SOCIAL ASPECTS OF SEWERAGE

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Abstract
The usage of sewer systems to convey all forms of household waste is ubiquitous in the UK. Whilst industrial waste producers have been made to behave more environmentally responsibly by regulation and policing, the 'environmentally impacting' behaviour of individuals, particularly in the home, has been an area largely uninvestigated and uncontrolled. Hence, in the UK, few concerted efforts have been made to encourage individuals to be more responsible in their actions. As a consequence, wastewater systems continue to receive and discharge into the environment a variety of solids and biochemicals, which, even where the wastewater receives conventional treatment, impact on receiving systems. New housing often includes kitchen grinders, shredding organic wastes and adding these to the sewer system. Customers in the UK are amongst the worst in the world for careless disposal of a wide range of solids into the WC as a 'rubbish bin'. The consequences of these actions have to be dealt with by the wastewater utilities and EA. Hence it is important to establish what solids are being flushed, by whom and in what amounts, and what happens to this material as it passes through sewer systems. This paper deals with a number of recent studies that have looked at public behaviour stratified by catchment type, social and ethnic mix, as a key component in the development of a gross solids predictive model.

Introduction
Domestic wastewater is traditionally conveyed to treatment in the UK via a waterborne collection system. Despite the introduction of separate drainage systems, the majority of sewers still operate as combined sewers where stormwater and wastewater are conveyed together in the same pipe. This is especially true in the larger urban areas in the UK. To prevent overloading of sewer networks, and subsequent flooding, and to limit the flow passed to treatment works so as to avoid overload and subsequent river pollution, combined sewer overflows are installed at strategic points on the sewer network. These inevitably lead to pollutant discharges to receiving waters in wet weather.

Table 1 – illustrative per capita contributions of all types of sanitary solids

Nature of solids	Contribution rate	Origin of data
Total Suspended Solids	60 – 80 g/capita/day	Europe
Faeces	100 – 130 g/capita/day	Europe and North America
Toilet Paper	6.4 g/capita/day	UK
Gross solids (screened at WWTPs)	1 g/capita/day	UK

Public inputs to sewers are largely uncontrolled in the UK. The disposal of domestic wastes via the waterborne route is habitual in the UK and stems from the 'out of sight out of mind' paradigm. Whilst industrial waste producers have been made to behave more environmentally responsibly by regulation and policing, the 'environmentally impacting' behaviour of individuals, particularly in the home, has been an area largely uninvestigated and uncontrolled. Hence, in the UK, few concerted efforts have been made to encourage individuals to be more responsible in their actions. As a consequence, wastewater systems continue to receive and discharge into the environment a variety of solids and bio-chemical cocktails, which, even where the wastewater receives conventional treatment, can still contain substances which impact drastically on the receiving waters. The pollutants may be in solution, in fine suspension, or larger solids transported as (near) bed, suspended load or floating material. Solids contributions from sanitary sources are shown in Table 1, drawn from a variety of sources (Ashley et al, 2003).

Larger gross solids (defined in the consent standards as >6 mm in two dimensions), which are obviously of sewage origin, frequently lead to complaints from the public. Such "aesthetic pollutants", consist largely of faecal matter, toilet tissue and feminine and male hygiene products. It has been shown that these types of solids are often difficult to retain at CSOs and this has stimulated substantial development in the design and upgrading of CSO chambers and CSO chambers with screens. However, there has traditionally been a significant lack of knowledge on the numbers, distribution and characteristics of aesthetic solids, of how they are moved and transformed as they pass through the system and as to how the screened CSO chamber should be designed. In particular there has been limited knowledge on the behaviour of the solids and screen performance when time varying flow and aesthetic loadings are discharged into a CSO chamber.

In the past twenty years there have been a number of studies in the UK investigating the movement of these solids in sewer systems as summarised in Table 2.

Table 2 Main recent field based studies of gross solids in UK (excluding screen performance).

Social aspects	Investigators/illustrative publication	Investigated
No	WRc [O'Sullivan (1990)]	Gross solids & aesthetic pollution monitoring
Yes	House et al (1994)	Public perception of aesthetic pollution
No	Balmforth (1997)	Gross solids monitoring and modelling
No	Jefferies & Ashley (1994)	Gross solids monitoring and modelling
Yes	Friedler et al (1996)	Solids discharged via the WC into sewers
No	Saul et al (1998)	Gross solids – nature and amounts arriving at CSOs
No	Johnstone et al (1999)	Modelling transport of gross solids
Yes	Ashley et al (1999)	Sustainability of flushing or binning sanitary waste
Yes	Swain & Souter (2002)	Assessment of behavioural change promotion on flushing
Yes	Ashley et al (2002)	Assessment of willingness to change behaviour in regard to WC flushing
No	Davies et al (2002)	Modelling gross solids transport
Yes	Butler et al (2002)	Aesthetic pollutants and combined sewer overflows

The Table shows which of these studies investigated social and behavioural aspects that lead to the input of these solids, via the WC. Over the last 20 years there has been a significant increase in the amount and types of 'disposable' items flushed, with the volume of products containing plastics predicted to continue to increase. Plastics and other intractable waste, which persist in the environment, make up a group of the most problematic wastes in the wastewater system, introduced via the WC. Each woman consumes, between puberty and menopause, about 200 sanitary towels or tampons per year and in addition more than 100 panty liners. Some 2.5 million tampons, 1.4 million sanitary towels and 700,000 panty liners are flushed every day in the UK. Generally the usage of towels and panty liners (61.3% by value of total market in 1997 compared with 57.2% in 1993) is increasing, and tampons are used by an estimated 60% of women.

