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Title

Establishing a functional framework for monitoring protected landscapes; with a case study of English Areas of Outstanding Natural Beauty (AONB)

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Abstract

Protected landscape status is one of the highest designations afforded by the British legislature. To maintain consistent landscape quality, track environmental interventions, or measure the impacts of planned and unexpected events there is a need for co-ordinated national as well as local environmental monitoring. Conventionally indicators are used as monitoring proxies for tracking complex changes in landscape form and qualities, designation criteria, compliance against protective legislation, and the effectiveness of varying governance programmes. The regulatory agency of UK (English) environmental standards on behalf of the government, Natural England, monitors against a framework of indicators for the designation criteria of 'natural beauty' in 10 UK National Parks (NP) and 33 Areas of Outstanding Natural Beauty (AONB), and distributes data and analyses annually. This paper centres on an empirical case study that investigates environmental indicators used on-the-ground, as evidenced in AONB management plans. These bottom-up indicators are compared with top-down indicator frameworks from both Natural England's monitoring programme (FMEOPL), and the emerging indicators associated with the UK 25-Year Plan to Improve the Environment (25YEP). A methodology is developed to collate diverse indicators from these three policy and governance sources and to recommend a synthetic list of 158 indicators with future potential as candidates of a national framework for monitoring environmental change in the UK at landscape-scale. Given the trans-national action of environmental stressors, this work is also considered to represent internationally significant findings.

Keywords

25YEP

AONB

environmental designation

environmental indicators

environmental policy

monitoring framework
natural beauty
Natural England
protected landscapes

Abbreviations

25YEP – UK 25 Year Environment Plan
AONB – Area of Outstanding Natural Beauty
DEBIS – Department for Business Energy and Industrial Strategy
Defra – Department for Environment, Food & Rural Affairs
DFT - Department for Transport
EA – Environment Agency
(F)MEOPL – (Framework for) Monitoring Environmental Outcomes in Protected Landscapes
FC – Forestry Commission
Geo SSSI - Geological Sites of Special Scientific Interest
HAR – Heritage at Risk
HE – Historic England
HER - Historic Environment Records
IMD - Ministry of Housing, Communities, and Local Government
LPA – Local Planning Authority
MENE - Monitor of Engagement with the Natural Environment (annual survey)
MHCLG - Ministry of Housing, Communities and Local Government
NE – Natural England
NP – National Park
OFWAT - The Water Services Regulation Authority
ONS – Office for National Statistics
SSSI – Site of Special Scientific Interest
RESTATS – Renewable Energy Planning Database
RSPB – Royal Society for the Protection of Birds

1 Introduction

2 Environmental condition and sustainability issues are increasingly prominent in the
3 media and public sphere (Calderwood, 2018), and thus strongly influence the politics of
4 policy formulation (Campbell, 2008). Unfortunately, it is well documented that the
5 concrete outcomes from environmental interventions are mis-aligned with the pace of
6 political change and can often take years to manifest positive results (Koontz and
7 Biddle, 2014). Annually reported datasets are often used as short term, proxy
8 indicators of these longer-term objectives. (Bell and Morse, 2013). Such proxy
9 indicators offer opportunities to both track and report on changes in environmental
10 condition, quality or status in the short term whilst maintaining and working towards
11 more aspirational long-term goals. This technique is evident in the United Kingdom
12 (UK¹) government's 25 Year Environment Plan (25YEP) (HM Government, 2018a) and
13 in the adoption of the UK Climate Change Committee's third carbon budget (Committee
14 on Climate Change, 2019). Since 2013 the approach has been introduced to the UK
15 Protected Landscape management cycle with bespoke datasets being provided
16 annually by Natural England (NE) to both National Parks (NP) and Areas of
17 Outstanding Natural Beauty (AONB).

18 This paper aims to illustrate a relevant and representative framework of indicators for
19 monitoring environmental outcomes in English AONBs through an examination of the
20 ways in which the concepts that underpin the designation of UK protected landscapes
21 align with the theoretical contexts of existing indicators. The paper discusses a
22 methodology for describing indicators and concludes recommendations for future
23 research.

24 *1.1 Protected landscapes*

25 Both the Council of Europe and Natural England (NE) define a landscape as 'an area,
26 as perceived by people whose character is the result of action and interaction of natural
27 and/or human factors (Natural England, 2015; ELC, Landscape Institute, 2019). Whilst
28 the European Landscape Convention (ELC) asserts that 'all landscapes matter' the
29 term commonly invokes a notion of unspoiled or 'natural beauty' that is generally held
30 to imply a rural or wilderness areas distant from dense conurbations and characterised
31 by special features that are often unique to a given locale (Tudor, 2014).

32 Over the last 70 years there has been a gradual transition in the character of the British
33 countryside that reflects an integration of broader economic and cultural land uses with
34 the formerly dominant drivers of agricultural production (Cantore et al., 2011), not least
35 due to the legislative imperative to make the designated landscape more accessible to
36 the broader public (HM Government, 2000). Managers of protected landscapes have
37 sought to protect and enhance rural heritage and natural landscape character

¹ It is important to note that since devolution of the UK (1998-2011) environmental management has been delegated in varying degrees to the devolved authorities of Scotland, Wales, and Northern Ireland. Natural England is formally the regulator for England only.

38 encouraging its commodification; an approach that is intended to accomplish
39 conservation aims through linkage to local income generation (Shucksmith, 2012).
40 However, the number of permanent residents in or near protected landscapes has
41 increased (Natural England, 2013). It could be asserted that conservation priorities
42 have been eclipsed by the effects of socioeconomic development (Bell and Stockdale,
43 2015) and the demand for recreation access. These pressures and their
44 consequences have been acknowledged and addressed by the British Government in
45 three ways:

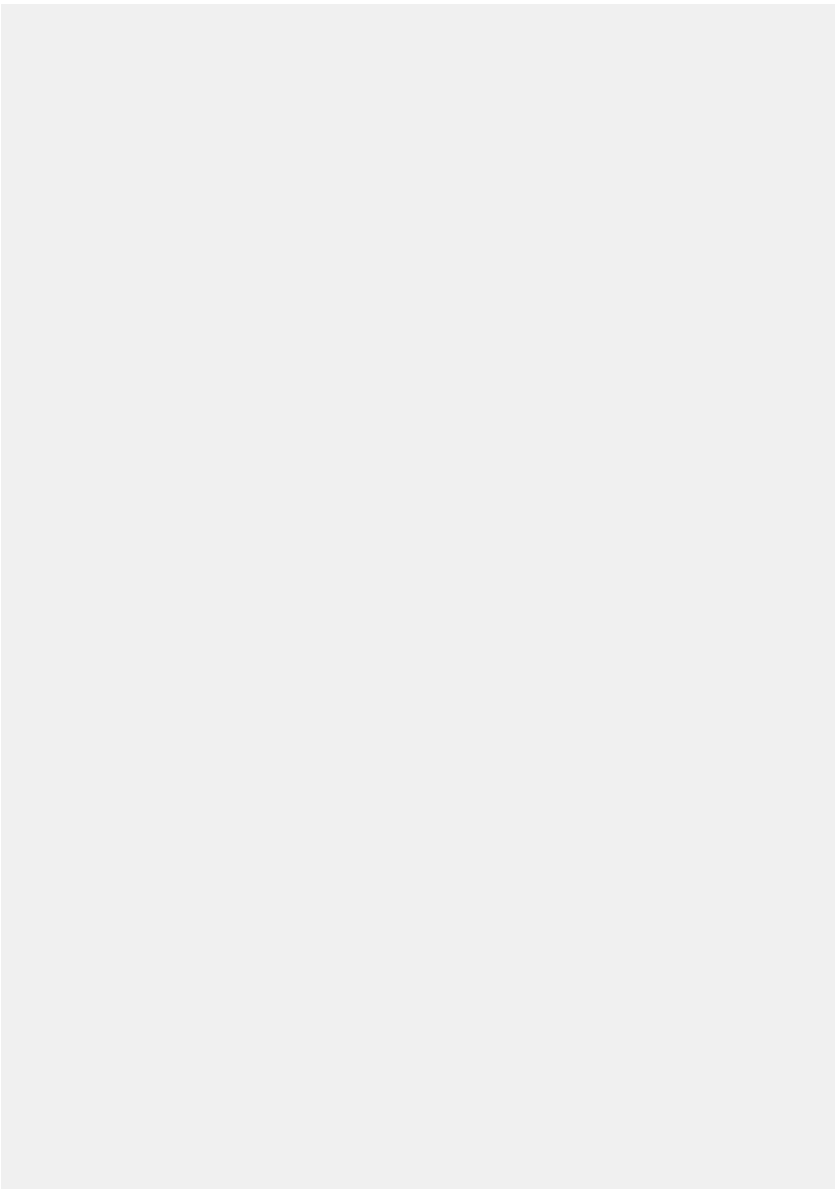
46 UK Protected Landscapes are designated with two main priorities: the conservation
47 and enhancement of 'natural beauty' (including wildlife and cultural heritage) and the
48 promotion of opportunities for the understanding and enjoyment of the special qualities
49 of National Parks by the public (HM Government, 1949, 1981, 1995, 2000). This
50 includes the introduction the Sandford principle (Countryside Agency, 2001) aimed to
51 manage conflict through prioritising conservation of the cultural and natural
52 environment over unconditional access for recreation and enjoyment.

53 There is increasing policy adoption of methodologies that aim to 'value nature' (UK
54 Research Councils, 2015) through explicit quantification of the environmental sources
55 of benefits, and the loss in derived well-being (for humans and non-humans) that would
56 result from undervaluing, or 'externalising' in the terms of environmental economics
57 (Spash and Aslaksen, 2015), these stocks (Natural Capital) and flows (ecosystem
58 services) of value. Such approaches increasingly recognise cultural or intangible
59 values (IPBES, 2019; Kenter, 2016; UNEP-WCMC, 2014) and that people must inhabit,
60 work in, or visit high-value landscape to ensure the continuity of the more biotic
61 ecosystem (supporting, provisioning, and regulating) services.

62 Among the recommendations of the 25YEP was an independent review of Protected
63 Landscapes within England. This was known as the Glover Review (Defra, 2019b).

