INSTITUTE OF HYDROLOGY

# THE WALLINGFORD URBAN SUBCATCHMENT MODEL

by

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ABSTRACT

This report describes the Wallingford Urban Subcatchment Model for the above-ground (hydrological) phase of the rainfall-runoff process, developed as part of a new de design package for storm sewer systems, in collaboration with the Hydraulics Research Station. The model has three components: a runoff volume submodel, a loss distribution (in time and space) submodel, and a surface routing submodel. A lumped modelling approach has been adopted with model parameters related to catchment characteristics through regression analysis. Finally, details are given of how the method can be applied in practice.

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## PREFACE

*This report is one of a series covering various aspects of continuing studies in urban hydrology.*

*Those available are:*

*53 RAINFALL-RUNOFF PROCESSES OVER URBAN SURFACES Proceedings of an International Workshop, April 1978*

*59 URBAN HYDROLOGY PROJECT: COLLECTION AND ARCHIVE OF UK HYDROLOGICAL DATA*

*60 THE WALLINGFORD URBAN SUBCATCHMENT MODEL*

*61 SELECTION OF DESIGN STORM AND ANTECEDENT CONDITION FOR URBAN DRAINAGE DESIGN*

*62 A SIMPLIFIED MODEL FOR SEWERED CATCHMENTS*

*63 THE EFFECTS OF URBANISATION ON FLOOD MAGNITUDE AND FREQUENCY*

*The work they describe was performed under contract to the Department of the Environment and formed the hydrological basis of new procedures for the design of storm sewers and of river works to cater for urbanisation.*

*December 1979*

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# 1. INTRODUCTION

As part of an ongoing programme of research in urban hydrology, the Institute was invited (in 1974) to contribute to the development of improved methods of storm sewer design. The overall responsibility for the programme lay with Hydraulics Research Station (HRS) acting under the guidance of a Working Party reporting to the Department of the Environment and the National Water Council. The Institute was to provide a mathematical model of the hydrological processes, which are predominantly above ground, while HRS would handle the underground pipe-flow routing, surcharging, and overflow aspects. This division of the two phases of runoff, above and below ground, was a new depature for a British design method and reflected growing concern that previous methods had not adequately mirrored observed features of the overall process.

Having decided to model the above ground phase of runoff separately, it became clear why it had not been done before; there were no relevant data. The first stage of the investigation, therefore, was to collect data at the point of entry to the sewer system (ie a road gully). Following the development of a meter for this purpose (Blyth and Kidd, 1977), a number of experimental sites were established in Stevenage, Bracknell, Southampton and Wallingford. Data were also exchanged with other European research workers (Kidd, 1978b) and some were derived from the laboratory catchment rig at Imperial College (Johnston & Wing, 1978). These various data, summarised in Table 1, enabled the runoff routing process to be studied on a reasonably wide range of slopes and sizes of typical subcatchments. All these data are described in detail in a companion report (Makin and Kidd, 1979). Meanwhile, existing and new data from larger fully-sewered catchments were being analysed in a study of catchment average values of runoff coefficients. Together, the two studies of runoff routing and of runoff coefficients enabled the development of a complete model of the above-ground process of rainfall-runoff transformation. Called simply the Wallingford Urban Subcatchment Model, its development, calibration, and testing are the subject of this report.

Existing storm drainage methods vary greatly in complexity and in the consequent demands they make on the designer to provide the necessary catchment details. On the one hand lie the traditional methods such as the Rational Method and its UK derivative, the Lloyd-Davies (1906) method, simple formulae, easy to apply but very crude and clearly inadequate in many design situations. On the other hand, there are now many methods - most of them developed in the USA - which attempt a much more comprehensive modelling of the various physical processes. Probably the most widely known is the Storm Water Management Model (SWMM) described by Metcalf and Eddy (1971). Such models are sophisticated and flexible enough to give

TABLE 2 SUMMARY OF SUBCATCHMENT DATA

| Subcatchment No | Name | Location | No of gullies | No of processed events | Total area to gully (m²) 1 | 2 | 3 | 4 | Period of experiment | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 203 | Ennerdale Two | Bracknell | 3 | 15 | 118 | 358 | 90 | | 1976-1977 | |
| 204 | Bishopdale | Bracknell | 2 | 11 | 167 | 591 | | | 1976-1977 | |
| 205 | Hyde Green North | Stevenage | 2 | 9 | 485 | 644 | | | 1976-1977 | |
| 206 | School Close | Stevenage | 2 | 13 | 459 | 717 | | | 1976-1977 | |
| 214 | Hawthorn Close | Wallingford | 4 | 11 | 215 | 145 | 176 | 206 | 1977-1978 | no data from gully 3 |
| 215 | Hyde Green North (78) | Stevenage | 1 | 12 | 1329 | | | | 1978-1978 | as 205, but 1 gully blocked |
| 216 | School Close (78) | Stevenage | 2 | 17 | 500 | 802 | | | 1978-1978 | as 206, but road widened |
| 301 | Twyford Gardens | Nottingham | 2 | 3 | 475 | – | | | 1978- | experiment continuing |
| 301 | Lelystad Housing Area | Lelystad, Netherlands | – | 10 | 20000 (total) | | | | 1969-1975 | |
| 311 | Lelystad Parking Lot | Lelystad, Netherlands | – | 10 | 7000 (total) | | | | 1969-1975 | |
| 4175 | Lund 1:75 | Lund, Sweden | 1 | 11 | 291 | | | | 1975 | |
| 4176 | Klostergarden 1:76 | Lund, Sweden | 1 | 11 | 326 | | | | 1976 | |
| 4177 | Klostergarden 1:77 | Lund, Sweden | 1 | 13 | 335 | | | | 1977 | |
| 4276 | Klostergarden 2:76 | Lund, Sweden | 1 | 11 | 82 | | | | 1976 | |
| 4277 | Klostergarden 2:77 | Lund, Sweden | 1 | 12 | 78 | | | | 1977 | |
| 4376 | Klostergarden 3:76 | Lund, Sweden | 1 | 11 | 306 | | | | 1976 | |
| 4377 | Klostergarden 3:77 | Lund, Sweden | 1 | 13 | 413 | | | | 1977 | |
| 4476 | Klostergarden 4 76 | Lund, Sweden | 1 | 10 | 277 | | | | 1976 | |
| 4477 | Klostergarden 4:77 | Lund, Sweden | 1 | 13 | 279 | | | | 1977 | |
| 101-5 | Lab Catchment | Imperial College | 1 | 102 | Various | | | | 1978 | |

excellent performance in the reproduction of observed data. However, they should be seen primarily as simulation models (not design models); they are more costly to operate and their requirements for catchment details are extensive. They can operate in design mode, but are then often obliged to run with default parameter values and this calls into question the benefits of their use, particularly in UK conditions where urban layout is much more irregular than in the USA.

Between the two extremes there lie a number of methods which aim for a compromise between scientific rigour and engineering expediency. The British Road Research Laboratory's hydrograph method (Watkins, 1962) is the best-known example having been widely used in the UK and, in various guises, overseas. The methods under development at HRS and IH fall into this category. Although it is also a compromise, the Wallingford urban subcatchment model incorporates rather more of the science with only a minor increase in data requirements when compared to the RRL method.

The rainfall-runoff processes over an urban subcatchment are as complex as on any other catchment. The apparent simplicity of an infiltration function, for example, is confounded by the variability of the surfaces and the interactions with temporary storages. So it is necessary to represent the processes by simpler concepts and, in Section 2, the use of storage elements based on reservoirs or channels is illustrated in the case of the Rational, RRL, and Wallingford models.

## 2. SIMPLE CONCEPTUAL MODELS OF THE HYDROLOGICAL PROCESSES

### The processes

The movement of water over the catchment surfaces of an urban area is often thought to be relatively easy to understand and to model. But in reality there is marked variability between inlet areas, even in the same catchment. Also, in any one area, there is a wide range of observed response to apparently similar input.

To illustrate some of the reasons why there is such variety, consider a storm starting to fall on a dry urban area. The first few tenths of a millimetre are absorbed by all the different surfaces. Then, on the least pervious surfaces droplets coalesce and small pools form quickly. On steep slopes, downhill movement begins immediately: in flat areas, puddles form. As the storm continues, overland flow is generated on an increasing proportion of the catchment. Finally, all the surface depressions are full and most of the impervious area is contributing some incident rainfall to the overland flow process. Most urban surfaces, however nominally impervious, allow some degree of infiltration or hold water by surface tension so do not contribute 100% runoff. A certain proportion of the impervious area will contribute even less, because its runoff is immediately passed to pervious surfaces either by design or by inadvertent gutter overflow. The timing and volume of runoff from the 'impervious' surfaces can therefore be expected to depend on the permeability, the state of maintenance, the rate of rainfall, surface slopes and design features such as whether or not front driveways shed water to the side (onto earth or grass) or to the road.

A similar sequence is followed on the pervious parts of the catchment but usually at a much reduced rate since infiltration is the dominant process. Runoff generation is dependent on the type of soil, the rainfall intensities, surface slopes, and vegetation. A steeply sloping, close cropped grass verge on a clay soil can become a runoff contributing area before a flat and poorly maintained (i.e. potholed) car parking area.

Clearly, if the catchment is wet at the start of the storm, with some of the surface depressions already full and with saturated soils, the proportion of runoff is likely to be significantly increased.

As the generated runoff moves downhill over the assorted surfaces, its depth and velocity changes with distance and time depending on the surface slope and roughness. These changes can be described mathematically in the idealised case of sheet flow over plane surfaces (the St Venant equations) but these equations (one for the conservation of mass and one for the conservation of momentum) are too complex for analytical solution. Numerical solutions are possible but time consuming. Fortunately, the kinematic wave model (Wooding, 1965; Rovey and Woolhiser, 1977) is particularly applicable to overland flow modelling where spatially uniform rain is converted to a hydrograph at the point where the flow converges. This is a simplification of the general conservation of momentum equation and reduces to the statement that, for a given type of surface, discharge per unit width is a function only of depth. Of course, the mass conservation equation still applies, computing is costly, and application to the markedly irregular surfaces of a real catchment is hard to justify in a design method. For the purposes of this section, however, the kinematic wave equation will be assumed to be the optimum representation of above-ground runoff routing; the assumptions of the various models used in design will be related to it below.

The processes discussed above - infiltration, filling and overflow from depression storages, overland flow - are those of most significance in urban rainfall-runoff modelling. Other processes, such as interception and evaporation, have a negligible effect in the time scale of a storm event on urban areas, although evaporation is clearly important in determining how quickly a catchment dries out between events.

This brief account of the major processes is intended to show that a model based on physical laws would be inappropriate for simulation purposes (i.e. to reproduce observed events on an existing catchment) let alone design (imaginary events on a future catchment). This is partly because the laws themselves are complicated and require an unlikely knowledge of initial conditions but mainly because the individual microtopography of sub-catchments draining to inlets may be beyond description and is certainly beyond prediction. Despite being a simplified version of the theoretical flow equations, even the kinematic wave model of the overland flow process is too complex for design use.

These more physically-based options such as the kinematic wave model require the division of the subcatchment into a network of segments - these are either overland flow segments (rectangular in plan), the input to which is rainfall intensity, or channel segments, the input to which is either an inflow hydrograph at the top of the reach and/or a spatially (but not temporally) constant lateral inflow. In some cases the division of the subcatchment into such segments is quite convenient, as in the case of the subcatchment in Figure 1, which may be quite well represented as two overland flow segments leading into a central channel or gutter segment. Under these circumstances, simulation using such a model can be very fruitful. The example in Figure 2 shows a comparison between simulated and recorded hydrographs for an event on the subcatchment in Figure 1. The simulated hydrograph is produced by the kinematic wave model (formulated after Singh, 1975). This analysis demonstrates that a good reproduction of observed data can be achieved by the use of a physically-based distributed approach. More comprehensive details of this model have been given by Gunst and Kidd (1979).

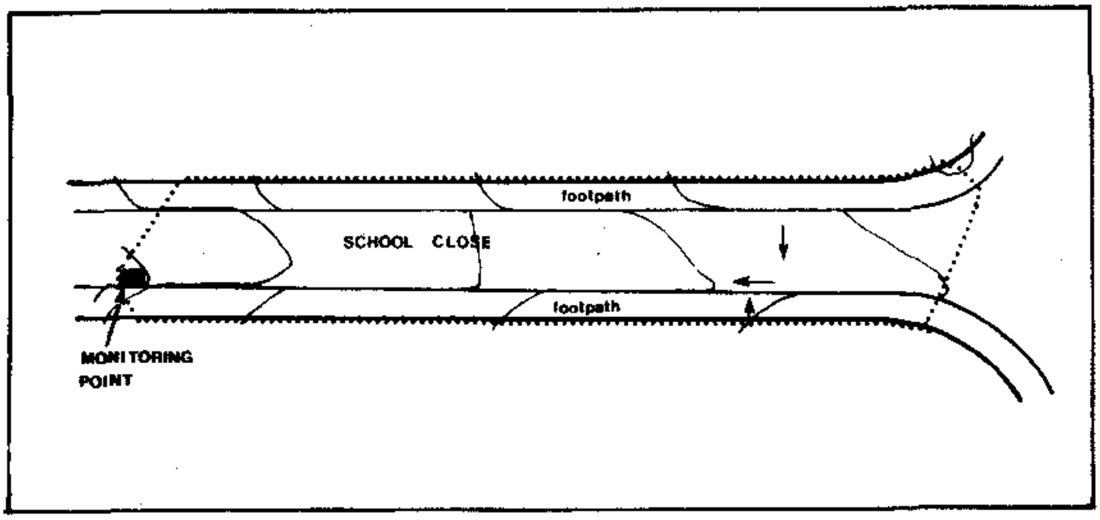



FIGURE 1 SCHOOL CLOSE SUBCATCHMENT, STEVENAGE (206/2)

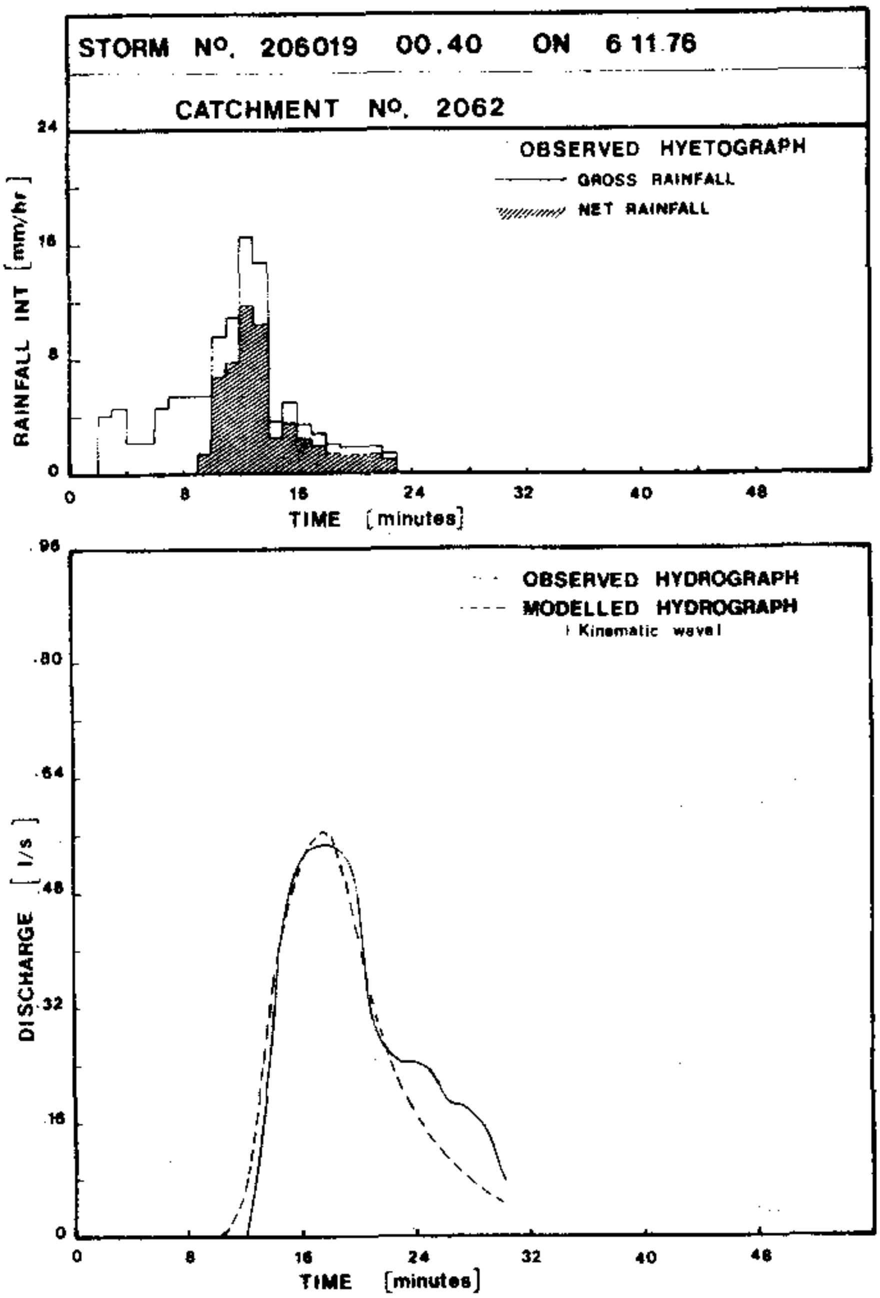



FIGURE 2 EXAMPLE OF PERFORMANCE OF KINEMATIC WAVE MODEL

Similarly successful results have been reported by Lyngfelt (1978) under very similar circumstances. However, subcatchments seldom yield themselves very satisfactorily to the kind of segmentation used in this example, even if the considerable increase in the data requirements could be justified. In practice, a certain amount of idealisation of catchment geometry becomes necessary (c.f. the SWMM runoff block - Metcalf and Eddy, 1971), under which circumstances a physically-based solution on an idealised catchment loses any advantage that it might have had over its conceptual counterpart.

Although, as demonstrated, it would be unrealistic for a model to be based explicitly on the individual physical processes, their effects can be represented in a simplified way consistent with the accuracy required by, and the data available to, design users. Hydrologists do this by conceiving the various processes as storage elements (simple channels or reservoirs) each with prescribed capacities and/or storage v. outflow relationships. There may also be parameters defining the branching of input between different storages (e.g. some runoff from grassed areas passing on to impervious areas and vice versa). Clearly, this approach to modelling can, like the physical approach, become much more complicated than is warranted by the problem. Figure 3 illustrates a typical set of linked storages and represents probably the most complicated model of this type that could be visualised for practical purposes.

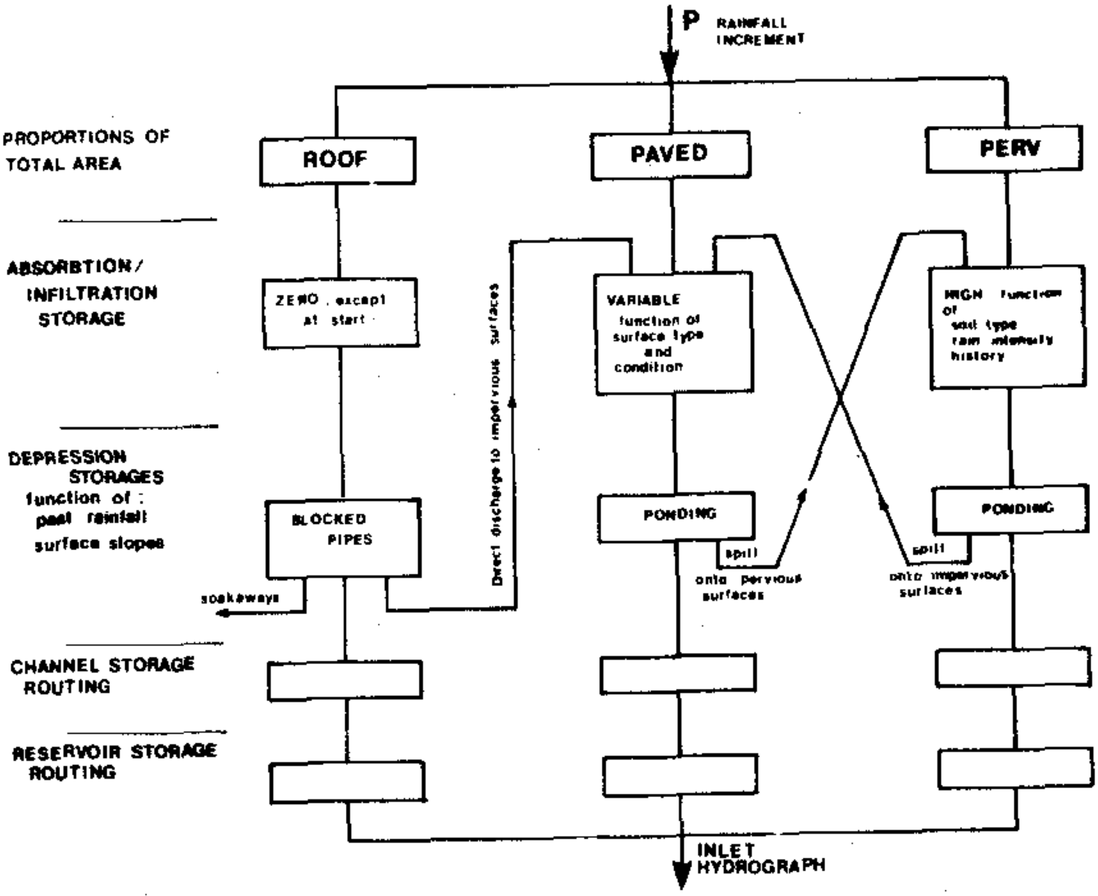



FIGURE 3 STRUCTURE OF CONCEPTUAL MODEL

## The simple models

The arrangement of conceptual storage elements illustrated in Figure 3 needs to be further simplified for practical applications. Although the Rational and RRL (now TRRL) Methods are quite different in their treatment of pipeflow, they use an identical model of the above ground phase. In the context of Figure 3, 'Roof' and 'Paved' areas are combined; infiltration and depression storages are assumed to be zero on the combined impervious surfaces and assumed to be infinite on the pervious surface. Reservoir storage routing is neglected and channel storage routing is achieved by the 'time of entry', - usually two or three minutes and representing travel time for water flowing on the surface. It can be shown (Appendix 1) that the use of a time of entry (Te) by the Rational and TRRL methods with a computing time step of $\Delta t$ is equivalent to a set of n equal width linear channels with travel times $\frac{\Delta t}{2}$, $\frac{3\Delta t}{2}$ ....... $(n-\frac{1}{2})\Delta t$. The channels operate in parallel with each receiving an identical input (rainfall) from $\frac{1}{n}$th of the of the subcatchment area. As elaborated in Appendix 1, the time of entry concept, being equivalent to linear channels, is an unjustified simplification of the kinematic wave model.

