**Annex to Fair Share Options Paper**

**Introduction**

When determining what action should be taken to improve or to prevent deterioration of the water environment, consideration should be given to the proportion each sector, business or individual contributes to the problem. Action to reduce pollutants should be targeted on a ‘fair share’ basis, whereby each sector, business or individual deals with its proportional contribution. This approach is rooted in the ‘polluter pays’ principle.

In July 2016, the PR19 NEP+ group confirmed that we would adopt a ‘fair share’ approach for the planning of the Water Framework Directive (WFD) and conservation objective (N2K) measures for phosphorus in PR19. This ‘fair share’ approach should be applied when developing programmes of measures for protected areas and waterbodies.

The group also recognised that we need to carry out a full review of the approach to planning improvement measures, and the different options for taking into account the contributions from all sectors. However, given the tight planning timescales for PR19, Defra agreed that this review will not take place until 2018, to avoid any uncertainty during PR19 planning.

The NEP+ group agreed that we will continue with the current approach, used in PR09 and PR14, of fair share, based on a proportionate contribution to the problem for all sectors, which has already been agreed for water quality but will also encompass water resources and fisheries, biodiversity and geomorphology planning.

**Developing the ‘fair share’ approach**

A Task & Finish (T&F) Group was formed to develop the ‘fair share’ approach to be used for PR19. Although staff from water quality, water resources and fisheries, biodiversity and geomorphology were invited to join the T&F group, the focus of the group has been largely on water quality.

As source apportionment is already taken into account when developing measures for coastal waterbodies, we have focussed on agreeing a methodology for calculating ‘fair share’ when developing programmes of measures to achieve water quality improvements in freshwaters. In particular we have focussed on phosphorus. However the methodology can be applied to other water quality parameters.

**How is the ‘fair share’ used when developing water quality improvement measures?**

All waterbodies within a catchment have a target concentration for phosphorus. This is the concentration (or EQS) that must be achieved to meet the objective assigned to that waterbody (eg Good ecological status[[1]](#footnote-1)). The phosphorus EQS is expressed as an annual mean concentration.

Within a catchment, the phosphorus concentration at any one point in a river is determined by the load of phosphorus arising from the point sources and diffuse sources in the catchment upstream of that point.

Many waterbodies are failing their current objectives (ie the target phosphorus concentration is being exceeded). In order to achieve the EQS at a point in a catchment, the phosphorus load from the upstream sources will need to be reduced. The fair share approach aims to ensure that the load reductions from point and diffuse sources are equitable. The amount of reduction required from point sources and diffuse sources should be in proportion to their respective contributions to the in-river phosphorus concentration.

We can use water quality models to calculate how much load reduction is required to achieve the EQS at any point in a catchment. We do this by setting a ‘target concentration’ to be achieved in the waterbody and then working out by how much we need to reduce point and diffuse source loads in order to achieve the target concentration.

The aim of the fair share approach is to calculate a ‘fair share’ of the EQS for both point and diffuse sources, and hence a ‘fair share’ target concentration to be met by reducing point source loads and a ‘fair share’ target concentration to be met by reducing diffuse source loads.

 For example, an EQS for a waterbody may be 0.1 mg/l.

The current concentration of phosphorus in that waterbody may be 0.2 mg/l. If the relative contributions of point sources and diffuse sources are 60% and 40% respectively.

Point source target concentration = **point share** \* EQS = 0.6\*0.1 mg/l = 0.06 mg/l

Diffuse source target concentration = **diffuse share** \* EQS = 0.4 \* 0.1mg/l = 0.04 mg/l.

The water quality model can then be used to work out the load reduction from the point sources upstream of the location that would be required to achieve the 0.06 mg/l point source target concentration.

There are a number of different ways of calculating the “point share” and the “diffuse share”. At a single point in a catchment, it is relatively straight forward to use a water quality model to calculate the contributions from point and diffuse sources upstream of that location. However, the WFD advocates a catchment approach to planning and it is more challenging to determine point and diffuse share at a catchment scale.