64 A balance must then be reached in protecting landscapes whilst simultaneously
65 encouraging visitors and meeting the infrastructural needs of increasing populations
66 (Natural England, 2013) of rural and peri-urban residents. Protected landscapes sit at
67 the forefront of this balancing act and management trade-offs are inevitable. For
68 example promotion of tourism supports rural livelihoods and meets the designation
69 purpose of providing more access to non-residents but can lead to further
70 environmental degradation, especially through increasing traffic. Housing development
71 can enhance local services and stimulate local businesses yet without careful and well-
72 resourced planning control often risks disrupting the perceived character of the
73 landscape. Multiple stakeholders, each with distinct priorities leads to multiple or
74 fragmented notions of 'the environment' dependent on occasionally contradictory
75 claims to authority, expertise, or civil rights (Laurell et al., 2018).

76 Protected landscapes comprise 28% of the United Kingdom (UK) land area and often
77 operate across multiple local planning authority boundaries (Ordnance Survey, 2019;
78 NAAONB, 2020). As a condition of designation managers of these landscapes are
79 required to monitor and report on various natural beauty criteria, including indicators of
80 environmental and cultural quality. Figure 1 demonstrates that since protected
81 landscapes exist throughout the length and breadth of the UK, and if the required
82 monitoring is conducted regularly and effectively, they offer a unique opportunity to
83 provide representative metrics of nationwide landscape change and public engagement
84 with the natural environment.



85 Figure 1: The 33 AONBs and 10 National Parks (Arc GIS Community Database, 2020).
86

87 1.2 Designation and differences

88 Currently there are 15 National Parks and 46 AONBs in the UK. Most were designated
89 between 1949 and 1995 (HM Government, 1941), but there have been rare additions
90 as recently as 2010, and the independent 2019 Glover Review of Protected
91 Landscapes has recommended a policy of renewed designation (Defra, 2019b).
92 Designation and compliance are overseen by Natural England, the watchdog body of
93 Defra², the Department for Environment, Food & Rural Affairs.

94 The process for designation and subsequent monitoring in the UK differs from many
95 international models in that the main protected landscapes are mostly working
96 countryside, with multiple landowners and with uncontrolled access points rather than
97 enclosed nature reserves (Natural England, 2017).

98 NPs and AONBs make up the key UK landscapes that are protected in law. There are
99 other UK landscape-level designations, including Marine Conservation Zones, National
100 Nature Reserves, and Heritage Coastlines (Natural England, 2018) although these do
101 not follow the same government mandated designation process, or invoke the same
102 degree of legal protection as do NPs and AONBs.

103 There are two main criteria to be considered before legally designating a protected
104 landscape (Natural England, 2017):

- 105 1. Natural Beauty criterion,
- 106 2. Opportunities for enjoyment of recreation criterion.

107 AONBs and NPs are both required to meet the criteria for Natural Beauty, but NPs
108 additionally have to fulfil the recreation criterion (Countryside Agency, 2001). The two
109 designation criteria were most recently clarified through the 2000 Countryside Right of
110 Way Act (CRoW) (HM Government, 2000) which not only strengthened but further
111 refined their role and purpose within the legislative context (Countryside Agency,
112 2001).

113 For AONBs the process of designation is initiated when Natural England receives a
114 proposal from an alliance of relevant stakeholders. The agency then decide whether
115 the proposal adequately defines a border that delineates enough features that meet the
116 natural beauty criterion, and whether it is desirable to grant the landscape the
117 protection that designation would afford. Natural England must also consult with the
118 local planning authorities and make the proposal accessible through local and
119 community publications and newspapers. Only after this process has been
120 scrupulously followed, and any objections dealt with, can the order of designation be
121 made (Natural England, 2017). The process has been criticised in the recent review of
122 National Landscapes (Defra, 2019b) as overly lengthy and challenging to aspiring
123 AONB groups, and the last AONB designation (Tamar Valley) was in 1995.

² 'Natural England's role is to help protect England's nature and landscapes, for their intrinsic value to the nation; for people to enjoy, and for the services they provide, both now and in the future. We have specific responsibilities for a range of landscape and biodiversity designations on land, coast and at sea' (Natural England, 2012).

124 The CRoW act also granted AONBs permission to form overseeing management
125 bodies and obliged them to provide five-year management plans detailing how they
126 would fulfil their primary purpose:

- 127 • To conserve and enhance the natural beauty of the landscape.

128 National parks have the additional purposes:

- 129 • To conserve and enhance the natural beauty of the landscape **wildlife and cultural**
130 **heritage,**
- 131 • To promote understanding and enjoyment of a landscape's special qualities by the
132 public (Natural England, 2011, p17).

133 Due to the differences in designation the practical management of conservation in
134 AONB and National Park landscapes can also differ (Defra, 2018). While National
135 Parks are supported by central government budgets AONBs have a funding regime
136 that is supported by both Defra (The Department for Food and Rural Affairs, of which
137 Natural England is one of several subsidiary agencies) and by those local authorities
138 whose boundaries transect the designated AONB area. In practice this means that
139 AONBs much smaller budgets than National Parks (Land Use Consultants, 2013).
140 Additionally, AONB funding has been markedly affected by the UK austerity funding
141 regime since 2008 since budget cuts have disproportionately been borne by local
142 authorities (Mendip Hills AONB, 2014).

143 For historical reasons National Parks are often made up of large open land areas or
144 commons, and free access for the public to these helps them fulfil the open-air
145 recreation criterion. In contrast AONBs often consist of mosaics of privately owned
146 land, working landscapes and residential properties. Consequently access is harder to
147 assure or maintain under such land-use conditions.

148 Finally, National Park authorities are statutory consultees with the authority to grant or
149 deny planning permission and are hence empowered to strictly enforce their
150 conservation remit through management of planning applications, or even by forming
151 their own planning strategies (National Parks England, 2020). AONB management
152 teams are only required to be 'considered' in planning applications (Countryside
153 Agency, 2001), a difference that may in practice lead to greater levels of landscape
154 change that is potentially detrimental to this conservation imperative, than in National
155 Parks.

156 *1.3 Need for monitoring*

157 The 2000 CRoW act stipulation for written protected landscape management plans was
158 followed by the publication of guidance on how to write these documents (Countryside
159 Agency, 2001). Explicit in this guidance was the encouragement of AONBs to actively
160 monitor their landscapes and the documentation provided initial suggestions for
161 monitoring indicators. This non-prescriptive approach was intended to allow each
162 landscape management body to pursue the individual monitoring strategies that were
163 most appropriate for their own landscape and resource capabilities.

164 By 2010 however, the necessity to assemble a comprehensive set of monitoring
165 indicators was raised when several studies established that insufficient monitoring was
166 being undertaken, especially given that both National Parks and AONBs received
167 government funding (Carter *et al.*, 2003; Natural England, 2014). Although these
168 publications cited a list of potential universal indicators it was noted that many of the
169 datasets had probably changed since 2001 (Bell and Morse, 2013). Indicators are only

170 as good as the data that underpins them; therefore it is imperative that robust and up to
171 date data sets are generated, maintained, and used (Dahl, 2012).

172 To address the perceived lack of a reliable and widely-applicable indicator set, from
173 2010 to 2013 Natural England worked with the National Parks, AONBs and other
174 partners to formulate and introduce a set of nationally agreed indicators that would
175 largely draw on existing and ongoing monitoring programmes. These indicators could
176 act as proxies for tracking landscapes change against the protection and enhancement
177 designation obligations of National Parks and AONBs. An additional requirement was
178 that the georeferenced data could be 'cut' by boundary to represent the spatial extents
179 of the various protected landscapes.

180 The resultant Framework for Monitoring Environmental Outcomes for Protected
181 Landscapes (FMEOPL) was intended to enable an annual snapshot of the state of the
182 environment in each protected landscape to aid managers in identifying long-term
183 trends and to inform strategic planning (Natural England, 2014). There was no desire to
184 rank individual landscapes or their management teams on their environmental
185 protection, or enhancement performance. There was however the ambition that the
186 framework would provide guidance for management plans, and 100% of National Park
187 and AONB respondents to a 2012 survey (Natural England, 2014) stated that they 'we
188 currently using, or plan to use' the MEOPL data going forward. There is no guarantee
189 that an indicator will be adopted or used, irrespective of the degree of their
190 development (Bell and Morse, 2011). Therefore the FMEOPL indicator set might be
191 considered by some intended users to be of limited local relevance in using data
192 collated only at a national scale, without adequate fine-grained local resolution.
193 Additionally these national metrics might not incorporate many of the indicators that are
194 informed by data available to AONBs at a local level, but which are not systematically
195 collated nationally. There are also questions around the actual completeness (in time
196 and space) of the datasets upon which the FMEOPL indicator set relies and whether
197 the annually published figures are always used when compiling AONB management
198 plans (University of Plymouth (Natural England), 2020).

199 *1.4 Why indicators?*

200 Indicators can simplify scientific metrics by providing a less-complex message for non-
201 expert data users with twofold benefits (Bell and Morse, 2011; Dahl, 2012; Vedung,
202 2010). Firstly, by informing a more rational, evidence-based approach by policy makers
203 without familiarity with all aspects of relevant and detailed scientific literature (McCool
204 and Stankey, 2004). Secondly, in allowing for messages to be more easily illustrated
205 and communicated to the public (Lyytimäki and Rosenström, 2008). Both asserted
206 benefits are however disputed. Several studies have demonstrated that policy makers
207 are influenced by more than the evidence and its indicators (Rinne *et al.*, 2013;
208 Sebastien and Bauler, 2013; Bauler, 2012; Holden, 2009). Dahl asserts that indicators
209 are more effective if they represent or are aligned with the values of their target
210 audiences (Dahl, 2012). Given that indicators simplify complex and dynamic data it is
211 also suggested that inconsiderate use might contribute to a disconnection between
212 policy makers and those who generate the data (Bell and Morse, 2011). This implies
213 that despite their best efforts policy makers continue to make decisions with incomplete
214 data and analyses. Yet, indicators are still believed to provide convincing direction in
215 policy formation and are useful tools in ensuring that achievable milestones are set, not
216 only to track the progress of policy enactment, but also to ensure accountability.

217 Rinne summarises three ways indicators are used; instrumentally, conceptually, and
218 politically (Rinne *et al.*, 2013):

- 219 a) Instrumental use – where a direct link between indicator and decision outcome
220 is assumed operationally,
- 221 b) Conceptual use – where indicators are used to communicate more complex
222 messages and subtly influence decision outcomes,
- 223 c) Political use - varies contextually, to sometimes of delay an intervention, to
224 legitimise a naturalised position, or to combatively to discredit an emerging
225 challenge to the *status quo*.

