

1 **A mixed methods approach to urban ecosystem services: experienced environmental**
2 **quality and its role in ecosystem assessment within an inner-city estate**

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4 **Abstract**

5 This paper contributes to the notion of ecosystem services (ES) and dis-services (EDS)
6 through an exploration of how they are experienced in an inner-city neighbourhood. We
7 contrast the findings of a science-led assessment with qualitative interview and visual data
8 from the residents of the Woodberry Down Estate (London, UK). We use the ontology of co-
9 production and co-construction to understand how material and interpretative factors
10 condition the translation of identified service-providing units (SPUs) into directly
11 experienced ES and EDS. Findings demonstrate that aspects contributing to the perceived
12 liveability of a neighbourhood also condition the experienced ES and EDS. In our case study,
13 the history of the estate translates into subjective feelings of safety which influence whether
14 individuals access parts of the regenerated estate. While the regeneration project provides a
15 broad range of new and improved SPUs with significant ES potential, the access and
16 recreational functions these offer are especially appreciated for the increased opportunities
17 for social interaction and visitors they provide. However, new SPUs such as landscape vistas
18 and formal gardens that attract people are also assigned further significance as markers of
19 new divisions among social housing residents. We suggest that in order to realise the much-
20 prophesised health and wellbeing benefits of urban ES in an equitable manner, a science-led
21 approach to designing and assessing potential ES should be accompanied by a context-
22 sensitive assessment of community needs and liveability aspects.

23

24 **Introduction**

25 The language of ecosystem services (ES) goods and benefits (MEA, 2005) and ecosystem
26 dis-services (EDS) has been evoked in an attempt to establish an integrated and equitable
27 approach to engaging with environmental values in policy (CBD, 2000). However, it is a
28 language established and empowered by scientific knowledge of ecosystems which risks
29 oversimplifying both the ecological and institutional premises of the human-nature interface
30 (Barnaud and Antona 2014; Menzel and Teng 2010; Norgaard 2009). By their definition
31 urban ecosystems are produced by humans – from planned, managed formal parks to the
32 natural re-vegetation of built infrastructure - and are appropriated and experienced in multiple
33 ways (Swyngedouw 2009; Williams 2014). With increasing attention focusing on the role of
34 urban blue-green spaces in contributing to quality-of-life e.g. in primary health care (Elley et
35 al 2003), public health (Maas et al 2009), mental health (Sugiyama et al 2008) and overall
36 urban liveability (Ravez 2015), there is an urgent need to better understand how urban
37 ecosystems are experienced.

38
39 This paper contrasts reductive scientific and qualitative data to demonstrate how the
40 exploration of experienced environmental quality in an inner-city neighbourhood can
41 generate a fuller understanding of how ES relate to liveability and wellbeing in an urban
42 context. Underpinned by the service cascade model (SCM; Haines-Young and Potschin 2009),
43 adapted through the inclusion of the service providing unit (SPU) concept (Andersson et al.,
44 2015) and a use value attribution step (Spangenberg et al., 2014), a science-led assessment of
45 urban ecosystem SPUs and potential ES is accompanied by a qualitative analysis of visual
46 and interview data of local residents' experiences of environmental quality in the same area.
47 We develop a categorisation of urban SPUs, and potential ES and explore the ways in which
48 these resonate with what urban residents perceive as the function and quality of their local
49 environment (van Dorst 2012; Pacione 2003; Zube et al. 1982). Our aim is to explore whether

50 and how these epistemologically different approaches to environmental quality can combine
51 to better inform the design and assessment of urban ES.

52

53 **‘Experienced environmental quality’ and ES**

54 The language of ES derives from an understanding that ecosystems provide a range of
55 services, goods and benefits that are critical to sustaining life e.g. oxygen, food, water and
56 psychological benefits (MEA 2005). The ES discourse is increasingly contributing to notions
57 of sustainability in the urban context and influencing the design of urban space and the
58 valuation of land (Ravez 2015; TEEB 2011). Whilst some literature distinguishes between
59 directly experienced (mainly provisioning and cultural, that directly contribute towards
60 meeting a human need) and indirect (mainly supporting and regulating) ES (Fischer and
61 Eastwood, 2016; Daniel et al. 2012), most ES literature overlooks the role of subjective needs
62 and interests and the social and political context in which ES are identified, experienced and
63 engaged with (Barnaud and Antona 2014; Fischer and Eastwood 2016). For example Barnaud
64 and Antona (2014) stipulate a constructivist ontology that recognises ES as a social
65 construction where humans actively part-take in the production of ES, thereby engaging
66 norms, values and expectations that are subjective but also contingent on social and political
67 context (Murdoch 2001). This resonates with the literatures on experienced environmental
68 quality and perceived liveability that contribute to addressing this lack of understanding of
69 the contingency and subjectivity of human engagement with nature (van Dorst 2012; Lejano
70 2011; Pacione 2003; Zube et al. 1982). In these literatures environmental quality (framed as
71 liveability or as experienced landscape quality) is conceptualised as a dynamic function of the
72 interaction of material environment-related, social and subjective personal characteristics,
73 recognising that these condition how benefits or dis-benefits derived from environmental
74 features come into being (Tyrvaainen et al. 2007; Zube et al. 1982). Van Dorst (2012) for

75 example stipulates a definition of sustainable liveability of urban neighbourhoods that
76 encompasses health and safety; prosperity and equality among residents; social cohesion;
77 control over social interactions and the physical environment; and contact with the natural
78 environment. All components condition perceived liveability and many relate to each other,
79 for example equality and the ability to control social relations contribute to social cohesion
80 and vice-versa, and safety plays a central role in perceived access to nature (van Dorst 2012).

81

82 We adopt this constructivist, dynamic conceptualisation of environmental quality and direct
83 ES and EDS which flow from the daily activities of local residents and their interactions with
84 natural and built entities (Murdoch, 2001). Like Fischer and Eastwood (2016) we view direct
85 ES and EDS as co-produced, where humans tangibly contribute in their production (e.g. when
86 undertaking recreational activities) and co-constructed, where different meanings are
87 assigned to these experienced services rendering them either beneficial services or dis-
88 services, depending on the individual and the social context in which they are experienced.

