Welborne Wastewater Infrastructure

An Initial Infrastructure Assessment

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1.0 Background

Welborne, a proposed new development north of Fareham, borders Albion's appointed sewerage area just north of Knowle Village. Due to its proximity and the local topography Albion has sought to provide its sustainable water services to Welborne and has made a number of submissions to Fareham Borough Council (BC) during previous consultation phases, leading to Albion being considered as one option for wastewater disposal in the Welborne Plan.

Albion submitted a Preliminary Infrastructure Assessment in August in response to a letter of enquiry from Fareham BC dated 6th August 2014. A number of questions were raised in this letter in order that Albion might address outstanding issues relevant for a Statement of Common Ground (in relation to waste water infrastructure phases and existing capacity) to be produced for the Inspector appointed to examine the Plan. A recommendation was made within Albion's preliminary report to undertake an initial assessment of infrastructure in order to provide a measure of additional confidence in phasing capacity.

Additional detail was sought following the preliminary assessment, set out in an email from Fareham BC dated 21st August 2014. The results of further investigative work are contained in section 4 below. Section 3 provides some background information on Albion's existing operation at Knowle Sewage Treatment Works (STW). This report does not seek to replace or duplicate the previous preliminary infrastructure assessment.

2.0 Facts at a Glance

Distance of Welborne to Albion's Ravenswood Public Sewer	250 metres
Percentage of Welborne that could drain by gravity to Knowle STW	37%
Existing capacity at Knowle STW for Welborne wastewater until	2018
Change in tanker movements related to Knowle STW operations	+3/week (2018 on)
Change in lorry/van movements related to Knowle STW other activities	-46/week (ave.)

Very low operational energy requirements for the existing treatment process chain.

3.0 Knowle Sewerage and Sewage Treatment

According to historic ordnance survey records, Knowle STW was constructed in its present location and form in the inter-war years, most probably during the 1930s. It remained in private hands until Albion agreed to adopt it, along with the local sewerage network, in 2009. Various upgrades have been undertaken, are on-going or are planned to improve treatment resilience and to provide facilities for research and development programmes. The following sections provide background details on the current sewerage infrastructure.

3.1 Existing Arrangement

The current Sewage Treatment Works services approximately 750 domestic properties along with the NHS Ravenswood Hospital and a number of non-household users. Flows drain to the works by gravity via a 225mm diameter main inlet sewer, which collects the foul sewage from the Knowle Village area. Approximately 20% of Knowle Village drains directly to the Sewage Treatment Works by gravity including the Hospital via the Ravenswood Public Sewer. The majority of the remainder drains to the main Mayles Lane Pumping Station which discharges to the gravity inlet sewer. Figure 1 provides a plan of Knowle STW and local sewerage infrastructure.

3.2 Surface Water System

There is a limited area of combined sewerage that discharges to the Mayles Lane Pumping Station. Surface water flows are generally collected separately and drain through a combination of individual and collective soakaways and adopted SuDS features.

3.3 Inlet Works

Flows drain from the 225mm diameter foul sewer into the primary settlement tank effluent feed channels. There is no primary screening, between the inlet channels and the primary settlement tanks, therefore materials, which would ordinarily be screened are hand raked from the tanks and manually removed.

3.4 Primary Treatment

From the effluent inlet channels the flows can be diverted into one of two primary settlement tanks via four penstocks. Each primary settlement tank has internal dimensions of 3.6m long x 5.0m wide x 2.8m deep. The outlet of these tanks consists of a series of scum boards and a weir system containing Copasacs.

Two parallel secondary settlement tanks receive flows from the primary tanks and are each 4.7m long x 5.0m wide x 1.95m deep. At the outlet of the Tanks the effluent passes over a weir which in turn feeds the siphon tanks.

There are two siphon tanks each 3.1m long x 3.1m wide x 1.3m deep each containing a siphon, which activate on a level system prior to filling the header tank which provides a gravity feed to the secondary treatment phase.

3.5 Filter Beds

The secondary treatment consists of a biological treatment phase. The header tank currently feeds one of two trickling filter beds. A third filter bed, which has been temporarily decommissioned remains available for use, should future demand dictate.

The trickling filter beds are of a circular brick built construction and approximately 12.0m in diameter. Each filter bed is approximately 2.0m deep and filled with blast furnace slag aggregate.

Effluent from the trickling filters drain to a series of rectangular humus tanks for final settlement via a serious of open concrete channels.

3.6 Effluent Outfall

The outfall from the works consists of a 150mm diameter gravity outfall pipe, which passes underneath the adjacent railway line in a culvert to discharge from a series of eight 100mm diameter outlets to the discharge land adjacent to the River Meon. Historically this system used to discharge along a 600m system of sluices.

3.7. Sludge Treatment

There are no automated de-sludge facilities on the primary or secondary settlement tanks and they are periodically drained down for sludge removal. There is a sludge return pump station for the return of humus sludge to the head of the works.

Sludge is no longer dried or treated on site. Therefore all sludge is collected by a tanker on a weekly basis.

