ISSUE PAPER "F"

Stormwater Credits
V.3

Date: April 11, 2005

To: Minnesota Stormwater Manual Sub-Committee

From: CWP and EOR

wq-strm8-14bl

EXECUTIVE SUMMARY

The entire range of BSD techniques were extensively reviewed in Paper D, and eight possible options are recommended for possible inclusion into the manual (Table 1). After a brief review of the purpose of stormwater credits, the remainder of this paper outlines the specific conditions and procedures by which stormwater credits are reviewed and granted, presented as they would appear in the final manual. A few general issues pertaining to stormwater credits should be emphasized:

- The decision to offer stormwater credits is a local option (i.e., by a community or watershed authority).
- A community may elect to offer all, some, or no credits, at their discretion
- Similarly, the use of credits by developers is strictly voluntary, although they should be able to reduce the overall size of facilities and the cost of stormwater compliance.
- Multiple credits can be used at each development site, although two credits cannot be taken for the same physical area of the site.

Note: This version reflects verbal comments received at the March Stormwater Manual Sub-Committee, when this issue paper was first presented.

Table 1 Summary of Proposed Stormwater Credits**			
Stormwater Credit	**Recharge**	**Water Quality**	**Channel Protection & Overbank Storms**
A. **Natural Area Conservation** (CA)	NONE	YES, subtract CA from Site DA*	Adjusted CNs*
B. **Site Reforestation/Prairie Restoration** (RA)	YES, credit based on percent area method	YES, subtract ½ RA from site DA	Adjusted CNs
C. **Stream and Shoreline Buffers** (BA)	YES, credit based on percent area method	YES, subtract BA from site DA	Adjusted CNs
D. **Surface IC* Disconnection** (DIA)	YES, credit based on Percent area method	YES, subtract DIA from site DA	Adjusted CN and Tc*
E. **Rooftop Disconnection** (DIA)	YES, credit based on Percent area method	YES, subtract DIA from site DA	Adjusted CN and Tc
F. **Grass Channels** (GA)	YES, meets recharge requirement	YES, subtract non-road area (GA) from site DA	Adjusted Tc
G. **Permeable Pavers** (PPA)	YES, pro-rated based on site HSG*	YES, subtract ½ PPA from site DA	NONE
H. **Green Rooftops**	Automatic Compliance	Automatic Compliance	NONE

***Notes:** DA= site drainage area, CN= NRCS curve number, Tc= time of concentration, HSG=hydrologic soil group, IC= site impervious cover
Two possible credits were dropped after further investigation: Stormwater Planters and Rooftop Storage
** Explanation of methods (ex. "percent area method") will be given in text that follows

I. OVERVIEW OF BETTER SITE DESIGN AND STORMWATER CREDITS

Better site design (BSD) refers to the application of non-structural practices at residential and commercial sites to reduce impervious cover, conserve natural areas, and use pervious areas for more effective treatment of stormwater runoff (CWP, 1998). The use of BSD techniques has been promoted in both the MPCA manual (2002) and the Metropolitan Council manual (2001). When applied early in the design and layout process, BSD techniques can dramatically reduce stormwater runoff and pollutants generated from development sites, and also sharply reduce the size and cost of the stormwater conveyance and treatment system (CWP, 1999). In recent years, several states have sought to encourage greater use of BSD techniques by creating a unified technique for the computation of stormwater credits that reduce the recharge, water quality or channel protection volume that must be provided at new development sites.

Note that the BSD term is an all-inclusive term that includes measures generally intended to reduce runoff volume and mitigate the effects of development. Other terms that mean essentially the same thing and are interchangeable include Low Impact Development, Design with Nature, and Sustainable Development. All of these practices should be the very first thing that is pursued whenever development or redevelopment is considered. Reducing overall runoff by soaking water into the ground on site is the goal of good surface water management. Issue Paper A set the stage for use of BMPs and the treatment train approach to reach this goal.

The purpose of establishing a stormwater credit system is to provide meaningful incentives to developers and designers to consider better site design techniques in the design of new development sites. Developers and designers that take advantage of the credit system can significantly reduce stormwater quality and quantity requirements outlined in the Issue Paper D. The credit system directly translates into cost savings by reducing the size of stormwater conveyance and treatment systems, consuming less land for practices, and reducing overall construction costs.

The stormwater credits presented here are tied directly to the unified stormwater sizing criteria outlined in the manual and recommended for local governments. In general, the credits are used to meet or reduce the recharge, water quality and channel volume requirements. In some cases, credits help to meet larger storm requirements by increasing times of concentrations and reducing post-development curve numbers. For example, water quality volume credits are given for site design practices that reduce the volume of runoff generated by a site (e.g., establishing naturally vegetated conservation areas). Not all credits will be available for each site, and certain site-specific conditions must be met to receive each credit.

For each potential credit, minimum conditions are established for the development or site situations where the credit can be applied. These minimum conditions include site factors such as maximum flow length and contributing area to avoid situations that could lead to significant flow concentration and erosion. Stormwater credits do not relieve the site designer from the normal standard of engineering practice to provide safe conveyance and drainage design.

The decision to allow stormwater credits is always a local option, and should reflect the goals and design review capabilities of the local reviewing authority. A community may elect to offer some or all of the credits, and their use by developers is also strictly optional and voluntary. Site designers are encouraged to use as many credits as they can on different portions of the site, since stormwater cost savings are maximized when they are combined. Two credits, however, cannot be claimed on the same site area (i.e., no double counting).

