

Drought Permit: Source X / Source S

Key Environmental Issues	Existing Monitoring / Surveys	Monitoring options
<p>Groundwater and Surface hydrology</p> <p><u>Groundwater</u></p> <p>The boreholes at Source X/Source S abstract water from the Chichester Chalk block aquifer which generally has low specific yields and high transmissivity. DO/DP conditions may result in short-term derogation of other springs and boreholes in the Chichester Chalk block aquifer. Previous studies have also indicated a link between pumping at Source X/Source S and Swanbourne Lake levels.</p> <p>Separate DO/DP could potentially be pursued by Portsmouth Water and Southern Water. Both Companies abstracts from the Chichester Chalk aquifer and they are both thought to affect Swanbourne Lake levels. It would be more logical to apply for the DO/DP at the same time and with the same justification. The potential event of both DO/DPs operating at the same time will need to be considered in terms of combined effects on groundwater, surface flows and standing water levels when analysing data. The proposed monitoring regime has been chosen to capture these.</p>	<ul style="list-style-type: none"> • Ongoing level monitoring in public water supply boreholes: <ul style="list-style-type: none"> ○ Source X (SW) ○ Source Q (PW) ○ Source R (PW) ○ Source S (PW) ○ Source T (PW) ○ Source Y (SW) • Private groundwater abstractions are also obliged to monitor levels and return data to the Environment Agency • Ongoing level monitoring in Observation boreholes, including: <ul style="list-style-type: none"> ○ Madehurst Stammers ○ Madehurst Punchbowl ○ Madehurst Lower Farm ○ Slindon Courthill ○ Swanbourne Copyhold ○ Tortington Test <p>Previous surveys and investigations are outlined in Appendix A.</p>	<p>Monitoring will continue before and during the DO/DP. The regime chosen may be influenced by any mitigation methods proposed (e.g. lake augmentation).</p> <ul style="list-style-type: none"> • Continue to monitor groundwater levels in public water supply boreholes: Portsmouth Water's Source Q, Source R, Source S and Source T boreholes and the Southern Water Source X and Source Y boreholes. • Also obtain an up-to-date list of vulnerable private licensed groundwater abstractions from the EA and monitor if appropriate. The most vulnerable abstractions will be the shallower wells. Private licenses over 20 cubic metres per day that may be affected include Baycombe Wood, Dale Park; Point A at Gaston Farm, Slindon; Point A at Woodlands Farm, Slindon; Madehurst Lodge, Arundel; Whiteway Lodge; Houghton Lodge and Havenwood Caravan park. • Monitor groundwater levels in observation boreholes. Suggested observation boreholes are Madehurst Stammers, Madehurst Punchbowl, Madehurst Lower Farm, Slindon Courthill, Swanbourne Copyhold and the Tortington Test observation boreholes. These have been chosen due to their location and length of record for the establishment of baseline conditions.

Key Environmental Issues	Existing Monitoring / Surveys	Monitoring options
<p><u>Surface Flow</u></p> <p>There is a groundwater component to flows in the River Arun derived from the Chichester Chalk aquifer, although the river is heavily tidally influenced from its mouth upstream to the weir at Pallingham Quay. DO/DP effects on flows in the River Arun below those normally observed in drought conditions would only occur at low tide and would not be observable.</p> <p>The Mill Stream, downstream of Swanbourne Lake is likely to be affected by groundwater levels and monitoring is recommended.</p> <p>The Park Bottom tributary, which joins the River Arun downstream of the confluence with the Mill Stream, may also be affected by the DO/DP. Possible effects include a decrease in flows and associated wetted width and depth below those normally observed in drought conditions.</p> <p>The rifes situated to the south of Tortington are known to only interact with groundwater during the wettest winters. These therefore do not need to be included in the monitoring regime.</p>	<ul style="list-style-type: none"> • Park Bottom flow gauging station (EA) 	<ul style="list-style-type: none"> • The tidal influence on the River Arun means that monitoring of flows on the river is not feasible despite the possible effects of the DO/DP at low tides. • Obtain and interrogate existing spot gauging data on Mill Stream. • Monitor flows in the Mill Stream during DO/DP. • Obtain and interrogate data from the EA flow gauge at Park Bottom. Continue to monitor during the DO/DP.