This paper considers the recent studies that have included these aspects. These comprise two groups of studies, each funded by the Engineering and Physical Sciences Research Council and the UK Water industry:

- Assessment of the relative sustainability of flushing, binning or otherwise dealing with gross solids (Ashley et al, 2002) and ways to promote behavioural change (Swain & Souter, 2002).

- Methods to estimate and model the input, nature and rates of transport of gross solids in sewers in order to control these more effectively (Butler et al, 2002).

Sustainability of managing gross solids

Figure 1 shows the approach taken in this group of studies.

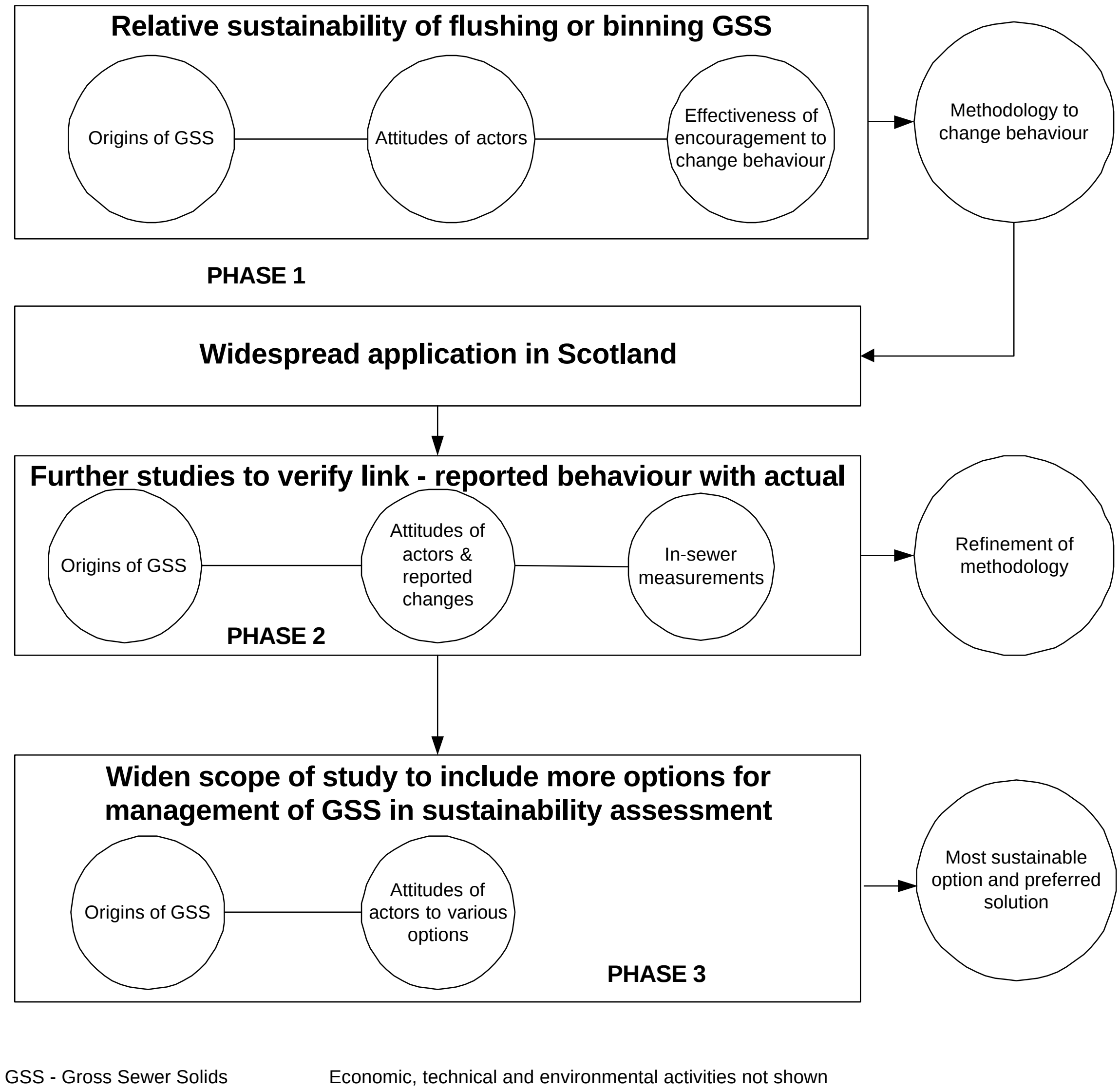

Figure 1 Developing a more sustainable way of managing the effects of gross solids

A questionnaire survey was undertaken of 72 countries (Ashley & Souter, 1999) to determine the disposal habits of large sanitary solids in terms of flushing or binning, as illustrated in Table 3. Whilst 33% of respondents claimed that sanitary items were regularly flushed, of those binning, some 62% claimed that binning is their only disposal route. Whilst a number of countries admitted flushing sanitary items, the practice appears to be most prevalent in the UK, certain Commonwealth countries, and the USA. In 26% of the countries responding, even toilet paper was reportedly placed into the solid waste disposal route. Segregation of the respondents into developed, developing and transitional countries revealed that the developed and transitional countries have similar attitudes to WC flushing of items, whereas, in the developing world, where flush toilets are less prevalent, disposal via the waterborne route is much less frequent (typically 15% less than for developed countries for those items flushed). However, it is probable that the respondents contacted in the developing world were those with a lifestyle more akin to the developed countries, and thus these were not necessarily representative of the majority of the population.