The Wallingford model's structure will be described in much more detail in the remaining sections but, at this stage, it is useful that it, too, should be briefly outlined in terms of Figure 3. In the Wallingford urban subcatchment model the three surface types are treated separately. Depression storage is expressed in terms of surface slope for paved and pervious areas; it is constant for roofs. Infiltration storage sizes and other parameters related to the interchange of flow from one surface to another are represented by proportional runoff functions giving the effective contributing areas of pervious and impervious types. Finally there is no channel storage routing but runoff from each surface type is passed through a (non-linear) reservoir storage whose storage constant is predicted from area and slope. It will be shown in Section 5 that, unlike the time of entry model, such a representation can be viewed as a logical simplification of the hydraulic principles behind the kinematic wave model.

## 3. PREDICTION OF RUNOFF VOLUME

### The statistical approach

Both the Lloyd Davies and Rational Methods assume that there is 100% runoff from impervious surface and 0% from pervious surfaces. These simplifications are refuted by experimental evidence, although errors incurred by the two assumptions are, if not equal, at least opposite. It was thought preferable for the Wallingford model to be based on actual runoff volume data and to relate these observations to measurable catchment characteristics and other variables. A statistical approach to the problem was adopted, as has been done recently for natural catchments in the Flood Studies Report (NERC, 1975). An earlier report (Stoneham and Kidd, 1977) gives a full account of the multiple regression procedure which was used and describes the various relationships which were explored; the next section briefly recounts the relevant features of that report. Since its publication, however, further data have been acquired and the calibration of the preferred relationship has been revised as described overleaf.

## Preliminary investigations (Stoneham and Kidd, 1977)

Having identified a number of catchment characteristics (paved, roofed and pervious areas, catchment slope, soil type) and storm variables (rainfall volume, duration, catchment wetness) which might be expected to affect runoff volume, these were extracted from the available data for the U.K. (Makin and Kidd, 1979). This resulted in a data set of 368 events on a total of 14 catchments.

In attempting to predict the runoff volume for a given rainfall event, some assistance can be given to the model by introducing into the dependent variable some other variables (principally rainfall volume and catchment area) which have the strongest direct effect. The major division that remains is between a loss rate type model (dependent variable = rainfall-runoff) and a percentage runoff model (dependent variable = runoff ÷ rainfall). The authors were able to demonstrate that the percentage runoff form of the model was much more appropriate and the finally adopted regression equation was

$$PR = -33.6 + .924\ PIMP + 53.4\ SOIL + .065 UCWI \quad \ldots\ldots \qquad (1)$$

where PR is the percentage runoff (%)

PIMP is the percentage impervious (%)

SOIL is the soil index (NERC, 1975)

and UCWI is the urban catchment wetness index, given by UCWI = 125 + 8API5 - SMD,

where API5 is the 5-day antecedent precipitation index using a daily decay factor of 0.5 and SMD is the soil moisture deficit.

This equation explained 53% of the variance in percentage runoff (correlation coefficient = .73), and each of the coefficients of the independent variables is highly significant (to within the .01% level).

It is possible to obtain unsound predictions from equation (1) by adopting extreme values of the independent variables. For the model to be useful in design, it is clearly important for it to be robust (in the sense that the model should give a reasonable result whatever set of conditions might be encountered for a sewered catchment). The work which has followed the publication of the results described above has been aimed at (a) the modification of equation 1 in the light of new data, and (b) appropriate adjustments to ensure the robustness of the model.

## Incorporation of additional data and model refinements

The addition of further data comprises (a) extra events on catchments included in the previous set (85 events on 4 catchments), and (b) new catchments (98 events on 3 catchments). This resulted in a total data set of 551 events on 17 catchments. This was reduced to a total of 510 events by the exclusion of all events having a rainfall volume of less than 2 mm. This data set is summarised in Table 2, and the catchment locations are shown in Figure 4. The complete data set is in Appendix 2.

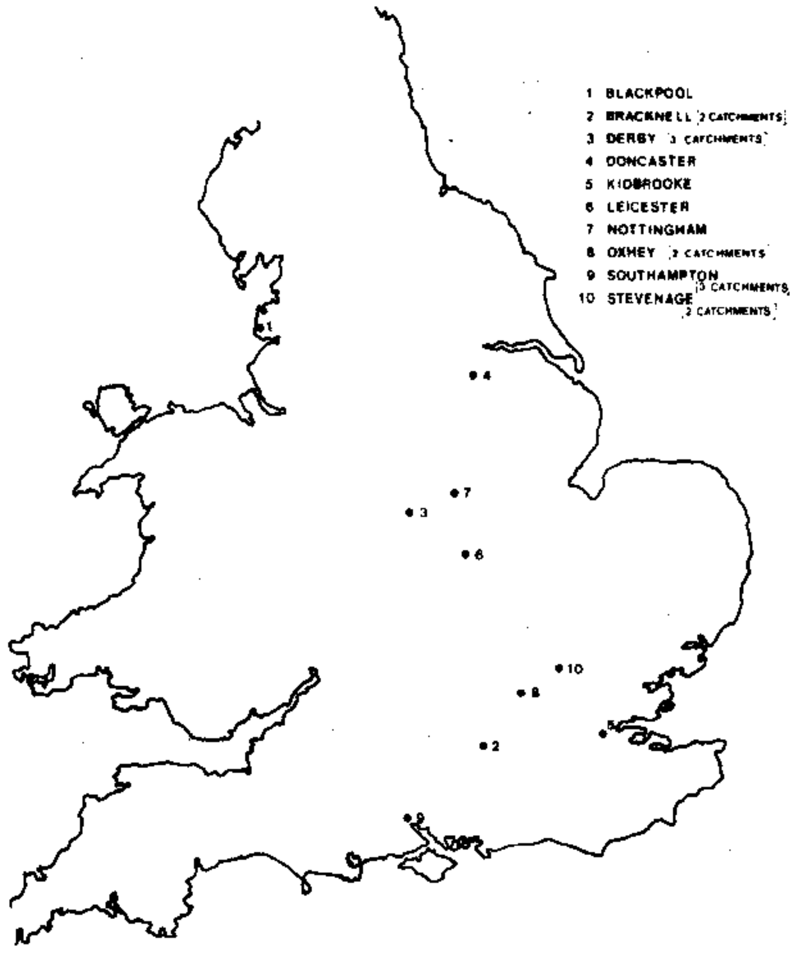



**FIGURE 4** LOCATION OF CATCHMENTS IN RUNOFF VOLUME DATA SET

TABLE 2 BRIEF DETAILS OF CATCHMENTS IN RUNOFF VOLUME DATA SET

| Catchment name and number | | Brief catchment description | Rainfall | Runoff | Sponsor | Total Area | % Imperv | Period of data | No of events |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Blackpool | Medium density residential development circa 1939 | RRL autographic gauge | Standing wave flume in combined sewer | RRL | 4.82 | 41.9 | 1953-1958 | 39 |
| 3 | Doncaster | Low density residential development probably prewar | RRL autographic gauge | Standing wave flume in separate sewer | RRL | 5.14 | 30.0 | 1955-1958 | 19 |
| 5 | Kidbrooke | Small factory area with large concrete yards | RRL autographic gauge<br>Dines autographic gauge | Standing wave flume in separate sewer | RRL | 3.42 | 68.2 | 1953-1958 | 70 |
| 6 | Leicester | Mixed older type development. High density close to outfall - low density at top of catchment | 2 RRL autographic gauges | Standing wave flume | RRL | 59.50 | 36.1 | 1958 | 6 |
| 7(1) | Oxhey Housing Estate | Large residential development | 3 RRL | Standing | RRL | 247.00 | 19.8 | 1953-1959 | 26 |
| 7(2) | Oxhey Road | 500 m length of road and grass verge in a shallow cutting | RRL autographic gauge. Dines autographic gauge | V notch weir | RRL | .78 | 60.3 | 1954-1959 | 46 |
| 8 | WPRL (Stevenage) | Small factory area similar to Kidbrooke | RRL autographic gauges<br>Dines autographic gauge | V notch | RRL | 1.39 | 50.0 | 1955-1959 | 14 |
| 9(1) | Wildridings (Bracknell) | Modern residential development, including shops and school | Dines autographic gauge | Standing wave flume at outfall | DGWE | 11.60 | 46.2 | 1974-1978 | 18 |
| 9(2) | G.T. Hollands (Bracknell) | Modern residential development similar to Wildridings | Dines autographic gauge | Standing wave flume at outfall | DGWE | 191.06 | 40.1 | 1974-1978 | 11 |

TABLE 2 Contd

| Catchment name and number | | Brief catchment description | Rainfall | Runoff | Sponsor | Total Area | % Imperv | Period of data | No of events |
|---|---|---|---|---|---|---|---|---|---|
| 10(1) | St Marks Road (1) (Derby) | 3 nested catchments mixed age residential area | Dines autographic gauge | Stage is measured in pipe at 3 points in the system (Arkon air purge system) | DGWE | 10.4 | 59.2 | 1974-1978 | 19 |
| 10(2) | St Marks Road (2) | | | | | | | | |
| 10(3) | St Marks Road (3) | | | | | | | | |
| 11 | Shephall (Stevenage) | Modern residential development | 2 dines autographic gauges | Stage in system. Flume at outfall | DGWE | 147.18 | 23.5 | 1974-1978 | 55 |
| 52(1) | Lordshill (1) | 3 small adjacent catchments, modern residential | Cassella tipping bucket gauge | Arkon | University of Southampton | .80 | 41.3 | 1974-1978 | 20 |
| 52(2) | Lordshill (2) | | | System in pre-fabricated flumes at outfalls | | .60 | | 1974-1978 | 15 |
| 52(3) | Lordshill (3) (Southampton) | | | | | 7.23 | 48.7 | 1978 | 3 |
| 55 | Rise park (Nottingham) | Modern residential development | Tipping bucket gauge | Dilution gauging | Trent Poly-technic | 62.0 | 31.1 | 1974 | 7 |

The equation resulting from a regression analysis with the final data set is

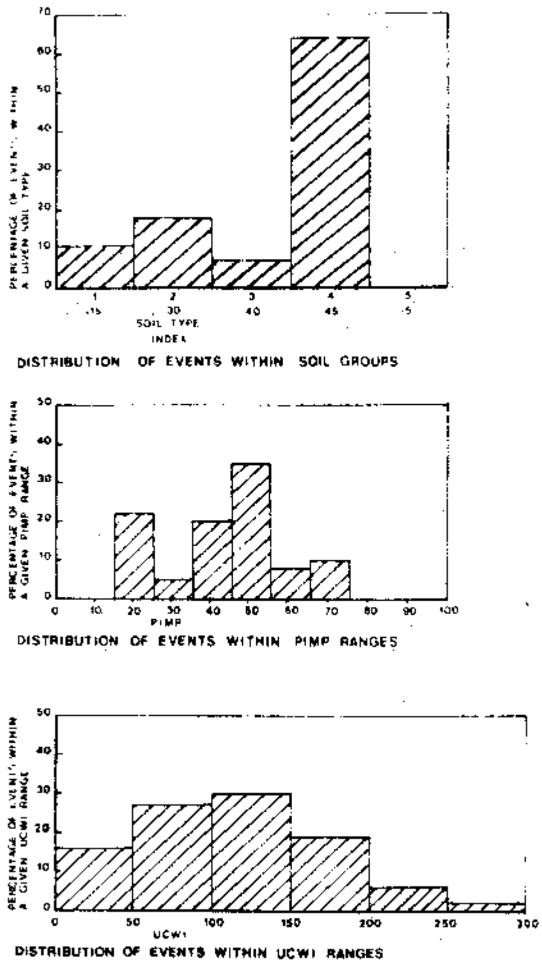
$$PR = -26.8 + .85\,PIMP + 39.6\,SOIL + .074\,UCWI \quad .. \quad (2)$$

This equation explains 58% of the variance in percentage runoff (correlation coefficient = .76), and the standard error of the estimate is 10.2%. Comparison of this with equation 1 indicates that the constant and coefficients of PIMP & SOIL have decreased while the significance of catchment wetness has increased slightly.

In terms of robustness, equation 2 is an improvement on its predecessor. It will always give sensible results at the top end of the percentage runoff scale, but erroneous results can be obtained at lower percentage impervious catchments on low soil-types. One cause of this problem is demonstrated in Figure 5, which shows the frequency distributions of the three variables within the data set. The predominance of high soil type catchments in the data set (which fairly samples the distribution of soil-types in U.K.

**FIGURE 5**

**FREQUENCY DISTRIBUTIONS OF THE INDEPENDENT VARIABLES**



urban areas) is reflected in the fact that the model fits high soil type catchments better than low soil-type ones. It should be stressed that the model is only poor for combinations of low values of PIMP on low soil-types, and thus the shortcomings are only associated with a very small number of catchments. Another interesting facet of Figure 5 is the higher probability of dry conditions (low UCWI) at the start of significant rainfall events on urban catchments. Although this simply confirms the accepted fact that high intensity, short duration storms are more common in summer, it has the unfortunate side-effect of preventing rainfall volume from appearing as a significant dependent variable in equation 2. Arguing from intuition and the physics of the dominant infiltration process, it would seem likely that higher rainfall should cause higher values of percentage runoff (all other things being equal). But the effect is masked by the fact that higher rainfalls tend to be associated with drier antecedent conditions and these produce lower values of percentage runoff. Despite this intuitive reasoning it was decided that, unlike the Flood Studies Report (NERC, 1975) where extrapolation to extremes of rainfall are involved, rainfall would not be forced into the regression equation.

Intuition did, however, have a part to play in refining the coefficient of the SOIL term. It is considered that the coefficient of SOIL in equation (2) gives a stronger control on the percentage runoff than might intuitively be expected. For this reason, the possibility of forcing the equation to take a lower value was investigated. This produces a sub-optimum solution as far as the correlation coefficient is concerned, and the manner in which its value falls away with decreasing values of the SOIL coefficient is shown in Figure 6. A SOIL coefficient of 25 is considered to be a satisfactory compromise, and this equation is given by:

$$PR = -20.7 + .829\ PIMP + 25\ SOIL + .078\ UCWI \quad \ldots \quad (3)$$

The correlation coefficient is still .76, but the standard error of the estimate has increased to 10.3.

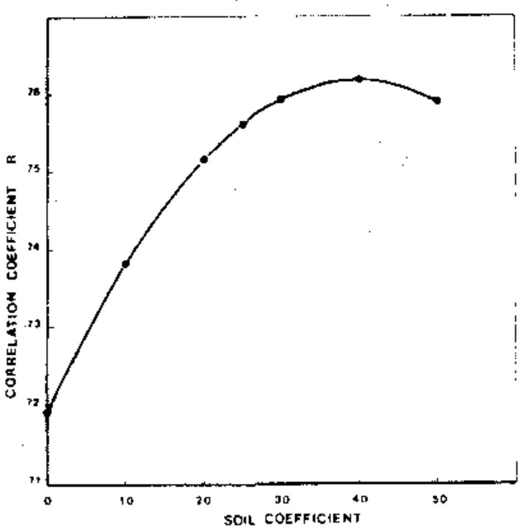



**FIGURE 6**

VARIATION OF CORRELATION COEFFICIENT WITH SOIL COEFFICIENT

The reduction of the SOIL coefficient between equation (2) and equation (3) has improved the robustness of the model, although erroneous results are still possible under very extreme conditions at low percentage runoffs. For this reason, a limiting condition has been put on the model which is:

$$\text{If } PR < .4\ PIMP, \text{ then } PR = .4\ PIMP \quad \ldots \quad (4)$$

Examination of equation (3) shows that for soil-type 1(SOIL = .15) and UCWI = 50 (minimum design value - see Kidd and Packman, 1979), this limiting condition comes into effect for PIMP < 26%. For soil-types 2 and 3, it comes into effect for PIMP < 17% and 11% respectively.

It is believed that a major source of remaining unexplained variance is associated with the variability of infiltration through paved surfaces. The Road Research Laboratory (Watkins, 1962) provided a graphic demonstration of this variability by resurfacing one of their Stevenage catchments - this increased the average percentage runoff from 22% to 34%. The Institute of Hydrology's own experimental programme (Makin & Kidd 1979) also demonstrated the large range in observed rates of infiltration. For the purposes of a design model, an index related to the degree of permeability is impracticable. Therefore, equation (3) with the limiting condition given by equation (4) is considered to be a suitable compromise. However, it is encouraging to note that the engineer may obtain an additional safety factor by ensuring that a very porous surface dressing is used.

Equation (3) with the limiting condition given in Equation (4) is considered suitable as a model for the prediction of runoff volume. A demonstration of how the model fits each of the 17 catchments used in the analysis is shown in Appendix 3. Analysis of variance has shown that two-thirds of the unexplained variance is associated with within-catchment variability and the remaining third is associated with variations from catchment to catchment.

A simplified model

Equation (3) is a suitable model for use in conjunction with a pipe routing model (for instance Bettess & Price, 1978), in the application of a design and simulation method for storm sewer systems. However, there is a further requirement for a slightly simpler version of the model for use in simple planning applications. A regression of percentage runoff on percentage of impervious surface alone yields:

$$PR = 1.2 + .74\ PIMP \quad \ldots \quad (5)$$

The correlation coefficient is .61.

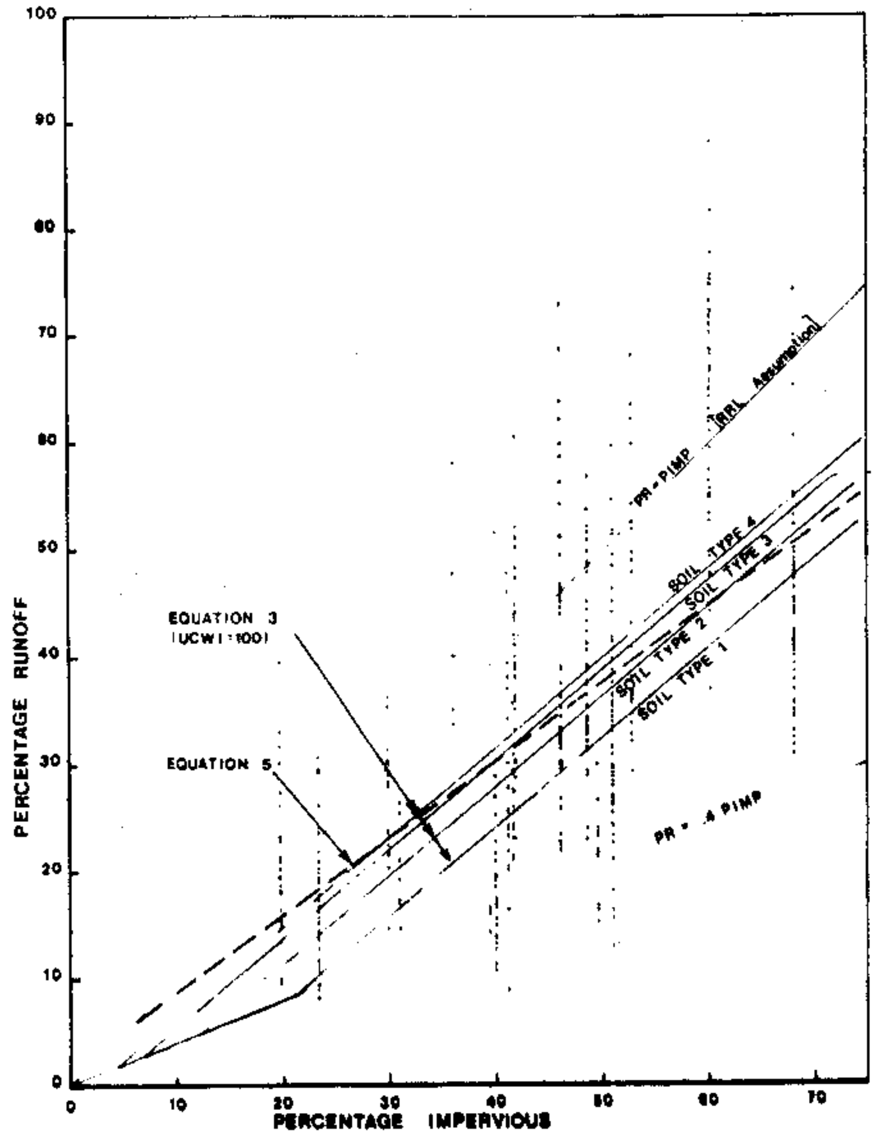



FIGURE 7 VARIATION OF PERCENTAGE RUNOFF WITH PIMP

Figure 7 shows the plot of equations (3), (4) (a value of UCWI = 50 is assumed) and (5), together with all the data used in the analysis. It shows how the omission of the SOIL variable in moving from equation (3) to equation (5) introduces a bias in that catchments with a high percentage of impervious surfaces are assumed to be on a low (high infiltration) soil type and vice versa. For this reason, equation (5) is only suitable for preliminary estimates.

