

Stephen Buss Environmental Consulting

Horsham Borough Council
Parkside
Chart Way
Horsham
West Sussex RH12 1RL

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Hydrogeological Assessment: Water Neutrality Statement for Sandgate Nurseries, Henfield

Dear Sirs

The following document was compiled to demonstrate that it is feasible that the proposed potable water use at the site at Sandgate Nurseries, Henfield can be water neutral.

BACKGROUND

Natural England (2022) believes that groundwater abstraction in the Sussex North water supply zone (SNWSZ) has a detrimental impact on the Arun Valley SAC, SPA and Ramsar site. The development site, like the whole of Horsham District, is in the SNWSZ. Hence to prevent further deterioration of the SAC, SPA and Ramsar site, Natural England insists that:

“For every new development, total water use in the Sussex North Water Supply Zone after the development must be equal to or less than the total water-use in the region before the new development.”

Hence each new development will need to demonstrate how that development will achieve no net increase in water consumption, by water efficiency measures, offsetting or, in the case of this proposal, not being reliant on groundwater resources that are used for public water supply in the SNWSZ

THE SITE

The site is off Sandgate Nurseries, West End Lane, Henfield, Horsham, West Sussex, BN5 9UL and the centre of the site is roughly at grid reference 520425E 116061N. A borehole supply has been proposed to provide potable water for the development. This site is close to the River Adur, which flows southwards past Henfield, at a distance of 1.5 km from the site.

The borehole will be sited to draw the water supply for the site from a source that is not hydrologically connected to the Sussex North water supply zone. Henfield is not in the catchment of the River Arun, which provides hydrological support to the Arun Valley SAC, SPA and Ramsar site.

All water to be abstracted is for potable uses. Price and Myers Ltd has estimated the potable water demand, after introducing water efficiency and smart metering devices at 17.2 m³/day or 6284 m³/year.

Stephen Buss Environmental Consulting Limited, registered in England and Wales no. 08595273

Registered office: 32 Port Hill Road, Shrewsbury SY3 8SA

www.hydro-geology.co.uk

01743 246977

steve@hydro-geology.co.uk

GEOLOGY

The local geological succession is presented in Table 1, along with brief lithological descriptions. Allen et al. (1997) describes the aquifer potential for the Lower Greensand sequence as follows:

“...the Folkestone and Hythe Formations can be considered as the major aquifers within the Lower Greensand Group of the Weald. The Sandgate Formation which separates them forms an inconsistent aquitard. Where present, the Bargate Beds can be included in the Hythe aquifer, and where the Marehill Clay is absent and the permeable layers of the Sandgate Formation are in continuity with the overlying Folkestone Formation, the younger parts of the Sandgate Formation can be included in the Folkestone aquifer. At depth, away from outcrop, where the Lower Greensand Group is undifferentiated, the sequence is believed to act as one aquifer.”

Outcrop at the Sandgate Nurseries site is mapped as “Lower Greensand Group – Silty Sandstone” whilst the Folkestone Formation outcrop is mapped separately to the east of the site, beneath part of Henfield (Figure 1). The British Geological Survey GeoIndex records two local borehole logs that can be used to assess the likely geology at the site:

- Borehole TQ11/NE6, which was previously constructed at Lidd Nurseries, about 440 m west of the Sandgate Nurseries site. The log records 19 m of Sandgate Formation clays, then 11 m of “Sandstone with hard veins” of the Hythe Beds (Appendix A). The borehole did not reach the Atherfield Clay below.
- Borehole TQ11/NW1 was constructed in 1976 at Nep Town about 630 m south-east of the Sandgate Nurseries site. The log records 6 m of Folkestone Formation and then sands, siltstones, mudstones and clays of the Sandgate Formation to 30 m, then sandstone of the Hythe Formation to 72 m depth.

Hence the aquifer beneath the Sandgate Nurseries site will be the Hythe Formation, probably between about 25 m and 70 m depth. The thickness of the Hythe Formation pinches out to the west, north and south of the site.

The Hythe Formation aquifer is not part of the “Wealden Greensand semi-confined aquifer”, which is the main source of water for the Sussex North WSZ. This is the Folkestone Formation aquifer that is exploited by Southern Water’s Hardham boreholes about 17 km west of the site.

All potable water used in the development will be sent northwards for treatment at Henfield Waste Water Treatment Works (WWTW). The outfall from Henfield WWTW is on the Cutlers Brook, a tributary of the River Adur, at grid reference TQ2174917097, about 1.6 km north-east of Sandgate Nurseries site, and about 3.5 km upstream (Figure 2).

Given that it is reasonable to expect that that some proportion of the proposed abstraction’s yield will be sourced from the Adur catchment, the proposal is therefore likely to lead to a slight net gain in flow to the Arun catchment.