Table 3 – Disposal habits (no. of countries) for the commonest domestic sanitary waste items (total 39)

Numbers Disposing via	Sanitary items	Condoms	Nappies	Toilet paper	Cotton buds	Disposable razors
Flushing	13	13	2	25	9	1
Binning	26	22	28	9	26	28

The detailed study has been underway in Scotland since September 1995, initially to investigate the relative sustainability of WC flushing or binning domestic sanitary waste items, including an assessment of public behaviour and how best to effect changes in that behaviour. Initially qualitative studies via focus groups (Figure 2) were used to determine the attitudes of residents to their domestic and sanitary waste disposal habits, and to aid in the design of a campaign to change behaviour. At the start of the study, public awareness of wastewater systems (assessed by qualitative studies via focus groups, segregated for age and sex, and recorded by video) was found to be very low, unless the household was connected to a septic tank, or other system that required personal maintenance. There was an awareness of the importance of recycling; that certain items could cause blockages if disposed via the WC; that sanitary waste items were commonly found on beaches and constituted both aesthetic and health risks; that because of this there was a reluctance to use local beaches; notwithstanding this awareness, they admitted to flushing a range of sanitary and other items from habit and convenience. There was general ignorance about the facilities for handling WC introduced items; and the UK national bag-and-bin-it-campaign (run since 1995); of those flushing sanitary items, there was a mixed view as to their willingness to desist, with social embarrassment and hygiene being the expressed reasons for reluctance to change for both men and women, and there was concern about the introduction into the household of a bin specifically for these items.

The analytical themes derived from this phase of the project were used to inform the construction of a questionnaire designed to elicit more detailed information about people's disposal habits in relation to sanitary products and other flushable items (Annex 1). In the first study, 927 people were interviewed in four test areas (A, B, C, D), and these were asked about 13 flushed items. It was found that the most frequent items being flushed (in terms of users of these items) were: (a) Female sanitary: tampons (79%); applicators (36%); sanitary towels (50%); panty liners (32%); (b) General: cotton buds (7%); cotton wool (15%); condoms (24%). Women in the age range 18 – 44 years were found responsible for 75% of all sanitary waste items flushed, and overall the majority of sanitary waste items being flushed were female hygiene items. See Figure 3. The test areas were of mixed types: area A was a commuter community, B a coastal tourist community, C an inland semi-rural community and D a deprived city area, with only 22% owner occupancy. The housing types (Figure 4) illustrate the community profiles.

