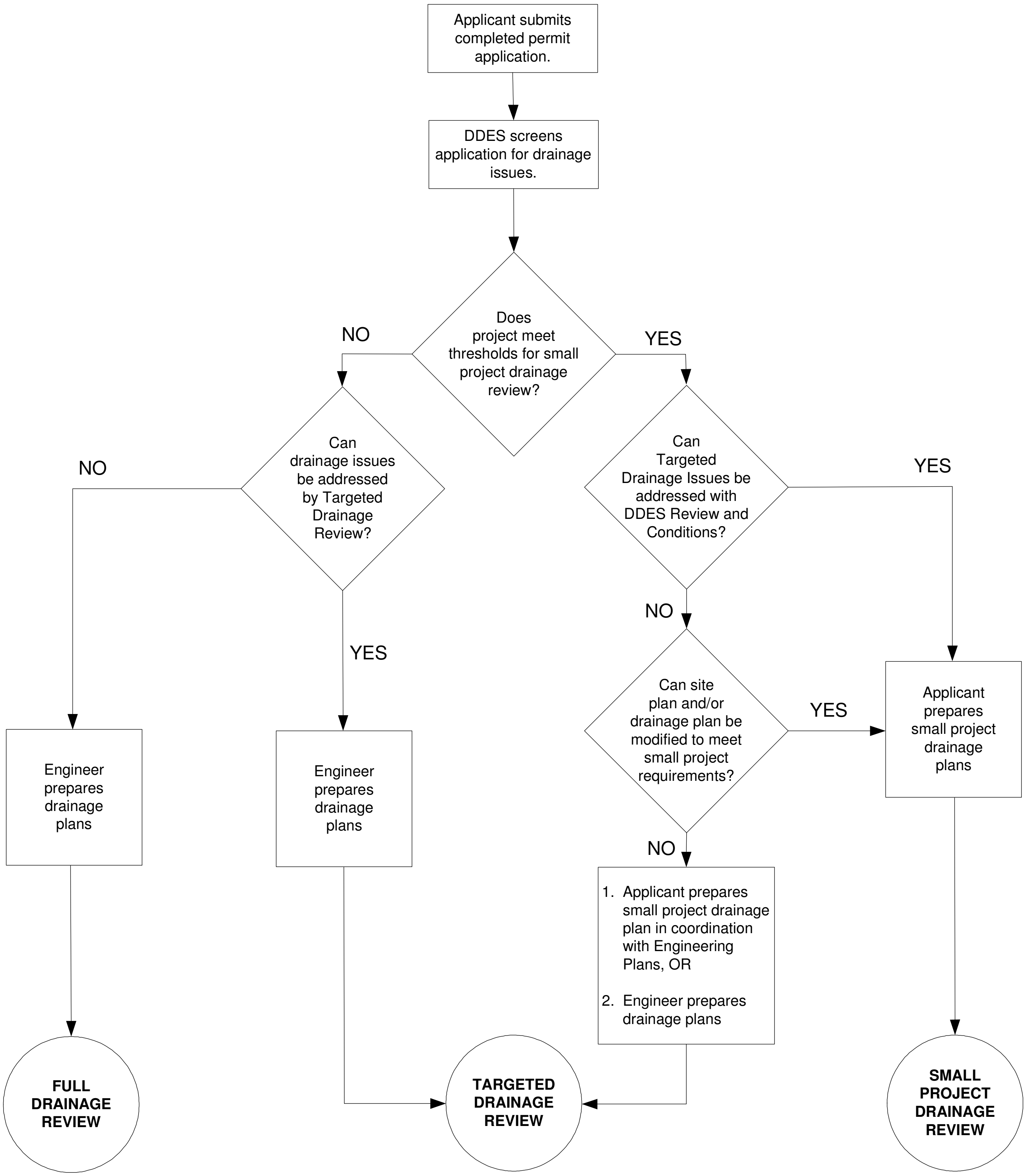
Maintain and clean

[18] If engineering plans are required, the information requested in the written drainage assessment should be incorporated in the technical information report.



LEGEND:
PROPERTY LINE
ST. CENTERLINE
CONTOUR
WETLAND
STEEP SLOPE (40%+)
OFFSITE DRAINAGE
APPLICANT: Malene McResident
600 NE Z Street
Sometown, WA. 98111
(206) 555-1212
PROJECT PARCEL NO.= 322708
PROJECT ADDRESS= 7519 NE Q Street
(proposed) Sometown, WA. 98111
SECTION/TOWNSHIP/RANGE: 32-27-08
TOTAL SITE ACREAGE: 1.69
TOTAL IMPERVIOUS AREA: 6950 SQ. FT.
℄ NE P ST.
BENCHMARK:
FIRE HYDRANT
480' AT BASE
12" PIPE
ELEV. 440'
ELEV. 460'
145'
WETLAND BUFFER
TOE OF SLOPE
WETLAND EDGE
N
SCALE: 1"60'
SOILS REPORT FOR
ON-SITE SEWAGE
SYSTEM ATTACHED.
TOP OF SLOPE
455'
460'
465'
470'
475'
480'
485'
490'
495'
500'
SWALE
STEEP SLOPE
BUFFER + 15'
B.S.B.L.
50' VEG. FLOW PATH
390'
PARKING
30'x40'
=1200 SQ. FT.
DOWN SPOUT
HOUSE
75'x50'
=3750 SQ. FT.
315'
DOWN SPOUT W/ EXT.
SEPTIC TANK
PUMP CHAMBER
4" PIPE
DISPERSION TRENCH
BERM
BUILDING SETBACK =
30' FROM STREET,
35' FROM INTERIOR
PROPERTY LINES.
RESERVE DRAINFIELD
PRIMARY DRAINFIELD
DRIVEWAY
10'x120'
=1200 SQ. FT.
ELEV. 502'
ELEV. 495'
290'
℄ NE Q ST.


LEGEND:
PROPERTY LINE
ST. CENTERLINE
CONTOUR
WETLAND
STEEP SLOPE (40%+)
OFFSITE DRAINAGE
APPLICANT: Malene McResident
600 NE Z Street
Sometown, WA. 98111
(206) 555-1212
PROJECT PARCEL NO.= 322708
PROJECT ADDRESS= 7519 NE Q Street
(proposed) Sometown, WA. 98111
SECTION/TOWNSHIP/RANGE: 32-27-08
TOTAL SITE ACREAGE: 1.69
TOTAL IMPERVIOUS AREA: 6950 SQ. FT.
℄ NE P ST.
12" PIPE
BENCHMARK:
FIRE HYDRANT
480' AT BASE
ELEV.
440'
ELEV.
460'
145'
FLAG WETLAND
EDGE W/ S.A.S.B.
TAPE
N
SCALE: 1"=60'
455'
TOE OF
SLOPE
460'
465'
470'
475'
480'
TOP OF
SLOPE
485'
SWALE
390'
490'
485'
SILT FENCE
315'
490'
APPROX. AREA TO BE CLEARED.
ALL EXPOSED SOILS WILL BE
MULCHED WHEN NOT BEING WORKED.
495'
MARK CLEARING LIMIT
W/ S.A.S.B. FENCE
500'
ROCK CONSTRUCTION
ENTRANCE
495'
ELEV.
502'
ELEV.
495'
290'
℄ NE Q ST.

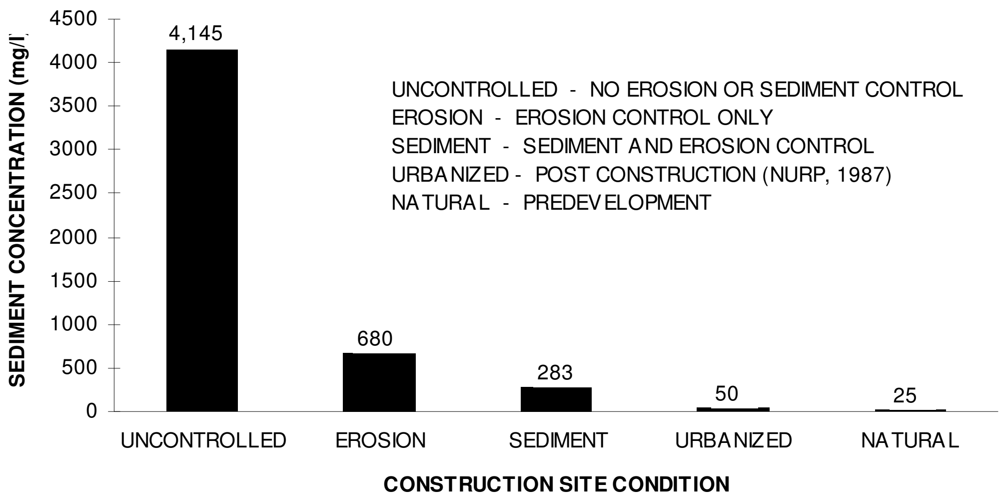

Applicant submits completed permit application.
DDES screens application for drainage issues.
Does project meet thresholds for small project drainage review?
NO
YES
Can drainage issues be addressed by Targeted Drainage Review?
Can Targeted Drainage Issues be addressed with DDES Review and Conditions?
NO
YES
YES
NO
Can site plan and/or drainage plan be modified to meet small project requirements?
YES
NO
Engineer prepares drainage plans
Engineer prepares drainage plans
Applicant prepares small project drainage plans
1. Applicant prepares small project drainage plan in coordination with Engineering Plans, OR
2. Engineer prepares drainage plans
FULL DRAINAGE REVIEW
TARGETED DRAINAGE REVIEW
SMALL PROJECT DRAINAGE REVIEW

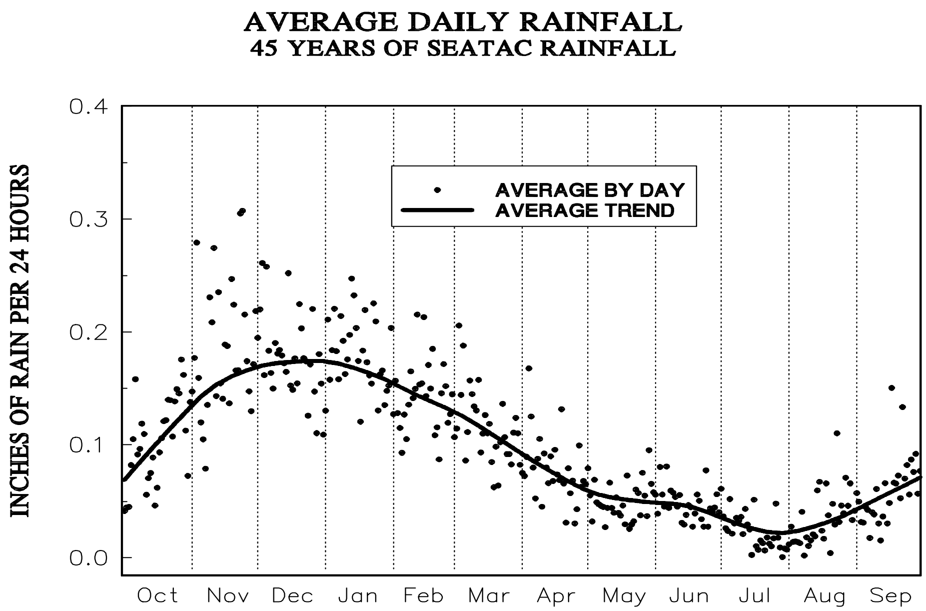
D-1

[1] *Maximum extent practicable* means the use of best management practices that are available and capable of being designed, constructed and implemented in a reliable and effective manner including, but not limited to, consideration of site conditions and cost.

[2] *Land disturbing activity* means any activity that results in a change in the existing soil cover (both vegetative and non-vegetative and/or the existing soil topography. Land disturbing activities include, but are not limited to demolition, construction, clearing, grading, filling, excavation, and compaction. Land disturbing activity does not include tilling conducted as part of agricultural practices, landscape maintenance, or gardening.

[33] *Project site* means that portion of a site and any offsite areas subject to proposed project activities, alterations, and improvements. *Site* means a single parcel, or two or more contiguous parcels that are under common ownership or documented legal control, used as a single parcel for purposes of applying for authority from King County to carry out a development/project proposal. For projects located primarily within dedicated rights-of-way, site includes the entire width of right-of-way within the total length of right-of-way subject to improvements proposed by the project.