89 We therefore suggest that directly experienced ES and EDS are integrated into (and
90 contingent on) the social fabric of urban life, and draw agency from the material and
91 interpretative associations that order it (De Landa 2006; Gandy 2006; Williams 2014). Hence,
92 we argue that any ES based approach should integrate environmental quality not only as
93 measurable units, based on a reductive science-led assessment of biophysical structures
94 (defined here as units of interacting biotic and abiotic components) and their functions in
95 context, but simultaneously as an experienced quality hinging on material and interpretative
96 factors.

97

98 Recent ecosystem assessment approaches have begun to embrace some of this complexity
99 and offer good scope for integrating a more qualitative epistemology. Of these, the SCM

100 (Haines-Young and Potschin, 2009) and the concept of SPUs (broadly a ‘grouping’ of
101 biophysical structures by land cover) (Andersson et al., 2015) with the potential to deliver ES,
102 has gained traction in the literature. For example, the SCM was recently adopted as a key
103 element of a systematic framework consultatively developed by academics and EU Member
104 State representatives to enable a consistent approach to implementing the mapping and
105 ecosystem assessment components of the EU Biodiversity Strategy (EC, 2011). Recognising
106 its limitations with regard to addressing societal issues, various authors have looked to further
107 develop the SCM. Spangenberg et al (2014) propose adding a ‘use attribution step’,
108 suggesting that biophysical structures generate potential ES with their translation into actual
109 benefits dependent on local circumstances. These points of translation render the SCM
110 particularly adept for the integration of a more interpretative, parallel epistemology to better
111 represent the production and function of ES and EDS. Andersson et al., (2015) take a
112 different approach to contextualising the flow of ES from ecosystems to people, expanding
113 the concept of SPUs to consider how internal dimensions (e.g. spatial and temporal scale) and
114 external forces (e.g. access rights) influence their performance. Having identified SPUs as
115 potentially providing ES, the authors develop a framework which incorporates these
116 mediating factors to reveal whether and how identified ES potential is translated into actual
117 ES. Whilst Andersson et al. (2015) refer to ‘perceptions’, their discussion features mainly
118 cultural variations in preferences for particular features/functions. This is a useful refinement,
119 but its implementation does not reveal anything about whether accessible ES are actually
120 accessed, who accesses them - and crucial in debates around ‘inclusive cities’ - who does not,
121 nor how identified ES/EDS are co-produced by local communities which experts later
122 perceive as ES beneficiaries. Recent research by Fischer and Eastwood (2016) focuses on
123 interactions between ES and people, and develops a framework which distinguishes between
124 the co-production of ecosystems, ES and the attribution of meaning to these structures and

125 services (co-construction). Whilst this study starts to unpick individual-ES
126 experiences/interactions in a systematic way, our research builds on and extends this by co-
127 locating a science-led methodology linking biophysical structures and functions to ES
128 potential and a social science-led methodology exploring the translation of biophysical
129 structures/functions to directly experienced ES and EDS.

130

131 **Methodology: assessing ES by applying the services-cascade model and integrating**
132 **qualitative data on experienced environmental quality in Woodberry Down estate**

133 *Site description:* The Woodberry Down Estate (London, UK; Figure 1) was built in the 1940s.
134 Over subsequent decades, it suffered from chronic under-investment and physical
135 deterioration, accompanied by high levels of crime and anti-social behaviour. In 1999,
136 Hackney Council agreed to redevelop the estate and, following consultation with residents,
137 planning consent was given in 2014. The redevelopment involves replacing 1,981 homes with
138 5,561 new ones of which 41% are allocated for social renting and shared ownership with the
139 remainder available as private ‘luxury apartments’. All housing and associated facilities
140 (including three new parks, a community centre and school) are being delivered by Berkeley,
141 a publicly owned FTSE 100 development company (Berkeley 2016).

142

143 The 20 year programme is one of the largest in Europe and is being delivered in partnership
144 with Genesis Housing Association, Hackney Homes, the Greater London Authority, Manor
145 House Development Trust (MHDT) and the Woodberry Down Community Organisation
146 (WDCO) resident steering group (MHDT 2015). At the time of the project (2014-2015),
147 redevelopment was well advanced; several tower blocks had been replaced (including the
148 development of a ‘private tower block’) and the landscaping of several blue-green areas, with
149 a stark juxtaposition between old and new components apparent within the estate.

150

151 *Qualitative data collection*

152 Ten participants (four men and six women) were recruited by intercepting passers-by on the
153 street and during visits to the MHDT, a local community organisation. Participants
154 represented a broad demographic ranging from 18 to over 80 years old. Eight of the
155 participants lived in local social housing, whilst two participants had worked there for over
156 one year. Eight of the participants were in employment. All participants were asked to
157 download a bespoke smartphone app, the Urban App, and to record over a seven day period
158 the features of the estate they liked and disliked. Urban App has the capacity to record geo-
159 referenced visual and textual data to a secure domain where it is visible as either a list or a
160 GIS map of individual participants' entries. Of the ten participants, six entered data via Urban
161 App with only three providing five or more entries. For the purpose of this paper, Urban App
162 data was used to support the cross-referencing of interview data with scientific-led
163 identification of SPUs and potential ES.