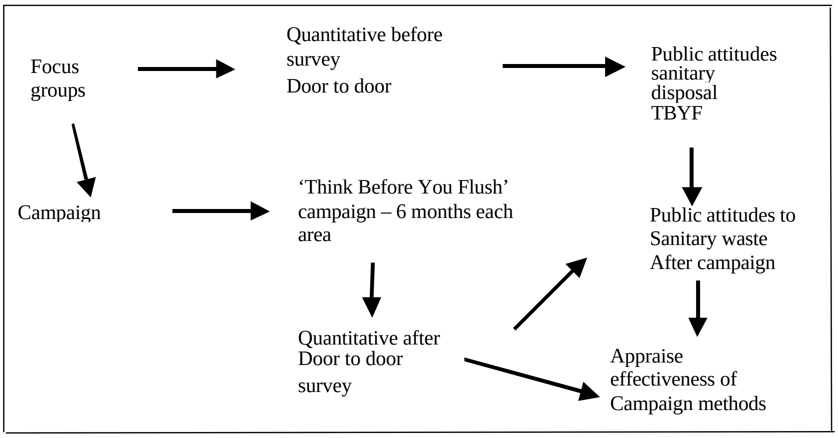

Figure 2 – Methodology for assessing public attitudes and changing behaviour

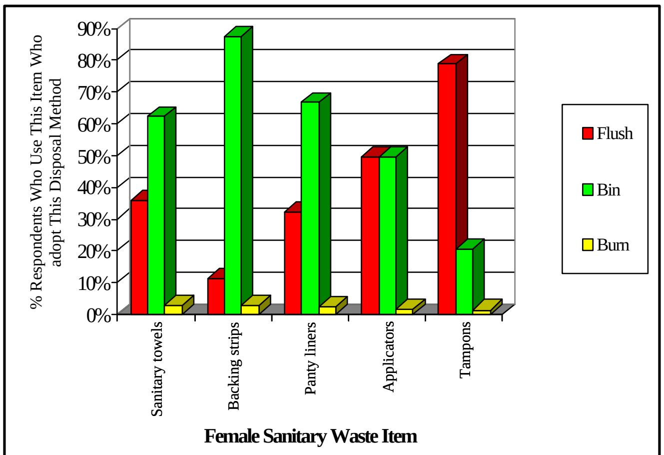

Figure 3 Disposal routes for most commonly flushed items

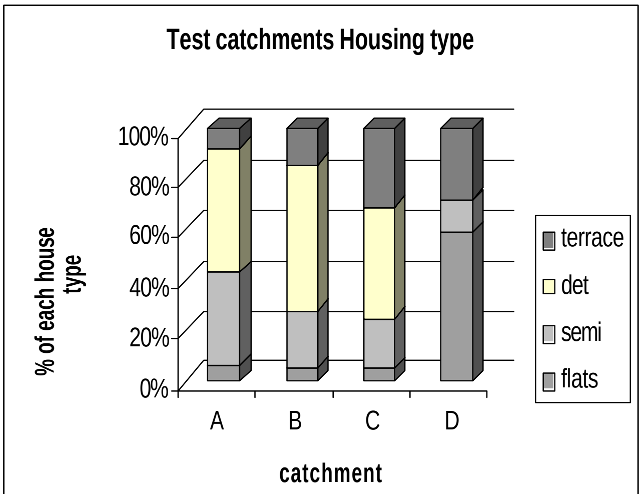

Figure 4 Housing types

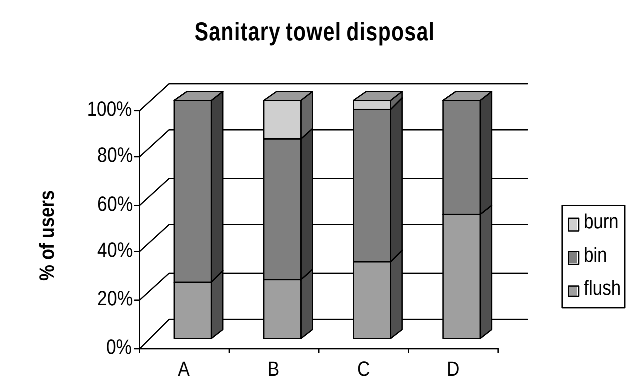

Figure 5 disposal route for sanitary towels

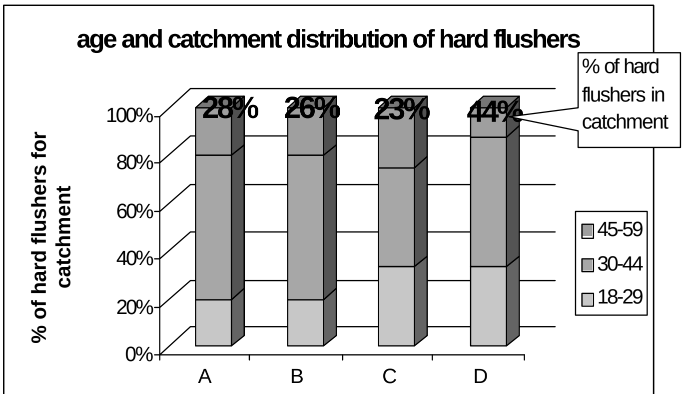

Figure 6 hard flushers - distribution

There were observable differences in what was flushed in the lower income area compared with the other areas. As well as using more cotton buds per capita, more sanitary towels were flushed, Figure 5, possibly due to the communality of much of the refuse system. Figure 6 shows the proportions of women originally flushing sanitary items who would not be willing to change flushing behaviour. This clearly shows that there was typically some 20-30% resistance in the three higher income communities, whereas in the lower income community resistance was much higher at 44%. Hence, not only are more items flushed in the lower income community, but also, those doing so were apparently more resistant to change.

Changing behaviour

These results were used to design habit change initiatives around the concept: ‘Think Before You Flush’ (TBYF). Initially TBYF campaigns were conducted over 6 months in the four test areas in Scotland, and then a second quantitative survey was used to appraise the campaign effectiveness. It was concluded that increasing public awareness via specific campaigns could significantly reduce sanitary waste inputs to wastewater systems. Overall this first set of campaigns resulted in a high level of awareness of the campaign (Figure 7) and a self-reportedly significant reduction in the numbers of sanitary towels and applicators being flushed. These were reduced by: sanitary towels 50%; applicators 36%; tampons 28%, compared with those reportedly flushed prior to the campaign. It was notable that community awareness of the campaign was lowest amongst the population in the lowest income catchment.

