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31st March 2017

**Saul White**
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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 31st January 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 further information in relation to the Groundwater Risk Assessment provided with our original application due primarily to the then proposed discharge to ground.

The October 2016 application detailed a proposed effluent treatment and discharge route which included:

1. Treatment to a high quality by a membrane bioreactor (MBR);
2. Further treatment in a designed and lined reedbed; and
3. Discharge split between soakaway to the local groundwater and the River Teme, depending on the height of the water table and river level on any given day.

This route was justified based on a desire to recharge the aquifer downgradient of where Radnor Hills is abstracting, and to allow for the complex nature of the ground- and

surface water in the area, with high groundwater levels during wet periods and drying of the river during dry periods.

Your Schedule 5 notice highlighted concern with this discharge pathway, regarding in particular the groundwater discharge aspect. These concerns can be summarised as:

1. How adequate control is given by the Environmental Management System (EMS) over where the discharge occurs;
2. How the reedbed and soakaway areas are sized, designed and constructed, with reference to the relevant British Standards (BS6297:2007);
3. Why relevant British Standards have not been followed in the design of the discharge scheme;
4. Whether the hydrogeological setting of the soakaway is suitable for groundwater discharge;
5. Whether the trade effluent would contain hazardous substances; and
6. Why discharge is not suggested to be made wholly to river.

The notice also suggested carrying out ground investigation works to support the desk-based Site Condition Report.

After detailed discussions with NRW and consideration of the concerns expressed in your Schedule 5 notice, and to avoid delays in permitting that could prolong the current unpermitted discharge to ground, **we have elected to withdraw the proposed joint approach of discharging to both groundwater and river, and discharge the effluent wholly to the River Teme** as suggested in paragraph 16 of your notice. This eliminates the groundwater discharge portion of the activity.

Many questions provided in your Schedule 5 notice are therefore no longer relevant[1], and so we use this response as an opportunity to describe the new scheme and river discharge in detail. Maps detailing the altered permit boundary are included in this submission (RH01.3 showing the installation site and RAD02-4-100-1-001 showing the pipeline and discharge location).

## Quality of Trade Effluent

Sections 13 – 15 of your notice request additional information and confirmation regarding the quality of the proposed trade effluent.

Discharge quality

Effluent will be treated by the treatment system described in the original permit application;

1. Balancing tank
2. Bioreactor tank with aeration, pH correction and nutrient dosing
3. Membrane biomass separation banks

The discharge quality of the permeate is shown in Table 1. The MBR is designed to treat a maximum of 290 $m^3$ per day.

*Table 1 - Expected quality of proposed discharge*

| Parameter | Design average | Minimum | Maximum | Units |
|---|---|---|---|---|
| Instantaneous flow rate | 7.6 | - | 12.1 | $m^3$ / hr |
| Daily flow rate | 193.5 | - | 290 | $m^3$ / d |
| Temperature | 18.17 | 15 | 25 | $^oC$ |

[1] Sections 1-12 and 17-19 inclusive are deemed to be inapplicable given the new proposed scheme and are therefore not addressed in this response.

| Parameter | Design average | Minimum | Maximum | Units |
|---|---|---|---|---|
| pH | 7.5 | 6.0 | 9.0 | pH |
| TSS concentration | 5 | <1 | 10 | mg / l |
| BOD concentration | 5 | <1 | 10 | mg / l |
| Ammonia as $NH_4$ | 0.5 | <0.5 | 5 | mg / l |
| Phosphorus as $PO_4$ | 0.2 | <0.2 | 1 | mg / l |

Ingredients, chemicals and spills

The treatment process will treat the various cleaning fluids *et cetera* that are used in Radnor Hills' process, and there is no expectation that any of these will be present in the final effluent.

