FORM WR-46 Determination Report Template

DETERMINATION REPORT

REPORT OF AN APPLICATION FOR TWO NEW (RENEWALS) FULL ABSTRACTION LICENCES AN/034/0009/008 AND AN/034/0009/009 UNDER THE WATER RESOURCES ACT 1991 (AS AMENDED) AND THE ENVIRONMENT ACT 1995

In determining this application, the Environment Agency has exercised its duties and powers under the Water Resources Act 1991 (as amended) and the Environment Act 1995.

1. APPLICATION DETAILS

Application No.	NPS/WR/003092	NPS/WR/002725
Existing licence serial No.	7/34/09/*G/0141C	7/34/09/*G/0144B
Type of licence applied for	Full (Renewals)	
New Licence No.	AN/034/0009/009	AN/034/0009/008
Date application received as complete and valid	04/11/2009	
Relevant date	04/11/2009	
Date determination due	04/02/2010	
Date agreed for extended determination	31/03/2010	
Name and address of applicant	Mr AW Alston White House Farm Marsham Norfolk NR10 5PJ	
Location of abstraction	Ludham Road, Catfield	Plumsgate Road, Catfield
Application contact	Andrew Alston – 07785935498 or via andrew.alston@farmline.com	

2. SUMMARY OF THE PROPOSALS

These applications are to renew licences 7/34/09/*G/0141C and 7/34/09/*G/0144B on the same terms that would otherwise expire on 31 March 2010. The full histories of these abstractions can be found in Section 3 of this report.

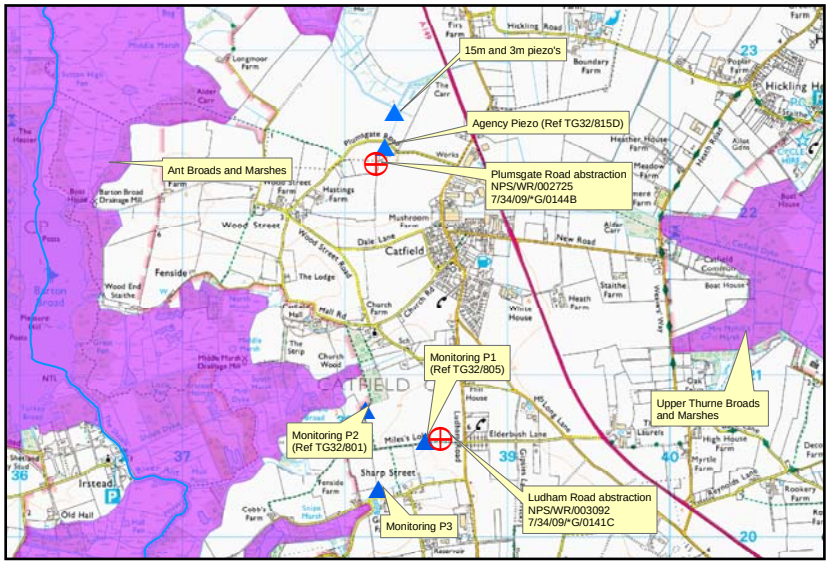
Although these applications do not require advertising, a representation has been received to the local Area Environment Planning (AEP) team in Ipswich due to concerns that the abstractions are impacting on water levels in Catfield Fen, part of the Ant Broads and Marshes SSSI. The details of this representation can be found in Appendix 2 of this report.

The details of the abstractions are shown overleaf.

Particulars	NPS/WR/003092 (141C)	NPS/WR/002725 (144B)
Catchment	Tidal River Bure and Ant (C034/0009)	
Source of Supply	Crag borehole (Ludham Road)	Crag borehole (Plumsgate Road)
Means of Abstraction	Pump	Pump
Point of Abstraction	TG 386 206	TG 382 223
Purpose of Abstraction	Spray irrigation	Spray irrigation^
Quantities	45m³/hour 800m³/day 22,700m³/year* 12.5l/s	1,090m³/day 68,000m³/year 15l/s
Period of Abstraction	April to October	April to October
Method of Measurement	Flow meter – monthly readings	Flow meter – monthly readings
Addendum monitoring	*Water level monitoring at 3 piezo's at the following locations; • TG 3850 2059 • TG 3813 2078 • TG 3821 2029	*Water level monitoring at the following piezo's; • 15m piezo - TG 3831 2262 • 3m piezo - TG 3831 2262 • Agency piezo 5 – TG 3825 2240 *Information to be gathered from Sutton IDB pump *Further pump testing if required

^The current licence states an additional purpose of "Private water supply for spray irrigation". This dates back to when the area of land was required as a licence condition. After speaking to the applicant it was agreed that the purpose should be updated to spray irrigation only.
*In the covering letter submitted with the application forms for this renewal the applicant had requested that the abstraction be increased but did not provide any specifics. After discussion with the applicant (See "FILE NOTE_conversation with Andrew Alston_060110" saved on the Agency's Electronic Document Record Management system (EDRM) for more information) it was decided that at this moment in time these applications would both be straight renewals. The renewal of licence 7/34/09/*G/141C was originally set up as a renewal on different terms under NPS/WR/002760 and was later amended to a straight renewal under application reference NPS/WR/003092.

The relative locations of the abstractions and their associated monitoring points are shown in the Map 1 below;



Map 1. Location map

3. CASE HISTORY

NPS/WR/003092 – Renewal of licence 7/34/09/*G/0141C (Ludham Road)

Licence Number	Issue date	Expiry date	Event
7/34/09/*G/0111	01/02/1988	-	Original licence issued for quantities of 22,700m³/year for the purpose of spray irrigation
7/34/09/*G/0111	?/04/1994	-	Second purpose of private water undertaking (medium loss) was added to the licence. No changes to abstraction quantities.
7/34/09/*G/0111	-	-	01/10/1997 – the licence was revoked. The reason for this is unknown.
7/34/09/*G/0130	01/06/1998	31/10/2000	Abstraction was re-issued under the same conditions as previous.
7/34/09/*G/0141	23/06/2001	31/10/2004	Above licence renewed at same quantities with the only purpose of spray irrigation.
7/34/09/*G/0141A	26/07/2004	31/03/2006	Straight renewal – time limited for a short period due to ongoing Review of Consents (RoC); i.e. the review carried out by the Agency of existing consents pursuant to regulations 50 and 51 of the Conservation (Natural Habitats &c.) Regulations 1994
7/34/09/*G/0141B	01/04/2006	31/10/2008	Straight renewal – time limited for a short period due to ongoing RoC
7/34/09/*G/0141C	01/11/2008	31/03/2010	Straight renewal – time limited to the RoC implementation date.
7/34/09/*G/0141C	-	-	Application received on 04/11/2009 to renew licence on same terms.

NPS/WR/002725 – Renewal of licence 7/34/09/*G/0144B (Plumsgate Road)

Licence Number	Issue date	Expiry date	Event
7/34/09/*G/0126	01/04/1997	31/10/2001	Original licence issued for quantities of 68,000m³/year in aggregate for the purposes of spray irrigation and private water undertaking (high loss).
7/34/09/*G/0144	18/02/2002	31/10/2006	Abstraction was re-issued under the same conditions as previous. Time limited for a short period due to ongoing RoC
7/34/09/*G/0144A	01/11/2006	31/10/2008	Straight renewal – time limited for a short period due to ongoing RoC
7/34/09/*G/0144B	01/11/2008	31/03/2010	Straight renewal – time limited to the RoC implementation date.
7/34/09/*G/0144B	-	-	Application received on 04/11/2009 to renew licence on same terms.

Concerns regarding the potential for these abstraction to impact on water levels at Catfield Fen were raised in 2008 – please see Appendix 2 for information.

4. WATER RESOURCES RISKS & SUMMARY LIST:

The risk screening tool was not run for these applications as they are straight renewals of existing abstractions.

Status of the source in relation to:

Category	**NPS/WR/003092** (141C)	**NPS/WR/002725** (144B)
Source Protection Zone (SPZ)	0.3km from SPZs 1, 2 and 3	Within SPZ 1
Restoring Sustainable Abstraction Programme (RSAP)	None within 3km of either abstraction	
National Park (NP)	Within 0.5km of The Broads	Within 0.7km of The Broads
Scheduled Ancient Monuments (SAMs)	None within 3km of either abstraction	
Catchment Abstraction Management Strategy Area (CAMS)	Broadland Rivers CAMS	
Water Resources Management Unit (WRMU)	Within a CAMS non assessed area (tidally influenced)	WRMU A – Ant and Lower Bure (No Water Available)
Other e.g. Minimum Acceptable Flow (MAF) or other projects	None	

5. ENTITLEMENT TO APPLY

The applicant has completed the standard declaration that they are entitled to apply for the necessary licences. Section 35 of the Water Resources Act 1991 has therefore been complied with.

6. WATER RESOURCES (ENVIRONMENTAL IMPACT ASSESSMENT) REGULATIONS 2003

These Regulations do not apply given the history of the licences as set out in section 3 above. Paragraph 13.2 of our Guidance Note 67_03 on these Regulations provides that: 'The Water Resources (EIA) Regulations will not apply to licences coming up for renewal after 1 April 2003 if the original licence was applied for before 1 April 2003 because the Regulations do not apply retrospectively'.

7. SUPPLEMENTARY REPORT

No supplementary reports were requested or provided in support of these applications, other than the monitoring requirements as requested in the licence addendums.

8. VALIDATION OF THE APPLICATIONS

The applicant has completed the correct application form for a type of licence that is appropriate to these proposals.

The applicant has provided an acceptable map or drawing to accompany the applications.

The applicant has provided any additional reports or information requested.

It is confirmed that the correct application fees have been paid.

The applicant has complied with all of the requirements for complete and valid applications.

9. ADVERTISING

The applications are exempt from the requirement to publish a notice because the proposals only involve the renewal of a existing time limited licences on materially the same terms, and the new licences will be granted to the same person who holds the expiring licence.

Although the applications were not advertised, a representation has been received regarding the potential for these abstractions to impact on water levels at Catfield Fen. This is discussed further in Section 13 of this report, with further details available in Appendix 2.

10. APPLICATION PROCESS AND NOTIFIABLE BODIES

No statutory bodies have been notified because the proposals are not subject to advertising.