II. DETAILS ON INDIVIDUAL STORMWATER CREDITS

The following eight site design approaches are recommended for receipt of stormwater credits:

A. Natural Area Conservation
B. Site Reforestation or Prairie Restoration
C. Drainage to Steam or Shoreline Buffers
D. Surface Impervious Cover Disconnection
E. Rooftop Disconnection
F. Use of Grass Channels
G. Permeable Pavers
H. Green Rooftops

Credit A. Natural Area Conservation

Natural area conservation identifies and protects natural resources and features at the site that maintain the predevelopment hydrology by reducing runoff, promoting infiltration and preventing soil erosion. Natural areas that are not disturbed during construction are eligible for a direct stormwater credit.

Natural areas must be protected by a permanent conservation easement that prescribes allowable uses and activities on the parcel and prevents future development. Eligible conservation areas include any areas of undisturbed vegetation at the development site, such as forests, prairies, floodplains and riparian areas, ridge tops and steep slopes, stream, wetland and shoreline buffers, and erodible soils.

The undisturbed soils of conservation areas promote infiltration by attenuating runoff due to storage in the pores created by tree roots and in the organic matter. Forested areas intercept rainfall in their canopy, reducing the amount of rain that reaches the ground, and use water through tree roots and increasing space available for water storage in the soil. Additionally, trees and native vegetation prevent erosion by stabilizing soil, filtering sediment and pollutants from runoff, and taking up nutrients such as nitrogen.

Credit Offered : WQ_v, Cp_v Q_p

1. No credit is given for the recharge requirement (Re_v) under this credit.

2. A WQ_v credit is granted for all conservation areas protected. Designers can subtract conservation areas from total site area when computing the water quality volume. The percentage of impervious cover used in the calculation is still based on the percent impervious cover for the entire site.

3. The post development curve number[1] (CN) used to compute the CP_v, Q_{p10}, and Q_{p100} for all natural areas protected can be assumed to be woods in good condition when calculating the total site CN.

[1] Curve numbers are input parameters to the NRCS unit hydrograph procedure used in TR-55 and TR-20 that calculates runoff as a function of rainfall and travel time (i.e., time of concentration). Curve numbers are based on soils, plant cover, amount of impervious areas, interception, and surface storage. The higher the curve number, the greater the runoff from a drainage area.

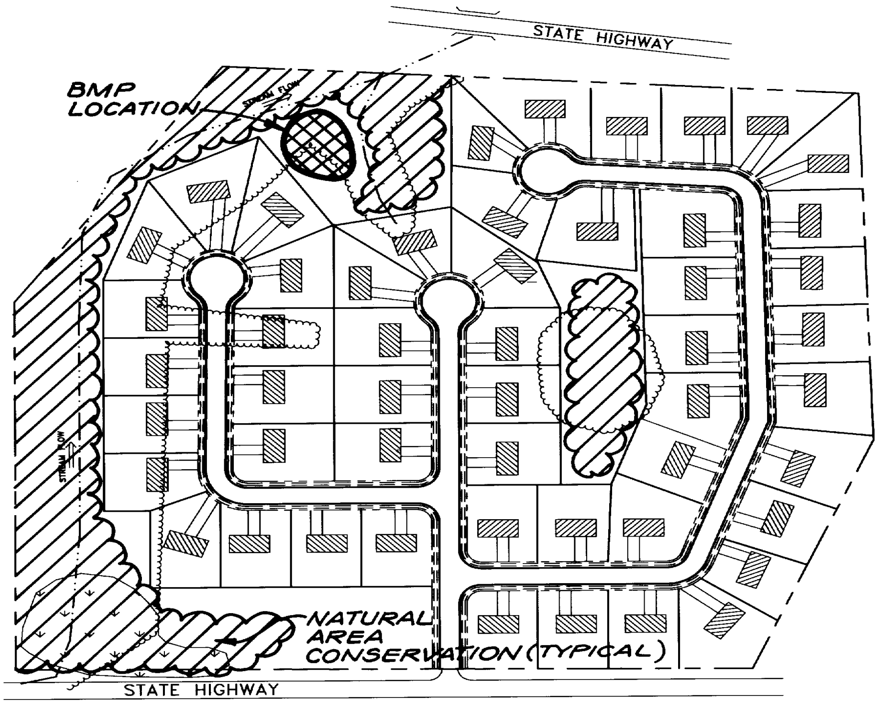

Figure 1: Schematic showing the application of natural area credit to a hypothetical subdivision. Cross-hatched areas are deducted from total site area.

Conditions for the Credit: A proposed conservation areas for the site must meet all of the criteria outlined in Table 2 to be eligible for the credit.

Table 2: Criteria for Natural Area Conservation Credit
• Minimum size of all conservation areas must exceed one acre • No disturbance of the conservation area is allowed during or after construction (i.e., no clearing or grading except for temporary disturbances associated with incidental utility construction or restoration operations). • Area must be clearly shown as outside the limits of disturbance on all construction drawings. • Area must be managed in a natural vegetative condition (e.g., forest, prairie, etc.), and a long-term vegetation management plan must be prepared. • Area must be protected by a perpetual conservation easement that specifies no future development or disturbance to the area • Managed turf is not considered an acceptable form of vegetation management. Only the passive recreational areas of dedicated parkland are eligible for credit • No credit is offered for natural areas already protected by existing federal, state, or local law. • Areas should be reserved to maximize contiguous conservation area and avoid fragmentation

How to Calculate the Credit; Based on the MPCA WQ Rules contained in the 2003 Construction General Permit (CGP), the site WQ_v is adjusted to account for conservation areas in the manner shown in Table 3.

