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Enhancing the uptake and quality of SuDS within new housing developments

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This study investigates how private housebuilders navigate the provision of Sustainable Urban Drainage Systems (SuDS) within new housing developments, focusing on the often-overlooked land acquisition and valuation processes that shape environmental decision-making. It situates SuDS provision at the intersection of three calculative domains in housebuilding—land valuation, construction costs, and maintenance liabilities. Drawing on elite interviews with volume and super housebuilders operating in Yorkshire, UK, the study shows how these domains influence the uptake of multi-benefit, nature-based drainage solutions compared to minimal "compliant" systems. The paper concludes that without mandatory, consistent regulation and clearer institutional arrangements for SuDS adoption and maintenance, developers will continue to favour minimalist, hydrologically compliant designs over multi-benefit systems. By reconceiving SuDS as market-embedded infrastructure, this study highlights the need for governance reforms that align environmental resilience goals with the economic logics of housebuilding.

Keywords: Sustainable Urban Drainage Systems (SuDS); housing development; land valuation; water governance; planning

1. Introduction

The combined effects of climate change and urbanisation have created an acute need for enhanced surface water management to reduce flood risk and pollution in urban areas. In England, more than 3.4 million properties are now at risk of flooding (House of Commons Committee of Public Accounts 2024), including 325,000 properties in the highest risk category (National Infrastructure Commission 2022). Meanwhile, heavy rain and creaking infrastructure contributed to 3 million hours of sewer overflows in 2023 (Rivers Trust 2024). This problem is expected to worsen considerably with heavier rain during the coming decades (HM Government 2022).

Alongside climate change, however, the UK remains in the grip of a serious housing affordability crisis. On average, private renters spend nearly a third (32%) of household income on housing, while mortgagors pay 18%. For those in the bottom quintile of household incomes, this rises to 59% of gross household income (HM

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Government 2024). Over 1.3 million households are on the social housing waiting list (HM Government 2025), and the number of children living in temporary accommodation is at record levels (MHCLG 2025). The Labour government has partly pinned its hopes of re-election on its ability to solve this problem, promising to build 1.5 million homes in the course of the current parliament, a strategy that expresses a perhaps naïve conviction that increasing supply will lower housing prices (Bradley 2023; Colenutt 2020). Ensuring that new homes are resilient against flooding, however, will require the implementation of new approaches to drainage.

Whereas traditional approaches to surface water focused on rapid draining, contemporary 'Sustainable Urban Drainage Systems' (SuDS) aim to slow the flow of rain into the drainage network (Department for Environment, Food and Rural Affairs 2015; White and Howe 2004; Woods-Ballard *et al*. 2015). However, SuDS should be seen as an umbrella term that encompasses a multitude of very different practices, guided by varying underlying rationales. Distinct policy drivers shape regional practices of water management: for example, regulations in Australia and Scotland prioritise water quality, prioritising treatment trains and vegetated features, while policies in the USA, England and Wales are historically centred on managing water volume (Fletcher *et al*. 2015). In England, this legislative focus on water quantity leads developers to design "compliant" SuDS schemes that merely meet legal detention requirements by routing runoff into underground tanks or large ponds but do not deliver wider public goods (McLeod and Mickovski 2024; Melville-Shreeve *et al*. 2018; Potter and Vilcan 2020).

Other types of SuDS schemes, however, can deliver multiple social and environmental benefits beyond legally mandated attenuation (Fletcher *et al*. 2015; Woods-Ballard *et al*. 2015). For example, some SuDS constitute a form of Nature-Based Solution (NBS) to manage water within developed areas, creating opportunities for pollution to be attenuated *via* vegetation, positively impacting air quality, reducing carbon emissions, and providing blue and green infrastructure for biodiversity (Choe, Kenyon, and Sharp 2020; EPC 2017; McLeod and Mickovski 2024; Susdrain 2025). SuDS can also provide social benefits, for example, opportunities for human recreation and education, contact with green space for health and wellbeing, and space for social activity and contact. The influential 'Four Pillars of SuDS' model emphasizes these social and environmental benefits, focusing on water quality, water quantity, amenity and biodiversity (Woods-Ballard *et al*. 2015). However, this conceptualisation ignores the fact that economic goods can also be delivered, since such schemes are often cheaper to construct than conventional engineering projects, and bring indirect benefits to an area *via* the beautification of an area, potentially making it more attractive to investors (Ossa-Moreno, Smith, and Mijic 2017). We wish to emphasize at the outset that there is no one view of the multiple benefits that SuDS schemes deliver, and that there may be conflicts both between these different domains of value and within a particular type of value (for example, the view and valuation of nature possessed by a professional ecologist may differ significantly from that possessed by members of the community).

We term the kinds of SuDS scheme that can deliver these extra public goods 'multi-benefit SuDS'.[1] They often include a combination of elements such as rain gardens, swales, permeable paving, and reuse tanks to achieve an appropriate balance between goals. Best practice SuDS design involves coproduction with local communities who are full participants in the process (Sharp *et al*. 2023; Starkey *et al*. 2025), although this was rarely achieved in the past (Dubois *et al*. 2025). While regional

strategies now encourage collaborative SuDS development (Flood Ready London 2025; Greater Manchester Combined Authority 2023), this is easiest on land that is already managed by a collaborating authority. Shifting the delivery of new SuDS on private housing developments towards public participatory methodologies remains a significant challenge.

Factors militating against the use of multi-benefit SuDS in previous evaluations of public sector practice include difficulties in quantifying the value of the multiple benefits they deliver (Dubois *et al*. 2025; Ossa-Moreno, Smith, and Mijic 2017). Developers have had little incentive to design and construct drainage schemes in a way that maximises multiple benefits, linking flood alleviation to non-water objectives (Potter and Vilcan 2020). Other barriers include the lack of a clear legal framework around surface water drainage (Melville-Shreeve *et al*. 2018); a neoliberal planning process that favours powerful private sector commercial interests (Potter and Vilcan 2020); a lack of resources in public sector Local Planning Authorities (Vilcan and Potter 2020); a shortage of expertise amongst lead local flood authorities in the design and delivery of schemes with multiple benefits (Landscape Institute 2019); the need to engage with multiple stakeholders (McLeod and Mickovski 2024); and a lack of understanding of the ways in which SuDS might interface with natural capital to provide an additional revenue stream for their creation (EPC 2017).

In the private sector, documented problems include a lack of expertise in recognising the multiple benefits that can be delivered by well-designed water infrastructure, and the fact that forms of valuation for these forms of benefit lie outside of the financial calculus of development. Water consultants often originated from an engineering background and may lack both capacity and expertise to integrate social, ecological and economic objectives alongside a focus on water quality and quantity. In the construction industry, some contractors and subcontractors are inexperienced at delivering multi-benefit designs. Further, the estate management companies tasked with their ongoing maintenance often lack a holistic understanding of the need for their work to support multiple aims (Chapman and Tait 2025).

However, in this paper we argue that there may be an additional barrier, in the shape of the land acquisition and development process as it is understood by developers in a market-led context. While many previous studies have noted that the development industry has an antipathy to environmental measures that might introduce additional uncertainty or cost (CIWEM 2024; Ellis and Lundy 2016), very few have studied the implication of the practices of the housebuilding industry for the development of SuDS. This paper addresses this gap, offering a novel insight into the attitudes and behaviours of developers towards water management, which raises opportunities to reflect on the political economy of surface water drainage in the contemporary neoliberal development context. This research therefore sits at the intersection of the literature on SuDS and the literature on land valuation, exploring the ways in which valuation processes, which are not always rational, inflect environmental decision-making.

Following a literature review outlining current policy and practice regarding SuDS provision, the paper outlines the findings from elite interviews with development sector actors delivering new build housing. These explore the ways in which SuDS design interfaces with three key calculative processes in the housebuilding industry: land valuation, construction costs, and ongoing maintenance costs, shedding new light on the barriers to the implementation of nature-based surface water

drainage solutions in this key sector. A discussion section then delivers key recommendations for professionals in the water sector, from hydrological engineers to policymakers and planners.

2. Literature review

The late twentieth century saw a shift in water governance, away from a technocratic, modernist ideal of state delivery focused on 'flood resistance' (Gleick 2023; Graham and Marvin 2002; Sharp 2017) and towards a hybrid model of partial delivery by both the private and public sectors (along with civil society), centred on an idea of 'flood resilience' in which we learn to live with some flooding (Butler and Pidgeon 2011; Climate Change Committee 2020; Environment Agency 2022; McClymont *et al*. 2020; Sharp 2017). This shift arguably forms part of a wider process of 'roll out/roll back' neoliberalism, in which a centralised command-and-control state is replaced by a hybrid arrangement that works in the interests of capital (Peck and Tickell 2002).