164

165 The semi-structured interviews conducted either before or after use of Urban App were led by
166 the participants' understanding of the term 'environment' and their delimitation of the
167 neighbourhood. Interviews lasted approximately 40 minutes and focussed on the following
168 themes:

- 169 • Personal background (length of residency in Woodberry Down; reason for moving here;
170 occupation; age)
- 171 • General perceptions of the neighbourhood (as a place to live; what are its best and worst
172 aspects; what changes have taken place over the years; are there any specific development
173 needs; what would you change if you could; what would the ideal Woodberry Down be
174 like);

- 175 • Environmental perceptions (what do you understand by the word environment; what
176 environmental values/problems do you perceive in Woodberry Down; what is your
177 favourite aspect of the Woodberry Down environment; what are the most frequent
178 routes/places you visit; are you interested/worried about environmental issues and if so
179 which; are you familiar with the New River – how do you see its function; what is your
180 view on the green features in Woodberry Down – do you think more greenery is needed);
- 181 • Agency (do you feel your needs are being met by local planning/design solutions; do
182 planners listen to the local population)

183 The interviews were undertaken in a conversational style with questions used as prompts to
184 ensure that interviews provided as full as possible an account of how the functions and
185 experienced quality of the local environment were constructed, experienced and sustained
186 (Rapley 2007). The aim was to ensure a data-led approach, where interview participants were
187 freely able to raise issues that they saw as central to a good neighbourhood and to the quality
188 of their local environment. No systematic differences were evident between participants who
189 were interviewed before or after use of the Urban App. However, it is plausible that using the
190 App to record positive and negative features of the local environment rendered participants
191 better able to articulate their perceptions of local environmental values. In future studies, App
192 use prior to interviewing could be encouraged to optimise interview outcome.

193

194 Data analysis was in keeping with the constructivist approach to environmental quality where
195 experienced quality is seen as subjective, and based on aesthetic, material and social
196 characteristics of a place as well as the subjective cultural values, meanings, expectations and
197 needs of the individual (Fischer and Eastwood 2016; Tyrväinen et al. 2007; Zube et al. 1982).

198 The following categories were used for the initial coding of data: descriptions of
199 environmental quality; described functions of the environment; access to blue-green areas;

200 and agency. While these constitute recurring themes in the data (e.g. Bryman 2016), they
201 were also informed by the way that experienced quality is conceptualised in our methodology
202 as co-produced and co-constructed in the everyday lives of residents and relative to their
203 subjective preferences and needs. While we used existing conceptualisations as a ‘spring-
204 board for themes’ (Bryman 2016) we also maintained an openness to potential further themes,
205 or their broader definitions. For example, ‘agency’ initially referred to participants’
206 perceptions of the extent to which urban planning, and particularly the regeneration,
207 responded to their views and needs but, led by the interview data, expanded to encompass a
208 broader range of experiences of empowerment or disempowerment that respondents
209 associated with their neighbourhood. A further axial coding was performed to derive the
210 experienced benefits as well as dis-benefits (direct ES and EDS) delivered from the SPUs
211 identified within Woodberry Down (see Tables 4 and 5) and the contextual factors on which
212 these hinged. Our analysis therefore represents a generic approach to thematic analysis
213 (Bryman 2016: 587).

214

215 While a small, purposively sampled data set such as ours is valid in qualitative research, it is
216 emphasised that our findings are illustrative of how ES and EDS are constructed within the
217 target area, rather than representative of a universal constructions of urban environmental
218 quality. As stated earlier, our aim is to understand and illustrate whether and how qualitative
219 experiential data could enrich our understanding of urban ES and how they are accessed.
220 Further research needs to be undertaken to understand the nature and contingency of
221 experienced quality (and direct ES and EDS) more universally.

222

223 *The scientific ecosystem assessment of the target area*

224 The Woodbury Down Estate (including Finsbury Park and the two reservoirs referred to in
225 the interview data) formed the focus of the scientific ES assessment (see Figure 1). Using the
226 approach to mapping ecosystem services developed by Maes et al. (2016), the first step was
227 to review the study area using CORINE land cover maps (ARCGIS 10, 2016; CLC, 2016).
228 However, under CORINE the 2.2km² target area is uniformly classed as ‘discontinuous urban
229 fabric’ i.e. land coverage is 30-80% impermeable, with the exception of Finsbury Park which
230 is classed as ‘sports and leisure facilities’. The land cover within the target area is
231 discriminated at a much greater resolution under ‘Open Streetmap’ (an online open-source
232 map; Open Streetmap, 2016) and this image was used to identify a site walk-over route which
233 would take in a range of land cover types. The site walk-over was conducted over the course
234 of two visits (28/11/14 and 5/1/15) with the route taken identified on Figure 1. Site walkovers
235 were undertaken to identify the range of biophysical structures within the study area as the
236 first stage in implementing the SCM (Haines-Young and Potschin, 2009). Urban App was
237 used to record field notes and geo-tagged photographs. The current lack of standardised
238 approach to undertaking an urban ecosystem assessment, a highlighted research gap,
239 inevitably led to a degree of subjectivity within the reductive scientific approach
240 implemented. However, as the aim of this study is to contrast scientific understandings of the
241 urban environment with lay perspectives, rather than quantify the delivery of specific services,
242 the approach is considered to be sufficiently robust.

243

244

245

246 **Figure 1:** Map of the Woodberry Down Estate study area

247

248 Open Streetmap identifies seven land cover types within the study area, and reveals a range
249 of smaller greenspaces, two storage reservoirs and a canal (see Tables 1 and 2). The land
250 cover types identified during the desk-based phase were verified during the site walkover,
251 with the decision taken to integrate commercial and retail within a single land cover type due
252 to the similarity in the limited range of biophysical structures observed in the field. Using a
253 combination of literature data outlining a range of urban ES (e.g. UK NEA 2011, Gomez-
254 Baggethun et al., 2013, Holt et al., 2015), land cover maps and on-site observations, the
255 biophysical structures with the potential to generate ES within the study area were identified
256 (see Tables 1 and 2 and pictures 1-4). Whilst the site walk-over involved visiting all land
257 cover types, the process of documenting biophysical structures was not exhaustive as the
258 routes taken only covered part of each land cover class. As with the qualitative data, this
259 assessment was made for the purpose of illustrating connections between biophysical
260 structures, potential ES and experienced ES/EDS, rather than providing a conclusive account
261 of all biophysical structures and associated potential ES in the study area.