4500
4000
3500
3000
2500
2000
1500
1000
500
0
SEDIMENT CONCENTRATION (mg/l)
4,145
680
283
50
25
UNCONTROLLED - NO EROSION OR SEDIMENT CONTROL
EROSION - EROSION CONTROL ONLY
SEDIMENT - SEDIMENT AND EROSION CONTROL
URBANIZED - POST CONSTRUCTION (NURP, 1987)
NATURAL - PREDEVELOPMENT
UNCONTROLLED
EROSION
SEDIMENT
URBANIZED
NATURAL
CONSTRUCTION SITE CONDITION

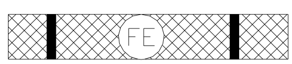


4 *Wet season* means October 1st to April 30th.

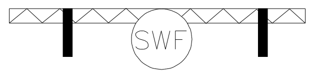
5 *Dry season* means May 1st to September 30th.

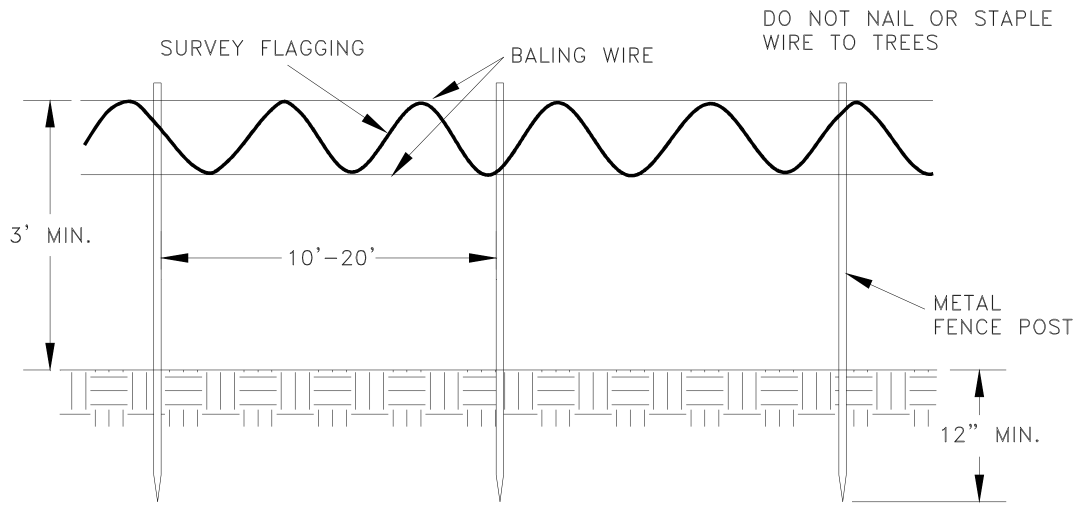
D-7

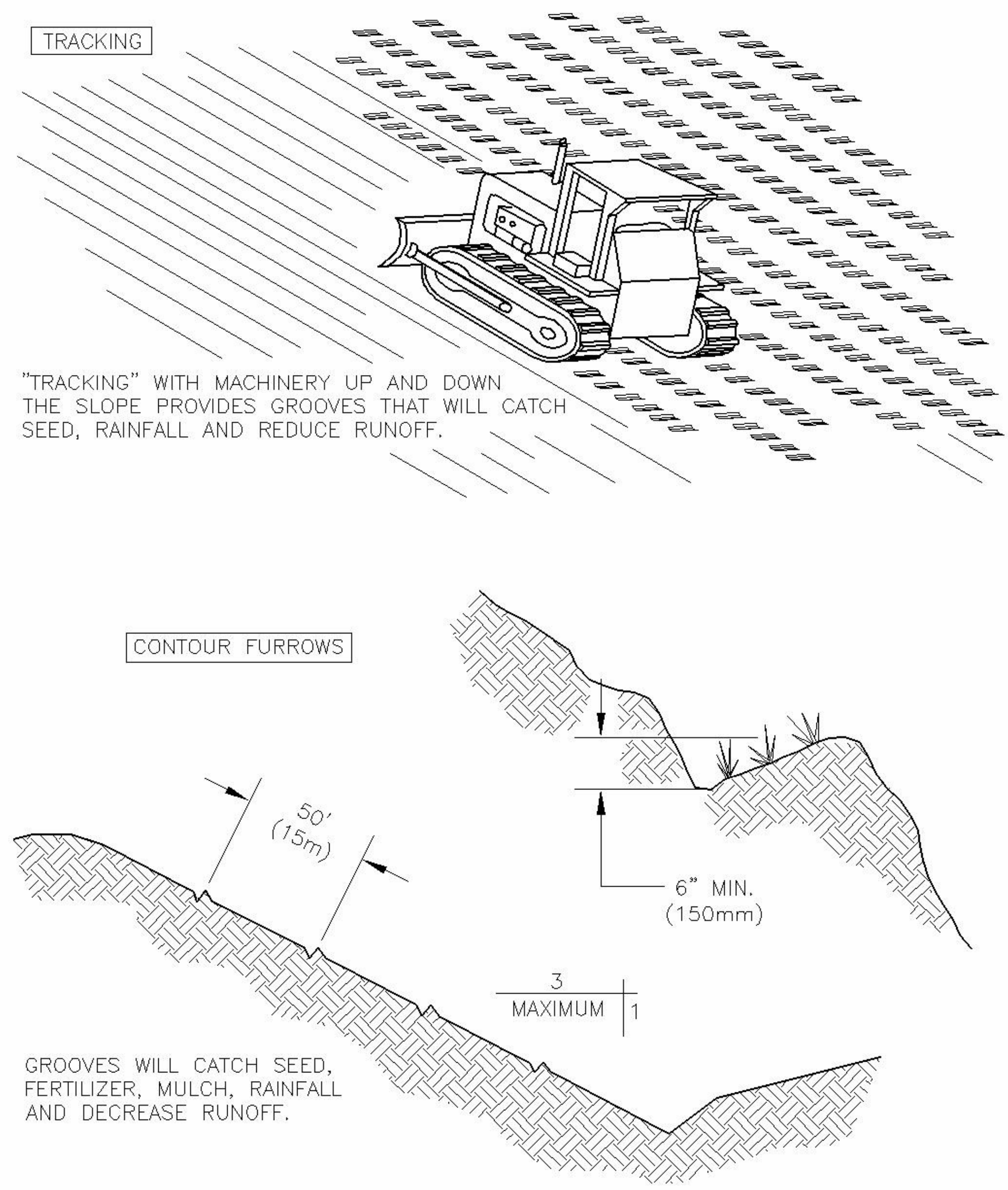
[6] *Best Management Practices (BMPs)* means the best available and reasonable physical, structural, managerial, or behavioral activities, that when singly or in combination, eliminate or reduce the contamination of surface and/or ground waters.


FE

D-9




DO NOT NAIL OR STAPLE WIRE TO TREES
SURVEY FLAGGING
BALING WIRE
3' MIN.
10'–20'
METAL FENCE POST
12" MIN.



SURFACE ROUGHENING BY TRACKING AND CONTOUR FURROWS

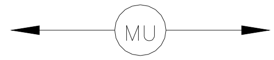
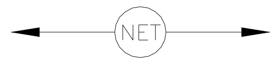
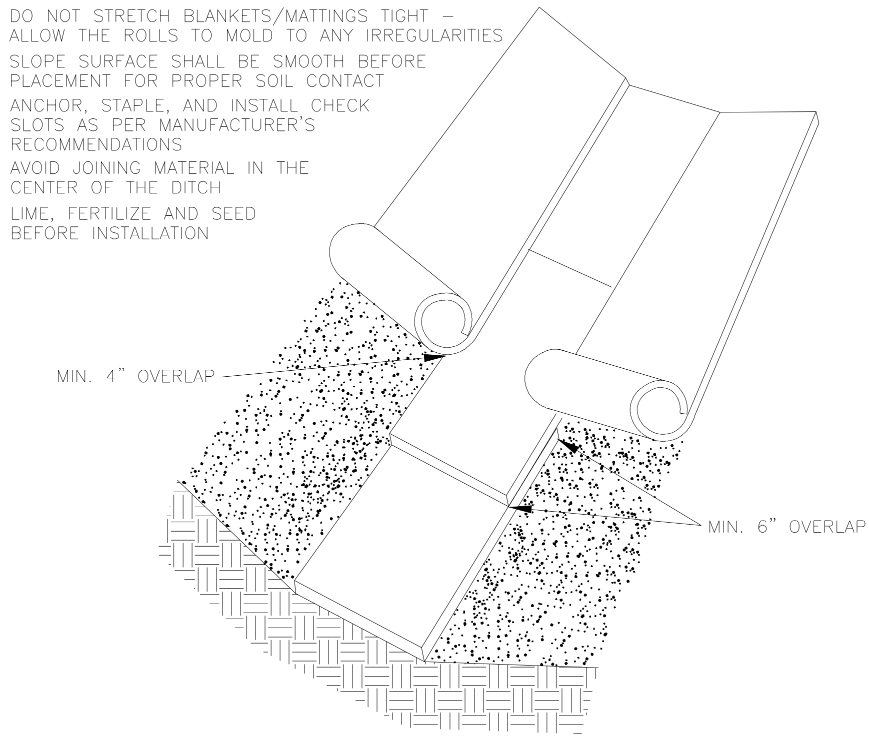
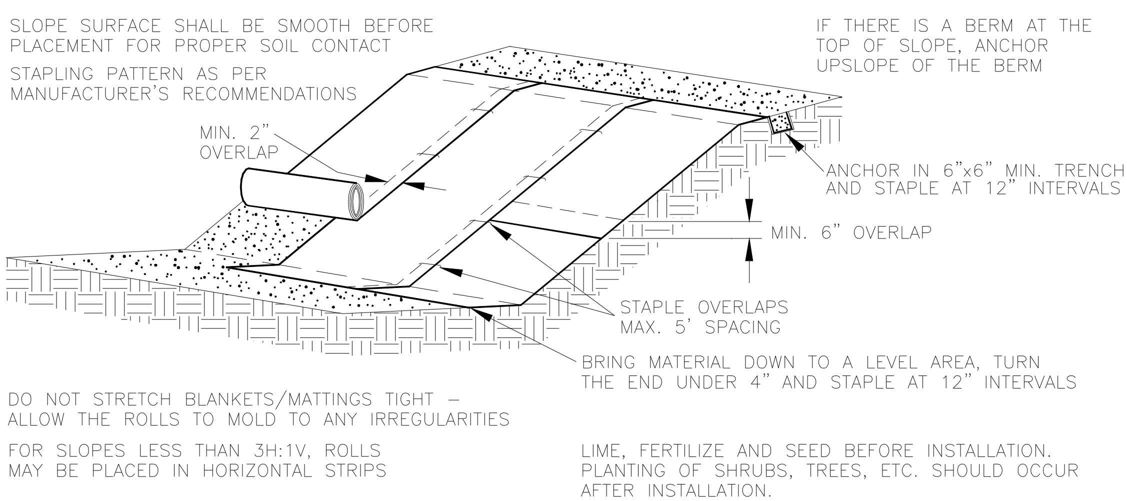

MU

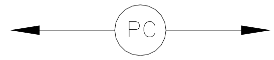
TABLE D.3.2.A MULCH STANDARDS AND GUIDELINES			

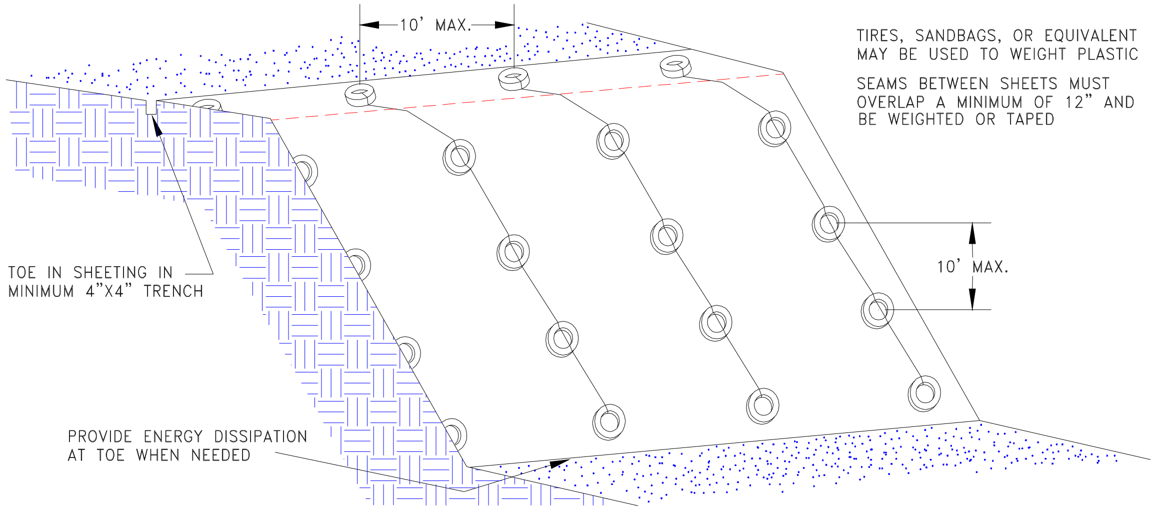
[7] *Sensitive lake* means a lake that has proved to be particularly prone to eutrophication; the County gives this designation when an active input plan has been adopted to limit the amount of phosphorous entering the lake.