11. INTERNAL CONSULTATION

Consultee	Summary of Comments
Fisheries, Recreation and Biodiversity	Not applicable
Ecological Appraisal	Not applicable
Groundwater & Contaminated land (Hydrogeology)	The following reports have been produced as part of these applications by Gavin Sharpin; • Review of Monitoring Data (Available in Appendix 4 of this report) • Contouring of the crag around abstraction under 7/34/09/*G/0144B (Available in Appendix 5 of this report). The following response was received from Gavin Sharpin on 22/02/2010; <u>0141C (NPS/WR/003092)</u> Renewal of 0141C for two years with further monitoring under a new RSA project seems

	appropriate to me. At the end of that period we should have enough information to understand the magnitude of any impact from these abstractions. As for the cessation condition, I think it would only be appropriate for licence 0141C if we thought that water levels falling below a defined threshold could threaten the integrity of the site, and that a difference in surface water level of the order of 1 - 2 cm could be significant. If we don't think this is the case I can see no reason for a cessation condition on 0141C. <u>0144B (NPS/WR/002725)</u> I don't think this abstraction has a measurable impact on water levels in the Crag beneath the Fen (though the impact might be model-able), and on its own I don't think the impact from this abstraction alone would justify any further investigation. Having said that, if Catfield Fen is to be investigated under the RSA scheme, I suppose it makes sense to renew 0144B for two years alongside 0141C so as not to pre-empt the investigation unnecessarily and to allow for flexibility in the licensing of abstraction at the end of that period. As for the cessation condition, I can't see how the information available to us presently could be used to justify us preventing abstraction taking place under licence 0144B, regardless of the water levels in the Fen. I can see no good reason to put a cessation condition on licence 0144B.
Environment Management	Not applicable
Development Control	Not applicable
Area Environment Planning (Senior Environment Planning Officer Water Resources)	The local AEP team (Marion Martin and Anna De'Ath) have been involved in these applications and correspondence regarding the representation.
Regional Environment Planning	Not applicable
Area or Regional Hydrologist	Not applicable

12. EXTERNAL CONSULTATION

The Environment Agency has consulted the following bodies about the proposal:

Consultation Bodies (where relevant)	Comments
National Park Authority (NPA)	Not applicable
Natural England (NE) /	Clive Doarks was consulted via the

Countryside Commission for Wales (CCW)	following (all paperwork is available in Appendices 8-10 of this report); • Appendix 4 – Ant and Upper Thurne Broads and Marshes • Appendix 11 – Upper Thurne Broads and Marshes • Appendix 12 – Ant Broads and Marshes (For the avoidance of confusion with the Appendices to this Determination Report, the references to appendices 4, 11 and 12 are references to the names of the standard consultation documents we send to NE/CCW when considering applications for abstraction licences and variation applications). A response was received on 22/02/2010 – please see details below this table.
Broads Authority	<u>Beth Williams – 08/03/2010</u> We are very aware of the potential impact of water abstraction so close to the internationally important fen sites. On this basis we agree with the precautionary approach of the time limited licence. We wonder if there will be an interim review meeting to look at the first year of data to pick up on any early change? Clearly two years gives a better dataset and we do not wish to suggest an interim review if this is too onerous for the returns in this investment. <u>In response (08/03/2010)</u> A review date is something that we have not considered, however the data will be examined as and when it comes in and if there are any concerns they will be addressed at that point if appropriate. <u>Confirmation from Broads Authority (08/03/2010)</u> Thank you for your reply. Ongoing monitoring and dealing with any concerns at the time if they arise is a sensible approach that we are happy to accept.
Other public bodies, where relevant, e.g. English Heritage/CADW, Internal Drainage Board	The local Sutton IDB (via Tony Goodwin on Tony@wlma.org.uk) were consulted regarding the Sutton IDB pump. <u>The following information was provided</u>

	on 11/01/2010; I assume this is Andrew Alston's renewal. I sent him some figures for the pump operation for last year. Sutton pump is still operating, and will be for the foreseeable future because it drains parts of Sutton village and part of Catfield as well as arable. However, in the longer term we are looking at the possibility re-siting the pump in order to reduce ochre reaching the SSSI. We have a consulting engineer producing a scheme at the moment. It will be some time before the scheme will be implemented, certainly not in the next 3-5 years. The pump operating levels are: Summer: -0.55m to -0.9m OD Winter: -0.8m to -1.1m OD. These are sometimes adjusted for weather conditions.

Natural England's response to the consultation (22/02/2010)

Thank you for consulting Natural England on the above proposal. Your email was received by this office on 4 February 2010, and a further report on the *Contouring of crag groundwater levels* was received on the 17th February. This letter represents Natural England's formal consultation response under Regulation 48 of the *Habitats Regulations 1994*[1] and Section 28 of the *Wildlife and Countryside Act 1981* (as amended).

The application site is in the vicinity of an area which forms part of the Broads SAC and Broadland SPA and Ramsar site.

We are concerned to note that the Appendix 11 as submitted does not relate to the component SSSI most likely to be impacted by these renewals, namely the Ant Broads & Marshes SSSI*. In terms of the Ant Broads & Marshes SSSI, to which the Appendix 12 relates, it is our view that, as the proposed licence renewals are not directly connected with or necessary to site management for nature conservation and are likely to have a significant effect on the internationally important interest features of the site, either alone or in combination with other plans and projects, the

[1] *The Conservation (Natural Habitats, &c.) Regulations 1994*

** Note that an Appendix 11 proforma was not completed for the Ant Broads and Marshes SSSI as historically in Anglian Region – Eastern area if an Appendix 12 proforma (appropriate assessment) was required, the Appendix 11 proforma would not be completed as the full assessment would be contained within the Appendix 12 proforma.*

Environment Agency, as decision-taker and competent authority, was correct to undertake an appropriate assessment. We concur with the Agency's assessment and conclusion of allowing a two year extension to both licences, with the imposition of conditions to require further monitoring. Given that damaging reductions in water levels can occur within a single abstraction season, we would ask that you also consider a cessation clause on these licences linked to water levels within the ditches of Catfield Fen. We would be happy to advise on what might be considered an appropriate trigger level for cessation if the Agency agree that such a measure would be required to maintain the integrity of the European wildlife site.

If you have any queries relating to the content of this letter, please do not hesitate to contact me at the above address. Natural England will be copying this letter to Mr and Mrs Harris of Catfield Hall given their interest in this matter. We look forward to continued involvement in this case and the development of an appropriate monitoring network.

Our response to the above (dated 01/03/2010)

Thank you for your response to the consultation regarding the Alston licence renewals and Catfield Fen.

We have considered putting a cessation condition on both of the licences, however we feel that at this point in time it is not appropriate as we are still unclear of the level of impact these abstractions are having on water levels in the Fen.

Having said that, such a condition should be considered at the next licence renewals once we have gathered some more data and have a better understanding of the abstractions' impacts.

Update – 05/03/2010

Following on from the above discussions with Natural England the issue of a cessation clause was discussed further with both Natural England and the applicant. It was confirmed that we do not feel it is appropriate at this renewal to include a cessation clause while we are still uncertain about the level of impact these abstractions are having water levels in the Fen.

The use of our powers under Section 57 of the Water Resources Act 1991 was discussed as an alternative way to restrict abstraction if water levels in the Fen were to fall as a result of a drought condition. Our powers under Section 57 are normally only applied to surface water abstractors for spray irrigation, however after discussing this with the applicant they agree that it is a good compromise and are happy for us to apply our powers is required. This phone conversation has been saved on EDRM as "FILE NOTE_conversation with Andrew Alston_050310".

This was then confirmed with Natural England via email – please see email saved to EDRM as "Correspondence_email to CDoarks re cons response_120310".

13. EXTERNAL REPRESENTATIONS

While these applications did not require advertising, a representation was received to the local AEP team by Mr Harris (via his agent Peter Riches) regarding the

potential for these abstractions to impact on water levels at Catfield Fen, part of the Ant Broads and Marshes SSSI.

As part of the concerns raised, the following report was also produced (shown in Appendix 6 of this report);

Professor David Gilvear 'Current Understanding of the Hydrology of Catfield Fen, Norfolk; Implications regarding hydrological Vulnerability to Groundwater Abstraction' on behalf of the Harris' dated 09/01/2010.

The recommendation of this report is as follows;

'Given the potential vulnerability of the hydrology and the over-riding influence of hydrology of the nature conservation interest of Catfield fen and consequent nature conservation designations the precautionary principle should be followed. In this case the precautionary principle could be refusal of renewal of groundwater licences.'

Following on from this report and in response to our consultation with Natural England, a letter of representation was received on 23 February 2010. The representation letter and our response to it (dated 04 March 2010) can be found in Appendices 2 and 3 of this report respectively.

The main points raised within the representation letter were surrounding concerns that in 2008 and 2009 water levels in Catfield Fen were particularly low, coinciding with years when abstraction – particularly under licence 7/34/09/*G/0141C – were higher. Concern was expressed that further investigation was required along with queries over the reliability of the monitoring data collected to date and its use in our decision making.

As mentioned in our response to this representation (available in Appendix 3 of this report) we agree that further monitoring data is required, however from analysis of the current data there is uncertainty regarding the level of impact these abstractions are having on water levels in the Fen.

Due to these uncertainties and taking into account the impact assessment as detailed in sections 15.4 and 16.5.1, it is proposed that the precautionary principle is applied to these abstractions by the imposition of a short time limit to 31 March 2012. This will allow an additional 2 years of monitoring data to be gathered and reviewed, and for a better understanding of the interaction of the crag with Catfield Fen to be gained.

It is also proposed that a Restoring Sustainable Abstraction (RSA) project be set up to investigate the functioning of the Fen and gain a better understanding of the impact of abstraction on water levels and its associated ecology. (RSA projects are those set up by the Agency to assess whether it should be formulating proposals to either vary or revoke abstraction licences pursuant to its powers under section 52-54 of the Water Resources Act 1991.)

14. JUSTIFICATION OF APPLICANT'S REQUIREMENTS (as required by section 38(3)(b) of the Water Resources Act 1991)

Both of the applications are considered to be justified based on their return quantities.

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Table (a) below provides the return for the last 11 years, indicating an average uptake of 67.16% of the authorised quantity, with a maximum uptake of 22,910m³/year. The abstraction is further justified by the cropping requirements provided in table (b).

