Property Creep
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Abstract

OFWAT recognise that hard drainage area in urban catchments grows over time – a phenomenon know as 'impermeable area creep'. This increases the load on sewer systems and contributes to deteriorating levels of service that are largely outside the control of the water companies. The paper is a case study of a project that set out to gain better understanding of the level of creep and the parameters that affect it. Through the use of desk studies, site investigation and aerial survey, different types of creep were identified and their extent and impact assessed. The outcome of this was the production of an average value for property creep and conclusions on the rate of growth over time.

1. Background

As part of Severn Trent Water Ltd AMP 04 submission Ewan Associates Ltd were commissioned to undertake an assessment of 'Residential Creep' within the suburb of Oakwood, North East of Derby city centre. This area was chosen as it is served by a separate sewerage system and has been developed over approximately the last 20 years, and contains detached, semi-detached and terraced houses of 1 to 5 bedrooms.

The driver for the project was the preparation of an Asset Case for Severn Trent's AMP4 submission. The OFWAT guidance notes state

> ***'We recognise that illegal connections and increased hard area drainage from existing customers can, over time, affect the performance of sewers. Companies should identify and quantify the impact and associated costs of this as part of their supply/demand balance plan.'***

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Residential Creep for the purposes of this study has been defined as the percentage of increase in additional contributing area due to the modifications made to a property since its original construction.

2. Methodology

Ten sample areas were chosen within the Oakwood subcatchment. These areas consisted of a range of house types/sizes and ages, in order to be representative of the range of properties and assess the whether certain property types are more prone to creep than others. The areas chosen are shown in Figure 1.

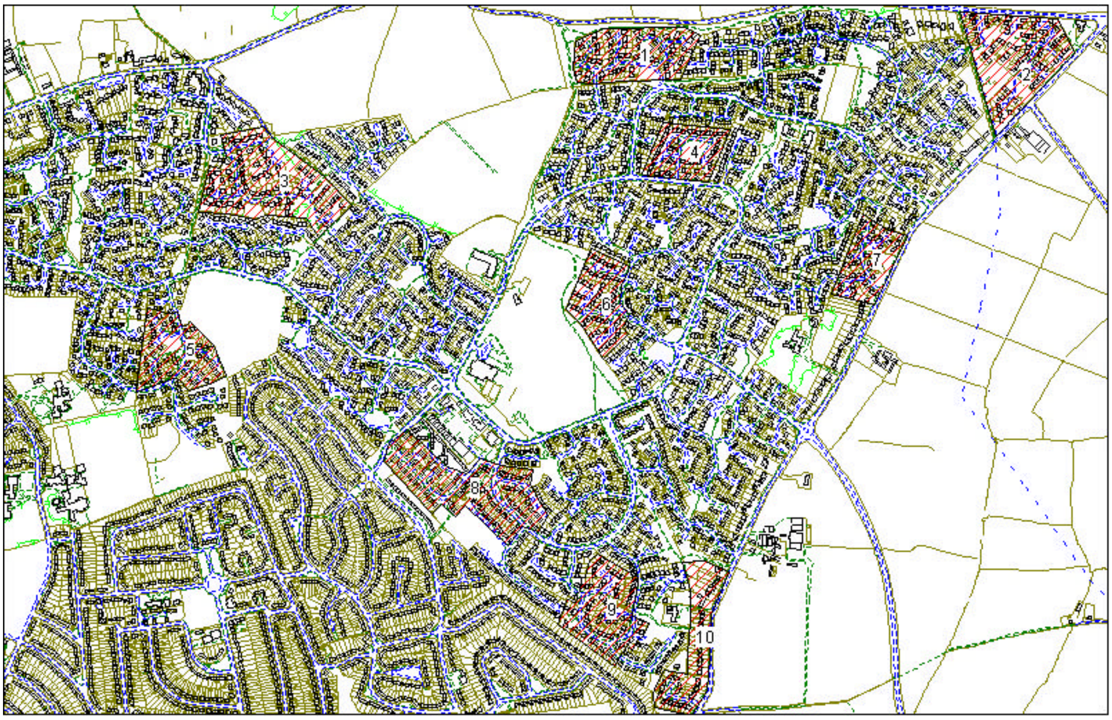

Figure 1 Overview Plan of Oakwood and Areas Surveyed

The survey was undertaken in April and May 2003. The site visits were undertaken during the day and evening in order to gain a higher percentage of full surveys (see below). In addition aerial photographs and video footage were taken and an aerial photograph of the Oakwood area was purchased from the internet.

The site visits, together with the aerial photography, produced sufficient information to complete the survey. Two levels of survey were completed:

- ***Full:*** if the householder was in and allowed complete visual inspection of their property.
- ***Visual:*** an inspection undertaken from outside the boundary, using aerial photographs for assistance as appropriate where no access was possible.

The following information was recorded as part of the survey.

- House number, street and postcode
- STWL age category
- Estimated Age
- Estimated size and house type
- Types of Creep, their extent and the drainage system to which they are connected.

The split of full and visual surveys is not uniform for each area but sufficient information was collected in all areas for the data to be processed and conclusions made.

The original areas of each property were calculated by digitising using the same method as would be applied in an impermeable area analysis. These areas were then used to calculate the percentage of creep of each property. This figure was averaged for each area. The final figure of mean percentage creep is the average of all the areas combined.

The creep was split into 'Roof' creep (extensions, garages and conservatories) and 'Paved' creep (driveways and patios).

Assumptions

During the data collection a number of assumptions had to be made as detailed information was not always available. These assumptions were made using engineering judgement and the evidence available on site.

1. All creep recorded is as present during data collection. Where the purchased aerial photograph was used, it is assumed that it is recent, although there is some creep recorded during site work as being constructed within the last 2 years that does not appear in the image. The data is only a snap shot of the current situation.