Despite recent planning reforms offering an opportunity to rewrite guidance on SuDS, the English planning system makes provision of multi-benefit SuDS advisory rather than mandatory (Chisholm 2025). Following severe flooding in June 2007, Schedule 3 of the 2010 Flood and Water Management Act was drafted to make the use of these schemes on new developments compulsory, with local authorities designated as Sustainable Drainage Approval Bodies (SABs) to oversee their design and approval, and ultimately adopt and manage the SuDS in perpetuity (Ellis and Lundy 2016; Susdrain 2025). Fifteen years on, however, Schedule 3 is yet to be implemented in England (Chartered Institute of Water and Environmental Management 2024) even though Wales has successfully introduced similar legislation. This regulatory gap misses the vast potential gains that could arise were multi-benefit SuDS integrated into the nation's 1.5-million-home building target (MHCLG 2025).

Instead, the implementation of SuDS is regulated by the planning system, making SuDS an area where the local state negotiates with private developers for the provision of public benefits, as part of the wider delivery of housing and infrastructure. Planning policy has required SuDS to address runoff quantity from new developments since 2018, and the 2024 National Planning Policy Framework provides strong, albeit non-statutory, guidance on their provision, positioning SuDS as a material consideration that encourages their widespread adoption. It also stipulates that water management systems should seek to "provide multifunctional benefits wherever possible" (MHCLG 2024, sec. 182). Similarly, more recent National Standards for SuDS (DEFRA 2025) requires that all schemes meet seven criteria, for example, prioritising water reuse and collecting water as close to its source as possible. However, this guidance offers a 'get-out clause', allowing private developers to argue that it is not possible to meet one or more of the standards if by doing so a development ceases to be viable. Consequently, schemes continue to be subject to veto if they are not considered to be proportionate to the scale and nature of the development (DEFRA 2025; Independent Water Commission 2025; MHCLG 2024). In this weak national legislative context, some Local Planning Authorities have provided stricter guidance on SuDS in Local Plans (for example, West Yorkshire Combined Authority, n.d.), while others have looser policies, leading to a locally variable picture of delivery on the ground. As Vilcan and Potter (2020, 3) argue, the result is that the implementation of SuDS becomes "a matter of power relations between developers and LAs [local authorities]."

In England, 76.2% of new homes are built by private developers (BCIS 2025), one third of which are regularly delivered by just three nationally operating housebuilders alone (Foye and Shepherd 2023). The concentrated nature of the industry (Nicol and Hooper 1999) means that private developers exert a large degree of power over housing delivery, strategically acquiring land and timing the release of properties for optimal surplus value creation. Designs for SuDS schemes are submitted by the developer as a part of a site-specific planning application. Once negotiated, they are conditioned as part of the planning approval for the site. However, developer responsibility for drainage and flood resilience ends once the homes are sold.

In the longer term, of course, SuDS schemes require maintenance. Whereas conventional drainage schemes are adopted and maintained in perpetuity by water companies, with the work funded through standard water bills, this is not an option for SuDS due to the need for multi-sectoral maintenance, in particular landscape management, which draws on skills beyond water company competencies. Instead, developers sometimes negotiate adoption agreements with a local authority or water company, usually associated with a commuted sum to cover costs: for example, Cambridge City Council have published standards that schemes need to meet in order for the local authority to adopt them (Cambridge City Council n.d.). More frequently, maintenance is left in the hands of an estate management company with costs met from a management charge levied on residents of the new estate (CMA 2024; Susdrain 2025). These ongoing fees raise a number of questions about the social justice and equity of such arrangements. Homeowners have no choice but to pay but have little right to any say over the way in which SuDS features are maintained. Many may not even be aware of the drainage features around them, or that they are paying towards their upkeep. Administrative charges on fee payments can be extremely high, leaving too little for landscaping, and there is a lack of transparency or accountability over the level at which these are set (CMA 2024). Furthermore, one group of residents in an area becomes financially responsible for the costs associated with infrastructure that benefits a much wider group, since amenity areas are often used by the whole community rather than new residents alone. Concerns have also been raised about a lack of auditing over the quality of construction (some schemes are incorrectly installed), and an absence of ongoing monitoring. This has implications for safety, for environmental impacts, and for the future financial liabilities that might be faced by residents in the event of infrastructure like a SuDS scheme failing, potentially incurring high costs (Arup 2023).

This brings SuDS into line with other ecological mitigation and enhancement features on new housing estates, including some smaller Biodiversity Net Gain plans, which are also financed by estate management charges (alternatively, in some cases, a Section 106 agreement is put in place to secure a commuted sum from the developer for ongoing maintenance) (Bright 2022). However, recent research on enforcement and delivery of planning conditions suggested that only half of the ecological features that are specified in English planning conditions are delivered on the ground, and that ongoing maintenance was often not performed in accordance with agreed plans (Chapman, Tait and Postlethwaite 2024). This raises serious questions not only about the quality of the built environment that developers are constructing, but also about the ability of estate management companies to maintain features like biodiverse SuDS schemes. Yet planning enforcement, which could deal with such breaches, is currently severely underfunded, and Local Authorities are frequently unwilling to take expensive and risky legal action, meaning that there is often little practical oversight or remedy

when delivery departs from agreed plans (Chapman, Tait and Postlethwaite 2024). The findings of this paper therefore will apply more broadly to other landscaping features that are secured in this manner.

Developers are often portrayed as antipathetic to SuDS, an attitude that is often assumed to be a result of the cost pressures that are inherent to a market-led housing delivery system (CIWEM 2024; Sharp 2023). In terms of the upfront costs to developers themselves, these can be broken down into three main areas: land costs (i.e. the costs of the 'undevelopable' area that is used by multi-benefit SuDS versus compliant SuDS, which are often assumed to be more land-sparing), construction costs (i.e. the costs of materials and installation of multi-benefit SuDS versus compliant SuDS) and ongoing maintenance costs (i.e. the relative costs associated with the upkeep of the multi-benefit SuDS feature in the longer term, as compared with compliant SuDS, as discussed above). However, very few studies consider all three aspects of cost together or locate them fully within the wider economics of housing.

For example, in work commissioned to support the implementation of Schedule 3 in Wales, Environment Policy Consulting looked at 34 cases and found that both the construction and maintenance costs of multi-benefit SuDS were lower than those of conventional solutions (EPC 2017). However, the research did not consider land take. Similarly, Duffy *et al*. (2008) considered capital and maintenance costs, but not land take, finding that multi-benefit SuDS offered a cheaper solution. McLeod and Mickovski (2024) used a residential case study to compare the costs of multi-benefit SuDS with compliant SuDS and found the latter to be more expensive in terms of land costs, though substantially cheaper in terms of construction costs, but did not look at ongoing maintenance. Furthermore, when considering the relative costs of multi-benefit SuDS, it is important not just to consider the absolute cost of land-take, construction and maintenance, but also the fact that these costs are uncertain, that they occur at different stages in the development cycle, and that developers must manage their cash flow against the (uncertain) profit from future houses sales (Payne *et al*. 2023).

Of course, these forms of accountancy at work in the development process rarely consider the wider social and environmental benefits of multi-benefit SuDS, since these fall outside of the calculations of development capital, which is fundamentally oriented towards the creation of surplus value. It is nonetheless important to note that, outside of the process under discussion in this paper, such SuDS can provide significant public goods, including greenspace and amenity provision, health and wellbeing benefits, improvements in water and air quality, reductions in heat and noise, and downstream flood mitigation (Ashley *et al*. 2018; Johnson and Geisendorf 2019; Ossa-Moreno, Smith, and Mijic 2017; Vincent *et al*. 2017). Apart from the issue of flood mitigation, which is factored into developer's calculus through the rules about hydrological compliance, the rest of these benefits are experienced by other people, often in the future. Careful planning, modelling, monitoring and evaluation is needed to reduce significant uncertainty over the extent of these benefits (Dubois *et al*. 2025). While the variety of beneficiaries highlight the need for democratic oversight of SuDS, it is also clear why these broader benefits seldom influence developer decision-making, unless they are required by planners.

In this paper, we will explore the way that developers envisage SuDS, with a view to situating their development in a wider process of housebuilding. In so doing, our aim is to show how environmental decision-making is inflected by negotiated processes of land valuation. In particular, we explore the distribution of power and agency

between housebuilders and landowners, and the way that it shapes the way that the 'land take' for environmental improvements is quantitatively calculated, qualitatively conceptualised, and ultimately contested as different actors endeavour to shape the practices of the land market to suit their priorities (Araujo 2007; Crosby and Henneberry 2016). Through this exploration we hope to show how calculative processes shape spatial outcomes, drawing attention to the need for analyses that engage with the economics of housing and land in the environmental field.

