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NATURAL ENGLAND

WWF-UK case study: the impact of over-abstraction on the River Kennet

Summary

The purpose of this case study is to demonstrate the effects of over-abstraction on the ecology of a particular river. It looks at the current state of the River Kennet's ecosystem, the key drivers for protection, the evidence demonstrating abstraction impacts and future pressures.

This case study presents a complex picture of the river Kennet ecosystem within which river quantity, quality and hydomorphology and climate all play their part in determining the health of the river. What is clear is that the ecosystem of the river Kennet is already suffering, and the special habitats and species the river provides and protects are being affected. This is reflected in the current SSSI and WFD classifications, which are failing or at risk of failing statutory targets, with over-abstraction a key contributing factor.

Abstraction is having an impact on the river – it has been shown to lead to reduced river flows and falling groundwater levels have been observed over the period during which abstraction increased significantly. Low river flows, whether natural (due to low precipitation and drought) or manmade (the result of abstraction), can affect the sensitive ecology of the Kennet chalk stream (e.g. impairing the growth of water crowfoot). Abstraction reduces the resilience of the river's ecology to withstand natural low flows, which are increasingly likely under various climate change scenarios.

The evidence suggests that a reduction in abstraction is needed to protect the river both now, and in a future facing increased demand and climate change.

It is difficult to demonstrate scientifically direct causal relationships, due to the difficulties of isolating one variable in an incredibly complex picture. Further investigation is underway[1] to quantify the problem and measures needed to restore and protect the river's ecology.

[1] For example, a study looking at abstraction from the River Og, which is due to report in 2009.

Background

The River Kennet springs from chalk in the Marlborough downs and flows eastwards for around 40 km before entering the River Thames at Reading. The upper Kennet is designated a Site of Special Scientific Interest (SSSI) in recognition of its outstanding plant and animal communities, including Biodiversity Action Plan (BAP) priority species such as the water vole, water crowfoot (*Ranunculus sp.*), river lamprey and brown trout.

The catchment area, which covers 1200 km^2, is mainly rural chalk downland, predominantly used as arable farmland. There are several large towns along the main channel which discharge treated sewage directly into the Kennet. The catchment provides water for public and industrial supply by means of surface and groundwater abstractions.

Current state of the ecosystem

Over the last decade, there have been growing concerns about ecological deterioration of the river.

In 2008, the SSSI condition for units on the upper Kennet was *"unfavourable no change*[2]*"*, with water abstraction and high levels of pollutants (acerbated by low river flows) included amongst reasons for the adverse condition. A classic chalk river in favourable condition is characterised by gin clear water, a clean gravel bed and luxuriant beds of water crowfoot (*Ranunculus* sp.). Clean gravels and healthy macrophyte beds are integral to the life cycle of a wide range of invertebrates and to the recruitment success of wild fish. By contrast, flow in unfavourable reaches typically appears sluggish and turbid. Gravels become coated with sediment, algal growth excessive and water crowfoot (*Ranunculus* sp) scarce or absent.

More progress is needed in order to meet the PSA target for chalk river SSSIs to be in favourable or recovering condition by 2010.

The Water Framework Directive (WFD) assessment to date classifies the Og and Middle Kennet as "moderate ecological potential" (the Upper Kennet is yet to be assessed). All three water bodies are anticipated to be "not good" by 2015, with quantity and dynamics of flow significantly contributing to the not achieving "good ecological status". There is still considerable work to do in terms of understanding catchment dynamics and the impact that low flow quantity is having upon the environment; more investigation is needed.

The current SSSI and WFD assessments suggest that low flows impacting the ecology and are preventing the Kennet from achieving ecological targets.

