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2nd August 2017

Saul White
Wales Permitting Centre
Natural Resources Wales
Cambria House
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CF24 0TP

Via email: saul.white@naturalresourceswales.gov.uk

Application reference: PAN-000849
Applicant: Radnor Hills Mineral Water Company Ltd
Facility: Radnor Hills, Heartsease, Knighton, Powys, LD7 1LU

Dear Mr White,

We are responding to your Schedule 5 notice dated 20th June 2017 on behalf of Radnor Hills Mineral Water Company Ltd.

Contents

Introduction

Thank you for your Schedule 5 notice requiring further information on our environmental permit application, dated 17th October 2016. We understand that your notice requires additional information in relation to the proposed surface water discharge to the River Teme. As discussed previously, we are proposing to alter the design of the outfall itself from a headwall / reno mattress arrangement to a softer swale-type design at the request of the Environment Agency. Full details of this will follow.

River Quality Modelling

Introduction

It has been requested that further modelling work is undertaken based on the targets described in the Common Standards Monitoring Guidance 2016, as opposed to the Water Framework Directive targets. It was requested that the following parameters are modelled:

1. Soluble Reactive Phosphorus (SRP)
2. Ammonia
3. BOD
4. Total Suspended Solids (TSS)

It was also requested that summertime flow rates (March – September) are modelled in addition to annual mean flow.

Methodology

The modelling methodology was undertaken in line with Environment Agency Horizontal Guidance document H1 Annex E – Surface Water Discharges (complex). For the calculation, the Monte Carlo Method was used, as set out in Appendix A 'Calculation of River Needs Permits'. This was conducted using the RQP software provided by the Environment Agency on request.

Flow rates for the months March to September inclusive were calculated for the River Teme at Lingen Bridge by Rukhydro Limited to support this response. The approach for calculating full year flows at Lingen Bridge is set out in full in Section 4 of the Rukhydro report "Evaluation of Risks to the Water Environment – Addendum A" for Radnor Hills, dated 18 October 2017. A copy of this report has been provided to Natural Resources Wales, the Environment Agency and Natural England.

The approach was modified by applying the correlation factors (between the spot flows at Teme at Lingen Bridge and flows at other gauged catchments and the river stage at Knighton) to flow (and stage) percentiles for the months March to September from the comparison gauges. The following flow rates were calculated for the River Teme at Lingen Bridge:

Variable	Flow rate (litres / second)
Annual Mean*	2,288
Annual 95%ile*	90
March – Sep mean	1,330
March – Sep 95%ile	54

Note: (*) As provided in Table 4.2 of Rukhydro, October 2017 report.

Background water quality was sourced from the Environment Agency. Previous modelling work was submitted as part of the original environmental permit application, which used background data from the EA's What's In Your Backyard resource and also the River Teme SSSI Diffuse Water Pollution Plan. These data generally date from 2009.

A further request for more recent information was made as directed in the Schedule 5 notice, and the data received from the EA on Tuesday 25th July 2017. Not all the determinands that we were required to model have been measured as part of this dataset, and in these cases the older data were used. The data used in the modelling were as follows:

Parameter	Average (mg/l)	Standard Deviation (mg/l)	Comment on source (sample point is at Buckton Bridge, around 1 km downstream)
Biological Oxygen Demand	1.13	1.2	Not included in recent data – data from EA WIYBY used[1].
Total Ammonia (as N)	0.018	0.012	Levels below LOD (which varies from sample to sample) in recent data – data from EA WIYBY used[1], which appear to have a lower LOD and therefore actual values are presented.
Unionised Ammonia (as NH_3)	<LOD	n/a	Data provided by EA in July 2017.
Soluble Reactive Phosphorus (Orthophosphate as PO_4)	0.10	0.11	Data provided by EA in July 2017. An average was taken of readings in the last two years (15/06/17 – 20/06/17) excluding a single high outlier result in January 2017. Values below the LOD have been presented as being at the LOD (0.01).

[1] http://bit.ly/1U3Rids

Total Suspended Solids	8.1	No data	Not included in recent data – data from EA River Teme SSSI Diffuse Water Pollution Plan[2].