Our argument complicates the idea that developers reject multi-benefit SuDS because of their 'land take', i.e. the fact that they take up space within the red-line boundary of a site that could be more profitably used to develop housing. By offering insights into the valuation processes of housebuilders, we will argue that this cost is *already included* in land pricing, meaning that it is landowners, rather than developers, who bear the cost burden of the area of land that cannot be developed. Further, we will show that the non-adoption of SuDS by local authorities or water companies, and the concomitant tendency to offload ongoing maintenance costs onto residents *via* estate management charges, mean that the costs of such schemes to developers in many cases boil down to a question of construction costs alone. Given the UK Government's intention to build 1.5 million homes in England, the research is highly topical at a moment when the balance to be struck between environmental and social goals is a matter of considerable ideological controversy (MHCLG 2025). Findings are also more generally applicable to other forms of environmental mitigation in the UK and elsewhere, most notably onsite delivery of biodiversity benefits, such as Biodiversity Net Gain.

3. Methodology

The empirical research presented here sought to examine housebuilders' experiences and perspectives of managing surface water and delivering SuDS in new housing developments in Yorkshire, UK, selected as a reasonably typical non-capital city location that was proximal to the researchers (see Figure 1). Four key lines of enquiry framed the empirical investigation:

- the contested process of land valuation, and the way that the 'land take' of SuDS is factored into the decision-making processes for land acquisition by landowners and housebuilders in a weak regulatory context
- the technical, cost, and planning constraints that inhibit the routine use of multi-benefit SuDS for flood alleviation in new developments
- the added-value multi-benefit SuDS bring to new housing developments
- what needs to change if multi-benefit SuDS are to be used more routinely for flood alleviation

The study made initial contact with divisional directors in the regional offices of all volume and super private housebuilders operating in Yorkshire. 'Volume builders' are defined as those constructing between 2000 and 5000 units per annum and 'super builders' as those constructing more than 5000 units per annum (Payne 2013, 2020). This recruitment strategy was adopted as a pragmatic access route, reflecting established approaches for engaging this typically difficult-to-reach industry (Payne 2020). Divisional directors were asked to facilitate access to those most directly involved in

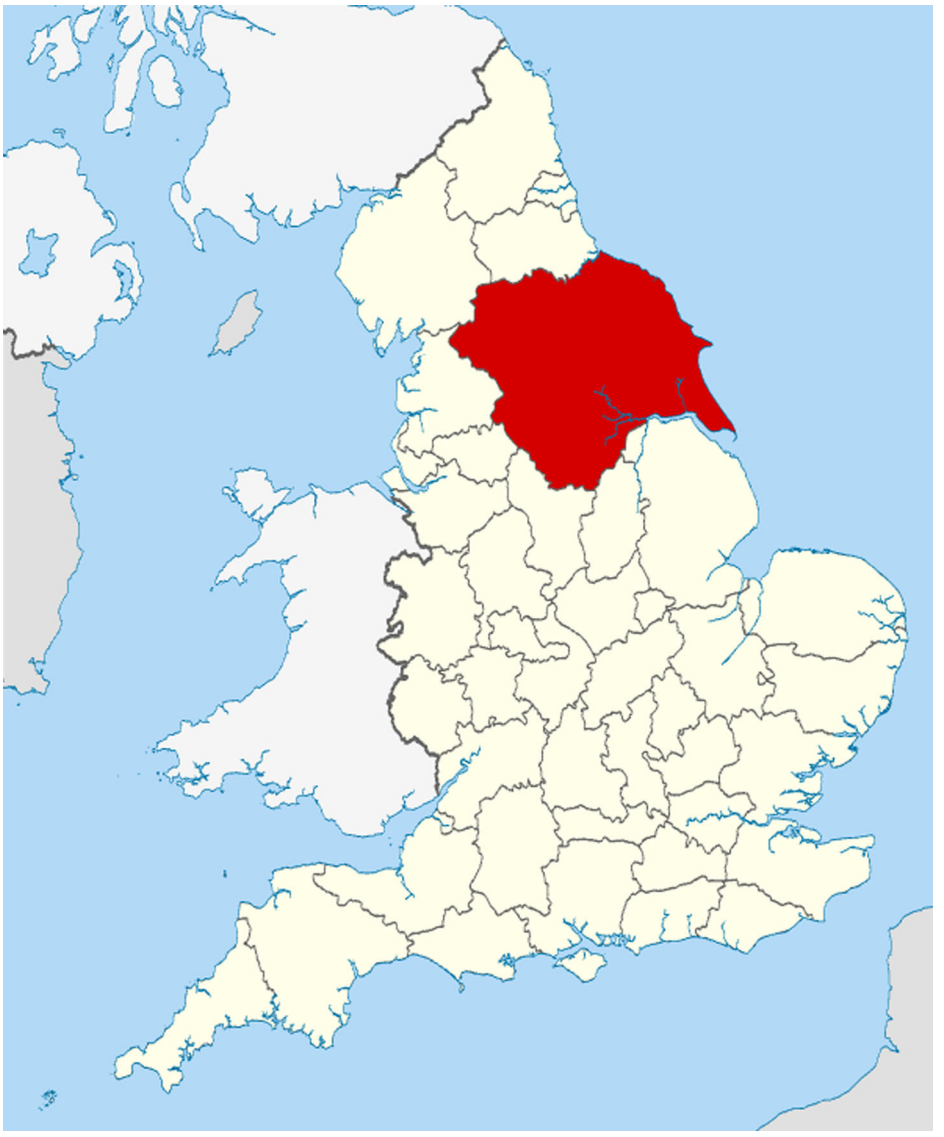

Figure 1. Location of Yorkshire in England. Source: Wikimedia Commons (CC BY-SA 3.0), based on Ordnance Survey OpenData.

SuDS design and delivery. As a result, interviews were conducted with senior technical decision-makers (technical directors and engineering managers) responsible for drainage, infrastructure, and site-level technical decision-making. These participants were selected due to their direct involvement in hydrological compliance, SuDS design, and associated cost and feasibility considerations.

Notably, the private housebuilding industry in the UK is highly concentrated, with the ten largest volume and super builders alone accounting for over 40% of all new housing completions in England in 2022 (Department for Levelling Up, Housing and Communities 2023; Housebuilder Media 2023). Typically, these organisations have a head office responsible for strategic direction and decision making, and regional

divisions that oversee land acquisition, housing construction, marketing and sales activity (Payne and Barker 2018). Engaging participants positioned within regional technical roles enabled the research to capture a richer and more nuanced understanding of site-specific constraints, design choices, and feasibility considerations shaping SuDS delivery in a dynamic development context.

Since housebuilders are notoriously difficult to reach and interview in academic research (Payne 2020), the achieved sample size, while numerically small, reflects the practical realities of engaging this sector. Interviews were requested from nine organisations representing all volume and super private housebuilders operating in Yorkshire. Follow-up correspondence was undertaken where appropriate. Ultimately, interviews were secured with senior technical decision-makers from four housebuilders. Although this represents a modest response rate, the participating organisations collectively accounted for approximately 35% of new homes delivered in the region in 2022, with one organisation alone responsible for nearly 20%. Comparatively, these four organisations were responsible for delivering 23% of all new homes in England in 2022. Given the concentration of the industry and the study's objective of examining SuDS delivery within the institutional context of large-scale housebuilding operations, this sample was deemed sufficient to generate meaningful analytical insights.

Some caveats are, however, necessary: by focusing on volume and super housebuilders, the study overlooks the contributions of SMEs and other housing providers to SuDS implementation. There are good reasons to think that the processes of land pricing and site allocation described here work quite differently for this smaller, less well-resourced sector of the market, who often operate on smaller sites where there is less available space to mitigate ecological and hydrological harms while maintaining significant levels of profitability. Additionally, the research adopts a market-centric perspective but raises questions about the complex interplay between state and market in SuDS implementation and environmental governance more broadly, suggesting important avenues for future research.

Interviews were conducted between November 2021 and February 2022. At this time, the NPPF required SuDS in all new major developments (>10 homes); the 2024 NPPF subsequently removed this size restriction and asks developers to consider SuDS on all schemes in a manner that is proportionate to their scale and nature. Guidance encouraged multi-benefit SuDS, but planners had limited muscle to mandate this encouragement, particularly given the conflicting pressures to approve land to deliver housing. Meanwhile, changes to related legislation concerning Biodiversity Net Gain and nutrient neutrality, which have added further support for a multi-benefit vision of SuDS schemes were planned but not yet fully implemented. The Research Ethics Committee at the University of Sheffield approved our interviews (approval: 036544) on 5 November 2020. Participants gave written consent for review and signature before starting interviews.

Interviews were semi-structured and guided by a consistent interview framework organised around four thematic areas: decision-making processes, perceived benefits, constraints, and institutional change. This structure ensured comparability across participants while allowing flexibility to explore organisation-specific practices and experiences. All participants were asked a common set of core questions, with follow-up prompts used where appropriate. The full interview guide is provided in Appendix A.

The interviews were transcribed verbatim and analysed using thematic analysis (Clarke and Braun 2017). Transcripts were manually coded through an iterative, multi-

Table 1. Relationship between interview focus areas and emergent analytical themes.

Interview focus areas	Emergent themes
Decision-making processes	Land valuation, site feasibility and hydrological compliance
Perceived benefits	Marketability and value rationalities
Constraints	Construction logics and cost management practices
Institutional change	Maintenance, adoption and long-term liabilities

(Analytical domains derived through thematic analysis of interview data).