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Quantity of Water Abstracted (m³)	8,129	9,196	9,715	20,491	22,177	17,387	10,028	21,414	4,160	22,910	22,100
% of authorised annual abstraction quantity	35.81	40.51	42.80	90.27	97.70	76.59	44.18	94.33	18.33	100.93	97.36

(a) Return quantities for Ludham Road abstraction

Crop	Area (HA)	Applicant's data		Average Year*		Dry Year*	
		Irrigation Depth (mm)	Quantity of water Required (m³)	Irrigation Depth (mm)	Quantity of water Required (m³)	Irrigation Depth (mm)	Quantity of water Required (m³)
Salads^	20			140	28,000	200	40,000
Potatoes"	40			165	66,000	220	88,000
TOTAL:	60				94,000		128,000

* Based on Optimum Use Guide using agroclimatic zone 6 and Medium AWC soil.

^ Based on the water needs of lettuce

" They also grow sugar beet and cereals, however potatoes is shown as the main crop.

(b) Cropping requirements for the Ludham Road abstraction

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Table (c) below provides the return for the last 13 years, indicating an average uptake of 27.35% of the authorised quantity, with a maximum uptake of 65,211m³/year. The abstraction is further justified by the cropping requirements provided in table (d).

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Quantity of Water Abstracted (m³)	18,183	24,883	14,935	7,625	5,285	11,612	26,050	8,034	5,051	23,501	15,912	21,331	65,211
% of authorised annual abstraction quantity	26.74	36.59	21.96	11.21	7.77	17.08	38.31	11.81	7.43	34.56	23.40	31.37	95.90

(c) Return quantities for Plumsgate Road abstraction

Crop	Area (HA)	Applicant's data		Average Year*		Dry Year*	
		Irrigation Depth (mm)	Quantity of water Required (m^3)	Irrigation Depth (mm)	Quantity of water Required (m^3)	Irrigation Depth (mm)	Quantity of water Required (m^3)
Salads^	50		49,000	140	70,000	200	100,000
Potatoes"	50		49,000	165	82,500	220	110,000
TOTAL:	100		98,000		152,500		210,000

* Based on Optimum Use Guide using agroclimatic zone 6 and Medium AWC soil.

^ Based on the water needs of lettuce

" They also grow sugar beet and cereals, however potatoes is shown as the main crop.

(d) Cropping requirements for the Plumsgate Road abstraction

15. RESOURCE ASSESSMENT

15.1 Water Resources Policy – *does the proposal accord with our local water resources policy (CAMS)?*

Both abstractions are located within the Broadland Rivers CAMS areas. Licence 7/34/09/*G/0144B (Plumsgate Road) is located within WRMU A – River Ant and Lower Bure which has a water resource availability status is 'no water available' with a target status to remain as 'no water available'. The crag is included in the surface water assessment for this area.

Licence 7/34/09/*G/0141C (Ludham Road) however is located within the non assessed area of the Broads which is considered to be tidally influenced. This area has not been assessed for water availability through CAMS and is instead subject to local assessment, although it is generally considered to be committed.

As both of these abstractions have already been included within the resource balance, there will be no additional impact on water availability as a result of the licence renewals.

15.2 Geology/Hydrogeology

Taken from report written by Gavin Sharpin, 20/01/2010 (Found in Appendix 4)

The geology in the Catfield area consists of Chalk overlain successively by London Clay, Norwich Crag and glacial deposits. The Crag is in excess of 30 metres thick and is composed of layers of sands, gravels and clays, some having a silty content. There is thought to be substantial vertical anisotropy in the Crag, with the clay strata acting as aquitards (Martin, 2001). The glacial deposits are restricted to the upland areas.

The abstraction borehole for licence 0141C is located on the upland between Catfield Fen and Barton Broad to the west and Hickling Broad to the east. It is close to the groundwater divide between catchments 34/9 and 34/10, although this is poorly defined due to the shallow groundwater gradients in this area. The abstraction borehole for licence 0144B is to the north-west of Catfield, close to drains feeding Sutton Broad. Natural groundwater gradients between the licences and the water

features to the west of the boreholes are shallow, but appear from piezometry to follow the topography of the area (Goodfield, 2006).
The drilling log details for the abstractions are as follows;

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The current borehole was constructed in 1993 when the original collapsed. It measures 33.5 metres in depth and 300 millimetres in diameter and is lined. Whilst 6 metres plain lining was specified on the application form there is no record of a drilling log for the present borehole.

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Depth below ground level (m)	Geology
0 – 0.6	Top soil
0.6 – 1.5	Marl sandy clay
1.5 – 5.2	Silver sand and gravel
5.2 – 8.2	Yellow and grey clay
8.2 – 11.3	Green sand and grey clay
11.3 – 12.2	Green sand
12.2 – 12.5	Grey clay
12.5 – 13.7	Grey sand and gravel
13.7 – 16.2	Grey sandy clay
16.2 – 17.4	Fine green sand and clay
17.4 – 20.7	Fine green sand

15.3.1 Hydrology

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The abstraction borehole is over 2 km from the River Ant at its nearest point. An abstraction of this small volume is unlikely to have a direct effect on river flows but it will ultimately be at the expense of flows somewhere in the river system.

To give some context to the relatively small size of the abstraction, the maximum flow depletion in the River Ant if the whole abstraction was taken directly from the river (averaged over a year) would be 0.41% of the Q95 flow (the river flow that is exceeded 95% of the time) at Honing Lock Gauging Station.

The River Thurne is approximately 3.2km to the east of this abstraction. At this distance, given the geology of the area, there is not anticipated to be a significant impact on flows.

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The River Ant flows north-south through Barton Broad and is over 2km west of the abstraction source. Considering there is no predicted drawdown at this distance and the fact that the cone of depression is thought to extend primarily to the north of the source there will not be any measurable impact upon the river.

In terms of maximum impact even if the entire volume was abstracted directly from the river (averaged over the whole year), flow depletion based on flows in the River

Ant with a Q95 of 174l/s as measured at Honing Lock Gauging Station this abstraction would equate to 1.2% of the Q95 flow.
The River Thurne is approximately 2.9km to the east of this abstraction. At this distance, given the geology of the area, there is not anticipated to be a significant impact on flows.

15.4 Technical assessment.

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Updated from Determination report dated 15/06/2001 (Marion Martin)

In September 1987 a 7-day pump test was carried out at a yield of 9.9l/s. With 25% of the licensed quantity being abstracted during the test a drawdown of 12.3m was experienced. There was no detectable drawdown in the observed shallow well 550m to the east.

A new borehole was constructed in 1993 when the original one collapsed. A 4-hour pump test was carried out on the borehole but no other sources were observed. A yield of 10.4l/s was obtained with a drawdown of 6.7m.

Fluctuations in pumping rate made the constant pump test data on the original borehole difficult to analyse therefore a transmissivity value of 406m^2/d was derived from the recovery data. It was not possible to derive a value for storativity as no observation borehole data was available.

A transmissivity value of approximately 470 m^2/d was derived from the yield test on the replacement borehole and a representative value of 450 m^2/d has been chosen for predictive purposes. From information for other crag sources in the area, a storativity value of 0.05 is considered to be appropriate.

Other investigations of the Norwich Crag indicate that there is a substantial amount of vertical anisotropy, with the clay strata acting as aquitards in many cases. There is also some evidence of a "leaky" response to pumping, in particular the pump test on the borehole at Laurels Farm, approximately 1km distant (HA Overton & Sons).

For further details please refer to the 1998 Determination report – saved on EDRM.

Based on a transmissivity value of 450m²/day and a storativity value of 0.05 Theis predicts the following maximum drawdowns in the crag, see table below. These are likely to be overestimates due to the assumptions made by Theis such as that the aquifer is infinite in extent, homogeneous and isotropic. These conditions are rarely satisfied and the methodology tends to over-predict drawdowns. Additionally, the calculations carried out assume that abstraction takes place continuously at the maximum daily rate until the annual volume has been taken.

Distance (m)	Maximum predicted drawdown in the crag (m)
50	0.77
100	0.57
200	0.38
400	0.20
600	0.11

1000	0.03
1400	0.01

NPS/WR/002725 – Renewal of licence 7/34/09/*G/144B (Plumsgate Road)

Updated from Determination report dated 03/07/2002 (Marion Martin)

An 11 day constant rate pump test was carried out in July 1985. A yield of 15.4l/s was obtained with a maximum drawdown of 14.3m in the test source. A further 48-hour pump in August 1985 was carried out to gain early test data due to lack of dip access at the start of the 11 day test. The shorter test saw for an average instantaneous rate of 13.1l/s a maximum drawdown of 11.08m. Five sources were monitored during the test (listed in the table below), with none showing any obvious reaction to test pumping other than an abandoned well 35m away which saw a drawdown of 0.33m.

Monitored Source Locations;

Monitored Source	Distance
Abandoned well	35m SW
Well 4	600m SW
Well 2	600m E
Bore 1	600m E
Well at Longmoor Farm	500m SE

Analysis of the test data was difficult due to the unusual behaviour of the test bore and the abandoned well, resulting from the complexity of the geology at this location. Analysis of the test data gave a range of values, however a storativity value of 0.25 and transmissivity values of 800m²/day and 3000m²/day are used for predictive purposes (in this report, the higher drawdowns produced using the value of 800m²/day are used). Theis predicts the following maximum drawdowns for the crag;

Predicted Drawdown;

Distance (m)	Maximum predicted drawdown in the crag (m) – based on transmissivity value of 800m²/day	Maximum predicted drawdown in the crag (m) – based on transmissivity value of 3000m²/day
50	0.56	0.19
100	0.41	0.15
300	0.19	0.09
400	0.13	0.07
600	0.07	0.05
900	0.02	0.03
2000	0.00	0.00

The time-drawdown curves for the test borehole and abandoned bore are highly complex due to the inter-bedded relationships between the variable lithologies, which constitute the aquifer. Reliable pump test data analysis is therefore considered virtually impossible. In general leaky-confined aquifer conditions are thought to exist.

Test pumping of the Catfield fish refuge borehole (Agency borehole, Ref TG32/914, located approximately 1.5km east of the Alston bore) provided more reliable aquifer parameter values with storativity of 0.05 and transmissivity of 950m²/day. These values are more consistent with those observed at the Alston bore.
A number of conclusions were drawn from this study:

- An area of elevated transmissivity is implied in the vicinity of the Alston borehole, thus supporting the high transmissivity obtained during test pumping of this source.
- The cone of depression extends primarily to the north.
- The extent of the cone of depression is highly sensitive to the rate of infiltration to the aquifer.