As stated in your notice, some chemicals and ingredients are to be stored externally in a bunded and roofed area. This area will drain to a 30 $m^3$ holding tank to capture spills. This tank will drain to the 300 $m^3$ balancing tank, from where it will be pumped to the new effluent treatment plant. This two-stage holding would act to protect the biomass in the main bioreactor tank from shocks of 'neat' chemicals in the case of spills. The contents of the 30 $m^3$ tank would be slowly bled into the balancing tank, which would allow for dilution and mixing prior to entry into the main bioreactor tank.

It should be noted that the types of 'chemicals and ingredients' stored in this area are mainly syrups and flavourings (sugars which can be treated by the biological activity in the treatment plant), and acids and caustic (which can be treated by pH correction in the treatment plant). Chemicals for the boilers, cooling tower, and other chemicals are kept in different locations onsite and spills of these materials would be dealt with as recommended in their MSDS; not sent to the treatment plant.

Under the exceptional circumstance of a large spill the 30 $m^3$ holding tank and bunded storage area could be pumped out and the spill disposed of offsite rather than sent to the treatment plant. This would be managed by the EMS.

Hazardous substances

The current discharge has had historical issues with toluene and nonylphenol being present. Your Schedule 5 notice showed concern regarding their possible presence in the proposed discharge.

Toluene was of concern previously because it is identified as a hazardous substance for groundwater[2]. However, toluene is not a priority hazardous substance or a priority substance for surface water[3]; it is volatile and will not persist in surface waters. Now that the discharge is to surface water only, toluene is of a lesser concern, however we acknowledge that it should still be removed as far as possible from the effluent prior to discharge.

In the current system, toluene has not been found to be present in the effluent until after the reedbed, and is therefore being formed in the anaerobic conditions in the reedbed and lagoons, not produced by the manufacturing operations (seen in monitoring results from May 2016, June 2016 and August 2016). As effluent will be piped straight from the

[2] http://www.wfduk.org/sites/default/files/Media/170116%20Substance%20Determinationsfinal.pdf

[3] https://www.gov.uk/guidance/surface-water-pollution-risk-assessment-for-your-environmental-permit

balancing tank to the new MBR system, there will be no opportunity for toluene to form. It is therefore not expected to be present in the discharge.

As a freshwater priority hazardous substance, nonylphenol should not be discharged from the treatment plant. Aquabio – the provider of the treatment technology – has stated that they do not have experimental evidence that their specified treatment technology will remove all nonylphenol, however they can demonstrate the dramatic reduction in many other hazardous substances by their technology.

Academic studies have shown that nonylphenol can form during anaerobic sludge formation, and is not generally present during aerobic processes (Brunner et al., 1988[4]). Secondly, because nonylphenol is moderately volatile, it will tend to be removed by aeration (Lee et al., 1998[5]). These two factors mean that we would expect nonylphenol not to be present in permeate from an aerobic treatment system such as the one proposed, where the aeration in the bioreactor should act to strip out the nonylphenol.

Thirdly, nonylphenol – due to its hydrophobicity – tends to sorb to solids during wastewater treatment, especially when there is high organic content (Ejlertsson et al., 1999[6] & Giger & Ahel, 1991[7]), meaning that any nonylphenol present would be expected to be seen in the sludges from the MBR and not the permeate being discharged to river.

While we would not expect to see nonylphenol present in the discharge, there has not been a guarantee of this from the technology provider. Therefore, we would propose to test the permeate for nonylphenol once the MBR is up and running. If it is found to be present above the limit of detection, further work will be done on finding the source of the compound and eliminating it at its source (or preventing its creation).

For surface waters, the AA-EQS for nonylphenol is 0.3 µg/l, with a MAC-EQS of 2.0 µg/l. Nonylphenol has been sampled for from the outlet of the existing balancing tank 4 times in the past year, with the following results:

*Table 2 – Nonylphenol analysis results*

| Date | Concentration from EQT |
|---|---|
| February 2016 | 1.3 µg/l |
| May 2016 | 0.7 µg/l |
| June 2016 | 3.05 µg/l |

## Discharge Location

The permeate from the MBR will be piped to the nearest point downstream on the River Teme where flow is continuous year-round, at a point 134 metres upstream of Lingen Bridge. This is a distance of c.1.2 kilometres from the manufacturing plant, and will require pumping.