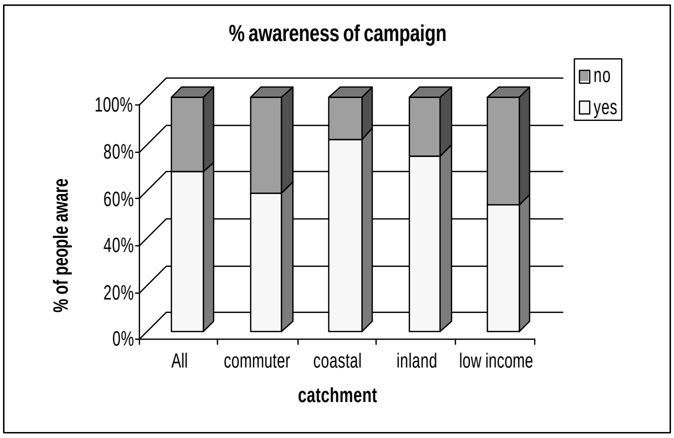

Figure 7 Community awareness of the Campaign

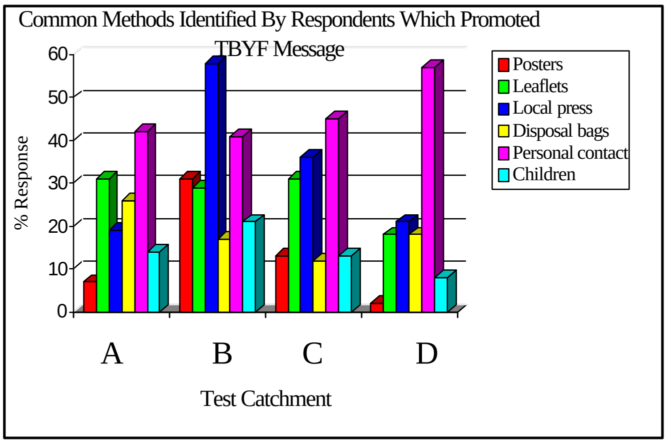

Figure 8 Effectiveness of promotional methods

The effectiveness of the promotional approaches and media used were also assessed, as illustrated in Figure 8. It is apparent that there are significant differences between communities in terms of receptivity. In the coastal community, the very active local press was very effective, whereas in the lower income area, personal contact was the more effective approach. Overall it was concluded that TBYF campaigns would be most effective when employed in identifiable communities with populations up to 5,000, particularly where investment in wastewater infrastructure is required. Interest by schools (primary and secondary) in educationally based presentations (particularly as part of the national curriculum) has been found to be substantial and special events, with competitions and donated prizes, very effective at promoting the message, particularly to the young. This element was considered to be very important for inculcation of citizen responsibility and longer terms sustainability, and also effective in getting the message by report from children to parents. Unfortunately the provision of bins in UK school toilets for the disposal of sanitary waste is unlikely due to childrens’ behaviour and embarrassment factors.

This environmental benefit was assessed using a Contingent Valuation Method (CVM) survey conducted to place a monetary value to the local population of the removal of gross solids pollution (Dunkerley, 1999). The respondents to the survey were asked to give their 'willingness-to-pay' for local collective services for environmental improvement. The methodology used was based on the Foundation for Water Research (1996) manual, notwithstanding the known problems associated with this type of methodology (e.g.Willis and Powe, 1998). The willingness to pay was not linked to any particular solution, and could be applied equally to 'perfectly operating' screens or some other means of reducing gross solids, such as a change in public behaviour.

Issues of possible bias and choice of methodology were addressed in devising and carrying out a door-to-door survey which was conducted in a location where the impact of water-borne gross solids disposal was particularly visible to the local population adjacent to a major river estuary. From the survey results, a regression equation was developed which gave the willingness to pay in terms of the characteristics of the population of 'age', 'ability-to-pay', and 'awareness of the problem'. These results where then used to estimate the willingness to pay for the study areas in terms of 'age', 'ability–to–pay' and 'awareness'. The bid curve was estimated using an OLS method of regression analysis for 144 cases.

The council-tax banding was obtained for each property contacted and has been used as a proxy for income or 'ability to pay', as there were insufficient responses in the survey where the household income was given. The distance from the shore was used for the control variable 'awareness of the problem'. Households in close proximity to the beach were assumed to be more aware of the problem and interested in using the beach as an asset, whereas those who have selected to live further away may not be so aware of the problem. It should be noted here that this survey is of the local population and not just beach users.

The mean values of 'ability-to-pay' and 'age' of the population of the study area were used to give an estimated value for willingness to pay. This allowed the estimate of willingness to pay to vary as the ability to pay and with age. The 'awareness' variable was left unchanged. The forecast was made on the basis that the sum bid is made when the population were aware of the environmental impact of the change in services as a result of better control of sanitary solids.

In the study survey area itself the willingness to pay was determined at £16.31 per household. In the middle class suburban area (catchment A) this gave an equivalent willingness to pay of £15.05 per household, or £1 2,581 for the 836 households. This represented an increase of 1.5% in payment of local taxation. For the lower socio-economic group catchment, the figures are: £7.06 per household; £5373 for the 761 households and an increase of 1% in payment of local taxation.

Hence based on the CVM, households were apparently willing to pay a significant sum for the removal of visual gross solids pollution from the foreshore. This willingness-to-pay may be interpreted as the value placed by the population on the environmental improvement that will come about from a change in disposal route from a successful TBYF campaign. This valuation can be used to reinforce the conclusion of the direct costing of the change in disposal route so that direct and indirect benefits outweigh the costs involved in achieving a change in disposal practice.

Table 4 - Sanitary waste (SW) disposal via WC – assessment of relative sustainability

The options addressed the management of gross solids at different points in the system,	Six Options (1) Installing 6 mm screens to overflows (A); (2) an educational	Infoworks was used to model the hydraulics of the existing sewer system. Gross solids were monitored in sewers and	Despite the different complexities of the various MCDA models used, the general order of preference of the 6 options was similar. Preferred option suggested that running public awareness campaigns highlighting the problems of

& can be grouped into three generic methods: A End of pipe solutions; B Habit change; C Spill reduction. The exercise has been undertaken for a real catchment (1500 pop.)	approach to habit change (B); (3) installing in-sewer storage (C); (4) retrofitting source control measures (C); (5) sewer rehabilitation to reduce infiltration (C); (6) retrofit/fit low-flush small-bore outlets to existing/new WCs (B).	collected at screens. Consultations with water authority staff allowed data to be gathered for a range of (mostly economic) criteria . Life Cycle Analysis (LCA) using SIMAPRO was used to determine the quality impact on & the total energy use for the 6 options and to produce an initial environmental impact assessment. Community surveys were conducted to establish customers' attitudes towards wastewater & SW disposal Workshops & focus groups were held with a wide range of stakeholders to validate & weight the criteria. Three Mulit-Criteria Decision Analyis (MCDA) models (ELECTRE, PROMETHEE, SMART) were used to analyse the full dataset. Each led to similar output results. Detailed sensitivity testing was undertaken with the data and for the selection of preferred option stage.	SW disposal via the WC is the most sustainable approach. **Installing screens to overflows, in-sewer storage, or constricting WCs were determined to be the least sustainable of the options** according to the criteria used. The low sustainability of the screen option was interesting (Gouda et al, 2003). Results were presented to water authority staff who considered that a combination of unproven methods identified by the MCDA as being more sustainable (e.g. educational campaigns), & a complementary proven method (e.g. screens), was the most likely way that the problem should be approached. Ultimately phasing out the screens (i.e. not replacing them at the end of their useful life, 20 years). **For this case, it was concluded:** **1. Complex MCDA techniques which tend to be opaque, may give more reliable results than simpler methods, but they may not be the most effective methods of informing the decision.** **2. Sensitivity testing showed that the preferred options were robust.** **3. Perceived 'best' solutions (e.g. installing screens at CSOs), may not be the most sustainable solution.** **4. The use of LCA alone, with built-in environmental impact assessment techniques (e.g. eco-indicators) is inadequate to assess relative sustainability.**