Results

The results of the modelling are shown below:

Parameter	Current mean river quality (mg/l)	Design average effluent quality (mg/l)	Resultant river quality – full year flows (mg/l)	Resultant river quality – summer flows (mg/l)	River quality target (mg/l)
Biological Oxygen Demand (mean)	1.13	5.00	1.18	1.20	1.50
Total Ammonia as N (90%ile)	*0.018*[3]	0.50	0.04	0.05	0.25
Unionised Ammonia as NH_3 (95%ile)	<LOD	n/a	0.0001	0.0002	0.025
Soluble Reactive Phosphorus as PO_4 (mean)	0.10	0.20	0.10[4]	0.10[4]	0.015
Total Suspended Solids (mean)	8.1	5.00	8.07	8.05	n/a

A second discharge location has also been proposed, which has potentially slightly lower river flows though according to the Environment Agency and Natural England still maintains continuous flow throughout the year. Based on a very limited spot flow dataset for 200m upstream of Lingen Bridge, and in the absence of more specific flow data, it has been assumed that both annual mean and summer flows are 70% of those at Location A above. This is conservative as the mean flows are likely to be very similar to those at Lingen Bridge.

	Flow rate (litres / second)
Annual Mean	1,601
Annual 95%ile	63
March – Sep mean	931
March – Sep 95%ile	38

The results of modelling at this location are as follows:

Parameter	Current mean river quality (mg/l)	Design average effluent quality (mg/l)	Resultant river quality (mg/l)	Resultant river quality – summer flows (mg/l)	River quality target (mg/l)
Biological Oxygen Demand (mean)	1.13	5.00	1.20	1.23	1.50
Total Ammonia as N (90%ile)	*0.018*[3]	0.50	0.04	0.05	0.25
Unionised Ammonia as NH_3 (95%ile)	<LOD	n/a	0.0002	0.0002	0.025

[2] http://bit.ly/1PWWCTy
[3] Note that although 90%ile is being calculated, the modelling tool still requires mean level as the input. This is presented here.
[4] The tool only reports to 2 decimal places.

Soluble Reactive Phosphorus as PO_4 (mean)	0.10	0.20	0.10[4]	0.10[4]	0.015
Total Suspended Solids (mean)	8.1	5.00	8.06	8.03	n/a

Conclusions

The modelling results above demonstrate the following:

1. For BOD and ammonia, the discharge would not result in the river exceeding its quality targets at either location option, either for annual mean or summertime mean flows.

2. There are no quality targets for TSS, however it can be seen that under all scenarios there would be a slight reduction in river TSS as the discharge would have a lower concentration than the background quality.

3. The river is already in breach of its quality targets for SRP, however under all scenarios the discharge would lead to a negligible increase in concentration.

Effluent Treatment Plant Nutrients and Chemicals

A question was raised in the Schedule 5 regarding the nutrients and chemical additives that are to be added to the effluent treatment plant, and whether any of these will be present in the final discharge.

Aquabio provided the following details on nutrients and cleaning chemicals for the process:

Item	**Details**
Nutrient N solution	Assuming 40%
UF cleaning chemical: sodium hypochlorite	Assuming 14%
UF proprietary caustic cleaner	Ultrasil 88
UF proprietary acid cleaner	Ultrasil 78
RO operation chemical: antiscalent solution	Genesys LF
RO operation chemical: acid solution	Assuming 32% hydrochloric acid
RO proprietary caustic cleaner	Genesol 40
RO proprietary acid cleaner	Genesol 38