262

263 Results indicate that a range of biophysical structures occur throughout this inner city
264 location across a range of scales, from Finsbury Park to that of an individual hanging basket.
265 Identified biophysical structures were then subjectively categorised into generic groupings
266 according to their dominating structures/features (e.g. scale, level of management, presence
267 of water). This resulted in a total of nine biophysical structure types being identified within
268 the seven land cover types distinguished under Open Streetmap (Table 1). Identified
269 biophysical structure types were then cross-referenced to the concept of urban SPUs through
270 a revision of the list of urban SPUs identified by Andersson et al., (2015) i.e. retaining SPUs
271 observed to occur within the study area, deleting those not observed and including additional
272 SPUs observed (but not listed) e.g. pocket greenspace. As per Andersson et al., (2015), SPUs

273 are seen as potentially existing across a range of scales – from an individual plant to a land
274 cover type - but only actively exist when they provide an ES to humans. This reinterpretation
275 of biophysical structures to SPUs is seen as a modification of the move from step 1 to step 3
276 of the SCM, recognising the need to contextualise the relationship between land cover,
277 biophysical structures and their potential to deliver ES as a preliminary step before
278 understanding if potential ES are mobilised and, if so, by whom (see Figure 2).

279

280

281 **Figure 2:** Linking the flow of ES from nature to experienced environmental quality (adapted
282 from Spangenberg et al. 2014)

283

284 A total of 15 urban SPUs were identified as occurring with the seven land cover types
285 identified by Open Streetmap and the two CORINE land cover class ‘urban discontinuous’
286 (Table 1) and ‘sports and leisure facilities’ (Table 2).

287

288 Literature identifying types of urban ES (e.g. Gomez-Baggethun et al., 2013; UK NEA 2011),
289 combined with field notes, were used to identify the potential ES delivered by each urban
290 SPU, with these then classified using the common international classification of ES (CICES)
291 typology. The hierarchical CICES typology provides a standardised approach to classifying
292 ES in a manner which facilitates environmental accounting (Haines-Young and Potschin,
293 2016). Its use has been proposed in meeting the requirement to improve the knowledge base
294 on ES under the EU Biodiversity Strategy (Maes et al., 2016) and is hence used here to
295 facilitate comparability of results with other studies. This activity took place in two phases:
296 firstly the potential of identified SPUs to contribute to the delivery of ES at a CICES section
297 level was considered (see rows 6-8 in Tables 1 and 2). The second phase involved the

298 integration of the 15 SPUs into seven ‘SPU bundles’ (see Table 3) to reduce repetition due to
299 the co-location of various SPUs. For example, the SPU ‘park’ includes vegetated surfaces,
300 plants and soil bacteria and landscape vistas SPUs (identified as separate SPUs by Andersson
301 et al., 2015). The seven SPU bundles, together with the ES they have the potential to provide
302 classified using CICES to a class type level (with associated example), are presented in Table
303 3.

304

305 **Results and discussion**

306 **Science-led assessment of ES generated within the Woodberry Down area**

307 A descriptive analysis of the data indicates that identified SPU bundles can deliver a range of
308 regulating/maintenance services and cultural services, with opportunities to potentially
309 deliver provisioning services less abundant (see Table 1 and 2). These findings indicate that
310 even densely urbanised developments can host urban ecosystems which may impact on local
311 community well-being at both the local-scale (e.g. temperature regulation) as well as through
312 contributing to global-scale processes e.g. carbon sequestration. This potential for urban
313 ecosystems to deliver a host of benefits is well-established in the literature (Gomez-
314 Baggethun et al., 2013; MEA, 2005; UK NEA 2011). In terms of the delivery of potential
315 cultural ES, the area is rich in, for example, potential entertainment (e.g. recreation) and
316 aesthetic ES, with the potential for a range of visual, auditory and intellectual goods and
317 benefits to be delivered.

318

319 **Table 1.** Land cover classes identified in the target area (not including Finsbury Park) cross-
320 referenced to observed biophysical structures and their further classification into urban SPUs
321 bundles (adapted from Andersson et al., 2015)

322

323 **Table 2:** Land cover classes identified in Finsbury Park cross-referenced to observed
324 biophysical structures and their further classification into urban SPUs (adapted from
325 Andersson et al., 2015)

326

327 **Table 3:** Classification of potential ES provided by identified SPUs

328

329 **Figure 3:** Examples of SPUs in the target area as photographed by respondents and during
330 the science-led ES assessment. Image 1: waterbody; park; Image 2: garden; flowering plants,
331 waterbody; Image 3: garden; park; pocket greenspace; Image 4: park.

332

333 **Direct ES and EDS in the Woodberry Down environment**

334 Axial coding of the interview data yielded a range of direct benefits and dis-benefits
335 associated with the SPUs identified in the Woodberry Down environment (see Tables 4 and
336 5). Whilst many of these closely align with the potential cultural ES associated in literature
337 with the identified SPUs, data also suggests that some regulating services such as air
338 purification and cooling effects of greenery are also experienced as directly beneficial (Daniel
339 et al. 2012; La Rosa et al. 2015). The delivery of provisioning services, such as products from
340 an 'edible garden' are also recognised. In some cases cross-referencing the interview data and
341 the Urban App data enabled the specific SPUs to be identified; in others ES and EDS were
342 described at a very general level and this was not possible. It is notable that not all ES, let
343 alone EDS, identified by participants were identified in the science-led assessment (see Table
344 3) or would be readily classified using the CICES typology. This suggests that including
345 experienced environmental quality enriches the range of potential services recognised and
346 that both approaches are needed to gain a full understanding.