**Fair Share approaches**

There are a number of possible approaches to calculating catchment ‘fair share’ and these were reviewed by E&B water quality during the Summer of 2016[[2]](#footnote-2). It was agreed that three potential approaches would be given further consideration. These were:

1. End of catchment approach;
2. PR19 Proportional catchment reduction approach (referred to as the local approach in [Fair Share: options for water quality (v2)](file:///%5C%5Cprodds.ntnl%5Cshared%5CSW%5CHHO%5CBristol%5CLand_%26_Water_Quality%5CMaxs%20files%5CFair%20Share%5CT%26F%20Gp%5CFair%20Share%20options%20%20v2.docx) – see footnote 2 ); and
3. Catchment percentile approach.

In order to decide the approach to be used for PR19 the T&F group considered:

* The technical advantages and disadvantages of each approach;
* How easily each approach could be applied in practice, with the tools and models we have available, and taking into account the fairly tight timescales for PR19 planning;
* How easily we could explain and justify each approach to 3rd parties, particularly water companies and Natural England; and
* How ‘future-proof’ each approach is.

We also took into consideration Defra’s request for us to carry out a more in depth review in 2018, of the different options for taking into account sector contributions which will inform policy and planning beyond PR19.

The three approaches, and the advantages and disadvantages of each, are presented below.

1. **End of catchment approach**

The annual mean phosphorus concentration at the most downstream point of the catchment is used to determine the relative contributions of point and diffuse sources. A catchment water quality model can be used to calculate the concentration that would arise from only the point sources within the catchment, and from only the diffuse sources within the catchment.

The relative contributions of point and diffuse sources can then be calculated to give a ‘point source share’ and a ‘diffuse source share’ to the phosphorus concentration.

The end of catchment point source share and diffuse source share are then applied at all points within the catchment when calculating the target concentration for P reduction:

Target EQS for point source reduction = point source share \* EQS

Target EQS for diffuse source reduction = diffuse source share \* EQS

*Advantages*

* Simple method of calculation, using a single point within the catchment
* Straightforward to explain to 3rd parties
* This approach was used by some Water Companies during PR14
* The ‘Catchment Optimiser’ tool could be adapted to optimise point source reductions using the point source share calculated using this approach

*Disadvantages*

* As the contribution from point sources tends to diminish with distance moving downstream, the calculated point source share is very dependent on the locations of the point sources within the catchment (i.e. a large STW located close to the downstream limit of the catchment will tend to cause an overestimate in the point source share).
1. **PR19 Proportional catchment reduction approach**

The annual mean phosphorus concentration at each of the STW discharge points within the catchment is used to determine the relative contributions of point and diffuse sources at that point[[3]](#footnote-3). A catchment water quality model can be used to calculate the concentration that would arise from only the point sources within the catchment upstream of that point, and from only the diffuse sources within the catchment upstream of that point.

The relative contributions of point and diffuse sources can then be calculated to give a ‘point source share’ and a ‘diffuse source share’ to the phosphorus concentration.

The point source share and the diffuse source share are then applied at the discharge point only when calculating the target concentration for P reduction:

Target EQS for point source reduction = point source share \* EQS

Target EQS for diffuse source reduction = diffuse source share \* EQS

*Advantages*

* This approach, combined with the current ‘Catchment Optimiser’ tool was used by several Water Companies during PR14.
* By using the ‘Catchment Optimiser’ tool with this approach, the optimum catchment solution to achieving P targets can be developed.

*Disadvantages*

* This approach could be seen to give preference to the STWs, as the locations where the fair share is calculated (particularly if use the STW discharge point, location) would be those where the point source impact is at its greatest.
* This approach would lead to a diffuse share which varied across the catchment. The diffuse target would vary dependent on the location relative to STW discharges and so obligations on the agricultural sector to reduce their loads would vary across a catchment.
1. **Catchment percentile approach**

The contribution to the phosphorus concentration from point sources varies spatially within a catchment, with the concentration tending to decrease with distance downstream of a point source input. The contribution from diffuse sources tends to be less variable within a catchment (see Figure 1 below).





Figure 1

A third approach is to use a catchment model to calculate the point and diffuse source contributions based on the relative contributions to the total concentration at all points within the catchment.