Abstraction

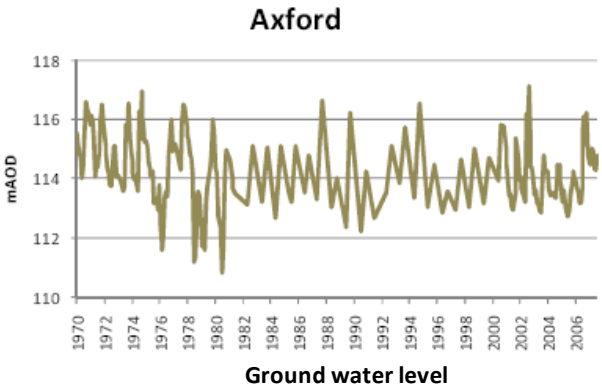
The Kennet and Pang Catchment Abstraction Management Strategy[3] classification in 2008 was *"over abstracted"*.

The focus of this case study is the abstraction point at Axford (downstream from Malborough), which Thames Water use to supply the Swindon-Oxford (SWOX) region.

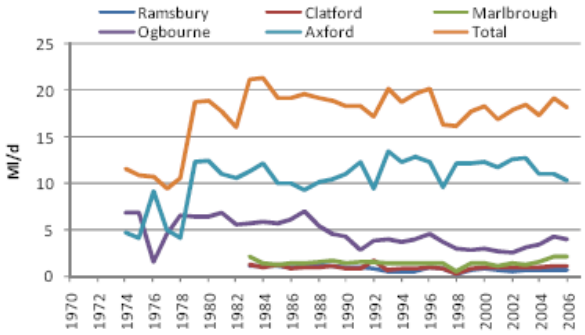
Water abstracted from the Axford borehole is pumped to service reservoirs: around 85% is supplied to South Swindon and around 15% is supplied to areas around Marlborough and Ramsbury. The water exported to Swindon is not returned to the Kennet Valley as wastewater. This means that the majority of water abstracted at Axford is never returned to the catchment and thus results in an overall decrease of water ("net consumptive abstraction").

The graphs below show the groundwater levels at Axford (left) and the annual mean volume of groundwater abstracted at Axford and other local points (right). The graphs show an observed fall in ground water levels between 1970 and 1980, during which time abstraction increased significantly.

[2] http://www.english-nature.org.uk/special/sssi/unitlist.cfm?sssi_id=2000164
[3] http://www.environment-agency.gov.uk/research/planning/33436.aspx



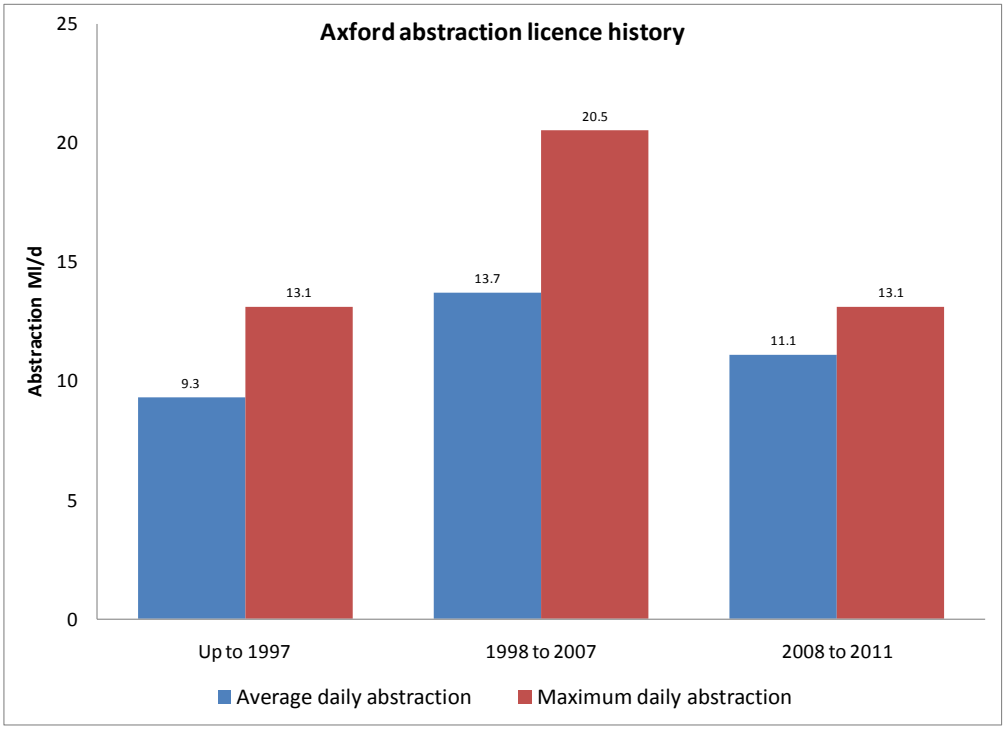
Ground water level



Annual mean volume abstracted

The Axford abstraction has had two recent licence variations: increased in 1998 and reduced in 2008 (see graph below).