Table 1: Geological formations local to Henfield

Formations	Members	Lithology
Gault Formation		Mudrock
Folkestone Formation		Sand, with iron-pan deposits.
Sandgate Formation	Marehill Clay Member	Silty clay
	Pulborough Sandrock Member	Fine-grained sandstone
	Fittleworth Member	Complex sequence of clays, silts, sands
Hythe Formation		Fine-grained sands and sandstones
Atherfield Clay Formation		Mudrock
Weald Clay Formation		Mudrock

BOREHOLE YIELD AND SUSTAINABILITY

The target aquifer beneath the site is the Hythe Formation. Shand et al. (2003) summarise the hydrogeology from Allen et al. (1997) as follows.

“Groundwater flow in the Hythe Formation is predominantly intergranular where the sands are poorly cemented, but fracture flow dominates where the aquifer is more consolidated. The geometric mean of transmissivities from all parts of the Hythe Formation is 310 m²/day, with higher values (up to 1500 m²/day) being recorded where the aquifer is fractured. Transmissivities in the southern province of the study area tend to be quite high (around 1000 m²/day), whilst north towards Guildford they are thought to be lower, around 200 m²/day, because the sands are less well consolidated and flow is mainly intergranular.”

The log of borehole TQ11/NE6 records a pumping test at a rate of 78 m³/day which caused no drawdown after 8 hours. Most of the other wells in Henfield were completed in the Folkestone Formation and/or the Sandgate Formation and gave poor yields. But one borehole, TQ21/NW11, at Henfield Common about 1.3 km east of the site, exploited the confined Hythe Beds and yielded 59 m³/day with only 0.66 m drawdown after 8 hours.

These results indicate that the desired yield of 17.2 m³/day should easily be available from the proposed Sandgate Nurseries borehole.

Mean potential recharge to the River Ems catchment on the South Downs (for example) is about 398 mm/year (Buss, 2022) and for the North Downs is about 267 mm/year (Buss and Daily, 2010). Being about halfway between the South Downs and the North Downs, it might therefore be assumed that the potential recharge at Henfield is about halfway between the two values: 332 mm/year. If there was no runoff in the recharge area, the annual abstraction rate would be satisfied by the recharge passing through an area of 18 910 m², or a circle with radius 78 m.

GROUNDWATER QUALITY

There are no local examples of water quality in the Hythe Beds but Smock Alley Waterworks is completed in the Hythe Beds about 11 km west of Sandgate Nurseries (Appendix A). When the Smock Alley boreholes were sampled in 1948, water quality was fairly good and moderately hard, but not potable raw (Table 2). The water quality at the time slightly exceeded the drinking water standard for iron and approached the drinking water standard for ammonium.

Elsewhere in the Hythe Beds aquifer, there have been changes in groundwater quality since 1948. Most notably (Shand et al., 2003) there has been a rise in concentration of nitrate. However, the water chemistry required to keep iron dissolved tends to preclude high concentrations of nitrate.

Table 2: Water quality, Smock Alley Pumping Station, 1948

Determinand	Unit	Measurement	2024 drinking water standard
pH		7.4	
Ammoniacal nitrogen	mg N/l	0.345	0.39*
Albuminoid [organic] nitrogen	mg N/l	0.075	n/a
Nitrous (nitrite) nitrogen	mg N/l	0	0.15
Nitric (nitrate) nitrogen	mg N/l	4.0	11.3
Hardness, temporary	mg/l as CaCO ₃	197	n/a
Hardness, permanent	mg/l as CaCO ₃	63	n/a
Permanganate figure (chemical oxygen demand)	mg/l	0	n/a
Total [dissolved] solids	mg/l	340	n/a
Chloride	mg/l	26	250
Nitrate	mg NO ₃ /l	17.7	50
Iron	mg/l	0.36	0.2

* this standard for ammonium is not currently a statutory limit, but was previously.

CONCLUSIONS AND RECOMMENDATIONS

After review of available geological and hydrogeological data, the following conclusions may be made regarding design parameters for the borehole at the Sandgate Nurseries site:

- The effect of the proposed abstraction on the water balance of the Sussex North WRZ is negligible. All of the borehole yield will be from the Hythe Beds aquifer in the catchment of the River Adur. There is no interaction between the abstraction and groundwater in the Folkestone Formation aquifer: the “Wealden Greensand semi-confined aquifer”. The effect of the proposed abstraction on the water balance of the River Arun will be zero.
- There is no reasonable doubt that a borehole drilled to the recommended depth (see below), and completed correctly, will be able to yield in excess of 17.2 m³/day. The Hythe Formation is a good aquifer, that locally was able to supply 59 to 78 m³/day with little or no drawdown, and formerly maintained a public water supply abstraction of about 3000 m³/day near West Chilington Common.
- Water quality is probably good, and moderately hard. The iron concentration might be slightly above drinking water standard, and ammonium might be elevated.

