AVON WATER CONSULTING LTD

Heyford Park Sewage Treatment Plant

An Assessment of the Odour Potential and the need for a Cordon Sanitaire

1.Background

Heyford Park is an ex-RAF base situated in Oxfordshire approximately 7.5 km to the north-west of Bicester. The site is being developed for residential housing by Dorchester Living. There exists a sewage treatment plant originally built in the 1960s which treats wastewater from the site.

Currently there is a 'cordon sanitaire' comprising undeveloped farmland around the treatment plant which extends to approximately 177m (see cover photograph).

Avon Water Consulting was asked to examine the odour potential for the existing treatment plant and to comment on the future need for a cordon sanitaire.

2.Works Description

The sewage treatment plant serves a population equivalent (PE) of approximately 1290 (2017) rising to 1830 (2018) and is in many ways typical of its era. The works comprises the following main treatment processes shown in Table 1.

Table 1. Main treatment processes at Heywood Park Sewage Treatment Plant

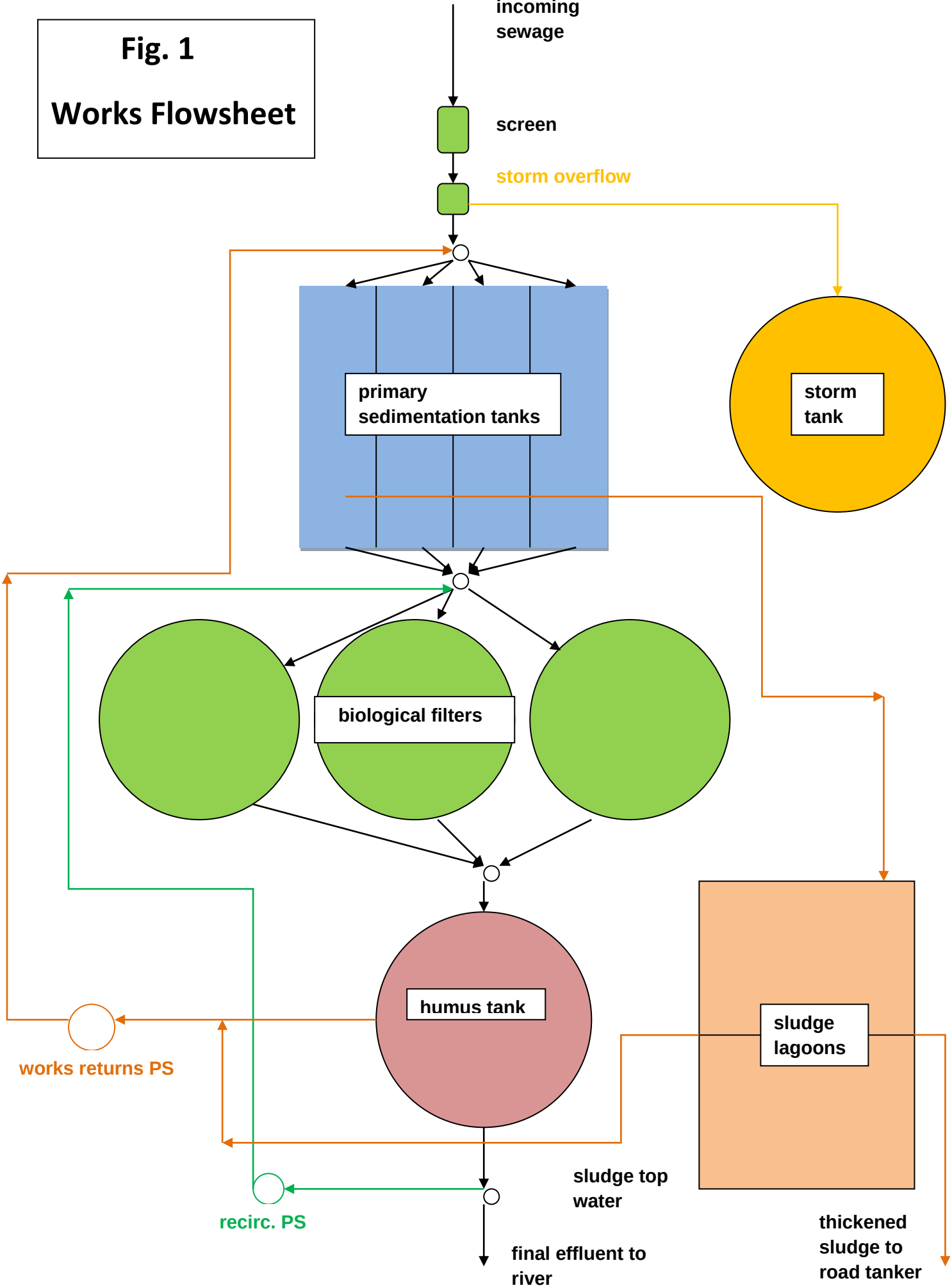
Treatment process	No. of units in use		Comment
Screens	1		New plant item in 2017
Primary sedimentation tanks	4		Shallow tanks need frequent emptying
Biological filters	3		Mineral media. Recirc. added in 2017
Humus tanks	1		Circular tank
Sludge holding tanks	2		Concrete lagoons.
Storm tank	1		Circular steel tank