3.8 Current Consent

The existing discharge consent is subject to the following conditions:

- Biochemical Oxygen Demand (Allylthiourea) in 5 days @ 20°C not to exceed 40mg/l
- Suspended solids dried at 105 °C not to exceed 60mg/l
- The volume of effluent discharged under dry weather shall not exceed 685m^3 in any period of 24 hours

Additional or tighter conditions may result from planned and future Environment Agency reviews associated with the Water Framework Directive and Urban Wastewater Treatment Regulations.

3.9 Future infrastructure

The schematic in figure 2 illustrates how Albion could extend its treatment operations within existing land holdings in order to accommodate future flows from Welborne. Sensitive choice and placement of treatment processes and appropriate mitigation measures are necessary to both minimise any negative impact on neighbouring land owners and enhance positive improvements.

Figure 1. Map of Albion's Land at Knowle STW (including current discharge area)

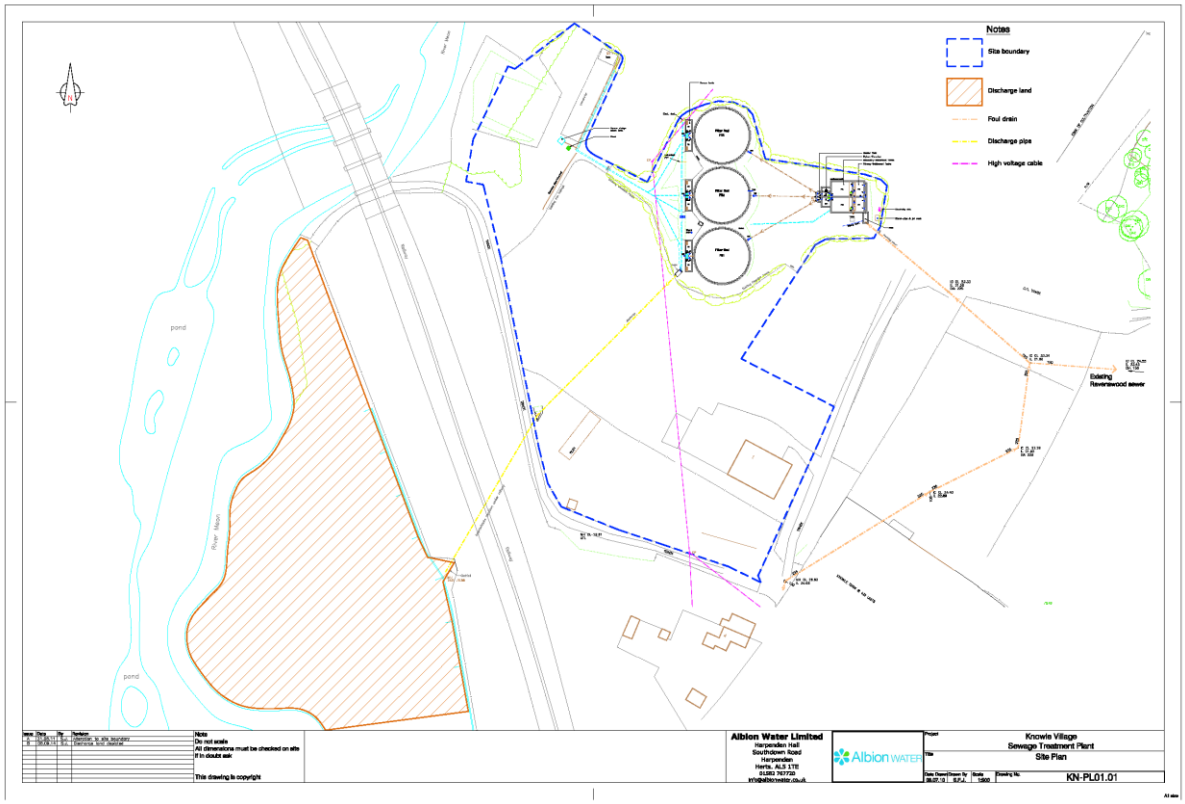
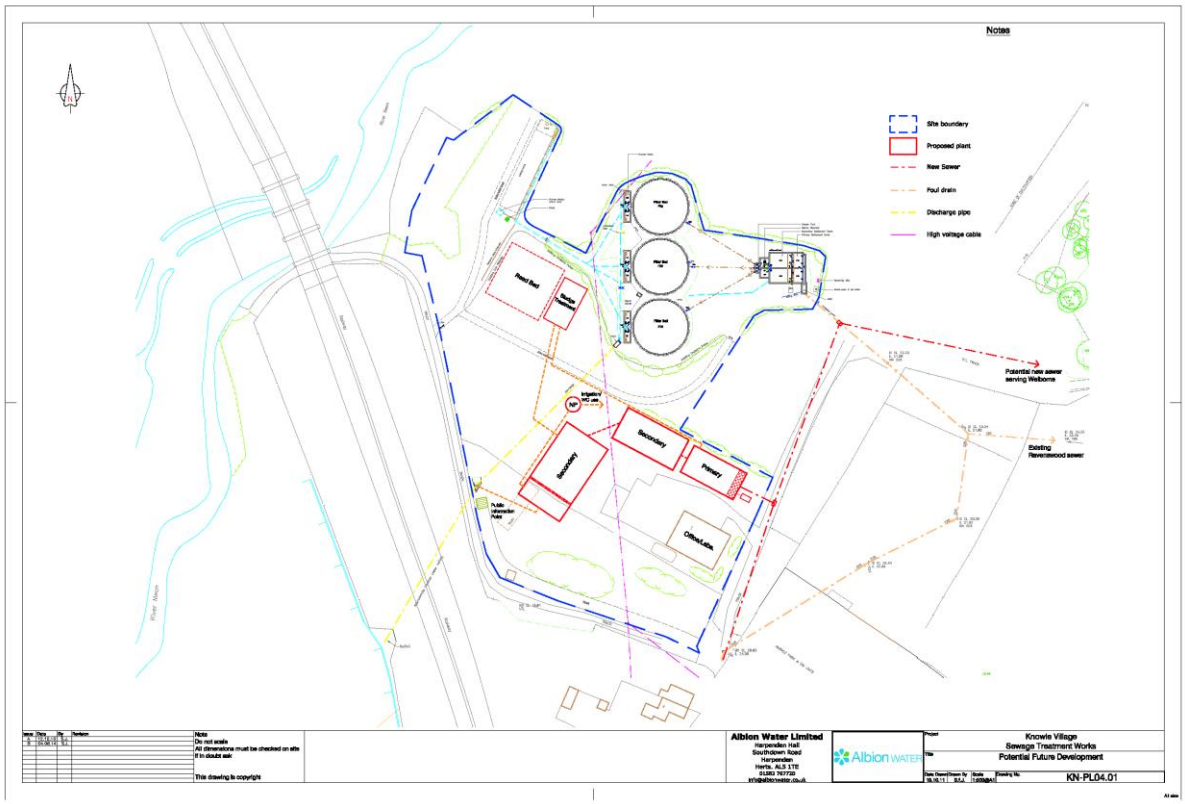