Figure 7 also shows the Rational and RRL methods' assumption (PR = PIMP) in the light of the collected data; it is clearly conservative, especially on catchments with a low soil index.

# 4. DISTRIBUTION OF NET RAINFALL IN TIME AND SPACE

## Time distribution of net rainfall (loss model)

The basic loss model selected for use with each surface type separately is an 'initial loss plus constant contributing area' model. The initial loss is considered to be that due to depression storage and is assumed to be constant for a particular subcatchment. This is clearly an over-simplification and is the concept of initial loss *per se*, but it is usually a very small fraction of the design storm rainfall.

Falk and Kidd (1979) describe an analysis which can be used to determine the depression storage on a given subcatchment. This analysis involves a plot of rainfall volume against runoff volume - the intercept on the rainfall axis gives the depression storage estimate while the slope of the line reflects any time-varying loss. Such estimates were obtained for a total of 27 subcatchments, and a relationship generated to predict the depression storage in terms of the average ground slope (%), given by:

$$\text{DEPSTOG} = .71\ \text{SLOPE}^{-.48}$$
(correlation coefficient = .84) ... (6)

Although the size of the depression storage is quite small (of the order of .5 - 1 mm) in the context of a design model, the fact that it occurs at the beginning of an event may mean that it has a significant effect on the timing of runoff. The value of depression storage predicted from equation (6) is taken to apply, in design, to the combined paved and pervious areas. For roofs, a constant value of 0.4 mm is assumed.

Having deducted depression storage from the beginning of a storm, the remaining loss is applied as a constant proportion. For reasons which will be enlarged upon later (Section 6) it is convenient to regard this remaining loss as serving to limit the effective contributing area of the particular surface type. In other words, all the remaining rainfall (i.e. after deduction of depression storage) is assumed to run off from a reduced (or 'notional') contributing area. As far as the arithmetic of losses is concerned, however, the percentage runoff for each surface type is exactly equal to the ratio of contributing area to total area. So now it is necessary to estimate the percentage runoff values for each surface type.

## Spatial distribution of net rainfall

The prediction equation (3) provides a catchment average value of percentage runoff. It remains to distribute this between the separate paved, pervious, and roofed surface types. The rules for doing so are necessarily arbitrary but have the merit of simplicity. Firstly, the amount of runoff generated from an assumed 70% of the impervious surface is compared to the equation (3) estimate; the difference is called x:

$$x = PR - 70 \times \frac{PIMP}{100} \qquad \ldots \quad (7)$$

If x is negative, the runoff is assumed to be confined to the impervious surfaces (paved ground surfaces and roofs)

$$\left.\begin{array}{l} PR_{pav} = PR_{roof} = \frac{PR \times 100}{PIMP} \\ PR_{perv} = 0 \end{array}\right) \qquad \ldots \quad (8)$$

If x is positive, the extra (i.e. that required in excess of 70% from the impervious surfaces) is assumed to be generated equally on all surfaces.

$$\left.\begin{array}{l} PR_{pav} = PR_{roof} = 70 + x \\ PR_{perv} = x \end{array}\right) \qquad \ldots \quad (9)$$

These conditions may be expressed quite simply. If 70% or less runoff from the impervious surfaces is sufficient to provide the quantity predicted from equation (3), there is no runoff from pervious surfaces. Otherwise, the additional runoff required is assumed to be generated equally on all surfaces. Knowing the percentage runoff figures for each surface type and taking depression storage into account, notional contributing areas are calculated for use in scaling the results of applying the reservoir routing model.

$$\left.\begin{array}{l} A_{pav} = PR_{pav} \left(\frac{RF}{RF-DEPSTOG_{pav}}\right) * AREA_{pav}/100 \\ A_{perv} = PR_{perv} \left(\frac{RF}{RF-DEPSTOG_{perv}}\right) * AREA_{perv}/100 \\ A_{roof} = PR_{roof} \left(\frac{RF}{RF-DEPSTOG_{roof}}\right) * AREA_{roof}/100 \end{array}\right) \qquad \ldots \quad (10)$$

# 5. SURFACE ROUTING MODEL

## Surface routing by a non-linear reservoir

The choice of the non-linear reservoir as a single conceptual storage element to model a subcatchment's retention and translation processes followed from previous satisfactory experience of its use (Kidd and Helliwell, 1977; Kidd, 1976). It is a two-parameter model which simply represents the whole of the subcatchment (or particular surface type within the subcatchment) as an ordinary reservoir with a relationship between storage and outflow:

$$S = kQ^n \quad \ldots \quad (11)$$

and obeying the normal requirements of continuity:

$$\frac{dS}{dt} = I - Q \quad \ldots \quad (12)$$

I is the input (net rainfall, mm per time unit)

Q is the outflow (mm per time unit)

S is the storage (mm)

K and n are the two model parameters

It should be noted that the non-linear reservoir is operating directly on the rainfall rather than on the rainfall multiplied by area (to convert to units of discharge) or on the rainfall multiplied by percentage runoff. This does not affect the principle of the model although changes of scale or units will clearly require different K values (see page 22).

Justification for a non-linear reservoir concept follows broadly from consideration of the Chézy formula where, for wide shallow flow, the dependence of velocity (v) on depth (h) is expressed as

$$V = C\,h^{\frac{1}{2}} \quad \ldots \quad (13)$$

where C is the Chézy constant

If the flow is assumed to be spilling from a rectangular sided tank of length L and width W then the discharge is V.W.h. and the storage is W.h.L. Thus

$$Q = C.W.h.^{3/2}$$

$$= C.W. \left(\frac{S}{WL}\right)^{3/2}$$

$$\text{or} \quad S = k.Q^{2/3} \qquad \ldots \qquad (14)$$

a non-linear reservoir.

k, the storage constant, cannot sensibly be evaluated from C, L, and W as L and W are not measurable quantities and C is dependent on depth (Ackers, 1963). *So these lines of argument do not* comprise a proper mathematical justification for the model; they merely point to a logical basis for considering the model in the first place and for fixing the value of n. As Kidd (1978a) has shown, the optimum values of n and k are highly interdependent and very little is lost by adopting a fixed value of n. The value of 2/3 is, in fact, close to the average optimum value and it was adopted in all use of the model.

From equations (11) and (12):

$$nkQ^{n-1} \frac{dQ}{dt} = I - Q \qquad \ldots \qquad (15)$$

There is no direct analytical solution for general values of n and $I \neq 0$, but a numerical approximation is suitable for computer application. Expressing (15) in finite difference form

$$f(Q_2) = n.k \left|\tfrac{1}{2}(Q_2 + Q_1)\right|^{n-1} . \frac{Q_2 - Q_1}{\Delta t} + \frac{(Q_2 + Q_1)}{2} - I = 0 \qquad (16)$$

Knowing I (the rainfall intensity during the $\Delta t$ computation interval) and $Q_1$ (the 'routed' rainfall intensity at the start of the interval), equation (16) is solved for $Q_2$ by a Newton-Raphson iteration:

$$Q_2' = Q_2 - \frac{f(Q_2)}{f'(Q_2)} \qquad \ldots \qquad (17)$$

which usually converges to the required accuracy within four iterations. Although this may seem a more laborious model for urban runoff routing than, say, the time of entry, it is found to occupy a very small proportion of the computer time required in simulation of a sewer system.

Having described the operation of the non-linear reservoir model, it remains to evaluate k, the routing constant. As with *percentage* runoff, a multiple regression approach was adopted. Optimum values of k were derived from gully-meter data collected on the four experimental areas at Bracknell, Stevenage, Wallingford and Southampton (Makin and Kidd, 1979). However, to maximise the range of catchment soils and slopes, data from other workers were also used as described in the next section.

Results from the International Workshop, April 1978

In 1977, preliminary contact was made with a number of European research groups who were working along very similar lines in the collection and analysis of urban subcatchment data. As a result, an International Workshop was held at the Institute of Hydrology in April 1978 for a concentrated attack on the common problem. The proceedings of this Workshop are available as a companion report (Kidd, 1978b), but a brief resumé of the findings now follows.

Firstly, the Workshop participants investigated optimisation methods, concluding that the most appropriate method was to fit the model by a least squares objective function to each event in turn (a Rosenbrock (1960) algorithm was employed); the "best" value of routing constant for a given subcatchment equals the arithmetic mean of the event optima. Secondly, a number of loss models were studied and the 'initial loss plus continuing proportional loss rate' model was considered to be the most suitable of those examined.

Finally, seven different surface routing models were compared. Each model was optimised on 12 of the 16 available subcatchments for which there were rainfall and runoff data. The optimum routing constants for these 12 subcatchments were regressed on catchment characteristics; the resulting equation was then used to predict suitable values for the remaining 4 subcatchments. Simulations on all the events in these latter 4 subcatchments permitted two major conclusions to be drawn as to the relative merits of the 7 models:

> The non-linear models (such as that described above) were generally better than the linear ones.
>
> The time of entry model as used by the rational and TRRL methods (see also Section 2. and Appendix 1), and with the recommended design value of 2-4 minutes, typically overestimates the peak outflow by a large margin. Even when the time of entry was related to catchment characteristics, the model performed less satisfactorily than the others.

As the single non-linear reservoir model was found to be as good as any other, its adoption for the current study was confirmed. Relating the routing constant to catchment characteristics produced:

$$k = .172 \text{ SLOPE}^{-.362} \text{ LENGTH}^{.068} \quad \ldots \quad (18)$$

where LENGTH is the maximum overland flow length in metres. (In this case, k is appropriate to the case when rainfall is multiplied by percentage runoff before routing - see next section).

Developments in the prediction of the routing constant

Following the International Workshop, further data became available which allowed refinement of equation (18). Among these were some data received from controlled experiments made on the laboratory catchment at Imperial College (Johnston & Wing, 1978). Table 3 summarises all the data finally used in the analyses and gives the optimum k values derived for each catchment. Two sets of k values are given (i) those applicable when the proportional runoff is applied after routing and (ii) (in brackets), those when rainfall is multiplied by percentage runoff before routing i.e. as with equation (18). It was decided to adopt the former set in accordance with the model as described earlier because it is consequently much simpler to apply in the design situation. The different k values are logically related: rewriting (15) with $n = \frac{2}{3}$

$$k = \text{const.} \ \frac{(I-Q)}{dQ/dt} \cdot Q^{1/3} \qquad \ldots \qquad (19)$$

Changes in the scaling of I and Q by a multiplier, X, therefore result in a change to k by the multiplier $X^{1/3}$. In the case of the percentage runoff multiplier, k values optimised when PR is applied before routing should be divided by $PR^{1/3}$ to give the equivalent values for the case when PR is not so applied (ie as $PR \nmid 1$, they are always increased - as shown in Table 3).

Using the data in Table 3, the new equation for k is

$$k = .051 \ \text{SLOPE}^{-.23} \ (\text{AREA}_{pav})^{.23} \qquad \ldots \qquad (20)$$

The correlation coefficient is 0.67 (but over half the unexplained variance is associated with 3 subcatchments) and the standard errors of estimate are - 24% to + 32%. Figure 8 shows two graphical representations of Equation (20).

The reason for inclusion of $\text{AREA}_{pav}$ in preference to LENGTH is twofold: firstly, it is a more readily available catchment characteristic, and, secondly, it is the more significant variable in the large data set. It is, therefore, the paved subcatchment area per gully which is the required variable when the equation is applied in the design situation where 'subcatchments' include several road gullies.

The optimum k values of Table 3 apply to ground surfaces (or flat roofs). Ideally, pitched roof data should be used to establish an appropriate k value for this case, but such data are scarce. One such roof has been monitored by the Geography Department of Middlesex Polytechnic (Makin and Kidd, 1979) and some analyses have been

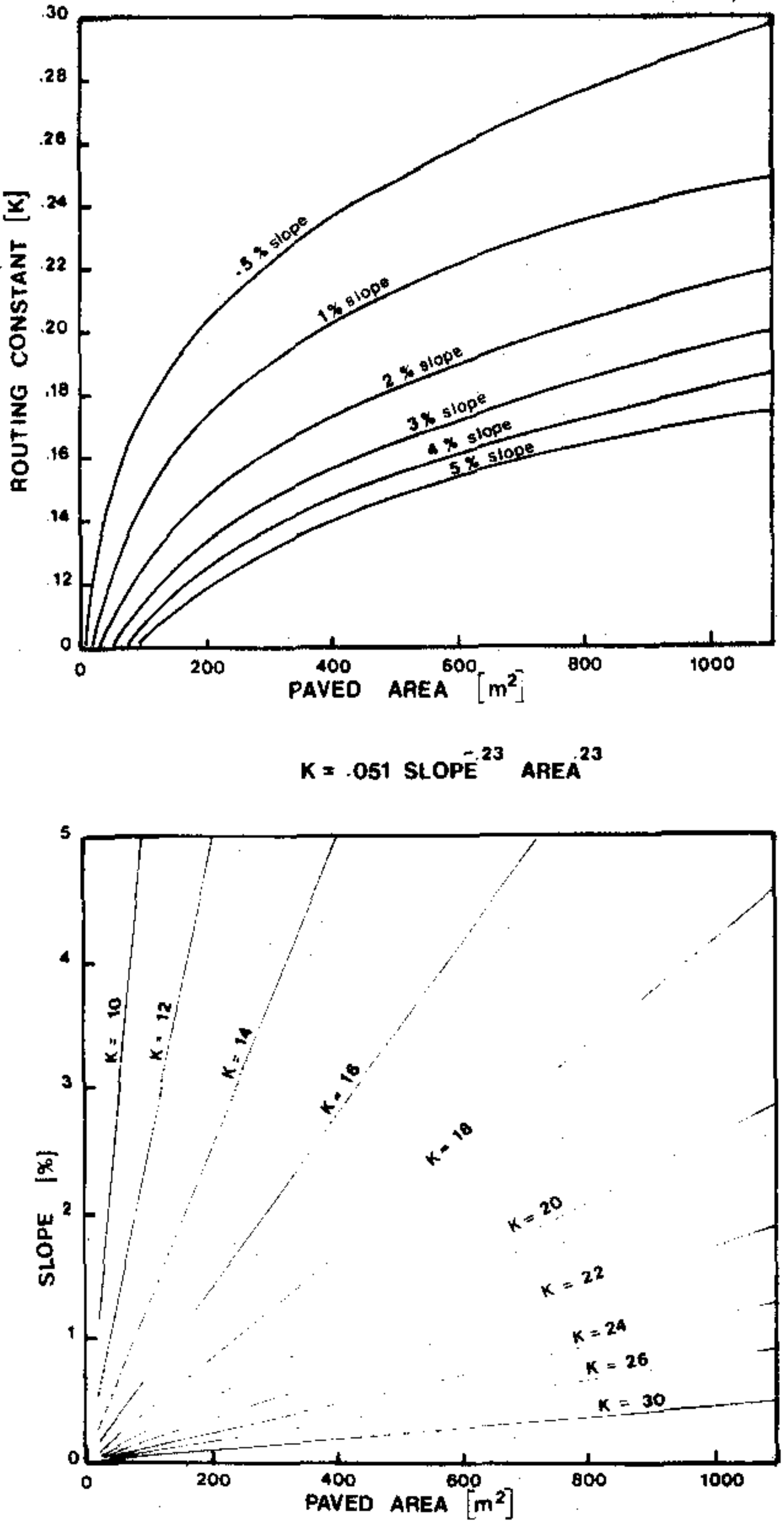



FIGURE 8 GRAPHICAL REPRESENTATION OF EQUATION 20

TABLE 3 RESULTS OF THE SUBCATCHMENT ANALYSIS

| Subcatchment | Optimum K value† | Slope (%) | Length (m) | Area ($m^2$) | Residual error from equation 3 |
|---|---|---|---|---|---|
| 301 | .311 (.290) | 0.5 | 12.0 | 176 | +.114 |
| 311* | .232 (.219) | 0.5 | 12.0 | 196 | +.031 |
| 2032* | .135 (.113) | 3.1 | 25.0 | 320 | -.014 |
| 2033* | .149 (.173) | 3.0 | 10.6 | 90 | +.037 |
| 2042* | .136 (.131) | 2.4 | 25.0 | 450 | -.035 |
| 2051* | .183 (.167) | 2.2 | 45.0 | 346 | +.019 |
| 2052 | .199 (.191) | 2.0 | 30.0 | 417 | +.023 |
| 2061* | .190 (.177) | 1.7 | 16.3 | 283 | +.024 |
| 2062* | .231 (.214) | 0.9 | 50.0 | 393 | +.023 |
| 4175* | .107 (.107) | 2.1 | 9.3 | 291 | -.053 |
| 4176* | .391 (.391) | 0.9 | 27.0 | 326 | +.193 |
| 4177* | .152 (.152) | 2.3 | 32.1 | 335 | -.010 |
| 4276 | .106 (.106) | 3.3 | 8.6 | 82 | -.001 |
| 4277* | .132 (.132) | 4.1 | 6.1 | 78 | +.032 |
| 4376* | .155 (.155) | 3.1 | 10.6 | 306 | +.007 |
| 4377* | .171 (.171) | 2.3 | 13.2 | 413 | +.002 |
| 4476* | .149 (.149) | 1.6 | 10.2 | 277 | -.019 |
| 4477 | .141 (.141) | 1.9 | 10.1 | 279 | -.021 |
| 101 | .116 (.116) | 0.6 | 13.4 | 36 | -.015 |
| 104 | .100 (.100) | 0.7 | 8.5 | 18 | -.008 |
| 105 | .083 (.083) | 1.4 | 13.4 | 36 | -.025 |
| 2161 | .125 (.110) | 0.8 | 20.0 | 240 | -.066 |
| 2162 | .123 (.111) | 1.0 | 45.0 | 572 | -.098 |
| 2150 | .251 (.224) | 2.1 | 45.0 | 763 | +.051 |
| 2141 | .178 (.159) | 1.1 | 30.0 | 215 | +.005 |
| 2142 | .155 (.141) | 1.3 | 28.0 | 145 | +.003 |
| 2144 | .159 (.144) | 0.9 | 38.5 | 165 | -.011 |
| 3011 | .237 (.196) | 0.5 | 39.0 | 475 | -.012 |

† Figures in brackets are the optimum K-values obtained by multiplying rainfall by the percentage runoff BEFORE routing

* These are the subcatchments from which equation 18 was derived

possible (e.g. Figure 9). From these limited studies, a value of .04 was determined for the pitched roof routing constant.

