CATCHMENT DATA FOR THE WALLINGFORD PROCEDURE PERCENTAGE RUNOFF MODEL

WaPUG Committee

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1. INTRODUCTION

One of the difficult parts of building a sewer system model is defining the catchment areas and the percentage of impermeable surfaces in those areas.

This User Note gives guidance on the collection of sub-catchment area data for use with the Wallingford Procedure Percentage Runoff Model which is described in WaPUG User Note No 9.

2. THE PROBLEMS

There are four main problems to be addressed in the definition of sub catchment data. These are:

- Definition of the total area.
- Definition of total impermeable area.
- Partially separate drainage systems.
- Runoff from permeable areas excluded from the model.

3. DEFINITION OF TOTAL AREA

The boundaries of urban catchments are affected much more by the drainage system than by natural fall of the ground. The natural watershed is therefore not generally important in deciding on the catchment boundary.

The original advice was that the catchment should extend to the property boundaries on the edge of the built up area, and that all areas within this, whether permeable or impermeable, should be included in the model. This was the rule used for the catchments from which the runoff equation was derived.

Later experience was that the inclusion of large permeable areas within a catchment could give anomalous results, and it was advised that these should be omitted.

This advice is now given more rigorously.

(i)   The catchment should extend to the property boundaries of the built up area. Areas outside of this should only be included in exceptional circumstances, and should be treated under item (v) below.

(ii)   A line is drawn around the paved area which includes all parts of the catchment which are within approximately 10 m of a paved area which is positively connected to the drainage system. This is intended as a rule of thumb, and it is not necessary

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to spend a lot of effort in accurately drawing the 10 m boundary line. Note that only paved areas, not roof areas are used to define this line. Any permeable areas within this line must be included.

(iii)   Any roof areas which are positively connected to the drainage system but which lie outside of the 10 m line are also included in the total area, but without any extra permeable area.

(iv)   Permeable areas further than 10 m from a connected paved area are excluded if they are positively drained by another system, such as a natural water course.

(v)   Other permeable areas more than 10 m from a connected paved area should be included if hand calculation of the PR equation for the permeable area plus any impermeable areas which are completely surround by and drain to these permeable areas (such as pathways and sports pavilions) gives a positive value of PR. The effect will vary with catchment wetness, and check should be made using a high value of UCWI. This area can then be allocated to a separate pipe which does not take any directly connected impermeable area. The runoff of the area will then be assessed alone. (Note that if the model is then used with a lower value of UCWI such that the PR on these areas becomes negative, then it is automatically ignored). See also the comments on runoff from permeable areas in this note.

4. DEFINITION OF IMPERMEABLE AREA

The total impermeable area will generally include all paved and roof areas in the catchment with the following exceptions:

(a)   Impermeable surfaces which are not directly drained and which are completely surrounded by permeable areas which have been excluded under item (iv) or (v) above. These are excluded.

(b)   Impermeable surfaces which are not directly drained, but which are within permeable areas which are included (such as driveways, garden sheds, paths etc). These should be included if they might indirectly contribute runoff to the drainage system.

5. PARTIALLY SEPARATE SYSTEMS

Where an area is drained by partially separate systems, for example one taking the roof and one taking the road drainage there are further difficulties in deciding on the contributing area. The total catchment area and the total impermeable area should still be allocated following the rules given above. This must then be divided between the two systems. A correct division will show sensible values for both systems.

The division of the impermeable areas is generally straightforward as they will be positively drained to one system.

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The recommended method is:

1.   Roof surfaces are allocated with no surrounding permeable surfaces. A pipe taking only roof drainage will therefore have 100% roof surfaces.

2.   Paved surfaces will be associated with all of the included permeable surface. Where the paved surfaces in one subcatchment drain to two different systems, the permeable areas shall be allocated according to which surface they are likely to drain to. All of the total area defined using the rules above must be allocated to one of the drainage systems. Checks should be made that the effective PIMP for one system has not become so low that the minimum value of 40% for PR/PIMP is reached.

The ideal situation is for both systems to be modelled and verified, as this will show up discrepancies more clearly.

6. RUNOFF FROM PERMEABLE AREAS EXCLUDED FROM THE MODEL

Where there are significant large permeable areas in the catchment, which have been considered under rule (v) for total area (whether they have then been included or excluded) extra checks should be made on the operation of the system. In these circumstances the high runoff in winter conditions when the catchment is wet may become more critical than the conditions in summer. Some guidance on how to analyse this situation is given in WaPUG User Note No 10, but familiarity with the use of the percentage runoff equation and Flood Studies Report is essential for this type of study.

7. RUNOFF IN OLDER WALLINGFORD PROCEDURE MODELLING PACKAGES

The earliest Wallingford procedure modelling packages calculated PR once for the entire catchments. This led to certain modelling approaches which should be considered when converting such models for use with more recent modelling packages.

The earliest models were more susceptible to the inclusion of extra permeable areas. For such models Rule (v) for total area was modified as given below.

(v)   Other permeable areas more than 10 m from a connected paved area should be included if this leads to an increase in total runoff from the catchment as a whole. This can be tested by hand calculation of the PR equation for the entire catchment. Any impermeable areas that are completely surrounded by and drain to these permeable areas (such as pathways and sports pavilions) should be taken into account in making this check. The effect may vary with catchment wetness. The check should therefore be made using the design value of UCWI. See also the comments on runoff from permeable areas later in this note.

There were also particular implications when modelling partially separate systems these are addressed in WaPUG User Note No 5.

AMENDMENTS

Ver	Description	Date
1.	First Published	September 1990
2.	Revision	March 2009

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