Technical Note

Project:	SES Water Drought Plan Support		
Subject:	Groundwater Options		
Author:	V Crellin		
Date:	February 2021	Project No.:	5198463
Distribution:	A Murphy	Representing:	SES Water

Document history

Revision	Purpose description	Origin-ated	Checked	Reviewed	Author-ised	Date
Rev 1.0	Draft	VC	LH	SW	SW	Jan 2021
Rev 2.0	Minor update to table 5.1	VC	VC	SW	SW	Jan 2021
Rev 3.0	Following client comment	VC	VC	SW	SW	Feb 2021
Rev 4.0	Update to Elmer WTW	VC	VC	SW	SW	Feb 2021

1. Introduction

Atkins is providing technical support to SES Water in the production of its 2021 Drought Plan. This technical note firstly provides a review of the potential groundwater drought options that could be included within the Plan and secondly summarises the selected Drought Plan options.

2. Screening of options

In 2019 Atkins undertook a review of deployable output (DO) at SES Water's groundwater sources. The DO assessment includes a consideration of whether predicted groundwater levels may constrain abstraction rates under certain climatic scenarios in order to determine the reliable source yield available over the course of a design drought, a 1 in 500 year event. The results of this assessment have been used as the basis for screening which sources would be suitable for supply-side drought options.

Drought permits and orders typically allow a temporary relaxation of abstraction licence conditions enabling additional water to be abstracted to meet an exceptional shortage in supply requirements. Therefore, those sources that are suitable as drought permit / order options are those where the 1 in 500 year DO is limited by the licence conditions, but where the source is capable of producing additional water and the associated water treatment works (WTW) have the capacity to process it.

However, prior to the application of drought permits and orders, there may be options to maximise water abstraction within licence through the installation of a larger pump or by lowering the pump depth. Whilst these may strictly be classed as WRMP options requiring capital investment, consideration to these potential options has also been considered in this technical note.

The screening therefore considered:

- Whether the DO was licence constrained under a 1 in 500 year event;
- Whether the DO was pump capacity or pump cut off constrained under a 1 in 500 year event;
- Whether there is spare headroom on the licence and group licence;
- Whether the WTW had capacity to process additional water;
- The size of the additional output benefit a drought permit would provide.

The results of the assessment for operational sources are shown in **Table 2-1** and disused sources in **Table 2-2**. The following is noted in relation to the tables:

- The DO constraints have been classified into three categories: hydrogeological, such as DAPWL constraints, infrastructure, such as pump capacity and cut off depth, and licence, including apportioned licences.
- A traffic light system is employed for each of the contributing aspects; green indicates suitability for drought option whilst red indicates a limitation.
- The screening result considers each of the aspects to determine the overall classification as potentially suitable for a drought permit / order; potentially suitable as an infrastructure drought option, or not suitable as drought options.