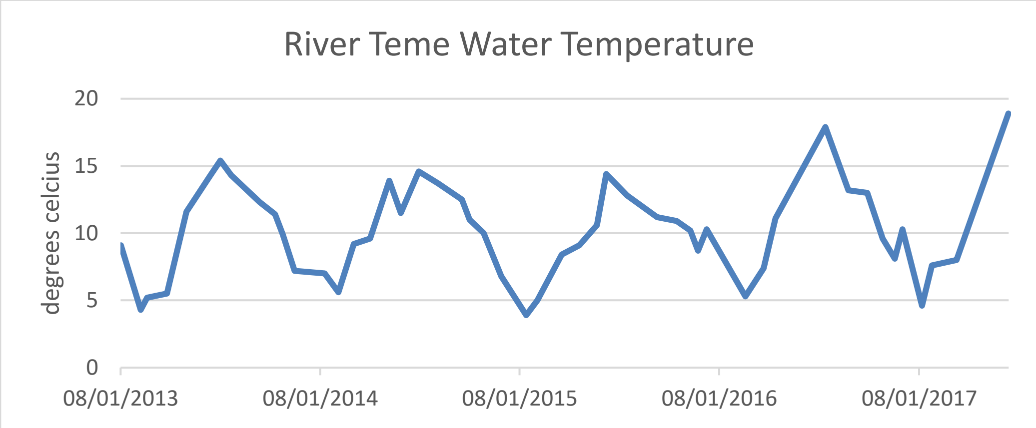
It has been confirmed by Aquabio that any added nutrients and chemicals to the process will be removed by the MBR and will therefore not be present in the discharge.

River Temperature

The Schedule 5 asked three questions relating to the temperature of the discharge, and resultant river temperature. These can be summarised as follows:

1. Confirm at what point in the process the effluent will be at 25^{o}C, and what temperature the effluent will be at the discharge point, providing written evidence to show how this has been calculated.
2. Model the temperature of the river after the mixing zone.
3. Outline measures in place to reduce the effluent temperature before it discharges to the river.

Data provided by the EA shows water temperatures fluctuating annually between a low of 3.9^{o}C and high of 18.9^{o}C.



According to Aquabio – the manufacturer and installer of the plant – the MBR will increase the temperature of the effluent by up to 2-3ºC. The final temperature of the discharge, then, will depend on the temperature of the effluent input to the MBR. Prior to the MBR, the effluent will spend time in a 300m^3 balancing tank and so will reduce in temperature towards ambient. The effluent may have a temperature of up to 25ºC (according to the vendor, more likely 22-23ºC maximum) when it leaves the MBR, but this will vary with air temperature. It must then travel through approximately 1.2 km pipe before discharge into the Teme. A rule-of-thumb assumption of a 1-2ºC temperature drop per kilometre might be used. It has been suggested that a lined wetland and swale discharge arrangement is used prior to final discharge into the river, which will provide further cooling towards ambient air temperature.

The actual heat loss will be dependent upon the temperature and insulative properties of the ground and pipe used, the retention time in the swale, and will vary with air temperature (note that in winter when the river temperature is lowest, the effluent temperature will also be lowest). It is therefore not possible at this stage to calculate the actual temperature of the discharge.

In terms of measures to reduce effluent temperature, the wetland / swale system would allow the water to reduce in temperature. It is proposed that temperature is measured at three locations on commissioning of the discharge:

1. At the outfall of the MBR
2. At the final discharge point
3. After the mixing zone in the river

If the temperature of the river is found to be unacceptably increased by the discharge, further measures can be put in place quickly – for example a passive heat exchanger – to reduce temperature further. These cannot be specified and sized at the present time, because as stated above it is not possible to calculate the heat reduction requirement.

We feel that due to the unknown temperature from the source, the unknown temperature reduction in the pipeline and from the swale and the very variable river flows and temperature mean that any modelling done would not provide a high-quality prediction. Therefore, as above, we would suggest an interim period of up to a year monitoring as described above. If within that year the temperature from the discharge is shown to affect the river temperature above around 1ºC then a passive heat exchanger would be sized and installed. The temperature monitoring at the MBR and final discharge would then continue in line with the environmental permit requirements, and potentially the river temperature modelling as well if required. We believe this to be an appropriate approach as an Improvement Condition, as modelling or calculations will include assumptions that are difficult to validate at this time.

We trust that this appropriately responds to your queries on these points and provides clarification. Please let us know if you have any further queries. As stated above, details of the design of the swale-type discharge structure will be provided.

Yours sincerely,

Via email

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