In the first phase of the project, no quantitative assessment was made of whether or not there were observable differences in the gross solids amounts in the sewer networks, to correlate with the self-reported changes in flushing behaviour. Subsequently, the Scottish Water Authorities commissioned a number of campaigns to encourage behavioural change, and more than a dozen communities were targeted, with some 10,000 people interviewed. As part of this process, a more detailed, second stage study was commissioned by West of Scotland Water to correlate supposed changes with actual in-sewer observation of gross solids transport rates in 3 sewer networks over a 12-month period. One network was used as a control, with no campaign activity. The community populations were 1516, 1076 and 1351 (control). The results from the study showed good correlation between the observed in-sewer gross solids reductions and the reported change in flushing of gross solids, albeit that the changes were not of the same magnitude. In the period studied, there was also a small reduction in the gross solids observed in the control system. Overall the reductions in solids entering the system were found to be more than 60%.

In the third stage studies, a number of alternative options for managing the effects of gross solids were evaluated in terms of relative sustainability (Ashley et al, 2002; Gouda et al, 2003). The options considered, and results are shown in Table 4.

Dealing with the solids

It is unlikely that the removal of gross solids from sewer networks is a realistic proposition for the foreseeable future. Thus the aim of this study was to develop a thorough understanding of the correlation of the production, transport and transformation of aesthetic solids in combined sewer systems during storm events, and to relate these to the physical properties of the catchment, the characteristics of the sewer network, and the socio-economic groupings of the population. It also is aimed to apply this understanding to produce a predictive model known as Gross Solids Simulator (GROSSim) of aesthetic pollutant loadings for use in the of CSOs, to assess loadings to CSO screens and to downstream treatment works.

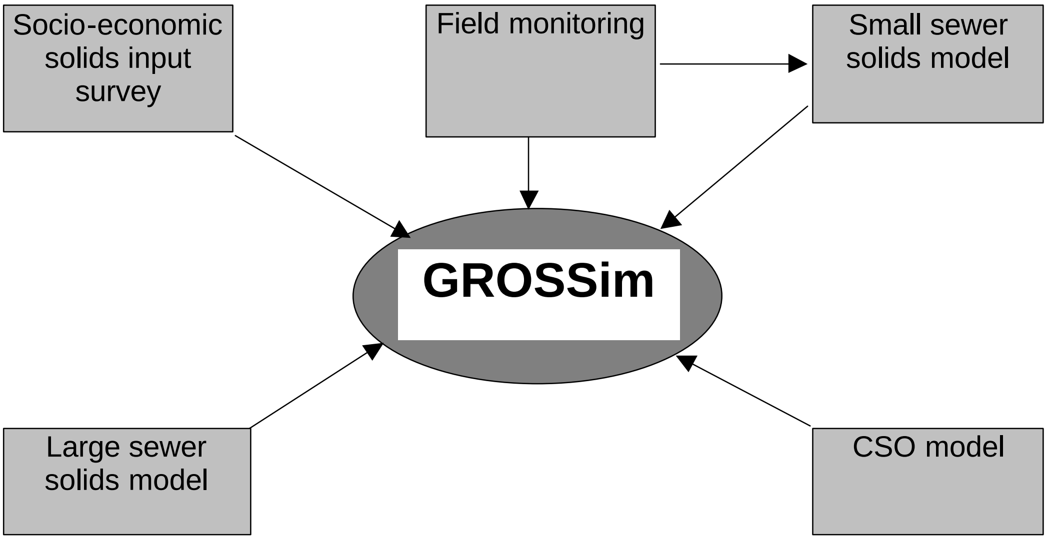

Figure 9 Conceptual overview of Gross Solids Simulator project

Three study catchments in Sheffield were used and these were selected to account for different economic, social and ethnic characteristics of the catchment and its population, and referred to as: Low income; High Income and Ethnic – with the latter having a 30% Asian originating population. Research included questionnaire surveys, fieldwork, component model development, the application of Computational Fluid Dynamics and the construction and application of the overall model. Figure 9 illustrates how this project was organised and how each sub-project was integrated into the final model.

Socio-economic solids input survey

The aim of the solids input survey was to characterise the differences in the numbers and types of gross solids that were input to the system for each of the socio-economic groups. Census data were used to identify the population details and a postal questionnaire was devised and distributed to a random sample of the population on each of the three catchment types. The questionnaire enquired about the disposal of eight sanitary products (cotton buds, cotton wool, nappies, condoms, tampons, applicators, sanitary towels and panty liners). For each product respondents were asked how many they flushed and how many they binned over a 28-day period. Relevant socio-economic data about the respondent (sex, age, ethnic group and household income) was also requested. In total, across all sites, 468 responses were received, which represented a 62% response rate.