Table 2-1 - Screening of operational groundwater sources

Group licence	Source	1 in 500 MDO constraint	1 in 500 PDO constraint	Annual group licence capacity	WTW capacity	Screening result	Justification
Cheam	Cheam	Hydrogeological	Hydrogeological	Capacity	Capacity	Not suitable	Not licence constrained.
	Cheam park	Hydrogeological	Hydrogeological			Not suitable	Not licence constrained.
	Springclose Lane	Infrastructure	Infrastructure			Infrastructure option	Potential benefit is small. Source is pump capacity constrained. However, if a larger pump was installed this would give an additional 0.8 Ml/d (MDO and PDO) before the source became hydrogeologically constrained.
	Langley Park	Infrastructure	Infrastructure			Not suitable	Potential benefit is too small. Source is pump capacity constrained. However, if a larger pump was installed this would only give an additional 0.3 Ml/d (MDO and PDO) before the source became hydrogeologically constrained.
	Nonsuch Park	Licence	Licence			Permit / Order	Source licence constrains abstraction.
	Sutton	Hydrogeological	Hydrogeological			Not suitable	Not licence constrained.
	Sutton Court Road	Infrastructure	Infrastructure			Infrastructure option	If the source was not pump capacity constrained (0.64 Ml/d MDO and 1.1 Ml/d PDO) the source would be hydrogeologically constrained. This would give a small benefit of 0.96 Ml/d at MDO and 0.7 Ml/d at PDO.
Woodmansterne	Chipstead	Hydrogeological	Hydrogeological	Limited	Capacity	Not suitable	Not licence constrained.
	Holly Lane	Hydrogeological	Infrastructure			Not suitable	At MDO: Not licence constrained. At PDO: Potential benefit is too small. Source is pump capacity constrained. However, if a larger pump was installed this would only give an additional 0.32 Ml/d before the source became hydrogeologically constrained.
	Woodmansterne	Hydrogeological	Hydrogeological			Not suitable	Not licence constrained.
	Outwood Lane	Licence	Licence			Permit / Order	Source licence constrains abstraction.
	Smitham	Licence	Licence			Not suitable	Potential benefit is small. If the source was not licence constrained (5.7 Ml/d daily peak), the source would be infrastructure constrained (5.9 Ml/d). Drought option would generate a 0.2 Ml/d benefit.
Hackbridge	Hackbridge	Licence	Licence	None	Capacity	Permit / Order	Licence constraint is driven by the recharge volume.
Oaks/Woodcote	Oaks	Licence	Licence	None	Capacity	Not suitable	Licence constraint is driven by AIM* which is assumed cannot be breached (even in drought).
	Woodcote	Licence	Infrastructure / Licence			Not suitable	At MDO: Licence constraint is driven by AIM* which is assumed cannot be breached (even in drought). At PDO: Source is constrained by both licence (AIM) and infrastructure (pump capacity).
Kenley/Purley	Kenley	Licence	Infrastructure	PDO only	MDO only	Permit / Order?	Annual average licence constrains MDO.
	Purley	Licence	Infrastructure			Permit / Order?	Annual average licence constrains MDO.
Fetcham	Fetcham springs	Hydrogeological	Hydrogeological	Capacity	MDO only	Not suitable	Not licence constrained.
Leatherhead, Young St/Elmer	Elmer & Young	Licence	Licence	None		Permit / Order?	Capacity at WTW under MDO only.
	Leatherhead	Licence	Licence			Permit / Order?	Capacity at WTW under MDO only.
Dorking	Dorking	Licence	Licence	None		Not suitable	Potential benefit is small. If the source was not licence constrained (11.8 Ml/d) it would be infrastructure constrained (12 Ml/d). Drought option would generate a 0.2 Ml/d benefit.
Buckland, Clears & Cliftons Lane	Buckland	Infrastructure	Infrastructure	PDO only	Limited	Not suitable	Not licence constrained and limited WTW capacity.
	Cliftons Lane	Licence	Hydrogeological			Not suitable	Potential benefit is too small. If the source was not licence constrained (0.87 Ml/d) it would be hydrogeologically constrained (0.93 Ml/d) Drought option would generate 0.06 Ml/d MDO.
Brewer Street	Warwick Wold	Hydrogeological	Infrastructure	Capacity	None	Not suitable	Not licence constrained and no WTW capacity.

Group licence	Source	1 in 500 MDO constraint	1 in 500 PDO constraint	Annual group licence capacity	WTW capacity	Screening result	Justification
	Brewer Street	Infrastructure	Infrastructure			Not suitable	At MDO: Potential benefit is too small. The DO is constrained by pump cut off but the WTW spare capacity is only 0.37 Ml/d. At PDO: Not licence constrained and no WTW capacity.
Bletchingley	Bletchingley	Infrastructure	Infrastructure	Capacity		Not suitable	At MDO: Potential benefit is too small. Source is pump cut off constrained (2 Ml/d) but the WTW spare capacity is only 0.37 Ml/d. At PDO: Not licence constrained and no WTW capacity.
Godstone	North Park	Licence	Infrastructure	PDO only		Not suitable	No WTW capacity.
	Godstone	Licence	Infrastructure			Not suitable	No WTW capacity.
	Flower Lane	Licence	Infrastructure			Not suitable	No WTW capacity.
Westwood	Water Lane	Infrastructure	Infrastructure	PDO only	MDO only	Infrastructure option	Source is pump capacity constrained (2 Ml/d). If a larger pump was installed and at a lower depth, the source would be (apportioned) WTW constrained at 4.1 Ml/d. This has the potential benefit of 2.1 Ml/d. However, this source feeds an isolated zone, which historically has a supply surplus. Therefore, to benefit from this additional water during drought, network rezoning would be required.
	South Green	Licence	Licence			Not suitable	Potential benefit is small. If the source was not licence constrained (2.18 Ml/d) source would be infrastructure constrained (2.3 Ml/d). Drought option would only generate a 0.12 Ml/d benefit.
	Westwood	Hydrogeological	Hydrogeological			Not suitable	Not licence constrained.