2. All sizes are estimated. Where possible structures such as garages and conservatories were classified in to size groups to allow quantitative assessment.

3. Assessment of the extent of original driveway, house and garaging was made by comparison to the OS sheet provided and from on site observations of similar features in a particular house type and driveway.

4. Full survey did provide more data and in some cases useful additional information. However the accuracy of this additional data is unknown as householders provided it.

3. Results

The table below shows the values of creep for each sample area together with the predominant house type and age.

Area	Average Property Age	Main Property Type	Property Area m^2	Additional Area m^2			Percentage Creep (Additional to Property)		
				Total	Roof	Paved	Total	Roof	Paved
1	1997	D4	2172.22	56.00	56.00	0.00	2.58	2.58	0.00
2	1995	S3	1618.97	139.00	125.00	14.00	8.59	7.72	0.86
3	1998	D5	3437.08	195.00	195.00	0.00	5.67	5.67	0.00
4	1992	D3	2334.89	65.00	61.00	4.00	2.78	2.61	0.17
5	1996	D3	1706.00	138.00	138.00	0.00	8.09	8.09	0.00
6	1988	D4	2168.00	317.00	67.00	250.00	14.62	3.09	11.53
7	1993	D4	1954.85	137.25	112.25	25.00	7.02	5.74	1.28
8	1986	T2	1997.34	178.00	125.50	52.50	8.91	6.28	2.63
9	1985	D4	1485.99	78.00	78.00	0.00	5.25	5.25	0.00
10	1935	S4	1991.90	237.00	192.00	45.00	11.90	9.64	2.26
					Average (%)		**7.55**	**5.67**	**1.87**

4. Discussion

The results show that the amount of creep for a number of (individual) similar properties varies. This variation is large with many houses of all types and ages not being extended in any way but at the other extreme the addition of extensions, conservatories and garages almost doubling the size of some property's impermeable area.

The percentage of the subcatchment value is smaller than the values frequently applied for illicit connections during model calibration. This is because only extension to paved areas has been considered in the scope of this study, not any original driveway or other drained impermeable area constructed with the property.

The results show that the properties fall into two bands of average total creep away from the mean value. These cannot be simply classified as being older and newer homes or larger and smaller as they cover the range of areas chosen. The reason for this variation is unknown.

The age of the property is not linearly related to its extent of creep. In broad terms the older the property (within the data set) the greater the increase in impermeable area but a direct relationship does not seem present in the properties surveyed. In addition property creep does not stop at a certain age. Older (pre war) properties surveyed were still undergoing recent addition of conservatories and extensions.

The size of the property affects the type of creep more so than its extent. Smaller starter homes predominately have additional garaging and car standing, whereas larger family homes have more extensions and conservatories. These both result in similar overall creep percentages for the properties surveyed.

The change in the design of housing estates over the time that the Oakwood estate was developed has resulted in a range of issues for the extension of driveways. In most cases driveways are originally constructed to either slope towards the highway or have gully drainage to the storm system and when extended these systems are still used. Older properties, even when they are larger family homes were only provided with space for 1 car and as a result a large percentage of these have added additional parking that feeds into the storm system. New properties are more likely to have 2 spaces, particularly when larger, but are also more likely to be served by long shared non adoptable highway which means these areas of drained tarmac will not (as a rule) be picked up by an impermeable area study. Although these are not creep as they are original construction, they will be contributing to the storm system without being accounted for in the areas initially put into models.

Investigation of patios and all paved areas other than driveways has concluded that no positive water removal is connected to either foul or surface water sewerage networks. This is true even though the area of Oakwood is on a clayey soil and drainage is poor. It can therefore be assumed that the paved patio and other areas do not contribute to a property's percentage creep. The connectivity of drainage from the extension to properties was not investigated as part of this study. It has been assumed that all connections are to the storm system but in reality illicit connections are likely.

The aerial photographs, taken from the plane and purchased from the internet, did not offer sufficient information for a complete assessment without the local knowledge gained from on site surveying, even once the patio areas were removed from the survey. It is best to consider the aerial photographs as a supplement to the site work rather than an alternative.

The aerial photographs did allow for greater understanding of large paved areas such as shared driveways and the addition of some creep. However, without the aid of a site survey, it is difficult to be certain that all the contributing factors to the total creep are identified and accurately quantified using this method alone.

5. Conclusions

The assessment of creep was successful in producing a percentage value for average increase in impermeable area and a degree of agreement was found between the areas surveyed once factor such as age were taken into account. However the large number of uncertainties and unknowns means that the assessment of creep globally is not a simple process.

Application of the final value found during this study may not provide a sufficiently accurate impermeable area for modeling purposes. The assessment of creep of each study area is also not practical due to the additional time that would be required. A compromise may be to use aerial photography together with OS property data to identify large areas of creep and other impermeable areas for inclusion within models to attempt to obtain a better fit. This probably will not remove the need for inclusion of an allowance for illicit connections but should reduce the area to be added for calibration.

The creep of properties means that over time an area with no further development will yield an increase in the flow to its storm and foul system in storm conditions. This increase will occur over an extensive period of time and will result in a gradual increase to the demands on a system.

The amount of creep within a particular area is also affected to a great extent by many social and economic factors beyond the scope of this study. These include the housing market (including price, availability, mortgage rates etc) and the quality of the area (amenities, schools etc). All these factors will result in one area creeping more or less than another that is physically very similar and thus creep in specific areas is difficult to predict.

Ultimately what dictates the limit of creep or future potential creep is the amount of available land and the planning restriction upon it, as this will govern the maximum additions to a property in terms of both extensions and parking space expansion.