Figure 2. Potential Locations for Future Infrastructure



4.0 Initial Infrastructure Assessment – Knowle STW

In this report the following assumptions or definitions are relevant:

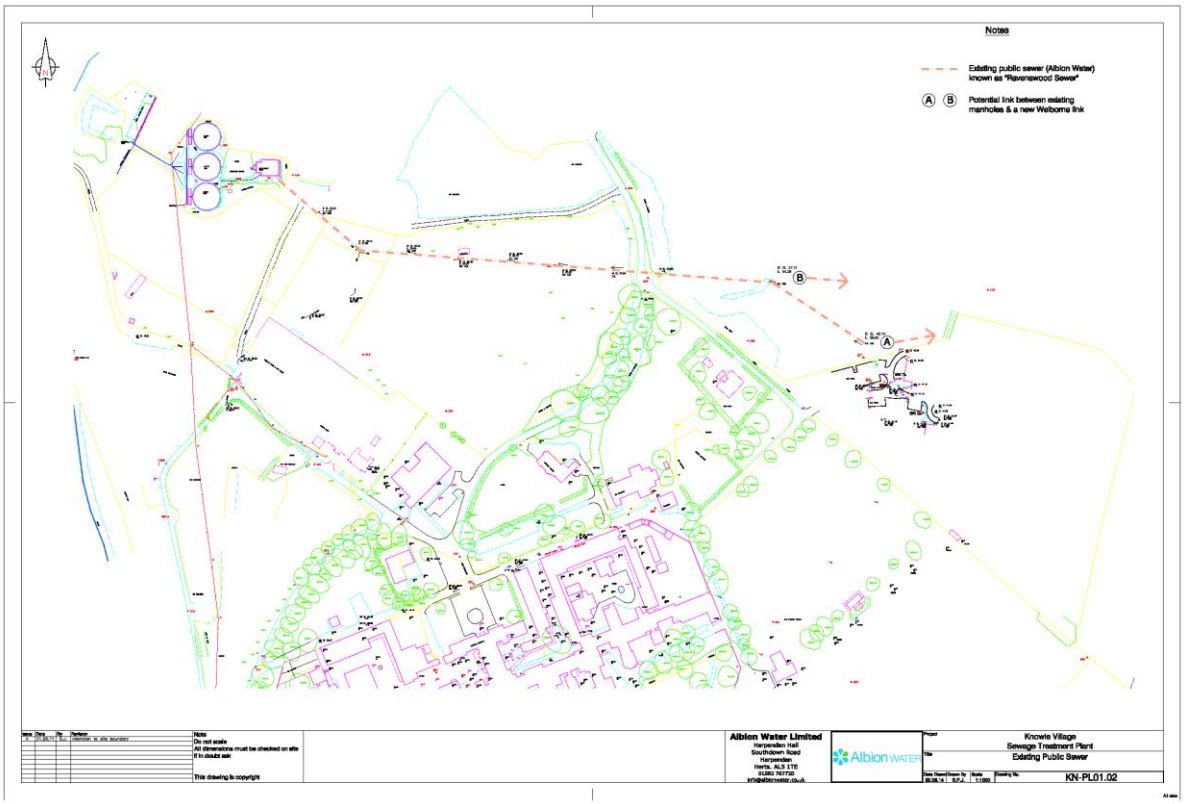
1. Details are based on the provision of a conventional water & wastewater system rather than one providing a recycled (greenwater) supply.
2. New properties are built to meet the Code for Sustainable Homes level 4 = 105 l/h/d
3. Off-site infrastructure refers to sewerage provision outside the Welborne area.
4. On-site infrastructure refers to sewerage provision within the Welborne area.
5. Discharge land is an area/areas of tertiary treatment land over which Albion is permitted to discharge secondary treated effluent.
6. The impact of employment completions is assessed by a fixed flow uplift due to the uncertainties associated with water consumption and type of non-household usage.