* AIM = abstraction incentive mechanism

Table 2-2 - Screening of disused sources

Group licence	Source	MDO constraint	PDO constraint	Annual group licence capacity	WTW capacity	Screening result	Justification
Cheam	Secombe Centre	WRMP14 1 in 50yr: hydrogeological	WRMP14 1 in 50yr: infrastructure	Capacity	Capacity	Not suitable	Source out of supply due to bacteriological issues. Assessed in WRMP14 as non licence constrained (MDO 3.9 Ml/d, PDO 4.5 Ml/d). Group licence has 5 Ml/d spare capacity which would accommodate Secombe Centre pumping at WRMP14 DO rates. This assumes that abstraction from Nonsuch Park has not been increased through a permit.
Fetcham	Fetcham borehole	WRMP19 1 in 200 yr-hydrogeological	WRMP19 1 in 200yr-hydrogeological	Capacity	MDO only	Not suitable	Source now out of supply but not previously assessed as licence constrained and capacity on group licence.
Hackbridge	Bishopsford Road	n/a	n/a	None	Capacity	Not suitable	Source is not connected.
Buckland, Clears & Clifton Lane	Clears	n/a	n/a	PDO only	Limited	Not suitable	Source is capped off.
Godstone	Duckpit Wood	n/a	n/a	PDO only	None	Not suitable	Source is not connected.
n/a	Chalkpit Lane	n/a	n/a	Capacity	unknown	Not suitable	Source is not connected.
n/a	Pains Hill	n/a	n/a	Capacity	unknown	Not suitable	Source has been out of supply since 2000, and unlikely to be able to reinstate quickly in drought.

3. Potential infrastructure drought options

Prior to the implementation of drought permits and orders that may have environmental impacts, it is anticipated that SES Water would need to demonstrate to the Environment Agency that there are no alternative options within their existing licences. Whilst these are strictly WRMP investment options, the screening identified three potential options.

- Springclose Lane: There is the potential to install a larger pump to generate an additional 0.8 Ml/d at MDO and PDO. The benefit of this option is therefore relatively small.
- Sutton Court Road: There is the potential to install a larger pump to generate an additional 0.96 Ml/d at MDO and 0.7 Ml/d at PDO. The benefit of this option is therefore relatively small.
- Water Lane: Whilst there is the option to increase the MDO and PDO from this source by 2.1 Ml/d by installing a larger pump at a lower depth, the WTW feeds an isolated DMA. Therefore, this option has limited real benefit unless combined with an option to rezone this part of the network.

It is noted that this assessment has not considered the feasibility of these options, for example whether there is sufficient power readily available to power a larger pump, or whether the borehole diameter is suitable. However, from this review it is evident that there are limited options open to SES Water to maximise water during drought within their existing licence constraints.

4. Potential drought permits / orders options

The screening exercise identified five potential drought permit / order options. Each of these are considered in turn below. Whilst other options may be available, these would require water resource investments, e.g. to improve the treatment capacity at Godstone WTW.

Nonsuch Park

Nonsuch Park abstraction is limited by the individual licence limits on this source; the Minimum DO (MDO) is limited by the annual average (5 Ml/d) and the Peak DO (PDO) by the daily licence (12 Ml/d). The source also has a 60-day licence limit of 8.5 Ml/d.

Pumping test data suggest that the source is capable of producing a maximum sustained rate of 8 Ml/d. A drought option could therefore be to increase the annual average licence to allow abstraction up to 8 Ml/d over a maximum 6-month duration on top of the 5 Ml/d for the remainder of the year. The pumping test indicated abstraction above 8 Ml/d is not sustainable and therefore there is limited benefit in seeking to amend the peak licence condition. The group licence, Cheam Group, has spare headroom which would accommodate the 3 Ml/d increase in abstraction from Nonsuch.