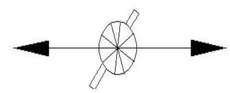

NET

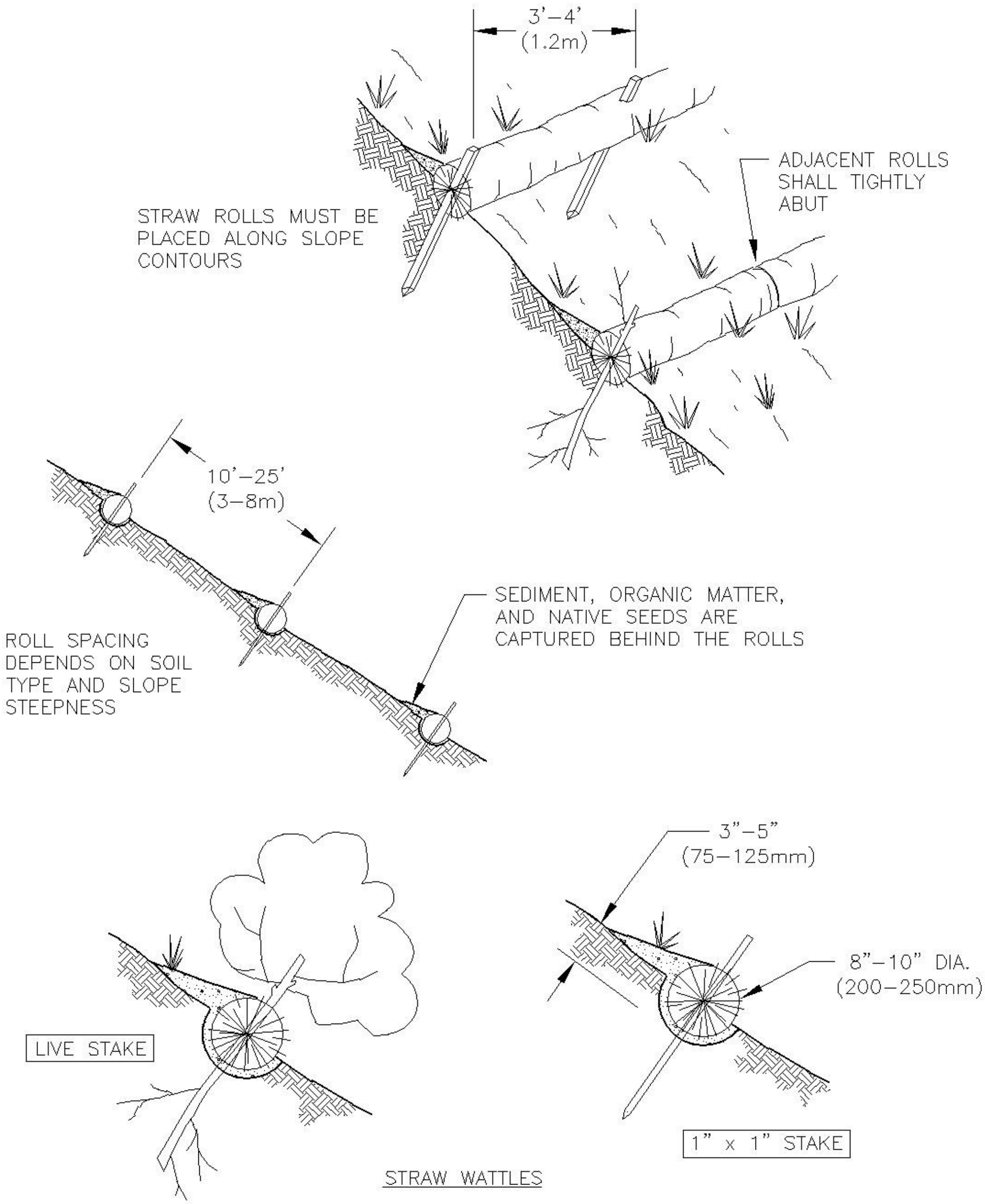

DO NOT STRETCH BLANKETS/MATTINGS TIGHT – ALLOW THE ROLLS TO MOLD TO ANY IRREGULARITIES
SLOPE SURFACE SHALL BE SMOOTH BEFORE PLACEMENT FOR PROPER SOIL CONTACT
ANCHOR, STAPLE, AND INSTALL CHECK SLOTS AS PER MANUFACTURER'S RECOMMENDATIONS
AVOID JOINING MATERIAL IN THE CENTER OF THE DITCH
LIME, FERTILIZE AND SEED BEFORE INSTALLATION
MIN. 4" OVERLAP
MIN. 6" OVERLAP


SLOPE SURFACE SHALL BE SMOOTH BEFORE PLACEMENT FOR PROPER SOIL CONTACT
STAPLING PATTERN AS PER MANUFACTURER'S RECOMMENDATIONS
MIN. 2" OVERLAP
IF THERE IS A BERM AT THE TOP OF SLOPE, ANCHOR UPSLOPE OF THE BERM
ANCHOR IN 6"x6" MIN. TRENCH AND STAPLE AT 12" INTERVALS
MIN. 6" OVERLAP
STAPLE OVERLAPS MAX. 5' SPACING
BRING MATERIAL DOWN TO A LEVEL AREA, TURN THE END UNDER 4" AND STAPLE AT 12" INTERVALS
DO NOT STRETCH BLANKETS/MATTINGS TIGHT – ALLOW THE ROLLS TO MOLD TO ANY IRREGULARITIES
FOR SLOPES LESS THAN 3H:1V, ROLLS MAY BE PLACED IN HORIZONTAL STRIPS
LIME, FERTILIZE AND SEED BEFORE INSTALLATION. PLANTING OF SHRUBS, TREES, ETC. SHOULD OCCUR AFTER INSTALLATION.


PC


10' MAX.
TIRES, SANDBAGS, OR EQUIVALENT MAY BE USED TO WEIGHT PLASTIC
SEAMS BETWEEN SHEETS MUST OVERLAP A MINIMUM OF 12" AND BE WEIGHTED OR TAPED
10' MAX.
TOE IN SHEETING IN MINIMUM 4"X4" TRENCH
PROVIDE ENERGY DISSIPATION AT TOE WHEN NEEDED





STRAW WATTLES

NOTES:

1. STRAW ROLL INSTALLATION REQUIRES THE PLACEMENT AND SECURE STAKING OF THE ROLL IN A TRENCH, 3" x 5" (75–125mm) DEEP, DUG ON CONTOUR. RUNOFF MUST NOT BE ALLOWED TO RUN UNDER OR AROUND ROLL.

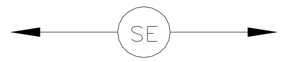

SE

TABLE D.3.2.BTEMPORARY EROSION CONTROL SEED MIX			

TABLE D.3.2.C LANDSCAPING SEED MIX			

TABLE D.3.2.D LOW-GROWING TURF SEED MIX			

TABLE D.3.2.E BIOSWALE SEED MIX*			

TABLE D.3.2.F WET AREA SEED MIX*			

TABLE D.3.2.G MEADOW SEED MIX			

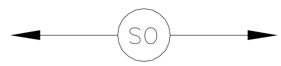
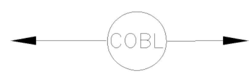
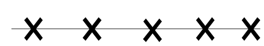
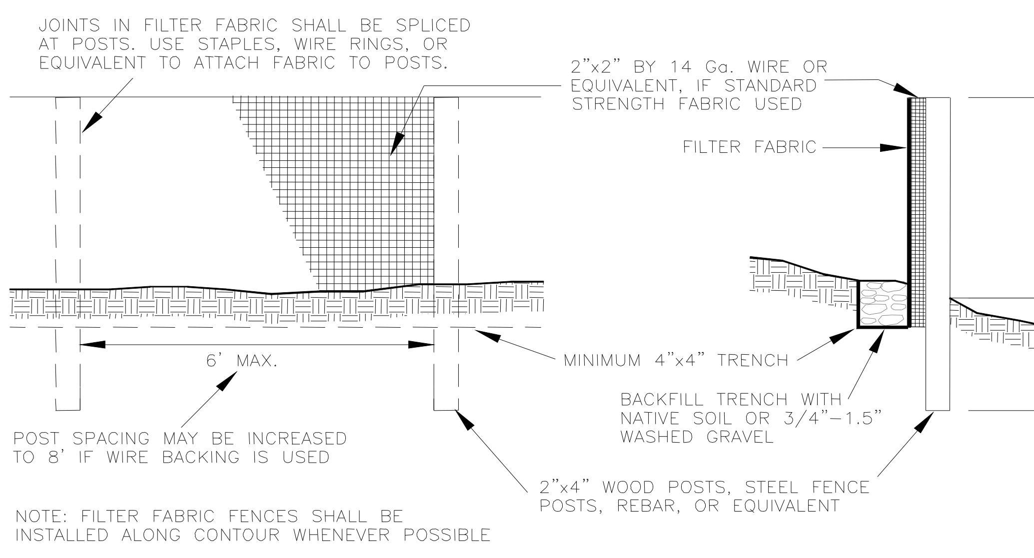
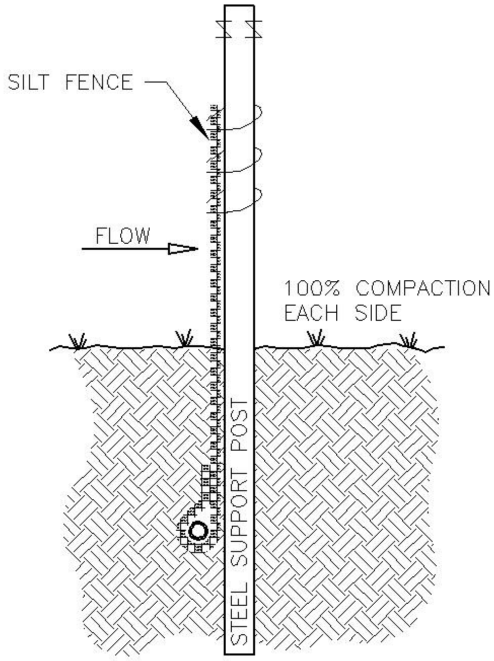

SO

TABLE D.3.2.H PAM AND WATER APPLICATION RATES


COBL

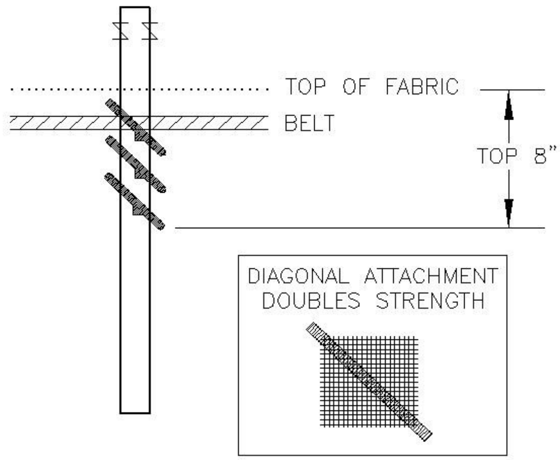



JOINTS IN FILTER FABRIC SHALL BE SPLICED AT POSTS. USE STAPLES, WIRE RINGS, OR EQUIVALENT TO ATTACH FABRIC TO POSTS.
2"x2" BY 14 Ga. WIRE OR EQUIVALENT, IF STANDARD STRENGTH FABRIC USED
FILTER FABRIC
2' MIN.
12" MIN.
6' MAX.
MINIMUM 4"x4" TRENCH
BACKFILL TRENCH WITH NATIVE SOIL OR 3/4"–1.5" WASHED GRAVEL
POST SPACING MAY BE INCREASED TO 8' IF WIRE BACKING IS USED
2"x4" WOOD POSTS, STEEL FENCE POSTS, REBAR, OR EQUIVALENT
NOTE: FILTER FABRIC FENCES SHALL BE INSTALLED ALONG CONTOUR WHENEVER POSSIBLE