For example, the point source sector impact can be calculated from the sum of point source concentrations at all points within the catchment; and the diffuse source sector impact is calculated from the sum of diffuse source concentrations at all points within the catchment. These can then be used to calculate a catchment point share and a catchment diffuse share:

e.g.

$$point share=\frac{point sector impact}{\left(point sector impact+diffuse sector impact\right)}$$

As the impact of STW discharges varies spatially (i.e. decreases with distance downstream of the discharge location) we need to ensure that this spatial variation is taken into account when deciding which concentration to use for calculating the point source contribution.

One option is to use the mean concentration to calculate a catchment average impact for the point and diffuse sectors. However this option was discounted as it would not reflect the decreasing impact of point sources downstream of the discharge point.

A second option is to use the mean concentration + 1 standard deviation (approximately equivalent to the 85th %ile – see Figure 1 above). This 85th percentile approach is considered to more fairly reflect the spatial variation of point source impacts.

*Advantages*

* Catchment optimiser tool can be adapted for use with this approach
* Use of 85th %ile takes into account diminishing contribution from point sources as move downstream from their discharge location.
* Single point source share and diffuse source share calculated per catchment – this is a useful figure to have to be able to characterise a catchment, eg when speaking to partners.
* Results from applying this approach and the local approach (calculating fair share at sample points, rather than discharge points) to the Severn and Wye catchments give broadly similar results for point source share.

*Disadvantages*

* New approach which was not used by any water company during PR14.
* More difficult to explain to 3rd parties than the end of catchment approach or local approach.
* EA staff would not be familiar with this approach, and hence may need training in order to use this approach for PR19 planning.

**Future Proofing**

One of the considerations when deciding upon a preferred method, is whether the approach would be affected by future changes. We believe that foreseeable future changes (eg a reduction in the monitoring programme) would affect all proposed options in a similar way.

**Preferred approach for PR19**

Of the three options presented above, the end of catchment approach was the least favoured, primarily as the targets set using this approach are very dependent on the locations of the larger STWs within the catchment.

The remaining two approaches, the ‘proportional catchment reduction approach’ and the ‘catchment percentile approach’ were both well regarded.

The catchment percentile approach appears to be the approach which would meet the aspirations of a truly catchment approach to planning. However, this approach has not been used by water companies or the EA in the past. With the tight timescales for PR19 planning, the risks associated with trying to implement a new methodology were thought to be too great.

The T&F group decided that the preferred option for PR19 planning should be the ‘local approach’. This approach is familiar to EA staff and many Water Companies, and so there would be no significant risks in using it for PR19 planning. The results of applying this approach and the ‘catchment percentile approach’ to the Thames and Wye catchments appear to give broadly similar results.

The main disadvantage of the ‘proportional catchment reduction approach’ is the fact that the calculated diffuse share would vary throughout a catchment. When communicating with partners it would be useful to be able to have single values for the point share and for the diffuse share in order characterise a catchment. This could still be achieved using the ‘proportional catchment reduction approach’. Once the local point and diffuse fair share values have been calculated at the discharge points within a catchment, an average point and diffuse source share could be calculated from these values to give a single catchment average point source and diffuse source fair share value.

**2018 review**

Following the submission of PR19 water company business plans in September 2018 the Environment Agency will commence a review looking at the different options for taking into account sector contributions that may be considered beyond PR19.

The T&F group recommended that the catchment percentile approach is given further consideration as part of this review. The group also recommended that worked examples showing the effects of applying each approach to a range of catchments/ waterbodies would help inform discussions as part of any future review.

**Next steps**

A further paper is being developed to outline the principles and rules of the local approach for use in PR19.

EA Internal Fair Share Task and Finish Group

17/01/17

1. The default objective under WFD is to achieve ‘Good’ ecological status. However a lower interim objective (eg Moderate status) may have been set for a waterbody if it is technically infeasible, or disproportionally expensive to achieve Good status. [↑](#footnote-ref-1)
2. See document “[Fair Share: options for water quality (v2)](file:///%5C%5Cprodds.ntnl%5Cshared%5CSW%5CHHO%5CBristol%5CLand_%26_Water_Quality%5CMaxs%20files%5CFair%20Share%5CT%26F%20Gp%5CFair%20Share%20options%20%20v2.docx)” [↑](#footnote-ref-2)
3. This approach could also be applied, by calculating fair share at monitoring point locations, not STW discharge locations. [↑](#footnote-ref-3)