Figure 2. Three calculative domains shaping SuDS provision.

cycle process designed to identify patterns of meaning across the dataset. Initial codes captured recurring concepts, decision logics, and institutional practices described by participants. These codes were subsequently reviewed and consolidated into higher-order themes, enabling systematic interpretation while preserving close engagement with participants' accounts. The themes were identified through repeated patterns across interviews rather than frequency counting, consistent with thematic analytical practice.

Due to the commercially sensitive nature of private housebuilding (Payne 2020), all participants have been anonymised and any contextual information that might identify them has been removed (Payne and Barker 2018). The relationship between the interview focus areas and emergent analytical themes is summarised in Table 1, while Figure 2 illustrates the three interrelated domains shaping SuDS decision-making identified through the analysis.

4. Results

This section presents findings derived from thematic analysis of the interviews, structured around three interrelated themes that emerged consistently across participants:

land valuation and land costs, construction logics and cost management, and long-term maintenance arrangements. We show how hydrological compliance and SuDS design are "priced in" during the land-acquisition process shifting costs onto landowners; how developers' standard construction choices influence the form and cost of SuDS features to keep costs low and design standard; and how long-term maintenance arrangements transfer risk and cost onto new homeowners.

4.1. SuDS and the question of land costs

The research revealed decision-making for hydrological compliance to be significantly influenced by the wider development context in which development decisions were made. None of the housebuilders interviewed had internal SuDS-specific corporate strategies that would enable a standardised approach to flood resilience. To some extent, this finding is expected, since flood alleviation measures are very much dictated by the specific, and often unique, features of a development site, such as topography, soil composition, existing watercourses, etc.

What emerged, instead, from the interviews was a process of land valuation in which questions of SuDS design, and arguments over the best way to achieve hydrological compliance, were aired from the very earliest phases of the land acquisition process. Despite a degree of heterogeneity in the processes of the four housebuilders who were interviewed, participants approached land pricing in a broadly similar manner, which is outlined in Table 2. Importantly, steps 1–6 are completed before a site is priced and before any land bid is formulated. This means that the 'land take' for the SuDS scheme is effectively 'priced in' to the site design from Step 2. Ultimately, the early design of SuDS schemes within the land acquisition process suggests that the cost of 'land hungry' environmental features is borne not by developers, but by landowners. This may be a contributing factor to explain why land prices have remained

Table 2. How hydrological compliance is initially considered on proposed development sites.

Step 1	A potential development site is received by the Technical Team from the Land Team.
Step 2	The Technical Team develops feasibility drawings for the site, working with the basic information available, which varies site by site, but may include a flood risk assessment, topographical survey and site investigation. This 'trio' is considered necessary to accurately 'price up' the site.
Step 3	The Technical Team produces a constraints plan which outlines how they would design the layout of the drainage system. During this, they consider where the low points on the site are and where attenuation and drainage can be placed.
Step 4	Designers (or architects less commonly) produce a sketch site layout, incorporating the drainage system as well as any public open space (if below ground tanks are used, public open space is typically placed above them).
Step 5	The sketch site layout is returned to the Technical Team, where a high-level drainage design is produced using in-house expertise or external consultants depending on requirements. This stage is influenced by ground conditions and watercourses available within the landowner's legal ownership boundary.
Step 6	The Technical Team communicates their site design to the Land Team, who pursues the acquisition of the site through formulating a land bid. If successful, they work with the Planning Team (in house or external consultants) to secure planning consent. The communication between the Technical Team and the Land Team might be iterative, particularly if re-designs are required.

relatively flat in recent years, while property prices have soared (Office for National Statistics 2023; Savills 2022, 2023).

However, the process of arriving at a price for a parcel of land involves determining the developable area, which introduces complex negotiations between regulatory state actors, landowners, and housebuilders. Across interviews, participants consistently noted the importance of gaining early insights into the views of regulatory bodies, including Local Planning Authorities and water companies, when considering SuDS schemes. The feedback of these actors on what might be required in a planning application fed into initial feasibility drawings, constraints plans, and site layout sketches that were used to determine land price. One area of complaint from the housebuilding industry concerned the varying priorities of different regulatory bodies, with some promoting multi-benefit SuDS, while others emphasizing just water quality or flood prevention. Across participants, housebuilders expressed frustration about the lack of a single, central point for decision-making in Local Planning Authorities, and were particularly concerned at receiving inconsistent advice from different departments on what was considered an acceptable SuDS design in a particular area. A lack of clarity over SuDS design in the land pricing process was particularly dreaded since it had the potential to increase costs after the conclusion of the land bidding process, a key determinant of profitability.

Perhaps surprisingly, the idea of strong regulation of surface water drainage was generally welcomed by the interviewed housebuilders. Early engagement with state actors in the process of planning a site was seen as vital by all four participants, with one emphasizing the need to "get to talk to them, understand what they want and try and negotiate with them." Agreeing aspects like discharge rates in advance of a formal planning application being submitted meant housebuilders were not wasting their time "… submitting something that they're just going to kick out of the door." To understand this more fully, it is necessary to delve into the workings of the land pricing and bidding process, to understand the triangulation of the relationship between regulatory state actors, housebuilders, and landowners.

Securing a piece of land in a competitive market can involve tricky negotiation and considerable calculation. When it comes to the 'land take' for features like SuDS (and Biodiversity Net Gain), housebuilders must accurately 'price in' the costs of existing and sometimes future policy compliance, while ensuring that their bid remains sufficiently attractive to a landowner. The industry's ability to make 'supernormal profits' of 25-30% (CMA 2024; Foye and Shepherd 2023) relies on their ability to closely define the parameters of a development's commercial viability, with land price a key determinant.

However, the process of bidding for land is negotiative and competitive. Landowners and housebuilders may clash over price, because they disagree over the developable area of the site. Housebuilders must therefore develop a bid that is at once realistic, yet that offers a sufficiently attractive deal to engage the landowner. An indication of the care with which such housebuilders approach the commercial question of SuDS design lies in the scepticism that interviewees expressed about sites where landowners had devised their own flood attenuation and water quality management assumptions. Participants noted that these were often based on incomplete topographical or soil composition data and often ignored industry-specific SuDS guidance and other relevant planning legislation. These layouts maximised developable space in isolation from the regulatory context, resulting in unrealistically high land valuations.

Uncertainty over whether land-hungry environmental mitigations will be required therefore runs through the land pricing and bidding process. The absence of a mandatory policy increases the degree of uncertainty that housebuilders experience in the land bidding process: landowners may not be aware of contemporary or anticipated SuDS requirements, and housebuilders may be tempted to adjust drainage schemes to reduce costs and thus secure a competitive edge in the land market. On some occasions, housebuilders claimed, the process worked against the use of multi-benefit SuDS, since these would have reduced the land price too far for a bid to be competitive. Managing landowner expectations around price in relation to SuDS is therefore a key task of the development process from the outset, but one that is made more difficult by the absence of regulatory certainty.

Housebuilders deploy a range of techniques to manage this situation. Some offer strongly competitive land bids simply to win the right to purchase sites, but then subsequently 'chip away' at those values. Others produce competitive land bids but caveat these with a series of statements that reduce the value in the event that more land is ultimately required for surface water management as the planning process proceeds. In both cases, there is a temporally extended project to gain 'a foot in the door' and then to challenge and contest landowner assumptions about what is viable and deliverable onsite, as one builder commented '… hopefully [we'll] catch landowners' attention because it's the highest bid and then [we'll] work through and kind of chip away later on'.

Multiple sets of regulatory standards for SuDS exacerbate this situation. For example, where Local Planning Authorities are considering SuDS adoption, they tend to have more stringent constructional requirements than water companies, who also offer speedier approval, lower costs for design checking, and accelerated adoption programmes. Consequently, these different requirements have obvious implications for land pricing. Under water company regulations, for example, the lateral size of ponds can be reduced, enhancing developable space and enabling the developer to pay the landowner a higher price. While both LPA and water company standards can be 'priced in' during the design process, any uncertainty over which set of standards are in play can complicate the negotiation process over land prices.

As discussed earlier (see 'Literature Review') developer understanding of the multiple benefits that can be delivered by SuDS schemes remains limited. All interviewees considered themselves to have delivered a nature-friendly solution if the detention basin at the end of their development's pipes was open and 'green', rather than a concrete tank. Developers' held a strong belief that replacing what they regarded as 'green compliant' SuDS with multi-benefit SuDS would demand higher land take. As one developer explained: 'Initially they're saying you've got a tank and I want it to be a pond now and we have to say we can't do it as a pond … because of the sheer land take. And these are sites we've already bid on … So, to change it now would severely impact our costs'. This raises an important temporal point about the land bidding process: where developers have already paid for land, then increased land requirements of SuDS schemes can increase costs. However, the purchase of 'options' (a sum paid to secure the right to buy land in future) can mitigate this risk, while future developments will not incur increased costs on the developer's part due to the 'extra' land take being factored into the land price.