4.1 Existing treatment and sewerage infrastructure capacity

4.1.1 Sewerage

An existing public gravity sewer (the 'Ravenswood Sewer') connects the NHS Ravenswood Hospital, adjacent to the north west boundary of Welborne (see figures 3 and 8), with Knowle STW. This sewer, predominantly 150mm diameter vitrified clay pipe, was transferred into Albion's ownership following implementation of the Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011. Albion's operational experience and previous CCTV surveys have identified no significant serviceability issues.

Figure 3 Ravenswood Sewer - Albion's existing adopted infrastructure



An initial sewer connection with Welborne would require the installation of as little as 250m of 150mm off-site pipe. The positioning of on-site trunk sewers and pumping stations, along with estimated timings, are referred to in sections 4.2 and 4.3 below.

Given the limited number of existing connections to the Ravenswood Sewer and the fact that hospital usage has recently declined, it is estimated that discharges from 250 new homes could be accommodated in the existing sewer, increasing perhaps to 350 with minor repairs and pro-active management.

4.1.2 Sewage Treatment

Knowle STW was designed to service a hospital that accommodated up to 2000 high dependency patients, staff, a busy laundry and associated facilities. In short, a community discharging greater waste water quantities than the present day (potentially double current levels). Tighter discharge limits/environmental controls/resilience requirements exist today and ageing infrastructure limits the number of additional properties that could be adequately treated without infrastructure upgrades.

Peak flows associated with surface water ingress due to rainfall is, or could be, a limiting factor on new connections. Analysis of rainfall and incoming water levels over last winter's exceptional wet period are instructive. Figures 4 and 5 below indicate that there is limited surface water ingress except during periods of peak rainfall intensity. A review of this evidence and our assets on the ground has highlighted such ingress reflects overland flows (not groundwater – see figure 6, which has been used to demonstrate that even during wet periods groundwater depths are typically below local public sewers) within a restricted geographical area served by only 1km of sewer pipe.

Based on this evidence, operational experience and some minor infrastructure modifications, waste water from up to 500 new properties could be treated at Knowle STW (this number increasing to perhaps 800 with the addition of redundant secondary treatment).

Figure 4 Rainfall – January 2014 (during which Knowle received 250mm rainfall)

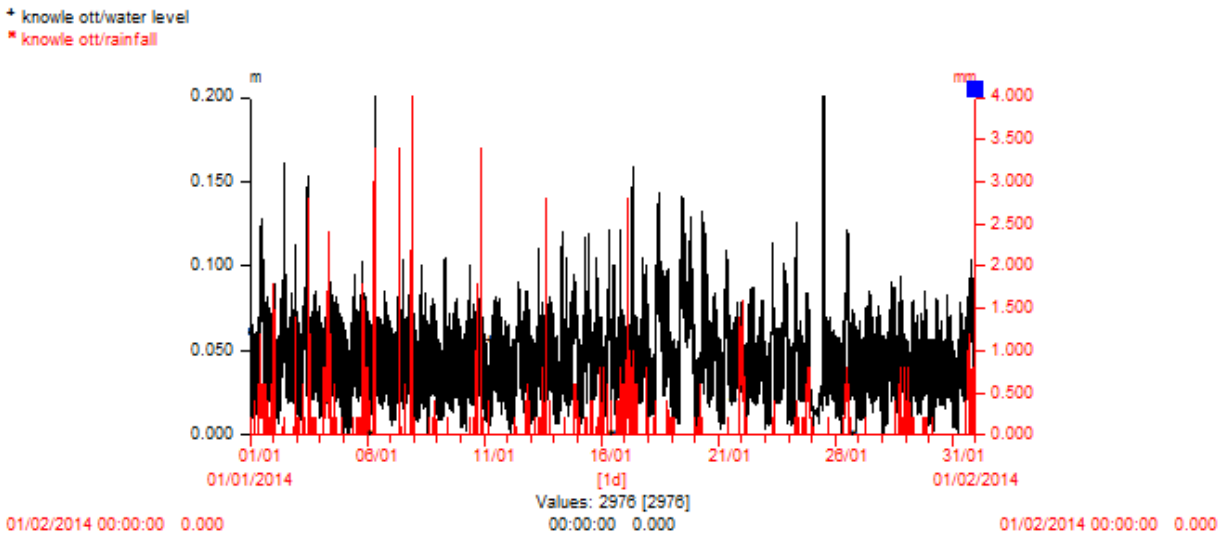


Figure 5 Rainfall – differing impacts of rainfall intensity on wastewater flows (14:00 to 17:00 rainfall having no impact on STW influent, whilst 21:00 rainfall increased water level)