The data collected were used to produce what has been termed the SEED (Social, Economic and Ethnic Day) factor. This factor was derived for each catchment by analysing the relationship between the reported number of products flushed and the socio-economic profile of the respondent. This was defined as the ratio of the catchment flushing mean to the overall flushing mean. Table 5 shows SEED factors for tampons, sanitary towels and panty liners.

Table 5 SEED factors for a range of female sanitary items flushed

Catchment type	Tampons	Sanitary towels	Panty liners
Low income	0.60	1.82	1.24
High income	1.69	0.32	1.21
Ethnic minority	0.71	0.86	0.55

This shows clear habit differences. For example, tampon flushing is greater in the higher income catchment (SEED factor 1.69) when compared with the lower income area and with the ethnic minority area (SEED 0.71).

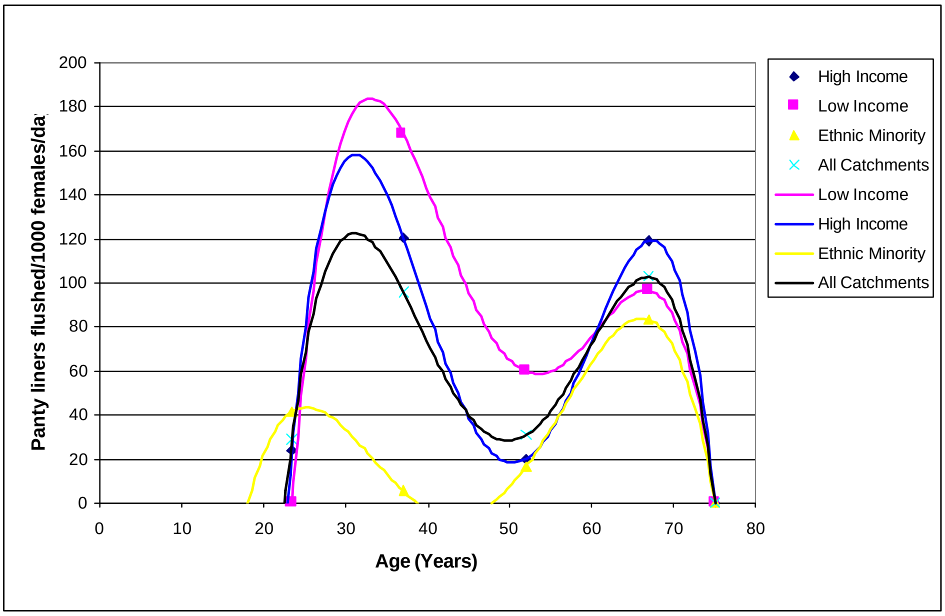

Figure 10 Panty liners flushed by age and type of catchment

SEED also facilitates the diurnal prediction of solids generated related to socio-economic characteristics. It is apparent that income levels and ethnic origin influence the input of gross solid via the WC. However, age and gender distribution of the catchment population are also influential. The catchment mean flushing data were classified by age into five groups. The mean for each catchment and item was considered in relation to age, as illustrated by Figure 10, for panty liners. The two peaks in the plot illustrate the use of panty liners for two purposes: Menstruation in younger women and incontinence for older women. Age related SEED factors were thus established for each type of solid, as shown in Table 6 for panty liners. These SEED factors were used successfully to predict the profile of inputs to the GSS model, based on socio-economic factors and age profiles in the catchments studied.

Table 6 SEED factors for panty liners

Age group	High income	Low income	Ethnic minority
18-29	0.84	0.00	1.45
30-44	1.26	1.75	0.06
45-59	0.65	1.94	0.53
60-74	1.16	0.94	0.81
75+	0.00	0.00	0.00

Subsequently the questionnaire survey data was verified by fieldwork monitoring of the actual aesthetic solids recorded in the dry weather flow at each catchment and in the storm flow. This monitoring exercise also provided data on the quantities of solids produced in terms of mass of solid type collected. The solids data were transformed into a standard format in the form of a Standard Solid Value (SSV), determined for each individual pollutant type, as this allows conversion between 'mass' (as measured) and 'number of pollutants' (as modelled). Consequently a Standard Production Value (SPV) for each solid per capita per day was calculated for each catchment. Dividing the catchment SPV by the overall SPV allowed the SEED factor to be derived from the field data. It was found that the ratio of solid numbers and consequently the SEED factors derived by both the questionnaire data and the fieldwork monitoring exercise produced very similar values. However, analysis revealed that approximately twice the numbers of solids were collected when compared with the respondent questionnaire data. Possible explanations for this difference include the fact that individuals may be modest in their reply, the sample population may have been too few or unequally distributed or there were problems with the sampling regime or representation of solids build-up and subsequent flush. Ultimately, the decision was taken to use the quantities of solids determined by the in-sewer monitoring as this represented a physically measured value rather than an estimated value.

Friedler, et al. (1996a & 1996b) collected evidence related to the flushing of faeces, toilet tissue and sanitary refuse. This enabled distributions to be produced that defined when solids enter the sewer via the WC during weekdays and weekends. In the GSS model the solids tracked include faeces, sanitary towels, tampons, toilet paper, panty liners and wipes and the quantity of solids defined by the in-sewer sampling was distributed over the temporal distribution. This distribution was combined with the populations assigned to each node of the system to determine the rate of solids entering the system. The SEED values were then be used to factor these plots in order to account for the population type.