Analysis of pump test data from 1985 using Theis shows that at a distance of approximately 0.9km and 2km (i.e. the distance the abstraction borehole is from the Ant and Upper Thurne Broads & Marshes respectively) there will be negligible drawdown as a result of abstraction with 0.03m drawdown at 0.9km and no drawdown predicted at 2km.

By examining pump testing at Catfield fish refuge borehole, approximately 1.5km east of the Alston borehole it appears that the cone of depression is not symmetrical and extends primarily to the north where a higher permeability is possibly encountered, therefore drawdown to the east and west is likely to be considerably smaller. As the Ant and Upper Thurne Broads & Marshes are both located to the east and west of the borehole any direct impact of this abstraction on these European sites will be reduced further.

15.5 Minimum Acceptable Flow (MAF) considerations under sections 21 and 40 of the Water Resources Act 1991.

Not applicable.

16. IMPACT ASSESSMENT OF PROPOSALS

16.1 Water Resources/Quantity.

See section 15.1.

16.1.1 Protected Rights and existing lawful uses of water

No protected rights have been identified as being at risk of derogation as a result of these proposals.

There are no documented well failures or derogation in the Catfield area since either of the abstraction licences have been issued and as these applications are for the straight renewal of existing abstraction there are not considered to be any further risk.

Regarding the Plumsgate Road abstraction (7/34/09/*G/0144B) there has in the past been some issues regarding potential derogation, however this is not applicable to this application for renewal. For information these details have been included within Appendix 7 of this report.

Existing lawful uses of water were considered when the abstractions were first authorised. There have been no records of derogation or other adverse impact on these lawful uses since this time, therefore no further assessment has been undertaken, as the applications are renewals on the same terms.

16.2 Water Quality/Discharge consents.

There is potential for water quality implications for the marsh dykes within the Ant Broads & Marshes SSSI. In the case of the marsh dykes, the concern is the potential depletion of good quality groundwater supply and the incursion of poor quality, nutrient-rich river water. However as the hydrological impact of these proposed abstractions are considered to be small the potential for impact on water quality is negligible.

16.3 Ecology.

There are no concerns anticipated on the local ecology as a result of these applications. Please refer to section 16.5.1 for more details.

16.4 Fisheries.

There are no concerns anticipated regarding fisheries impacts as a result of these proposals.

16.5 Conservation e.g. designated or wetland sites etc.

16.5.1 Local Designations and Perceived Risk

Nearest Conservation Receptors Within Search Area			
Designation Types	**Name of Site**	**NPS/WR/ 003092 (141C)**	**NPS/WR/ 002725 (144B)**
National Conservation Designations			
Special Area Conservation (SAC)	The Broads	0.65km E	0.9km E
Ramsar	Broadland	0.65km E	0.9km E
Special Protection Area (SPA)	Broadland	0.65km E	0.9km E
Site of Special Scientific Interest (SSSI)	Ant Broads and Marshes Upper Thurne Broads and Marshes	0.65km W 1.5km E	0.9km W 1.8km E
Groundwater Dependent Terrestrial Ecosystems (GWDTEs) GW only	Ant Broads and Marshes Upper Thurne Broads and Marshes	0.65km W 1.5km E	0.9km W 1.8km E
Other Conservation Designations			
National Nature Reserve (NNR)	Ant Broads & Marshes How Hill Hickling Broad	1.5km NW 1km SW 1.5km NE	1.3km SW 2.3km SW 1.8km E

Local Nature Reserve (LNR)	None within 3km of either abstraction	N/A	N/A
Ancient Woodland	None within 3km of either abstraction	N/A	N/A
National Landscape Designations			
National Parks	The Broad	0.5km W	0.7km W
Area of Outstanding Natural Beauty (AONB)	None within 3km of either abstraction	N/A	N/A
Heritage Coast	None within 3km of either abstraction	N/A	N/A
Others			
County Wildlife Sites	*Alder Carr & Gutteridge Bridge *Sutton Meadows *Land adjacent to Horse Fen *Stalham Fen	1.7km NE 2.1km N 2.8km SE Outside 3km	1.2km E 0.4km N Outside 3km 2.1km N

National Conservation Designations

Both the Ant and Upper Thurne Broads and Marshes SSSIs are component parts of the Broads SAC, Broadland SPA and Broadland Ramsar.

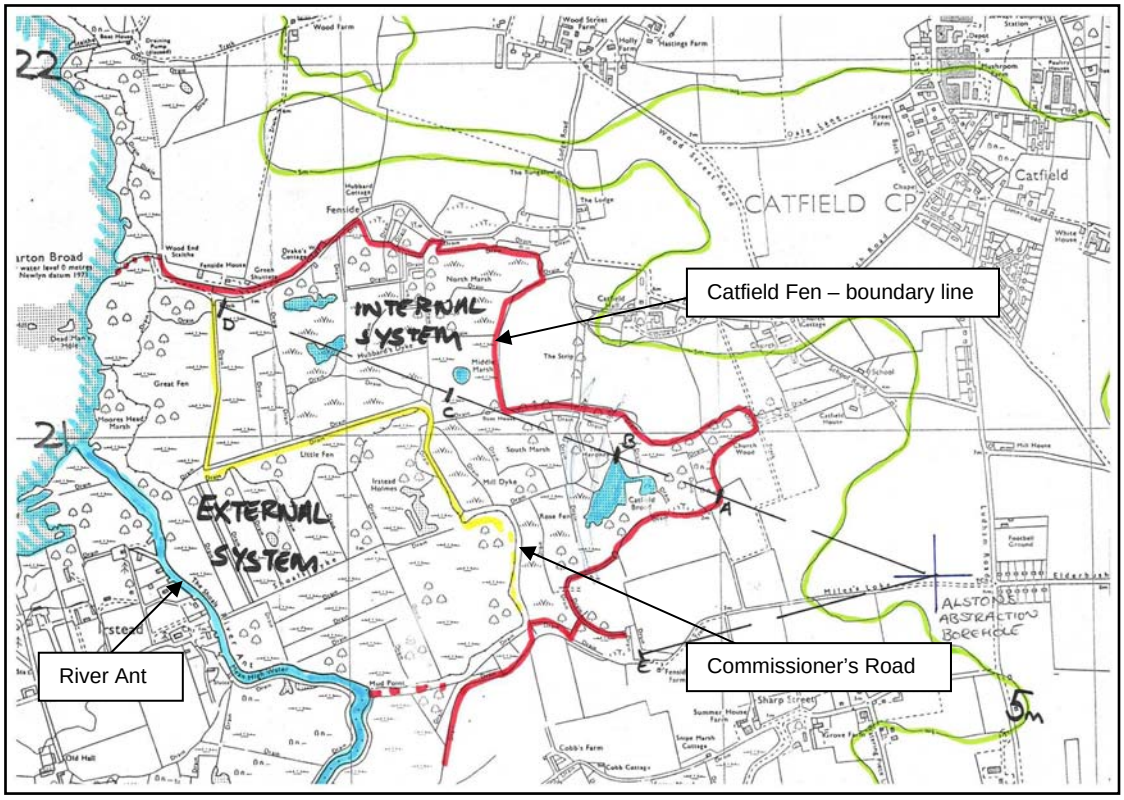
The impact of the abstractions on the European sites is discussed further in section 16.5.3, however the details relating to any potential impacts on the SSSIs as a result of these abstractions are discussed in more detail below.

Ant Broads and Marshes SSSI

As indicated in the table above the abstractions are 0.65km and 0.9km from the Ant Broads for the Ludham and Plumsgate Road licences respectively. The main concerns are however related to the potential impact of the abstractions on Catfield Fen and Sutton Broad – part of the Ant Broads and Marshes SSSI.

Catfield Fen
As described in the RoC Stage 4 Site Options Plan (SOP) report for Ant and Alderfen Broads (5 June 2009), Catfield Fen is split between an internal system (embanked by the Commissioner's Road) controlled by sluices and an external system linked to the River Ant – see map 2. The internal system is considered to be dependent on runoff and groundwater input, while the external system is fed predominantly from the River Ant.

Water levels in the internal system steadily increase from summer to winter. External system has a similar trend but with greater fluctuations suggesting influence from the river. Lines of monitoring wells, transecting both inside and outside of the system react to heavy rainfall as does the crag. This suggests a degree of connectivity.



Map 2. Catfield Fen map delineating the external and internal systems (Taken from 1998 Determination Report)

From the information provided in the 1998 Determination report, it can be shown that there is negligible lateral groundwater movement into Catfield Fen as the majority of this will be intercepted by the external dyke system which penetrates the Crag. The predominant way for crag groundwater to enter the fen is via upward vertical leakage from the Crag to peat at the fen edges, however no evidence of this is found in the main fen area. A Hydrochemistry study of Catfield Fen, carried out by Collins in 1988, suggested that fen water is dominated by surface water inputs and controlled primarily by rainfall and horizontal movement of water from dykes.

Details of the hydrological functioning of Catfield Fen were provided in the 1998 Determination Report (saved on EDRM) which can be summarised as follows;

- The maximum predicted drawdown in the Crag due to the abstraction is 0.11 metres at the fen margin and the predicted radius of influence is 900 metres (based on Theis, and likely to be an over-estimate).
- The fen deposits are separated from the Crag by a layer of clay, which is laterally fairly persistent, although there may be a few areas of limited extent where it is absent (clay "windows") and it may also have been removed in some of the drains.
- These factors, together with the absence of any observed upward gradients within the peat, suggests that any upward leakage across the clay will only wet the base of the peat and that the fen water table is controlled primarily by rainfall and horizontal movement of water from the dykes. The impact of the abstraction on the fen water table is therefore likely to be immeasurably small.
- There is a potential for a reduction in the summer dyke levels in the perimeter and linked dykes due to either direct depletion or water being drawn into the fen to compensate for any drawdown in the fen water table.

- There is also a potential for a reduction in the groundwater flow to the dykes. This may result in a change in the water quality balance within the dyke system, with more nutrient-rich water from the river being drawn further into the dykes. Given the relatively small volume of the abstraction (under 7/34/09/*G/0141C), the impact is also likely to be small.