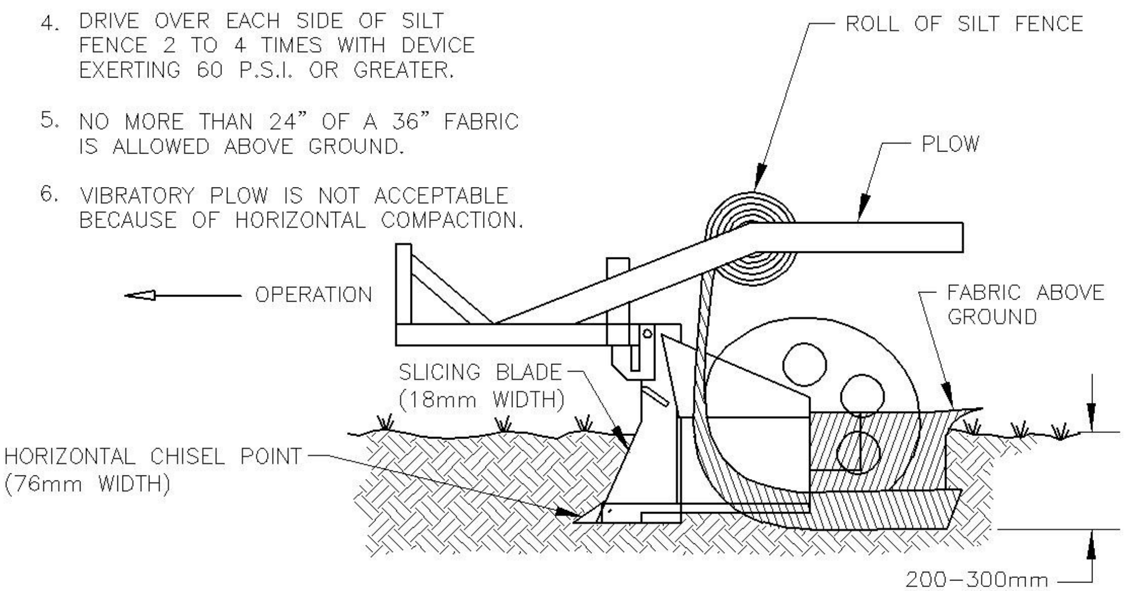
NOTES:

1. POST SPACING: 7' MAX. ON OPEN RUNS 4' MAX. ON POOLING AREAS.
2. POST DEPTH: AS MUCH BELOW GROUND AS FABRIC ABOVE GROUND.
3. PONDING HEIGHT MAX. 24" ATTACH FABRIC TO UPSTREAM SIDE OF POST.
4. DRIVE OVER EACH SIDE OF SILT FENCE 2 TO 4 TIMES WITH DEVICE EXERTING 60 P.S.I. OR GREATER.
5. NO MORE THAN 24" OF A 36" FABRIC IS ALLOWED ABOVE GROUND.
6. VIBRATORY PLOW IS NOT ACCEPTABLE BECAUSE OF HORIZONTAL COMPACTION.

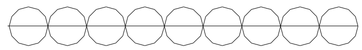


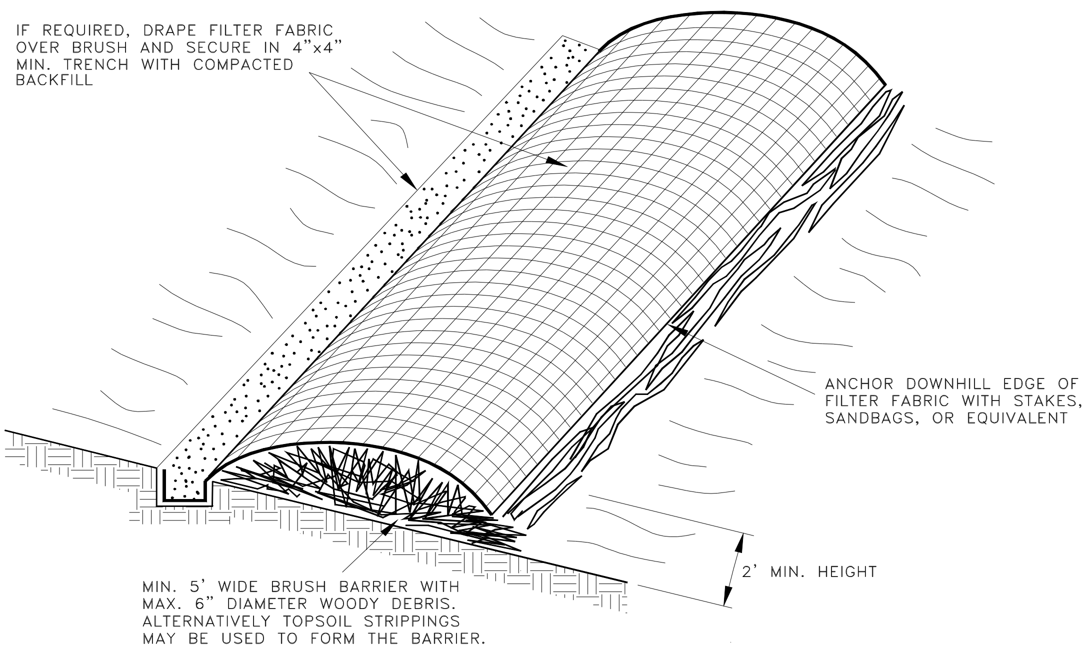
ATTACHMENT DETAILS:

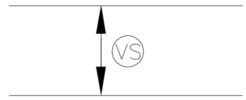
1. GATHER FABRIC AT POSTS, IF NEEDED.
2. UTILIZE THREE TIES PER POST, ALL WITHIN TOP 8" OF FABRIC.
3. POSITION EACH TIE DIAGONALLY, PUNCTURING HOLES VERTICALLY A MINIMUM OF 1" APART.
4. HANG EACH TIE ON A POST NIPPLE AND TIGHTEN SECURELY. USE CABLE TIES (50 LBS) OF SOFT WIRE.

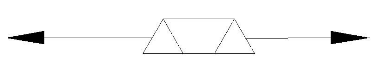


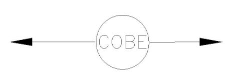
SILT FENCE INSTALLATION BY SLICING METHOD

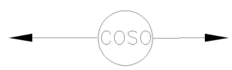


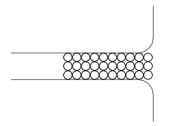

IF REQUIRED, DRAPE FILTER FABRIC OVER BRUSH AND SECURE IN 4"x4" MIN. TRENCH WITH COMPACTED BACKFILL
ANCHOR DOWNHILL EDGE OF FILTER FABRIC WITH STAKES, SANDBAGS, OR EQUIVALENT
2' MIN. HEIGHT
MIN. 5' WIDE BRUSH BARRIER WITH MAX. 6" DIAMETER WOODY DEBRIS. ALTERNATIVELY TOPSOIL STRIPPINGS MAY BE USED TO FORM THE BARRIER.