Nonsuch Park is located in the unconfined Chalk adjacent to the headwaters of the Chalk fed Hogsmill. This option may therefore cause environmental impacts on the Hogsmill which would need to be investigated.

Outwood Lane

Outwood Lane DO is currently licence constrained (3 Ml/d at MDO and PDO) and there is limited headroom within its group licence, the Woodmansterne Group. Previous drought plans included an option of increasing the source and group licence to accommodate pumping at 8 Ml/d for a maximum 6-month duration. This rate was taken from the 10-day constant rate test undertaken in 2008[1]. However, given that the current pump capacity is 5 Ml/d and that 8 Ml/d may not be sustainable (water levels did not stabilise during the pumping test) it is suggested that 5 Ml/d would be a more appropriate drought option. This drought option would therefore be to increase both the annual licence at Outwood Lane and the Woodmansterne Group to allow an additional 2 Ml/d pumping from Outwood Lane for a maximum 6-month duration.

Hackbridge

The Hackbridge licence is complicated due to the recharge component, which determines how much water can be abstracted in the following summer, and the aggregation with Wandle Laundry (previously referred to as Sunlight laundry). Previous drought plans, which assumed the maximum 730 Ml had been recharged in the preceding winter, included options to:

[1] Atkins (2009) Outwood Lane pumping test

a) Increase the annual licence to allow for continued abstraction at 19 Ml/d for the remaining 8 days up until recharge recommences; and

b) Increase the daily and 30-day licence by 1.8 Ml/d (the allocation of Wandle Laundry) to disaggregate Wandle Laundry.

SES Water does not typically recharge the maximum volume, partly due to wasted water and energy when the benefit is subject to subsequent undetermined demand and partly to avoid recharging in the autumn when they may impact fish spawning. Therefore, the previous drought permit option is not suitable to how SES Water now operates the Hackbridge source.

It is proposed that the drought option decouples abstraction from the volume recharged and allows abstraction to be maximised (19 Ml/d) regardless of the volume recharged in the preceding winter. On the assumption that SES Water typically recharges 250-350 Ml/d, which permits a 15 Ml/d abstraction in the following summer, this permit would generate 4 Ml/d benefit. A condition of this permit could be a commitment that SES Water recharges a minimum volume in the preceding and following winter, subject to the drought not continuing into a multi-year drought (in which scenario the water may not be available for recharge).

Kenley & Purley

Kenley and Purley are licence constrained at MDO (22.79 Ml/d). The PDO (41.28 Ml/d) which is almost double that of the MDO, is constrained by pump capacity. Therefore, there is the potential for a drought option to increase the annual average licence such that the PDO could be sustained, generating up to 18.5 Ml/d. The capacity at the WTW and pump capacity limits the potential to increase PDO further.

Previous drought plans also included a drought option at Kenley and Purley. The option sought to increase the annual licence to allow the pumping at the then PDO rate of 24.9 Ml/d. The PDO has now significantly changed; in WRMP19 the PDO increased from 24.9 Ml/d to 41.28 Ml/d and has since been confirmed in WRMP24. There is therefore the potential for a larger drought option at Kenley and Purley than previously identified. However, this is not currently believed to be required. Whilst the results of the current round of water resource modelling are not yet available to clearly demonstrate this, initial modelling does not indicate larger deficits would be encountered than in previous plans. Therefore, it is assumed the volume of water provided by the previous drought permit/orders (9 Ml/d) remains sufficient, and consequently no adjustment to Kenley and Purley option is required.

Elmer & Young Street and Leatherhead

Elmer & Young Street and Leatherhead are currently licence constrained at both MDO (42.2 Ml/d) and PDO (58 Ml/d). In the absence of the licence constraints, the PDO at Elmer & Young Street would increase by 4.8 Ml/d and the MDO by 6.7 Ml/d (hydrogeologically constrained). Similarly, the PDO at Leatherhead could increase by 22.1 Ml/d and MDO by 12.9 Ml/d (infrastructure constrained).