[4] Brunner, P., Capri, S., Marcomini, A., and Giger, W. (1988) Occurrence and Behaviour of Linear Alkylbenzenesulphonates, Nonylphenol, Nonylphenol Mono- and Nonylphenol Diethoxylates in Sewage and Sewage Sludge Treatment. Water Res. 22, 1465-1472.
[5] Lee, H-B. and Peart, T. (1998) Occurrence and Elimination of Nonylphenol Ethoxylates and Metabolites in Municipal Wastewater and Effluents. Water Qual. Res. J. Can. 33, 389- 402.
[6] Ejlertsson, J., Nilsson, M., Kylin, H., Bergman, A., Karlson, L., Oquist, M., and Svensson, B. (1999) Anaerobic Degradation of Nonylphenol Mono- and Diethoxylates in Digestor Sludge, Landfilled Municipal Solid Waste, and Landfilled Sludge. Environ. Sci. Technol. 33, 301-306.
[7] Giger, W., and Ahel, M. (1991) Behaviour of Nonylphenol Polyethoxylates and their Metabolites in Mechanical-Biological Sewage Treatment: In Proceedings of Seminar on Nonylphenolethoxylates (NPE) and Nonylphenol (NP), Swedish Environmental Protection Agency, Ingvar Bingman., 87-104.

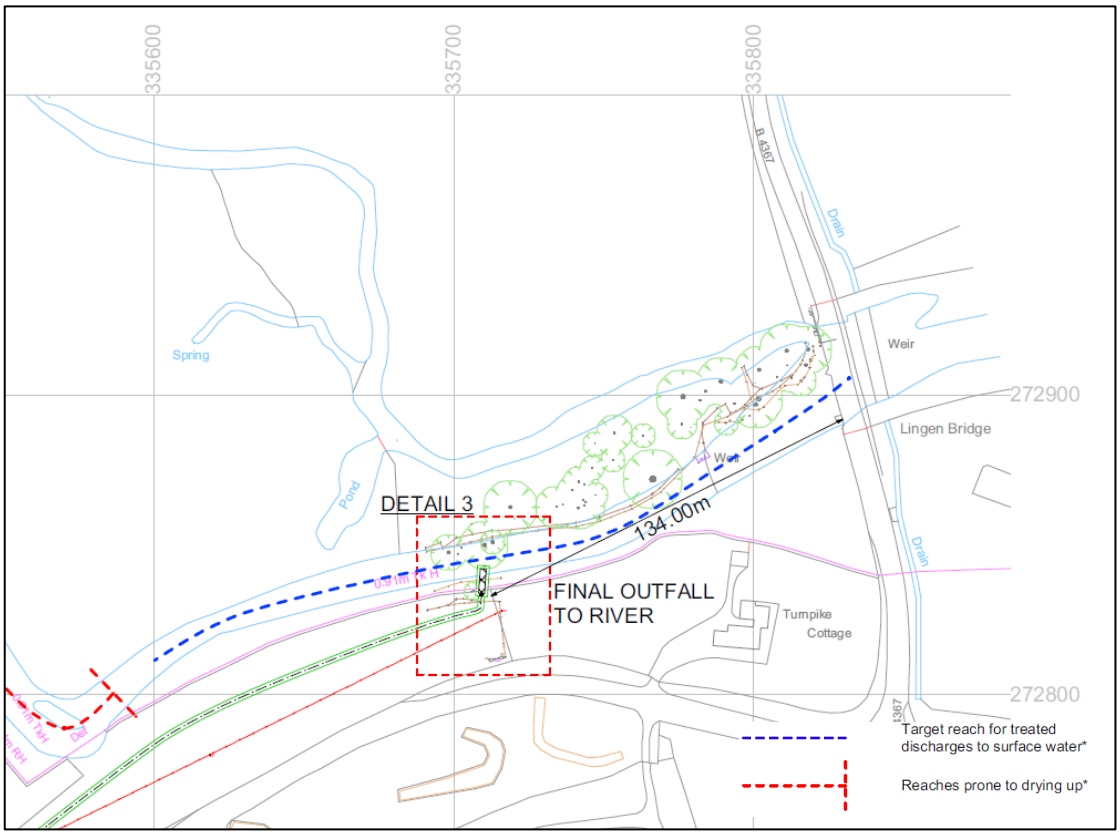
The location along the river at which there is continuous flow has been identified using information provided by the Environment Agency (P. Giles, 3rd March 2016), and is corroborated by the anecdotal experience of Radnor Hills and being east (downgradient) of where springs rise to the north of the river. The proposed discharge point is well within this reach of continuous flow.