During 2008/2009 concerns were raised regarding low water levels experienced in Catfield Fen (Refer to Appendix 2 for details) and whether this could be attributed to the Alston abstractions – namely the Ludham Road borehole under licence 7/34/09/*G/0141C. As a result of this the monitoring data available was reviewed by Gavin Sharpin – see Appendix 4 for full report.

In summary the conclusions of this report are that due to the complex hydrogeology of the area it has not been possible to establish with any certainty the impact of this abstraction on water levels and flows in the Fen. However, from the results the following conclusions are drawn;

- An upward hydraulic gradient (between the crag and the fen) has been maintained for the period of 2004 to 2009, despite 2009 being a very dry summer and abstraction taking place under these licences at virtually the whole quantity.
- No signal from either of these abstractions is visible in the water level monitoring of data in the Fen.
- Any impact of abstraction from the borehole at Plumsgate Road on crag groundwater levels beneath the Fen is likely to be insignificant.

Following on from this further investigations into the abstraction at Plumsgate Road (7/34/09/*G/0144B) have been carried out which involved looking at crag groundwater contours (the report is available in Appendix 5). This paper concludes that it is considered unlikely that this abstraction will take place at a rate high enough, and for enough days in succession, for a measurable drawdown in the Crag beneath Catfield Fen at a distance of 800 m or more to be attributed to abstraction under licence 0144B.

Overall, given the element of uncertainty and some gaps in the monitoring data it is proposed to apply a precautionary approach and to renew the licences but to time limit both to 31 March 2012. This will allow an extra 2 years of monitoring data to be collected and analysed.

<u>Sutton Broad</u>
As described in the RoC Stage 4 SOP report for Ant and Alderfen Broads (5 June 2009), Sutton Broad is well connected to the River Ant; it has very few dykes but rafted vegetation allows sub-irrigation from the river. Groundwater flow is generally towards the ditches.

For information Sutton Broad receives water from IDB pumping (Sutton Pump), although water levels are mainly controlled by the tidal River Ant.

In the past there have been concerns regarding the impact of the Plumsgate Road abstraction (7/34/09/*G/0144B) on Sutton Broad, hence some monitoring piezo's were put in place to monitor shallow water levels, along with the requirement to provide information on the amount of water pumped into the Broad.

From examining previous monitoring data for the piezos and comparing these to IDB pumping it appears that there is no observable impact as a result from this abstraction up to 2002. Since 2002 data has only been supplied in 2005 which appears inconclusive, however more recent information has been provided since this date.

Based on information provided on summer pumping at the Sutton IDB pump this abstraction represents 32% of the quantity pumped in 2004 and 28% in 2005, with the pump rate representing 4.2% of the IDB pumping rate. It should be noted that the abstraction has already been accounted for in the pumped quantities at the IDB pump. It is considered that the quantity abstracted will have negligible impact on water levels within the drainage ditches and hence Sutton Broad.

Upper Thurne Broads and Marshes SSSI

The Upper Thurne Broads and Marshes is located 1.5km and 1.9km to the east of the Ludham Road and Plumsgate Road abstractions respectively. At these distances there is not anticipated to be a significant impact on flows or water levels within the European site or River Thurne itself.

Other Conservation Designations

There are 3 NNRs located within a 3km radius of both abstractions. For the reasons stated above, there is not considered to be a significant impact on these sites as a result of these abstractions, however due to element of uncertainty regarding the potential impact of the abstractions on water levels in Catfield Fen, only a short term licence renewal can be considered.

National Landscape Designations

The abstractions are located adjacent to the Broad National Park, however for the reasons stated previously, there is not considered to be a significant impact on these sites as a result of these abstractions. Due to the element of uncertainty regarding the potential impact of the abstractions on water levels in Catfield Fen, only a short term licence renewal can be considered.

The Broads Authority were consulted on these proposals – please see response in section 12 for more details.

County Wildlife Sites

There are 4 county wildlife sites located within 3 km of both abstractions. For the reasons stated above, there is not considered to be a significant impact on these sites as a result of these abstractions, however due the uncertainty regarding the potential impact of the abstractions on water levels in Catfield Fen, only a short term licence renewal can be considered.

16.5.2 Downstream Conservation Sites and Perceived Risk

See section 16.5.1 above.

16.5.3 Habitats Directive/Regulations

Both the Ant and Upper Thurne Broads and Marshes SSSIs are component parts of the Broads SAC, Broadland SPA and Broadland Ramsar.

Ant Broads and Marshes SSSI – component of SAC/SPA/Ramsar

The RoC for the Ant Broads and Marshes has been completed, with both of these licences being listed within the Appendix 21 (again a reference to the Agency's standard document number in consulting with NE/CCW on applications'; not a reference to an Appendix to this report) as "No Adverse Effect on Site Integrity Could Not be Shown, in-combination" at Stage 3. Stage 4 of the RoC has however concluded that there was a low risk that the environmental outcomes for the site could not be met and that therefore we do not need to pursue any licence modifications.

Methodology for the RoC conclusion of low risk

The methodology adopted for the Stage 4 RoC assessment is based on hydrological criteria which can be simulated using the regional groundwater model. They relate to the Environmental Outcomes provided by Natural England and the hydrological functioning of the site and have been agreed with Natural England. A number of model cells have been chosen as being representative of the European features and distributed geographically through the Ant Broads & Marshes SSSI. Cell "G" is the cell chosen to represent conditions at Catfield Fen.

The primary thresholds for acceptable levels of abstraction are:

- For non-drought summers the soil moisture content should be above the stress threshold
- For drought summers the modelled water level in the uppermost layer should be greater than the lowest historical in drought summers (July 1976)

The results of modelling at "Real fully licensed" (RFL) abstraction rates are:

- there is no breach of the soil moisture threshold
- there is one breach of the water level threshold of 2.7 cm (in 1976)

The Anglian Region's technical approach for inland sites, which has been agreed with Natural England, is a risk based approach which scales the need for licence modifications to the risk to the site. A decision table (or risk matrix) is used to reach a judgement about the risk of environmental outcomes not being achieved under RFL abstraction.

For sites such as the Ant Broads & Marshes which have been divided into a number of units, one risk matrix is completed (for the unit with the highest risk) to decide the overall risk for the site. In this case it was the Barton Broad unit. The assessment concluded, taking all the information into consideration, that there is a sufficiently low risk associated with real fully licensed abstraction that environmental outcomes are likely to be achieved for the Ant Broads & Marshes SSSI.

Further information can be found in the Site Option Plan: Ant Broads & Marshes SSSI/ Alderfen Broad SSSI Issue 2 (Entec, June 2009).

Despite the RoC conclusion of low risk, as there are still some outstanding concerns and investigation required into the potential local impact of these abstractions on Catfield Fen, part of Ant Broads and Marshes SSSI, we are effectively updating the RoC conclusion for these licences. The RoC looks at the impact of permissions, including abstraction licences, on the site as a whole. In this case although the conclusion for the whole of the Ant Broads and Marshes is that the site is low risk regarding the impact of abstraction, we still need to look at a more local scale at the impacts on this component part of the SSSI.

To this end, and given the amount of uncertainty and some gaps in the monitoring data, it is proposed to apply a precautionary approach and to renew the licences but to time limit both to 31 March 2012. This will allow an extra 2 years of monitoring data to be collected and analysed.

Natural England were consulted on these applications via an Appendix 12 (attached in Appendix 8), along with an assessment under the Wildlife and Countryside Act 1981 as amended by the Countryside and Rights of Way Act 2000; i.e. a 'Crow assessment' (see Appendix 9). They responded on 22/02/2010 – see section 12, and agreed with our conclusions.

In summary we draw a conclusion of no adverse effect on Catfield Fen, part of the Ant Broads and Marshes SSSI/SPA/SAC over the 2 year proposed licence renewals. This is for the following reasons as previously mentioned within this report;

- Based on analysis carried out by our local groundwater team, they suggest that the renewal of licence 7/34/09/*G/0141C (Ludham Road) would result in a difference in surface water level in the Fen of the order of 1 - 2 cm. A change in water levels of this amount is not considered to be significant, to which Natural England agreed (reference to section 12 of this report).
- A Hydrochemistry study of Catfield Fen, carried out by Collins in 1988, suggested that fen water is dominated by surface water inputs and controlled primarily by rainfall and horizontal movement of water from dykes. This implies that the groundwater input from the crag is not the predominant influence on water levels in the Fen.
- An upward hydraulic gradient (between the crag and the Fen) was maintained for the period of 2004 to 2009, despite 2009 being a very dry summer and abstraction taking place under these licences at virtually the whole licenced quantity. This indicates that despite the Alston abstractions taking place, there was still a movement of water from the crag into the Fen.
- No signal from either of these abstractions was visible in the water level monitoring of data in the Fen that has been collected to date. This means that while abstraction has been taking place there have been no drops in water levels in the monitoring piezometers – please refer to Appendix 4 of this report for further details.

Based on the above information, we are satisfied that a renewal of both abstractions for an additional 2 years allows a conclusion of no adverse effect on the European sites to be reached.

Upper Thurne Broads and Marshes SSSI – component of SAC/SPA/Ramsar

The Upper Thurne Broads and Marshes is located 1.5km and 1.9km to the east of the Ludham Road and Plumsgate Road abstractions respectively.

The groundwater modelling carried out at Stage 4 of the RoC process confirmed that these licensed abstractions are not contributing to an adverse impact on the integrity of the site. Both abstractions were represented within the modelling at the correct quantities and have been affirmed within the Appendix 19 for the site.

Natural England were consulted via an Appendix 11 for information only (please see document in Appendix 10 of this report).

16.6 Flooding/Flood Defence Consent.

There are no considered to be any flooding issues associated with these applications.

16.7 Archaeology.

There are no Scheduled Ancient Monuments within 3km of either abstraction, therefore no impact is predicted.

16.8 Recreation/Amenity.

There are no recreation or amenity issues associated with these applications.

16.9 Subsidence and Desiccation

No representations have been received in relation to subsidence and desiccation as the applications did not require advertising.