Table 3: Computation on Natural Area Conservation Credit (WQv)	
Rule 1: **Ponds not Draining to Special Waters**	WQ_v = [0.5 inch + (0.5 inch * IC)] * (A – AC)
Rule 2: **Ponds Draining to Special Waters**	WQ_v = [0.5 inch + (1.0 inch * IC)] * (A – AC)
Rule 3: **Non-Ponds not draining to Special Waters**	WQ_v = (0.5 inch * IC) * (A – AC)
Rule 4: **Non-Ponds Draining to Special Waters**	WQ_v = (1.0 inch * IC) * (A – AC)
Where: IC = (new impervious area) / (total area of development site) - expressed as a fraction A = total area of the development site (acres) AC = natural areas conserved (acres)	

As an example, consider a 10-acre development site that includes three acres of impervious area and three acres of protected conservation area. Under the credit, the three acres of conservation area are subtracted from total site area when calculating the $WQ_{v,}$ as shown in Table 4.

Table 4: Example Calculation of WQ credit for Natural Area Conservation		
The "IC" for the site is: IC = (impervious cover of development site) / (total area of development site) = (3 acres) / (10 acres) = **0.30**		
MPCA Rule 1: Ponds that Do Not Drain to Special Waters		
W/Out Credit	WQ_v = [0.5 inch + (0.5 inch * 0.30)] * (10 acres) * (1/12) =	**0.54 acre-feet**
With Credit	WQ_v = [0.5 inch + (0.5 inch * 0.30)] * (10 acres – 3 acres) * (1/12) =	**0.38 acre-feet**
MPCA Rule 2: Ponds that Do Drain to Special Waters		
W/Out Credit	WQ_v = [0.5 inch + (1.0 inch * 0.30)] * (10 acres) * (1/12) =	**0.67 acre-feet**
With Credit	WQ_v = [0.5 inch + (1.0 inch * 0.30)] * (10 acres – 3 acres) * (1/12) =	**0.47 acre-feet**
MPCA Rule 3: Non-Ponds that Do Not Drain to Special Waters		
W/Out Credit	WQ_v = (0.5 inch * 0.30) * (10 acres) = * (1/12) =	**0.13 acre-feet**
With Credit	WQ_v = (0.5 inch * 0.30) * (10 acres – 3 acres) * (1/12) =	**0.09 acre-feet**
MPCA Rule 4: Non-Ponds that Do Drain to Special Waters		
W/Out Credit	WQ_v = (1.0 inch * 0.30) * (10 acres) * (1/12) =	**0.25 acre-feet**
With Credit	WQ_v = (1.0 inch * 0.30) * (10 acres – 3 acres) * (1/12) =	**0.18 acre-feet**

Credit B. Site Reforestation or Prairie Restoration

Site Reforestation involves planting trees on existing turf or barren ground at the development site with the explicit goal of establishing a mature forest canopy that intercepts rainfall, and maximizes infiltration and evapotranspiration. In some cases, a prairie community is the desired vegetative condition for the site. This credit can be modified to include any Prairie Restoration efforts conducted at a development site. Reforested or restored sites protected by a perpetual conservation easement and maintained over a defined growing period are eligible for a stormwater credit.

Reforestation is accomplished through active replanting or natural regeneration of trees. Capiella (2005) reviewed a range of research that demonstrates the considerable runoff reduction associated with forest cover compared to turf. The benefits of reforestation include reduced runoff, greater infiltration of stormwater, reduced soil erosion, and removal of stormwater pollutants. Forest soils actively promote greater infiltration rates through surface organic matter and macropores created by tree roots. Forests also intercept rainfall in their canopy, reducing the amount of rain that reaches the ground. Evapotranspiration by trees increases potential water storage in the soil. Prairie Restoration also accomplishes these same benefits.

Credit Offered (Re_v, WQ_v, Cp_v)

1. Recharge credit is given for the entire area reforested or restored (for prairies) using the percent area method (Re_v)
2. A WQ_v credit is granted for all areas reforested or restored by subtracting one-half of these areas from total site area when computing the water quality volume. The percentage of impervious cover used in the calculation is still based on the percent impervious cover for the entire site.
3. The post development curve number (CN) used to compute the CP_v, Q_{p10}, and Q_{p100} for the reforested area can be assumed to be "woods in fair condition" when calculating the total site CN.

***Conditions for Credit*:** A reforestation or prairie restoration project must meet all the conditions in Table 5 to qualify for the credit.

Table 5: Criteria for Site Reforestation Credit
• Minimum contiguous area of 20,000 square feet • Protected by permanent conservation easement • Reforestation method designed to achieve 75% forest canopy within 15 years • Planting plan is approved by local watershed organization or forestry agency, including any needed site preparation • Care and replacement warranty required to ensure survival and growth of trees over first three years • Long term plan must be filed with designated authority responsible for on-going vegetative management of the reforestation or restoration site.

Credit C. Drainage to Stream or Shoreline Buffers

Buffers may be required during the development process to provide a vegetative setback between development and streams, lakes and wetlands. Portions of the site reserved as buffers and maintained in native vegetation can help filter stormwater runoff. Stream and shoreline buffers can already receive credit as a natural area conservation area. This additional credit covers adjacent site areas that directly contribute runoff to the buffer.