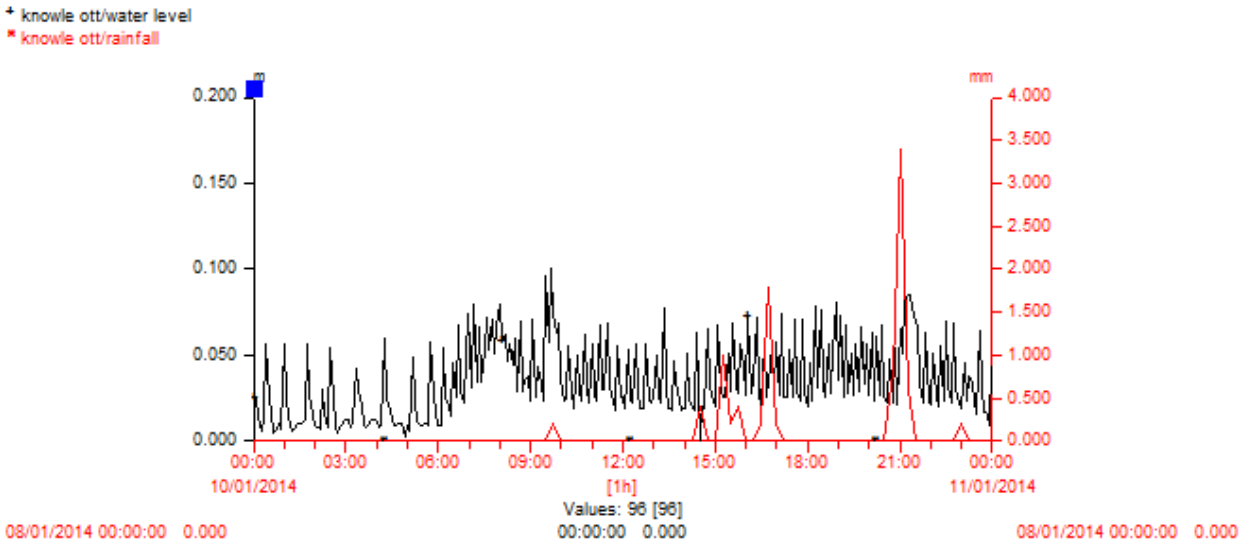
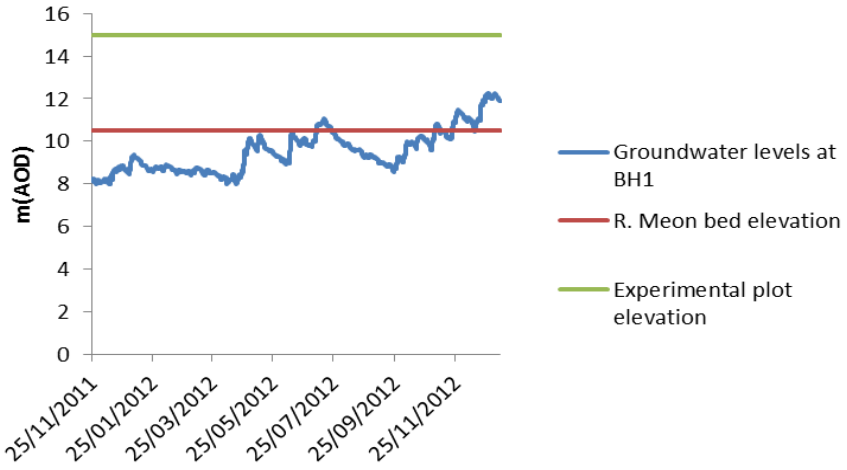


Figure 6 Groundwater levels in the vicinity of Knowle STW (taken at ground level 17.6m AOD)



4.2 Timing of off-site infrastructure upgrades associated with the Welborne development

Housing and employment trajectories were provided within Fareham BC's letter dated 6th August 2014. These are reproduced in Table 1 below, along with estimated wastewater arising (based on the assumptions in section 4.0) and identification of the critical points for off-site infrastructure upgrades or replacement.