It is recommended that the borehole be drilled at to the base of the Hythe Formation, and completed across its entire thickness. The base of the Hythe Formation is probably at a depth of c. 70 m. A pumping test should undertaken to verify the borehole yield.

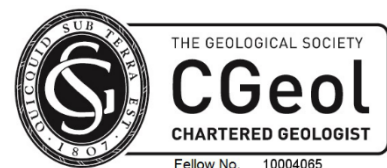
Water treatment for removal of ammonium, iron and possibly manganese should be anticipated (to be confirmed by taking a water sample on borehole commissioning). Elevated iron and manganese concentrations can be readily dealt with by filtration. If iron is present then nitrate concentrations should not be high enough to require removal. Elevated concentrations of ammonium might need treatment by, for example, reverse osmosis or ion exchange.

In summary, a borehole can be installed at the Sandgate Nurseries site that is capable of sustainably yielding 17.2 m³/day. The abstracted water will probably need treatment, but suitable treatment methods are readily available.

Yours sincerely



Dr Stephen Buss MA MSc FGS CGeol
Owner / Principal Hydrogeologist



References

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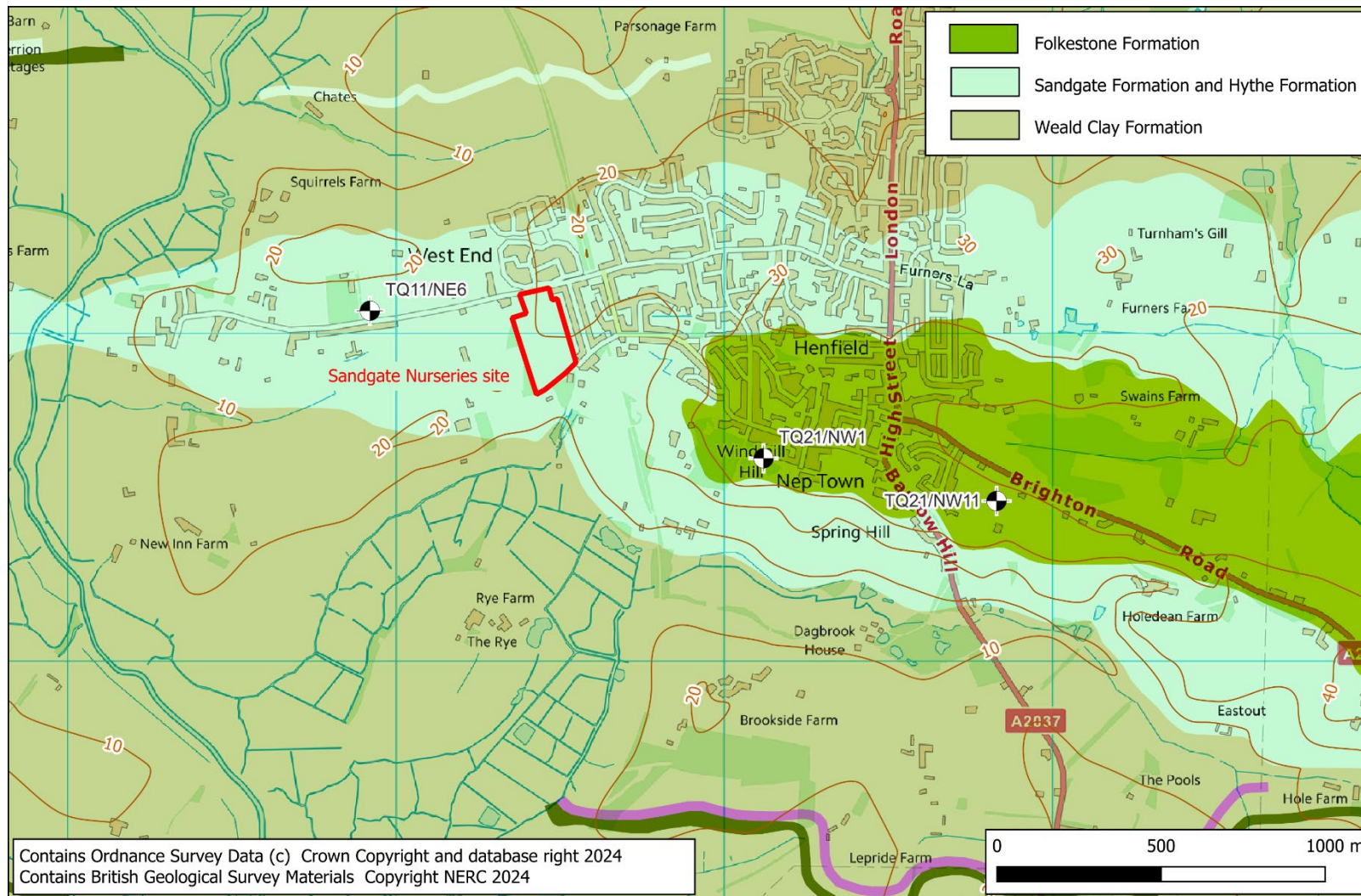