Key Environmental Issues	Existing Monitoring / Surveys	Monitoring options
<p><u>Standing water</u></p> <p>Swanbourne Lake is to the south-east of the Chichester Chalk aquifer. Lake level closely follows local groundwater levels, and studies have demonstrated a link between pumping at Madehurst and the lowering of lake levels. DO/DP conditions may result in the lowering of Swanbourne Lake level below that normally observed, although the lake has also been known to dry up on occasions during drought, irrespective of increased groundwater abstraction. In the case of the lake already being 'dry' increased groundwater abstraction from the Chichester Chalk aquifer will have no effect on the lake. The Lake would not be spilling during drought conditions but the effect of lowering groundwater levels is could impact on the downstream Mill Stream.</p> <p>The WWT reserve near to Swanbourne Lake is largely spring-fed and has some hydrological continuity with Swanbourne Lake. Previous surveys have indicated that water levels in the reserve are maintained by spring flow even when lake levels are at their lowest, however, monitoring should be carried out before, during and post DO/DP to establish any influence, especially in the event of the Source S DO/DP occurring in combination with the DO/DP at Source X.</p>	<ul style="list-style-type: none"> Swanbourne Lake level monitoring station (EA). WWT has previously monitored input from the springs, but it is not clear whether this is ongoing and it is understood that it was only undertaken annually. The East Hampshire and Chichester Chalk Groundwater Model characterise the impacts of groundwater abstraction at current, licensed and possible future rates. River flows, springs and harbour groundwater discharges can be estimated by the model. 	<ul style="list-style-type: none"> Lake level monitoring and data collection will continue before and during the DO/DP. Combined effects of Source X / Source S DO/DP will need to be considered in data collection and analysis. Monitor levels and/or flows at the WWT Reserve before and during the DO/DP.

Key Environmental Issues	Existing Monitoring / Surveys	Monitoring options
<u>Mitigation</u> Various mitigation measures are possible, for example augmentation of the wetland SSSI at the WWT site. This may influence the monitoring regime chosen and subsequent data analyses.		
Water Quality	Chemical Monitoring	
<u>Groundwater</u> Abstraction at full proposed DO/DP rate may result in higher turbidity of abstracted water.	Test pumping and groundwater analysis may be required	Monitor quality of abstracted groundwater before and during the DO/DP.
<u>Swanbourne Lake</u> Decrease in dissolved oxygen due to lower levels and algal blooms triggered by sunny warm still weather conditions typical of summer drought periods, although the lake has also been known to dry up on occasions during drought, irrespective of increased groundwater abstraction. In the case of the lake already being 'dry' increased groundwater abstraction from the Chichester Chalk aquifer will have no effect on the water quality of the lake.	None.	If the lake contains water, confirm dissolved oxygen is a problem if fish are seen to be distressed.
<u>River Arun</u> Significant effects on the water quality of the River Arun are not anticipated as a result of the DO/DP since the tidal flux is likely to be the dominant factor determining local water quality.	The nearest routine EA Chemical GQA location is on the River Arun upstream of the tidal limit (TQ 0358 2130).	Chemical GQA will continue at this site under EA routine monitoring procedures, before during and post DO/DP.