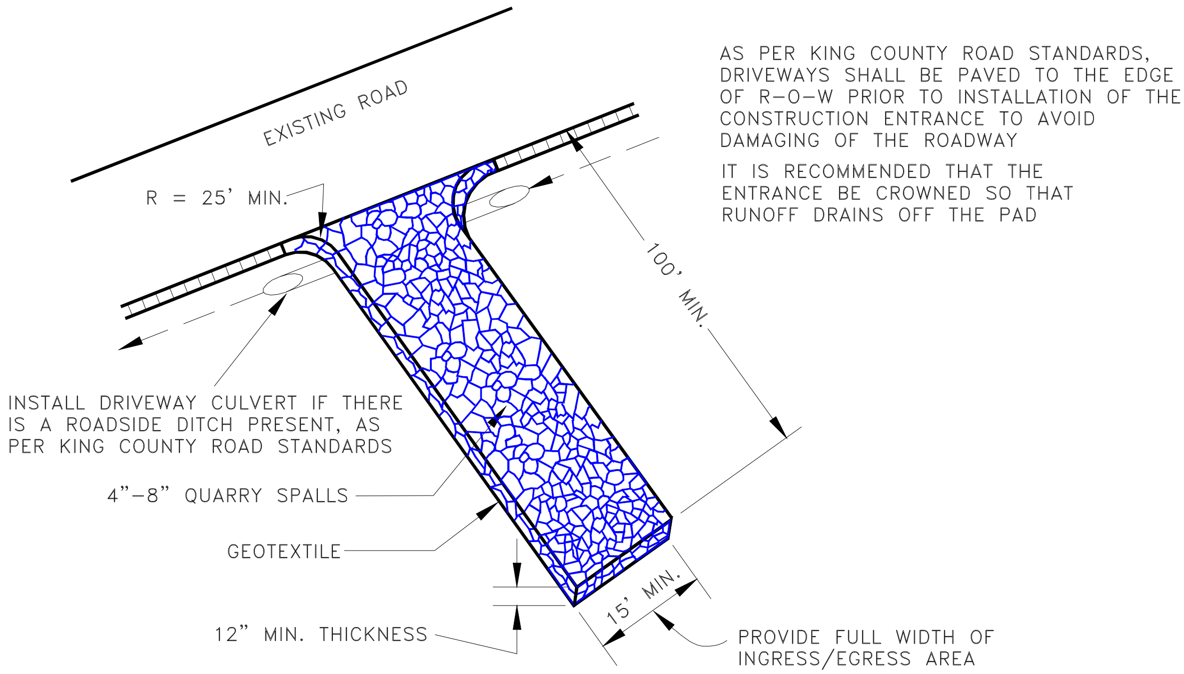

VS

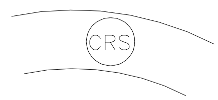


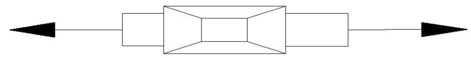

COBE

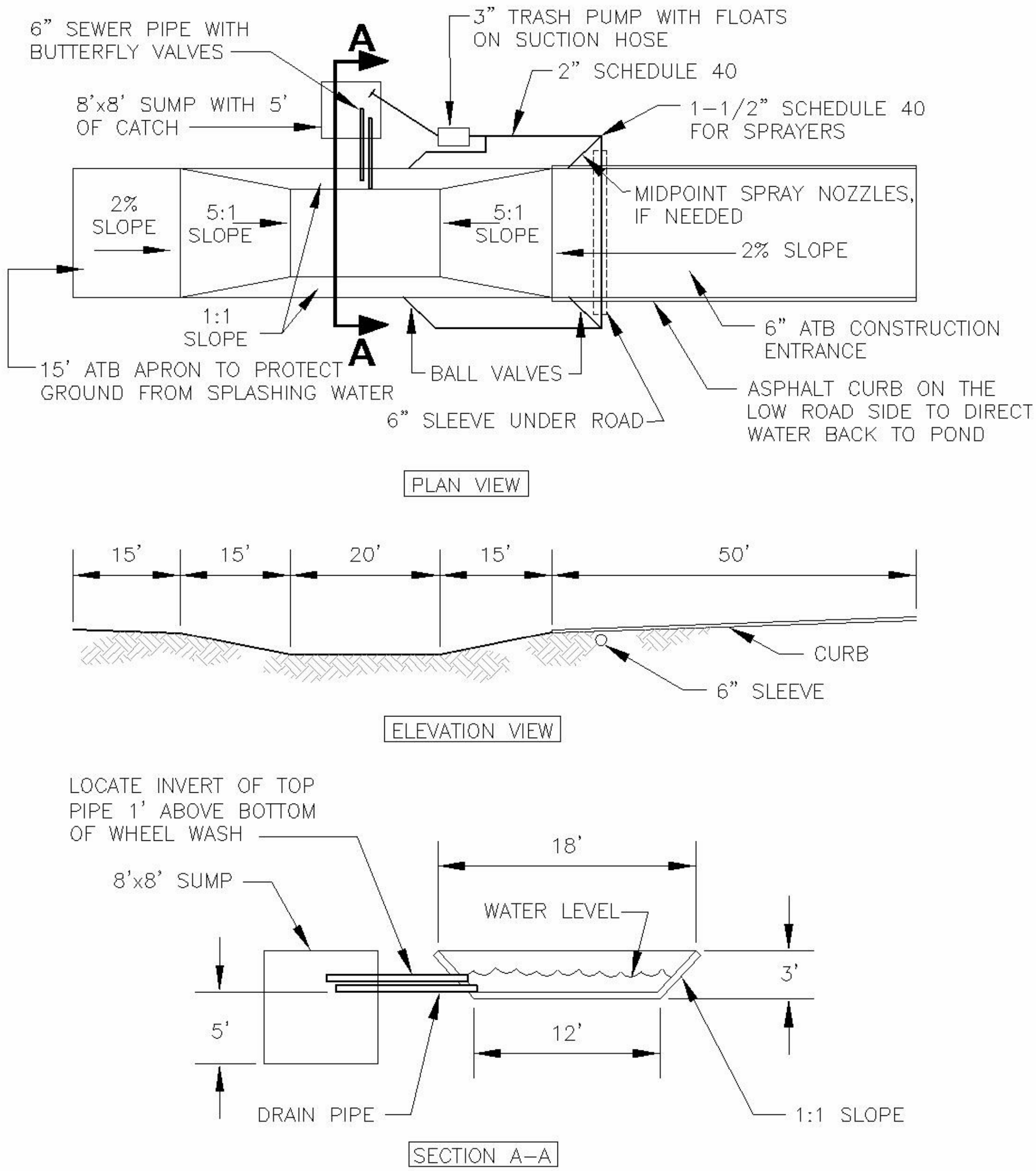

COSO




EXISTING ROAD
R = 25' MIN.
AS PER KING COUNTY ROAD STANDARDS, DRIVEWAYS SHALL BE PAVED TO THE EDGE OF R-O-W PRIOR TO INSTALLATION OF THE CONSTRUCTION ENTRANCE TO AVOID DAMAGING OF THE ROADWAY
IT IS RECOMMENDED THAT THE ENTRANCE BE CROWNED SO THAT RUNOFF DRAINS OFF THE PAD
100' MIN.
INSTALL DRIVEWAY CULVERT IF THERE IS A ROADSIDE DITCH PRESENT, AS PER KING COUNTY ROAD STANDARDS
4"-8" QUARRY SPALLS
GEOTEXTILE
12" MIN. THICKNESS
15' MIN.
PROVIDE FULL WIDTH OF INGRESS/EGRESS AREA


CRS

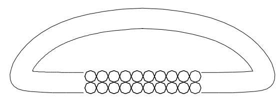


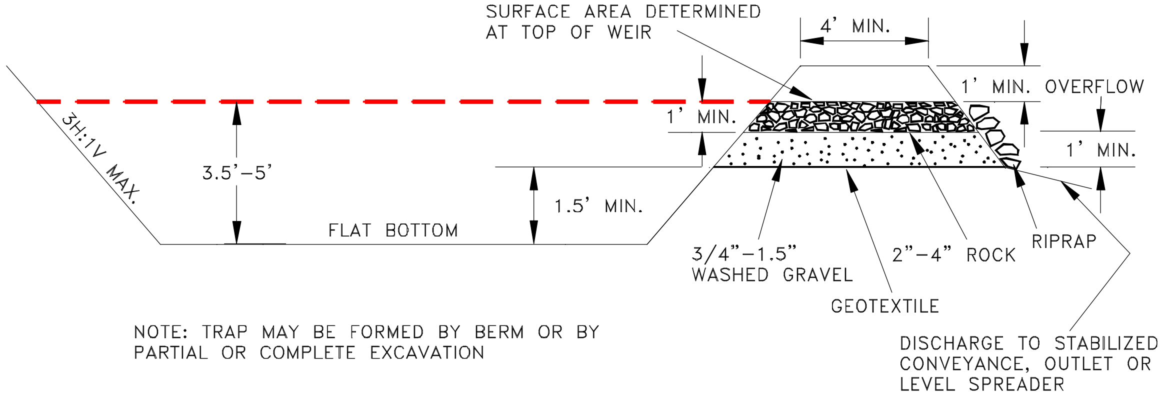


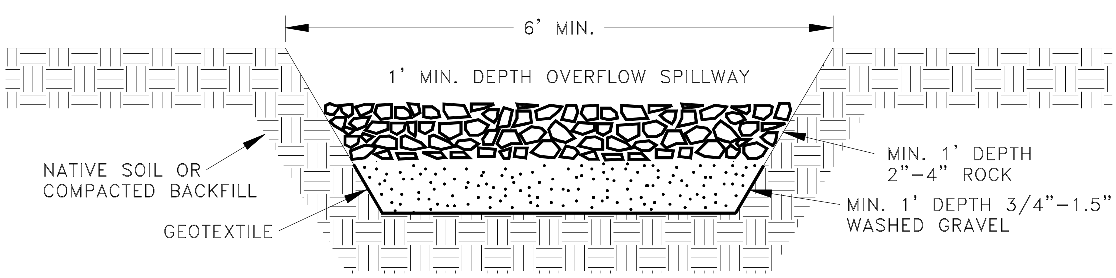
NOTES:

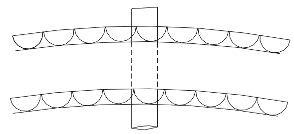
1. BUILD 8'x8' SUMP TO ACCOMODATE CLEANING BY TRACKHOE.

WHEEL WASH



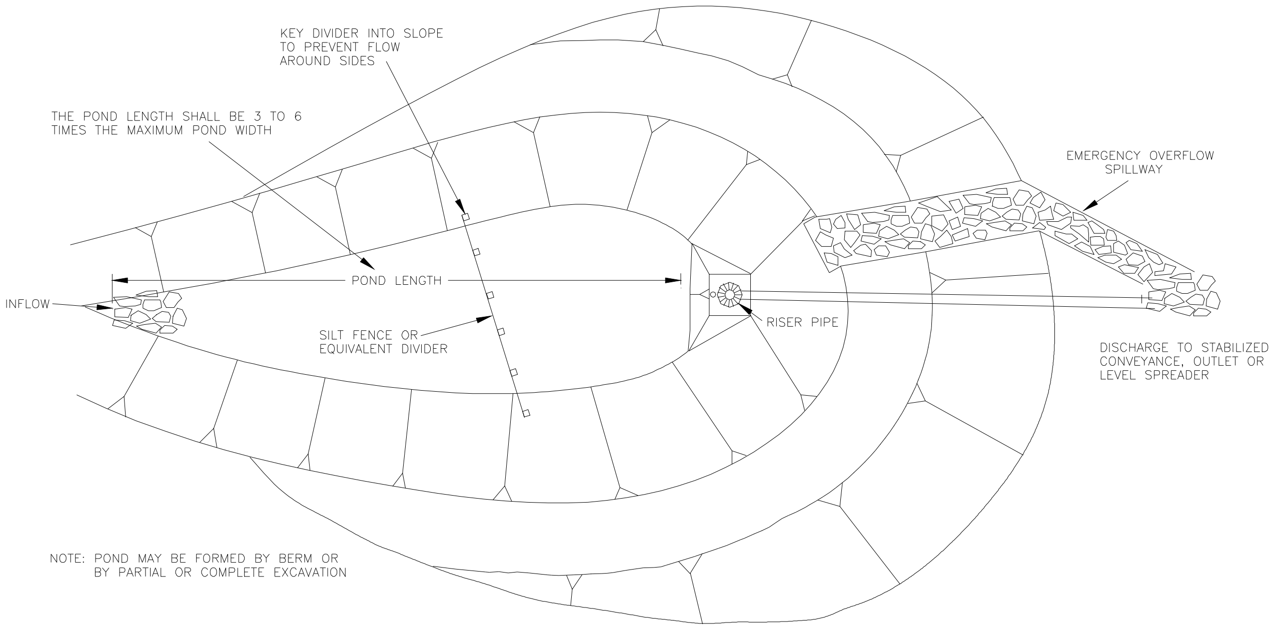

SURFACE AREA DETERMINED
AT TOP OF WEIR
4' MIN.
1' MIN. OVERFLOW
1' MIN.
1' MIN.
3H:1V MAX.
3.5'–5'
1.5' MIN.
FLAT BOTTOM
3/4"–1.5"
WASHED GRAVEL
2"–4" ROCK
RIPRAP
GEOTEXTILE
NOTE: TRAP MAY BE FORMED BY BERM OR BY
PARTIAL OR COMPLETE EXCAVATION
DISCHARGE TO STABILIZED
CONVEYANCE, OUTLET OR
LEVEL SPREADER

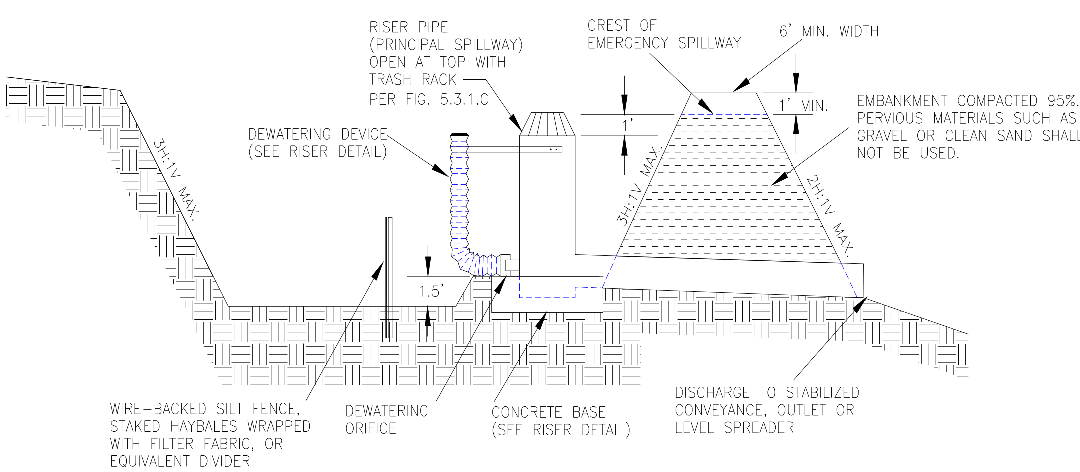

6' MIN.
1' MIN. DEPTH OVERFLOW SPILLWAY
MIN. 1' DEPTH
2"–4" ROCK
NATIVE SOIL OR
COMPACTED BACKFILL
MIN. 1' DEPTH 3/4"–1.5"
WASHED GRAVEL
GEOTEXTILE

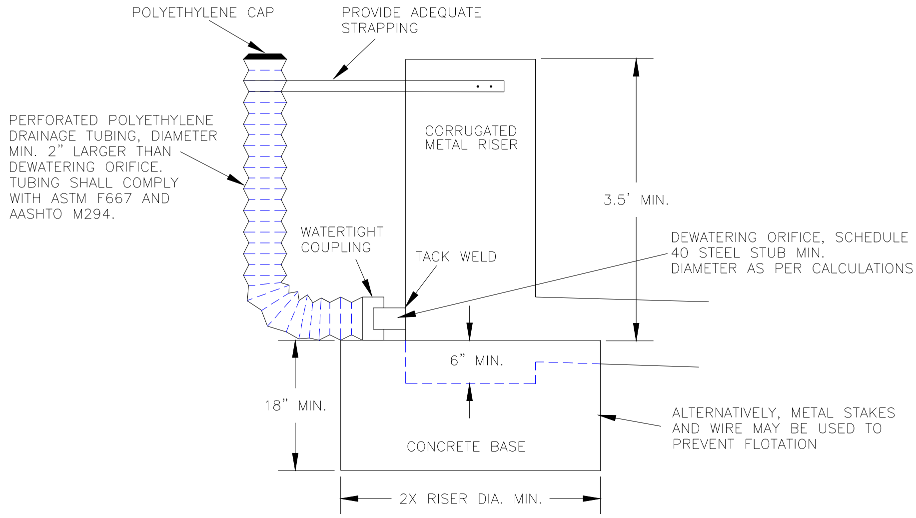


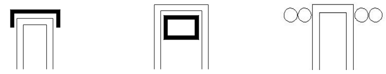
$$A_o = \frac{A_s (2h)^{0.5}}{0.6 \text{x} 3600 T g^{0.5}} = 4.81(10^{-6}) A_s \sqrt{h}$$