Credit is given when a stream or shoreline buffer effectively treats stormwater runoff by capturing and treating overland flow from pervious and/or impervious areas adjacent to a natural stream buffer. For optimal stormwater treatment, a buffer should be composed of three lateral zones: a stormwater depression area that leads to a grass filter strip that in turn leads to a shrub or forested buffer. The captured runoff within the stormwater depression can be spread across a grass filter designed for sheetflow conditions for the water quality storm. The grass filter then discharges into a wider forest buffer designed to fully infiltrate the surface runoff.

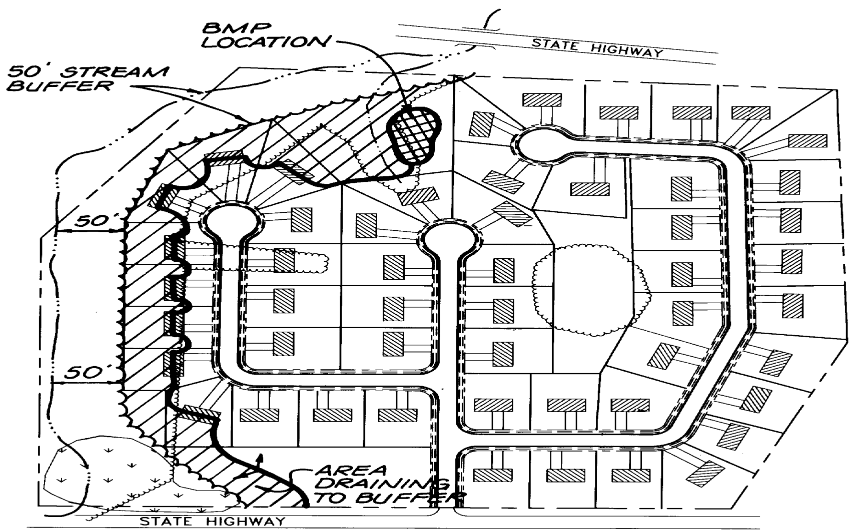

Figure 2: Application of Buffer Drainage Credit to Hypothetical Subdivision—the cross hatched areas draining to buffer are subtracted from site area

Credit Offered (Rev, WQv, Cpv)

The credits include:

1. Rev: Any impervious area draining to a buffer is deducted from the recharge requirement, (Re_v), under the Percent Area Method.
2. WQv: The total area draining by sheet flow into the buffer from adjacent areas can be subtracted from total site area in the WQ_v calculation.
3. The post development curve number (CN) used to compute the CP_v, Q_{p10}, and Q_{p100} for the contributing buffer area can be assumed to be woods in good condition when calculating the total site CN.

Conditions for the Credit

The stream buffer credit is subject to the conditions outlined in Table 6.

Table 6: Criteria for Buffer Drainage Credit
• A minimum buffer width (i.e., perpendicular to the stream, lake or wetland) of 50 feet is needed to constitute effective stormwater treatment. Averaging over the length of the buffer is allowed. • The maximum contributing flow path to the buffer shall be 150 feet for pervious surfaces and 75 feet for impervious surfaces. • The average contributing overland slope to and across the stream buffer shall be less than 3.0%. • Runoff shall enter the outer boundary of the buffer as sheet flow, although a depression or level-spreading device may be utilized to recreate sheet flow conditions • The credit is not applicable if rooftop or surface impervious cover disconnection is already provided (i.e., no double counting). • Buffers shall remain un-graded and un-compacted during construction and shall be maintained in a natural vegetative condition. A long-term vegetative management plan shall be developed with the responsible party • The area of the buffer itself may qualify as natural area conservation credit

How the Credit is Calculated?

The basic MPCA sizing criteria outlined in the 2003 CGP are modified to account for the buffer credit as shown in Table 7. The Recharge volume (Re_v) is determined as a function of annual predevelopment recharge for a given soil group, average annual rainfall volume, and amount of impervious cover at a site. Calculating the new Rev for the buffer credit requires the use of the "Percent Area" method, as shown in Table 8.

Table 7: Example of How Credit is Applied to Address Buffer Contributing Areas	
MPCA Rule 1: Ponds that Do Not Drain to Special Waters	WQ_v = [0.5 inch + (0.5 inch * IC)] * (A – AB)
MPCA Rule 2: Ponds that Do Drain to Special Waters	WQ_v = [0.5 inch + (1.0 inch * IC)] * (A – AB)
MPCA Rule 3: Non-Ponds that Do Not Drain to Special Waters	WQ_v = (0.5 inch * IC) * (A – AB)
MPCA Rule 4: Non-Ponds that Do Drain to Special Waters	WQ_v = (1.0 inch * IC) * (A – AB)
Where: IC = (new impervious area) / (total area of development site) - expressed as a fraction A = total area of the development site (acres) AB = total allowable drainage area to buffer (acres)	

Table 8: Methods For Calculating the Recharge Required on a Development Site		
"Percent Area" Method $Re_a = (S) * (A) * (IC)$ Where: Re_a = Recharge area requiring treatment (acres) S = Soil Specific Recharge Factor (unitless) A = total area of the development site (acres) IC = (impervious cover of development site) / (total area of development site) (expressed as a fraction)		
Hydrologic Soil Group	**Annual Recharge**	**Soil Specific Recharge Factor (S)[1]**
A	18 inches/year	0.62
B	12 inches/year	0.42
C	6 inches/year	0.21
D	3 inches/year	0.10
[1] Each specific recharge factor is based on the USDA average annual recharge depth per soil type divided by the annual local rainfall in Minnesota multiplied by 90%. This example uses a local annual rainfall average of 26 inches.		