There is therefore the potential for two drought options on this licence:

- Increase the daily licence limit by 3.3 Ml/d to maximise the capacity at Elmer WTW (84 Ml/d including water from Dorking and Fetcham).
- Increase the annual licence to allow sustained pumping of up to the Elmer WTW capacity (or network constraint). This would generate up to 21.7 Ml/d of additional water.

These sources are located adjacent to the Chalk fed river, the River Mole. The environmental impacts of this abstraction would need to be investigated.

5. Proposed drought plan options

Water resource modelling output for WRMP24 is not yet available, so, as stated in its pre-consultation letter dated September 2020[2] which was shared with stakeholders including the Environment Agency, SES Water is basing its draft Drought Plan on "*the methods and scenario analysis completed for our Water Resources Management Plan (WRMP) published in September 2019*". Based on the WRMP19 supply-demand modelling it is not deemed necessary that additional water is required from the drought permits/orders than identified in previous plans. Whilst moving from a 1 in 200 to a 1 in 500 baseline, and assuming the loss of the Thames Water transfer as a drought option, generates a reduction of 18 Ml/d and 32 Ml/d in MDO and PDO respectively, WRMP19 water resource modelling did not record any deficits for the duration of the planning period, well beyond the duration of this drought plan. Therefore the current understanding is that, with drought

[2] SES Water (September 2020) Draft Drought Plan: Pre-consultation letter

permits in place, SES Water will still be able to meet their obligations within the 5 year timescales of this current drought plan.

It is therefore suggested appropriate to retain the options from the previous Drought Plans, albeit with the revised detail to reflect the current DO position. These options have already previously been discussed with the Environment Agency and significant work has already been undertaken to quantify the environmental impact of these schemes. Further investigation into new options at Nonsuch Park and Elmer & Young Street/Leatherhead is currently unwarranted given this position but may be of value in the future.

The proposed drought options are tabulated in **Table 5-1**. It is noted that the drought option for Kenley and Purley could be increased, subject to the ultimate deficit predicted by the ongoing WRMP24 water resource modelling. Furthermore, although a 6-month duration has been assumed for each option, this will depend on the drought; the drought permit/order will cease operation earlier if supply levels recover.

Table 5-1 - Proposed Drought Plan options

Option name	Outwood Lane	Kenley and Purley	Hackbridge
Source of supply	Groundwater – Chalk aquifer	Groundwater – Chalk aquifer	Groundwater – Chalk aquifer
Licence number	28/39/41/0068	28/39/41/0037	TH/039/0041/014/R01
Licence period	Annual	Annual	Annual
Daily source limit (Ml/d)	3.024	44.39	19 (daily); 15 (30-day rolling) (assuming recharge of 280 - 350 Ml, in aggregate with Wandle Laundry)
Annual average source limit (Ml/d)	29.55 (in aggregate with Woodmansterne Group)	29.55	9.51 – 9.7 (assuming recharge of 280 - 350 Ml, in aggregate with Wandle Laundry)
MDO (Ml/d)	3.02 (constrained by licence)	22.79 (constrained by licence)	8.57 (constrained by recharge assumption of 280 - 350 Ml, excludes Wandle Laundry)
PDO (Ml/d)	3.02 (constrained by licence)	41.28 (constrained by pump capacity)	13.87 (constrained by recharge assumption of 280 - 350 Ml, excludes Wandle Laundry)
Permit or Order	Permit	Permit	Permit
Intervention level	3a*	3a*	3a*
Assumed drought option duration	6 months	6 months	6 months
Proposed drought option daily abstraction (Ml/d)	5 (Outwood Lane) 32.53 (in aggregate with Woodmansterne Group)	24.9 (380 Ml/d increase to group licence)	19 (in aggregate with Wandle Laundry)
Proposed drought option expected yield/gains (Ml/d)	1.98	2.11	4 to 5 (30day rolling) (exact benefit depends on volume abstracted by Wandle Laundry)
Permit/order requirements	n/a	n/a	Recharge in preceding winter of 280 Ml Best endeavours to recharge 280 Ml in following winter – feasibility of this condition will depend on drought duration / severity HoF at Grove gauging station is maintained through the Carshalton augmentation scheme

* presumed – to be confirmed by modelling of deficits at different return periods