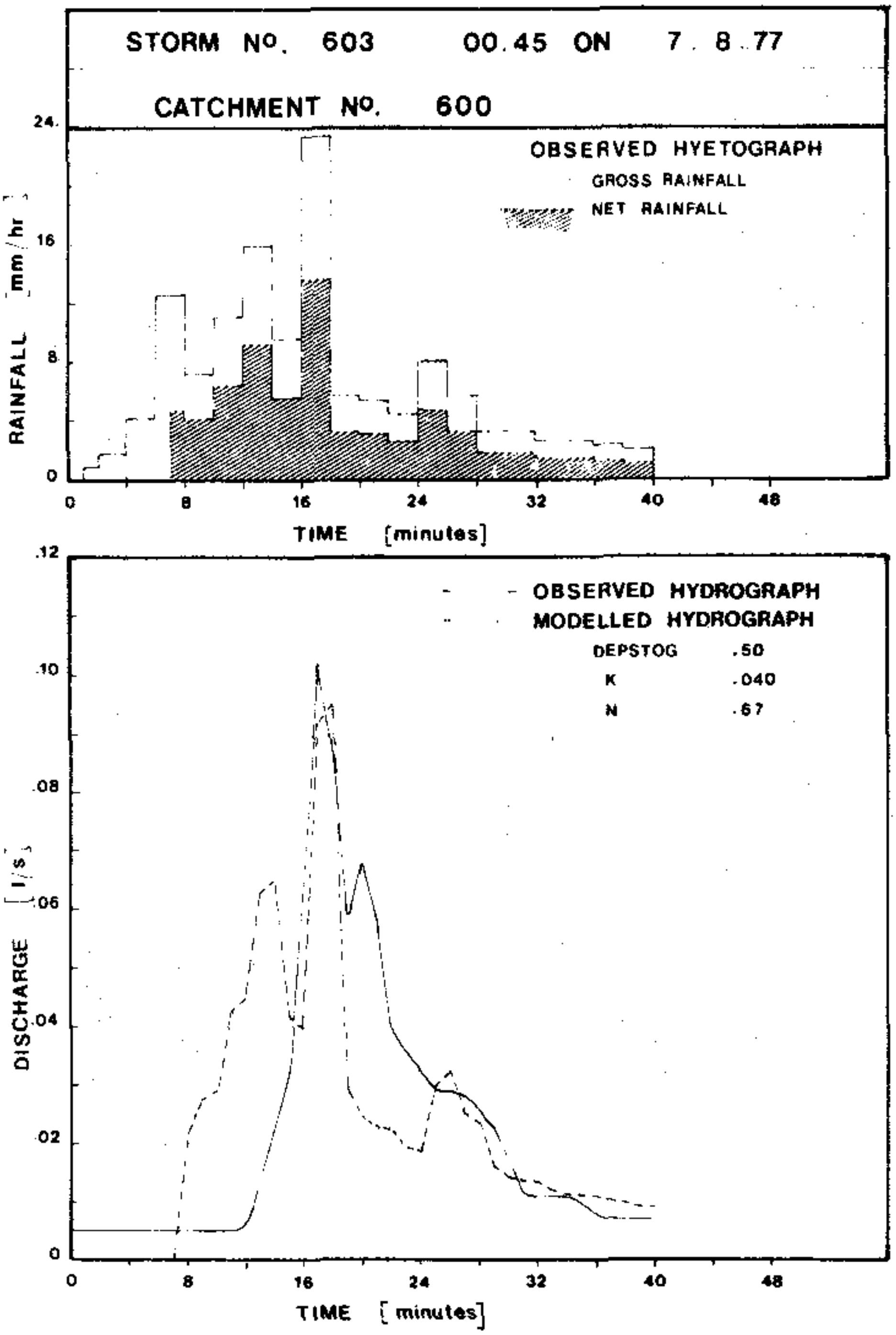



FIGURE 9 SIMULATION OF PITCHED ROOF RUNOFF

## 6. SUMMARY OF MODEL AND METHOD OF APPLICATION

### The model structure

The model comprises:

(a) an estimate for catchment average percentage runoff - equations (3) and (4)

$$PR = -20.7 + .829\ PIMP + 25\ SOIL + .078\ UCWI \quad \ldots \quad (3)$$

$$\text{If } PR < 0.4\ PIMP,\ PR = 0.4\ PIMP \quad \ldots \quad (4)$$

(b) prediction of initial loss or depression storage for ground surfaces

$$DEPSTOG = .71\ SLOPE^{-.48}$$

for roofs, DEPSTOG = 0.4 mm ... (6)

(c) determination of percentage runoff on the separate surface types from:

$$X = PR - 70 \times PIMP/100 \quad \ldots \quad (7)$$

$$\text{If X negative} = \left.\begin{array}{l} PR_{pav} = PR_{roof} = PR \times 100/PIMP \\ PR_{perv} = 0 \end{array}\right\} \quad \ldots \quad (8)$$

$$\text{If X positive} = \left.\begin{array}{l} PR_{PAV} = PR_{roof} = 70 + X \\ PR_{perv} = X \end{array}\right\} \quad \ldots \quad (9)$$

(d) Calculation of notional contributing areas:

$$\left.\begin{array}{l} A_{pav} = PR_{pav}\ (RF/(RF-DEPSTOG_{pav}) * AREA_{pav}/100 \\ A_{perv} = PR_{perv}(RF/(RF-DEPSTOG_{perv}) * AREA_{perv}/100 \\ A_{roof} = PR_{roof}(RF/(RF-DEPSTOG_{roof}) * AREA_{roof}/100 \end{array}\right\} \quad (10)$$

(e) Calculation of routing constant, k, for ground surfaces

$$k = .051\ SLOPE^{-.23}\ PAPG^{0.23} \quad \ldots \quad (20)$$

where PAPG is the paved area ($AREA_{pav}$) divided by the number of gullies (and $k_{roof}$ = 0.4)

(f) Applications of non-linear reservoir to the design storm - less depression storage - on the different surface types - followed by multiplication of each outflow hydrograph by the appropriate notional area from (d).

(g) Addition of the separate hydrographs to comprise the inlet hydrograph to the sewer system.

The steps described above are demonstrated schematically in Figure 10. Note that pervious and paved areas are not separated

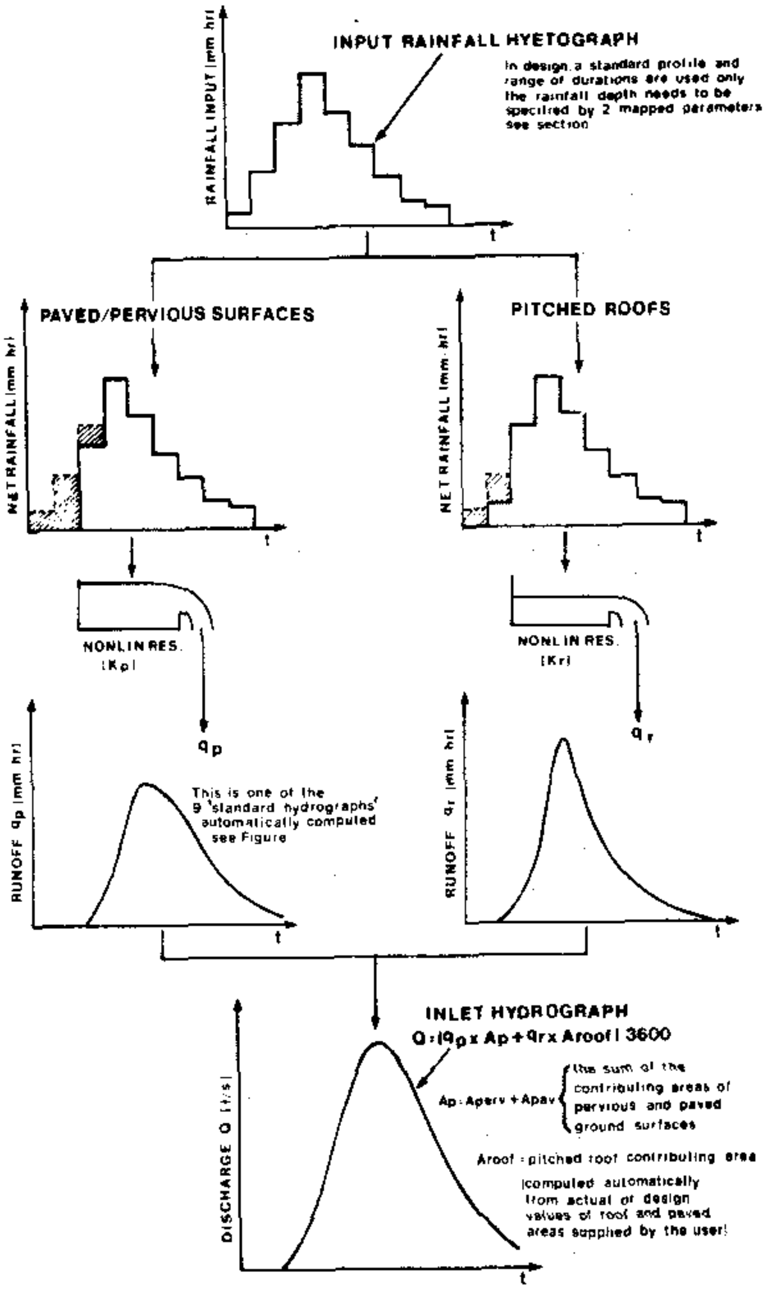



FIGURE 10 CONVERSION OF RAINFALL INTO RUNOFF

in the routing phase. This might be thought unwise as pervious areas are thought of as being slower to react. But, in urban subcatchments, contributing parts of pervious areas are likely to be front lawns and verges which, when they do contribute runoff, are likely to have a response time comparable to the adjacent paved surfaces. Furthermore, the data from which the surface routing model is derived relate to subcatchments containing proportions of just such areas.

## Application in a design case

For the model as it has been described so far, estimation of the model parameters from Equations (6) and (20) requires the specification of a paved area per gully and an overland slope for each subcatchment. It is considered that the UK engineering profession would find these data requirements too stringent and therefore some simplification has been sought. This simplification is demonstrated in Figure 11. This shows a 3 x 3 matrix of standard paved area runoff hydrographs which are related to 3 slopes (steep, medium or flat) and 3 areas per gully (small, medium or large). In addition to these 9 hydrographs, there is one relating to roofed areas. In practice, an engineer has the option to specify which of these boxes to use for each of his subcatchments or to ascribe global values to parts of a catchment. This represents a small increase in data input over the RRL requirements (slope and paved area per gully needed instead of 1 time of entry - effectively one more item of information per subcatchment).

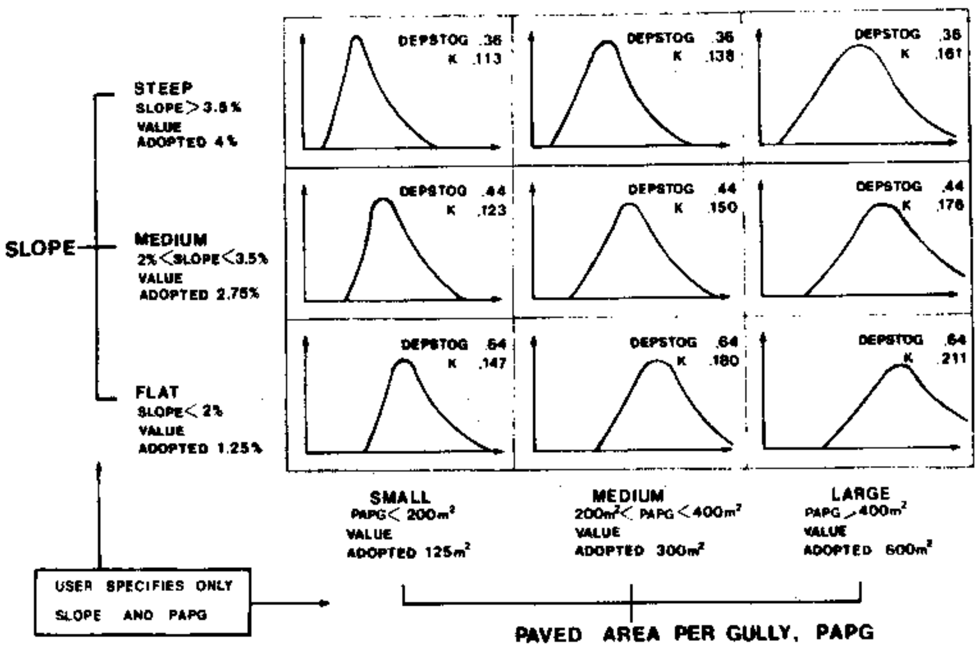



**FIGURE 11** 3X3 MATRIX OF STANDARD RUNOFF HYDROGRAPHS

Thus, in design, steps (b) and (e) are omitted and the non-linear reservoir is always applied (step (f)) directly to the ten slope/area combinations with their preset values of DEPSTOG and k. It was for this reason that it was decided to adjust for the percentage runoff factor (in the guise of a notional contributing area) after routing. In the context of a full model, this scheme (whereby surface routing is performed 10 times) is much more efficient than one in which the surface routing is performed individually for each subcatchment.

Other information needed for the application of the model include the SOIL index (from a national map and calculated as in the Flood Studies Report), and the design storm variables (RF, duration, profile, UCWI). This is the subject of a companion report (Kidd and Packman, 1979) wherein the results of a statistical simulation study - designed to ensure that the required rarity of sewer design flow is achieved - is described.

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## APPENDIX 1

## THE TIME OF ENTRY MODEL

Implicit in the use of a time of entry ($T_e$) by the rational and TRRL methods is that it represents the base length of a linear area-time diagram (Figure A1(a)) describing the growth of contributing area with time.

The area-time diagram is applied directly to the input rainfall as if it were the accumulating form of a $\Delta t$ (time) unit hydrograph (Figure A1(c)). The result of convolution with uniform net rainfall (P mm/h) is a hydrograph which looks just like Figure A1(a) but with maximum flow ordinate P.A.

The model can also be described in terms of linear channels. A wave travels from one end of a linear channel to the other without any change in shape. If a number (n) of equal width linear channels, with travel times $\frac{\Delta t}{t}$, $\frac{3\Delta t}{2}$ ..... $(n - \frac{1}{2})\ \Delta t = T_e$ are arranged in parallel with each receiving an identical input (rainfall) from $\frac{1}{n}$th of the subcatchment area, the summed output is the same as the result of applying the area-time diagram. Figure A1 (d) illustrates this for n = 4.

As a linear channel does not distort the passing hydrograph (or block of rainfall), it clearly requires velocity to be independent of depth. This is much simpler than the kinematic wave equation but the weight of experimental evidence suggests that it is an inadequate representation of the physics of overland flow. This is not to say that it is necessarily an inadequate concept for modelling purposes but it does point to its limitations for that purpose. For instance, flow would always cease at $T_e$ minutes after the end of rain rather than gradually tailing off in a more natural looking recession curve. For values of $T_e$ of the order of expected or observed travel times (2-4 minutes), underestimation of runoff volumes in the tail of the hydrograph must be balanced by overestimation of the peak. Whatever value of $T_e$ is taken, it would be difficult for this model to satisfy requirements of both the peak region and the recession. These expectations are supported by the findings of the International Workshop held as part of an investigation into alternative subcatchment models (Kidd, 1978b).