Humus sludge (from secondary sedimentation) is returned ahead of the primary sedimentation tanks which produce a co-settled sludge. This is thickened in lagoons located to the south of the site and the thickened sludge is taken off site by road tanker.

The treatment plant flowsheet is illustrated in Fig.1.

Fig. 1

Works Flowsheet



3. Odour Standards

The Chartered Institution of Water and Environmental Management (CIWEM) published its Odour Control policy position statement (CIWEM, 2012) which concludes in relation to odour impact criterion:

'CIWEM considers that the following framework is the most reliable that can be defined on the basis of the limited research undertaken in the UK at the time of writing:

• C_{98}, 1-hour >10 OU_E/m^3 - complaints are highly likely and odour exposure at these levels represents an actionable nuisance;

• C_{98}, 1-hour >5 OU_E/m^3, - complaints may occur and depending on the sensitivity of the locality and nature of the odour this level may constitute a nuisance;

• C_{98}, 1-hour <3 OU_E/m^3, - complaints are unlikely to occur and exposure below this level are unlikely to constitute significant pollution or significant detriment to amenity unless the locality is highly sensitive or the odour highly unpleasant in nature.'

The Environment Agency issued guidance as to acceptable levels of odour based on the source of the odour (EA, 2002). These are reproduced in Table 2.

Table 2. Environment Agency Benchmark Odour Criteria (adapted from EA, 2002)

Odour criterion $C_{98}OU_E/m^3$	**Offensiveness**		**Odour Emission Sources**
1.5	**Most offensive**		**Decaying animals or fish remains**
			Processes with septic effluent or sludge
			Biological landfill odours
3.0	**Moderately offensive**		**Intensive livestock rearing**
			Fat frying (food processing)
			Sugar beet processing
			Well aerated green waste composting
6.0	**Less offensive**		**Brewery**
			Confectionery
			Coffee

These criteria appear to put sewage treatment plants in the 'most offensive' category owing to the production, storage and removal of sludge. (Sludge will almost certainly be septic after storage for a few days).

More recently, the Institute of Air Quality Management (IAQM) has issued guidance on the assessment of odour for planning (IAQM, 2014). The report recognises the variability in other recommended target levels and concludes that 'in any specific case, an appropriate criterion could lie somewhere in the range of 1-10 OU_E/m^3.'

However it notes (section 5.7 Recommended Odour Assessment Criteria for Planning) that 'the C_{98} metric [i.e. the use of OU_E/m^3 expressed as a 98^{th} percentile of hourly mean odour concentrations] is predicated on the basis of a constant odour emission whereas many odour emissions are intermittent or only occur for certain periods within a calendar year'. This is particularly relevant in the case of sewage treatment works where highly odorous activities such as primary tank desludging are regular but infrequent, and are rarely taken into account in modelling. In the specific case of Heyford Park STW, the variability in odour emission is likely to be even more marked with large spikes during desludging and on occasions when primary sedimentation tanks are emptied.

4. Odour Sources at Heyford

As at any sewage treatment plant where filters are the main biological treatment, the prime odour sources at Heyford Park STW are likely to be sludge holding tanks, primary sedimentation tanks, inlet works and the biological filters.

However at Heyford Park the primary sedimentation tanks and the sludge holding tanks are likely to give rise to a greater source of odour than is normal on this type of works.

The primary sedimentation tanks, unusually for a works of this size are rectangular in plan. Although they have been fitted with travelling flight scrapers in an attempt to improve the efficiency of desludging, this has not been wholly successful and results in the need to completely empty the tanks more frequently than would otherwise be the case. This emptying of the tanks exposes wetted surfaces to the atmosphere creating additional odour and prolongs the period of time for which the sludge holding tanks are disturbed and therefore emitting odour. The tanks are desludged once weekly and are emptied on a monthly basis.

If the primary sedimentation tanks were to be emptied less frequently the inefficiencies of the flight desludging system would lead to a build up of sludge and would risk the works failing the quality standards in its discharge consent.