226 The possibility of clear instrumentality is disputed, and it is suggested that all usage is
227 in reality conceptual or political (Bell and Morse, 2013). Some instances of practical
228 indicator deployment have been critiqued as politically tactical in conferring differential
229 benefits to those in authority with respect to their stakeholders and hence questionable
230 in terms of equitable legitimacy (Gudmundsson *et al.*, 2009).

231 Rimppi describes indicators as either normative (informing action) or descriptive
232 (informing about states or changes); categories derived from considering the varying
233 practical objectives that form the criteria for indicator definition, and data monitoring
234 (Rimppi *et al.*, 2016). Thus indicators can be used to provide context and information or
235 to perform an evaluative function. This evaluative function is often prized when
236 designing indicator frameworks that are acting as a proxy for overarching aspirational
237 goals and objectives. Evaluative, or performance indicators are primarily used to
238 measure the deviation of any given state from a set of reference situations. They are
239 also effective in informing the degree of intervention required to move from an initial to
240 a desired state (Moldan *et al.*, 2012). Performance indicators can be single issue
241 indicators, such as volunteer hours, or composite indicators, which aggregate and take
242 account of several factors such as the water quality. Composite indicators
243 communicate a greater wealth of information; however they can be more difficult to
244 understand and analyse (Sebastien and Bauler, 2013). They can also lead to
245 communication difficulties since they may not resonate with the public as clearly as
246 single-issue indicators.

247 Natural beauty is a complex and subjective concept (Selman and Swanwick, 2010), yet
248 it forms the basis of the legal underpinnings of worldwide protected landscape
249 designation (Richardson *et al.*, 2018). Despite this remarked upon but often
250 unacknowledged ambiguity, the concept informs the core aims of UK AONBs and
251 National Parks; to protect and enhance natural beauty. AONBs are large, mosaic
252 landscapes that are challenging to manage, especially given that AONB managers act
253 as mediators between many stakeholder interests. The consequences of such holistic
254 environmental management that can overwhelm and overcomplicate management
255 plans (Frank *et al.*, 2012).

256 An emerging paradigm for characterising some of the diversity of landscape benefits
257 and beneficiaries is through using the toolsets of Ecosystem Services, or Natural
258 Capital (Defra, 2020). Although it has been argued that the ecosystem service concept
259 might best be considered as a heuristic or conceptual rather than descriptive indicator
260 set (Kirchhoff, 2019) the categorisation of and breaking down of landscapes into their
261 primary and secondary ecosystem services has for some commentators proven
262 beneficial for analysis and subsequent management decisions (Pülzl *et al.*, 2012).
263 These and similar approaches aim to disassemble complexity into more manageable
264 components and goals and allow indicators to be developed and assigned (Frank *et al.*,
265 2012). It is important to stress that through such deconstructive approaches the overall
266 context should not be lost, and that all goals and indicators should align. Furthermore,
267 an indicator is only as good as the data that sits behind it; therefore it is crucial to

268 choose indicators that are policy relevant, mapped to a clear strategy and adaptable to
269 changes over time (Dahl, 2012). Finally, a certain amount of natural selection of the
270 indicators should be anticipated for and expected to take place (Bell and Morse, 2013).
271 Thus, having a wide initial selection of representative indicators that can be used for
272 different goals would be both prudent and practical.

273 Large organisations can often employ multiple members of staff to carry out monitoring
274 and quality assurance as a matter of course. Such resource availability allows for more
275 complete and up to date datasets upon which to base decisions (Bell and Morse,
276 2011). Smaller organisations with less resources rarely have the expertise, time, or
277 financial backing to engage in sophisticated or longer-term monitoring strategies.
278 Inevitably the result is incomplete datasets, further compounded by the following issues
279 (Koontz and Biddle, 2014; Defra, 2018):

- 280 a) Management bodies are influenced by more than just 'scientific' evidence,
- 281 b) Licensing issues or costs may cause difficulties in accessing some data sets,
- 282 c) Difficulties in adequately 'cutting' data to protected landscape boundaries.

283 Hence protected landscapes management bodies are often unable to control and
284 subsequently disentangle the various compounding influences on landscape quality or
285 condition.

286 1.5 Change on the horizon

287 Since the 2013 introduction of the MEOPPL framework a great deal of change has
288 occurred, thus a review of the FMEOPPL indicators is both timely and necessary. 2016
289 saw the British population vote to leave the European Union (Brexit) which has
290 profound implications for the future of the UK agricultural sector. Principally through the
291 abolition of the agricultural subsidies assured through adherence to the Common
292 Agricultural Policy (CAP) (European Commission, 2019). The majority of AONB land is
293 farmland, but this is only one aspect of emerging landscape challenges. Public
294 awareness surrounding environmental sustainability has increased scrutiny of
295 protected landscapes and their management (Carrington, 2019; Dickman and
296 Mortimore, 2018). Finally, the 2018 publication of a governmental 25-year
297 environmental management plan (25YEP) with marked emphasis on the enhancement
298 (or restoration) of lost or degrading natural beauty (HM Government, 2018a) also
299 initiated an independent national review of the protected landscapes; The Glover
300 Report (Defra, 2019b). Among the detailed recommendations of the Glover report was
301 a detailed review of existing AONB management plans and the indicators that inform or
302 support environmental management judgements and decisions.

303 Despite the designation of AONBs being as early as 1956 (Quantock Hills AONB,
304 2019) there is a limited number of recent peer-reviewed literature³ describing
305 monitoring frameworks. This may in part be due to recognition of AONBs as of 'de facto
306 lower status' than National Parks (Burden *et al.*, 2002). There might be disconnect

³ Using a key word search of 'area of outstanding natural beauty' in Elsevier Scopus database only 5 of the first 40 'most relevant' files were dated later than 2000. (www.scopus.com)

307 between those indicators suggested by Natural England, and those that AONBs
 308 actually monitor actively. Therefore, an up to date analysis of the indicators used by the
 309 management bodies charged with looking after designated landscapes is both timely
 310 and of importance (University of Plymouth (Natural England), 2020).

311 **2 Methods**

312 This paper suggests a methodology for indicators describing separately developed
 313 data monitoring programmes to be brought together to inform action towards specific
 314 overarching targets. The paper considers three sources of published indicator lists:

- 315 a) 25YEP indicators – ‘top-down’ indicators from the UK 25 Year Environment
 316 Plan,
- 317 b) FMEOPL indicators – ‘pragmatic’ indicators specified in the Natural England
 318 Framework for Monitoring Environmental Outcomes in Protected Landscapes,
 319 AONB indicators – ‘bottom-up’ indicators from AONB management plans. Deriving
 320 these forms the main empirical research of this report.

321 The following text will refer to the three indicator sets as simply 25YEP indicators,
 322 FMEOPL indicators, and AONB indicators.

323 Once a full set of candidate indicators had been collated from each of the three
 324 sources above, they were coded, by assigning them to one of five indicator themes
 325 adapted from the FMEOPL as shown in table 1. Coding involved assigning each
 326 candidate indicator to the most appropriate theme. In order to generate a proposal for
 327 an indicator framework a subsequent coarse screening process was undertaken,
 328 followed by a final fine screening stage (see detailed screening criteria below) which
 329 resulted in a final indicator list containing a reduced, but harmonised indicator set (See
 330 supporting materials: [10.5281/zenodo.3843630](https://doi.org/10.5281/zenodo.3843630)). It is anticipated that such
 331 methodology and analysis will be both timely and valuable with applicability to
 332 international protected landscapes, as well as those of the UK (England).

333 Table 1. The 5 indicator themes identified in the FMEOPL (Natural England, 2014) with
 334 definitions, examples and supporting literature (developed in this research).

Indicator theme	Definition	Example Indicator
Natural Beauty	This is found in landscape quality, scenic quality, relative wildness, relative tranquillity, natural heritage features, and cultural heritage (Natural England, 2011, p.26)	Contributing to tranquillity - abundance of indicator birds or levels of traffic at certain points
Recreation	Access to high quality landscapes, natural or cultural heritage features or cultural associations, good recreation provision, accessibility, and potential for enhancement (Natural England, 2011)	Opportunities to enjoy the landscape and potential to enhance enjoyment – number of AONB specific interpretation boards
Ecosystem services	Final ecosystem services are components of nature, directly enjoyed,	Features that enhance the human experience and potential health benefits above that of

	consumed, or used to yield human well-being (Boyd and Banzhaf, 2007, p.6191) ⁴	just enhancing the beauty – water quality 335 336
Engagement	The process of working collaboratively with and through groups of people affiliated by geographic proximity; often involving partnerships and coalitions that help mobilize resources (Eder et al., 2018, p.149)	Evidence of interested persons being able to have a reciprocal relationship with the conservation board and AONB – participation in visitor surveys
Sustainable communities	Suitable and adequate services, population, and access to safe housing to allow a community to continue to thrive without overt external interference (United Nations, 2019; specifically UNSDG ⁵ 11 Sustainable cities and communities) .	Factors that enhance and allow a community to flourish within the AONB – local employment rates

337 **2.1 Case study selection**

338 This study adopted the case-study approach (Yin, 2014) in order to allow research
339 focus and insights of greater quality rather than attempting to describe the whole field
340 of potential environmental indicators. The 2000 CRoW Act required AONBs to publish
341 management plans every five years. Since 2018 the majority of AONB management
342 teams have published new plans, these protected landscapes constitute a
343 representative case study of current actions to monitor landscapes. The assumption
344 was that management plans would demonstrate 'bottom-up' practical monitoring
345 activity and active use of indicators and associated datasets. This empirical research
346 was undertaken in the context of more generic national indicator sub-sets.

347 **2.1 25YEP indicators**

348 The UK 25 Year Environment Plan (25YEP) was introduced in 2018 as an ambitious,
349 strategic policy document that would drive upcoming environmental legislation (HM
350 Government, 2018a). A 25YEP monitoring framework is under active development in
351 order to facilitate the movement of policies into 'on-the-ground' environmental
352 protection and enhancement actions. This emerging documentation was chosen as a
353 key source for candidate directive, or 'top-down' indicator recommendations.

4 This anthropocentric definition, although not representative of the entire literature, was taken to be the most appropriate for AONB management plans given that 80% of the plans analysed referred to the concepts of natural capital and ecosystem services.

⁵ Sustainable Development Goals (United Nations, 2015)

354 2.2 FMEOPL indicators

355 The FMEOPL indicator set was developed by Natural England as a pragmatic
356 compromise between the aspirations of policy, and the realities of monitoring activity
357 based on current funding and governance of the UK protected landscapes. These
358 datasets reflect the monitoring that already occurs in relation to management against
359 the two main statutory purposes of protected landscapes. It was envisaged that these
360 datasets would inform management plans developed by the English AONB
361 management teams (Natural England, 2014).

