APPENDIX D
DISTRIBUTED RUNOFF CONTROL (DRC) APPROACH

This appendix deals with outlet design for end-of-pipe facilities. The primary objective is to release stored water at a rate which is consistent with meeting established erosion control targets. Several different design approaches may be used; however, this appendix describes only the Distributed Runoff Control (DRC) method.

Under pre-development conditions, the ‘effective’ flow controlling channel form has been found to be in accordance with bankfull stage (1.5 to 2 year recurrence interval). The smaller mid-bankfull events, although significant in terms of sediment transport within the stream, play a secondary role in the formation of the active channel. Studies have shown that as a result of development, there is an increase in the frequency of occurrence of mid-bankfull flows, and these smaller runoff episodes become the ‘effective’ geomorphic agents controlling channel form (Figure D.1). Based on these findings, the intent of the DRC approach is the control of in-stream erosion potential for:

a) the range of flows exceeding the critical flow (the rate at which sediment transport of bed forms or intact boundary materials begins), up to bankfull stage, with
b) the highest level of control focussed on flows in the mid-bankfull range.

Flow rates under the critical flow are controlled for water quality purposes while flows exceeding bankfull stage are controlled for flood hazard objectives. The three design zones are illustrated using a conceptualized rating curve for an end-of-pipe facility as shown in Figure D.2. Figure D.2 also illustrates the difference between the rating curves for the:

a) 2 year peak flow shaving method (curve ADF);
b) 25 mm-24 hour approach (curve ABDF);
c) overcontrol procedure (curve AEF); and
d) the Distributed Runoff Control (curve AC2DF) concept.

These curves were developed for a stream formed in boundary materials considered moderately sensitive to scouring (sandy silt to clay loam). Point ‘D’ in Figure D.2 corresponds to the bankfull flow (Q_{BFL}) defined for the channel at bankfull stage (D_{BFL}). For all flows exceeding Q_{BFL}, flood hazard criteria apply. For all flows less than that corresponding to point ‘C1,’ water quality criteria apply.

The shaded portion of Figure D.2 denotes the flow rates which correspond to the mid-bankfull stage region of the channel (between 0.5 D_{BFL} and 0.75 D_{BFL}). These are the flows targeted by the DRC method for the greatest level of hydraulic routing. The mean annual flow rate lies within this region, and it is approximated by point ‘C2’ which is referred to as the DRC ‘inflection point.’ In more sensitive streams, the inflection point may shift toward point C3. In less sensitive streams, the inflection point may be adjusted toward point C1 as summarized in Table D.1.

Figure D.1: Mid-Bankfull to Bankfull Flow Range and the Corresponding Critical Flows

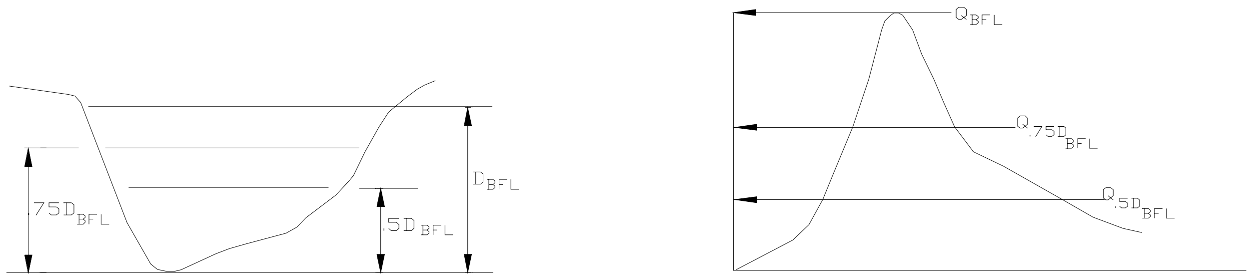

Figure D.2: Conceptual Rating Curve for an End-of-Pipe Facility showing:

- **(a)** **2 Year Peak Flow Shaving Method;**
- **(b)** **25 mm-24 hour Approach;**
- **(c)** **Overcontrol Procedure; and**
- **(d)** **Distributed Runoff Curve (DRC)**.