17. COSTS/BENEFITS AND ENVIRONMENTAL MITIGATION OR GAIN

Preferred option	2. Renew both licences on the same terms, time limited to 31 March 2012

Assessment of likely benefits and costs of proposed option to:

Water Resources/ The Environment	There is low risk of environmental damage occurring as a result of these proposals. The proposals accord with local water resources policy and is sustainable.
The applicant	The applicant will benefit from the availability of water for their operations. There will be a cost saving from not having to use mains water for this purpose. The applicant will incur the costs of installing and maintaining the method of abstraction and of measuring the volumes of water they abstract. The applicant will have to pay the application fees and

	annual subsistence charges based on their licensed quantity.
The Environment Agency	The Environment Agency will incur the cost of determining the applications and enforcing the licences. These costs will be recovered through the application charges and annual charges, where applicable In determining the licences in accordance with local and national policy, the Environment Agency is fulfilling its duties as a regulator.
The economic and social well being of the rural community.	No adverse effects upon on the social and economic well being of local communities in the rural area are perceived as a result of these proposals.

Options considered:

1. Renew both licences on the same terms, time limited to 31 March 2018
2. Renew both licences on the same terms, time limited to 31 March 2012
3. Refuse the applications

Reason for choosing preferred option over alternative option(s).

It is not suitable to refuse the applications as they are justified. It is also not appropriate to consider a longer time limit to the CAMS common end date due to the need for an RSA investigation.

18. BIODIVERSITY AND SUSTAINABLE DEVELOPMENT

The principles of sustainable development are embodied in the conditions attached to the draft licences.

19. TIME LIMIT

It is proposed that due to the element of uncertainty involved with these abstractions and their potential impact on water levels in Catfield Fen, part of the Ant Broads and Marshes, that a short time limit to 31 March 2012 be applied.

20. MEASUREMENT OF WATER ABSTRACTED

The applicant has been advised of the measuring requirements which will comply with the Environment Agency's Abstraction Metering Good Practice Manual (R & D Technical Report W84).

21. SPECIAL AGREEMENTS

The applicant will be invited to re-apply for the following for both licences;

Charges Scheme (Schedule 2) – Two-part Tariff Agreement (Holders of irrigation licences only).

22 DUTIES ARISING UNDER LEGISLATION

Section 4 Environment Act 1995 (pursuit of sustainable development).

Consideration has been given to whether additional requirements should be imposed in relation to the Agency's principal aim to contribute to attaining the objective of sustainable development under section 4 of the Environment Act 1995, but it is felt that existing requirements are sufficient in this regard and no other appropriate requirements have been identified.

Section 6(1) Environment Act 1995 (conservation duties with regard to water)

Consideration has been given to the Agency's duty to promote the conservation and enhancement of the natural beauty and amenity of inland and coastal waters and the land associated with such waters, and the conservation of flora and fauna which are dependent on an aquatic environment. See section 15.3.1 above.

Section 6(2) Environment Act 1995

It is considered that in reaching these determinations the Agency has taken all such action as it considers necessary or expedient for the purposes of conserving, re-distributing and otherwise augmenting water resources in England and Wales; and of securing their proper use.

Section 7 Environment Act 1995 (pursuit of conservation interests)

Section 7(1)(c) of the Environment Act 1995 places a duty on the Agency, when considering any proposal relating to its functions, to have regard amongst others to any effect which the proposals would have on the economic and social well-being of local communities in rural areas; and to take into account any effect which the proposals would have on the beauty or amenity of any rural area.

In reaching these determinations the Agency has had regard to these factors by taking account of the impact of the applicant's business and need for water to irrigate their crops. This helps to support the local community by providing job opportunities and boosting the local economy.

As these applications are for the renewals on the same basis there will be no additional effect on the beauty or amenity of the rural area as no further construction work is required.

Section 8 Environment Act 1995 and Section 28G Wildlife and Countryside Act 1981

Under section 28G of the Wildlife and Countryside Act 1981 the Agency has a duty to take reasonable steps to further the conservation and enhancement of the flora, fauna or geological or physiographical features by reason of which a site is of special scientific interest (SSSI).

The SSSIs identified within the vicinity of the abstractions are as follows;

- Ant Broads and Marshes - This is a composite site made up of the 3 former separate SSSIs known as Sutton Broad, Barton Broad and Ant Marshes. The site is designated for its open water and marginal swamp, along with its extensive areas of fen vegetation.

- Upper Thurne Broads and Marshes - This is a composite site made up of the Hickling Broad National Nature Reserve, and the 2 former separate Sites of Special Scientific Interest known as Hickling Broad-Horsey Mere and Martham Broad. The site is one of the finest examples of an unreclaimed wetland complex in Britain and is designated for its open water and marginal swamp, along with its extensive areas of fen vegetation, grazing marsh and woodland. It has been recognised (refer to Section 16.5.3 of this report) that the abstractions at Catfield can be shown to be having no impact on the features associated with the Upper Thurne Broads and Marshes SSSI.

We have taken reasonable steps to further their conservation and enhancement, particularly relating to the Ant Broads and Marshes – component part Catfield Fen - by the setting up of an RSA investigation to increase our understanding of the functioning and influences of these abstractions on the Fen. We have determined that the ecological features associated with the habitat site will be protected by the inclusion of a short two year renewal with continued monitoring while the RSA investigation is carried out – please refer to sections 16.5.1 and 16.5.3.

Section 39 Environment Act 1995

The Agency has a duty under section 39 of the Environment Act 1995 to take into account the likely costs and benefits of granting the applications ('costs' being defined as including costs to the environment as well as any person.). The Agency has taken these factors into account as indicated in section 17 above.

Section 15 Water Resources Act 1991 (particular regard to duties of water and sewerage undertakers imposed by Parts II-IV of the Water Industry Act 1991)

In granting the renewals there will be no additional effect on the water companies obligations to maintain a system of water supply.

The Conservation (Natural Habitats &c.) Regulations 1994

Under regulation 48 of these Regulations, the Agency must, before granting any abstraction licence, assess whether it is likely to have a significant effect on a European site (Special Areas of Conservation or Special Protection Area), either alone or in combination with other projects; and if so assess the implications of the abstraction upon that site in light of its conservation objectives. In the light of the conclusions of the assessment (and subject to regulation 49) the Agency shall grant the applications only after having ascertained that they will not adversely affect the integrity of the European site.

The European sites in proximity to the abstractions are as follows;

- The Broads Special Area of Conservation (SAC)
- Broadland Special Protection Area (SPA)

Both the Ant and Upper Thurne Broads and Marshes are component sites of the above European sites.

The interest features and conservation objectives for the European sites can be found in Appendices 8 and 10 of this report.

As indicated in section 16.5.3 of this report, a conclusion of no adverse effect on site integrity can be concluded for these abstractions by the inclusion of a two year time limit (to 31 March 2012) and continued groundwater monitoring.

The reasons for this conclusion are summarised below;

- Based on analysis carried out by our local groundwater team, they suggest that the renewal of licence 7/34/09/*G/0141C (Ludham Road) would result in a difference in surface water level in the Fen of the order of 1 - 2 cm. A change in water levels of this amount is not considered to be significant, to which Natural England agreed (reference to section 12 of this report).
- A Hydrochemistry study of Catfield Fen, carried out by Collins in 1988, suggested that fen water is dominated by surface water inputs and controlled primarily by rainfall and horizontal movement of water from dykes. This implies that the groundwater input from the crag is not the predominant influence on water levels in the Fen.
- An upward hydraulic gradient (between the crag and the Fen) was maintained for the period of 2004 to 2009, despite 2009 being a very dry summer and abstraction taking place under these licences at virtually the whole licenced quantity. This indicates that despite the Alston abstractions taking place, there was still a movement of water from the crag into the Fen.
- No signal from either of these abstractions was visible in the water level monitoring of data in the Fen that has been collected to date. This means that while abstraction has been taking place there have been no drops in water levels in the monitoring piezometers – please refer to Appendix 4 of this report for further details.

Based on the above information, we are satisfied that a renewal of both abstractions for an additional 2 years allows a conclusion of no adverse effect on the European sites to be reached.

Section 85 Countryside and Rights of Way Act 2000

Section 85 places a duty on Agency to have regard to the purpose of conserving and enhancing the natural beauty of the area of outstanding natural beauty (AONB) when exercising or performing any of our functions in relation to, or so as to affect, land in an such an area.

The abstractions are not located within or adjacent to an AONB area.

Section 40 Natural Environment and Rural Communities Act 2006

Section 40 places a duty on the Agency to have regard, so far as is consistent with the proper exercise of its functions, to conserving biodiversity. ‘Conserving

biodiversity' includes, in relation to a living organism or type of habitat, restoring or enhancing a population or habitat.

We are achieving this by requiring the applicant to continue to monitor groundwater levels around Catfield Fen and by the setting up of an internal RSA investigation to further our understanding of the interaction of abstraction to water levels, and hence the ecology, of the Fen.

Environmental Impact Assessment Directive 85/337/EEC as amended by 97/11/EC

These Directives are implemented by the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999. These Regulations apply to applications for planning consent made to a local planning authority; they do not apply to applications for an abstraction licence made to the Environment Agency under the Water Resources Act 1991.

The Agency's duties under the Water Resources (EIA) Regulations 2003 are considered in section 6 above.

Water Environment (Water Framework Directive) (England and Wales) Regulations 2003

As required by regulations 3 and 17 of these Regulations, in reaching these determinations the Agency has exercised its water resources functions so as to secure compliance with the Water Framework Directive and has had regard to the River Basin Management Plan for this river basin district which has been approved under regulation 14 of these Regulations.

The following table provides information taken from the Water Resources Graphical Information System (dated October 2009) for the Anglian River Basin District, Broadland Rivers catchment;

Water Body	Water Body ID	Status
River Ant	GB105034051330	Both have a river flow compliance of "Compliant" within the supporting good ecological status flow screening.
River Thurne	GB105034051360	
Broadland Rivers Chalk & Crag	GB40501G400300	• The combined groundwater body quantitative status is classed as "Good". • The combined groundwater body quantitative risk is classed as "At risk".

As these applications are for the renewal of existing licences with no changes to the conditions of abstraction, there will be no deterioration in the status as shown in the above table by the granting of these abstraction licences.

The Directive requires us to protect and restore all bodies of groundwater, and ensure that there is a balance between abstraction and re-charge of groundwater, with the aim of achieving good groundwater status by 2015 (or 2027 if appropriate). Currently the groundwater bodies in which the abstraction are located have a combined groundwater body quantitative risk of "At risk". The Anglian River Basin

Management Plan that addresses this status through relevant strategies, such as the Broadland Rivers Catchment Abstraction Management Strategy, as listed in Annex F (Mechanisms for Action) of the report, specifically section F5 which relates to the abstraction and impoundment of water.