362 Natural England has been responsible for the annual distribution of the 22 datasets that
363 inform the MEOPPL indicators since 2013. FMEOPL indicators rely on data that are
364 already being collected at a national level and circulated to the management teams of
365 the protected landscapes. For the full dataset/indicator list see Figure 2 in the Results
366 section; or FMEOPL Report (Natural England, 2014).

367 Prior to the collection of any AONB indicators from management plans an audit of the
368 circulated MEOPPL datasets was completed in order to ground-truth the utility of these
369 resources to AONBs, or to other bodies wishing to perform or introduce landscape-
370 scale environmental monitoring programmes. This was accomplished by noting:

- 371 a) Which datasets actually had more than five years of data,
372 b) The incidence of each FMEOPL indicator, in each candidate AONB management
373 plan.

374 2.3 AONB indicators

375 AONB plans are developed by AONB management teams in consultation with local
376 conservation organisations, and stakeholders and community groups (Countryside
377 Agency, 2001). This collective process, in striving for full stakeholder representation,
378 results in a plurality of policy aims (East Devon AONB, 2019). It is important to
379 acknowledge that individual motives, understandings, and locally contextual issues will
380 necessarily shape the content of management plans leading to variation between the
381 different AONBs. Recognition of the inevitability of such idiosyncrasies has indirectly
382 influenced indicator usage across the AONB family (NAAONB, 2020), and the
383 consequent indicator selection, analysis, and results and recommendations of this
384 research paper.

385 Natural England is the regulator for English AONBs but not those of the devolved
386 authorities. Therefore of the total 46 UK AONBs, only the management plans of the 33⁶

387 English AONBs were considered as candidates for indicator collection. Only AONB
388 management plans from 2018 onward were considered for analysis since these plans
389 refer to the minimum acceptable span of five years of MEOPPL data.

390 Management plans and their supporting documents, such as State of the Park reports
391 (e.g. Arnside and Silverdale, 2019), were obtained by searching each of the AONB

⁶ A 34th AONB, Wye Valley spans the border between England and Wales.

392 websites. Where a management plan was in draft, or due for renewal in 2019 the final
393 or draft 2019 reports were requested by email. Documents representing 21 out of 33
394 English AONB's were obtained and analysed; 39 separate documents in total (See
395 Supporting Material).

396 The indicators for subsequent screening (coarse and then fine) were collated (in an MS
397 Excel data file) after reading each AONB document through and using key word
398 searches. It was anticipated that there would be duplicate indicators across the 21
399 AONBs. These were removed during the coarse screening. Candidate indicators in the
400 AONB management plans were not always directly presented as environmental
401 indicators, but occasionally as key performance indicators (KPI), success measures, or
402 as figures quoted as headlines which were interpreted as having resulted from indicator
403 usage (even if the indicators from which these figures were derived were not explicitly
404 listed).

405 To enrich the data collection process, two further themes were investigated.

406 Firstly, did the management plan discuss, or refer to four current topics:

407 a) **Clim**ate change adaptation and mitigation strategies - as an indication that the
408 management plan incorporated current scientific thinking (IPCC, 2018)

409 The UK 25 Year Environment Plan - demonstrating that the management team sought
410 guidance from recent government policy in writing their plan?

411 Natural capital and ecosystem services - which underlie the core methodologies of the
412 government's emerging environmental strategy (HM Government, 2018b)

413 Sustainable development - or the Sandford Principle for managing conflicts between
414 designation criteria (Defra, 2019b).

415 Secondly, which of the 22 FMEOPL indicators were referred to in each AONB
416 management plan, either directly as actual indicators, or obliquely as supporting
417 contextual data? This process also ensured that any FMEOPL indicators were not
418 accidentally double-counted as AONB sourced indicators.

419 Once this process was completed for every document the indicators were transferred
420 from their AONB specific data files to an Excel meta-list and their source (AONB
421 management plan) was anonymised. Cumulatively 600 AONB indicators were
422 identified.

423 *2.4 Coarse screen*

424 The coarse screen framework built on the methods used in the original 2013 FMEOPL
425 project. During the consultation period for this project a statistical audit was conducted
426 of multiple potential datasets. Only 22 datasets met the following criteria (Natural
427 England, 2014, p.29):

- 428 • Robust (i.e. we trust the results)
- 429 • Measure outcomes (not activity)
- 430 • Relevant to statutory purposes (designation)
- 431 • Useful (to protected landscape managers, Defra, Natural England, and others)
- 432 • Available (for all protected landscapes)
- 433 • Updatable (every 5 years or less)
- 434 • Affordable

- 435 • 'Cuttable' (to protected landscape boundaries)
 - 436 • Global
- 437 Implicit in these criteria is that the data collected should pertain to, or act as a proxy for
 438 the natural beauty or recreation designation purposes of protected landscapes. This is
 439 understandable given that these are the primary legal requirements for managing these
 440 landscapes.

441 This research adapted the criteria to form a 'broader' or coarser screen (See Table 2
 442 with reasoning given for selection of each criterion that 'final' indicators had to meet).
 443 Unlike the FMEOPL and 25YEP frameworks this coarse screen does not exclude data
 444 generated by AONB monitoring programmes that are additional to the nationally
 445 prescribed indicators, thus allowing for a bottom-up approach in augmenting 'top-down'
 446 policy goals.

447 Table 2. The framework used for coarse screening to ensure that only usable, high quality
 448 indicators were collated for the final selection(developed in this research).

Criteria	Reasoning	449
Relevant	To policies within the management plan and legislative remit	450
Robust	To ensure data is gathered with a reliable methodology or from a reliable source	451
Regular	Updates must be planned and not 'ad hoc' or contingent on a single research project. Updates made at least every management plan cycle (5 years)	The
Cuttable	Possible to limit data to the geographic area of any protected landscape (sometimes incorporating data from several administrative authorities)	
Internationally transferable	Indicators should not be so locally contextual that there is no international relevance	
Clear	The indicator should have a traceable foundation in an appropriate policy	
Evaluative	The indicator must be suitable for comparison between current conditions and preferred conditions, or to track changes in landscape condition	

452 screening process took each of the candidate indicators and compared them against
 453 the derived coarse-screening framework presented in Table 2. If an indicator met all
 454 the coarse screening criteria, it was transferred to a new Excel data file. This process
 455 was then repeated with the 25YEP and AONB indicators.

456 Since duplication of indicators was expected across the 21 AONB management plans
 457 the only unique step for AONB indicators was the removal of these duplicates (i.e. If an
 458 indicator appeared in an AONB management plan it was not double-counted when it
 459 occurred in a subsequent plan).

460 Candidate indicators at the end of this stage were therefore still held in 3 different MS
 461 Excel files, with some remaining duplicates expected across these separate files.

462 2.5 Fine screen and final indicator list

463 The main aim of the fine screen was to produce a single set of indicators held in a final
464 (Excel) indicator list. This was achieved in three stages:

465 **The** final indicator list was structured using each of the 16 25YEP headline indicators
466 (See Table 3). The FMEOPL and AONB indicators were added to their most closely
467 aligned headline. Judgement was made questions outlines in Section B of the 25YEP
468 framework indicator set questions (Defra, 2019a)

469 a) All of the 66 25YEP sub-indicators were added, but since many are still under
470 development, and had not meet all criteria of the coarse screen, they were
471 hidden from view in the final Excel spreadsheet.

472 Any further duplicates were removed. The only remaining duplicates at this stage were
473 between the 25YEP indicators and either the FMEOPL or AONB indicators. Because
474 the 25YEP was the most senior policy document, where there were any duplicates the
475 25YEP indicator was retained in the final results.

476 It was anticipated that this final indicator list would yield benefits in two main ways.
477 Firstly, from the 'bottom-up', by providing protected landscape bodies a better range of
478 grouped indicators that are relevant to current legislation. Secondly, from the 'top-
479 down', by bringing together a wide-ranging list of indicators that are currently being
480 used in at least one protected landscape across England and could contribute towards
481 the national picture.

482 3 Results

483 3.1 25YEP indicators

484 The 25YEP sets 10 high level 25-year goals with progress to be tracked through 15
485 headline indicators (See Table 3). The headline indicators are informed by 66 system
486 indicators, some of which are still under development (Defra, 2019a). These 66 system
487 indicators were the initial candidate indicators for the subsequent coarse screening.

488 Table 3. The 25YEP headline indicators (bold from original document) matched to the 25-year goals (Defra, 2019a).
489

	Headline indicator descriptions (1-16)	Relevant 25-year goals (10: A-J)
1	Changes in air quality that affect our health and ecosystems	A. Clean air
2	Changes in greenhouse gas emissions from natural resources	G. Mitigating and adapting to climate change
3	Changes in quality and quantity of water and the water environment that affect our lives and livelihoods	B. Clean and plentiful water
4	Changes in the diversity of our seas that affect our lives and livelihoods	C. Thriving plants and wildlife
5	Changes in the health of our seas that affect our lives and livelihoods	C. Thriving plants and wildlife E. Using resources from nature more sustainably and efficiently
6	Changes in wildlife and wild places that we cherish	C. Thriving plants and wildlife

7	Changes in nature on land and water that support our lives and livelihoods	C. Thriving plants and wildlife
8	Changes in production and harvesting of natural resources	E. Using resources from nature more sustainably and efficiently
9	Changes in resilience to natural hazards	D. Reducing risk of harm from natural hazards
10	Quality of our landscapes and waterscapes	F. Enhanced beauty, heritage, and engagement with the natural environment
11	People enjoying and caring about the natural environment	F. Enhanced beauty, heritage, and engagement with the natural environment
12	Changes in the impact of exotic diseases and invasive non-native species	J. Enhancing biosecurity
13	Changes in the exposure of people and wildlife to harmful chemicals	I. Managing exposure to chemicals
14	Resource efficiency and waste	H. Minimising waste
15	Changes in domestic consumption that have impacts on the natural environment overseas	There are no specific goals in the 25 Year Environment Plan for this headline indicator
16	Changes in our contribution towards improving the environment overseas	There are no specific goals in the 25 Year Environment Plan for this headline indicator

490

491 **3.2 FMEOPL indicators**

492 Of the 22 FMEOPL indicator datasets only 6 were found to have 5 years of continuous data points (see Figure 2),
493 however for the coarse screening all 22 of the indicators were considered as candidate indicators. Figure 2 indicates