Further, McLeod and Mickovski (2024) question whether multi-benefit SuDS always involve increased land take. Their case study of a site in Scotland suggests that

four more units could have been added to a 44-unit site had SuDS elements been designed throughout the site rather than achieving hydrological compliance *via* a large outdoor detention basin. Whereas the developers assumed that what was required was a pond, McLeod and Mickovski (2024) instead designed in multiple SuDS elements as part of a treatment train. While caution must be exercised about drawing definitive conclusions from work on one site, this research serves to question the presumption that multi-benefit SuDS would necessarily be more land hungry, and suggests that a greater degree of flexibility and creativity in the design of schemes could be economically beneficial for developers while delivering multiple benefits for the community. Negotiating this, however, may be a matter of interrogating and adjusting attitudes to risk: it may be that SuDS basins are preferred because they are viewed, either by engineers, developers, or the LPA, as inherently more reliable as a design than a series of swales and ponds. Further research on this point is needed.

In summary, the influencing effect of the land market and landowner expectations in shaping flood alleviation decision-making cannot be understated. Problems may arise where regulation is not clear, consistent or certain and in these cases, it is plausible to think that non-statutory standards can be bent towards a minimal point to maximise developable space. However, where local policy mandates SuDS, then compliant solutions like ponds and detention basins are preferred to a more distributed multi-benefit approach, not least because these can be constructed cheaply, following current procedures and with certainty about the land take involved. Of course, whichever form of SuDS are used, the land required by a SuDS scheme is theoretically priced into land costs.

4.2. Construction costs

Land costs interact with construction costs in complex ways that are not always rationally driven. For example, above-ground basins are cheaper to build than below-ground storage solutions, but the latter sometimes end up being the preferred solution because they 'fit' with landowner expectations about the developable area of a site. As one housebuilder put it: "… losing plots to fit something in costs a lot of money", though (as we have already noted) the process for pricing land means that the loss in this case affects the value that accrues to the landowner, not the developer. However, the bargaining process between the two parties essentially relies on the ability of the developer to convince the landowner that an additional land take is necessary for surface water drainage (or other environmental features, like BNG), reducing a site's value. Where this is not possible, the developer may lose the site to a more competitive bidder.

All housebuilders acknowledged site topography had a significant bearing on the drainage strategy for their sites. It affected where housebuilders could accommodate rainwater storage, irrespective of whether it was below or above ground, and influenced the incorporation of on-surface features. Soil composition was mentioned as a particular source of uncertainty: many sites in the Yorkshire area have clay-based soils, for example, which drain slowly after rainfall and result in standing water after heavy rainfall. This limits the effectiveness of infiltration-based interventions and means water may need to be directed towards drainage points where it can be attenuated. Behind the technical issues lay financial concerns, in particular concerns that a site might harbour invisible risks, entailing construction costs that even the most diligent site investigations could not reveal (such surveys are limited to boreholes, so there is a risk of discovering impermeable soil after construction starts).

In keeping with the findings of McLeod and Mickovski (2024), developers expressed a strong preference for interventions that had lower construction costs, in particular ponds and detention basins. These SuDS designs focus attenuation on specific spatial areas of a site that are topographically suited to water storage, maximising developable space outside of this area. Although many developers could use other areas of public open space on a site as drainage features (for example, swales on road verges), they often choose not to do so. Moreover, interviewees expressed strong antipathy to types of 'on plot' interventions that sit within individual house plots, such as water butts or permeable paving on driveways. The higher construction cost of these was mentioned as an inhibiting factor, as was the risk that homeowners would remove or fail to maintain the intervention. Finally, the disinclination of water authorities to consider 'on plot' interventions in their drainage calculations also discouraged the use of multi-benefit SuDS on private land.

Developers' standardised design and construction processes constitute a particular barrier to multi-benefit SuDS. Construction costs are minimised through stock designs that can be tailored to fit different site conditions. Altering these to include SuDS features that are on-plot (such as rain tanks and permeable paving) or distributed through the site (such as rain gardens and swales) would require more fine-tuned tailoring to specific site topography and soils. If such distributed elements were to be included more frequently, it could add significantly to uncertainties and costs, particularly during a transition period when the technologies are unfamiliar.

The interviews revealed a strong degree of negative consensus among the housebuilders on their perceptions about whether multi-benefit SuDS added value for them. None of them believed that surface water management schemes would enhance the price they could command for property, though this may reflect practices in the mortgage lending industry, where financiers are not willing to allow a greater level of borrowing on a house simply because the property is in close proximity to nature-based surface water drainage solutions or biodiverse features compared to others on the same estate. This is the case even where there is a clear recognition that SuDS schemes deliver multiple benefits, for example increased aesthetic appeal. In the view of housebuilders, potential homeowners were also not willing to pay more for a property with on- or off-plot SuDS features. Some did, however, acknowledge the positive impact that 'green' SuDS features (for example, detention ponds focused on hydrological compliance) had on the marketability and 'attractiveness' of a site, particularly where homes were sold before the entire development was built. In such cases, participants praised SuDS for enhancing sales rates, thus speeding up return on capital, improving cash flow, and accelerating debt repayment, all of which improve profitability. Others, however, complained that SuDS could interfere with the integration of a site into the wider setting, particularly when detention basins and ponds need to be fenced off with knee-rails or kept fully separate from the public realm for safety reasons. The use of such boundary treatments for sites that are dry for most of the time was mentioned as appearing incongruous, while the presence of lifebuoys could add an unwelcome sense of danger. Notably, at the time of the research, the developers had little awareness that multi-benefit SuDS might limit some of these perceived negative impacts, particularly through minimising the size and depth of ponds.

4.3. Maintenance constraints

The non-adoption of surface water drainage schemes by local authorities or water companies means that many pass into the ownership of estate management companies,

who levy a mandatory charge on residents of the new estate to pay for ongoing maintenance. In design terms, the demands of these companies were not reported to influence high-level decisions on surface water management, though housebuilders did acknowledge that they could dictate certain aspects of the spatial outcome onsite, such as the type of pond, and the kind of planting (for example, requiring the use of low maintenance grasses and low maintenance shrub planting). Some interviewees aired concerns about the efficacy of maintenance practices in the long term, and the potential for reputational problems to arise in the future if SuDS schemes were not maintained. One housebuilder worried that detention basins can often become "just a bit of dry grass that's got overgrown and rubbish starts getting in there." According to Chapman, Tait and Postlethwaite (2024), these concerns are not misplaced. Their survey of 42 new build housing estates found that land management practices were extremely piecemeal, with many of the subcontracted landscaping companies carrying out maintenance in a manner that did not accord with the conditioned landscape management plan. Poor-quality, litter-strewn SuDS and a lack of maintenance leading to the domination of vigorous species like bullrush, were a particular issue.

Privatising the management of public open space also introduces a potential for conflicts of interest between the desire of residents onsite to keep charges low, and the need for appropriate maintenance of the ecological elements of multi-benefit SuDS, for example, a rain garden. In a cost-of-living crisis, any additional costs associated with multi-benefit SuDS have the potential to stoke resentment against ecological mitigation and enhancement schemes amongst residents of new build estates. Further, there is evidence that estate management companies are being used to extract disproportionate sums of money from residents that are not necessarily then spent on landscaping. A recent Competition and Markets Authority report (CMA 2024) found that around 60% of the estate management charge paid by residents is absorbed by so-called 'administration fees', leaving only 40% for the actual work of managing the estate including its SuDS.

Preliminary research in this area also suggests that some of these estate management companies are now owned and operated by the housebuilders themselves, meaning that the institutional void created by local authority non-adoption of public open spaces and SuDS is being used to generate an additional ongoing revenue stream for the development industry (Chapman and Tait 2025). If this is widely the case, then not only is the 'land take' for SuDS borne by the landowner rather than the developer, but at the other end of the construction process, estate management charges hypothetically make the creation of environmentally sustainable above-ground features such as SuDS and Biodiversity Net Gain areas a revenue-yielding opportunity for housebuilders. More research in this area is required to understand the full consequences of this.

5. Discussion: enhancing uptake – what needs to change?

The planned construction of 1.5 million new homes in England over the next five years intensifies existing threats of surface water flooding, water shortages, and river pollution. This makes the urgent question of how we manage rainwater in new housing developments in the context of climate change even more critical. While legislation has successfully mandated SuDS for hydrological compliance, their broader potential to benefit water supply, pollution management, biodiversity enhancement, and the quality of outdoor space remains largely unfulfilled. This paper has used academic literature, regulatory

updates, and elite interviews with Yorkshire's leading private housing developers to explore constraints on evolving rainwater management practices in new housing.

We have argued that the challenges of delivering SuDS need to be understood in the context of the wider processes of the development industry when it comes to calculating land values, construction costs, and maintenance costs. Our research has shown that while developers pay the construction costs of SuDS, if they bargain successfully and manage appropriately, the land and maintenance costs are currently covered by other parties. The competitive dynamic is important here – while land costs are accounted for, the regulatory environment's lack of mandatory requirements means that success ultimately hinges on convincing the landowner that the proposed price is accurate and fair, given the necessity of the SuDS scheme.