Table 1 Housing completions, waste water arising and off-site infrastructure upgrades

Year end March	Properties	Wastewater (m3/d) = **A**	**A** + infiltration = **B**	**B** + non-hhld	Off-site infrastructure required	Est. cost £k
2015	0	0	0	0	Ongoing enhancement works	n/a
2016	0	0	0	0	Connection to Ravenswood Sewer	30
2017	120	34	37	41	Off-site sewer repairs	6
2018	300	85	94	102	STW modifications	500
2019	500	142	156	170	Upgrade/duplicate existing off-site sewer	525
2020	820	232	256	279	Commissioning of parallel STW	4,250
2021	1,160	329	362	395	Enhanced tertiary &/or direct discharge	300
2022	1,500	425	468	510		
2023	1,840	522	574	626		
2024	2,180	618	680	742		
2025	2,520	714	786	857		
2026	2,860	811	892	973		
2027	3,200	907	998	1,089	Commissioning of STW replacing existing	5,750
2028	3,540	1,004	1,104	1,204		
2029	3,880	1,100	1,210	1,320		
2030	4,220	1,196	1,316	1,436		
2031	4,560	1,293	1,422	1,551		
2032	4,900	1,389	1,528	1,667		
2033	5,180	1,469	1,615	1,762		
2034	5,460	1,548	1,703	1,857		
2035	5,740	1,627	1,790	1,953		
2036	6,000	1,701	1,871	2,041		
					Estimated off-site infrastructure	**11,361**

Based on the above analysis it is estimated that the off-site infrastructure investment required to service the Welborne development through to 2036 would amount to £11.5 million. This sum does not include any on-site infrastructure.

4.3 Site connection options

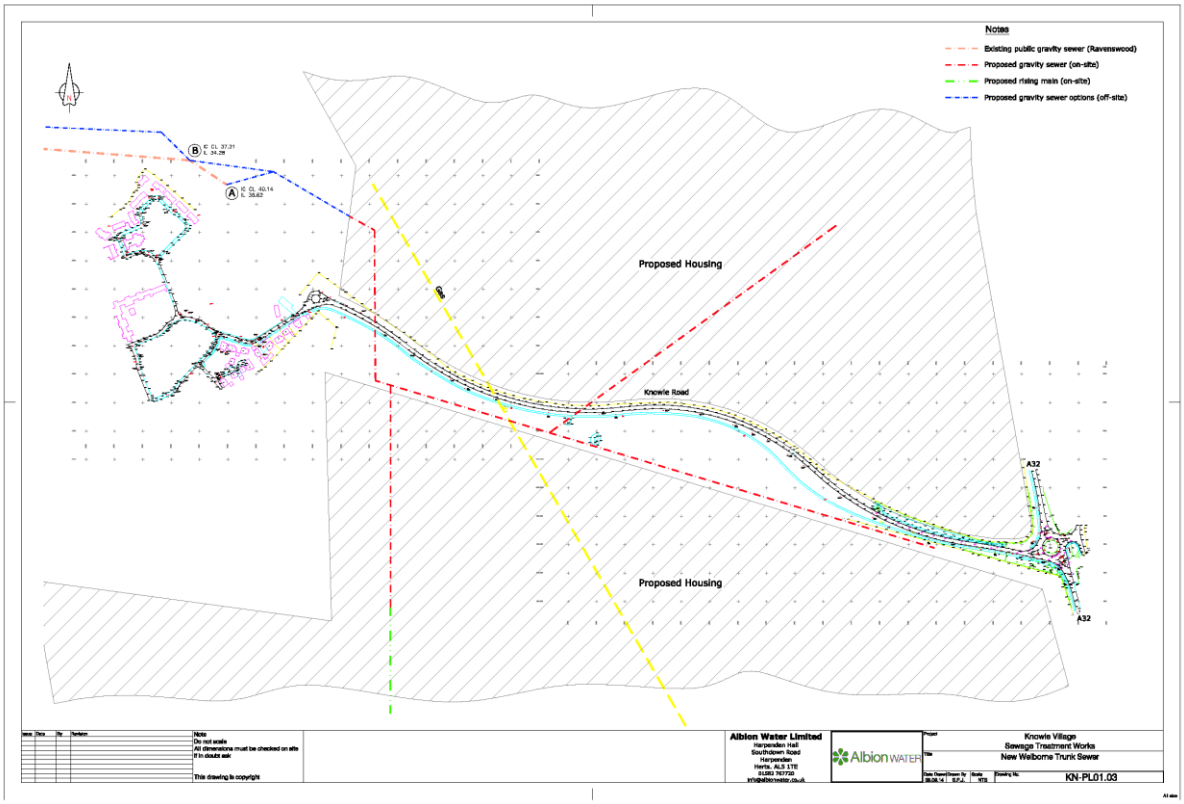
Based on land surveys and the published ordnance survey Albion believes that it is possible to connect Knowle STW and sewers serving the northern part of the Welborne development entirely by gravity. This area of development land equates approximately with the land to the north of a line drawn between Charity Farm (off the A32) and Dean Villas, Knowle Village - approximately 40% of the Welborne site.

The preferential use of gravity rather than pumped drainage is consistent with WEL37 and the forth objective of the Welborne plan, that is:
'*Fostering the principles of sustainability and resource efficiency in all development types, including reductions in water consumption and carbon emissions arising from operational energy use in buildings and infrastructure*'.

Only connection to Knowle STW can offer this important ongoing sustainability benefit.

The potential location of on-site and off-site gravity trunk sewers serving Welborne are illustrated in figure 7 overleaf, along with a potential link to a rinsing main serving the south of the site.