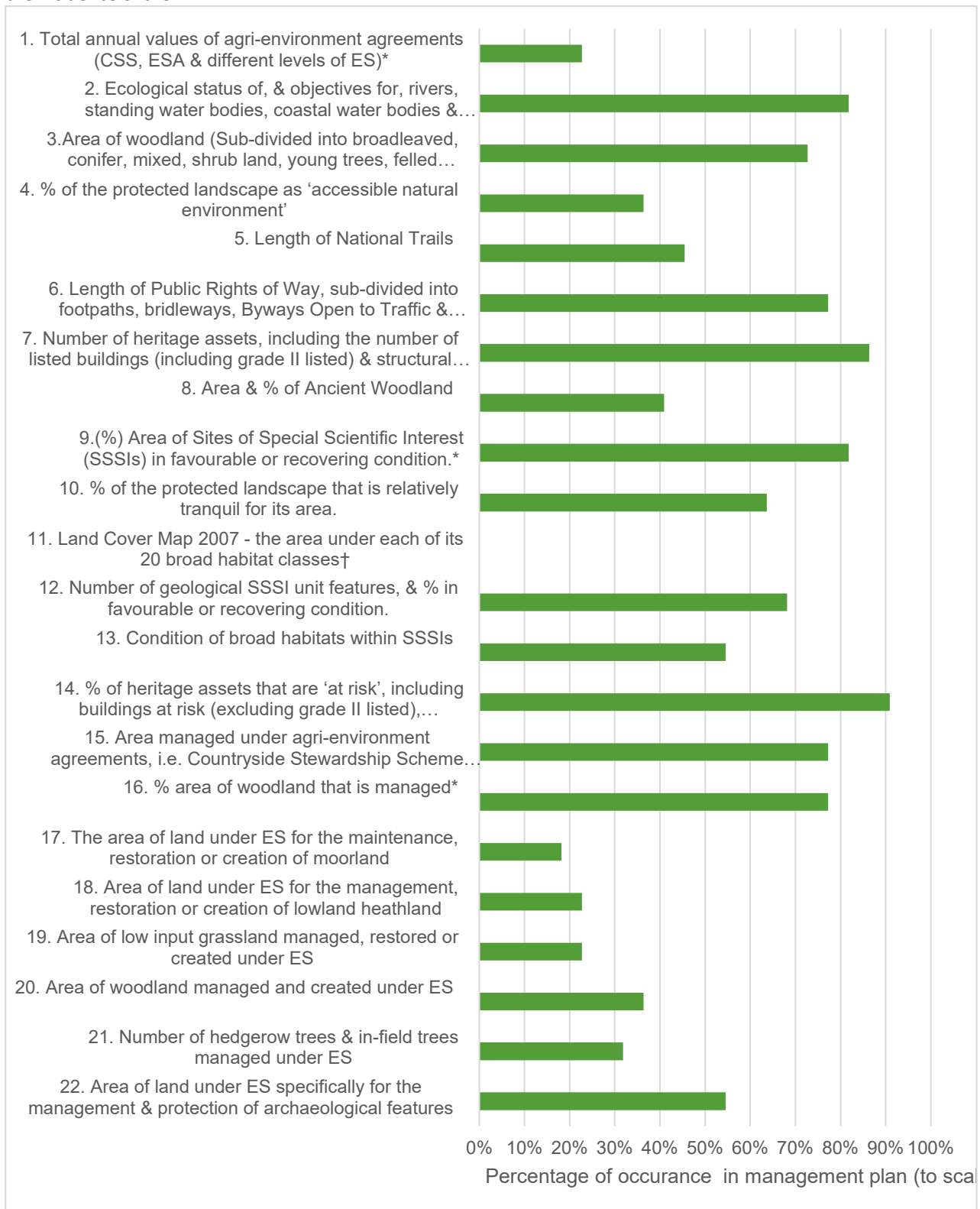


Figure 2. The 22 FMEOPL indicators and incidence in AONB management plans examined (where 0% = appeared in none, and 100% = appeared in all). *6 FMEOPL indicators with 5 contiguous years of data. †Indicator superseded by 2015 Land Cover Map. Incidence in management plans was negligible.

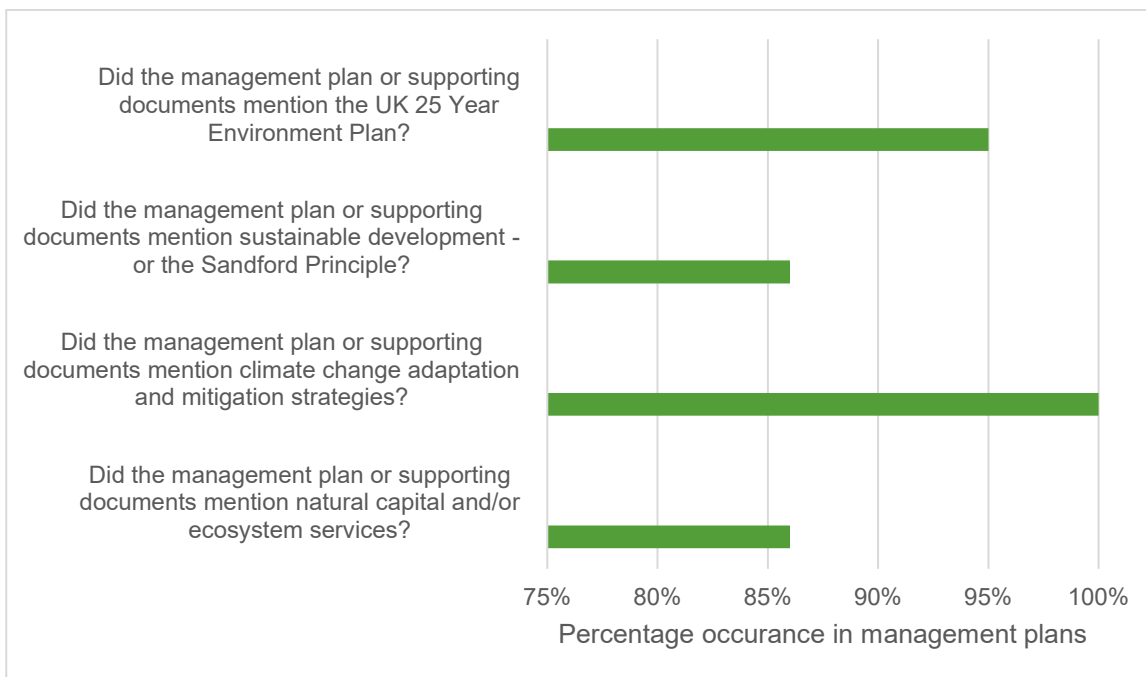
501 **3.3 AONB indicator collection**

502 33 English AONB management teams receive the FMEOPL data circulated by Natural
503 England. Once the exclusions outlined in the methods section had been applied 21
504 AONBs remained as sample candidates for indicator collection. This sample generated
505 39 documents for analysis (management plans and supporting documents). Upon
506 completion of the analysis 600 indicators were identified, with an average of 29 per
507 AONB.

508 (The full spread of the 600 indicators found in each AONB is shown in the final
509 indicator list in the Supporting Material)

510 As described in the Methods section 2 additional lines of investigation were applied to
511 the detailed analysis of AONB management plans.

512 Firstly the presence or absence in AONB management plans of four topics (climate
513 change, 25YEP, Natural Capital or ecosystem services, and sustainable development).
514 The topics were discussed in at least 85% of the management plans, with arguably the
515 most politically dominant current issue of climate change (IPCC, 2018) present in all
516 plans (See Figure 3).



517
518
519 Figure 3. Percentage of AONBs that discussed 4 topical themes.

520
521 Secondly, the use of any of the 22 MEOPL indicators as either indicators or contextual
522 data points was noted. In the 21 AONB management plans and supporting documents
523 analysed an average of 12 out of the 22 FMEOPL indicators were present. Figure 2
524 illustrates the frequency with which each MEOPL indicator occurs. It was beyond the
525 scope of this research to investigate the reasons behind decisions by AONB
526 management teams to include or exclude data points or how data are used internally.

527 3.4 Coarse Screening

528 The coarse screening was primarily designed to reduce the number of indicators and to
529 begin the process of harmonisation as a final single data file. The screening was
530 performed in two tranches: a) AONB indicators; b) 25YEP and FMEOPL indicators.

531 The coarse screening removed 474 of the AONB indicators which brought the total
532 down from 600 to 126. Many of the indicators removed were duplicates, however it is
533 not possible to state definitively how many were duplicated, or how many times, as
534 many were worded in slightly different ways in each AONB plan.

535 In preparation of the set of 66 system indicators the 25YEP literature candidates were
536 graded 1-6 with many noted as currently supported by 'insufficient methodologies'.
537 Therefore only 35% of the 25YEP indicators were included in the final indicator list,
538 whereas 86% of the FMEOPL indicators passed the coarse screening.

539 Upon completion of the coarse screening there remained 23 25YEP indicators, 18
540 FMEOPL indicators, and 126 AONB indicators. At this stage they were held in 3
541 different MS Excel files, with some duplicates across the separate files.

542 During this coarse screening, the framework outlined in Table 2 had ensured a
543 consistent approach. However, there were some potentially valuable indicators
544 eliminated during the coarse screening. These missed opportunities were retained in
545 an additional category some examples will be elaborated on in the discussion.

546 3.5 Final indicator list and fine screening

547 Once the coarse screening was complete there were no duplicates within each of the 3
548 separate indicator lists, or between FMEOPL and AONB indicators. However, there did
549 remain duplication between the 25YEP indicators and either the FMEOPL or AONB
550 indicators. For example 'ecological water status' was included in both the 25YEP and
551 FMEOPL indicator sets, whereas 'concentration of PM2.5' was present in the AONB
552 and 25YEP sets, but not in the FMEOPL indicators. The aim of the fine screening was
553 to remove these remnant duplicates and amalgamate all three sets of indicators as one
554 set in a final indicator list organised under the 16 headline 25YEP indicators; aligned to
555 the 10 25YEP goals (See Table 3).

556 Following fine screening 8 AONB indicators and 1 FMEOPL indicator had been
557 removed as duplicates of the 25YEP indicators. The summary post-screening results,
558 and figures for the intermediate stages are shown in Table 4.

559

560 Table 4. Number of indicators pre and post screening.

Indicator source	Pre screening	Result after coarse screening	Result after fine screening
25YEP	66	23	23
FMEOPL	22	18	17
AONB	600	126	118
Total	689	167	158

561

562 After both coarse and fine screening 689 initial candidates had been reduced to 158
563 unique indicators. These results are summarised in Table 5.