The adjusted Re_v after the buffers credit is calculated as shown in Table 9:

Table 9: Four Steps to Adjust Rev for the Buffer Credit

1. Determine the Soil Specific Recharge Factor (S) for the site based on the HSG. If there is more than one HSG on the site, calculate the composite S.
2. Calculate the original Re_a (using the Percent Area method) for the site.
3. Subtract the "drainage area to the buffer" (acres) from the Re_a to come up with a revised Re_a. The revised Re_a is the remaining area of the site that must still be treated for recharge.
4. Calculate the remaining Re_v that must be treated by a BMP:

$$(\text{remaining } Re_v) / (\text{revised } Re_a) = (\text{original } Re_v) / (\text{original } Re_a)$$

Credit E. Surface Impervious Cover Disconnection

Surface disconnection spreads runoff generated from small parking lots, courtyards, driveways, sidewalks and other surface impervious cover into adjacent pervious areas where it is filtered and infiltrated. These pervious areas, with grass or natural vegetation, can be used to infiltrate runoff, reduce runoff velocity, and remove pollutants. Minimum design standards regarding the length of the pervious area, slope, soil characteristics and contributing drainage area are needed to prevent reconnection of stormwater runoff into the storm drain system. Impervious surface disconnection techniques primarily involve diversion of runoff to a vegetated filter strip or pervious area. By disconnecting small impervious surfaces from the storm drain system, the total volume and rate of runoff can be greatly reduced at a development site. Credits are offered for surface disconnection when runoff can be spread over an acceptable pervious area with minimum dimensions and porosity. In some cases, minor grading of the site may be needed to promote overland flow and vegetative filtering.

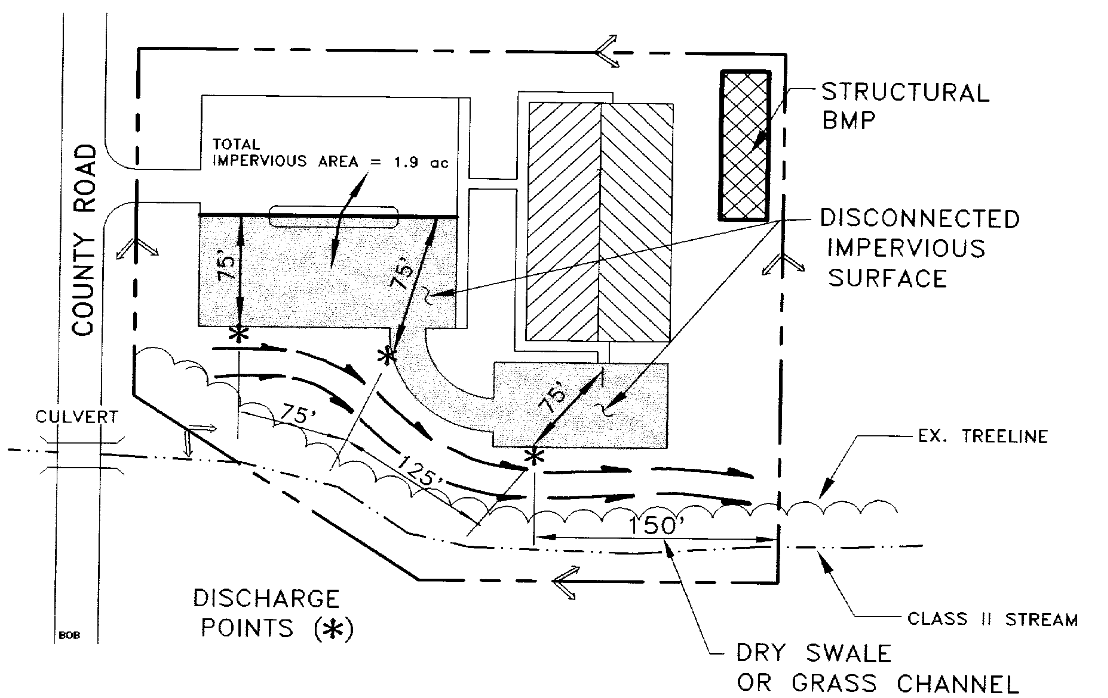

Figure 3. Example of Application of Surface IC Disconnection Credit to a Hypothetical Development. Shaded areas are deducted from total site area.

Credits Offered (Re_v, WQ_v, Cp_v)

Credit is given for disconnection of surface impervious cover runoff in three ways:

1. Recharge: The impervious area disconnected is deducted from the recharge requirement, (Re_v) under the Percent Area Method.

2. Water Quality: The “disconnected” impervious area is subtracted from the total site impervious area when computing WQ_v.
3. Larger Storm Events: The post development curve number (CN) used to compute the CP_v, Q_{p10}, and Q_{p100} for the disconnected surface cover area can be assumed to be grass in good condition when calculating the total site CN.

Conditions for Credits:

The disconnection credit is subject to the restrictions outlined in Table 10.