Fig. 2 shows one of the primary sedimentation tanks being emptied and shows the wetted surface of the tank walls and floor exposed to the atmosphere and emitting odour.

Fig. 2. Primary sedimentation tanks during emptying

The sludge holding tanks are unusual in modern sewage treatment practice in that they are in the form of open lagoons. This makes them much more likely to transmit odours to the atmosphere compared with the glass-coated steel sectional tanks commonly used on a works of this size.

These open lagoons will be a source of odour throughout the sludge handling cycle; intense odour production during transfer of sludge into the tanks, mild but continuous odour production during sludge storage due to wind action across the tank surface, mild but prolonged odour production during the decanting of top water, and intense odour production during the removal of sludge by road tanker.

Fig.3 shows the sludge holding tanks with one tank being filled by the emptying of the primary sedimentation tank. This also shows the disturbance to the ‘crust’ which has formed on the tank surface.

Fig. 3. Sludge holding tanks with sludge discharging into one tank.

5. Odour Surveys at Comparable Sites

5.1 Malvern

Ove Arup carried out a Site Specific Odour Assessment at a development site in Poolbrook, Malvern (REC, 2013). This site is located 80m west of the Malvern STW operated by Severn Trent Water. The dispersion model ADMS 5 was utilised and for one run of the model (when emissions from the storm tanks were present) predicted odour concentrations ranged up to 5 OU_E/m^3 across the development site. A second run (without emissions from the storm tanks) predicted odour concentrations of below 1.5 OU_E/m^3 across the whole development site. However the emissions from the sludge tanks were NOT included within the model as emissions could not be monitored during the survey period.

Malvern STW is much larger than Heyford Park Sewage Treatment Plant but utilises the same biological treatment (biological filters). The sludge holding tanks were not included in the model; this is surprising as sludge storage and treatment is always a major source of odour. However despite this omission, the odour at the development site (80m from the works perimeter) was predicted to be up to 5 OU_E/m^3 i.e. above the CIWEM recommended level for avoidance of nuisance.

5.2 Princes Risborough

Princes Risborough was identified as having sites suitable for residential development comprising 1900-2500 homes. Amec Foster Wheeler/OdourNet carried out an odour control assessment for Princes Risborough WwTW as part of a wider study to look at impacts on river water quality (Amec Foster Wheeler, 2017).

The modelling showed that an odour limit of 3 OU_E/m^3 was reached at a distance from the works which encroached on the land earmarked for development. A rough scaling suggests that this distance would be approximately 200m from the works perimeter.

Once again Princes Risborough WwTW is much larger than Heyford Park STW but utilises the same biological treatment. The sludge treatment on this site is storage in a covered sludge holding tank and daily collection by road tanker. This sludge storage/removal operation is likely to be much less odorous than the process current at Heyford Park and indeed the modelling took little account of sludge as an odour source.

The Wycombe District Local Plan (Wycombe DC, 2017) contains an Indicative Constraints Plan (Fig. 27) which shows an area marked 'buffer to sewage works (150 m)'. In section 5.3.39 the report states 'The odour buffer needed around the sewage treatment works will restrict land uses within it. The land can be used for nature conservation and flood management.' This does suggest that Wycombe DC is planning a cordon sanitaire around the STW of about 150 m.

5.3 Stocksbridge

In December 2009, WYG completed an odour assessment of the Stocksbridge WwTW (Sheffield) on behalf of Bloor Homes (WYG, 2009). In this study the odour was modelled on the basis of the existing works as well as on the works after odour control measures had taken place.

No size was given for the Stocksbridge works and so comparison to Heyford Park on a size basis is difficult. However there were 4 No. biological filters (compared to 3 at Heyford Park) and the overall footprint for works suggested that Stocksbridge was somewhat larger. The primary sedimentation tanks appear to have been operated as septic tanks i.e. desludged

infrequently, and this will undoubtedly have added to the odour emissions from this source. The source apportionment for odour was established as follows:-

Table 3. Odour Source Apportionment for Stocksbridge WwTW

ODOUR SOURCE		MAXIMUM 98 %ile ODOUR CONCENTRATION (OU_e/m^3)
Inlet		1.4
Primary sedimentation tanks		168.5
Biological filters		26.7
Humus tanks		3.6
Tertiary tanks		22.5
Sludge tanks		127
Storm tanks		4.2

The importance of the sludge holding tanks to the overall odour emission can be clearly seen.

The modelling showed that the existing works would give rise to a maximum odour concentration of 179.5 OU_E/m^3 and that the critical level of 5 OU_E/m^3 was exceeded at about 200m downwind and 50-100m upwind.