The renewed licences will be time limited to expire in 2012, therefore there will be another opportunity for further assessment at that stage.

23. CONCLUSIONS AND RECOMMENDATION

The applications to renew licences 7/34/09/*G/0141C and 0144B are considered to be justified.

Full and due consideration has been given to any representations made, and due regard has been taken of protected rights, riparian and other lawful in-river interests. Due to the level of uncertainty regarding the potential impact of these abstractions on Catfield Fen, component part of the Ant Broads and Marshes SSSI/SAC/SPA a short time limit will be applied to both licences (to 31 March 2012) to allow for more monitoring data to be collected and analysed in support of any future licence renewal. An RSA project will also be set up to address the location of monitoring points and interaction of crag water levels (and hence abstraction) on water levels in the Fen.

It is recommended that the possibility of applying a cessation condition, linked to water levels in the Fen, to the licences is re-considered at the next renewals in light of the conclusions from the proposed RSA investigation.

It has also been agreed with Natural England and the applicant that we can apply our powers under Section 57 of the Water Resources Act 1991 if required to restrict abstraction in times of drought to safeguard the ecological features of Catfield Fen.

The conditions incorporated on the licence are considered to be necessary and reasonable in the light of the available and presented evidence. The conditions are also considered to be consistent with appropriate standards for enforcement by the Environment Agency.

- I therefore recommend approval of these applications and issue of the Licences with the conditions as drafted.

<u>NPS/WR/003092 – Renewal of licence 7/34/09/*G/141C (Ludham Road)</u>

- Issue with new licence number AN/034/0009/009
- Time limited to 31 March 2012
- Updated frequency of meter readings as per new guidance (to monthly)
- Retain the monitoring within the Important Information section of the licence
- Remove the reference to area of land from the Important Information section.

NPS/WR/002725 – Renewal of licence 7/34/09/*G/144B (Plumsgate Road)

- Issue with new licence number AN/034/0009/008
- Time limited to 31 March 2012
- Updated frequency of meter readings as per new guidance (to monthly)
- Retain the monitoring, IDB pump information and pump test requirement within the Important Information section of the licence
- Remove the reference to area of land from the Important Information section.
- Update the purpose to spray irrigation only.

The applicant will be invited to apply for a Two Part Tariff agreement under section 127 of the Water Resources Act 1991 for both abstractions in the issue letter.

24. AUTHORISATION

Report by: Hannah Goodfield **Position:** Senior Permitting Officer

Signed ……..
Date: 09/03/2010

Audited by: Mladen Vukovic **Position:** Senior Permitting Officer

Signed……..
Date:09/03/2010

Audited by: Teresa Johnstone **Position:** Permitting Officer

Signed……..
Date:

Authorised by: Fiona Ireland **Position:** Permitting Team Leader

Signed Fiona Ireland
Date:26/03/2010

Appendix Listing

Appendix	Title
1	Charging Details and Finance Memos
2	Representation Letter
3	Response to representation
4	Review of monitoring for renewal of licence 7/34/09/*G/0141C
5	Influence of abstraction under 7/34/09/*G/0144B on Crag groundwater levels
6	Current Understanding of the Hydrology of Catfield Fen, Norfolk; Implications regarding hydrological vulnerability to groundwater abstraction.
7	Information regarding previous issues related to derogation as a result of licence 7/34/09/*G/0144B (Plumsgate Road)
8	Ant Broads and Marshes Appropriate Assessment
9	Crow Assessment
10	Upper Thurne Broads and Marshes assessment of likely significant effect on a European site

Appendix 1 - Charging Details and Finance Memos

1. ENFORCEMENT – CRITICALITY CLASS

Critical

2. FINANCIAL CHARGE CALCULATION

The charging scheme for 2010/11 has not yet been finalised, therefore the charge calculation has not been worked out.

FINANCE MEMO – Renewal of 7/34/09/*G/0141C

The Following Licence To Abstract Water Has Been Issued

Licence Number: AN/034/0009/009	**Account Ref No:**	**IAS No:**

Licence Holder: A W Alston	Previous Holder:
ID no :	ID no:
Registered Address: White House Farm Marsham Norfolk	Correspondence/Invoice Address :
Postcode : NR10 5PJ	Postcode :
ID no :	ID no :

Date Effective From 01 April 2010		Issue Date March 2010
Licence in force until revoked N		Expiry Date 31 March 2012
Two Part Tariff Offered Y	Accepted Y/N	Other Agreement Y/N

Chargeable Y	Reason if non chargeable :
Total Authorised Quantity (tcma) :	22.700

Charge 1 – Annual Quantity (tcma) 22.700

Source Crag borehole at Ludham Road at NGR TG 386 206	Period April to October	Loss (purpose) Spray irrigation
	Summer 1.6	High 1.0
Unsupported 1.0		

FINANCE MEMO – Renewal of 7/34/09/*G/0144B

The Following Licence To Abstract Water Has Been Issued

Licence Number: AN/034/0009/008	**Account Ref No:**	**IAS No:**

Licence Holder: A W Alston	Previous Holder:
ID no :	ID no:
Registered Address: White House Farm Marsham Norfolk	Correspondence/Invoice Address :
Postcode : NR10 5PJ	Postcode :
ID no :	ID no :

Date Effective From 01 April 2010	Issue Date March 2010	
Licence in force until revoked N	Expiry Date 31 March 2012	
Two Part Tariff Offered Y	Accepted Y/N	Other Agreement Y/N

Chargeable Y	Reason if non chargeable :
Total Authorised Quantity (tcma) :	68.000

Charge 1 – Annual Quantity (tcma) 68.000

Source Crag borehole at Plumsgate Road	Period	Loss (purpose) Spray irrigation and private water undertaking for spray irrigation
	Summer 1.6	High 1.0
Unsupported 1.0		

Appendix 1

Appendix 2 – Representation Letter

(please note that the response was received as 3 letters within one word document)

O P RICHES
Willis Cottage
Lower East Carleton
Norwich
NR14 8LF
01508 571449

RURAL LAND MANAGEMENT 23 February 2010

Hannah Goodfield

By e-mail

Dear Hannah

Alston licence renewals

On page 2 of your document headed “Habitats Directive – Supporting Document for Appendix 12 Form for Stage 3 Assessing adverse effect on site integrity”, you refer to a requirement to monitor three piezometers in the vicinity of each of the two boreholes.

1. Are these monitored solely by Mr Alston?

2. I would like to see copies of the monitoring records for the last three years for these six piezometers.

Yours sincerely

O P Riches

cc: Marion Martin

O P RICHES
Willis Cottage
Lower East Carleton
Norwich
NR14 8LF
01508 571449

RURAL LAND MANAGEMENT 23 February 2010

Hannah Goodfield
Environment Agency
Iceni House
Cobham Road
Ipswich
IP3 9JD

Dear Hannah

Abstraction Licence Renewals
A.W. Alston
Ref.7/34/09/*G/0141C
7/34/09/*G/0144B

Thank you for your consultation documents relating to the renewal of the above licences.

I enclose a further report by Professor Gilvear:

(a) This report calls into question the location of the monitoring points with reference to Catfield Hall Fen and this questions the validity of the data on which your decisions are taken.
(b) He suggest that the use of the Green report (1998) may have been on too simplistic a manner and that the Green results could lead to a conclusion that there is a reduction of groundwater directly into the peat.
(c) He highlights the considerable uncertainty as to the reliability of the data and its interpretation.
(d) To date there appears to be no clear explanation or consensus as to why water levels in 2008 and 2009 on Catfield Fen were so low although in both years abstraction was significantly higher
(e) He concludes that the conclusions that Gavin Sharpin has reported are not matched by the material within his report.

1. Form HR01 – This form relates purely to the Upper Thurne Broads and Marshes SSSI and I have no comment to make on this document. However, I do not appear to have a similar form for the Ant Broads and Marshes SSSI.

2. Supporting Document for Appendix 12 Form Stage 3 – Appropriate Assessment. I would make the following comments:-
(i) Page 4: Change in flow or velocity regime:-

We do not believe that you have given significant weight to the degree of connectivity between the crag and surface water levels. It is now accepted that Catfield Fen is more dependent on groundwater than previously thought and I notice that the Entec report, of which I have so far only been allowed to see part, refers to the fen as being particularly groundwater dependent. The report by Gavin Sharpin appears to accept the findings of Gilvear (2010) that the fen is groundwater dependent.

(ii) Page 4: Other hazards

You mention that the abstractions are not considered to have an adverse effect on habitat loss among other things. I do not accept this point. It is only in the last two years that the abstraction has been used to its maximum levels and in these two years there have been significant drops in dyke water levels on Catfield Fen. Global warming studies suggest low summer precipitation and therefore maximum abstraction is likely to take place. We believe that continued low dyke water levels could lead to a habitat shift at Catfield.

(iii) Page 5 – "In Combination Impacts"

Para 2: It is not clear from this paragraph how much weight you are giving to the Review of Consent Process (RoC) for the Ant Broads and Marshes. It appears to me the structure of the RoC process is flawed in relation to the review/renewal of individual licences because it does not take into account localised issues. The process for the renewal of these two licences is without the RoC process and I should be glad to have confirmation that the RoC conclusion has not been given significant weight.

(iv) Conclusions of your Appropriate Assessment.

We acknowledge that you consider that the effect of these licences could have an impact on the Ant Broads and Marshes SSSI. I note that you propose to modify the existing licences by extending them only for a period of two years and that, within this time frame, further monitoring will be collected and analysed. We do not believe that this is the conclusion that should be drawn from the current facts:-

1. Gilvear suggests that the monitoring points are not correctly positioned to allow the effects on Catfield Fen to be adequately analysed.

2. It is agreed that Catfield Fen is much more groundwater dependent than was thought to be the case at the start of the RoC process.

3. It is accepted that the hydrogeology of the area is complex and that it is not possible to use standard analytical solutions to accurately assess the draw-down in the crag beneath Catfield Fen.

4. Further monitoring based on the existing monitoring stations would not significantly inform current knowledge.

5. The drop in water levels in 2008 and 2009 when abstraction was at maximum permitted levels demonstrates that the site is at significant risk of damage. There has been no explanation as to why levels dropped so dramatically.