Table 5. The final 155 indicator set by 25YEP headline indicator and goal showing indicator source and data monitoring body.

No	25YEP Headline Indicator*	25YEP Goal*	Final Indicator	Indicator source	Monitoring body/data source
1	1	A	Concentrations of fine particulate matter (PM2.5)	25YEP/AONB	Defra
2	1	A	Area exposed to damaging levels of ammonia in the atmosphere	25YEP	Defra
3	1	A	Roadside nitrogen dioxide (NO2) compliance (followed to nearest site)	25YEP	Daily Air Quality Index - Defra
4	2	G	Emissions of greenhouse gases from natural resources	25YEP	UK NAEI
5	2	G	Levels of traffic in/around AONB	AONB	DFT count locations/LPA/AONB survey
6	2	G	Mode of transport for visitors	AONB	AONB survey
7	2	G	% of settlements that have a daily bus service	AONB	AONB/LPA
8	2	G	Average energy consumption per household	AONB	DBEIS
9	2	G	Number of households in fuel poverty	AONB	DBEIS
10	2	G	Number of renewable energy schemes permitted (Can extend to area or at sea)	AONB	AONB/LPA
11	2	G	Number of wind turbines (Can extend to area or at sea)	AONB	RESTATS
12	3	B	Ecological status of water	25YEP/FMEOPL	EA
13	3	B	Condition of bathing waters	25YEP/AONB	EA
14	3	B	Waters achieving sustainable abstraction criteria	25YEP	EA
15	3	B	Pollution loads entering waters	25YEP	EA
16	3	B	Serious pollution incidents to water	25YEP	EA
17	3	B	Amount of rainfall	AONB	EA
18	3	B	River fly monitoring (Indicator species for river quality)	AONB	AONB
19	4	C	Clean seas: marine litter	25YEP	Survey/NE Biodiversity targets
20	6	C	Condition of protected sites -land, water, and sea (Composite indicator of extent and classification)	25YEP/AONB	NE
21	6	C	Abundance and distribution of priority species (Data collected by individual conservation groups)	25YEP	England Biodiversity Indicators
22	6	C	Presence of indicator species	AONB	RSPB/NE/other groups
23	6	C	Area and condition of priority habitats or under active management	AONB	AONB
24	6	C	Number of species recovery programmes delivered	AONB	AONB
25	6	C	Hectares of land enhanced for geodiversity through work of AONB teams	AONB	AONB
26	6	C	Condition of broad habitats within SSSIs	FMEOPL	NE
27	6	C	% area of SSSIs in favourable or recovering condition	FMEOPL	NE
28	7	C	Functional species including pollinators and freshwater invertebrates	25YEP	England Biodiversity Indicators
29	7	C	Characteristic species (birds, butterflies, bats, plants) of farms, woods, wetlands, and coasts	25YEP/AONB	England Biodiversity Indicators
30	7	C	Number of native trees planted	AONB	AONB
31	7	C	Length of hedgerow in active management (Can be expanded, created, restored, etc.)	AONB	AONB
32	7	C	Length of verges in active management (Can be expanded, created, restored, etc.)	AONB	AONB
33	7	C	Length of field margins in active management (Can be expanded, created, restored, etc.)	AONB	AONB
34	7	C	Length of undeveloped estuary shoreline	AONB	AONB

35	7	C	% of woodland ownership types	AONB	FC
36	7	C	% under UK Woodland Assurance Scheme	AONB	FC
37	7	C	Hectares of wildflower meadows planted	AONB	AONB
38	7	C	Area of a particular feature e.g. orchards	AONB	AONB - Aerial photography
39	7	C	% of woodland in the England Woodland grant scheme (AKA Forestry Commission Grant Scheme)	AONB	FC
40	7	C	Number of hedgerow trees and in-field trees managed under Environmental Subsidy Scheme (ES)	FMEOPL	NE
41	7	C	Area of woodland managed and created under ES	FMEOPL	NE
42	7	C	Area of low input grassland managed, restored, or created under ES	FMEOPL	NE
43	7	C	Area of land under ES for the management, restoration, or creation of lowland heathland	FMEOPL	NE
44	7	C	The area of land under ES for the maintenance, restoration, or creation of moorland	FMEOPL	NE
45	7	C	% area of woodland that is managed	FMEOPL	NE
46	7	C	Area and % of Ancient Woodland	FMEOPL	NE
47	7	C	Area of woodland (Sub-divided into broadleaved, conifer, mixed, shrub land, young trees, felled woodland, ground prepared for new planting, coppice.)	FMEOPL	NE
48	8	E	Farm types within AONB (Can also be expressed as % change)	AONB	Defra
49	8	E	Farm sizes within AONB (Can also be expressed as % change or % of land in agricultural use)	AONB	Defra
50	8	E	Agricultural land use types (Broken-down by area of arable, grassland, etc.)	AONB	Defra
51	8	E	Breakdown of farm labour (Can also be expressed as a % change)	AONB	Defra
52	8	E	Livestock numbers and types (Can also be expressed as a % change)	AONB	Defra
53	8	E	Increase in average rural income	AONB	Defra
54	8	E	% of land being farmed organically	AONB	Soil Association Certification Group
55	8	E	Area of land under ES for soil management	AONB	NE
56	8	E	Number of 'land management schemes' appraised (e.g. Woodland Management, Catchment Sensitive Farming, Countryside Stewardship, Natural Flood Management, etc.)	AONB	AONB
57	8	E	Number of farmers actively engaged in Catchment Sensitive Farming (CSF)	AONB	Defra
58	8	E	Area managed under agri-environmental agreement: Countryside Stewardship Scheme (CSS), Environmentally Sensitive Areas (ESA) and different levels of Environmental Stewardship (ES) (Expressed as a % of a protected landscape (PL), or as % Utilisable Agricultural Area within PL.)	FMEOPL	NE
59	8	E	Total annual values of agri-environment agreements (CSS, ESA, and different levels of ES)	FMEOPL	NE
60	9		Disruption or unwanted impacts caused by droughts	25YEP	OFWAT security of supply index
61	9		Distribution of flood risk (Using EA defined flood risk envelopes)	AONB	EA
62	9		% of floodplain woodland and wetland features	AONB	FC
63	9	D	Length of river and adjacent habitat under active management	AONB	AONB
64	9	D	Number of new flood management schemes to aid water management/climate change	AONB	AONB
65	10	F	Heritage features of designated sites and scheduled monuments (Composite indicator of Geo SSSI condition and Scheduled Monuments at Risk. Both are discrete FMEOPL indicators.)	25YEP	NE/HE
66	10	F	Condition of landscape/seascape	AONB	AONB Fixed point photography
67	10	F	Production of a publicly available Annual Report and Business Plan	AONB	AONB
68	10	F	Extent of geological designations	AONB	NE
69	10	F	Hectares of landscape enhanced by the removal of overhead power lines	AONB	AONB

70	10	F	Hectares of land enhanced for natural beauty through work of AONB teams	AONB	AONB
71	10	F	Hectares of land enhanced for geodiversity through work of AONB teams	AONB	AONB
72	10	F	Area of land enhanced through AONB programmes (e.g. biodiversity, environmental and cultural protection, designation of habitats, etc.)	AONB	AONB
73	10	F	Increase in Historic Environment Records (HER) for woodlands and non-wooded habitats	AONB	County HER statistics
74	10	F	Number of historic ponds restored	AONB	AONB
75	10	F	Number of non-designated heritage sites identified and mapped	AONB	AONB
76	10	F	Scheduled parks and gardens (Can expand to 'at risk')	AONB	HE
77	10	F	Length of coastline in protective public ownership	AONB	AONB
78	10	F	Number and geographic spread of moorings and pontoons in undeveloped estuary areas	AONB	AONB
79	10	F	Number of accessible quays	AONB	AONB
80	10	F	Clear-felling rates	AONB	AONB
81	10	F	Location of recreation activities	AONB	AONB survey
82	10	F	Length of cycle routes	AONB	Ordinance Survey mapping
83	10	F	Number of AONB specific interpretation panels	AONB	AONB
84	10	F	Length of improved Public Rights of Way (PRoW) due to AONB activity	AONB	AONB
85	10	F	Number of walking routes developed and promoted by AONB (Can expand to include distance/proportion considered easily accessible)	AONB	AONB
86	10	F	Condition of AONB roads and road signs	AONB	LPA/AONB survey
87	10	F	Hectares of land where the heritage asset condition or setting has been conserved or enhanced	AONB	HE/AONB
88	10	F	Lengths of paths made accessible	AONB	NE/AONB
89	10	F	Area of land under ES specifically for the management and protection of archaeological features	FMEOPL	NE
90	10	F	Number of heritage assets (Including the number of listed buildings (including grade II listed) & structural scheduled monuments, scheduled monuments, registered parks & gardens, registered battlefields.)	FMEOPL	HE
91	10	F	% of heritage assets that are 'at risk' (Including buildings at risk (excluding grade II listed), monuments, registered parks and gardens, registered battlefields, and places of worship.)	FMEOPL	HE
92	10	F	Number of Geo SSSI unit features, and % in favourable or recovering condition	FMEOPL	NE
93	10	F	Length of Public Rights of Way (Sub-divided into footpaths, bridleways, Byways Open to Traffic and restricted byways)	FMEOPL	NE
94	11	F	Engagement in the natural environment (Cutttable to the region. Although sample size may not be sufficient to prove statistical significance, it may provide an indication of engagement.)	25YEP	NE MENE
95	11	F	People engaged in social action for the environment (Cutttable to the region. Although sample size may not be sufficient to prove statistical significance, it may provide an indication of engagement.)	25YEP/AONB	NE MENE
96	11	F	Environmental attitudes and behaviour (Cutttable to the region. Although sample size may not be sufficient to prove statistical significance, it may provide an indication of engagement.)	25YEP/AONB	NE MENE
97	11	F	Number of users of accessibility enhancement tools (e.g. mobility scooter, etc.)	AONB	AONB
98	11	F	Number of people completing rural skills courses	AONB	AONB
99	11	F	Number of people trained in conservation techniques (Can expand to include traineeships, apprenticeships, wardens, etc.)	AONB	AONB
100	11	F	Total number of visitors	AONB	AONB survey
101	11	F	TripAdvisor or other equivalent rating for AONB	AONB	TripAdvisor/Google