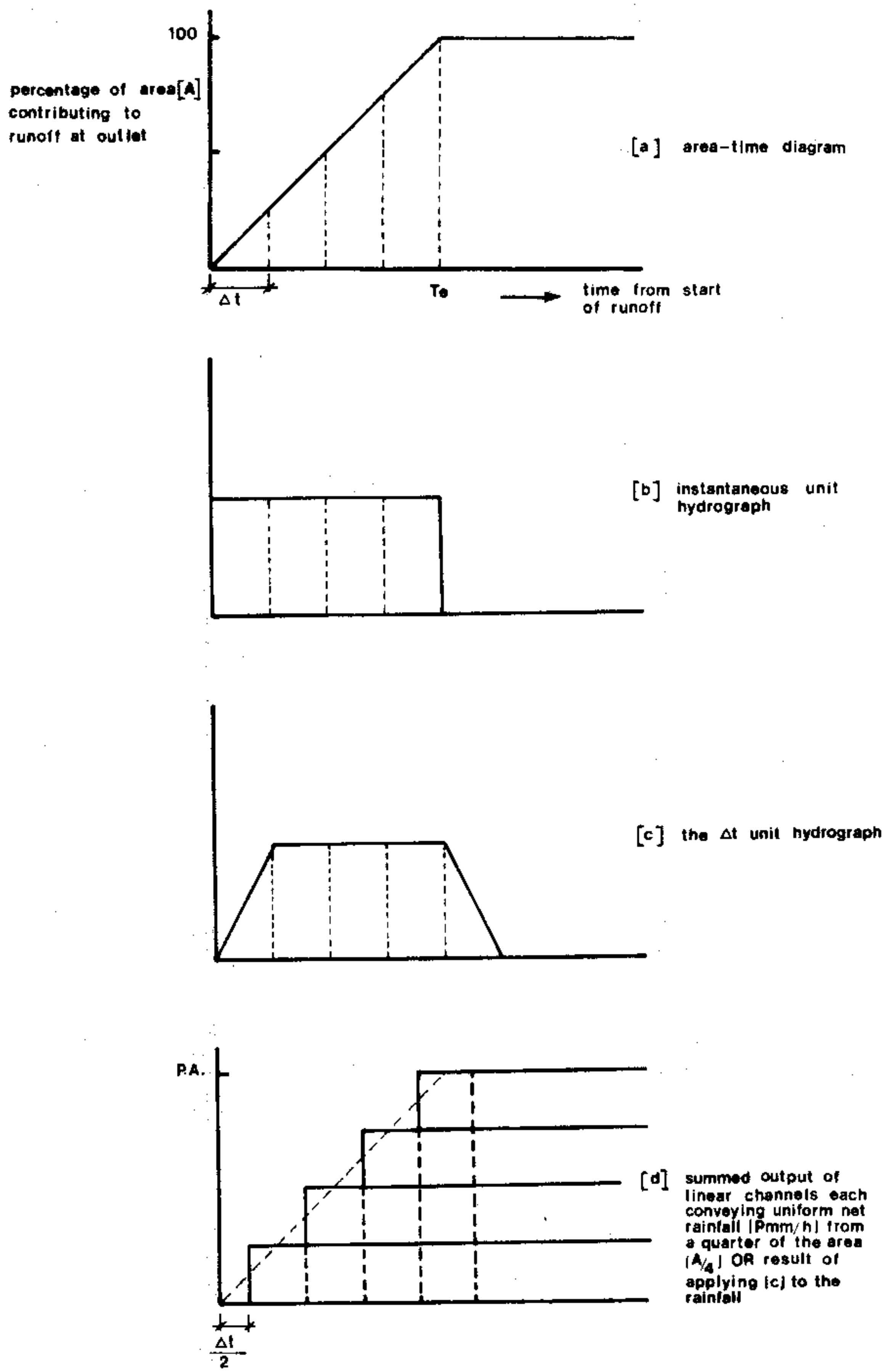


FIGURE A1 THE TIME OF ENTRY CONCEPT

## APPENDIX 2

## RAINFALL-RUNOFF VOLUME DATA SET

A complete listing of the data used in the analysis

| CATCHMENT CHARACTERISTICS | | | | | | EVENT CHARACTERISTICS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Catchment No: | Ave. pipe slope (%) | Total area (ha) | Impervious area (ha) | Roof/paved ratio | Soil type | Event No: | Rainfall depth (mm) | Runoff depth (mm) | Antecedent wet/dry | APIS (mm) | SMD (mm) | Duration (mins) | Max, 5 min. intensity (mm/hr) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 1 | 3.94 | 4.41 | 0 | 9.29 | 42.31 | 21 | 14.10 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 2 | 3.40 | 3.92 | 0 | 12.36 | 38.00 | 26 | 10.35 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 3 | 5.69 | 4.90 | 1 | 3.80 | 50.29 | 34 | 17.46 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 4 | 2.31 | 1.59 | 1 | 11.99 | 22.86 | 18 | 14.25 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 5 | 11.86 | 10.02 | 1 | .17 | 12.87 | 129 | 11.28 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 7 | 3.50 | 3.25 | 1 | 1.56 | .76 | 21 | 28.04 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 8 | 2.15 | 2.04 | 1 | 1.10 | 47.25 | 12 | 18.74 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 9 | 7.35 | 6.88 | 1 | 7.76 | 25.73 | 57 | 20.27 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 10 | 14.92 | 15.03 | 1 | .15 | 13.46 | 110 | 26.35 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 11 | 6.42 | 5.69 | 1 | 1.42 | .00 | 24 | 30.35 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 121 | 11.99 | 12.50 | 1 | 1.71 | .00 | 50 | 60.67 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 122 | 4.80 | 5.75 | 0 | 9.45 | .00 | 35 | 23.87 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 131 | 2.95 | 2.90 | 1 | 6.00 | .00 | 24 | 22.71 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 132 | 2.82 | 3.44 | 1 | 8.41 | .00 | 12 | 24.99 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 133 | 4.38 | 6.34 | 0 | 10.38 | .00 | 25 | 20.45 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 141 | 5.20 | 4.35 | 1 | 1.69 | 64.95 | 39 | 18.04 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 142 | 2.53 | 1.83 | 0 | 5.39 | 59.82 | 30 | 15.24 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 15 | 7.42 | 7.05 | 1 | 2.59 | 2.54 | 38 | 39.76 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 17 | 2.90 | 3.08 | 0 | 11.03 | .00 | 18 | 15.78 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 181 | 5.41 | 5.01 | 1 | 6.54 | .00 | 30 | 23.44 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 182 | 6.80 | 6.75 | 0 | 10.26 | .00 | 54 | 33.74 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 191 | 5.78 | 5.37 | 1 | 1.25 | 7.80 | 38 | 24.54 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 192 | 4.10 | 4.03 | 0 | 7.99 | .00 | 20 | 31.76 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 20 | 4.70 | 5.78 | 1 | 1.72 | .00 | 26 | 24.25 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 21 | 2.02 | 2.29 | 0 | 11.74 | .00 | 11 | 18.68 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 22 | 2.37 | 2.15 | 1 | 2.28 | .00 | 18 | 17.17 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 24 | 3.37 | 2.64 | 0 | 18.12 | 18.82 | 15 | 33.10 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 25 | 3.64 | 2.63 | 1 | 13.28 | .00 | 17 | 37.01 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 45 | 5.95 | 5.61 | 1 | 1.15 | 12.88 | 22 | 28.13 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 46 | 3.15 | 3.15 | 1 | 9.72 | 6.56 | 31 | 13.66 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 47 | 8.65 | 9.12 | 1 | 9.85 | 8.35 | 45 | 32.97 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 48 | 2.24 | 1.95 | 0 | 6.12 | .00 | 11 | 24.29 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 49 | 2.55 | 1.41 | 1 | 7.50 | 47.29 | 8 | 28.32 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 50 | 7.85 | 5.77 | 1 | .85 | 24.62 | 59 | 24.59 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 51 | 2.15 | 2.72 | 0 | 13.99 | .46 | 15 | 15.30 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 52 | 6.31 | 7.13 | 1 | 5.77 | .33 | 45 | 27.49 |
| 1 | 3.97 | 4.82 | 2.02 | .59 | .45 | 53 | 6.01 | 5.54 | 0 | 5.54 | .00 | 32 | 31.53 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 1 | 2.71 | 2.16 | 1 | .48 | 7.37 | 11 | 22.22 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 2 | 2.00 | 2.03 | 1 | 3.01 | 4.45 | 18 | 14.87 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 3 | 9.36 | 9.41 | 0 | 4.81 | 2.29 | 63 | 31.54 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 4 | 2.51 | 2.97 | 1 | 7.11 | 6.60 | 15 | 24.23 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 5 | 2.91 | 2.72 | 1 | 5.46 | 6.00 | 13 | 29.81 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 6 | 12.94 | 13.51 | 1 | 6.16 | .00 | 110 | 25.36 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 8 | 6.12 | 7.38 | 1 | 2.89 | .00 | 37 | 13.35 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 9 | 3.24 | 3.06 | 0 | 7.92 | .00 | 25 | 19.48 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 101 | 2.65 | 2.58 | 0 | 11.84 | 85.12 | 16 | 20.17 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 102 | 7.64 | 5.49 | 0 | 13.50 | 83.39 | 30 | 39.91 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 11 | 5.41 | 3.93 | 0 | 14.81 | 76.00 | 34 | 30.93 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 12 | 5.36 | 4.22 | 0 | 19.40 | 68.28 | 27 | 22.42 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 13 | 6.49 | 5.17 | 1 | 1.75 | 90.63 | 28 | 29.25 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 14 | 8.93 | 6.69 | 1 | 1.86 | 89.43 | 54 | 35.40 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 15 | 12.25 | 11.51 | 1 | 2.39 | 87.12 | 27 | 49.27 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 16 | 8.12 | 6.41 | 1 | 14.38 | 85.06 | 14 | 64.69 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 17 | 3.89 | 3.06 | 1 | 7.82 | 73.92 | 10 | 38.09 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 18 | 13.08 | 8.92 | 1 | .45 | 13.38 | 49 | 42.12 |
| 3 | 1.56 | 5.14 | 1.54 | 1.09 | .45 | 19 | 4.29 | 2.11 | 1 | 1.01 | 10.41 | 19 | 33.25 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 2 | 4.56 | 2.39 | 1 | .19 | 74.48 | 96 | 5.58 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 6 | 2.20 | 1.19 | 1 | 1.97 | 114.17 | 14 | 20.20 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 9 | 2.11 | 1.26 | 1 | 1.23 | 97.28 | 11 | 16.00 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 10 | 2.91 | 3.18 | 1 | 1.07 | 110.82 | 16 | 16.16 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 11 | 2.06 | 1.44 | 0 | 4.23 | 107.18 | 18 | 12.83 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 12 | 3.77 | 2.65 | 1 | 7.33 | 100.81 | 54 | 10.70 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 14 | 13.22 | 8.05 | 1 | 2.03 | 123.57 | 158 | 22.66 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 515 | 3.79 | 2.24 | 1 | 7.77 | 119.18 | 34 | 27.12 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 15 | 3.63 | 2.67 | 0 | 15.76 | 58.37 | 27 | 20.63 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 161 | 2.59 | 1.31 | 1 | 5.60 | 58.93 | 27 | 20.17 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 18 | 2.04 | 1.96 | 1 | 3.69 | 64.26 | 19 | 16.11 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 19 | 10.85 | 7.82 | 1 | 1.22 | 45.72 | 73 | 30.98 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 20 | 3.35 | 2.28 | 1 | 6.50 | 41.91 | 17 | 22.03 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 211 | 3.40 | 2.48 | 1 | .21 | 50.80 | 34 | 14.02 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 212 | 4.20 | 2.70 | 0 | 4.25 | 46.18 | 19 | 36.25 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 22 | 2.92 | 2.93 | 0 | 8.03 | 41.76 | 22 | 20.69 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 23 | 3.59 | 1.93 | 1 | 2.17 | 49.78 | 18 | 29.17 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 25 | 5.15 | 3.69 | 1 | 1.37 | 32.74 | 88 | 16.63 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 26 | 2.43 | 1.44 | 1 | 4.04 | 37.03 | 34 | 9.77 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 27 | 2.66 | 2.07 | 1 | 3.96 | 32.26 | 24 | 12.80 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 28 | 4.88 | 2.87 | 1 | .01 | 40.13 | 62 | 11.83 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 29 | 4.47 | 2.89 | 1 | 2.10 | 101.76 | 37 | 14.18 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 30 | 7.88 | 5.76 | 0 | 5.64 | 97.16 | 128 | 12.44 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 31 | 2.82 | 1.92 | 1 | .03 | 124.46 | 10 | 28.96 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 32 | 5.54 | 2.64 | 1 | .41 | 123.44 | 31 | 34.52 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 33 | 3.82 | 2.53 | 0 | 5.17 | 118.21 | 25 | 29.55 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 34 | 2.78 | 1.60 | 0 | 8.33 | 114.58 | 19 | 25.55 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 35 | 9.90 | 6.56 | 0 | 8.17 | 98.86 | 28 | 46.94 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 361 | 2.79 | 2.14 | 1 | .77 | 73.23 | 24 | 16.49 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 362 | 2.04 | 1.25 | 1 | 2.65 | 70.59 | 39 | 6.84 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 37 | 6.30 | 5.61 | 0 | 7.15 | 91.06 | 23 | 42.40 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 38 | 2.49 | 2.56 | 0 | 14.11 | 87.58 | 16 | 19.67 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 41 | 5.24 | 3.09 | 1 | .25 | 108.71 | 40 | 16.09 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 43 | 7.11 | 5.74 | 1 | 4.67 | 85.22 | 48 | 24.75 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 441 | 5.73 | 3.80 | 1 | 3.70 | 89.41 | 79 | 12.91 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 45 | 7.14 | 3.21 | 1 | 2.66 | 94.57 | 80 | 12.22 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 46 | 3.30 | 1.91 | 1 | 4.21 | 97.79 | 22 | 20.06 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 47 | 5.35 | 3.28 | 1 | 5.08 | 90.53 | 30 | 24.92 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 48 | 7.34 | 4.79 | 1 | 3.48 | 84.61 | 64 | 15.81 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 49 | 2.27 | 1.28 | 1 | 2.42 | .00 | 12 | 23.01 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 51 | 4.49 | 2.30 | 1 | .13 | 106.53 | 17 | 33.19 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 521 | 3.16 | 1.44 | 1 | .22 | 117.09 | 32 | 18.22 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 53 | 2.44 | 1.23 | 1 | 7.48 | 110.19 | 18 | 15.88 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 54 | 2.42 | 1.49 | 1 | 3.95 | 93.07 | 23 | 17.34 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 55 | 2.20 | 1.33 | 0 | 7.85 | 88.34 | 14 | 21.33 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 56 | 4.98 | 2.33 | 1 | 4.11 | 98.30 | 26 | 37.66 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 57 | 12.81 | 7.12 | 1 | .32 | 106.91 | 211 | 11.63 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 58 | 4.85 | 3.19 | 1 | 4.12 | 85.17 | 33 | 30.15 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 591 | 2.21 | 1.47 | 0 | 16.82 | 55.43 | 14 | 16.10 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 60 | 6.96 | 4.32 | 1 | 2.56 | 49.84 | 58 | 43.40 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 61 | 9.76 | 5.91 | 1 | 5.26 | 31.72 | 98 | 15.72 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 62 | 2.40 | 1.67 | 1 | 2.05 | 44.71 | 13 | 24.24 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 63 | 2.83 | 1.37 | 1 | 2.09 | 58.17 | 8 | 32.09 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 64 | 5.71 | 4.57 | 1 | .18 | 23.88 | 44 | 14.09 |
| 5 | 1.39 | 3.42 | 2.33 | 1.14 | .15 | 55 | 6.47 | 4.36 | 0 | 11.75 | 10.49 | 87 | 22.62 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 1.89 | 59.50 | 21.50 | .86 | .45 | 3 | 2.31 | 2.56 | 1 | 5.99 | 34.80 | 40 | 5.83 |
| 6 | 1.89 | 59.50 | 21.50 | .86 | .45 | 4 | 2.55 | 2.48 | 0 | 8.03 | 32.16 | 40 | 6.93 |
| 6 | 1.89 | 59.50 | 21.50 | .86 | .45 | 5 | 2.24 | 2.09 | 1 | 7.48 | 32.66 | 19 | 16.16 |
| 6 | 1.89 | 59.50 | 21.50 | .86 | .45 | 6 | 2.00 | 2.64 | 0 | 13.97 | 24.41 | 54 | 4.94 |
| 6 | 1.89 | 59.50 | 21.50 | .86 | .45 | 7 | 4.26 | 6.85 | 1 | 3.55 | .00 | 82 | 10.08 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 1 | 2.00 | .98 | 1 | .91 | .00 | 23 | 8.40 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 2 | 6.11 | 3.66 | 1 | 1.51 | .00 | 86 | 6.96 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 4 | 3.13 | 2.59 | 1 | 3.13 | .00 | 52 | 6.86 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 5 | 3.67 | 2.99 | 1 | 3.87 | .00 | 80 | 5.14 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 6 | 9.23 | 12.06 | 0 | 6.29 | .00 | 243 | 11.20 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 7 | 2.95 | 2.36 | 1 | 7.21 | .00 | 147 | 3.76 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 8 | 4.62 | 2.08 | 1 | .75 | .00 | 88 | 8.61 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 9 | 9.63 | 5.92 | 1 | .97 | .00 | 197 | 8.96 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 10 | 4.71 | 2.72 | 1 | 2.04 | .00 | 145 | 4.86 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 11 | 2.95 | 1.70 | 1 | .00 | 13.30 | 20 | 20.83 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 12 | 2.17 | 1.14 | 0 | 9.25 | 6.00 | 22 | 11.24 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 14 | 2.49 | 1.15 | 1 | .29 | 27.24 | 39 | 11.15 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 15 | 18.07 | 16.19 | 0 | 2.14 | 22.70 | 449 | 6.65 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 17 | 4.61 | 1.59 | 1 | .00 | 76.90 | 19 | 28.49 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 18 | 5.38 | 1.87 | 1 | .00 | 125.20 | 27 | 48.02 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 19 | 6.04 | 2.57 | 0 | 2.15 | 104.00 | 28 | 36.52 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 19 | 4.32 | 1.65 | 0 | 7.77 | 97.96 | 35 | 24.97 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 32 | 9.86 | 7.52 | 1 | .50 | 142.99 | 148 | 22.01 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 33 | 12.91 | 11.10 | 0 | 19.43 | 110.64 | 125 | 17.20 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 36 | 4.79 | 3.95 | 0 | 2.93 | 72.61 | 94 | 6.07 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 40 | 2.30 | 2.00 | 0 | 4.02 | 7.62 | 53 | 6.39 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 40 | 2.54 | 2.37 | 0 | 4.86 | 6.80 | 65 | 3.59 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 21 | 4.16 | 3.78 | 1 | .73 | .00 | 57 | 9.08 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 302 | 3.97 | 4.43 | 1 | 10.75 | .00 | 116 | 7.98 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 303 | 9.47 | 7.19 | 1 | .90 | .00 | 308 | 7.16 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 306 | 2.93 | 1.72 | 1 | 1.15 | .00 | 88 | 5.82 |
| 11 | 2.65 | 142.19 | 33.37 | .83 | .30 | 307 | 12.33 | 8.83 | 1 | 5.63 | .00 | 100 | 27.94 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 308 | 6.58 | 4.31 | 1 | .93 | .00 | 232 | 11.04 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 309 | 6.74 | 3.25 | 1 | 1.21 | .00 | 77 | 16.97 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 311 | 2.17 | 1.10 | 1 | .57 | 19.30 | 19 | 10.81 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 312 | 8.17 | 5.70 | 1 | .80 | 17.50 | 133 | 16.50 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 313 | 14.67 | 12.31 | 1 | 3.46 | 22.70 | 213 | 25.12 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 314 | 2.29 | 1.87 | 0 | 3.30 | 14.20 | 33 | 5.86 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 315 | 8.48 | 5.67 | 1 | 2.91 | 60.20 | 308 | 8.19 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 316 | 12.30 | 6.77 | 1 | 4.08 | 54.50 | 102 | 20.98 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 318 | 26.22 | 17.63 | 1 | 9.47 | 35.70 | 174 | 68.16 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 319 | 7.56 | 3.09 | 1 | .24 | 103.40 | 312 | 5.86 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 338 | 13.22 | 6.38 | 1 | 5.75 | 93.40 | 83 | 27.60 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 322 | 4.41 | 2.85 | 1 | 1.71 | 59.20 | 168 | 4.59 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 322 | 2.03 | 2.08 | 0 | 5.63 | 54.80 | 47 | 4.99 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 322 | 2.56 | 2.12 | 0 | 7.60 | 52.30 | 108 | 8.29 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 324 | 2.24 | 1.10 | 1 | 5.52 | 60.50 | 11 | 18.60 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 325 | 5.97 | 2.84 | 1 | .12 | 72.50 | 54 | 44.15 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 326 | 9.81 | 7.65 | 1 | .09 | 57.80 | 105 | 16.90 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 328 | 3.86 | 4.83 | 1 | .04 | .00 | 121 | 4.18 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 329 | 2.08 | 2.63 | 1 | 1.13 | 1.60 | 97 | 3.90 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 1 | 15.20 | 11.33 | 0 | 5.58 | 100.80 | 90 | 23.36 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 2 | 4.30 | 2.18 | 1 | .33 | 71.40 | 32 | 16.87 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 3 | 13.10 | 9.68 | 1 | 8.14 | 57.30 | 205 | 19.01 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 4 | 10.70 | 6.99 | 1 | .37 | .00 | 21 | 67.35 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 5 | 3.80 | 1.89 | 1 | .58 | 79.70 | 37 | 15.35 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 7 | 2.00 | 1.35 | 1 | 6.16 | 53.40 | 11 | 19.93 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 8 | 7.20 | 5.40 | 1 | 5.38 | 57.10 | 51 | 40.35 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 9 | 3.30 | 3.33 | 0 | 11.26 | 50.00 | 7 | 36.83 |
| 11 | 2.65 | 142.18 | 33.37 | .83 | .30 | 10 | 5.30 | 2.89 | 1 | .17 | 66.10 | 14 | 38.57 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 2 | 5.08 | 4.22 | 1 | 4.32 | 81.03 | 34 | 28.24 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 31 | 2.20 | 1.50 | 0 | 5.31 | 73.35 | 55 | 5.99 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 32 | 6.73 | 5.23 | 0 | 7.36 | 70.96 | 40 | 19.40 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 4 | 9.26 | 6.72 | 1 | 6.10 | 83.64 | 39 | 28.51 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 5 | 18.64 | 20.12 | 0 | 6.73 | 31.88 | 38 | 84.86 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 6 | 7.12 | 3.60 | 1 | 2.05 | 34.06 | 34 | 23.69 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 7 | 15.49 | 23.61 | 1 | 2.89 | .00 | 67 | 43.36 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 8 | 6.96 | 5.23 | 0 | 6.51 | 105.46 | 45 | 26.78 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 9 | 29.73 | 41.22 | 0 | 13.26 | 78.25 | 179 | 43.86 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 10 | 6.96 | 11.60 | 1 | 4.91 | 39.47 | 13 | 62.33 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 11 | 4.35 | 4.11 | 0 | 8.66 | 34.52 | 17 | 28.72 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 12 | 14.00 | 13.68 | 0 | 13.50 | 46.02 | 79 | 42.69 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 13 | 18.56 | 17.10 | 1 | 3.45 | 74.91 | 41 | 57.92 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 14 | 7.80 | 8.02 | 0 | 17.85 | 64.32 | 78 | 13.17 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 15 | 5.85 | 4.48 | 1 | 5.08 | 74.93 | 30 | 32.98 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 16 | 15.41 | 24.67 | 1 | 7.92 | 12.40 | 55 | 44.49 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 17 | 17.67 | 35.25 | 1 | 20.43 | 1.93 | 111 | 31.56 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 18 | 11.37 | 12.08 | 1 | .55 | 106.96 | 38 | 65.33 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 19 | 8.11 | 7.39 | 0 | 4.15 | 70.28 | 44 | 27.16 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 20 | 9.32 | 14.25 | 0 | 6.02 | 19.10 | 51 | 33.26 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 21 | 6.38 | 5.91 | 0 | 4.23 | 26.77 | 26 | 33.87 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 22 | 3.61 | 4.77 | 0 | 9.97 | 17.93 | 18 | 20.93 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 23 | 3.93 | 4.61 | 1 | 3.32 | 25.27 | 18 | 21.55 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 24 | 14.48 | 7.08 | 1 | .24 | 97.79 | 22 | 105.96 |
| 71 | 3.13 | 247.00 | 49.00 | 1.12 | .45 | 25 | 10.76 | 12.50 | 1 | 4.03 | 53.09 | 36 | 69.97 |
| 72 | .93 | .78 | .47 | .00 | .45 | 11 | 3.28 | 2.01 | 0 | 5.36 | 32.54 | 25 | 14.89 |
| 72 | .93 | .78 | .47 | .00 | .45 | 13 | 5.37 | 4.41 | 0 | 9.18 | 27.66 | 40 | 19.60 |
| 72 | .93 | .78 | .47 | .00 | .45 | 2 | 5.08 | 5.43 | 1 | 3.77 | 2.42 | 38 | 23.95 |
| 72 | .93 | .78 | .47 | .00 | .45 | 3 | 3.12 | 3.23 | 1 | 1.10 | 34.22 | 18 | 25.37 |
| 72 | .93 | .78 | .47 | .00 | .45 | 4 | 3.84 | 3.54 | 0 | 11.23 | 11.43 | 18 | 25.96 |
| 72 | .93 | .78 | .47 | .00 | .45 | 5 | 3.12 | 3.48 | 1 | 1.22 | .00 | 22 | 26.24 |
| 72 | .93 | .78 | .47 | .00 | .45 | 8 | 4.81 | 4.39 | 1 | 1.35 | 110.08 | 24 | 19.57 |
| 72 | .93 | .78 | .47 | .00 | .45 | 10 | 5.36 | 6.42 | 0 | 7.56 | 104.27 | 28 | 23.43 |
| 72 | .93 | .78 | .47 | .00 | .45 | 111 | 5.27 | 6.57 | 0 | 17.20 | 74.16 | 16 | 39.08 |
| 72 | .93 | .78 | .47 | .00 | .45 | 112 | 4.01 | 4.73 | 0 | 21.22 | 70.00 | 11 | 41.76 |
| 72 | .93 | .78 | .47 | .00 | .45 | 113 | 5.48 | 6.40 | 0 | 26.35 | 64.46 | 21 | 45.37 |
| 72 | .93 | .78 | .47 | .00 | .45 | 114 | 6.02 | 6.43 | 0 | 31.80 | 58.72 | 28 | 28.17 |
| 72 | .93 | .78 | .47 | .00 | .45 | 12 | 2.84 | 2.94 | 0 | 8.23 | 48.48 | 25 | 12.68 |
| 72 | .93 | .78 | .47 | .00 | .45 | 13 | 6.31 | 6.01 | 1 | 4.98 | 39.35 | 16 | 46.66 |
| 72 | .93 | .78 | .47 | .00 | .45 | 15 | 3.74 | 4.04 | 1 | 2.28 | 78.86 | 44 | 12.59 |
| 72 | .93 | .78 | .47 | .00 | .45 | 16 | 14.16 | 17.08 | 1 | 1.88 | 61.49 | 66 | 34.19 |
| 72 | .93 | .78 | .47 | .00 | .45 | 17 | 5.60 | 7.61 | 0 | 12.65 | 46.94 | 29 | 27.21 |
| 72 | .93 | .78 | .47 | .00 | .45 | 19 | 7.76 | 10.03 | 1 | 14.18 | 60.05 | 69 | 14.49 |
| 72 | .93 | .78 | .47 | .00 | .45 | 20 | 4.92 | 6.00 | 0 | 20.29 | 50.83 | 40 | 13.72 |
| 72 | .93 | .78 | .47 | .00 | .45 | 21 | 6.70 | 6.35 | 1 | 4.61 | 74.80 | 25 | 38.63 |
| 72 | .93 | .78 | .47 | .00 | .45 | 22 | 2.83 | 2.96 | 0 | 10.62 | 67.69 | 20 | 18.99 |
| 72 | .93 | .78 | .47 | .00 | .45 | 23 | 3.96 | 3.47 | 1 | 6.77 | 60.65 | 24 | 20.49 |
| 72 | .93 | .78 | .47 | .00 | .45 | 24 | 12.88 | 16.11 | 1 | 17.15 | 1.70 | 51 | 35.91 |
| 72 | .93 | .78 | .47 | .00 | .45 | 25 | 3.78 | 2.78 | 1 | 2.56 | 51.76 | 19 | 21.80 |
| 72 | .93 | .78 | .47 | .00 | .45 | 26 | 12.33 | 14.81 | 1 | .40 | 107.44 | 32 | 56.73 |
| 72 | .93 | .78 | .47 | .00 | .45 | 27 | 4.85 | 5.60 | 1 | 4.47 | 98.30 | 38 | 17.06 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 72 | .93 | .78 | .47 | .00 | .45 | 291 | 5.25 | 5.98 | 1 | 2.32 | 72.13 | 26 | 22.67 |
| 72 | .93 | .78 | .47 | .00 | .45 | 292 | 3.44 | 3.72 | 0 | 5.82 | 68.50 | 16 | 24.10 |
| 72 | .93 | .78 | .47 | .00 | .45 | 30 | 10.12 | 11.45 | 0 | 10.69 | 12.70 | 51 | 43.64 |
| 72 | .93 | .78 | .47 | .00 | .45 | 32 | 6.29 | 6.78 | 1 | 1.39 | 38.86 | 50 | 18.14 |
| 72 | .93 | .78 | .47 | .00 | .45 | 34 | 3.59 | 3.92 | 0 | 10.97 | 18.82 | 17 | 32.21 |
| 72 | .93 | .78 | .47 | .00 | .45 | 35 | 4.29 | 4.35 | 0 | 12.72 | 14.17 | 22 | 28.67 |
| 72 | .93 | .78 | .47 | .00 | .45 | 36 | 5.04 | 4.98 | 1 | 2.90 | 25.80 | 19 | 40.24 |
| 72 | .93 | .78 | .47 | .00 | .45 | 37 | 2.74 | 3.20 | 1 | 7.15 | 1.45 | 17 | 20.88 |
| 72 | .93 | .78 | .47 | .00 | .45 | 381 | 5.20 | 5.35 | 1 | 5.80 | 88.35 | 25 | 20.52 |
| 72 | .93 | .78 | .47 | .00 | .45 | 382 | 2.70 | 2.39 | 0 | 10.14 | 83.27 | 12 | 26.72 |
| 72 | .93 | .78 | .47 | .00 | .45 | 383 | 3.96 | 3.12 | 0 | 12.50 | 80.47 | 29 | 24.33 |
| 72 | .93 | .78 | .47 | .00 | .45 | 41 | 4.81 | 4.51 | 0 | 15.37 | 90.98 | 21 | 40.60 |
| 72 | .93 | .78 | .47 | .00 | .45 | 42 | 7.77 | 8.59 | 1 | .12 | 97.91 | 34 | 42.79 |
| 72 | .93 | .78 | .47 | .00 | .45 | 43 | 7.48 | 6.95 | 0 | 22.21 | 30.99 | 18 | 66.11 |