Recent guidance advocates even more strongly for multi-benefit SuDS, yet their implementation remains constrained by the negotiative nature of the planning system. Consequently, areas experiencing high development pressure could see multi-benefit SuDS in the future, while those with fewer resources or less development pressure might achieve only minimal hydrological compliance. In the long term these issues are likely to exacerbate existing unequal access to green space (Health Foundation 2024). As more water management infrastructure is surfaced and made visible within developments, the imperative for multi-purpose green infrastructure becomes more pressing. Our findings suggest that SuDS cannot be understood purely as technical drainage devices, but as integral parts of the green infrastructure of new housing developments, with implications for amenity, biodiversity, and long-term place quality.

Developers' belief that multi-benefit SuDS will demand more land than hydrologically compliant SuDS has been questioned in recent research (McLeod and Mickovski 2024). Even if this finding about the relative land take is confirmed, it is probable that the combination of land, construction, and maintenance costs associated with multi-benefit SuDS will continue to militate against their development. In an industry that relies on standardisation for profits, multi-benefit SuDS' requirements for the use of novel materials and methods, alongside their need for enhanced site data and tailored design, appears to be an important factor influencing developer preferences against these designs. Notably, however, this is a transition issue: if unambiguously required, developers would adjust business models to accommodate requirements for multi-benefit SuDS. This highlights the crucial role of incentives and hard legislation in shaping private-sector choices. Insofar as the private sector remains the primary delivery vehicle for new housing, the framing of regulatory requirements and the extent to which they are clear, consistent, and enforceable will be decisive in steering developers towards multi-benefit SuDS rather than minimal compliance.

Housebuilders consistently stated that pitching an elaborate, multi-benefit SuDS layout jeopardises their land bid competitiveness. By contrast, "hard" underground solutions were favoured because they maximise developable coverage and win the site. Similarly, although they take somewhat more land, the predictable demands of detention basins were favoured as they are easy to plan and cheap to construct. To overcome the strategic hesitation about multi-benefit SuDS, more work – building on McLeod and Mickovski's (2024) demonstrations of SuDS land efficiency – could quantify how integrated, multi-functional systems actually preserve or even increase saleable plot area, thereby removing the perception that multi-benefit SuDS designs inherently weaken a developer's bid. Planning requirements (national, regional and local) to optimise SuDS' multiple benefits could further enhance transparency and comparability across land bids. More broadly if decentralized SuDS

elements can match traditional tanks/detention basins in cost and flood protection, while delivering extra benefits, this reality needs to be communicated clearly to developers, planners, and the community.

Another significant issue hindering multi-benefit SuDS concerns the extent to which on-plot SuDS elements contribute towards hydrological compliance. Multi-benefit SuDS usually include a treatment train of SuDS features, including some positioned within individual housing plots. Although the challenge of managing publicly beneficial SuDS infrastructure on private land may be new, there are many components of other infrastructure systems (electricity supply poles, water supply pipes) that sit, and are effectively maintained, on private property. Careful thought may be needed, but standards supporting development and maintenance of public SuDS infrastructure on private land are required.

Negotiating the adoption of SuDS by local authorities or water companies significantly complicates the development process. Developers rightly worry about added costs and uncertainty due to the varying capacities, preferences, and interpretations of rules among potential adoption authorities, many of whom are not keen to take on these avoidable responsibilities. Increasingly, to sidestep these issues, SuDS are maintained by private estate maintenance companies. However, current evidence suggests these services are often of poor quality and expensive. This creates an element of risk about assets which serve a public need and also unfairly burdens new homeowners with the cost of flood alleviation and pollution abatement, which are broader societal benefits.

The challenges of negotiating adoption, combined with the risks associated with private maintenance companies, highlight a critical ongoing gap in the institutional structure: a lack of support for SuDS maintenance. This is likely to be the central issue hindering the development of multi-benefit SuDS. Without addressing this, the government's new SuDS standards are unlikely to achieve their desired outcomes (DEFRA 2025).

However, this research also reveals the benefits of a much wider, more holistic view of the benefits of SuDS schemes. At present, outside of Biodiversity Net Gain, the calculative accountancy of development does not 'price in' many of the forms of multiple social, economic and environmental benefit that these schemes can potentially deliver. Indeed, the benefits are so broad that they raise questions about what can be quantified in monetary terms: can we place a defined value on the qualitative health and wellbeing benefits of contact with high quality green space, or opportunities for social engagement with other residents, without a degree of quantitative reductionism? Further, there are significant social justice issues connected with the fact that the residents who are paying for these features via estate management fees are not seen as key stakeholders in their design or ongoing management. A perspective that included the views and valuations of residents towards green spaces, and that included citizens in processes of coproduction and stewardship could reframe SuDS as a critical environmental, social, and economic infrastructure across multiple domains beyond water management.

6. Conclusion

This study makes three principal contributions to the literature on sustainable urban drainage systems (SuDS) in new housing developments. First, it reconceptualises SuDS as a market-embedded infrastructure, showing that the cost of land take, construction, and maintenance is not always borne by developers but is often offloaded onto landowners and homeowners. By tracing how SuDS requirements are built into

competitive processes of land bidding, and how maintenance liabilities are passed to estate managers or residents, we reveal a commodification of hydrological compliance that sits at the intersection of the economics of housing and land and the environmental field.

Second, our analysis advances governance scholarship by exposing the regulatory fragmentation between Local Planning Authorities and water companies. We demonstrate that overlapping but misaligned mandates create zones of ambiguity that developers exploit, opting for standardised, low-cost designs that meet only the bare minimum of hydrological criteria. This insight extends theories of regulatory governance by illustrating how institutional gaps – not merely weak enforcement or market failure – actively shape the form and function of environmental infrastructure.

Third, at an empirical level, this research addresses a notable gap in SuDS studies by shifting the focus from technical performance and ecological benefits to the socio-economic and institutional drivers of design decision-making. While much existing work evaluates retention volumes or biodiversity outcomes, this paper foregrounds how cost pressures, risk perceptions, and regulatory uncertainty together channel development toward minimalist compliance. In doing so, it lays a foundation for rethinking how multi-benefit SuDS might be incentivised in practice.

More broadly, our analysis underscores that incentives for SuDS delivery cannot be interpreted at face value. Their effects depend on the institutional context of the UK's land and housing markets where landowners, developers, and regulators negotiate outcomes. SuDS requirements, such as the need to limit runoff, exemplify how national policy signals must be translated through local market conditions and professional practices before shaping on-the-ground infrastructure.

This study should be interpreted in light of several limitations. The empirical sample focused on volume and super housebuilders within a single regional context, meaning findings may not fully represent SuDS practices among SMEs, housing associations, or other development actors. The research also examined SuDS provision in new build development rather than retrofit or public realm settings, where economic and regulatory dynamics may differ (Zhu *et al*. 2025). Additionally, the study captures developer perspectives within an evolving policy environment. Regulatory frameworks, technical standards, and industry practices relating to SuDS continue to develop, suggesting that the findings reflect prevailing decision-making rationalities at the time of research. Notwithstanding these limitations, the study provides analytical insight into the institutional and economic processes shaping SuDS delivery within large-scale market-led housing development.

Looking beyond this study, future scholarship should continue to unravel how market mechanisms and institutional arrangements shape environmental infrastructures. Further research, enumerating the very different economics of SuDS in contexts of SME building, retrofitting, social housing, and public space would also be beneficial. The rigidity of mortgage lending in relation to practices of valuation that are inflexible to the proximity of green spaces to individual houses also requires further investigation. Perhaps most significantly, understanding the rich ways in which ordinary people understand blue-green spaces, their views and valuations of biodiversity, and the relative weight they give to different social, economic, environmental, and water management goals would be useful in ensuring that future infrastructure integrates well with the needs of local people.

By articulating how economic and regulatory forces converge to shape SuDS in practice, this paper not only broadens the academic discourse on urban water management but also suggests that enduring environmental resilience depends as much on market governance and institutional clarity as on technical design.

Note

1. These are known by various local terms, such as Best Management Practices (USA), Low Impact Design (New Zealand), Water Sensitive Urban Design (Australia), and Sponge Cities (China) (Fletcher et al. 2015; Thomas 2025).

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References

Araujo, Luis. 2007. "Markets, Market-Making and Marketing." *Marketing Theory* 7 (3): 211–226. doi:10.1177/1470593107080342.

Arup. 2023. *Sustainable Drainage Systems (SuDS) Schedule 3 Post Implementation Review*. Cardiff: Welsh Government. https://www.gov.wales/sites/default/files/publications/2023-07/sustainable-drainage-systems-suds-schedule-3-post-implementation-review.pdf.