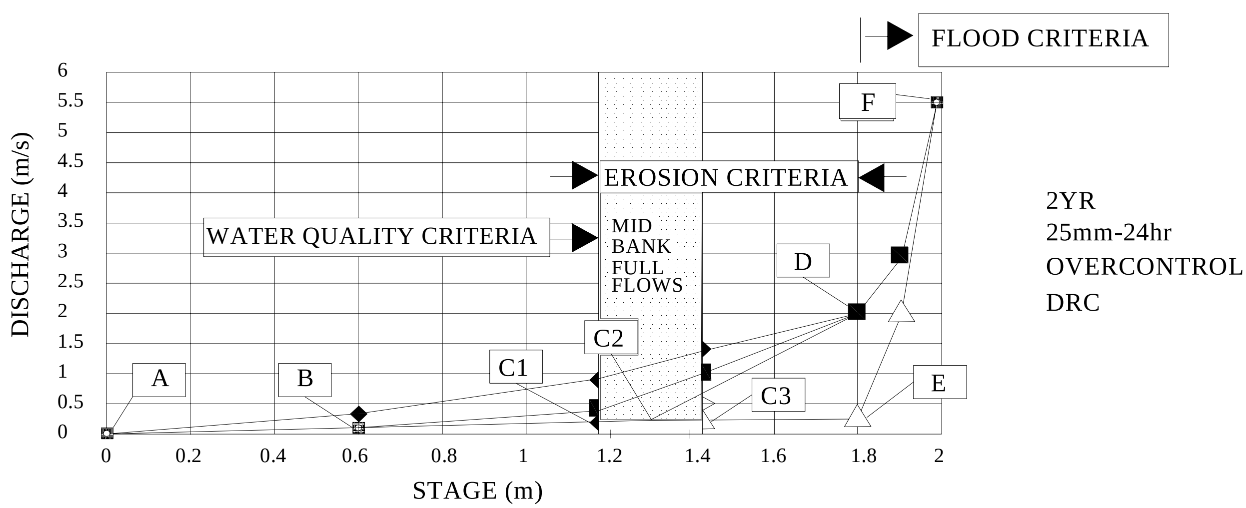

Table D.1: Selection of the DRC Curve Inflection Point

Boundary Material Composition	Inflection Point (Figure D.2)
Sand to Sandy Loam (Very Soft to Soft)	Point C3 defined as Q at 0.75 D_{BFL}
Sandy Silt to Clay Loam (Firm)	Point C2 defined as Q at 0.65 D_{BFL}
Clayey Silt to Silty Clay (Stiff)	Point C1 defined as Q at 0.5 D_{BFL}

The DRC approach follows the overcontrol curve until the DRC inflection point. The overcontrol curve is determined as a multiple of the 2 year peak flow shaving curve. For example, to obtain 80% overcontrol (80%OC), the ordinates for the 2 year peak flow shaving curve are multiplied by 0.2 up to the bankfull flow. The amount of control (e.g., whether it is a 60%OC (multiplier 0.4) or 90%OC (multiplier 0.1)) is determined by the sensitivity of the receiving channel. The more sensitive the channel boundary materials to scour, the greater the degree of control as summarized in Table D.2.

Table D.2: Degree of Overcontrol (Multiplier) as a Function of Boundary Material Composition

Boundary Material Composition	Description	Degree of Overcontrol (Multiplier)
Sand to Sandy Loam	Very Soft (loose to moderately compacted)	0.15-0.2
Sandy Silt to Clay Loam	Soft (moderately compacted)	0.2-0.3
Clayey Silt to Silty Clay	Firm (compacted)	0.3-0.4
Silty Clay	Stiff (highly compacted)	0.4-1.0

The procedure for the development of the DRC rating curve is outlined in the following steps.

Step 1: Determine the composition of the intact boundary material (unless armored in which case the armor layer is used) at the bank toe of both banks (within the range of $0.2D_{BFL}$ to $0.4D_{BFL}$) and within the mid bed region at representative cross-sections in the channel downstream of the point-of-entry of the stormwater drainage from the development site.

Step 2: Using the least resistant of these units, determine the OC multiplier from Table D.1.

Step 3: Construct the 2 year peak flow shaving rating curve (ADF in Figure D.2) by drawing a straight line between points A and D.

Step 4: Construct the OC rating curve by multiplying the ordinates for the 2 year peak flow shaving rating curve by the OC multiplier (ABCE in Figure D.2 in which C is represented by one of C1, C2 or C3).

Step 5: Determine the DRC inflection point from Table D.1.

Step 6: Construct the DRC rating curve (points ABCDF in which C is one of C1, C2 or C3 as determined in Step 5).