102	11	F	Total number of visitors in specific areas	AONB	AONB survey
103	11	F	Visitor centre enquiries	AONB	AONB
104	11	F	Social media following	AONB	AONB
105	11	F	Website interactions	AONB	AONB
106	11	F	Interactions with downloadable material	AONB	AONB
107	11	F	Type and demography of visitors	AONB	AONB survey
108	11	F	Visitor perception/value of AONB	AONB	AONB survey
109	11	F	Number of attendees at events/initiatives organised by AONB	AONB	AONB
110	11	F	Number of educational visits conducted	AONB	AONB
111	11	F	Level and awareness of AONB designation and purpose	AONB	AONB survey
112	11	F	Membership numbers of groups associated with AONB (e.g. conservation trusts, etc.)	AONB	AONB
113	11	F	Reason for visiting	AONB	AONB survey
114	11	F	Number of events/initiatives held by AONB	AONB	AONB
115	11	F	Number of practical tasks completed by volunteers	AONB	AONB
116	11	F	Number of volunteers	AONB	AONB
117	11	F	Value of volunteer work	AONB	AONB
118	11	F	Volunteer days	AONB	AONB
119	11	F	Number of planning applications commented upon (Can be expanded to: recommendations adhered to; % of objections over-ruled; supported with plan.)	AONB	AONB
120	11	F	% of settlements that have appropriate plans (e.g. neighbourhood plans. Can also include shoreline plans.)	AONB	AONB/LPA
121	11	F	Number of dwellings built that year (Can expand to include 'affordable homes', or proportion in small scale developments.)	AONB	AONB/LPA
122	11	F	Number of 'major development schemes' appraised -LPA planning applications	AONB	AONB/LPA
123	11	F	Number of 'non-major development schemes' appraised – LPA planning applications	AONB	AONB/LPA
124	11	F	Number of businesses associated with local 'green tourism' scheme	AONB	AONB/LPA
125	11	F	Number of caravan pitches	AONB	LPA
126	11	F	Number of community groups engaged	AONB	AONB
127	11	F	Total value of work delivered directly or secured by the work of AONB Teams	AONB	AONB
128	11	F	Number of other 'development schemes' appraised (Public Sector e.g. Highways Agency, EA, etc.; Private sector e.g. British Telecom, etc.)	AONB	AONB
129	11	F	Number of press mentions	AONB	AONB
130	12	J	% of woodland managed to remove invasive species	AONB	AONB
131	13	I	Emissions of nationally significant substances to the environment	25YEP	Pollution inventory reporting - Gov.uk
132	13	I	% area designated a nitrate vulnerable zone	25YEP/AONB	EA
133	14	H	Waste crime	25YEP	Defra
134	14	H	Municipal waste recycling rates	25YEP/AONB	LPA
135	17	N/A†	Tourism contribution to local economy (Using STEAM methodology or local tourist board figures.)	AONB	AONB survey
136	17	N/A†	Tourist bed space capacity	AONB	AONB survey
137	17	N/A†	Value of external projects substantially influenced/generated by the AONB Team	AONB	AONB

138	17	N/A†	Value of other 'external' grants or contributions received for projects/non-core activity	AONB	AONB
139	17	N/A†	Index of Multiple Deprivation (IMD) score (AKA level of deprivation. Can also be expressed as % change.)	AONB	IMD - MHCLG
140	17	N/A†	Health deprivation and disability score (Can also be expressed as % change)	AONB	IMD - MHCLG
141	17	N/A†	Barriers to housing and services score (Can also be expressed as % change)	AONB	IMD - MHCLG
142	17	N/A†	Income score (rate) (Can also be expressed as % change)	AONB	IMD - MHCLG
143	17	N/A†	Employment rates (Can also use inversed for unemployment, or retirement rate.)	AONB	ONS mid-year statistics
144	17	N/A†	Number of local population	AONB	ONS mid-year statistics
145	17	N/A†	Age distribution of population	AONB	ONS mid-year statistics
146	17	N/A†	Gender distribution	AONB	ONS mid-year statistics
147	17	N/A†	% of houses above county/national average (Can include affordability ratio)	AONB	HM Land Registry
148	17	N/A†	% employed due to tourism	AONB	AONB survey/census
149	17	N/A†	% AONB that has access to faster broadband	AONB	AONB/Think Broadband website
150	17	N/A†	% of AONB villages that have a shop, pub, Post Office service or community building	AONB	AONB/LPA
151	17	N/A†	Amount (£) awarded in small grants	AONB	AONB
152	17	N/A†	Amount (£) invested in local companies	AONB	AONB
153	17	N/A†	Amount of funding brought in by the AONB team	AONB	AONB
154	17	N/A†	Number of partnerships where the AONB Team promotes the delivery of the Management Plan (Partnerships e.g. steering groups, research projects, etc.)	AONB	AONB
155	17	N/A†	Number of partnerships where AONB promote delivery of Management Strategy (Partnerships e.g. steering groups, research projects, etc.)	AONB	AONB
156	17	N/A†	Number of partnerships where the AONB Team is a supporting partner (Partnerships e.g. steering groups, research projects, etc.)	AONB	AONB
157	17	N/A†	Number of partnerships where the AONB Team is part/lead of the project/team/steering group (Partnerships e.g. steering groups, research projects, etc.)	AONB	AONB
158	17	N/A†	Number of National Infrastructure Projects appraised	AONB	AONB

* See Table 3 for lists of 25YEP headline indicators and goals; † Indicators with potential to inform multiple AONB and 25YEP goals.

566

567 In the final indicator list 24 indicators, all derived from AONB management plans, did
568 not directly align with any of the 16 25YEP headline indicators. Whereas the 25YEP
569 headline indicators were developed specifically for environmental policy action, the 24
570 additional indicators refer more to community, socio-economic or demographic aspects
571 of landscape-scale management of AONBs. Indicators with potential to inform multiple
572 AONB and 25YEP goals have been signified with a new headline indicator (number 17)
573 in the final indicator set (Table 5). It is suggested that such multipurpose indicator types
574 might well support monitoring in line with the European Landscape Convention (ELC)
575 assertion that 'all landscapes matter' and that they should be valued for cultural as well
576 as environmental qualities (Council of Europe, 2000).

577 Although the purpose of screening was to simplify the final indicator set it was
578 considered important to retain information about duplication by source, since this
579 shows that independent bodies have made similar value judgements about the
580 usefulness of these indicators (See 'Source' column in Table 5).

581 It also was acknowledged that some of the 25YEP indicators are still under
582 development, therefore rather than just deleting the indicators, where they are not
583 relevant to AONBs 43 indicators have been 'hidden' in the final Excel spreadsheet, and
584 are not represented in the results tables.

585 Table 5 also shows the data monitoring programme or body that underpins any of the
586 final indicator set.

587 **4 Discussion**

588 The research conducted in this paper has 2 main outputs. Firstly a method has been
589 illustrated that combines indicators from three sources: top-down policy, nationally
590 available datasets, and on-the-ground (bottom-up) activity. Secondly, a comprehensive
591 indicator list of 158 nationally relevant final indicators has been suggested. These
592 indicators are categorised according to the latest iteration of the British Government's
593 most senior environmental policy, the 25-Year Environment Plan (25YEP). Several
594 findings were made, methodological constraints are explored, and future research is
595 suggested.

596 **4.1 Key findings**

597 **4.1a 'Natural Selection' of indicators**

598 Research showed that retention or loss of indicator usage is not based on immediately
599 perceptible criteria. For example one FMEOPL indicator, 'Total annual values of agri of
600 agri-environmental schemes' (; Final Indicator No. 59, See Table 5), should have been
601 present in most management plans, since it is one of the 6 FMEOPL indicators
602 identified as having 5 continuous years of data (FMEOPL indicator No. 1; See Figure
603 2).

604 Of the 6 similar indicators (with 5 years of contiguous data) 5 were present in at least
605 80% of the management plans, whereas the above indicator was only present in 24%
606 of the management plans reviewed. This is evidence of the 'natural selection' of
607 indicators through the practices of AONB management teams. It is possible that this
608 indicator has fallen out of use because the data it summarises is too complex for the

609 intended audience of the management plan. Answering such questions was beyond
610 the scope of this project and would require detailed field interview-based research.

611 Another indicator, 'relative tranquillity' investigated as a candidate for the FMEOPL, but
612 not adopted, was however present in 67% of management plans. That the indicator
613 was present in two thirds of management plans would suggest it is of significance to
614 management teams and their stakeholders. A possible reason for the high incidence is
615 that 'relative tranquillity' is recognised as a 'Factor related to Natural Beauty' (Natural
616 England, 2011) and is therefore important to monitor. However, the dataset that
617 informs the indicator was derived in a one-off national study in 2007 by the Campaign
618 to Protect Rural England (CPRE) (CPRE, 2019). There has only been one subsequent
619 localised study, and no further proxies have been suggested. This is an example of an
620 indicator that should have naturally fallen from use yet is still prevalent due to a lack of
621 suitable replacement indicators. In this study the indicator failed to meet the coarse-
622 screening criteria and is not represented in the final indicator list (See Table 5).

623 To overcome emerging monitoring challenges, including replacement of irrelevant
624 indicators it is important that new or novel indicators are regularly developed. Existing
625 indicators must also be managed to maintain continuity and ensure the production of
626 longitudinal datasets to track trends in environmental condition. To meet these
627 objectives the FMEOPL indicators were agreed upon by Natural England in
628 collaboration with the AONB and National Park management teams. The results of this
629 research however revealed that on average only 12 of the 22 FMEOPL indicators were
630 present in any single AONB management plan. This suggests that the no matter how
631 well intentioned or designed an indicator is, there is no guarantee that it will be used,
632 and indicators are continually lost to natural selection (Bell and Morse, 2011). This
633 finding may also suggest that AONB managers had not engaged with the FMEOPL
634 data as actively as Natural England had initially projected. Further research is
635 suggested to gain a better understanding of why the use of some indicators has
636 ceased, whilst others have remained prevalent and what informs these decisions.

637 **4.1b Beyond the primary purpose of designation**

638 AONBs are designated with the main purpose of 'Conserving and enhancing natural
639 beauty', whereas National Parks are designated with the extended purpose of
640 'Conserving and enhancing natural beauty, and promoting understanding and
641 enjoyment of special qualities by the public' (Countryside Agency, 2011 p. 17). With an
642 average of 29 indicators per AONB document, it is clear that many AONB management
643 teams have moved beyond these limited original designation purposes and the
644 phenomena monitored by the initial 22 FMEOPL datasets suggested in 2013. Of the
645 158 final indicators selected through this research, 118 were collated from solely AONB
646 management plans, illustrating the breadth of indicators that AONB teams have
647 developed or adopted (See Table 4). Use of such indicators as 'TripAdvisor rating',
648 'amount invested in local companies', or types and demography of visitors,
649 demonstrates the AONB management team concerns with issues additional to the
650 initial designation criteria and purposes.