| 72 | .93 | .78 | .47 | .00 | .45 | 461 | 4.02 | 5.89 | 1 | 1.43 | 107.45 | 20 | 33.36 |
| 72 | .93 | .78 | .47 | .00 | .45 | 462 | 10.89 | 13.67 | 0 | 4.72 | 103.89 | 27 | 46.97 |
| 81 | 2.13 | 1.39 | .69 | .64 | .30 | 1 | 8.52 | 4.14 | 1 | 2.34 | 113.49 | 116 | 15.47 |
| 81 | 2.13 | 1.39 | .69 | .64 | .30 | 2 | 2.45 | .83 | 0 | 21.73 | 50.83 | 16 | 17.13 |
| 81 | 2.13 | 1.39 | .69 | .64 | .30 | 31 | 12.45 | 6.03 | 1 | 8.66 | 63.53 | 21 | 72.55 |
| 81 | 2.13 | 1.39 | .69 | .64 | .30 | 32 | 4.83 | 2.92 | 0 | 14.43 | 56.60 | 9 | 42.57 |
| 81 | 2.13 | 1.39 | .69 | .64 | .30 | 33 | 17.41 | 5.73 | 0 | 17.54 | 52.84 | 23 | 151.25 |
| 81 | 2.13 | 1.39 | .69 | .64 | .30 | 4 | 3.18 | 1.52 | 1 | 5.52 | 54.71 | 5 | 37.99 |
| 81 | 2.13 | 1.39 | .69 | .64 | .30 | 6 | 8.45 | 3.66 | 1 | .36 | 105.66 | 52 | 24.93 |
| 81 | 2.13 | 1.39 | .69 | .64 | .30 | 7 | 4.78 | 2.12 | 1 | .70 | 93.39 | 25 | 30.53 |
| 81 | 2.13 | 1.39 | .69 | .64 | .30 | 8 | 15.85 | 7.47 | 0 | 11.26 | 99.16 | 70 | 35.71 |
| 81 | 2.13 | 1.39 | .69 | .64 | .30 | 9 | 4.77 | 1.46 | 1 | .85 | 88.85 | 24 | 34.06 |
| 81 | 2.13 | 1.39 | .69 | .64 | .30 | 10 | 13.55 | 5.95 | 1 | .06 | 36.58 | 108 | 28.85 |
| 81 | 2.13 | 1.39 | .69 | .64 | .30 | 11 | 11.57 | 4.98 | 1 | 4.47 | 6.63 | 77 | 28.64 |
| 81 | 2.13 | 1.39 | .69 | .64 | .30 | 12 | 3.63 | 1.95 | 0 | 8.40 | 21.81 | 11 | 34.80 |
| 81 | 2.13 | 1.39 | .69 | .64 | .30 | 13 | 13.72 | 7.39 | 1 | 4.78 | 13.47 | 82 | 31.30 |
| 81 | 2.13 | 1.39 | .69 | .64 | .30 | 14 | 4.11 | 2.22 | 1 | .33 | 75.69 | 20 | 41.07 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 1 | 3.64 | 2.81 | 1 | 6.34 | 6.80 | 42 | 21.00 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 2 | 6.16 | 5.85 | 0 | 9.91 | .00 | 36 | 18.99 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 31 | 4.91 | 5.98 | 1 | 2.17 | 14.00 | 38 | 20.95 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 32 | 8.68 | 5.68 | 0 | 5.68 | 9.95 | 90 | 12.40 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 41 | 2.77 | 2.19 | 1 | 1.63 | 84.50 | 24 | 14.86 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 42 | 8.24 | 3.96 | 1 | 3.22 | 82.57 | 70 | 17.85 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 5 | 3.00 | 2.15 | 1 | 2.63 | 94.40 | 24 | 16.45 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 6 | 5.09 | 6.59 | 0 | 19.09 | 34.00 | 48 | 14.73 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 7 | 3.58 | 2.02 | 1 | 1.66 | 30.75 | 46 | 22.56 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 8 | 8.93 | 6.39 | 1 | 1.83 | 8.80 | 98 | 14.38 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 9 | 9.62 | 10.69 | 0 | 16.01 | .00 | 71 | 19.41 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 10 | 4.95 | 7.83 | 0 | 24.92 | .00 | 26 | 36.66 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 13 | 9.89 | 8.36 | 1 | 11.77 | .00 | 154 | 20.74 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 14 | 17.35 | 16.76 | 1 | 3.91 | .00 | 146 | 26.04 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 15 | 2.74 | 1.39 | 1 | 4.63 | 98.10 | 13 | 22.43 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 16 | 10.79 | 5.30 | 1 | .13 | 112.40 | 25 | 59.47 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 507 | 4.73 | 3.06 | 1 | .34 | 115.10 | 15 | 34.43 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 607 | 7.62 | 4.88 | 0 | 4.41 | 109.90 | 58 | 37.30 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 707 | 2.11 | 1.77 | 0 | 10.43 | 101.25 | 29 | 10.26 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 707 | 6.23 | 6.08 | 0 | 11.88 | 99.24 | 52 | 19.56 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 8 | 16.95 | 11.92 | 1 | 1.05 | 122.02 | 53 | 66.62 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 509 | 8.23 | 5.85 | 1 | 2.52 | 129.70 | 64 | 18.67 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 609 | 3.58 | 4.20 | 0 | 7.29 | 129.60 | 24 | 17.61 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 512 | 2.60 | 1.78 | 1 | 4.85 | 123.10 | 15 | 12.80 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 612 | 3.54 | 2.42 | 0 | 6.88 | 120.10 | 13 | 33.15 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 13 | 10.60 | 7.66 | 1 | 5.38 | 116.80 | 92 | 47.58 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 15 | 9.37 | 6.56 | 1 | 6.90 | 111.70 | 70 | 33.65 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 16 | 7.35 | 5.09 | 1 | 9.33 | 105.00 | 81 | 18.70 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 17 | 4.44 | 4.39 | 0 | 14.95 | 97.36 | 51 | 24.91 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 518 | 5.40 | 4.56 | 1 | 9.28 | 93.40 | 41 | 30.58 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 618 | 7.14 | 5.80 | 0 | 13.08 | 87.98 | 26 | 28.40 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 19 | 4.38 | 2.86 | 0 | 16.78 | 80.95 | 36 | 21.20 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 20 | 2.95 | 1.72 | 0 | 5.45 | 73.90 | 27 | 8.38 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 21 | 2.44 | 2.11 | 0 | 7.05 | 71.10 | 27 | 18.16 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 26 | 4.56 | 3.57 | 1 | 2.11 | 3.80 | 70 | 28.08 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 28 | 7.16 | 6.82 | 0 | 9.92 | .00 | 145 | 9.06 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 29 | 6.34 | 6.34 | 1 | .76 | .00 | 83 | 9.49 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 530 | 2.44 | 3.37 | 1 | 5.07 | .00 | 21 | 9.71 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 630 | 2.06 | 3.07 | 0 | 7.04 | .00 | 25 | 8.71 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 31 | 2.61 | 2.64 | 0 | 9.27 | .00 | 19 | 20.97 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 32 | 4.79 | 6.09 | 1 | 5.86 | .00 | 50 | 9.26 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 36 | 2.53 | 3.41 | 1 | 6.07 | .00 | 40 | 6.60 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 40 | 2.80 | 3.00 | 1 | 3.08 | .00 | 18 | 20.38 |
| 91 | 4.96 | 11.60 | 5.36 | .52 | .45 | 42 | 4.62 | 3.44 | 1 | 4.35 | 21.40 | 25 | 26.48 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 507 | 4.20 | 2.06 | 1 | .34 | 115.10 | 15 | 34.43 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 607 | 7.62 | 2.70 | 0 | 4.41 | 109.90 | 58 | 37.30 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 707 | 8.39 | 4.13 | 0 | 10.43 | 101.25 | 92 | 19.56 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 8 | 16.95 | 4.76 | 1 | 1.05 | 122.02 | 53 | 61.22 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 509 | 8.23 | 4.05 | 1 | 2.52 | 129.70 | 64 | 18.67 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 609 | 10.06 | 2.74 | 0 | 14.17 | 129.60 | 81 | 19.72 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 11 | 19.01 | 6.34 | 1 | .43 | 134.40 | 171 | 36.67 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 512 | 2.65 | 1.12 | 1 | 4.85 | 123.10 | 14 | 14.37 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 612 | 3.12 | 1.98 | 0 | 6.88 | 120.10 | 13 | 33.15 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 13 | 10.60 | 4.58 | 1 | 5.38 | 116.80 | 91 | 47.58 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 15 | 9.37 | 3.94 | 1 | 6.90 | 111.70 | 70 | 33.65 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 16 | 7.35 | 3.18 | 1 | 9.33 | 105.00 | 81 | 18.70 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 17 | 4.44 | 2.53 | 0 | 14.95 | 97.36 | 51 | 24.91 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 518 | 5.40 | 3.90 | 1 | 9.28 | 93.40 | 41 | 30.58 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 618 | 7.14 | 3.51 | 0 | 13.08 | 87.98 | 26 | 28.40 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 19 | 3.76 | 1.75 | 0 | 16.78 | 80.95 | 37 | 19.30 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 20 | 2.95 | 1.99 | 0 | 5.45 | 73.90 | 27 | 8.38 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 21 | 2.94 | 1.27 | 0 | 7.05 | 71.10 | 27 | 18.16 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 24 | 3.73 | 1.83 | 0 | 10.70 | 23.60 | 111 | 4.89 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 26 | 4.56 | 1.58 | 1 | 2.11 | 3.80 | 70 | 28.08 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 28 | 7.16 | 3.74 | 0 | 9.92 | .00 | 145 | 9.06 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 29 | 6.34 | 2.38 | 1 | .76 | .00 | 83 | 9.49 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 530 | 2.44 | 1.07 | 1 | 5.07 | .00 | 21 | 9.71 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 630 | 2.39 | 1.30 | 0 | 7.04 | .00 | 23 | 9.57 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 31 | 2.61 | .83 | 0 | 9.27 | .00 | 19 | 20.97 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 32 | 4.79 | 2.32 | 1 | 5.86 | .00 | 50 | 9.26 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 34 | 3.48 | 4.49 | 0 | 14.43 | .00 | 91 | 7.34 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 36 | 2.53 | 1.21 | 1 | 6.07 | .00 | 40 | 6.60 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 39 | 3.76 | 2.39 | 1 | 6.23 | .00 | 71 | 9.40 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 42 | 4.62 | 1.93 | 1 | 4.35 | 21.40 | 25 | 26.48 |
| 92 | .16 | 191.06 | 76.53 | .00 | .32 | 43 | 3.07 | 1.20 | 1 | 3.17 | 16.60 | 44 | 12.36 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 2 | 3.80 | 2.94 | 1 | 3.10 | 94.75 | 32 | 17.29 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 9 | 7.64 | 5.50 | 0 | 6.06 | 39.97 | 30 | 37.46 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 13 | 41.32 | 40.66 | 1 | 3.33 | 46.82 | 841 | 15.68 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 14 | 7.59 | 5.13 | 0 | 7.41 | 47.11 | 95 | 18.06 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 19 | 6.86 | 8.07 | 1 | 4.17 | .00 | 167 | 12.36 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 20 | 9.43 | 9.67 | 1 | 2.53 | 22.84 | 99 | 16.94 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 21 | 15.48 | 7.91 | 1 | .00 | 32.84 | 232 | 13.68 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 22 | 4.83 | 5.80 | 1 | .00 | 56.70 | 114 | 20.88 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 23 | 4.07 | 3.69 | 1 | 1.15 | 40.20 | 66 | 9.69 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 24 | 3.50 | 3.29 | 1 | .47 | 94.72 | 29 | 15.55 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 27 | 3.84 | 2.34 | 1 | 2.81 | 67.97 | 43 | 20.50 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 28 | 2.46 | 3.17 | 1 | 5.00 | 50.63 | 12 | 17.33 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 29 | 4.86 | 3.19 | 1 | 2.16 | 102.25 | 22 | 26.34 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 30 | 8.39 | 9.50 | 0 | 5.53 | 97.95 | 42 | 30.93 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 31 | 3.06 | 2.12 | 1 | .78 | 101.75 | 34 | 11.96 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 321 | 4.09 | 2.27 | 1 | 1.25 | 117.94 | 31 | 16.88 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 322 | 2.88 | 1.79 | 0 | 4.85 | 113.54 | 89 | 7.29 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 33 | 7.28 | 6.74 | 1 | .54 | 125.00 | 53 | 24.05 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 35 | 6.28 | 4.31 | 1 | 2.79 | 116.70 | 114 | 7.27 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 36 | 4.36 | 3.56 | 1 | 7.73 | 110.34 | 54 | 9.92 |
| 101 | 1.12 | 10.40 | 5.50 | .44 | .45 | 37 | 5.59 | 5.55 | 0 | 9.36 | 75.82 | 132 | 12.58 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 1 | 25.54 | 22.60 | 1 | .27 | 54.94 | 147 | 77.33 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 2 | 3.80 | 2.53 | 1 | 3.10 | 94.75 | 32 | 17.29 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 51 | 2.11 | 1.23 | 1 | 2.03 | 84.68 | 32 | 7.82 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 52 | 2.17 | 1.54 | 1 | 3.92 | 82.28 | 30 | 8.35 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 6 | 8.10 | 6.16 | 1 | 4.36 | 86.36 | 183 | 17.09 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 71 | 3.64 | 2.50 | 1 | 5.87 | 78.36 | 24 | 14.50 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 72 | 4.74 | 4.10 | 0 | 9.23 | 74.36 | 44 | 30.34 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 8 | 18.31 | 16.65 | 1 | 8.42 | 40.64 | 321 | 18.09 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 10 | 10.12 | 6.79 | 1 | 1.19 | 44.77 | 34 | 32.54 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 11 | 7.98 | 5.74 | 0 | 14.85 | 34.14 | 96 | 37.48 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 12 | 2.50 | 1.54 | 1 | 4.87 | 38.78 | 32 | 8.65 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 13 | 41.32 | 33.81 | 1 | 3.33 | 46.82 | 841 | 15.68 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 14 | 7.59 | 5.94 | 0 | 7.41 | 47.11 | 95 | 18.06 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 15 | 5.66 | 5.72 | 0 | 7.52 | .00 | 84 | 7.45 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 161 | 3.58 | 3.63 | 0 | 11.84 | .00 | 50 | 9.92 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 17 | 3.89 | 2.74 | 1 | 4.65 | .00 | 72 | 5.62 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 18 | 5.95 | 4.84 | 1 | 4.71 | .00 | 122 | 26.01 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 19 | 6.86 | 6.66 | 1 | 4.17 | .00 | 167 | 12.36 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 20 | 9.43 | 5.71 | 1 | 2.53 | 22.84 | 99 | 16.94 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 21 | 15.48 | 9.38 | 1 | .00 | 32.84 | 232 | 13.68 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 22 | 4.83 | 3.00 | 1 | .00 | 56.70 | 114 | 20.88 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 23 | 4.07 | 2.51 | 1 | 1.15 | 40.20 | 66 | 9.69 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 212 | 2.60 | 1.45 | 1 | 2.45 | 32.62 | 83 | 3.74 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 212 | 2.29 | 2.18 | 1 | 4.22 | 30.02 | 17 | 11.25 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 24 | 3.50 | 4.10 | 1 | .47 | 94.72 | 29 | 15.55 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 251 | 2.01 | 1.57 | 1 | 1.80 | 88.42 | 43 | 7.33 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 252 | 6.60 | 6.69 | 1 | 3.71 | 85.82 | 86 | 18.06 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 26 | 7.71 | 4.11 | 1 | 6.75 | 69.51 | 79 | 33.14 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 27 | 3.84 | 2.73 | 1 | 2.81 | 67.97 | 43 | 20.50 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 28 | 2.46 | 2.64 | 1 | 5.00 | 50.63 | 12 | 17.33 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 29 | 4.86 | 2.50 | 1 | 2.16 | 102.25 | 22 | 26.34 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 30 | 8.39 | 4.19 | 0 | 5.53 | 97.95 | 42 | 30.93 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 31 | 3.06 | 1.58 | 1 | .78 | 101.75 | 34 | 11.96 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 321 | 4.09 | 2.34 | 1 | 1.25 | 117.94 | 31 | 16.88 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 322 | 2.88 | 1.70 | 0 | 4.85 | 113.54 | 89 | 7.29 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 33 | 7.28 | 4.12 | 1 | .54 | 125.00 | 53 | 24.05 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 34 | 21.42 | 14.40 | 1 | .90 | 119.95 | 169 | 36.89 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 35 | 6.28 | 2.99 | 1 | 2.79 | 116.70 | 114 | 7.27 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 36 | 4.36 | 1.99 | 1 | 7.73 | 110.34 | 54 | 9.92 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 37 | 5.59 | 3.23 | 0 | 9.36 | 75.82 | 132 | 12.58 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 38 | 12.82 | 6.66 | 1 | 3.39 | 33.90 | 347 | 5.78 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 39 | 4.76 | 2.39 | 0 | 2.07 | 63.38 | 12 | 43.44 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 40 | 3.66 | 1.03 | 1 | 1.51 | 131.36 | 73 | 12.68 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 41 | 5.45 | 4.63 | 0 | 4.47 | 127.93 | 17 | 30.37 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 42 | 5.20 | 2.73 | 0 | 1.12 | 126.69 | 87 | 12.59 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 43 | 12.28 | 6.95 | 0 | 3.40 | 125.54 | 194 | 14.80 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 44 | 10.06 | 7.01 | 0 | 11.84 | 113.88 | 82 | 20.18 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 45 | 4.32 | 2.24 | 1 | 4.85 | 100.70 | 25 | 22.95 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 46 | 6.58 | 3.39 | 1 | 3.63 | 99.40 | 135 | 9.21 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 47 | 5.31 | 2.74 | 1 | 3.81 | 87.00 | 23 | 38.55 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 48 | 6.31 | 3.47 | 1 | 1.86 | 27.40 | 79 | 11.34 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 49 | 2.01 | 1.31 | 0 | 1.69 | 3.89 | 7 | 17.45 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 50 | 2.35 | 1.50 | 0 | 6.89 | 19.73 | 10 | 20.68 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 51 | 3.15 | 1.12 | 0 | 2.22 | 98.20 | 46 | 8.55 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 62 | 2.50 | 1.20 | 0 | 4.34 | 92.80 | 31 | 7.93 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 63 | 4.52 | 2.49 | 1 | .92 | 111.90 | 46 | 38.77 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 64 | 5.57 | 1.42 | 1 | .14 | 114.30 | 232 | 9.04 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 65 | 22.57 | 14.09 | 1 | 1.51 | 106.10 | 328 | 19.44 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 66 | 7.84 | 4.34 | 1 | .45 | 80.00 | 55 | 35.89 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 67 | 2.06 | .85 | 0 | 6.79 | 56.30 | 56 | 10.12 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 67 | 3.36 | 1.07 | 0 | 8.18 | 54.30 | 72 | 6.71 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 67 | 2.47 | 1.02 | 0 | 10.35 | 51.10 | 57 | 4.99 |
| 102 | 1.22 | 8.55 | 4.36 | .49 | .45 | 67 | 3.16 | .96 | 0 | 11.88 | 48.60 | 68 | 13.89 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 1 | 25.54 | 19.12 | 1 | .27 | 54.94 | 147 | 77.33 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 2 | 3.80 | 2.60 | 1 | 3.10 | 94.75 | 32 | 17.29 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 4 | 8.45 | 7.16 | 1 | 2.58 | 94.95 | 107 | 41.45 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 51 | 2.11 | 1.92 | 1 | 2.03 | 84.68 | 32 | 7.82 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 52 | 2.17 | 1.98 | 1 | 3.92 | 82.28 | 30 | 9.35 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 71 | 3.64 | 1.72 | 1 | 5.87 | 78.36 | 24 | 14.50 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 72 | 4.74 | 2.34 | 0 | 9.23 | 74.36 | 44 | 30.34 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 8 | 18.31 | 14.21 | 1 | 8.42 | 40.64 | 321 | 18.09 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 9 | 7.64 | 4.61 | 0 | 6.06 | 39.97 | 30 | 37.46 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 10 | 10.12 | 6.91 | 1 | 1.19 | 44.77 | 34 | 32.54 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 11 | 7.98 | 6.96 | 0 | 14.85 | 34.14 | 96 | 37.48 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 12 | 2.50 | 2.46 | 1 | 4.87 | 38.78 | 32 | 8.65 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 13 | 41.32 | 38.25 | 1 | 3.33 | 46.82 | 841 | 15.68 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 14 | 7.59 | 6.40 | 0 | 7.41 | 47.11 | 95 | 18.06 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 15 | 5.60 | 5.78 | 0 | 7.52 | .00 | 84 | 7.45 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 161 | 3.58 | 3.56 | 0 | 11.84 | .00 | 50 | 9.92 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 17 | 3.89 | 2.75 | 1 | 4.65 | .00 | 72 | 5.62 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 18 | 5.95 | 5.04 | 1 | 4.71 | .00 | 122 | 26.01 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 19 | 6.80 | 7.55 | 1 | 4.17 | .00 | 167 | 12.36 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 20 | 9.43 | 6.09 | 1 | 2.53 | 22.84 | 99 | 16.94 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 22 | 4.83 | 3.30 | 1 | .00 | 56.70 | 114 | 20.88 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 23 | 4.07 | 3.23 | 1 | 1.15 | 40.20 | 66 | 9.69 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 212 | 2.60 | 2.00 | 1 | 2.45 | 32.62 | 83 | 3.74 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 212 | 2.29 | 2.45 | 1 | 4.22 | 30.02 | 17 | 11.25 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 251 | 2.01 | 2.10 | 1 | 1.80 | 88.42 | 43 | 7.33 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 252 | 5.60 | 6.62 | 1 | 3.71 | 85.62 | 86 | 18.06 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 26 | 7.71 | 4.62 | 1 | 6.75 | 89.51 | 79 | 33.14 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 27 | 3.84 | 3.08 | 1 | 2.81 | 67.97 | 43 | 20.50 |
| 103 | 1.08 | 7.23 | 3.52 | .56 | .45 | 28 | 2.46 | 2.63 | 1 | 5.00 | 50.63 | 12 | 17.33 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 35 | 6.28 | 4.35 | 1 | 2.79 | 116.70 | 114 | 7.27 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 36 | 4.36 | 2.83 | 1 | 7.73 | 110.34 | 54 | 9.92 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 37 | 5.59 | 4.06 | 0 | 9.36 | 75.82 | 132 | 12.58 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 38 | 12.82 | 8.90 | 1 | 3.39 | 33.90 | 347 | 5.78 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 39 | 4.76 | 4.14 | 0 | 2.07 | 63.38 | 12 | 43.44 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 40 | 3.66 | 2.57 | -1 | 1.51 | 131.36 | 73 | 12.68 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 41 | 6.45 | 4.36 | 0 | 4.47 | 127.93 | 17 | 30.37 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 42 | 5.20 | 3.58 | 0 | 1.12 | 126.69 | 87 | 12.59 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 43 | 12.28 | 8.11 | 0 | 3.40 | 125.54 | 194 | 14.80 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 44 | 10.06 | 7.02 | 0 | 11.84 | 113.88 | 82 | 20.18 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 45 | 4.32 | 2.61 | 1 | 4.85 | 100.70 | 25 | 22.95 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 46 | 6.58 | 4.81 | 1 | 3.63 | 99.40 | 135 | 9.21 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 47 | 5.31 | 3.21 | 1 | 3.81 | 87.00 | 23 | 38.55 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 48 | 6.31 | 4.37 | 1 | 1.86 | 27.40 | 79 | 11.34 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 49 | 2.01 | 1.66 | 0 | 1.69 | 3.89 | 7 | 17.45 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 50 | 2.35 | 2.17 | 0 | 6.89 | 19.73 | 10 | 20.68 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 61 | 3.12 | 1.86 | 0 | 2.22 | 98.20 | 46 | 8.55 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 62 | 2.50 | 1.73 | 0 | 4.34 | 92.80 | 31 | 7.93 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 63 | 4.52 | 3.09 | 1 | .92 | 111.90 | 46 | 38.77 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 64 | 5.57 | 3.32 | 1 | .14 | 114.30 | 232 | 9.04 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 65 | 22.57 | 17.99 | 1 | 1.51 | 106.10 | 328 | 19.44 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 66 | 7.84 | 5.04 | 1 | .45 | 80.00 | 55 | 35.89 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 67 | 2.06 | 2.41 | 0 | 6.79 | 56.30 | 56 | 10.12 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 67 | 3.36 | 2.99 | 0 | 8.18 | 54.30 | 72 | 6.71 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 67 | 2.47 | 2.62 | 0 | 10.35 | 51.10 | 57 | 4.99 |
| 103 | 1.10 | 7.23 | 3.52 | .56 | .45 | 67 | 3.16 | 2.63 | 0 | 11.88 | 48.60 | 68 | 13.89 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 2 | 4.19 | 3.06 | 1 | 6.74 | 49.37 | 31 | 10.81 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 3 | 8.40 | 4.73 | 1 | .00 | 87.31 | 78 | 7.98 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 4 | 3.69 | 2.14 | 1 | 13.07 | 80.60 | 24 | 16.04 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 5 | 6.47 | 4.04 | 1 | 2.36 | 82.48 | 61 | 10.79 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 61 | 2.30 | .94 | 1 | 8.39 | 88.30 | 18 | 9.67 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 62 | 2.37 | 1.25 | 0 | 12.56 | 83.94 | 11 | 16.32 |