Table 10: Criteria for the Surface IC Disconnection Credit
• The maximum contributing impervious flow path length shall be 75 feet. • The minimum length of pervious area over which runoff must be spread is 75 feet to receive full credit. Compensatory storage may be needed in the form of a dry well, rain garden or spreading device for shorter disconnection lengths, or sites with poor infiltration capability. • In all cases, the disconnection length must exceed the contributing length of overland flow. • The entire vegetative "disconnection" should be on a slope less than 5.0%. • The total surface impervious area contributing to any single discharge point shall not exceed 1,000 ft^2 and shall drain continuously through a pervious filter strip until it reaches the property line or drainage swale • No on-site soil evaluations are needed if the NRCS Soil Survey indicates soils are relatively permeable (e.g., HSGs A and B). • On-site soil evaluations by an engineer, geologist or soil scientist are needed for less permeable soils (HSGs C and D), including water table depth and permeability. Soil amendments may be needed to restore porosity of pervious areas, as outlined in Appendix A. • If the surface IC ultimately drains to a stream buffer, the designer must choose either the surface IC disconnection credit or the stream buffer credit, but not both. • The credit may not be used if the surface impervious cover is designated as a stormwater hotspot or PPGLU (see Issue Paper E or H).

How the Credit is Calculated

The MPCA WQv sizing rules in the 2003 CGP are adjusted in the same manner as shown in Table 7 (drainage area to buffers). The only change is that term AD (area disconnected) replaces AB (area of contributing drainage to buffer). Similarly, the recharge credit is computed using the same general steps shown in Tables 8 and 9.

Credit F: Rooftop Disconnection

Disconnection of both residential and non-residential rooftops can offer an excellent opportunity to spread rooftop runoff over lawns and pervious areas where it can be filtered and infiltrated.

Downspout disconnection can infiltrate runoff, reduce runoff velocity, and remove pollutants. Alternately, downspouts can be directed to a dry well, rain garden or surface depression Stormwater credits are offered for rooftop disconnections that are effectively spread runoff over an acceptable pervious area.

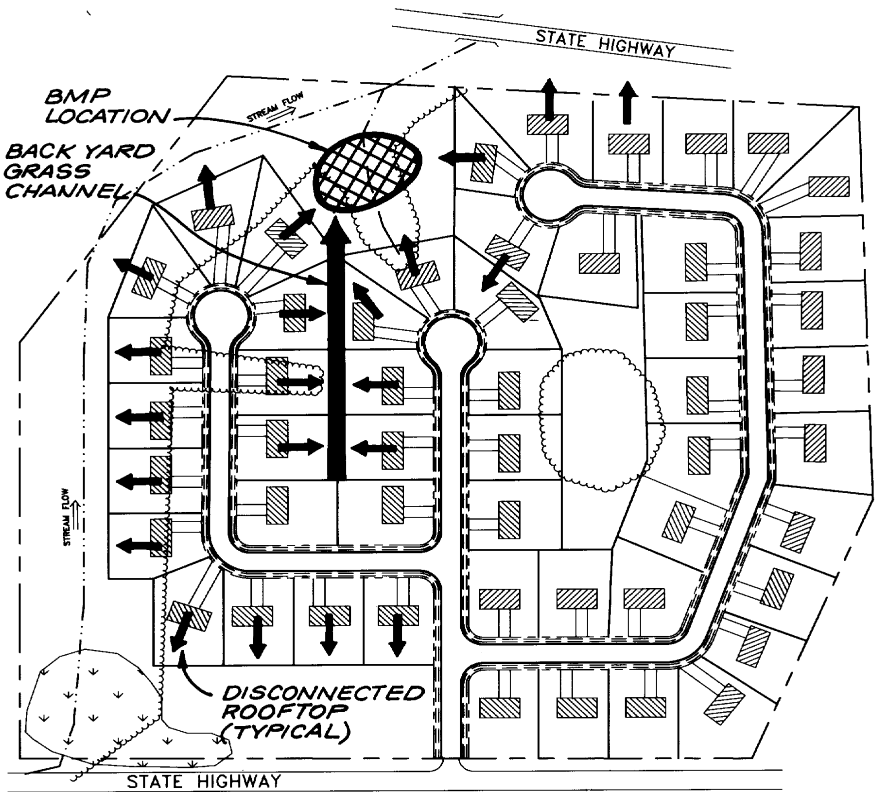

Figure 4. Application of Rooftop Disconnection Credit to Hypothetical Subdivision. Each individual rooftop must be assessed—only those with black arrows are eligible for credit

Credit Offered (Re_v, WQ_v, Cp_v)

Credit is given when disconnected rooftop runoff is spread over a pervious area with sufficient distance, velocity and permeability to allow reasonable filtering and/or infiltration. In some cases, individual lots may need minor grading to meet these minimum conditions for overland flow. Three credits are possible:

1. Recharge: The rooftop areas effectively disconnected are deducted from the recharge requirement, (Re_v) using under the Percent Area Method.
2. Water Quality: Disconnected rooftops are subtracted from the total site impervious area when computing WQ_v.
3. Larger Storm Events: The post development curve number (CN) used to compute the CP_v, Q_{p10}, and Q_{p100} for the disconnected rooftops can be assumed to be grass in good condition when calculating the total site CN.

Conditions for Rooftop Disconnection Credit

The rooftop disconnection credit is subject to the restrictions outlined in Table 11.