Figure 2 shows an excerpt from RAD02-4-100-1-001 prepared by Wildfowl & Wetlands Trust (Consulting) Limited (WWTC), and shows the proposed location of the outfall. As can be seen, it is around 100m downstream of the location where the river flow is continuous.

Due to land ownership boundaries, this point is the furthest downstream that can be accessed from the south bank of the river. A river crossing was investigated as an option to take the outfall closer to the bridge (as flow does increase a little further downstream), however due to the very different heights of the north and south bank, the presence of overhanging branches and tree roots, and the susceptibility of the north bank to flooding, this was deemed to be unfeasible. As the proposed discharge point on the south bank is well within the reach of continuous flow, a river crossing to the south bank has also been deemed unnecessary.

It is understood that the construction of the outfall will require an environmental permit for a Flood Risk Activity. This will be submitted promptly to the Environment Agency (as the discharge location is in Shropshire).

*Figure 2 - Proposed discharge point (excerpt from RAD02-4-100-1-001).*




## Discharge Arrangements

The practical arrangements for the river discharge have been specified by Wildfowl & Wetlands Trust (Consulting) Limited (WWTC). Their report dated March 2017 should be read in conjunction with this letter.

The pipe route (shown in RAD02-4-100-1-001) covers mainly agricultural land with one road crossing under the A4113. A 90mm OD HDPE (PE100) plastic pipe with compression fittings has been specified, and all pipes, fittings and working methods will conform to the relevant British and other Standards, as described in Chapter 3 of the WWTC report. The road crossing is to be undertaken by a separate contractor and is therefore not covered within the specification. The pipeline will be pressure tested to prove that it is free from leaks and signs of physical distress at 1.5 times pressure at maximum flow.

The final outfall is located adjacent to the property boundary for Turnpike Cottage and discharges directly into the River Teme, 134 metres upstream of Lingen Bridge. The specified headwall is a precast concrete unit (suggested product Althon H3C), and is proposed to be situated at the top of the bank. Because the potential peak discharge velocity from the outfall pipe could be greater than 1 m/s, some degree of energy dissipation would be required in the design. An anti-erosion reno mattress has been specified to provide adequate energy dissipation and protect the bank from erosion.

Please refer to the WWTC report (March 2017) for full details of the specification for discharge arrangements and working methods.

## River Quality

A discharge to surface water is usually acceptable if it does not cause the water quality in the river to deteriorate. The impact of the discharge on river quality therefore needs to be modelled.

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 provide by the Environment Agency on request.