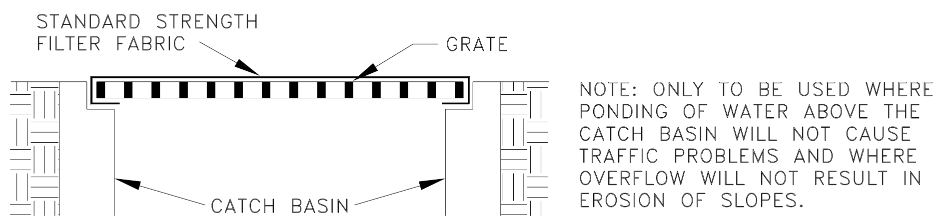
$$D = 24 \text{x} \sqrt{\frac{A_o}{\pi}} = 13.54 \text{x} \sqrt{A_o}$$

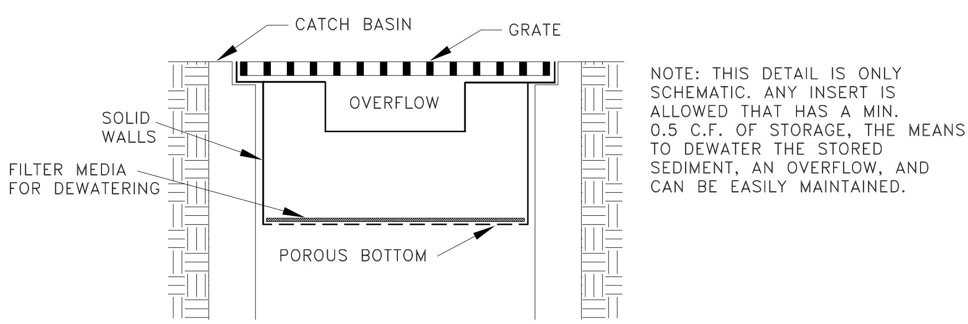

KEY DIVIDER INTO SLOPE
TO PREVENT FLOW
AROUND SIDES
THE POND LENGTH SHALL BE 3 TO 6
TIMES THE MAXIMUM POND WIDTH
EMERGENCY OVERFLOW
SPILLWAY
POND LENGTH
INFLOW
RISER PIPE
SILT FENCE OR
EQUIVALENT DIVIDER
DISCHARGE TO STABILIZED
CONVEYANCE, OUTLET OR
LEVEL SPREADER
NOTE: POND MAY BE FORMED BY BERM OR
BY PARTIAL OR COMPLETE EXCAVATION

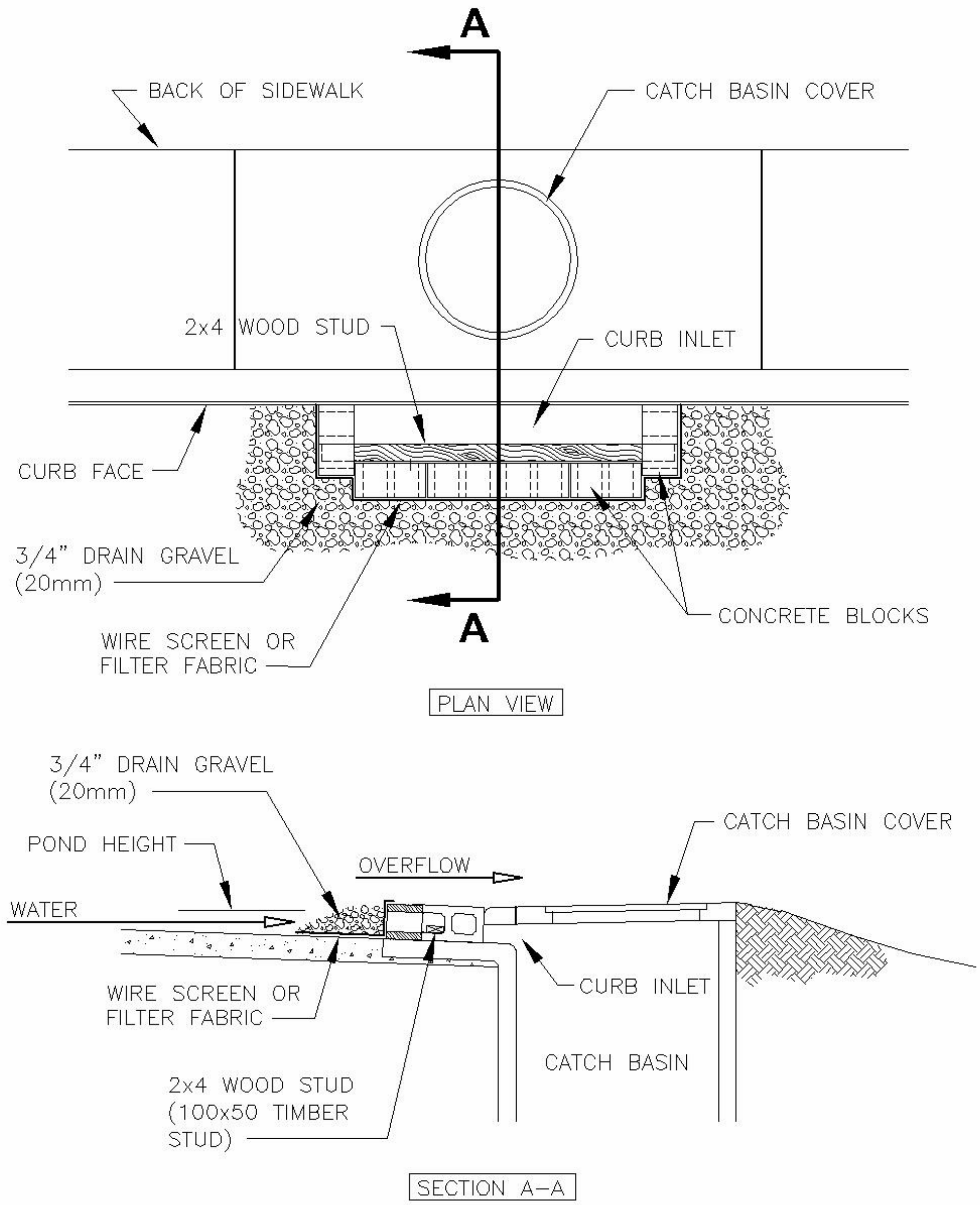

RISER PIPE
(PRINCIPAL SPILLWAY)
OPEN AT TOP WITH
TRASH RACK
PER FIG. 5.3.1.C
CREST OF
EMERGENCY SPILLWAY
6' MIN. WIDTH
1' MIN.
EMBANKMENT COMPACTED 95%.
PERVIOUS MATERIALS SUCH AS
GRAVEL OR CLEAN SAND SHALL
NOT BE USED.
DEWATERING DEVICE
(SEE RISER DETAIL)
1'
3H:1V MAX.
3H:1V MAX.
2H:1V MAX.
1.5'
WIRE-BACKED SILT FENCE,
STAKED HAYBALES WRAPPED
WITH FILTER FABRIC, OR
EQUIVALENT DIVIDER
DEWATERING
ORIFICE
CONCRETE BASE
(SEE RISER DETAIL)
DISCHARGE TO STABILIZED
CONVEYANCE, OUTLET OR
LEVEL SPREADER


POLYETHYLENE CAP
PROVIDE ADEQUATE STRAPPING
PERFORATED POLYETHYLENE DRAINAGE TUBING, DIAMETER MIN. 2" LARGER THAN DEWATERING ORIFICE. TUBING SHALL COMPLY WITH ASTM F667 AND AASHTO M294.
CORRUGATED METAL RISER
3.5' MIN.
WATERTIGHT COUPLING
TACK WELD
DEWATERING ORIFICE, SCHEDULE 40 STEEL STUB MIN. DIAMETER AS PER CALCULATIONS
6" MIN.
18" MIN.
ALTERNATIVELY, METAL STAKES AND WIRE MAY BE USED TO PREVENT FLOTATION
CONCRETE BASE
2X RISER DIA. MIN.




STANDARD STRENGTH
FILTER FABRIC
GRATE
CATCH BASIN
NOTE: ONLY TO BE USED WHERE PONDING OF WATER ABOVE THE CATCH BASIN WILL NOT CAUSE TRAFFIC PROBLEMS AND WHERE OVERFLOW WILL NOT RESULT IN EROSION OF SLOPES.

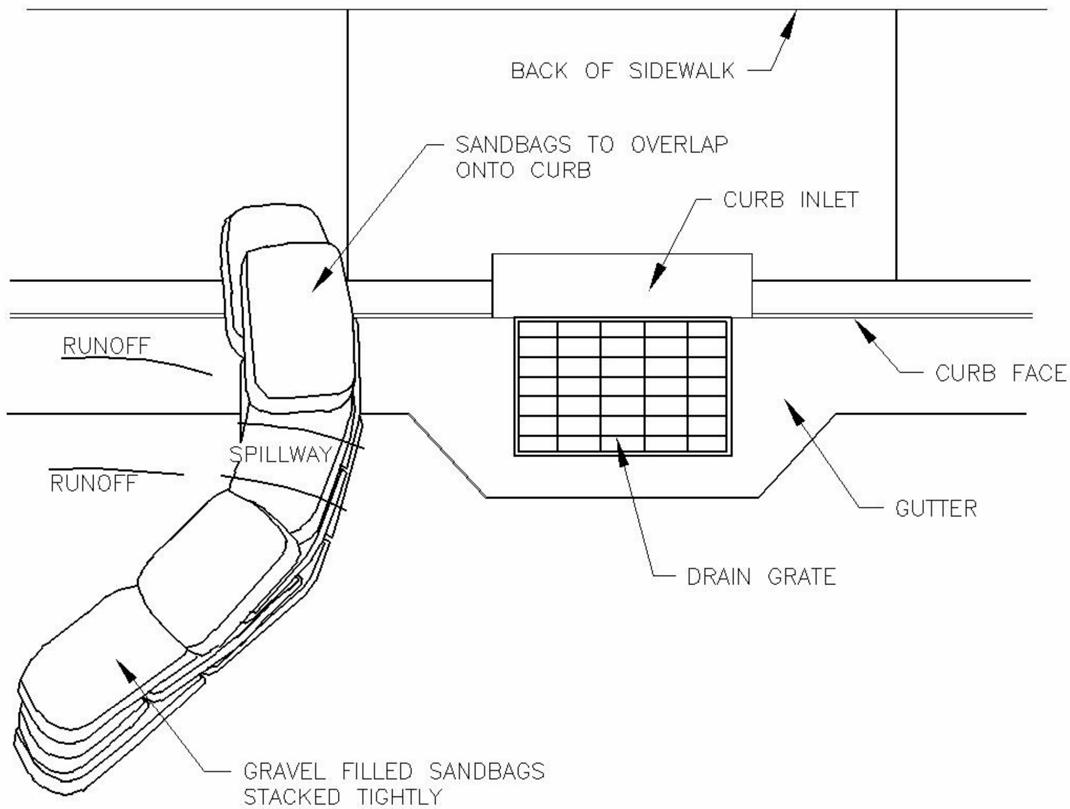

CATCH BASIN
GRATE
OVERFLOW
SOLID
WALLS
FILTER MEDIA
FOR DEWATERING
POROUS BOTTOM
NOTE: THIS DETAIL IS ONLY SCHEMATIC. ANY INSERT IS ALLOWED THAT HAS A MIN. 0.5 C.F. OF STORAGE, THE MEANS TO DEWATER THE STORED SEDIMENT, AN OVERFLOW, AND CAN BE EASILY MAINTAINED.