Table 11: Criteria for Meeting the Rooftop Disconnection Credit
• Disconnections shall adequately prevent basement seepage. • Rooftop runoff must be spread over a minimum length of 75 feet of pervious area for full credit. See Table 12 for storage-compensation rules for disconnection lengths less than 75%. A runoff storage device such as a dry well or rain garden is needed for shorter disconnection lengths • The rooftop contributing area to any single downspout cannot exceed 1,000 ft^2. • The length of the "disconnection" should be equal to or greater than the contributing rooftop length. • Disconnections are only credited for residential lot sizes that exceed 6,000 ft^2. • The entire vegetative "disconnection" should be on a slope less than or equal to 5.0%. • Where provided, downspouts must be at least 10 feet away from the nearest impervious surface to discourage "re-connections." • Where a gutter/downspout system is not used, the rooftop runoff should drain as either sheetflow from the structure or drain to a subsurface drain field that is <u>not</u> directly connected to the drainage network. • No on-site soil evaluations are needed if the NRCS Soil Survey indicates site soils are relatively permeable (e.g., HSGs A and B). • On-site soil evaluations by an engineer, geologist or soil scientist are needed for less permeable soils (HSGs C and D), including water table depth and permeability. Soil compost amendments may be needed for the pervious areas, as outlined in Appendix A . • If the disconnected rooftop also drains directly to a stream buffer, the designer must choose the rooftop disconnection credit or the stream buffer credit, but not both. • If the rooftop is designated as a hotspot or PPGLU, disconnected rooftop runoff cannot commingle with any other runoff from any paved surfaces at the site

How the Credit is Calculated

The MPCA WQv sizing rules in the 2003 CGP are adjusted in the same manner as shown in Table 7 (drainage area to buffers). The only change is that term AD (area disconnected) replaces AB (area of contributing drainage to buffer). Similarly, the recharge credit is computed using the same general steps shown in Tables 8 and 9. Guidance on storage-compensation rules for shorter disconnection lengths is provided in Table 12.

Table 12. Guidance on Storage-Compensation Rules for Shorter Disconnection Lengths						
Disconnection Length provided	0 to 14 ft	15 to 29 ft	30 to 44 ft	45 to 59 ft	60 to 74 ft	> 75 ft
% WQ treated by disconnect	0%	20%	40%	60%	80%	100%
RO storage needed	100%	80%	60%	40%	20%	0%
Max Storage Volume*	40 cubic feet (cf)	32 cf	24 cf	16 cf	8 cf	0 cf
* assuming 500 square feet roof area to each downspout disconnection						

<u>Credit G. Use of Grass Channels</u>

Curbs, gutters and storm drains are all designed to be hydraulically efficient in removing stormwater from a site. However, they also tend to increase peak runoff discharges, flow velocities, and the delivery of pollutants to downstream waters. Grass Channels are preferable to curb and gutters as a conveyance system, where development density, topography, soils and slopes permit and where vegetation can be kept suitably thick. While research has not demonstrated that grass channels or roadside ditches remove pollutants reliably enough to qualify as a stormwater management practice (Winer, 2000), they have been shown to reduce the total volume of runoff for smaller storms when compared to curbs and gutters. Stormwater credits are provided for some grass channels, based on their ability to reduce the volume of runoff through infiltration and capture and treat stormwater pollutants.

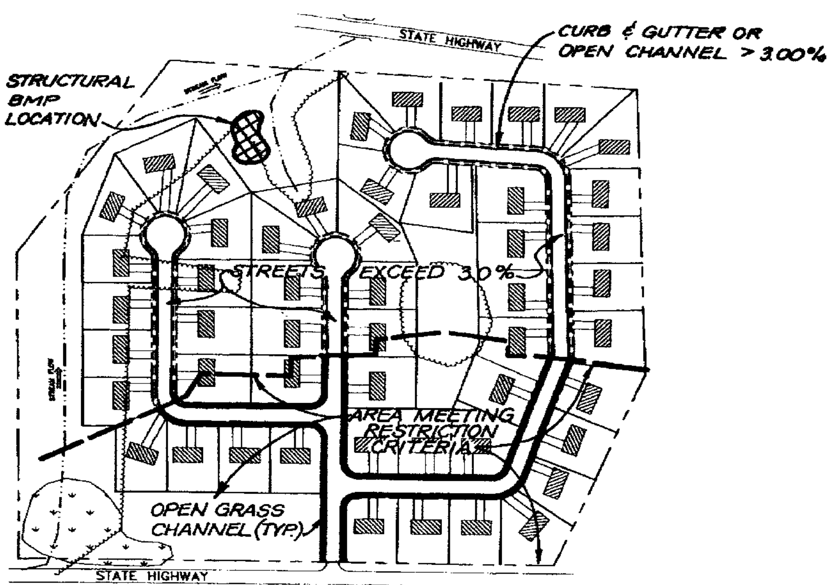

Figure 5. Example of Assessing the Grass Channel Credit in a Hypothetical Subdivision—the drainage area to dark-shaded swales is deducted from total site area

Credit Offered (Re_v, WQ_v, Cp_v)

1. Recharge: The total drainage area served by an effective grass channel will automatically meet the minimum recharge Re_v requirement regardless of channel geometry or slope.
2. Water Quality: The non-roadway portion of the area draining to the swale can be subtracted from the total site impervious area when computing WQ_v.
3. Larger Storm Events: While post development curve number (CN) used to compute the CP_v, Q_{p10}, and Q_{p100} will not change, grass channels may increase the time of concentration and thereby reduce required storage volumes

Conditions for Grass Channel Credit

Credit is granted for grass channels that meet the minimum design criteria outlined in Table 13. Designers must meet all the design parameters shown for density, channel dimensions, and slope limitations to qualify for the credit.