The following data have been used for the upstream river quality:

*Table 3 - River Teme upstream quality*

| Parameter | Mean average quality (2009) | Standard deviation | Source |
|---|---|---|---|
| BOD (mg/l) | 1.13 | 1.2 | Environment Agency WIYB[8] |
| Ammonia (mgN/l) | 0.018 | 0.012 | Environment Agency WIYB |
| Phosphate as P (mg/l) | 0.02 | n.d. | River Teme SSSI Diffuse Water Pollution Plan[9] - data from the Environment Agency |
| Suspended solids (mg/l) | 8.1 | n.d. | River Teme SSSI Diffuse Water Pollution |

[8] http://bit.ly/1U3Rids
[9] http://bit.ly/1PWWCTy

| | | | |
|---|---|---|---|
| | | | Plan[10] - data from the Environment Agency |

Data for other parameters are not available, and calculations have therefore not been possible.

The river flow data used in the calculations was provided to Sustainable Direction by Rukhydro by email on 6th May 2016. There are no nearby continuous flow data for the Teme (nearest gauge is at Tenbury) and so Rukhydro derived these flow statistics using available spot flows for the Teme near Heartsease correlated to gauged flows on other nearby rivers or rive stage measurements at Knighton. The derivation of the data is described in the Rukhydro (October 2016) Groundwater Addendum that has been provided to NRW previously.

- 95 percentile (stage at Knighton = 0.535 m): 0.09 $m^3/s$ (7,776 $m^3$/day)
- 50 percentile (stage at Knighton = 0.660 m): 1.32 $m^3/s$ (114,048 $m^3$/day)
- Mean flow (stage at Knighton = ~0.739 m): 2.29 $m^3/s$ (197,856 $m^3$/day)

Figure 4 shows the current mean river quality and quality standard for the four parameters with background data available, the design average effluent quality, and the resultant mean river quality calculated using the RQP software. It also shows the percentage increase in river concentration of that parameter, and for reference the threshold at which the river would deteriorate into the next quality standard.

*Table 3 - Results of river quality impact modelling*

| Parameter | Current mean river quality (mg/l) | Design average effluent quality (mg/l) | Resultant mean river quality (mg/l) | River concentration increase (%) | Threshold before deterioration to lower standard (mg/l) |
|---|---|---|---|---|---|
| Biological Oxygen Demand | 1.13 'High' | 5.00 | 1.18 | 4% | 3.00 |
| Ammonia | 0.018 'High' | 0.50 | 0.02 | 11% | 0.2 |
| Phosphorous as PO4 | 0.0613 'Good' | 0.20 | 0.06[11] | < 16% | 0.12 |
| Total Suspended Solids | 8.1 | 5.00 | 8.07 | - 0.4% | - |

The results above show that the discharge will have only a minor effect on mean river quality, with the largest impact being on ammonia at 11%. In all cases the river would remain well within its current quality standard for the parameter. Ammonia would oxidise within the river – especially due to there being a weir just downstream that will promote mixing and aeration.

## Monitoring

Effluent quality will be monitored at the outlet of the MBR membrane banks. This is labelled ES1 on the map RH01.3.

[10] http://bit.ly/1PWWCTy
[11] The precision of the software tool is such that the output does not show the impact of the discharge. It is only possible to tell that river quality would not decrease more than 16%.

## Site Condition Report

A desk-based Site Condition Report in line with H5 was submitted as part of the original permit application and updated to reach Duly Made status. In your Schedule 5 notice you requested that ground investigation work be undertaken to support this by providing a contamination baseline for the ground beneath the installation. It was noted that to not provide this information would be at Radnor Hills' own risk as the baseline would be presumed to be zero pre-existing pollution.

Extensive borehole water quality analysis has been conducted at the Radnor Hills site, including by the Environment Agency. We propose that this is used as a baseline for groundwater quality.

Geotechnical Engineering Ltd conducted intrusive investigative work on the site in March 2017. Their report has not been received at the time of writing, but has been promised on Monday 3rd April. This will be passed to NRW once it has been reviewed and authorised by Radnor Hills, together with Radnor Hills' abstraction water quality which provides a baseline for local groundwater quality.

We trust that this appropriately responds to your queries on this point and provides clarification. Please let us know if you have any further queries.

Yours sincerely,

*Via email*

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