Proposed Expansion of Fennings Farm Poultry Site
Water Usage – Further Analysis
February 2023

This paper forms a response to the Essex & Suffolk Water (ESW) email dated 1 February 2023.

The below tables summarise the impact of the following factors not previously considered:
- drought year level rainfall
- evaporation from the reservoir
- run off losses between the roofs and the reservoir
- alternative water sources – bore hole supply and direct rainfall into the reservoir

The calculations have been carried out on the following MetOffice rainfall datasets:
- 1921 rainfall data – being the drought year proposed by ESW and the worst drought year on record
- 2013-2022 average rainfall data – being a realistic expectation of actual outcomes

1921 Rainfall
- Drought year surplus of 1,277m^3 – equivalent to 64 days bore operation
- Note that the next lowest rainfall since 1910 was in 2011 which had 454mm of rain – 30% higher.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rainfall (mm)	50.2	9.0	24.3	35.1	28.4	10.0	9.1	36.4	38.1	30.7	42.2	36.6	350.1
Rainwater Captured	1,399	251	677	978	792	279	254	1,015	1,062	856	1,176	1,020	9,758
Evaporation	(152)	(137)	(456)	(441)	(456)	(441)	(456)	(456)	(441)	(456)	(147)	(152)	(4,190)
Runoff Losses	(140)	(25)	(68)	(98)	(79)	(28)	(25)	(101)	(106)	(86)	(118)	(102)	(976)
Direct Rainfall	246	44	119	172	139	49	45	178	187	150	207	179	1,715
Rainwater Harvested	**1,403**	**142**	**297**	**647**	**424**	**(131)**	**(174)**	**672**	**739**	**496**	**1,161**	**982**	**6,658**
Bore	620	560	620	600	620	600	620	620.0	600	620	600	620	7,300
Total Water Available	**2,023**	**702**	**917**	**1,247**	**1,044**	**469**	**446**	**1,292**	**1,339**	**1,116**	**1,761**	**1,602**	**13,958**
Usage	**1,408**	**391**	**1,589**	**746**	**1,041**	**1,578**	**532**	**1,358**	**1,169**	**631**	**1,501**	**737**	**12,681**
Surplus / (Deficit) - m³	**615**	**311**	**(672)**	**501**	**3**	**(1,109)**	**(86)**	**(66)**	**170**	**485**	**260**	**865**	**1,277**

2013 – 2022 Average Rainfall
- Average year surplus of 9,801m^3
- Total water available is 97% of the total site requirement (including existing poultry houses)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rainfall (mm)	55.0	43.9	39.5	33.3	49.8	53.8	51.8	54.4	45.4	69.5	61.9	66.9	625.2
Rainwater Captured	1,532	1,223	1,101	927	1,389	1,499	1,445	1,516	1,264	1,938	1,725	1,866	17,425
Evaporation	(152)	(137)	(456)	(441)	(456)	(441)	(456)	(456)	(441)	(456)	(147)	(152)	(4,190)
Runoff Losses	(153)	(122)	(110)	(93)	(139)	(150)	(144)	(152)	(126)	(194)	(172)	(187)	(1,742)
Direct Rainfall	269	215	194	163	244	263	254	267	222	341	303	328	3,063
Rainwater Harvested	**1,551**	**1,223**	**768**	**590**	**1,089**	**1,225**	**1,150**	**1,230**	**965**	**1,699**	**1,771**	**1,922**	**15,182**
Bore	620	560	620	600	620	600	620	620	600	620	600	620	7,300
Total Water Available	**2,171**	**1,783**	**1,388**	**1,190**	**1,709**	**1,825**	**1,770**	**1,850**	**1,565**	**2,319**	**2,371**	**2,542**	**22,482**
Usage	1,408	391	1,589	746	1,041	1,578	532	1,358	1,169	631	1,501	737	12,681
Surplus / (Deficit) - m³	**763**	**1,392**	**(201)**	**444**	**668**	**247**	**1,238**	**492**	**396**	**1,688**	**870**	**1,805**	**9,801**

Conclusion

Even in the most severe drought on record, enough water could be sourced from a combination of rainwater harvesting and bore hole supply to meet the additional drinking water requirement of the proposed new houses.

Whilst the surplus water in a 1921 level drought is relatively small (albeit over 1 million litres), it should be noted that this is only relevant if a drought of this scale occurs in the first year of operation. The proposed reservoir provides storage for 16,000m^3 of water which could be built up in years with a surplus (which is expected to be the vast majority of years) and used to cover any short term shortfall in supply.

It is extremely likely that a technical solution to meet the water requirements for the site could be developed and the applicant would be happy to agree to a planning condition to this effect.

Modelling Assumptions

- **Drought Impact**

ESW have cited 1921 as an appropriate drought year to consider. Whilst the need to consider a drought from 102 years ago could be questioned, the data is available from the MetOffice and has been used to recalculate the potential rainwater available.

- **Evaporation**

Evaporation from the reservoir can be calculated at 1mm per m^2 of reservoir surface area per day during winter months (prudently taken as November to February) and 3mm per m^2 for summer months. This is based on standard MicroDrainage simulation criteria.

Evaporation has been based on a reservoir with a surface area of 4,900m^2 (which would be c.3.3m deep to hold the required 16,000m^3).

- **Runoff Losses**

An allowance has been made at 10% for water that falls on the shed roofs but evaporates before entering the reservoir (or is otherwise lost). No officially verified value for this runoff loss is available (and 0% is assumed in storm water calculations) but a runoff coefficient of 0.9 for pitched steel roofs appears to be generally accepted – see link in footnote 1 for example.

- **Comparison to Essex & Suffolk Water Calculations**

Applying the above assumptions to average rainfall from 1910-2015 (MetOffice data) results in average annual captured rainfall of 11,228m^3.

This is comparable to the 11,400m^3 indicated by ESW for the same period (although slightly more prudent). On this basis the evaporation & runoff assumptions appear appropriate.

- **Alternative Water Sources**

As acknowledged by ESW, there are alternative water sources which can be utilised in conjunction with rainwater harvesting to remove the need for additional mains water, even in a severe drought year:

1. Bore Hole

A bore hole could be installed to abstract up to 20m^3 without any requirement for an abstraction licence[2]. A number of neighbouring farms already use bore holes for supplying drinking water for livestock.

A bore hole would yield up to 7,300m^3 of water per year (20m^3 x 365).

2. Direct Rainfall

Whilst some water will evaporate from the reservoir, it is also true that some rain will fall directly into the reservoir.

Given the area of the reservoir being considered at 4,900m^2 even at 1921 rainfall levels this would result in additional 1,715m^3 of available water.

1. https://www.graf.info/en/rainwater-harvesting/all-about-rainwater-harvesting/lexicon/runoff-coefficient.html
2. https://www.gov.uk/guidance/check-if-you-need-a-licence-to-abstract-water