651 The Glover Review of Protected Landscapes highlighted that AONBs appear to '*do a*
652 *great deal with very little*' (Defra, 2019). Furthermore, The National Association of
653 AONBs acknowledges that AONB teams not only conserve the landscape but also
654 'advance education, understanding and appreciation' (NAAONB, 2019a). Such
655 statements acknowledge that AONB management activity has incorporated aspirations
656 beyond the minimum mandatory requirements, whilst simultaneously absorbing and
657 overcoming reductions in guaranteed funding (Mendip Hills, 2019). Although there is

658 clearly investment in wider positive outcomes for landscapes and communities,
659 management teams increasingly need to fund these additional activities from sources
660 beyond the core income from central government and local authorities, often through
661 pursuing additional grants and fundraising.

662 Additional grants are usually conditional upon meeting novel or contextual funding
663 criteria. For example, the National Lottery Heritage Fund offers a substantial grant with
664 which to form a Landscape Partnership (NLHF, 2020) in order to conserve and
665 enhance a specific landscape. However, approval of funding stipulates additional
666 monitoring requirements, and hence new indicators, that must be evidenced. The
667 diversification of funders and consequent indicators has expanded the expected
668 workload of already-stretched AONB management teams.

669 No single AONB team can be expected to collect data for 118 indicators on an annual
670 basis. However, with a selective, nationally co-ordinated approach, some of this set,
671 could become regular features of AONB landscape monitoring strategies. Although
672 introducing such a 'best practice' indicator subset would require additional initial
673 resources, once a consistent methodology were developed and shared across the
674 entire network of 46 AONB teams that operate in the UK, up to 18% (NAAONB, 2019)
675 of the UK could be consistently and comparatively monitored for key environmental
676 criteria. A coherent approach to monitoring protected landscapes by NE and the
677 NAAONB could provide a strong foundation for 'AONB family' level (national) funding
678 for monitoring that would address landscape quality issues.

679 *4.2 Methodological constraints*

680 One of the main outputs of this paper is a suggested method that amalgamates
681 different levels of policy to suggest one coherent list of indicators that could be of use
682 for policy makers and practitioners. The research encountered some methodological
683 constraints, but also suggested solutions.

684 *4.2a Duplicate AONB indicator removal*

685 Applying the coarse screening criteria was relatively simple (as set-out in Table 2).
686 Although it had been foreseen that there would be duplicate indicators from the 39
687 AONB documents it had not been anticipated how time consuming it would be to
688 remove them. To overcome this it is suggested that an additional criterion of
689 'uniqueness' should have been included at this screening stage, rather than through
690 the fine-screening process. The criteria would be met by answering the following
691 questions:

- 692 a) **Is it** this indicator an exact duplicate? – For example, 'volunteer hours'. The first
693 occurrence will pass the coarse screen, whereas any further instances are
694 redundant.
- 695 b) Is this an inverse of another indicator? – For example, 'rate of employment' and
696 'rate of unemployment'. Simple inverses count as only one indicator, although this
697 might raise the question of which of the inverse pair to retain.
- 698 c) Is this indicator an extension of another indicator? Could it be amalgamated with
699 another one? For example, 'number of houses built' and 'number of houses built, of
700 which proportion were affordable'. Although these indicators highlight subtly
701 different issues they could be combined and the extension attribute 'of which
702 proportion were affordable' could be added. See Table 5 for more examples.

703 An additional suggestion that might enrich future iterations of similar data collection
704 exercises and subsequent analysis might be to pay closer attention to the frequency of
705 duplication and the analytical reason for removal. This step could help raise further
706 research questions concerning over or under-representation of certain indicator types.

707 **4.2b Final indicator list construction**

708 Whilst constructing the final indicator list some value judgements were required when
709 categorising the AONB and FMEOPL indicators. For most-there was a strong link with
710 one of the 16 25YEP headlines. In some cases however one of the 22 FMEOPL
711 indicators or an AONB sourced indicator aligned with more than one headline indicator.
712 In such a case the indicator was ascribed to the most-related headline indicator. This
713 judgement was aided by reference to the 'Questions' associated with each of the 16
714 25YEP headline indicators laid-out in Section B of the May 2019 document: 'Measuring
715 environmental change: outcome indicator framework for the 25 Year Environment Plan
716 (Defra, 2019).

717 For example, an AONB management report derived indicator such as 'Number of new
718 flood management schemes to aid water management and /climate change' (final
719 indicator No. 64, Table 5) might have at first sight belong under 25YEP headline
720 indicator No. 3: 'Changes in quality and quantity of water and the water environment
721 that affect our lives and livelihoods'. But on examination of the associated policy
722 questions, headline indicator No. 3 was shown to be inappropriate, and the derived
723 indicator could only be associated with headline indicator No. 9; 'Changes in resilience
724 to natural hazards'.

725 It was more difficult to ascribe some of the derived indicators to any single 25YEP
726 headline indicator. For example, 'length of hedgerow in active management' (final
727 indicator No. 31, Table 5) could, even after reference to the associated policy
728 questions, be ascribed to any of three headline indicators:

- 729 (6) Changes in wildlife and wild places that we cherish,
730 (7) Changes in nature on land and water that affect our lives and livelihoods,
731 (10) Quality of our landscapes and waterscapes.

732 However, when considering the policy questions for each of these three headline
733 indicators the choice was to associate the final indicator with headline indicator number
734 7 because:

735 *'This headline focuses on the wider benefits provided to society by thriving plants
736 and wildlife as a fundamental part of ecosystems that deliver multiple benefits, and
737 endow resilience on natural systems,'*

738 And answers the policy questions:

739 *'Are plants and wildlife that contribute to important ecosystem functions (e.g.
740 pollination) thriving? Are wildlife habitats increasing in their extent, quality, and
741 connectivity? Are wildlife habitats becoming less vulnerable to climate change
742 impacts? Are the populations of widespread species that characterise our farmland,
743 woodlands, wetlands and coastline increasing?' (Defra, 2019)*

744 Although this process was time consuming it was an important step to ensure that the
745 indicators were categorised as logically as possible.

746 One of the difficulties in combining indicators derived from top-down legislation and
747 bottom-up activity was the differences between intended audiences for each set of
748 documents. The 25YEP is intended for both domestic and international audiences,

749 whereas AONB management plans are written primarily for those who reside within or
750 near the AONB boundaries. For example there are two 25YEP Headline Indicators that
751 focus on UK foreign policy aspirations, for which AONB derived indicators might prove
752 inappropriate. It is important to note however that the UK government has yet to
753 suggest any indicators with which to monitor progress against these policy aspirations.
754 Furthermore one 25YEP headline indicator; ‘changes in exposure of people and wildlife
755 to harmful chemicals’ (See Table 2) related to few AONB-derived or FMEOPL
756 indicators since regulation for this set of risks falls under several legal frameworks that
757 are not within the direct management remit of AONB or NP management teams.

758 In addition to the difficulties in reconciling the intended audiences there was also the
759 complication of variance between the purpose and scope of the 25YEP headline
760 indicators and the AONB management plans. The 25YEP was written to directly
761 address environmental issues, whereas AONB management plans take account of the
762 wider landscape-scale concerns of local communities and stakeholders. Hence 24 of
763 the indicators that are of importance to AONBs do not align directly under the 16
764 25YEP headline indicators. An additional headline category (No 17, See Table 5) was
765 hence developed for the final indicator list. This additional headline category
766 predominantly reflects the economic ‘sustainability’ concerns of resident communities,
767 captured through indicators such as ‘percentage of people employed due to tourism’ or
768 ‘percentage of AONB that has access to faster broadband’ (final indicators No.148 and
769 149, Table 5). Such a headline indicator aligns well with the European Landscape
770 Convention, which stresses the importance of landscape quality to both people and the
771 environments that they inhabit.

772 **4.2c Missed opportunities**

773 The screening exercises employed might have excluded some potentially useful
774 indicators. Therefore these were only bracketed (or hidden in the final Excel file) and
775 retained as indicators that might pass future, wider screening criteria. One such
776 indicator outlined a methodology to track the amount of carbon stored within the
777 landscape; measured in terms of carbon tonnage and economic benefit. Since this
778 indicator was developed in a one-off study by Defra (Defra, 2019), and had not been
779 updated, it was eliminated by the coarse screening criteria. Failure to develop
780 indicators beyond initial research stages is a persistent issue. Despite the publication of
781 excellent candidate indicators and insights, some of the best practices and learnings
782 are not adopted into a coherent monitoring network.

783 Another potentially valuable indicator concerned dark night skies which are identified
784 as a special quality of several AONBs, and an aspect of the natural beauty criterion
785 (Countryside Agency, 2001). As an indicator the quality or extent of dark skies was
786 present in several of the management plans as a map overlay that gave a good visual
787 representation of change over a number of years (CPRE, 2019). It is possible that
788 these maps may contribute to planning applications.

789 Some proxy or combinative indicators would be challenging for AONB management
790 teams to replicate at a local level whilst ensuring the degree of comparability and
791 accuracy that would be required to contribute to a cumulative national dataset. A
792 network approach across all 46 AONBs might then provide sufficient data to generate a

793 **5 Conclusion**

794 Ultimately this paper has highlighted the necessity for a pragmatic approach to
795 landscape monitoring and acknowledges how variances in funding regimes and

796 ambitions of individual management teams has influenced the monitoring strategies
797 followed by organisations entrusted with managing UK landscapes. For reasons
798 explained in the methods the study was limited to AONBs and future research could
799 extend to National Parks and other designated or quasi-legally protected landscapes.

800 Future research should address an empirical investigation of the reasons for indicator
801 usage or loss, the degree of actual monitoring carried out as distinct from monitoring
802 aspirations, the mesh between local and national organisations with respect to data
803 collection, analysis and dissemination and the on-the-ground utility of datasets to busy
804 and under-resourced landscape managers. Also the impact and extension of the 25
805 Year Environment Plan and its systematic relationship to FMEOPL would be important
806 to follow.

807 Such research is timely considering such emerging national and international
808 challenges to environmental management as responses to the climate change
809 emergency, the UK withdrawal from the European Union, threats to long-established
810 environmental legislation in the USA, and potential environmental and governance
811 impacts on a global scale as a consequence of a post-covid10 economic downturn.

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