NOTES:

1. USE BLOCK AND GRAVEL TYPE SEDIMENT BARRIER WHEN CURB INLET IS LOCATED IN GENTLY SLOPING SEGMENT, WHERE WATER CAN POND AND ALLOW SEDIMENT TO SEPARATE FROM RUNOFF.
2. BARRIER SHALL ALLOW FOR OVERFLOW FROM SEVERE STORM EVENT.
3. INSPECT BARRIERS AND REMOVE SEDIMENT AFTER EACH STORM EVENT. SEDIMENT AND GRAVEL MUST BE REMOVED FROM THE TRAVELED WAY IMMEDIATELY.

BLOCK AND GRAVEL CURB INLET PROTECTION

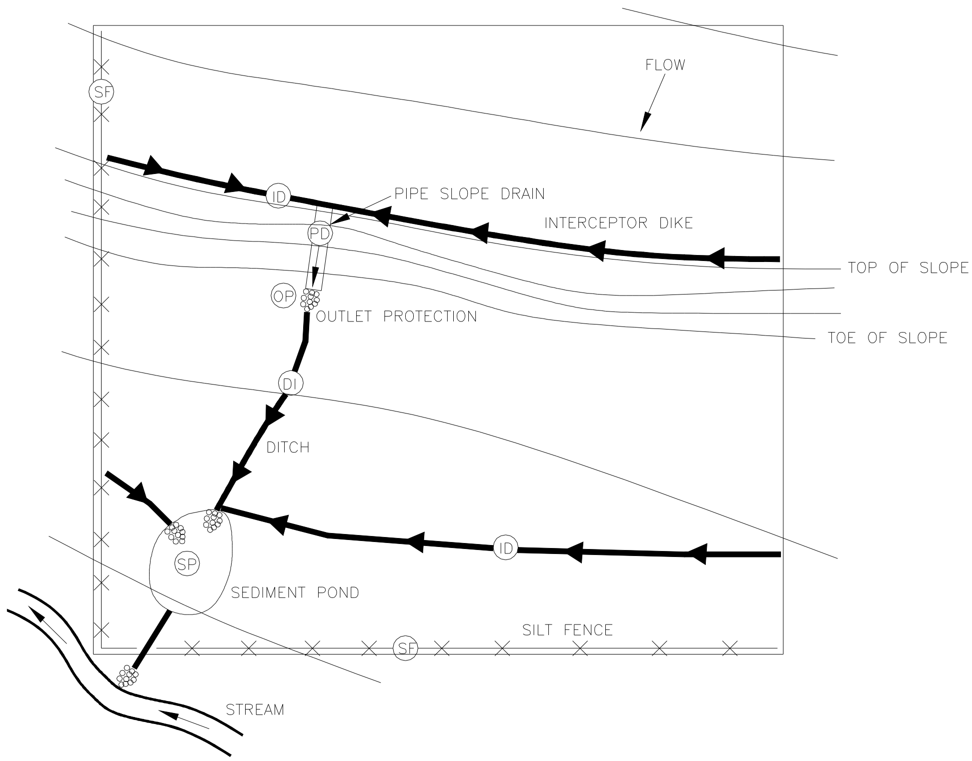


PLAN VIEW

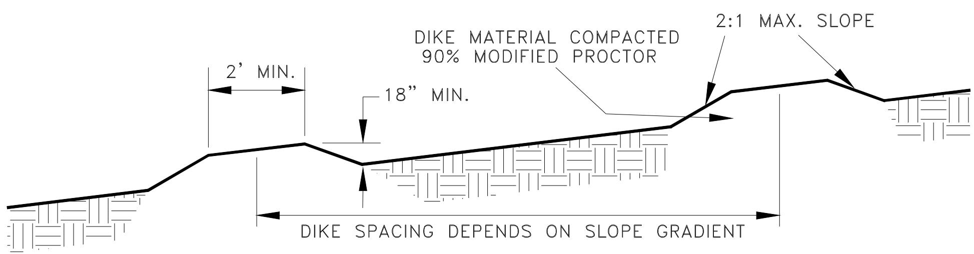
NOTES:

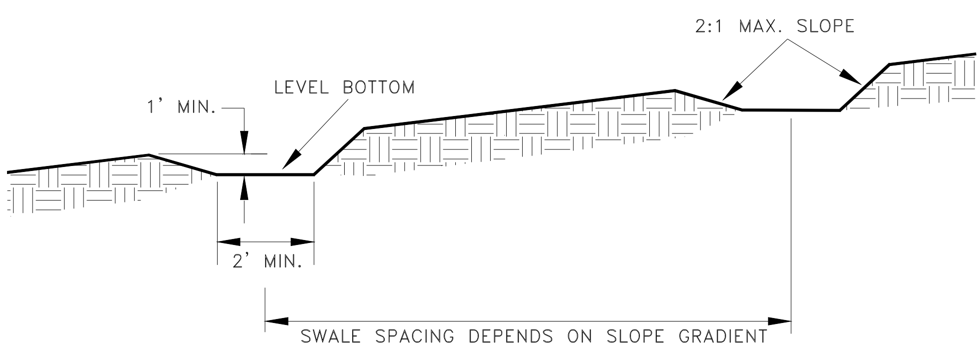
1. PLACE CURB TYPE SEDIMENT BARRIERS ON GENTLY SLOPING STREET SEGMENTS, WHERE WATER CAN POND AND ALLOW SEDIMNENT TO SEPARATE FROM RUNOFF.
2. SANDBAGS OF EITHER BURLAP OR WOVEN GEOTEXTILE FABRIC, ARE FILLED WITH GRAVEL, LAYERED AND PACKED TIGHTLY.
3. LEAVE A ONE SANDBAG GAP IN THE TOP ROW TO PROVIDE A SPILLWAY FOR OVERFLOW.
4. INSPECT BARRIERS AND REMOVE SEDIMENT AFTER EACH STORM EVENT. SEDIMENT AND GRAVEL MUST BE REMOVED FROM THE TRAVELED WAY IMMEDIATELY.

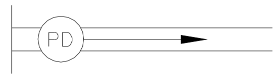
CURB AND GUTTER BARRIER

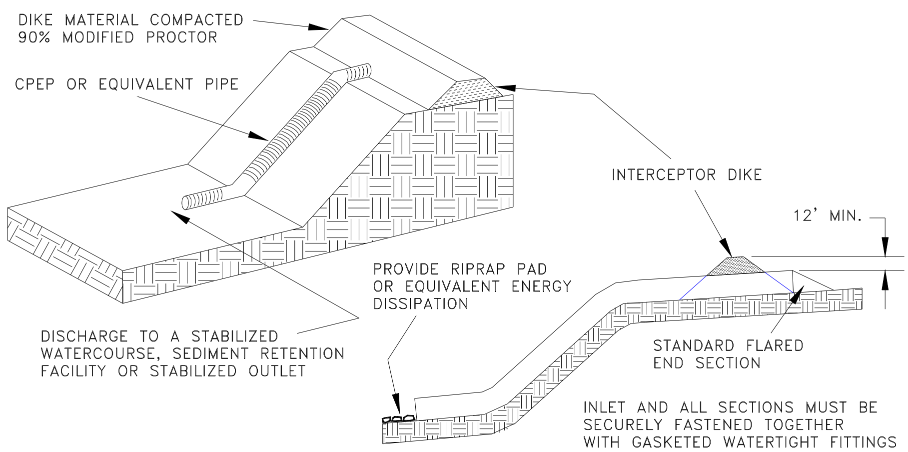

FLOW
PIPE SLOPE DRAIN
INTERCEPTOR DIKE
TOP OF SLOPE
TOE OF SLOPE
OUTLET PROTECTION
DITCH
SEDIMENT POND
SILT FENCE
STREAM
SF
ID
PD
OP
DI
SP

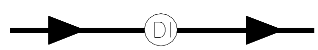

ID
IS

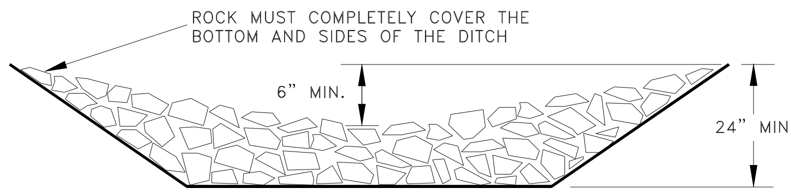

DIKE MATERIAL COMPACTED
90% MODIFIED PROCTOR
2:1 MAX. SLOPE
2' MIN.
18" MIN.
DIKE SPACING DEPENDS ON SLOPE GRADIENT

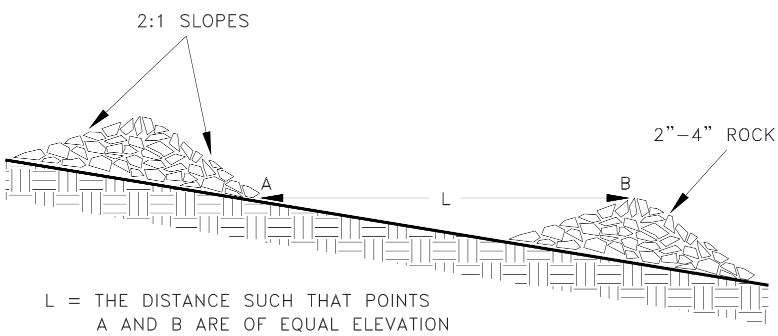

2:1 MAX. SLOPE
LEVEL BOTTOM
1' MIN.
2' MIN.
SWALE SPACING DEPENDS ON SLOPE GRADIENT

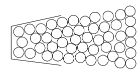

PD

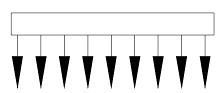

DIKE MATERIAL COMPACTED
90% MODIFIED PROCTOR
CPEP OR EQUIVALENT PIPE
INTERCEPTOR DIKE
12' MIN.
PROVIDE RIPRAP PAD
OR EQUIVALENT ENERGY
DISSIPATION
DISCHARGE TO A STABILIZED
WATERCOURSE, SEDIMENT RETENTION
FACILITY OR STABILIZED OUTLET
STANDARD FLARED
END SECTION
INLET AND ALL SECTIONS MUST BE
SECURELY FASTENED TOGETHER
WITH GASKETED WATERTIGHT FITTINGS

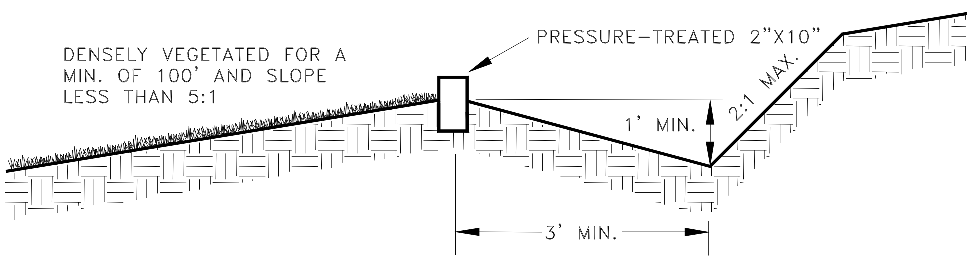

DI


ROCK MUST COMPLETELY COVER THE
BOTTOM AND SIDES OF THE DITCH
6" MIN.
24" MIN.


2:1 SLOPES
2"–4" ROCK
A
B
L
L = THE DISTANCE SUCH THAT POINTS
A AND B ARE OF EQUAL ELEVATION






DENSELY VEGETATED FOR A
MIN. OF 100' AND SLOPE
LESS THAN 5:1
PRESSURE-TREATED 2"X10"
1' MIN.
2:1 MAX.
3' MIN.