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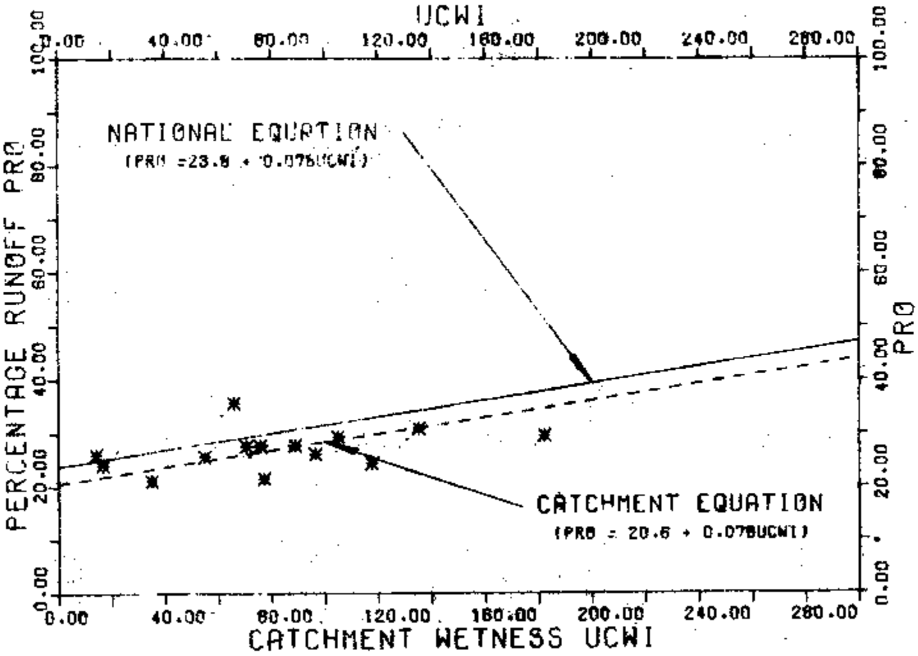
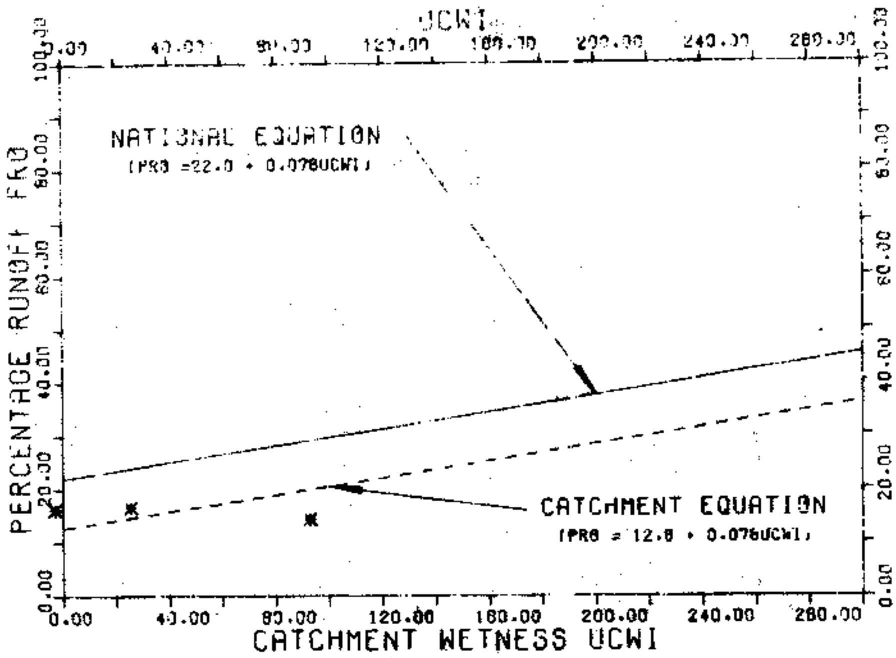
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 521 | 2.93 | .80 | .33 | .48 | .40 | 7 | 2.21 | 1.49 | 1 | 6.36 | 98.48 | 14 | 13.28 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 8 | 3.18 | 3.04 | 0 | 3.56 | 98.44 | 26 | 12.73 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 9 | 9.68 | 8.69 | 0 | 5.69 | 94.58 | 95 | 10.75 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 10 | 3.71 | 2.30 | 0 | 1.37 | 100.77 | 17 | 20.98 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 11 | 9.97 | 9.19 | 0 | 6.56 | 88.59 | 74 | 14.41 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 12 | 8.13 | 9.42 | 0 | 7.58 | 80.73 | 50 | 21.45 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 13 | 4.02 | 4.48 | 0 | 13.54 | 98.13 | 16 | 27.88 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 14 | 3.12 | 1.83 | 0 | .95 | 36.03 | 16 | 22.49 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 15 | 4.52 | 3.76 | 0 | 10.00 | 22.80 | 8 | 40.67 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 16 | 2.00 | 1.06 | 1 | .73 | 13.18 | 5 | 20.00 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 18 | 4.73 | 2.31 | 1 | .21 | 112.48 | 8 | 43.00 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 19 | 2.34 | 1.16 | 0 | 1.90 | 123.44 | 8 | 17.49 |
| 521 | 2.93 | .80 | .33 | .48 | .40 | 521 | 2.00 | .43 | 1 | .97 | 125.00 | 4 | 24.00 |
| 522 | 4.94 | .60 | .25 | 1.00 | .40 | 7 | 2.21 | 1.14 | 1 | 6.36 | 98.48 | 14 | 13.28 |
| 522 | 4.94 | .60 | .25 | 1.00 | .40 | 8 | 3.18 | 1.95 | 0 | 3.56 | 98.44 | 26 | 12.73 |
| 522 | 4.94 | .60 | .25 | 1.00 | .40 | 9 | 9.68 | 6.42 | 0 | 5.69 | 94.58 | 95 | 10.75 |
| 522 | 4.94 | .60 | .25 | 1.00 | .40 | 10 | 3.71 | 1.88 | 0 | 1.37 | 100.77 | 17 | 20.98 |
| 522 | 4.94 | .60 | .25 | 1.00 | .40 | 11 | 9.97 | 6.63 | 0 | 6.56 | 88.59 | 74 | 14.41 |
| 522 | 4.94 | .60 | .25 | 1.00 | .40 | 12 | 8.13 | 5.72 | 0 | 7.58 | 80.73 | 50 | 21.45 |
| 522 | 4.94 | .60 | .25 | 1.00 | .40 | 13 | 4.02 | 2.99 | 0 | 13.54 | 98.13 | 16 | 27.88 |
| 522 | 4.94 | .60 | .25 | 1.00 | .40 | 14 | 3.12 | 1.95 | 0 | .95 | 36.03 | 16 | 22.49 |
| 522 | 4.94 | .60 | .25 | 1.00 | .40 | 15 | 4.52 | 3.21 | 0 | 10.00 | 22.80 | 8 | 40.67 |
| 522 | 4.94 | .60 | .25 | 1.00 | .40 | 16 | 2.00 | 1.17 | 1 | .73 | 13.18 | 5 | 20.00 |
| 522 | 4.94 | .60 | .25 | 1.00 | .40 | 17 | 11.52 | 7.62 | 0 | 2.87 | 77.48 | 22 | 50.28 |
| 522 | 4.94 | .60 | .25 | 1.00 | .40 | 18 | 4.73 | 2.95 | 1 | .21 | 112.48 | 8 | 43.00 |
| 522 | 4.94 | .60 | .25 | 1.00 | .40 | 19 | 2.34 | 1.35 | 0 | 1.90 | 123.44 | 8 | 17.49 |
| 522 | 4.94 | .60 | .25 | 1.00 | .40 | 20 | 3.57 | 3.06 | 0 | 6.57 | 111.56 | 20 | 18.68 |
| 523 | 2.40 | 3.42 | 1.35 | .00 | .40 | 1 | 2.00 | .73 | 0 | 6.04 | 80.60 | 10 | 12.00 |
| 523 | 2.40 | 3.42 | 1.35 | .00 | .40 | 2 | 3.50 | 1.44 | 1 | .00 | 127.90 | 25 | 25.00 |
| 523 | 2.40 | 3.42 | 1.35 | .00 | .40 | 3 | 5.00 | 2.11 | 0 | 3.05 | 123.90 | 56 | 15.00 |
| 55 | 4.24 | 62.00 | 19.22 | .98 | .15 | 1 | 2.06 | .98 | 1 | .98 | 93.11 | 28 | 18.03 |
| 55 | 4.24 | 62.00 | 19.22 | .98 | .15 | 2 | 15.00 | 12.88 | 1 | .27 | 87.00 | 52 | 61.74 |
| 55 | 4.24 | 62.00 | 19.22 | .98 | .15 | 3 | 4.88 | 3.33 | 1 | 1.71 | 102.52 | 31 | 19.87 |
| 55 | 4.24 | 62.00 | 19.22 | .98 | .15 | 4 | 2.09 | 1.18 | 0 | 6.12 | 97.59 | 26 | 12.83 |
| 55 | 4.24 | 62.00 | 19.22 | .98 | .15 | 5 | 2.95 | 1.62 | 1 | 1.02 | 108.68 | 34 | 12.95 |
| 55 | 4.24 | 62.00 | 19.22 | .98 | .15 | 6 | 2.11 | 1.31 | 1 | 2.35 | 105.47 | 21 | 12.66 |
| 55 | 4.24 | 62.00 | 19.22 | .98 | .15 | 7 | 7.98 | 6.56 | 1 | .64 | 96.51 | 116 | 9.79 |