347

348 **Table 4.** Environmental benefits experienced in the target area

349

350 **Table 5.** Environmental dis-benefits experienced in the target area

351

352

353 *The role of the social-technological context in direct ES and EDS*

354 In our data, built and design related factors such as benches to sit on, walkways and a built
355 water feature are frequently portrayed as enabling or contributing to many of the direct ES
356 derived (either co-produced and/or co-constructed) from the waterbodies, gardens and parks
357 (e.g. Andersson et al. 2015). The interview data also evidences the co-production of the SPUs
358 themselves (see Fischer and Eastwood 2016 for a detailed discussion of this). For example,
359 gardens, raised flowerbeds and pocket greens such as street trees constitute landscape vistas
360 providing aesthetic ES when viewed from the higher floors of the apartment blocks (Figure 3;
361 image 3) and residents can take part in planting edible pot-plants in the edible garden.

362 Similarly, the role of the external environmental problem context is visible, for example,
363 where the water bodies and gardens are said to provide calm and quiet in contrast to the
364 major transport links which dissect the study area. The below discussion demonstrates how
365 experienced ES and EDS are contingent on three aspects in particular - safety, social
366 interactions and equality - that are also central to notions of liveability (van Dorst 2012;
367 Howley et al. 2009).

368

369 *Subjectively experienced ES and EDS*

370 As literature on experienced environmental quality suggests, while it is subjective, it is also
371 contingent on the subjective expectations and preferences focussed on the area or feature at
372 hand (Regionplane- och trafikkontoret 2001). This is visible in the data where one participant

373 (UAI3) suggests that previously the reservoir wasn't well maintained or accessible and
374 provided dis-benefits '*was stinky*' whereas, referring to the same SPUs, another (UAI4)
375 laments the need to manage everything as this is not good for nurturing 'nature' '*There's no*
376 *wild, left alone space*'. So, the same SPU can provide both benefits and dis-benefits
377 depending on individuals' different preferences. This is also demonstrated by the comments
378 regarding the park and waterbody SPUs (Tables 4 and 5), where in addition to many direct
379 ES they are seen to support anti-social behaviour.

380

381 Our data suggests that where a green area will be accessed by some, others may be much
382 more reluctant to enter because of the threat that they assign to the place for reasons of
383 previous experience/knowledge. Fischer and Eastwood (2016) identify the confidence to
384 engage with potential ES (or SPUs) as a part of an individual's capability to participate in ES
385 co-production. In this respect, the problematic past of the Woodberry Down estate bears
386 heavily on the way residents access parts of the estate and indeed construct the meaning of
387 SPUs:

388

389 "*it used to be not a nice area – full of crime and violence, but lately it's been more calm,*
390 *because they've started the renovation and building the buildings and creating more*
391 *greenspaces, more options for the people living in the area.*" UAI7

392

393 While this convinces some, others are more alive to the history of the neighbourhood and
394 potential dangers, not assuaged even by the private security hired by Berkeley:

395

396 "*It's like, you've got the security there but it's because it is the Woodberry Down estate...*"

397

398 This young woman (UAI3) knows the people who in her experience form the risk element in
399 the neighbourhood and draws on her social relations and past experience which contribute to
400 her perception of security.

401

402 *“because we’ve lived here for that long we’ve lived through that period you still have that in*
403 *the back of your mind like ‘is it all right to walk up the road’ ... It’s even me, sometimes,*
404 *though I’d probably know the person coming up to me trying to threaten me or say anything*
405 *I’d probably know them, but still, ... ” UAI3*

406

407 However, the below quote from an older female participant demonstrates that her identity as
408 recognised and connected in the community increases confidence in this respect. As Fischer
409 and Eastwood (2016) suggest, identity and confidence influence access and willingness to
410 engage with ES.

411

412 *“because I’ve lived here for so long, I’m very comfortable here, I’m not scared of different*
413 *areas, going into parts other people are ... I know a lot of people as well so if I see a young*
414 *guy I might know them I won’t speak to them but or anything, I know them and they know me.”*

415 UAI1

416

417 *ES, EDS and social interactions*

418 While parks and gardens are cast as meeting places that bring the community together, a
419 broader range of benefits pertaining to social interactions also emerges from the data. The
420 stigma of a dangerous inner-city estate is a prominent theme in the interviews and there is
421 evidence in the interviews of how the new buildings, paths and greenspaces constitute
422 (material) access routes and (expressive) features that are constructed as benefits that

423 alleviate this stigma because they are believed to attract visitors and passers-by, rendering the
424 estate *'less enclosed'* (UAI2). References to SPUs that enable the Woodberry Down
425 neighbourhood to establish beneficial associations exist in the interview data in two forms.
426 First, as references to how the newly opened and maintained reservoir path and the adjacent
427 New River physically connect the estate to the nearby 'castle' (a local hub of social/sporting
428 activities):

429

430 *'The castle is a major upheaval of Woodberry Down. Because of the path, the estate is*
431 *connected to the castle and there are lots of things that happen there'* (UAI9)

432

433 Second, participants describe how the landscaped greenspace and reservoir, private security
434 and less hostile-looking buildings render the estate more inviting to visitors.

435

436 *'...the way people are perceiving it from the outside is changing and it is good. People ... are*
437 *coming from so far to the activities in this area, must mean something is done well'* (UAI2)

438 *'I think it's more approachable ... it's better for people who use this area.'* (UAI7)

439

440 This emphasis on the desirability of visitors who engage positively with facilities resonates
441 with Kraftl's (2014) analysis of how different manifestations of liveability are afforded by
442 alternative urban neighbourhood designs, for example, to exclude less desirable fractions and
443 activities. The role of new attractive pathways which invite visitors to pass through the
444 neighbourhood are described as contributing to a more positive sense of place and stabilising
445 a positive identity or positive de-territorialisation of the estate (De Landa, 2006; La Rosa et al
446 2015). In this regard, the recent opening of the Woodberry Down Wetland visitor centre is a
447 further positive development. Similarly, plans outlined in the All London Green Grid strategy

448 to increase access to urban blue-green spaces bode well for Woodberry Down (Sharpe et al.
449 ND).