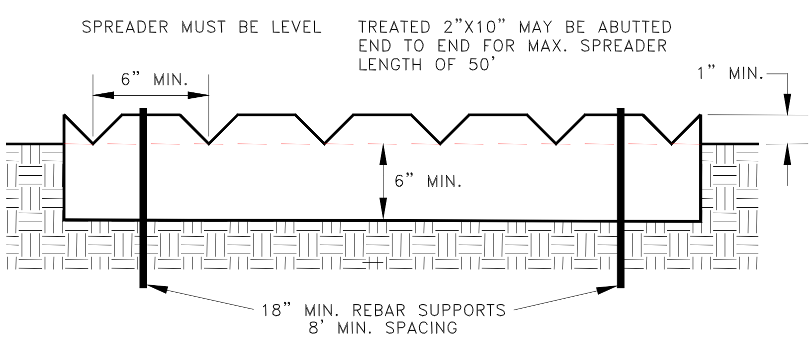
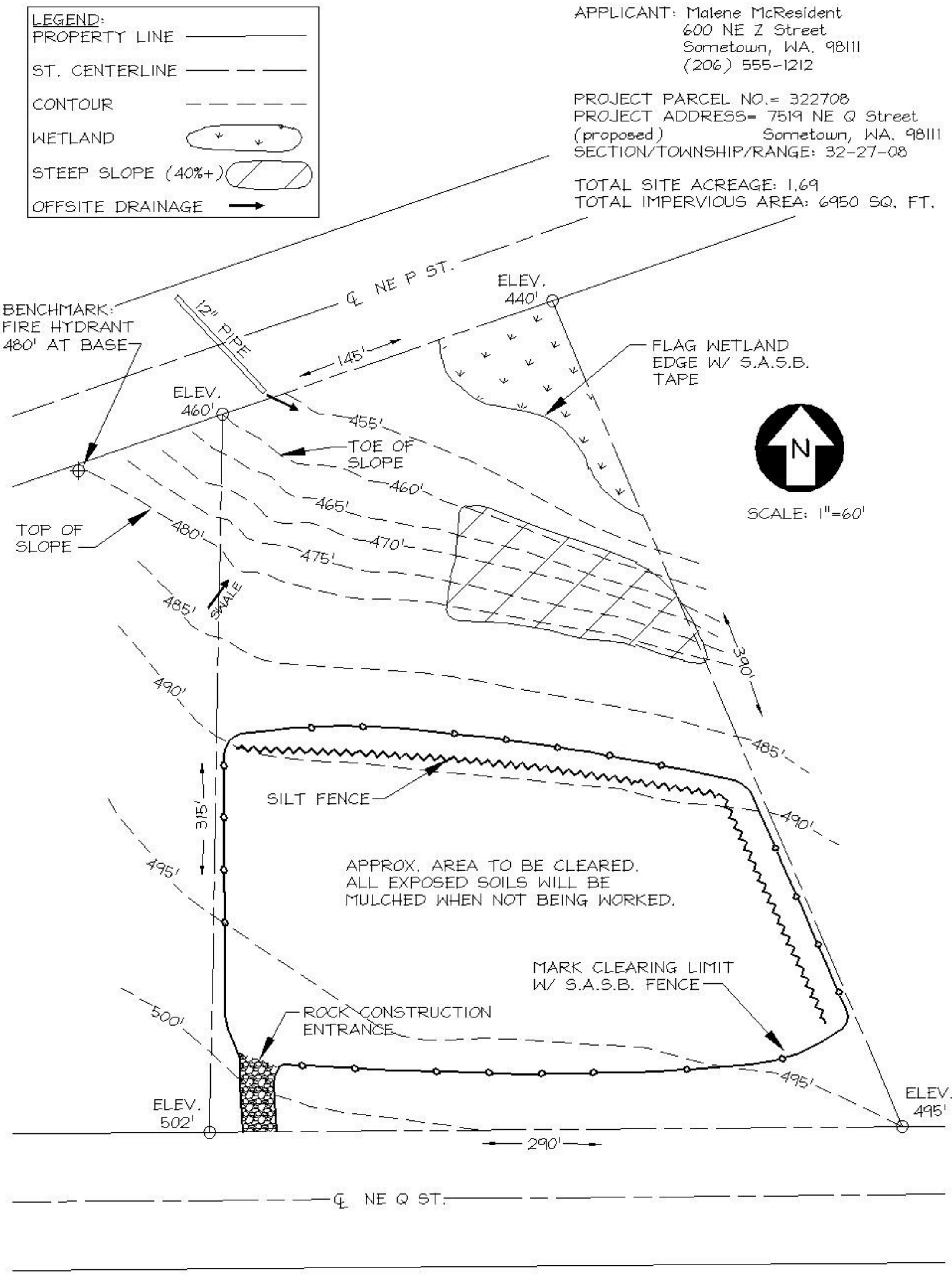

SPREADER MUST BE LEVEL
TREATED 2"X10" MAY BE ABUTTED
END TO END FOR MAX. SPREADER
LENGTH OF 50'
6" MIN.
1" MIN.
6" MIN.
18" MIN. REBAR SUPPORTS
8' MIN. SPACING

TABLE D.3.8.A DUST CONTROL MEASURES*

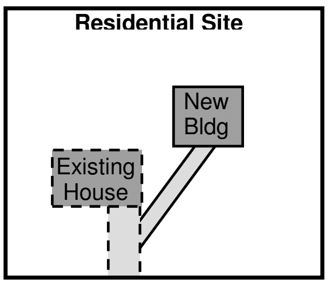
[8] *Relevant critical areas*, for the purposes of drainage review, include aquatic areas, wetlands, flood hazard areas, erosion hazard areas, landslide hazard areas, steep slope hazard areas, and critical aquifer recharge areas.

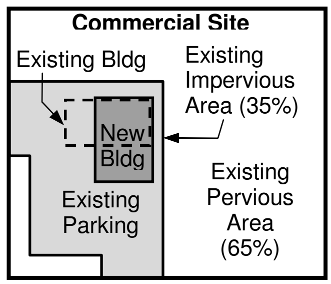

LEGEND:
PROPERTY LINE
ST. CENTERLINE
CONTOUR
WETLAND
STEEP SLOPE (40%+)
OFFSITE DRAINAGE
APPLICANT: Malene McResident
600 NE Z Street
Sometown, WA. 98111
(206) 555-1212
PROJECT PARCEL NO.= 322708
PROJECT ADDRESS= 7519 NE Q Street
(proposed) Sometown, WA. 98111
SECTION/TOWNSHIP/RANGE: 32-27-08
TOTAL SITE ACREAGE: 1.69
TOTAL IMPERVIOUS AREA: 6950 SQ. FT.
℄ NE P ST.
12" PIPE
BENCHMARK:
FIRE HYDRANT
480' AT BASE
ELEV. 440'
ELEV. 460'
145'
FLAG WETLAND
EDGE W/ S.A.S.B.
TAPE
N
SCALE: 1"=60'
455'
TOE OF
SLOPE
460'
465'
470'
475'
480'
TOP OF
SLOPE
485'
SWALE
390'
490'
485'
SILT FENCE
315'
490'
495'
APPROX. AREA TO BE CLEARED.
ALL EXPOSED SOILS WILL BE
MULCHED WHEN NOT BEING WORKED.
MARK CLEARING LIMIT
W/ S.A.S.B. FENCE
500'
ROCK CONSTRUCTION
ENTRANCE
495'
ELEV. 502'
ELEV. 495'
290'
℄ NE Q ST.

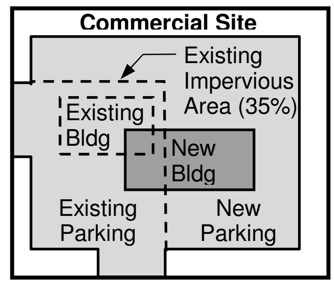
[1] *Subject to vehicular use* means the surface, whether paved or not, is regularly used by motor vehicles. The following surfaces are considered regularly used by motor vehicles: roads, unvegetated road shoulders, bike lanes within or not separated from the traveled lane of a roadway, driveways, parking lots, unfenced firelanes, diesel equipment storage yards, and airport runways. The following surfaces are not considered regularly used by motor vehicles: road shoulders primarily used for emergency parking, paved bicycle pathways, bicycle lanes adjacent to unpaved or paved road shoulders primarily used for emergency parking, fenced firelanes, and infrequently used maintenance access roads.

[2] *Erodible or leachable materials, wastes, or chemicals* are those substances that, when exposed to rainfall, measurably alter the physical or chemical characteristics of the rainfall runoff (examples include erodible soil, uncovered process wastes, manure, fertilizers, oily substances, ashes, kiln dust, garbage dumpster leakage, etc.).

[3] A covered parking area would be considered pollution-generating if runoff from uphill could regularly run through it, or if rainfall could regularly blow in and wet the pavement surface. The same parking area would not be included if it were enclosed by walls or if a low wall and berm prevented stormwater from being blown in or from running onto the covered area.


Residential Site
New
Bldg
Existing
House


Commercial Site
Existing Bldg
Existing
Impervious
Area (35%)
New
Bldg
Existing
Parking
Existing
Pervious
Area
(65%)

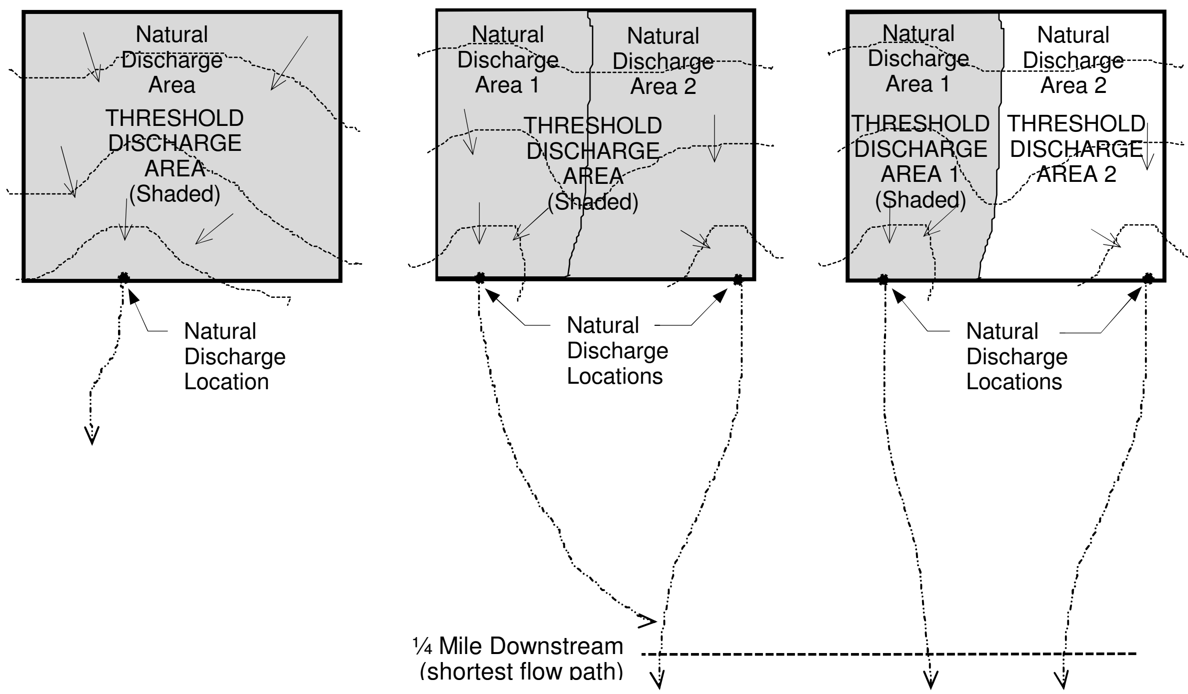

Commercial Site
Existing
Impervious
Area (35%)
Existing
Bldg
New
Bldg
Existing
Parking
New
Parking

[4] *Finished floor area*, for the purposes of defining ***severe building flooding problem***, means any enclosed area of a building that is designed to be served by the building's permanent heating or cooling system.

[5] *Habitable building* means any residential, commercial, or industrial building that is equipped with a permanent heating or cooling system and an electrical system.

[6] *Roadway*, for the purposes of this definition, means the traveled portion of any public or private road or street classified as such in the *King County Road Standards*.

[7] *Sole access driveway* means there is no other unobstructed, flood-free route for emergency access to a habitable building.


Natural
Discharge
Area
THRESHOLD
DISCHARGE
AREA
(Shaded)
Natural
Discharge
Location
Natural
Discharge
Area 1
Natural
Discharge
Area 2
THRESHOLD
DISCHARGE
AREA
(Shaded)
Natural
Discharge
Locations
Natural
Discharge
Area 1
Natural
Discharge
Area 2
THRESHOLD
DISCHARGE
AREA 1
(Shaded)
THRESHOLD
DISCHARGE
AREA 2
Natural
Discharge
Locations
¼ Mile Downstream
(shortest flow path)