## APPENDIX 3

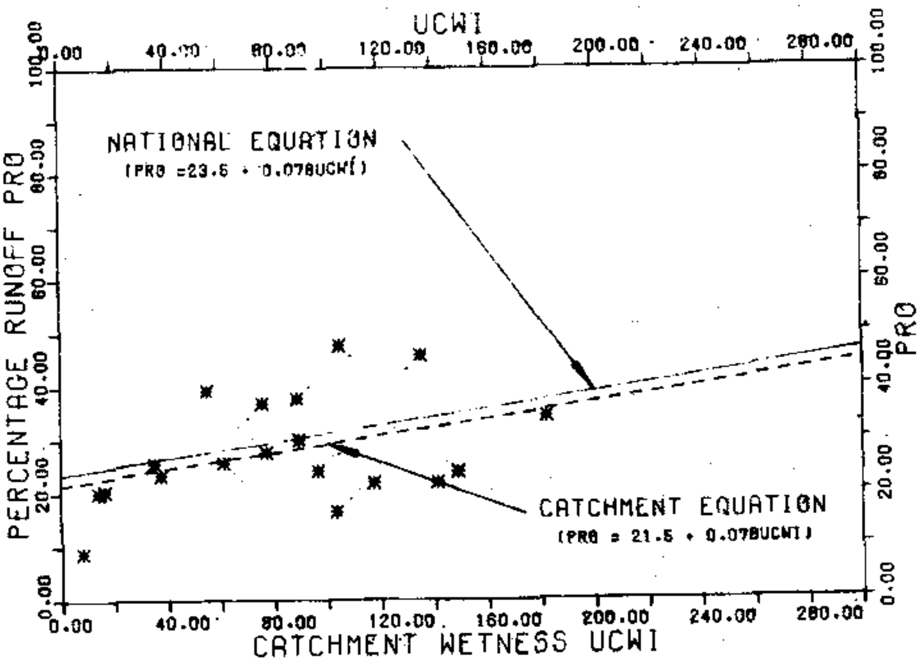
## PERCENTAGE RUNOFF MODEL FIT



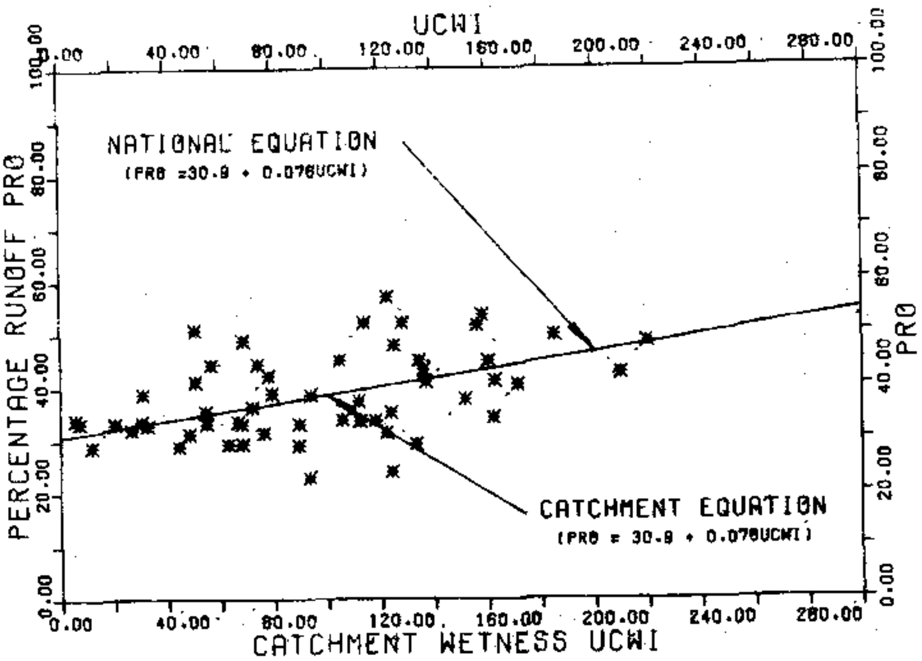

PERCENTAGE RUNOFF DATA FOR CATCHMENT 522



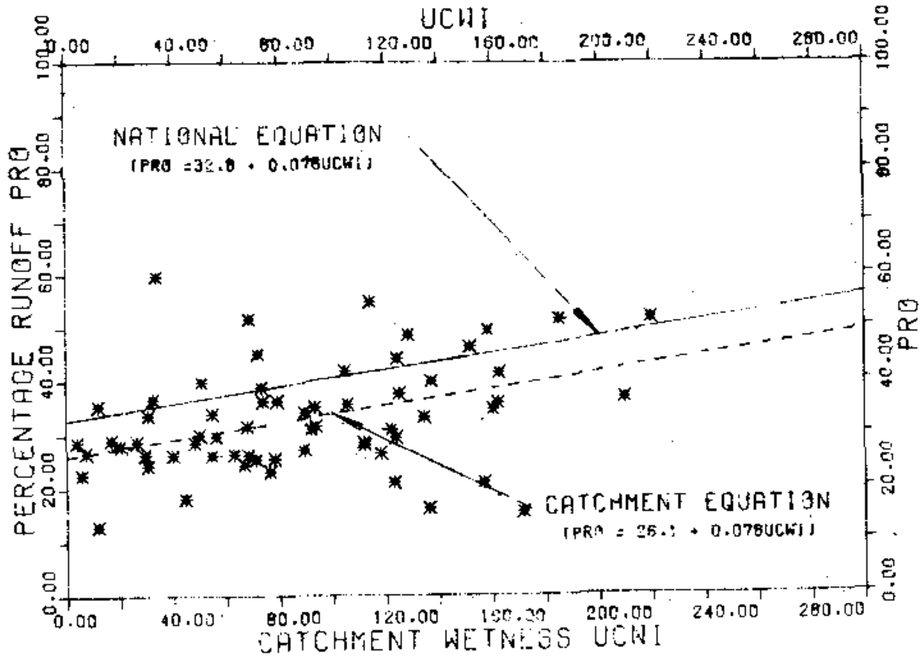

PERCENTAGE RUNOFF DATA FOR CATCHMENT 523



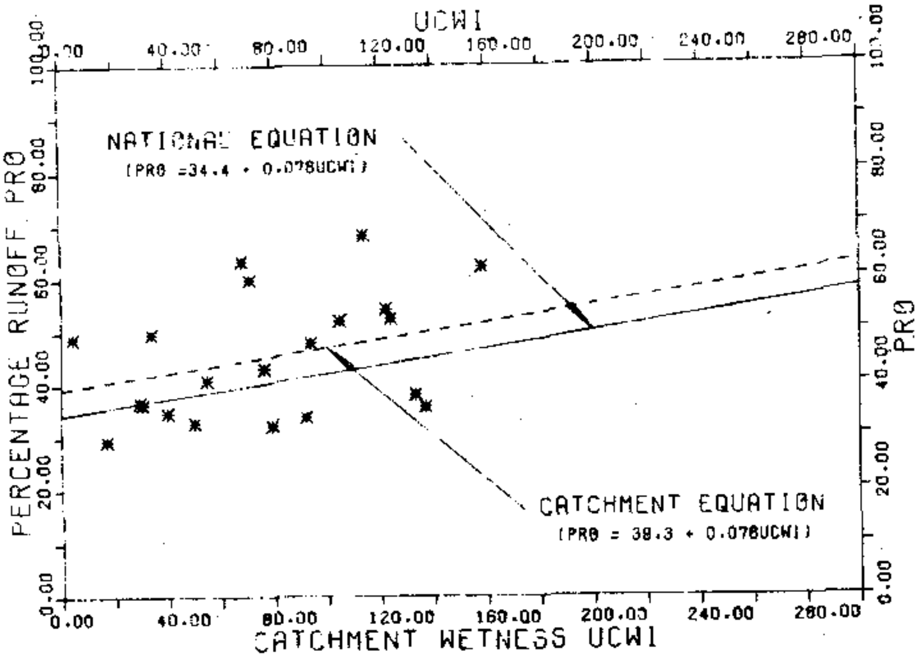

PERCENTAGE RUNOFF DATA FOR CATCHMENT 521



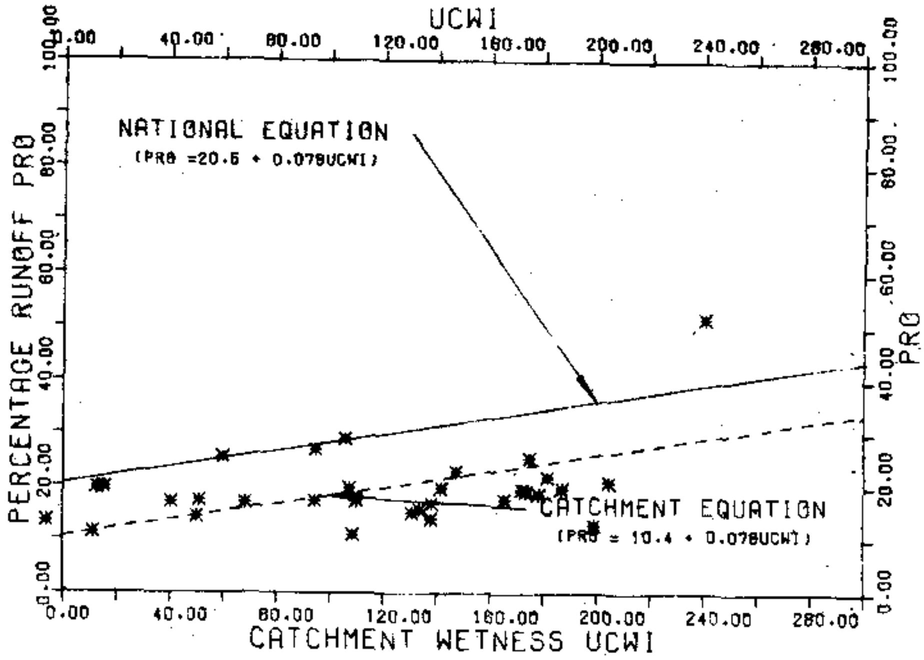

PERCENTAGE RUNOFF DATA FOR CATCHMENT 103



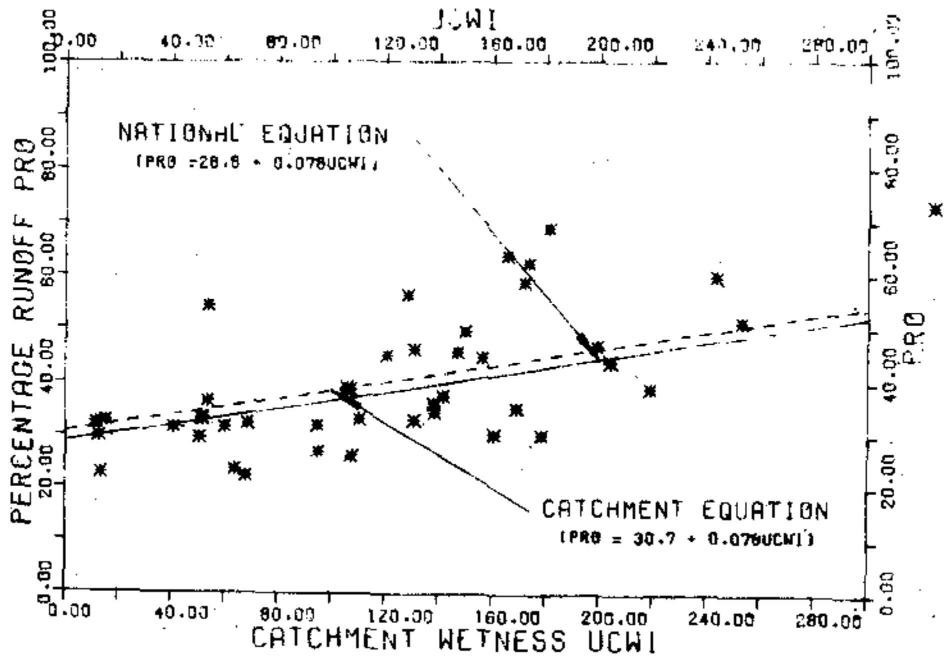

PERCENTAGE RUNOFF DATA FOR CATCHMENT 102



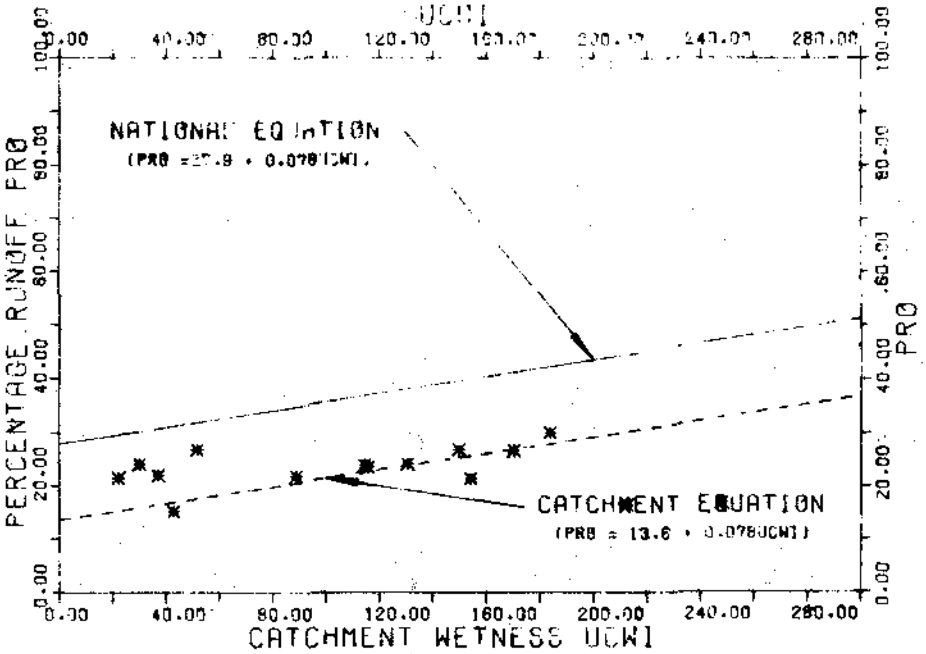

PERCENT-GE RUNOFF DATA FOR CATCHMENT 101



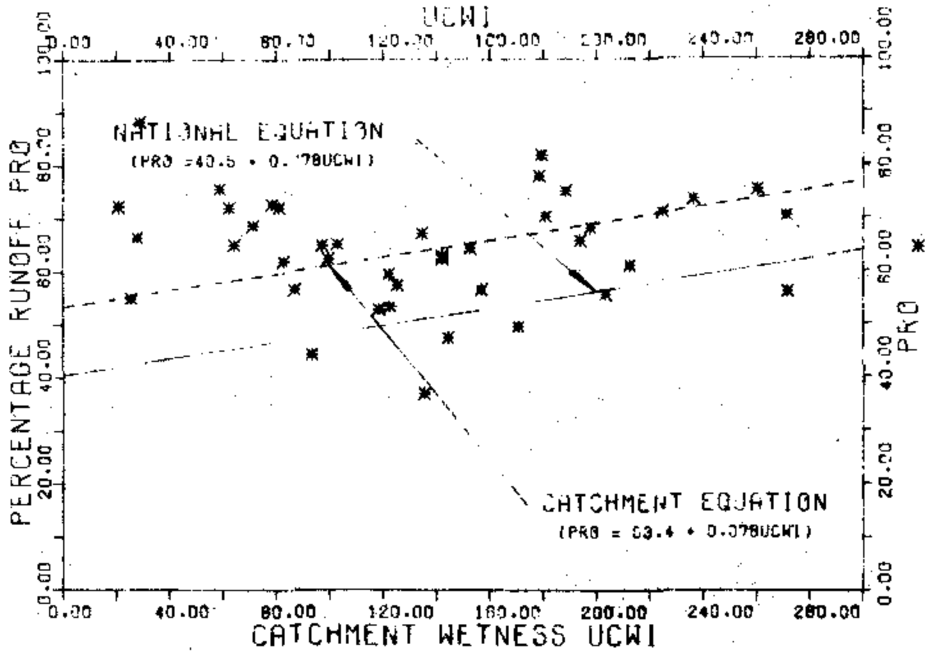

PERCENTAGE RUNOFF DATA FOR CATCHMENT 92



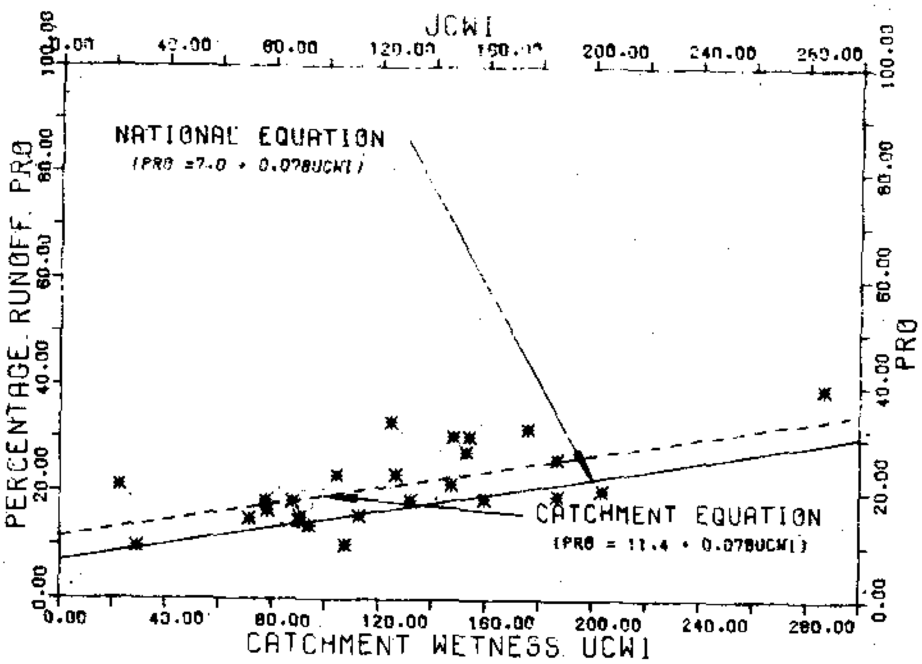

PERCENTAGE RUNOFF DATA FOR CATCHMENT 91



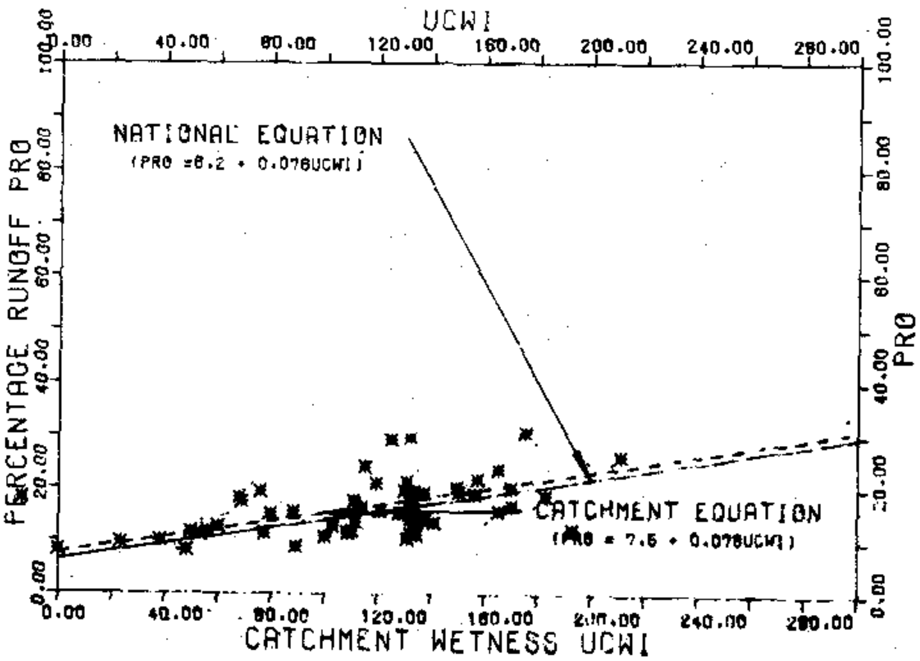

PERCENTAGE RUNOFF DATA FOR CATCHMENT 81



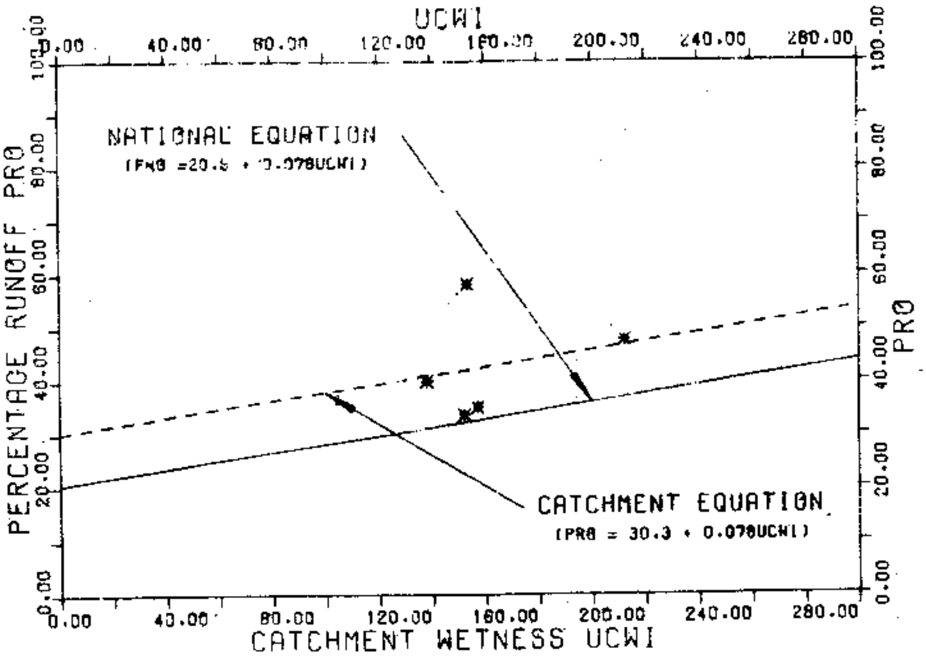

PERCENTAGE RUNOFF DATA FOR CATCHMENT 72



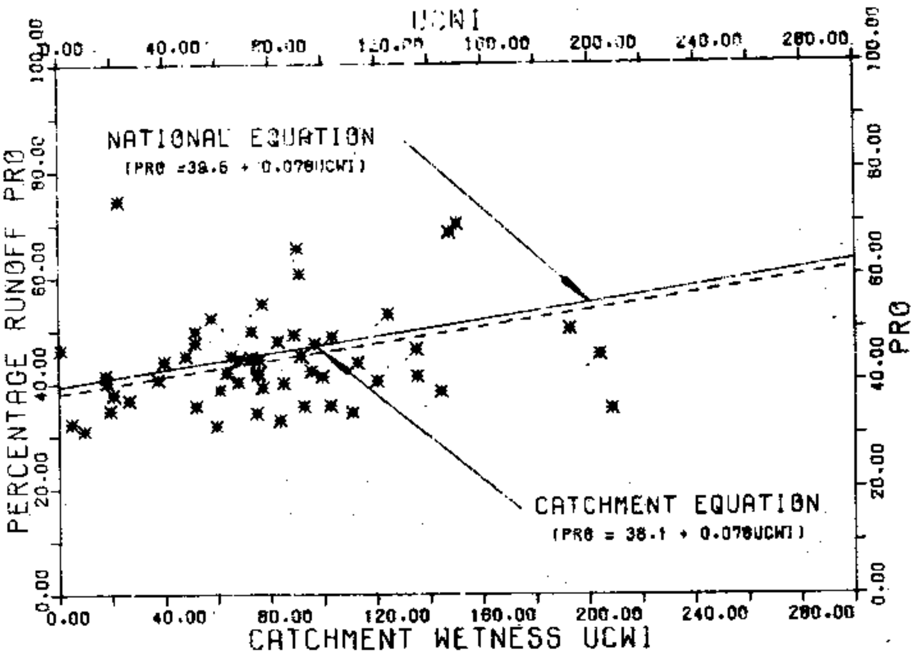

PERCENTAGE RUNOFF DATA FOR CATCHMENT 71



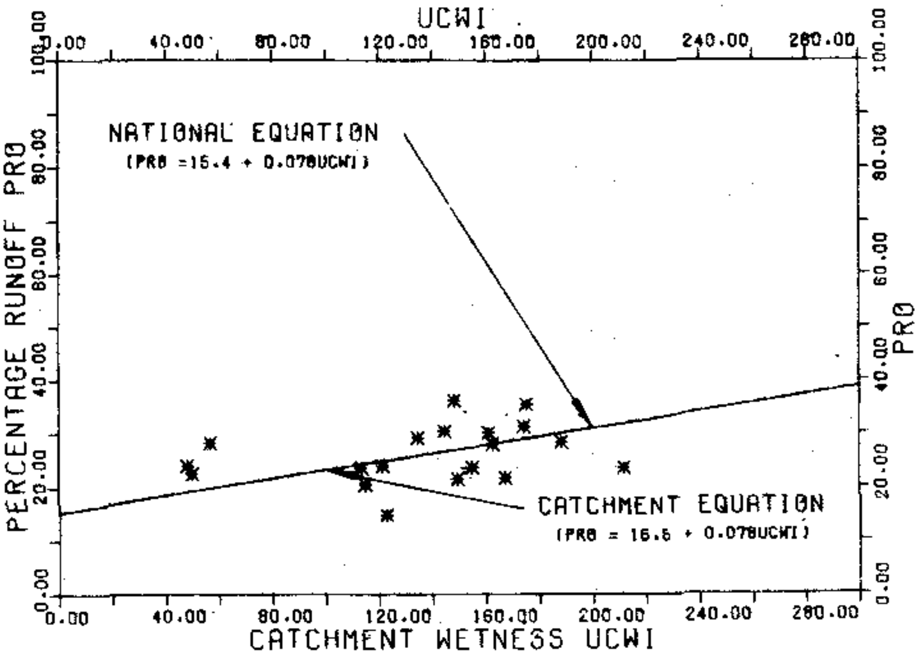

PERCENTAGE RUNOFF DATA FOR CATCHMENT 11



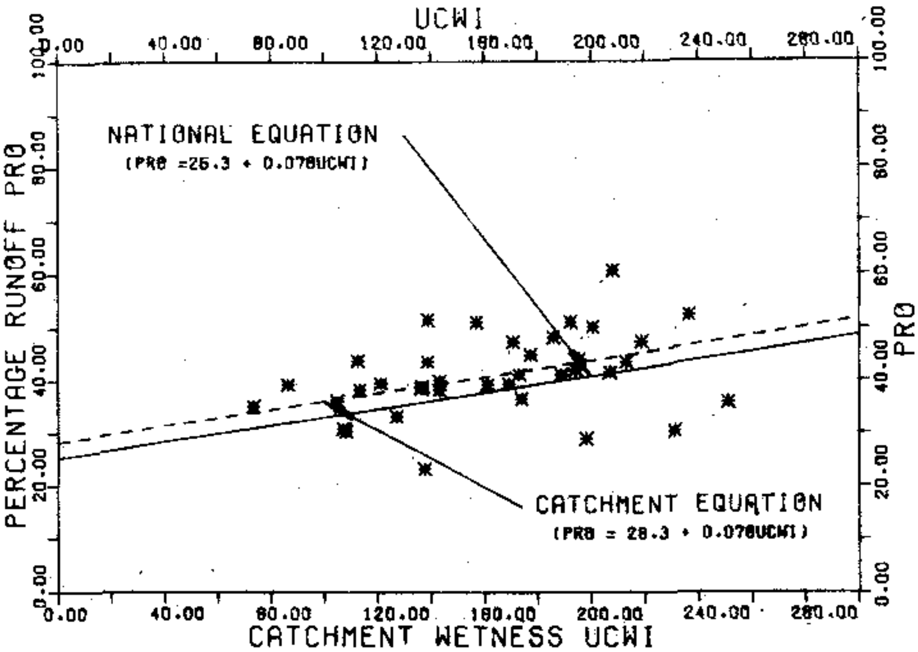

PERCENTAGE RUNOFF DATA FOR CATCHMENT 6




PERCENTAGE RUNOFF DATA FOR CATCHMENT 5




PERCENTAGE RUNOFF DATA FOR CATCHMENT 3




PERCENTAGE RUNOFF DATA FOR CATCHMENT 1