Ashley, Richard M., B. Gersonius, C. Digman, B. Horton, T. Bacchin, B. Smith, P. Shaffer, and A. Baylis. 2018. "Demonstrating and Monetizing the Multiple Benefits from Using SuDS." *Journal of Sustainable Water in the Built Environment* 4 (2): 05017008. doi:10.1061/JSWBAY.0000848.

BCIS. 2025. "Latest UK Housing Starts and Completions Figures." *BCIS*. https://bcis.co.uk/news/latest-uk-housing-starts-and-completions-figures/.

Bradley, Quintin. 2023. *Property, Planning and Protest: The Contentious Politics of Housing Supply*. London: Routledge.

Bright, Susan. 2022. "Far from Privatopia: Private Residential Estates in England and Wales." *SSRN*, January 12. https://ssrn.com/abstract=4007198.

Butler, Catherine, and Nick Pidgeon. 2011. "From 'Flood Defence' to 'Flood Risk Management': Exploring Governance, Responsibility, and Blame." *Environment and Planning C: Government and Policy* 29 (3): 533–547. doi:10.1068/c09181j.

Cambridge City Council. n.d. "Cambridge Sustainable Drainage Systems Design and Adoption Guide." *Cambridge City Council*. Accessed February 16, 2026. https://www.cambridge.gov.uk/media/5457/suds-design-and-adoption-guide.pdf.

Chapman, Kiera, Malcolm Tait, and Sarah Postlethwaite. 2024. "Lost Nature: Housing Developers Fail to Deliver Their Ecological Commitments." *Wild Justice*, December 12. https://wildjustice.org.uk/general/lost-nature-report/.

Chapman, Kiera, and Malcolm Tait. 2025. "Commodification, Labor, Abstraction: Three Key Concepts to Understand the Many-Headed Hydra of Biodiversity Offsetting." *Journal of Political Ecology* 32 (1): 6186. doi:10.2458/jpe.6186.

CIWEM (Chartered Institute of Water and Environmental Management). 2024. "CIWEM Reacts to Updated National Planning Policy Statement." *CIWEM*, 13 December. https://www.ciwem.org/news/ciwem-reacts-to-updated-national-planning-policy-statement/.

Chisholm, Alastair. 2025. "New National Standards for Sustainable Drainage: The Right Words but Missing a Mandate." *CIWEM*, 19 June. https://www.ciwem.org/news/new-suds-standards/.

Choe, Eun Yeong, Anna Kenyon, and Liz Sharp. 2020. *Designing Blue-Green Infrastructure for Water Management, Human Health, and Wellbeing: Summary of Evidence and Principles for Design*. Sheffield: University of Sheffield. doi:10.15131/shef.data.13049510.

Clarke, Victoria, and Virginia Braun. 2017. "Thematic Analysis." *The Journal of Positive Psychology* 12 (3): 297–298. doi:10.1080/17439760.2016.1262613.

Climate Change Committee. 2020. *The Sixth Carbon Budget: The UK's Path to Net Zero*. London: Climate Change Committee. https://www.theccc.org.uk/publication/sixth-carbon-budget/.

Colenutt, Bob. 2020. *The Property Lobby: The Hidden Reality Behind the Housing Crisis*. Bristol: Policy Press.

Competition and Markets Authority. 2024. *Housebuilding Market Study: Final Report*. London: HM Government. https://www.gov.uk/government/publications/housebuilding-market-study-final-report.

Crosby, Neil, and John Henneberry. 2016. "Financialisation, the Valuation of Investment Property and the Urban Built Environment in the UK." *Urban Studies* 53 (7): 1424–1441. doi:10.1177/0042098015583229.

Department for Environment, Food and Rural Affairs. 2015. *Sustainable Drainage Systems: Non-statutory Technical Standards for Sustainable Drainage Systems*. London: HM Government.

Department for Environment, Food and Rural Affairs. 2025. *National Standards for Sustainable Drainage Systems (SuDS)*. London: HM Government. https://www.gov.uk/government/publications/national-standards-for-sustainable-drainage-systems.

Department for Levelling Up, Housing and Communities. 2022. "Housing Supply: Net Additional Dwellings, England: 2023." https://www.gov.uk/government/statistics/housing-supply-net-additional-dwellings-england-2022-to-2023/housing-supply-net-additional-dwellings-england-2022-to-2023.

Dubois, Emmanuel, Taha Loghmani-Khouzani, Susanna Ottaviani, Livia Serrao, and Eleanor Starkey. 2025. "Are Water-Related Nature-Based Solutions (NbS) Assessed for Their Full Multi-Benefit Potential? A Review from an Urban Perspective." *Sustainability Nexus Forum* 33 (1): 22. doi:10.1007/s00550-025-00581-1.

Duffy, Alison, Christopher Jefferies, G. Waddell, G. Shanks, D. Blackwood, and A. Watkins. 2008. "A Cost Comparison of Traditional Drainage and SUDS in Scotland." *Water Science and Technology: A Journal of the International Association on Water Pollution Research* 57 (9): 1451–1459. doi:10.2166/wst.2008.262.

Ellis, J. Bryan, and Lian Lundy. 2016. "Implementing Sustainable Drainage Systems for Urban Surface Water Management Within the Regulatory Framework in England and Wales." *Journal of Environmental Management* 183 (Pt 3): 630–636. doi:10.1016/j.jenvman.2016.09.022.

Environment Agency. 2022. *National Flood and Coastal Erosion Risk Management Strategy for England*. London: Environment Agency.

Environment Policy Consulting. 2017. *Sustainable Drainage Systems on New Developments: Analysis of Evidence Including Costs and Benefits of SuDS Construction and Adoption*. London: Environment Policy Consulting. https://www.susdrain.org/files/resources/evidence/analysis_of_evidence_including_costs_and_benefits_of_suds_wg_2017_.pdf.

Fletcher, Tim D., William Shuster, William F. Hunt, Richard Ashley, David Butler, Scott Arthur, Sam Trowsdale, *et al.* 2015. "SUDS, LID, BMPs, WSUD and More – The Evolution and Application of Terminology Surrounding Urban Drainage." *Urban Water Journal* 12 (7): 525–542. doi:10.1080/1573062X.2014.916314.

Flood Ready London. 2025. "The London Surface Water Strategy: Increasing Resilience Through Collective Action 2025-30." *London: Flood Ready London*. https://www.london.gov.uk/sites/default/files/2025-05/The_London_Surface_Water_Strategy.pdf.

Foye, Christopher, and Edward Shepherd. 2023. *Why Have the Volume Housebuilders Been So Profitable?* Glasgow: UK Collaborative Centre for Housing Evidence. https://housingevidence.ac.uk/wp-content/uploads/2024/01/CaCHE-housebuilding-report-v9-25.09.pdf.

Gleick, Peter. 2023. "The Most Important Issue About Water Is Not Supply, But How It is Used." *Nature,* December 14. https://www.nature.com/articles/d41586-023-03899-2. doi:10.1038/d41586-023-03899-2.

Graham, Stephen, and Simon Marvin. 2002. *Splintering Urbanism: Networked Infrastructures, Technological Mobilities and the Urban Condition*. London: Routledge.

Greater Manchester Combined Authority. 2023. *Integrated Water Management Strategy.* Manchester: Greater Manchester Combined Authority. https://www.greatermanchester-ca.gov.uk/what-we-do/planning-and-housing/strategic-planning/integrated-water-management-plan/.

Health Foundation. 2024. "Inequalities in Access to Greenspace." *The Health Foundation*. https://www.health.org.uk/evidence-hub/surroundings/inequalities-in-access-to-green-space.

HM Government. 2022. *UK Climate Change Risk Assessment 2022*. London: HM Government. https://assets.publishing.service.gov.uk/media/61e54d8f8fa8f505985ef3c7/climate-change-risk-assessment-2022.pdf.

HM Government. 2024. "English Housing Survey 2022 to 2023: Affordability and Cost of Living Fact Sheet." https://www.gov.uk/government/statistics/english-housing-survey-2022-to-2023-affordability-and-cost-of-living-fact-sheet.

HM Government. 2025. "Live Tables on Rents, Lettings and Tenancies." *GOV.UK*. https://www.gov.uk/government/statistical-data-sets/live-tables-on-rents-lettings-and-tenancies.

House of Commons Committee of Public Accounts. 2024. *Resilience to Flooding*. London: House of Commons. https://committees.parliament.uk/publications/42888/documents/213370/default/.

Housebuilder Media. 2023. *Housing Market Intelligence Report 2023*. London: Housebuilder Media.

Housebuilder Media. 2024. *Housing Market Intelligence Report 2024*. London: Housebuilder Media.

Independent Water Commission. 2025. *Review of the Water Sector: Final Report.* London: Independent Water Commission. https://assets.publishing.service.gov.uk/media/687dfcc4312ee8a5f0806be6/Independent_Water_Commission_-_Final_Report_-_21_July.pdf.