Figure 1: Bedrock geology and some local boreholes

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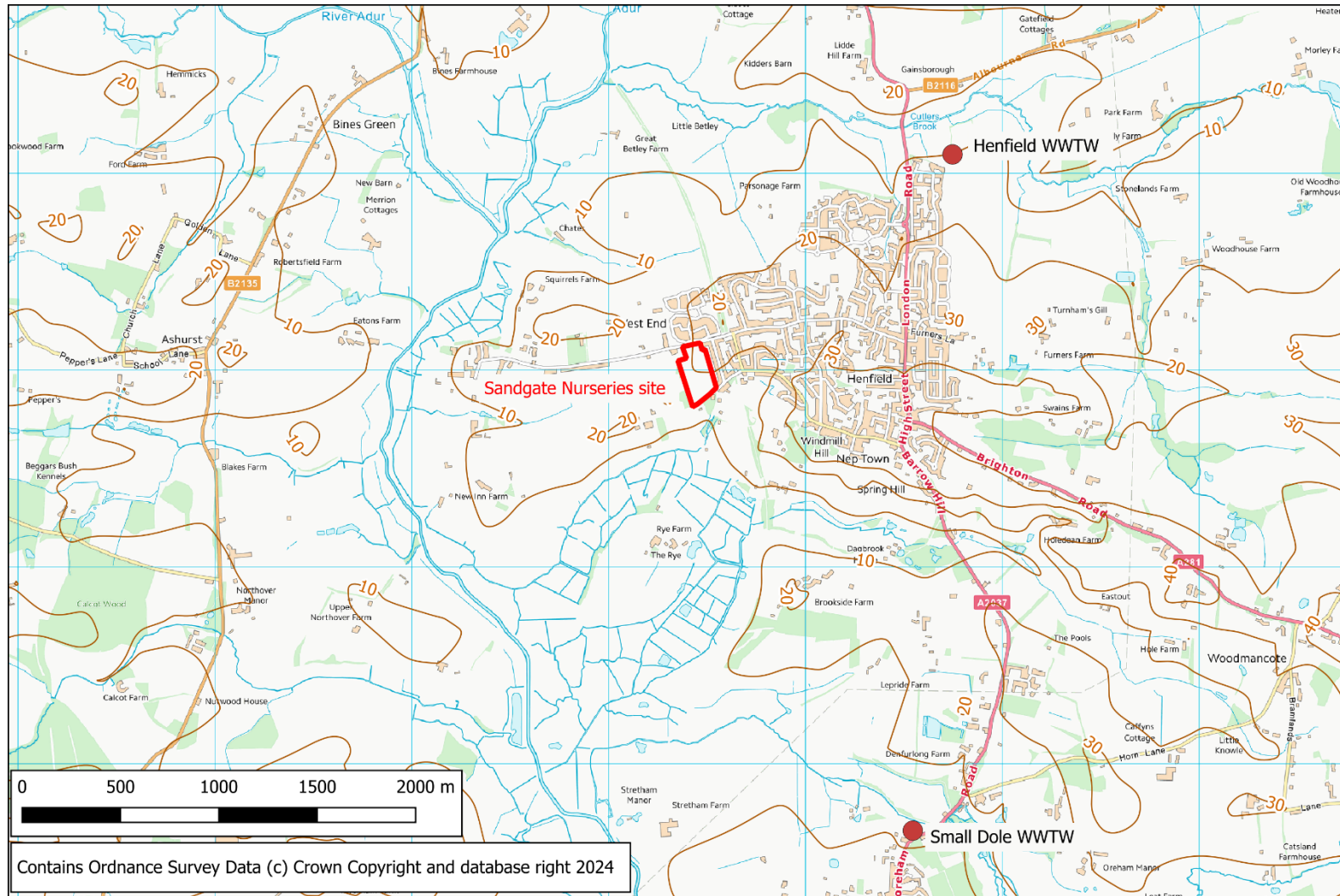


Figure 2: Local waste water treatment works (WWTW)

APPENDIX A: BOREHOLE LOGS

Presented as the following PDF files:

TQ11-NE6.pdf,

TQ21-NW1.pdf,

TQ21-NW11.pdf,

Smock Alley Waterworks log.pdf