Thames Water has included a "sustainability reduction" at Axford in its draft Water Resource Management Plan of 3.6 Ml per day peak and 3 Ml per day average from 2014/15 onwards.



The 2008 variation was licensed after a joint investigation[4] (Thames Water in conjunction with Natural England and the Environment Agency) into the impact of abstraction at Axford on the River Kennet. It concluded that abstraction was contributing to low flows but, due to the complex nature of the systems, it was difficult to demonstrate specific evidence of direct adverse impact on the environment.

The investigation found that abstraction of ground water led to a net depletion of river flow downstream: summer flows reduced by 10-14% on average and even more during low flow or drought periods (35-40% estimated during the early 1990s drought and 20% estimated during 2003).

The assessment of the impact on ecology focused on water crowfoot, which requires swift-flowing water over clean gravel. It suggested that the impact of the Axford abstraction upon flow could have an

[4] Axford Licence Variation Application, Environmental Report, August 2007, Thames Water Utilities Ltd.

adverse effect on water crowfoot growth during individual low flow years, and that there would be a potential benefit to its growth by reducing abstraction at times of low flow. The study referred to case studies that suggested that the ecology would benefit if net consumptive abstraction was capped at 3 Ml per day (currently, the average daily consumptive abstraction from Axford is approximately 9.4 Ml per day).

Future pressures and actions

Thames Water predicts an increase in overall demand in the SWOX region of 11% by 2030[5]. Domestic demand is forecast to increase by 21% by 2030, as a result of an increase in the number of households and changes in consumer behaviour. It is anticipated that an accelerated programme of metering to around 95% of properties from 2010/11 to 2015/16 would cause an initial fall in demand, but once complete, the normal drivers for demand increase would return. Thames Water anticipates a reduction in demand from non-household consumption and leakage (until 2010 when it is stabilised at the "economic level of leakage").

The Axford abstraction is due to be reviewed by the Environment Agency in 2011. Thames Water plans to review abstraction in 2014 (contingent on OFWAT approval of its business plan in 2009).

WWF-UK and Thames Water are discussing a potential water efficiency project to reduce demand on abstraction from the Kennet, in order to improve flow quantity.

Climate impacts on river flow

Climate projections[6] show increased winter and summer temperatures and a significant increase in winter precipitation post 2050. The outlook for summer precipitation and impact on river flow depends on the climate model, and ranges from large increases in river flow throughout the year[7] to reductions of around 50%[8]. There is also the potential for substantial reductions in annual runoff with increased seasonality[9], which would result in a reduction in water quality.

Given the uncertainty and variability of projected climate scenarios and associated water balance, any adaptation actions taken should be resilient to a range of plausible climate change scenarios ("low regret"), rather than led by a single 'central' scenario[10].

[5] Thames Water, 2008. Available at http://www.thameswater.co.uk/cps/rde/xchg/SID-F3465D5A-833A8F68/corp/hs.xsl/5373.htm [last accessed 6 Feb 09].
[6] SRES A2 emissions scenario
[7] climate model CGCM2
[8] HadCM3
[9] Limbrick, K.J., Whitehead, P.G., Butterfield, D. et al. 2000. Assessing the potential impacts of various climate change scenarios on the hydrological regime of the River Kennet at Theale, Berkshire, south-central England, UK: an application and evaluation of the new semi-distributed model, INCA. Science of the Total Environment, 251, 539-555.
[10] Wilby, R.L. 2008. River basin management in a changing climate: Guiding principles to assist adaptation. Report prepared on behalf of the Environment Agency, December 2008, 16pp.