Johnson, Daniel, and Sylvie Geisendorf. 2019. "Are Neighbourhood-Level SuDS Worth It? An Assessment of the Economic Value of Sustainable Urban Drainage System Scenarios Using Cost-Benefit Analyses." *Ecological Economics* 158: 194–205. doi:10.1016/j.ecolecon.2018.12.024.

Landscape Institute. 2019. *Achieving Sustainable Drainage: A Review of Delivery by Lead Local Flood Authorities*. London: Landscape Institute. https://landscapewpstorage01.blob.core.windows.net/www-landscapeinstitute-org/2019/01/11689_LI_SuDS-Report_v4a-Web.pdf.

McClymont, Kerri, David Morrison, Lindsay Beevers, and Esther Carmen. 2020. "Flood Resilience: A Systematic Review." *Journal of Environmental Planning and Management* 63 (7): 1151–1176. doi:10.1080/09640568.2019.1641474.

McLeod, Martin K., and Slobodan B. Mickovski. 2024. "The Use of End-of-Line SuDS for Residential Development." *Journal of Sustainability Research* 6 (2): E240031. doi:10.20900/jsr20240031.

Melville-Shreeve, Peter, Sarah Cotterill, Laura Grant, Ana Arahuetes, Virginia Stovin, Raziyeh Farmani, and David Butler. 2018. "State of SuDS Delivery in the United Kingdom." *Water and Environment Journal* 32 (1): 9–16. doi:10.1111/wej.12283.

Ministry of Housing, Communities and Local Government. 2024. *National Planning Policy Framework*. London: HM Government.

Ministry of Housing, Communities and Local Government. 2025. "Housing Secretary Pledges to 'Go Further than Ever Before' to Hit 1.5 Million Homes." *GOV.UK*. https://www.gov.uk/government/news/housing-sec-pledges-to-go-further-than-ever-before-to-hit-15-million-homes.

National Infrastructure Commission. 2022. *Reducing the Risk of Surface Water Flooding*. London: National Infrastructure Commission.

Nicol, Chris, and Alan Hooper. 1999. "Contemporary Change and the Housebuilding Industry: Concentration and Standardisation in Production." *Housing Studies* 14 (1): 57–76. doi:10.1080/02673039983000.

Office for National Statistics. 2023. *UK House Price Index: December 2022*. London: Office for National Statistics. https://www.ons.gov.uk/economy/inflationandpriceindices/bulletins/housepriceindex/december2022.

Ossa-Moreno, Juan, Karl M. Smith, and Ana Mijic. 2017. "Economic Analysis of Wider Benefits to Facilitate Suds Uptake in London, UK." *Sustainable Cities and Society* 28: 411–419. doi:10.1016/j.scs.2016.10.002.

Payne, Sarah. 2013. "Pioneers, Pragmatists and Sceptics: Speculative Housebuilders and Brownfield Development in the Early Twenty-First Century." *Town Planning Review* 84 (1): 37–62. doi:10.3828/tpr.2013.3.

Payne, Sarah. 2020. "Advancing Understandings of Housing Supply Constraints: Housing Market Recovery and Institutional Transitions in British Speculative Housebuilding." *Housing Studies* 35 (2): 266–289. doi:10.1080/02673037.2019.1598549.

Payne, Sarah, and Adam Barker. 2018. "Carbon Regulation and Pathways for Institutional Transition in Market-Led Housing Systems: A Case Study of English Housebuilders and Zero Carbon Housing Policy." *Environment and Planning E: Nature and Space* 1 (4): 470–493. doi:10.1177/2514848618784282.

Payne, Sarah, Louise Walker, Sue Illman, and Liz Sharp. 2023. *Sustainable Drainage and New Housing Developments*. Sheffield: The University of Sheffield. doi:10.15131/shef.data.22134440.v1.

Peck, Jamie, and Adam Tickell. 2002. "Neoliberalizing Space." *Antipode* 34 (3): 380–404. doi:10.1111/1467-8330.00247.

Potter, Kerry, and Tudorel Vilcan. 2020. "Managing Urban Flood Resilience Through the English Planning System." *Philosophical Transactions of the Royal Society A* 378 (2168): 20190206. doi:10.1098/rsta.2019.0206.

Rivers Trust. 2024. "2023's Sewage Deluge: New Data Highlights the Urgency of Our Fight." *The Rivers Trust*. https://theriverstrust.org/about-us/news/2023s-sewage-deluge.

Savills. 2022. *Residential Development Land: UK Development Q1 2022*. London: Savills.

Savills. 2023. *Residential Development Land: UK Development Q4 2022*. London: Savills.

Sharp, Liz. 2017. *Reconnecting People and Water: Public Engagement and Sustainable Urban Water Management*. London: Routledge.

Sharp, Liz, Christine Sefton, Gill Hughes, Kiera Chapman, and Ruth Quinn. 2023. *Community Engagement for Nature-Based Solutions*. Sheffield: University of Sheffield. doi:10.15131/shef.data.21997478.

Starkey, Eleanor, Edward Rollason, Sarah Cotterill, Puneeta Sreenivas, and Louise Bracken. 2025. "Maximising Urban Resilience Using Sustainable Drainage Systems (SuDS): Making the Case for Community-Led Urban Water Management." *Land Use Policy* 158: 107732. doi:10.1016/j.landusepol.2025.107732.

Susdrain. 2025. "Adoption and Maintenance." *Susdrain.* https://www.susdrain.org/delivering-suds/using-suds/adoption-and-maintenance-of-suds/adoption/adoption.html.

Thomas, Joel. 2025. "Nature-Based Solutions for Disaster Risk Reduction: Sponge Cities Increase Resilience, Reduce Risks, and Lower the Costs of Floods." *Journal of Water Resource and Protection* 17 (11): 798–809. doi:10.4236/jwarp.2025.1711044.

Vilcan, Tudorel, and Karen Potter. 2020. "Delivering Sustainable Drainage Systems Through the English Planning System: A Proposed Case of Institutional Void." *Journal of Flood Risk Management* 13 (1): e12591. doi:10.1111/jfr3.12591.

Vincent, Santiago Urrestarazu, Mohanasundar Radhakrishnan, Laszlo Hayde, and Assela Pathirana. 2017. "Enhancing the Economic Value of Large Investments in Sustainable Drainage Systems (SuDS) through Inclusion of Ecosystem Services Benefits." *Water* 9 (11): 841. doi:10.3390/w9110841.

West Yorkshire Combined Authority. n.d. *WYCA SuDS Guidance.* Accessed February 16, 2026. https://www.calderdale.gov.uk/docs/planning/wyca-suds-guidance.pdf.

White, Iain, and Joe Howe. 2004. "The Mismanagement of Surface Water." *Applied Geography* 24 (4): 261–280. doi:10.1016/j.apgeog.2004.07.004.

Woods-Ballard, B., S. Wilson, H. Udale-Clarke, S. Illman, T. Scott, R. Ashley, and R. Kellagher. 2015. *The SuDS Manual.* CIRIA Report C753. London: Construction Industry Research and Information Association.

Zhu, Jingyi, Ying Wang, James T. White, Andy Inch, and Sarah Payne. 2025. *Urban Retrofit: A Systematic Evidence Review*. Glasgow: UK Collaborative Centre for Housing Evidence. https://urbanretrofit.housingevidence.ac.uk/projects/urban-retrofit-a-systematic-evidence-review/.

Appendix A

Sustainable urban drainage systems & new housing developments

We are conducting research to investigate the challenges and opportunities of using sustainable urban drainage systems for flood alleviation. The study's purpose is to make policy recommendations based on a deeper understanding of the issues facing development actors.

We would like to hear about your experiences and perspectives of using SUD's - also known as nature-based solutions - in new housing developments in the Yorkshire area.

Most of the questions relate to your experiences and perspective of flood risk management in new housing developments.

The types of things we will want to talk to you about are:

- **The decision-making processes used to achieve hydrological compliance on sites**
  - Can you talk us through a typical approach?
  - What determines the choice between above ground interventions and below ground interventions?
  - When choosing SUD interventions, do you favour one type over the other?
- **The technical, cost and planning constraints that inhibit the routine use of SUD's for flood alleviation in new developments**
  - What technical constraints inhibit the routine use of SUDs?
  - What about cost constraints?
  - What planning constraints exist?
- **What, if any, added-value nature-based solutions bring to new housing developments**
  - Are there any marketing benefits to using SUDs?
  - Do (potential) purchasers understand and recognise their features / benefits?
  - Are there examples of where SUDs have been negatively perceived by potential purchasers? Why? Will this dissuade you from using that intervention in future?
  - Are there any reputational benefits (housing market, corporate, local development nexus) to be gained from SUDs?
- **What needs to change if SUDs are to be used more routinely for flood alleviation**
  - Are NSTS attainable or appropriate?
  - What would it take for you to routinely use NSTS on every site?
  - What knock on effects on the development process exist that potentially discourage the use of NSTS?

At the end of the interview, you will also have an opportunity to let us know if there is anything else you would like to tell us. We hope that you will be able to find the time to speak to us.