Figure 7 Trunk sewer connection options for Welborne to Knowle STW



As figure 7 shows, the first phases of Welborne (up to 2019) could be connected through a new sewer link entering Albion's public sewer at manhole A (invert level 36.6m) or, alternatively, manhole B (invert level 34.3m).

Early phase development in the southern Welborne area would need to drain by gravity towards the M27 motorway. It is too early to identify the final configuration for pumping but this would be best located to occupy an area/areas earmarked for employment land. A pumped network and rising main would then discharge waste water into the gravity trunk sewer (see figure 7). In order to delay the expenditure on pumping stations, it may be possible to provide a temporary gravity connection into Southern Water's existing sewerage system with the local provision of back-up storage for periods when there is insufficient capacity.

4.4 Treatment options

Table 1 in Section 4.2 addresses the timing for Knowle STW upgrades. Some elements of the new or upgraded works (post 2019) will be modular but it is not currently possible to identify the impact of this on the timing or quantum of required capital contributions.

4.5 Location of predicted waste water infrastructure to serve Welborne

Figure 7 above provides an illustration of the on-site trunk and rising sewer options and the off-site links.

4.6 Assessed cost ranges for infrastructure provision

Table 1 in Section 4.2 provides cost estimates for off-site infrastructure (conveyance and treatment). There will also be significant costs associated with on-site trunk, rising, district and local sewers that will not be too dissimilar for any waste water service provider. These costs have not yet been assessed; neither has the cost related to provision of adequate pumping capacity to lift waste water from the south of Welborne to the gravity trunk sewer. More information on phase and plot layouts will be required to provide a useful estimate.

4.7 Estimated tanker or lorry movements – pre and post Welborne development

At present there is on average just over one sludge tanker movements a week from Knowle STW. This represents the discharge from a population equivalent of approximately 2,000. In addition to these tanker movements there are also frequent van or lorry movements related to an arboricultural business currently renting space from Albion (approximately 46 per week but variable due to seasonal work). The traffic movements related to the latter operation would cease should Albion be selected to serve Welborne.

Integral to the STW upgrades is the provision of sludge handling and thickening facilities that will allow a more concentrated sludge to be tankered off. Rather than the weak sludge associated with the current operation, the same tanker will be able to take a greater burden of solids (e.g. tankering 1000 litres with 1% dry solids could be reduced to tankering 500 litres at 2% dry solids – so the same tanker could take twice as much solid matter). This will reduce tanker movements.

Based on our current records we do not believe that there will be any increase in sludge tanker movements until 2018, these may rise by one tanker a week until 2020 and by a further one per week from 2024. Additional operational supplies would be required on an ad hoc basis (equivalent to less than one movement per week). These additional tanker movements will be offset by the substantial reduction in traffic movements associated with the termination of certain Albion land use operations from 2016.

4.8 Dealing with increased flows through Knowle STW and the receiving environment

Table 1 above contains estimates of waste water flows arising from Welborne. These are in addition to existing throughput from Knowle. It will clearly be necessary to engage with the Environment Agency in relation to significant changes that might affect the receiving environment. Albion has in fact already been pro-actively reviewing the impact of its operations on the local environment and has a programme of research into tertiary

treatment, phosphate accumulation and algae treatment, benefiting from strong links with Cranfield University.

Upstream (US), downstream (DS) and groundwater monitoring has provided valuable information into managing our operations and recording our achievements. Figures 8 to 10 below provide a location map and examples of water quality results which provide one measure of evidence from which the impact of Albion's current operations can be reviewed. Much of this information has been generated during research for which Albion has an authorised exemption from the Environment Agency.