450

451 *Spatial differentiation and inequality*

452 Our mixed methods data reveals how urban SPUs which generate potential ES inscribe new
453 and sometimes multiple ways of ordering of the Woodberry Down neighbourhood. Scientific
454 evaluations of environmental quality in terms of SPUs and potential ES, residents'
455 experiences of environmental quality as integral to liveability, and Berkeley's stated vision of
456 developing 'beautiful and successful places' (and the conception of liveability that emanates
457 from this) derive from different, even rival, rationalities (e.g. Howley et al. 2009; Williams
458 2014). While increased greenspace in Woodberry Down signifies increased actual and
459 potential ES delivery from an ecological point of view, for developers, it is '*one of its*
460 *[Unique Selling Points]*' (UAI8). It is this rationale which presumably has been the most
461 powerful in influencing the design of the new landscaped gardens and the waterfront features
462 established by Berkeley. The residents are keenly aware of this rationale, with one participant
463 describing the reservoir view as the estate's '*main catch*' (UAI9 – see Table 4). But for him,
464 the new landscaped gardens of Woodberry Down also inscribe a social change, a process, of
465 cleaning that represents a step up the socio-economic hierarchy of the city initiated by '*the*
466 *sweepers like Berkeleys* (AUI9) who swept away the '*red light district, with the drug culture*'
467 (UAI9) to further remaining outposts where gentrification hasn't yet reached. The interviews
468 evidence a trickle-down effect of experienced environmental benefits associated with the
469 investment that the development of new private high rise apartments in Woodberry Down has
470 inspired. At first sight, this challenges the idea that gentrification manifests in spatial
471 divisions often between people who can 'buy citizenship' via participation in the property
472 market (e.g. Gandy 2006). However, on further examination, it does appear that the new

473 SPUs with associated potential ES in Woodberry Down have established a spatial division
474 where not all parties benefit to equal extent.

475

476 *‘Many areas of the estate that are so pretty and clean and then there are so many areas that*
477 *are not so pretty and clean, really not so pretty and clean whatsoever.’UAI3*

478

479 While this may to some extent be due to the stage of the regeneration project, the interviews
480 demonstrate how the provision of potential ES can contribute to spatial differentiation and,
481 instead of providing uniformly co-constructed ES, manifest new mechanisms of inclusion and
482 exclusion in these ‘cleaned up’ neighbourhoods (Gandy 2006; Kraftl 2014). In Woodberry
483 Down, certain SPUs denote status and contribute to a perceived hierarchy of residences
484 where waterfront apartments are perceived as prestigious and sought after. However, our data
485 suggests that also the practices whereby SPUs have been planned, designed and distributed in
486 relation to the allocation of housing matter for how they are interpreted by residents. The
487 waterfront apartments have not been allocated on a basis that is perceived as fair or legitimate
488 by all the residents.

489

490 *‘They moved into a nice place ... on the waterfront. All those people, all my neighbours. They*
491 *used all kind of tricks not to put me there.’(UAI9)*

492

493 The different rationalities underpinning the alternative ways of ordering the neighbourhood,
494 and interpreting the SPUs within it, can be associated with different ways of defining
495 legitimacy of planning and SPU allocation. In this case, housing allocation outcomes have
496 possibly unintentionally upset a hierarchy of residents based on length of residency in the
497 estate.

498

499 *“I’m very happy with the regeneration. It’s much better. But I’m not the proper beneficent*
500 *and I should be, because I’ve lived here for over 30 years.”* UAI9

501

502 Therefore, blue-green areas can also be associated with what DeLanda (2006) terms negative
503 de-territorialisation, where they lend themselves to functions that potentially fragment the
504 community. Depending on how they are designed and/or retrofitted into existing
505 neighbourhood environments, urban SPUs can contribute to feelings of satisfaction and
506 empowerment (direct ES) but also potentially exclusion (direct EDS). These experienced
507 divisions suggest that ES delivery is a much more politicised activity than first appears
508 (Swyngedouw 2009) and that ES are as much a social as a natural phenomenon (Murdoch
509 2001). Accessing and acknowledging the expressive and the material roles of SPUs and
510 potential ES delivered by the urban fabric is not only central to understanding how ES are co-
511 produced and co-constructed by urban residents but also critical for delivering legitimate and
512 equitable governance and planning outcomes (Menzel and Teng 2010; Williams 2014; Wolch
513 et al. 2014).

514

515 While our small data set provides some ideas, more research is needed on how exactly
516 material and expressive direct ES and EDS are contingent. We suggest that while the SCM is
517 apt for assessing the provision of indirect supporting and regulating ES, a Venn diagram (see
518 Figure 4) better represents generation of directly experienced ES and EDS. A science-led ES
519 assessment may identify a range of SPUs and potential ES that indicate the potential for a
520 desirable ecological outcome (e.g. flood resilience, microclimate regulation) but in order to
521 understand how these translate into direct ES or EDS that meet a human need (particularly
522 significant to deriving health and wellbeing benefits and of course the urban justice agenda),

523 a different epistemological approach needs to be adopted where the ‘social causes’ (Murdoch
524 2001: 129) such as subjective perceptions of safety and ‘natural’ features and mechanisms of
525 social differentiation are studied in context.

526

527

528

529 **Figure 4.** Relationship between directly and indirectly experienced ES/EDS and the
530 methodologies which support their evaluation (source: authors)

531

532 **Conclusions**

533 Our findings demonstrate that to understand and optimise direct ES, such as recreational use
534 and increased positive sense of place, scientific evidence on the potential ES that an area can
535 yield needs to be accompanied by an understanding of how these features function or would
536 function as material and expressive components of existing (or envisaged) social and material
537 configurations. Hence, the passive role of ‘consumer’ inherent in the ES concept is
538 misleading and detrimental to its potential. The relational ontology of co-production and co-
539 construction is crucial for understanding how direct ES are derived for increased wellbeing
540 and both are shaped by and contribute to various components of liveability (van Dorst 2012;
541 Murdoch 2001). While perceptions of safety are central to the willingness to engage in the
542 co-production of ES for health and recreational benefit, the nature and desirability of the
543 social interactions that constitute the neighbourhood are, in our data, key to how the potential
544 ES will be realised into direct ES or EDS, and indeed to what the direct ES and EDS are. Our
545 data demonstrates that the route from SPUs to direct ES and EDS is more complex and non-
546 linear than the route from SPUs to indirect ES (Daniel et al. 2012; see Figure 4), and suggest
547 that the former are far from adequately resolved by a science-only evaluation of ES.