Key Environmental Issues	Existing Monitoring / Surveys	Monitoring options
<u>Other Surface Water Features</u> The water quality of various springs will not be impacted by increased abstraction.	Springs identified in various reports A.	None.
Biological Receptors	Biological Monitoring	
<u>Swanbourne Lake / Mill Stream</u> Invertebrates: The primary ecological interest of Swanbourne Lake according to Natural England is its invertebrate fauna. Previous studies for the EIA of the 2002/3 dredging scheme noted a reasonable invertebrate fauna.	There is no regular biological monitoring of Swanbourne Lake, although various bodies such as Natural England may hold copies of previous ad hoc reports. The following reports are known of: <ul style="list-style-type: none"> • The Coleoptera of Arundel Park (Peter Hodge, not dated, pre-1990); • 1995 Invertebrate Surveys of Swanbourne Lake (Andy Godfrey, 1995); • ES for Dredging Swanbourne Lake (Adams Hendry 2001, for Southern Water). Studies in 1995 indicated that at least eight Nationally Scarce and one RDB3 invertebrate species were associated with the lake or its wetland margins.	Surveys of the aquatic invertebrate fauna of the lake and Mill Stream during and after the DO/DP to provide indication of long-term effects of recent drought periods and lake drying on the invertebrate fauna.

Key Environmental Issues	Existing Monitoring / Surveys	Monitoring options
Fish: Swanbourne Lake supports a small coarse fish population but it is not fished.	<ul style="list-style-type: none"> ES for Dredging Swanbourne Lake (Adams Hendry 2001, for Southern Water). 	<p>No fisheries studies (beyond those undertaken in 2001) are considered necessary to support the drought permit application, although consideration should be given alongside an assessment of possible water quality changes.</p> <p>Weekly watch for distressed fish in the lake during DO/DP if operating while the lake contains water. Post signage informing recreational users of EA emergency contact number should they notice fish in distress.</p>
Biological Receptors	Biological Monitoring	
Other biological receptors: aquatic macrophytes and associated habitat are important in supporting amphibians, bats and breeding birds.	<ul style="list-style-type: none"> ES for Dredging Swanbourne Lake (Adams Hendry 2001, for Southern Water). 	
<u>The River Arun</u> The River Arun receives freshwater from Swanbourne Lake via the Mill Stream. However, it is considered unlikely that a reduction in flow from the lake due to the operation of the Source X or Source S will have a significant impact on the nature conservation interest of the Arun downstream of this point since the tidal flux is likely to be the most notable factor.	The nearest routine EA Biological GQA location is on the River Arun upstream of the tidal limit (TQ 0358 2130).	Biological GQA will continue at this site under EA routine monitoring procedures, before during and post DO/DP.
Designated Habitats	Habitat Surveys	

Key Environmental Issues	Existing Monitoring / Surveys	Monitoring options
<p>The following units of the Arundel Park SSSI could potentially be affected by the drought permit operation:</p> <ul style="list-style-type: none"> Unit 1 (Swanbourne Lake) – currently in 'Favourable' condition. Likely to be affected primarily in respect of its invertebrate fauna; Unit 2 (Reed bed and Mill Stream) – currently in 'Unfavourable Recovering' condition due to improved scrub control. Effects due to operation of DO/DP likely to be limited, probably related to impacts on invertebrates. 	<p>Natural England has a hard-copy SSSI site file, which details historical surveys of the Arundel Park SSSI.</p> <ul style="list-style-type: none"> Natural England has not re-assessed Swanbourne Lake since October 2010 but the lake is not a qualifying feature. Natural England re-assessed the condition of the reed bed in March 2014 and found a marked improvement. 	<ul style="list-style-type: none"> Check Arundel Park SSSI site file directly for further information on the ecological value of Swanbourne Lake / additional surveys not previously noted. Invertebrate surveys, as noted above.

Previous surveys and investigations include:

- i) Water Resources Source Filing: Sussex Coast Resource Zone. Madehurst 101265. Hydrogeological Services Ltd/ Southern Water; 2001
- ii) Conceptual Model of the hydrogeology of Swanbourne Lake in relation to possible dredging operations. Water Management Consultants Ltd/ Southern Water; 2000
- iii) Assessment of options to restore Swanbourne Lake. Entec/Environment Agency; 1997
- iv) Slindon Borehole Study; Swanbourne Lake Investigation and Field Tests at Swanbourne Lake. WS Atkins/Portsmouth Water; 1994
- v) Report on Hydrogeological Investigation of Swanbourne Lake Arundel. Rofo, Kennard & Lapworth; 1992