Response to reviewer #1

We would like to thank Anonymous Reviewer # 1 for their comments.

Comment 1

With respect to the first part of comment 1, information needed to understand the water resource management (WRM) practices that are the focus of the present study has been set out in detail in the paper. The source of the data used to analyse the WRM practices and conceptually how those practices may be related to BFI have been described. We also note, as part of the Discussion, which WRM practices are out of scope with respect to the current study.

In this context, the following sections of the paper are particularly pertinent:

- In the Introduction (lines 44-57) we cite and describe studies that have previously investigated how WRM practices may affect baseflow.
- In the Introduction (Lines 62-65) we describe which WRM practices are the focus for the study and link these to specific aims of the study, as follows:

  > "CAMELS-GB, a recently published large-sample hydrology dataset for Great Britain (GB) (Coxon et al., 2020a; 2020b), is unusual in that it contains quantitative information on WRM practices including surface water and groundwater abstractions, discharges, and reservoir numbers and capacities at the catchment scale. The aim of the present study is to use the CAMELS-GB large-sample dataset to identify which, if any, WRM activities influence baseflow; to assess the importance of these activities in the context of other factors known to influence baseflow, such as meteorology, catchment hydrogeology, catchment physiography, and LCLU; and, to investigate if WRM factors are important in any particular catchment or management settings.".

- In section 2.2 we note that the study is using WRM data taken from Coxon et al., (2020a; 2020b) where the nature of the management practices and source of the data are described in full.
- In section 2.2 at lines 148-156 (including Figure 4), we show how the WRM practices are conceptualised in the present study based on a modification of a conceptual model of baseflow generation after Price et al., (2011).
- In the Discussion at line 448-457 we describe WRM practices that are not in scope based on the present CAMELS-GB data and catchment settings and briefly describe what additional work could be undertaken to address this issue.

The second part of comment 1 raises the question of uncertainty in the estimates of BFI. BFI is a hydrological signature (McMillan, 2021) that can be estimated using a wide range of techniques from a wide range of data sources. To account for the uncertainty in calculating BFI, we have used two techniques (Lyne-Hollick and CEH method). Although there are small differences in the BFI estimates the conclusions that we draw between these techniques are consistent. In terms of uncertainties in the underlying data, we recognise that there are often large uncertainties in streamflow data (Coxon et al, 2015) but these are difficult to characterise across large samples of catchments and uncertainty estimates are not available for all the CAMELS-GB catchments. We also note that BFI typically has lower uncertainty compared with other hydrological signatures as it is based on temporal averaging (Westerberg and McMillan, 2015). We agree that this is an important point to consider and a note on uncertainty related to BFI estimates based on the above comments will be added to section 2.2 of a revised version of this paper.

Comment 2

The “practical implication” of the study is summarised in the final point of the conclusions, namely that:

> “WRM practices can and should where appropriate be incorporated in future conceptual models of BFI and baseflow generation, and consequently data and information about WRM practices should be included in future large-sample catchment datasets and in future investigations of baseflow”.

However, we acknowledge that this could be expanded on in the Discussion and we will add a short note to that effect in the revised paper.

Comment 3

We will work with HESS to improve the picture quality in a revised draft.

Comment 4

There is no repetition. However for clarity the text will be revised to read as follows:

> “Figure 3c shows that that there is a generally good linear agreement between the two estimated BFI indices. However, for BFIs below 0.7 BFI_CEH is systematically lower than BFI_LH and for BFIs above 0.7 BFI_CEH is systematically higher than BFI_LH.”

Comment 5

In the revised manuscript we will add the equation for Lin’s concordance coefficient:

$$\rho_c(x,y) = \frac{2\rho(x,y)\sqrt{\mathrm{var}(x)}\sqrt{\mathrm{var}(y)}}{\mathrm{var}(x) + \mathrm{var}(y) + \left(\mu_x - \mu_y\right)^2},$$

where $\rho_c(x,y)$ is Lin’s concordance coefficient for variables x and y, $\rho(x,y)$ is Pearson’s coefficient for the same variables, $\mathrm{var}(x)$ is the variance of x and μ_x in the mean of x. We will expand our description to state that Lin’s concordance coefficient can take values between -1 and 1, that a value of 1 indicates an exact match between the two variables and that the $\left(\mu_x - \mu_y\right)^2$ term means that variables with different mean values have a small coefficient value in contrast to standard correlation coefficients where perfectly correlated variables can have vastly different mean values.

Comment 6

A description of the modelling scheme and nomenclature is provided at the start of modelling methods, section 3 (Lines 157-166). However, for clarity a brief note related to the modelling scheme nomenclature will be added at the start of the results section, section 4, where Figure 5 is introduced.

Comment 7

Catchment area was included in the covariates for analysis since, as we note in Table A1 (Line 700) “catchment area is commonly identified as an important factor in explaining variability in low flows (Price et al., 2011)”. However, as the reviewer notes, catchment area was not identified as significant or important in either the LR or RF models respectively (Figure 5). It is not certain why this is the case. However, we also noted at Line 700 in Table A1 that catchment area is “less important with respect to mean residence and transit times where topographic relief appears to be more important” and this is consistent with the observation that, at least in the LR models (Figure 5), the covariate 'dpsbar' (catchment mean drainage slope path (m km-1)) was significant. Other recent studies of hydrological indices, such as Addor et al., (2018) have shown that catchment area is unimportant with respect to BFI whereas slope is important (Addor et al., 2020, Figure 4).

Comment 8

It is not clear why the LR models are more effective than the RF models in identifying which WRM covariates (groundwater abstraction, surface water abstraction, and discharges) may be contributing to the improvement of the model performance when WRM terms are added. It may be because the RF models are overfitted. However, note that the performance of both the models is discussed in the paragraph following the commented text (e.g. Lines 412-423).

Comment 9

The conclusions highlight the main findings of the paper in a manner complimentary to the Abstract while hopefully avoiding the common tendency of being overly long. We would be happy to address any specific comments or suggestions related to the Conclusions

Comment 10

The introduction includes an overview of the literature related to baseflow and water WRM practices and puts the study in the wider context of the very large field of research related to baseflow. We would be happy to address any specific comments related to the literature cited in the paper.

References

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