548

549 We therefore conclude that in aiming for legitimate and just ES delivery that contributes to
550 liveability and increased wellbeing for all, there is a need to understand how the area is
551 presently being used and what meanings and expectations residents assign to its features.
552 Following Spangenberg et al. (2014) we suggest that such place-sensitive ES delivery could
553 be based on a reversed version of the SCM to form a ‘management stairway’ starting from
554 ‘public benefit and use value objectives’ and from there work backwards to understand how
555 SPUs can be designed and managed to maximise the delivery of identified benefits in each
556 context. Whether retrofitting greenspace or designing new developments, designers should
557 ask questions about all components of liveability and how the planned SPUs will bear on
558 these. For example, while low inequality is reported as desirable for liveability (van Dorst
559 2012), can SPUs be designed and placed to minimise perceived inequality or - at least - to
560 avoid exacerbating it? If control over social interaction is central to liveability and feelings of
561 safety, how can SPUs be designed to contribute to this? What are the desirable activities and
562 which are to be discouraged in specific areas? Understanding generated through
563 consideration of these questions in retro-fitting/regeneration contexts can then be used to
564 inform the design of future developments at a design stage when the inclusion, type and
565 layout of open green spaces is first considered in context.

566

567 It is clear that the experience of the residents is central to identifying community needs and
568 public benefit, and to avoid potential counterproductive outcomes of ES delivery (Noergaard
569 2009; Wolch et al. 2014). The different epistemological basis of direct ES and EDS suggests
570 that these will need to be explored in parallel to rather than as an additional step in the
571 cascade model conceptualising the production of potential indirect ES, through a pluralistic
572 participatory approach with careful attention to representation (Williams 2014). This may sit

573 uncomfortably within the predominantly reductionist tradition of measuring and
574 conceptualising urban environmental quality and its monetary value (Lejano 2011). In
575 Woodberry Down, the broad membership of the partnership involved in rolling out the
576 regeneration plan (MHDT 2015) suggests that there are good premises for responding to
577 multiple perspectives in the design and allocation of public greenspaces in the remaining
578 regeneration project. Our data however suggests that competing rationalities for design have
579 not as yet been reconciled. Further research involving the application of the mixed
580 methodology approach identified here but at a greater scale is currently underway within a
581 Brazilian urban context, enabling its transferability across spatial scales and socio-economic
582 contexts to be evaluated.

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Tables

Table 1. Land cover classes identified in the target area (not including Finsbury Park) cross-referenced to observed biophysical structures and their further classification into urban SPUs bundles (adapted from Andersson et al., 2015)

Table 2: Land cover classes identified in Finsbury Park cross-referenced to observed biophysical structures and their further classification into urban SPUs (adapted from Andersson et al., 2015)

Table 3 Classification of potential ES provided by identified SPUs

Table 4. Environmental benefits experienced in the target area

Table 5. Environmental dis-benefits experienced in the target area

Table 1. Land cover classes identified in the target area (not including Finsbury Park) cross-referenced to observed biophysical structures and their further classification into urban SPUs bundles (adapted from Andersson et al., 2015)

Land cover approaches	Land cover descriptors under varying systems			
CORINE land cover class	Discontinuous urban fabric			
Open Streetmap land-cover class	Main roads	Residential	Commercial/retail	Lake and reservoir
Biophysical structures	Street trees; 'Pocket' green space	Enclosed gardens; Open gardens; Raised flower beds; Window boxes; Hanging baskets	Window boxes; Hanging baskets	Reservoir; Canal; Wetland
Biophysical structures cross-referenced to urban SPUs in relation to section level ES (under CICES)				
*Provisioning services		Trees, shrubs		
*Regulating services	Street trees; vegetated surfaces;	Trees, shrubs, vegetated surfaces;	Plants; soil bacteria; vegetated surfaces;	Water bodies; wetlands; plants; soil bacteria; vegetated surfaces;
*Cultural services	Street trees, flowering plants, birds, pocket greenspace	Trees, flowering plants, birds, green areas, gardens	Flowering plants	Waterways, nature reserve, trees, flowering plants, birds, green areas, landscape vistas

Key: SPUs = service providing units; pocket greenspace = urban open space at the very small scale, distributed throughout the urban fabric.

Table 2: Land cover classes identified in Finsbury Park cross-referenced to observed biophysical structures and their further classification into urban SPUs (adapted from Andersson et al., 2015)

Land cover approaches	Land cover descriptors under varying systems			
CORINE Land cover class	Sport and leisure facilities			
Open Streetmap land cover class	Sports pitches	Sports centre	Park	Commercial/retail
Biophysical structures	Open greenspace	Open greenspace	Trees; Shrubs; Formal gardens; Open greenspace; Canal; Pond c	Window boxes
Biophysical structures cross-referenced to urban SPUs in relation to section level ES (under CICES)				
*Provisioning			Trees, shrubs	
*Regulating	Vegetated surfaces; plants, soil bacteria		Trees, shrubs, vegetated surfaces; plants, soil bacteria, water bodies;	Plants; soil bacteria; vegetated surfaces;
*Cultural	Parks, green areas		Parks, trees, flowering plants, birds, green areas, gardens, pond, landscape vistas	Flowering plants