Even with the extensive odour control measures proposed (covering and odour control units at the primary sedimentation tanks and sludge holding tanks and complete replacement of the biological filters with an activated sludge plant) the predicted odour remained at levels above 5 OU_E/m^3 at about 100m downwind of the works.

6. Cordon Sanitaire

The use of a cordon sanitaire (i.e. an area of land between an odour source and receptors e.g. domestic residents) has long been used by the Water Companies and their predecessors to minimise nuisance from sewage works. The cordon sanitaire is typically 25-400m and acts as a buffer against the impacts of odour and flies (Notts. & Nottingham Waste Local Plan, 2002). A number of District Local Plans have contained policies which reinforce the cordon sanitaire principle.

Anglian Water have produced a Guidance Document for Asset Encroachment Risk Assessment Methodology (Anglian Water, 2012). Based on an odour footprint of 1.5 OU_E/m^3 the distances recommended between the treatment works and the development for low, medium and high risk are shown in Table 4. As Heyford Park STW currently treats flows from

a population equivalent of approximately 1001-2500 the required distance for low risk of customer complaint is 200m.

Table 4. Anglian Water Risk Assessment Methodology (adapted from Anglian Water, 2012)

Population Equivalent (PE)		Distance between housing development and STW (m)				
		50	100	150	200	250
0-1,000		medium	medium	low	low	low
1,001-2,500		high	medium	medium	low	low
2,501-5,000		high	high	medium	medium	low

The cover photograph to this report shows the existing cordon sanitaire from the boundary fence at the sewage inlet.

7. Conclusions

Heyford Park STW is thought to have been built in the 1960s and is a treatment plant which is generally typical of its era. However the primary sedimentation tanks are unusual being rectangular in plan and consequently more problematic to desludge. Travelling flight scapers have been fitted and these are believed to have been partially successful in improving the desludging efficiency. However the tanks require regular emptying to prevent the build-up of sludge and this process adds to the emissions of odour at the site.

Other improvements have been made to the treatment system including the replacement of the inlet screen, the installation of biological filter recirculation and provision of a washwater system. These improvements are believed to have helped to maintain full compliance with the Environment Agency quality standards embodied in the discharge consent.

However despite the improvements made to the plant, the 1960s approach to the design confers the use of biological filters as the main biological treatment and open sludge lagoons for sludge thickening. Biological filters can in many cases be the 3rd largest source of odour on a sewage treatment works (after primary sedimentation tanks and sludge tanks) and can also be a source of nuisance from the flies which can arise from the biofilm on the media (Learner,M.A., 2000).

Although the Anglian Water requirements for a cordon sanitaire around sewage treatment works may seem overly protective, based as they are on an odour threshold of 1.5 OU_E/m^3, it is considered that in the case of Heyford Park STW they are appropriate. This is primarily because the works has primary sedimentation tanks which require regular emptying, has open sludge holding tanks and has biological filters which will be a source of odour and may additionally be a source of fly nuisance.
Currently there is a distance of 177 m between housing and the treatment plant at Heyford

Park. On the basis of the Anglian Water Risk Assessment (Anglian Water, 2012) this would result in there being between a 'low' and a 'medium' risk of odour complaints. It is recommended that the existing cordon sanitaire be maintained and that the risk of odour complaint is not increased beyond the current level.

John Churchley

Avon Water Consulting Ltd. January 26th 2018.

Version 2.0

8. References

Amec Foster Wheeler, 2017 Princes Risborough and Little Marlow Wastewater Treatment Works Assessment, ERea008i1R, May 2017, for Wycombe District Council.

Anglian Water, 2012 http://www.anglianwater.co.uk/_assets/media/121212_Asset_Encroachment_Risk_Assessment_Methodology_publish(1).pdf

CIWEM, 2012 Position Policy Statement – Control of Odour.

Environment Agency, 2002 Assessment of Community Response to Odorous Emissions. R&D Technical Report P4-095/TR.

IAQM, 2014 Guidance on the assessment of odour for planning, Institute of Air Quality Management, May 2014.

Learner,M.A., 2000. Egression of flies from sewage filter-beds, Water Research, 34, (3), p877-889.

Nottinghamshire and Nottingham Waste Local Plan, 2002, p107.

REC, 2013 Land at Poolbrook Site Specific Odour Assessment – Peer review, REC report 33384r11, 10th July 2013, for Malvern Hills District Council.

Wycombe DC, 2017. Wycombe District Local Plan, Regulation 19, October 2017.

WYG Environmental, 2009 Proposed Residential Development – Land Adjacent to the Stocksbridge Wastewater Treatment Works. Odour Assessment, December 2009, for Bloor Homes.