Table 13 Criteria for Meeting the Grass Channel Credit
• Channel serves low to moderate density residential development (maximum density of 4 dwelling units per acre). • The bottom width of the channel shall be 2 feet minimum and 8 feet maximum. • The side slopes shall be 3H:1V or flatter. • The channel slope shall be less than or equal to 3.0%. • The length of the grass channel shall be equal to the roadway length • Maximum flow velocity for runoff shall be non-erosive for the two-year design storm event • Not applicable if the rooftop disconnection credit already been taken • Grass channels that conform to the dimensions above require no special water quality sizing to qualify for the credit, unless the NRCS Soil Survey indicates the soils are in the D HSG • Grass channel are an acceptable practice for non-residential land uses as long as the maximum flow velocity of 1 fps and the average residence time of 10 minutes are maintained during the water quality storm event

Credit H. Permeable Pavers

Permeable pavers refers to a broad range of products including porous pavement, concrete and brick products, grass pavers, and various block pavers that enable some fraction of rainfall to be infiltrated into a sub-base underneath the paver. Permeable pavers can replace asphalt and concrete for driveways, parking lots and walkways, and are particularly well suited for high-density development projects such as courtyards, plazas and spill-over parking areas. Given the broad diversity of paver products and applications, and their uncertain longevity in cold-climates, local governments need to be careful in designating which paver products qualify for stormwater credits.

Pervious asphalt and concrete appear the same as traditional pavement from the surface, but are manufactured without "fine" materials, and incorporate void spaces to allow infiltration. Paving blocks or grass pavers are concrete interlocking blocks or synthetic fibrous grid systems with open areas designed to allow grass to grow within the void areas. Paving blocks make the surface more rigid and gravel or grass planted inside the holes allows for infiltration. Depending on the use and soil types, a gravel layer can be added underneath to prevent settling and allow further infiltration. Permeable pavers can reduce stormwater runoff by temporarily storing runoff and allowing it evaporate or infiltrate into the soil.

Permeable paving systems also improve water quality through the many processes (ex., filtration, adsorption, bacterial degradation) that occur as water passes through a sand filter. That is, the sub-grade drainage system under the paved surface acts similar to a sand filter treatment system. In spite of this ability, chlorides from road salt will pass generally untreated.

Credit Offered (Re_v, WQ_v)

1. Recharge: The total drainage area covered by permeable paver is assumed to meet the minimum recharge Re_v
2. Water Quality: One-half the surface area covered by acceptable permeable pavers can be subtracted from the total site impervious area when computing WQ_v.

Conditions for Permeable Paver Credit

The conditions for granting credit for permeable pavers are restricted, and are outlined in Table 14.

Table 14 Criteria for Granting Permeable Paver Credits
• The credit is normally applied to redevelopment and infill activity at highly impervious sites less than five acres in area. • Permeable pavers must be applied to at least 5% of total site impervious area to receive credit • Acceptable paver products must achieve a minimum storage, infiltration or evaporation of the first 0.25 inches from rainfall • Paver applications on C and D HSG soils may require installation of sub-base underneath the product to provide infiltration • Permeable pavers are not acceptable option for roadways and parking lots that receive extensive traffic

Credit I. Green Rooftops

Green rooftops are an emerging site design practice that establishes a thin planting media on flat roof surfaces in which hardy, low-growing vegetation is planted. A green rooftop typically consists of several layers, including a waterproofing membrane, insulation, protection layer, drainage layer, filter mat, soil layer, and vegetation. Green rooftops may have an internal drainage network that directs an overflow away from the roof to inhibit ponding.

Recent research has shown that green roofs can fully store and evapotranspire rainfall from small and medium rainfall events, but may not capture enough rainfall to meet the full WQv requirement for the site. Because green rooftops are an innovative practice that have been shown to have impressive runoff and pollutant reductions (Liptan, personal communication, 2004) and eliminate the roof surface as a source of toxic metals (Chang et al 2004), their use should be promoted by offering a full WQv credit for the entire roof where they are installed. For example, the City of Portland (2004) design guidance on green rooftops should be used to receive the credit.

Credit Offered (WQ_{v},)

1. Water Quality: A green rooftop automatically meets the water quality requirement even if it does not provide the full WQ_V for the rooftop as a whole.

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Appendix A: **Soil Compost Amendments**

Soil compost amendments may be required to increase pervious area storage and filtration rates for sites with C and D soils that are expected to receive either rooftop or surface IC disconnection. This Appendix describes some of the procedures to take increase soil porosity in these pervious areas.

Soil compost amendments refer to tilling and composting of soil within a development site to recover soil porosity and reduce runoff. Research has shown that the soils of many new lawns and open spaces are highly compacted as a result of grading, construction traffic and ongoing soil disturbance (Schueler, 2001). Consequently, upper Midwest research has demonstrated these pervious areas generate more runoff than current NRCS models predict (Legg et al, 1996; Garn, 2002; Pitt, 1989).

The soil compost amendment process seeks to recover the porosity and bulk density of soils by incorporating soil amendments or conditioners, such as compost, top soil, lime and gypsum (Chollak and Rosenfield, 1998) into the lawn. Soil compost amendments improve the hydrologic properties of the lawn or landscaped area by promoting more storage and infiltration, and producing less runoff. In addition, reduced runoff from amended soils may also reduce nutrient and sediment loading to surface waters. Some guidelines for using soil compost amendments are set forth in Table 15.

Table 15: Conditions Where Soil Compost Amendments Should be Used
• Applies primarily (but not exclusively) to new lawns in residential subdivisions with lot sizes less than one half acre, and have soils in Hydrologic Soil Group C and D. • Existing soils are currently compacted or are expected to become compacted as a result of planned grading and construction activity at the site • Minimum area of 5,000 square feet for each soil amendment treatment, although individual treatments within a subdivision can be combined together to maximize treatment • Soil amendments must meet minimum local specifications; consult Chollak and Rosenfeld (1998) or City of Seattle (2002) for guidance