Table 3: Classification of potential ES provided by identified SPUs

Section	Provisioning		Regulation and maintenance			Cultural
Division	Nutrition		Mediation of wastes / toxics / other nuisances	Maintenance of physical, chemical, biological conditions	Mediation of waste, toxics and other nuisances	Physical and intellectual interactions with ecosystems
Group	Biomass	Nutrition	Mediation by ecosystems	Atmospheric composition and climate regulation	Mediation by biota	Intellectual and representative interactions
Class delivered by identified SPUs (with examples of class type given in brackets)						
Parks (including vegetated surfaces, plants and soil bacteria and landscape vistas SPUs)	Wild plants and their outputs (e.g. apples)		Storm protection (e.g. reduction in runoff volume); Filtration/accumulation by ecosystems (water quality enhancement); Mediation of noise (e.g. noise reduction)	Micro and local climate regulation (e.g. temperature regulation)	Sequestration and accumulation by micro-organisms and plants (C sequestration)	Aesthetics; Entertainment (e.g. recreation); Experiential use of plants, animals and landscapes (e.g. bird watching); Educational
'Pocket' green areas (includes vegetated surfaces, plants and soil bacteria SPUs)			Storm protection (e.g. reduction in runoff volume); Filtration/accumulation by ecosystems (water quality enhancement); Mediation of noise (e.g. noise reduction)	Micro and local climate regulation (e.g. temperature regulation)	Sequestration and accumulation by micro-organisms and plants (C sequestration)	
Trees, shrubs			Storm protection (e.g. reduction in runoff volume); Filtration/accumulation by ecosystems (air quality enhancement); Mediation of noise (e.g. noise reduction)	Micro and local climate regulation (e.g. temperature regulation)		Aesthetics; Experiential use of plants, animals and landscapes (e.g. bird watching)
Gardens (include vegetated surfaces, plants and soil bacteria SPUs)	Wild plants and their outputs (e.g. apples) Cultivated crops (e.g. herbs)		Storm protection (e.g. reduction in runoff volume); Filtration/accumulation by ecosystems (water quality enhancement); Mediation of noise (e.g. noise reduction)	Micro and local climate regulation (e.g. temperature regulation)		Aesthetics; Entertainment (e.g. recreation); Experiential use of plants, animals and landscapes (e.g. bird watching)
Water bodies (includes landscape vista)		Surface water for drinking (e.g. raw drinking)	Storage/accumulation by ecosystems (e.g. flood control); Storm protection (e.g. reduction in runoff volume); Filtration/accumulation by	Micro and local climate regulation (e.g. temperature regulation)		Aesthetics; Entertainment (e.g. recreation); Experiential use of plants, animals

		water)	ecosystems (e.g. water quality enhancement)			and landscapes (e.g. bird watching); Educational
Wetlands			Storage/accumulation by ecosystems (e.g. flood control); Storm protection (e.g. reduction in runoff volume); Filtration/accumulation by ecosystems (e.g. water quality enhancement)	Micro and local climate regulation (e.g. temperature regulation)		Aesthetics; Entertainment / symbolic (e.g. recreation, tranquillity); Experiential use of plants, animals and landscapes (e.g. bird watching); Educational
Flowering plants						Aesthetics

Table 4: Environmental benefits experienced in the target area

Scientifically identified SPU	Examples of direct ES from the interviews
Parks	<p>‘in the actual park itself, there is a basketball court. I have a lot of good memories from there.’</p> <p>‘You have Finsbury park just around the corner to jog in and to do some exercise.’</p> <p>‘a nice amount of greenspace the area has nice pathways which we’ve had little festivals on’ (Image 4)</p>
Pocket greenspaces	<p>‘nature is trying to squeeze into these spaces’</p>
Gardens	<p>‘I like to see the birds and the water. ... When I’m lying in bed in the morning in summer, it’s very nice, the birds singing very loudly. It’s beautiful.’ (Image 3)</p> <p>‘we come here to sit quietly, no traffic or anything’</p> <p>‘So it’s a nice place to meet and brings the community together.’ (Image 2)</p> <p>‘the greenery, open and no car fumes. ... I’m on the fifth floor and my balcony view overlooks all these. But we still come down here to get the real fresh air.’</p>
Water bodies	<p>‘I’ve done a few photography projects around this area and it’s quite a nice few things to take pictures of which I’d say is quite ironic.’</p> <p>‘you can walk there it’s accessible, it’s nice its clean its tidy, now it’s a nice view’ (Image 1)</p> <p>‘I think it’s more soothing, more calm’</p> <p>‘I cycle through it every day to get to work, it’s always clear and clean...’</p> <p>‘That’s, you could just walk through the water way and it’d take you into Hackney. And that [has] been there since the 18th century, the path has been there. ’</p> <p>‘I walk to work along it. I’m very lucky. I’m five minutes away.’(Image 1)</p> <p>‘you can sit on the bench and look out into horizon, and you have boats and everything. It’s the main catch.’</p> <p>‘The reservoir path which leads all the way to green lanes and the climbing tower, and you’ve got Finsbury park which is massive. So it works really well...’ (Image 1)</p>
Wetlands	<p>‘you have designated areas, for moor hens to nest or something like that’</p>

Table 5: Environmental dis-benefits experienced in the target area

Scientifically identified SPUs	Examples of direct EDS from the interviews
Pocket greenspace	‘... in these flats its very impersonal cos, you haven’t got balconies on the outside and you’re just going in.’
Gardens	<p>‘It’s a contrast between nice and new and we’ve got private and tenants sort of social housing. ... Bit of a divide I’d say.’</p> <p>‘[There was a little park behind] the row of shops where the building site now is, I used to hate that because it was just completely dirty horrible you didn’t know what was in them little sheds...’</p> <p>‘Some do get up to some bad activities around the estate and around Rowley Gardens, and, at times undertaking certain dealings.’ (picture 4)</p>
Water bodies	<p>‘Some people throwing rubbish, people do that with water, they just throw things.’</p> <p>‘The reservoir wasn’t a place to go it was stinky and it wasn’t well looked after or maintained at all it was mainly a place that you’d avoid.’</p>