Figure 8 Location of sampling points

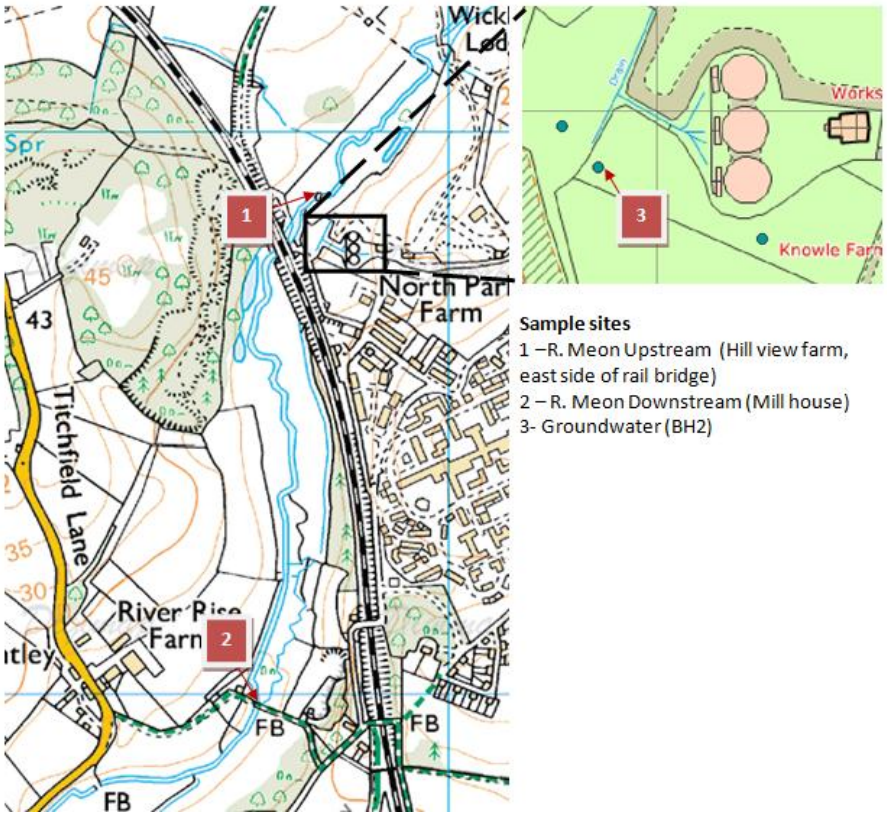


Figure 9 Dissolved Oxygen levels US and DS of Knowle STW

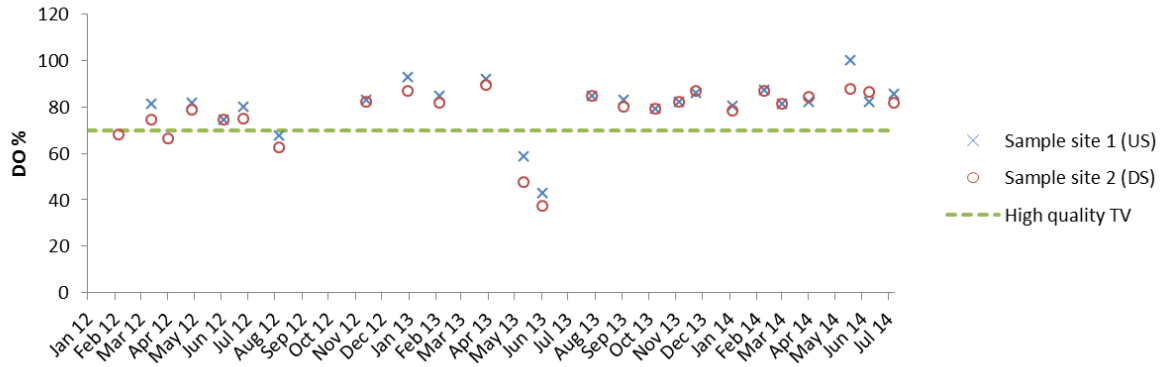
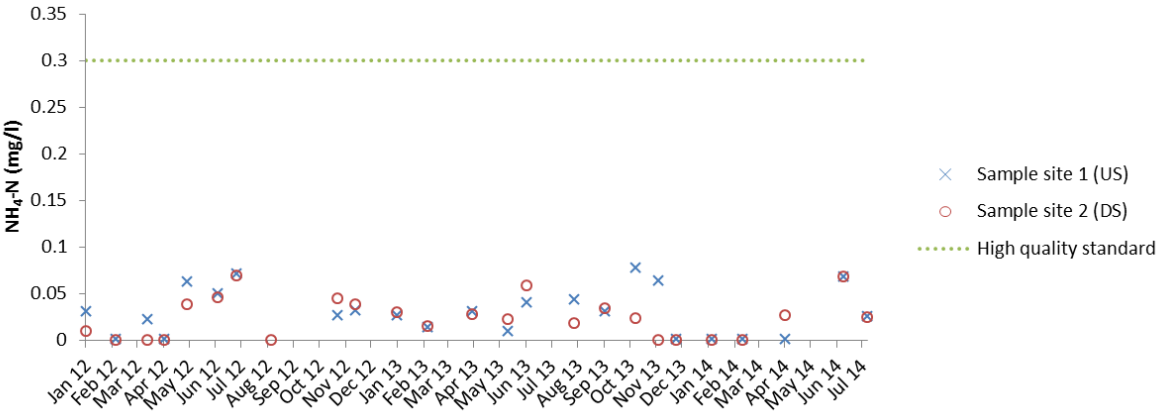


Figure 10 Ammoniacal nitrogen levels US and DS of Knowle STW



In the period up to 2020 Albion would need to discuss with the Environment Agency and other stakeholders how best to cater for the increased discharge flowing to the River Meon. This is likely to involve a combination of extended discharge land drainage by agreement with landowners (bordering the River Meon either to the north or south of Knowle STW) or the use of compulsory purchase powers and/or the provision of a direct discharge pipe. No work could or would commence until satisfactory environmental, flooding and habitat assessments are completed (including the biodiversity benefits associated with existing discharge land).

5.0 Public Document Statement

This report has been produced in response to Fareham BC's request for additional information to support its Statement of Common Ground. Albion is content that the details contained in this document can be disseminated to a public audience. Whilst every effort has been taken to assure accuracy, Albion does not necessarily support any inferences drawn by third parties or accept liability for any claims or actions resulting from the use of the data or opinions set out.