Conclusions

It is unfortunate that there has so far been limited actual engagement of wastewater engineers in the processes of understanding the motives and behaviour of sewer system users. This has resulted in engineering that deals more with the consequences of problems rather than the causes. It has also lead to misunderstandings on the part of both service providers and users, with for example, illogical concerns about potential health problems. In addition it has allowed less qualified technical 'experts' to offer customer services that are not needed. Recent moves to establish more effective customer dialogue by water companies are welcomed and it is hoped that some of these problems may be better dealt with, as is done very effectively elsewhere (e.g. Geldof, 2002). The explicit engagement of stakeholders in all stages of the processes in the Water Framework Directive, means that service providers and others, including practicing engineers, must be better at this type of activity.

It is apparent that the flushing of gross solids varies depending upon age, gender, socio-economic and ethnic originating grouping. The studies reported here indicate that although data collected from questionnaire and in-sewer surveys provide a good foundation for predictive models (e.g. Digman et al, 2001; Gouda et al, 2003). There are encouraging similarities in the results from the surveys in Scotland and Sheffield, with the lower socio-income groups flushing more sanitary towels and with tampons being flushed more by the higher income groups. Nonetheless these results should only be applied to other catchments with caution due to the limited number of studies so far undertaken. There is a great need to increase the number and scope of these types of study, and the industry should give serious consideration to promoting new research.

Whilst customer behaviour may change in relation to WC flushing of gross solids in the UK, the campaigns carried out in Scotland (and to a lesser extent in England and Wales) indicate that a hard core of persistent flushers will resist all attempts to encourage them to change. Hence it will be necessary for the foreseeable future to manage gross solids in sewers and at

CSOs as effectively and efficiently as possible. Unfortunately, current approaches to this may not be as sustainable as they could be.

Acknowledgements
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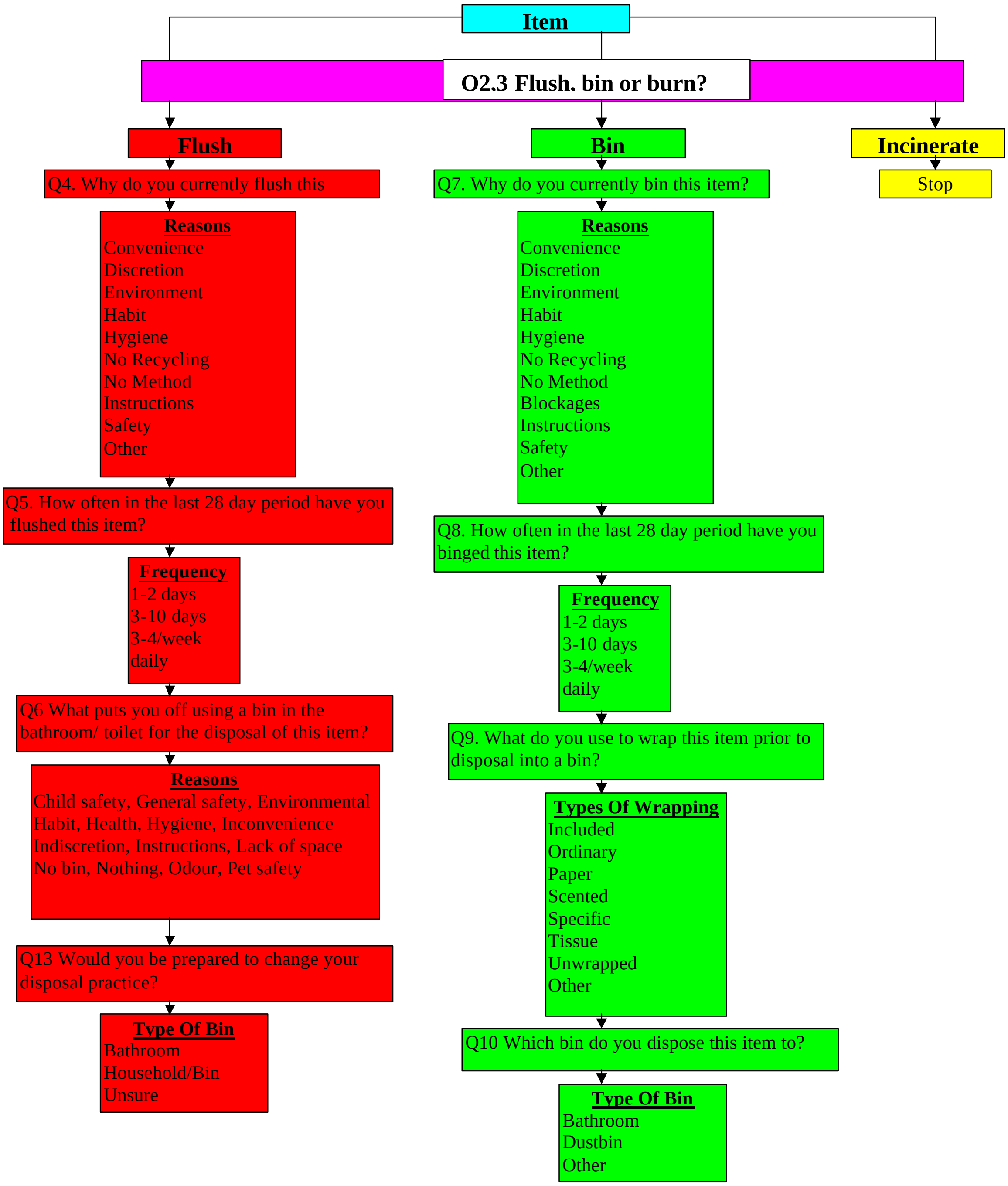

Annex 1 - Baseline questionnaire for current disposal habits