6. Further research is required to investigate the hydrogeology of the area and the effect of abstraction.

7. The Catfield Hall Fens are accepted to be of very high ecological importance and should not be put at risk.

We conclude that the precautionary principle suggests that, until further research is carried out, these licences should not be renewed.

Yours sincerely

O P Riches

O P RICHES
Willis Cottage
Lower East Carleton
Norwich
NR14 8LF
01508 571449

RURAL LAND MANAGEMENT 23 February 2010

Hannah Goodfield and Marion Martin
Environment Agency
Iceni House
Cobham Road
Ipswich
IP3 9JD

Dear Hannah and Marion

Review of Alston licences

I have written separately detailing comments on Hannah's documentation and appropriate assessment. However, there are other matters which I wish to raise:-

1. Provision of material:-

We asked for all material relevant to this issue at our meeting on 25th January. I have now just received a document containing correspondence and e-mails which I have not yet had time to digest. I have had to ask for a copy of the Entec report and have been sent only part of the document, the rest being retained at this stage for checking against data protection. The timescales are such that I do not think that my client has been discriminated against by not having significant time to analyse all the data involved in this complex issue. Natural justice has not been well served here. My client will use all remedies at his disposal, including the legal avenue, to ensure that the integrity of the site is not compromised. It is now over 18 months since the issue was first raised; we are now having to deal with a complex matter in far too short a space of time.

2. Entec report: Please let me have this by return of post.

3. Alston Application: The map included within the Alston application includes a 28acre field which belongs to my clients, not Mr Alston.

Yours sincerely

O P Riches

Appendix 3 – Response to representation

Mr. Peter Riches
Willis Cottage
Lower East Carleton
Norwich
NR14 8LF

(sent via email to
peter-riches@talk21.com)

Our ref: HG/Alston licence renewals

Date: 4 March 2010

Dear Peter,

RE: CONSULTATION RESPONSE FOR AW ALSTON LICENCE RENEWALS AND CATFIELD FEN

Thank you for your letter dated 23 February 2010 regarding your comments on the consultation documents sent in relation to the renewal of licences 7/34/09/*G/0141C and 7/34/09/*G/0144B held by AW Alston.

For clarification as three letters were included within your response, this letter will address each in turn.

Letter 1. Reference: Alston Licence Renewals

The monitoring piezometers included within the licences are as follows;

Licence 7/34/09/*G/0141C (Ludham Road)

NGR	Monitoring frequency	Who monitors?	Relative location
TG 3850 2059 (TG32/805)	Daily during abstraction season, weekly the rest of the year	This piezo is logged by us (but with data only available from 28/10/2009) and monthly dips by Agency hydrometry staff since March 2009.	Towards Catfield Fen
TG 3813 2078 (TG32/801)	Daily during abstraction season, weekly the rest of the year	This piezo is logged by us (but with vandalism causing some missing data) and monthly dips by Agency hydrometry staff since March 2009.	Towards Catfield Fen
TG 3821 2029	Daily during abstraction season, weekly the rest of the year	This is monitored by the applicant (It was not used in the Catfield Fen investigation).	Towards Sharp Street

Licence 7/34/09/*G/0144B (Plumsgate Road)

NGR	Monitoring frequency	Who monitors?	Relative location
15m piezo - TG 3831 2262 3m piezo - TG 3831 2262	Twice weekly between April and October, monthly the rest of the year.	This piezos were logged hourly by applicant in 2009 irrigation season.	North of the Alston abstraction, towards Sutton Broad
Agency piezo 5 – TG 3825 2240 (TG32/815D)	Hourly (via datalogger)	This is monitored using the applicant's logger with Agency dips. The Agency dips were used in contouring of impact of 0144B. Otherwise the data was not used in the Catfield Fen assessment.	Immediately north of the Alston abstraction

The data gathered and used by Gavin Sharpin in his assessment from the above monitoring piezometer's has been attached to this letter for your information and referenced as per the above table.

Letter 2. Reference: Abstraction Licence Renewals

The conclusion of the RoC for the Ant Broads and Marshes was that "there is sufficiently low risk associated with real fully licensed abstraction that the environmental outcomes are likely to be achieved." Both licences 7/34/09/*G/0141C and 7/34/09/*G/0144B were included in the groundwater model for the runs which led to this conclusion being reached.

The recent monitoring data that was collected has however been treated as new information which is why an Appropriate Assessment (Appendix 12) has been undertaken for the consideration of these licence renewals. This allows the new information to be taken into account along with the modelling work which has been carried out.

Regarding your comments on the Appropriate Assessment, this was produced based on the data and information available. Given the level of uncertainty of the impact of these abstractions on water levels in Catfield Fen and the need for an increased understanding of the hydrogeology of this area, the precautionary approach was applied to grant the renewals for a further 2 years in order to collect additional monitoring data and to carry out further investigations.

Due to concerns with low water levels on the Fen we are proposing to set up a Restoring Sustainable Abstraction (RSA) project to further investigate the interaction of the crag with the Fen and as such the level of impact these abstractions are having. This is likely to include the need to re-assess the locations of the current monitoring network.

With specific reference to Professor Gilvear's comments (dated 20 February 2010) our responses are as follows;

i. As indicated previously, it is agreed that the monitoring points are not located at the optimum location for assessing any impact from the AW Alston abstractions on Crag heads beneath the Fen. The RSA project that is to be undertaken will look at whether further monitoring on the eastern side of the Fen is required.

ii. With reference to the findings of the Green (1998) report it is important to note that

the report's estimate of maximum predicted drawdown of 0.11 m is summarised in the Sharpin (2010) report but is not considered to be realistic. The monitoring suggests that analytical solutions such as the Theis solution that the estimate is based on are not appropriate due to their assumptions not being correct in this case.

The report also states that the impact would be measurably small. We are not able to say what the impact of a drawdown in the crag will relate to in ecological terms and as such are reliant on Natural England to provide us with their views as to what is meant by adverse effect. In this case they are happy with our recommendations that by renewing both Alston licences for a further 2 years will allow a conclusion of no adverse effect to be made. I would hope that any RSA scheme put in place would help to address and quantify the potential ecological impact of abstraction on water levels in the Fen.

Regarding the potential for groundwater abstraction to reduce groundwater inflow to the dykes, rather than assume the drawdown at any windows in the clay will be the same as beneath the dykes, it could be that the presence of the dykes reduces drawdown beneath clay windows by providing some recharge to the Crag. Again, the Green (1998) conclusions were based on a drawdown at the Fen that is significantly higher than the drawdown observed in 2009 as a result of the abstractions.

iii. The low water levels in the surface water drains in 2008 and 2009 have not yet been explained. The low levels in 2009 are not surprising as there was exceptionally low rainfall in September and October. Those in 2008 are not readily explicable. It should however be recognised that the abstraction from licence 7/34/09/*G/0144B was much lower in 2008 than 2009 (21,300m³/year compared with 65,200m³/year respectively) and was comparable with the historical abstraction.

The monitoring suggests that abstraction under licences 7/34/09/*G/0141C and 0144B are not the main cause for low water levels, and other possible explanations include a problem with the rond and the prolonged dry weather, particularly in 2009. Further investigation is required through an RSA project to address these uncertainties.

iv. The final point raised by Professor Gilvear in his comments dated 20 February 2010 relate specifically to the conclusions reached by the report produced by Gavin Sharpin (14 January 2010).

The Sharpin (2010) report states that Theis should be used with caution, but does not base its conclusions on Theis analysis.

It is not clear which conclusion(s) are considered to be a "sizeable jump". Each of the conclusions from the Sharpin (2010) report are given below with some comments to justify them:

- *There appears to be a flow of groundwater from the Crag to the Fen. The upward hydraulic gradient persisted throughout the period 2004 to 2009, even during the very dry summer of 2009 when the two abstraction licences were utilised almost to their fully licensed quantities and uptake of the Anglian Water Services Ludham licence was high.*

We assume that this conclusion is not contested.

- *No signal from either abstraction is visible in the piezometry or surface water level monitoring in the Fen.*

No suggestion is given in Professor Gilvear's comments that he disagrees with this conclusion, although he does point out that the piezometry is not ideally located to detect impacts, a point on which we agree.

- *Any impact of abstraction 0144B on Crag groundwater levels beneath the Fen is likely to be insignificant.*

No comment has been received that argues that any evidence shows an impact from abstraction 7/34/09/*G/0144B. This conclusion was made prior to the contouring work that was carried out. It is felt that this contouring supports the conclusion. Again, the position of the monitoring on the Fen is not ideal for detecting an impact. A logger on a piezometer(s) between the abstraction and the Fen, or on the northeastern edge of the Fen, could be used to confirm (or refute) this conclusion.

- *Gilvear (2010) reports that an estimate of groundwater inflow from the Crag was made as part of a study in the 1980s based on a water balance. Over a 15-month period the average monthly inflow was estimated to be 6 mm per month. The hydraulic gradient between the Crag (P1) and the peat in the Fen (P3) appears to be approximately 0.2 m (Figure 7). Levelling in the surface water observations made by the Catfield Hall Estate to Ordnance Datum or determining what piezometers TG32/616a, 616b, 616d, 617, 617a and 617e show would give a more accurate hydraulic gradient between the Crag and surface water in the Fen. But assuming the gradient is approximately 0.2 m, carrying out a simple rearrangement of the Darcy equation with these speculative figures, a 2 cm decrease in Crag levels might equate to a 0.6 mm (i.e. 10 per cent) decrease in upward groundwater flow to the Fen. It is likely to be decrease in Crag water level of this order of magnitude that is to be considered in assessing the impact of licence 0141C on the Fen, though this approximation is clearly sensitive to errors in all of the variables estimated.*

  The implications of a specific decrease in groundwater flow on the ecology of the Fen is beyond the scope of this paper.

This conclusion is necessarily speculative, since the original modelling reported by Gilvear (2010) was reported with appropriate uncertainty and there is some uncertainty on any impact of abstraction. The purpose of this conclusion was to quantify an impact on groundwater flows to the Fen given a specific impact on head in the Crag, to aid the assessment of any impact of abstraction on the ecology of the Fen. The figures were taken from Gilvear (2010) and from the monitoring available. No specific comments were received to suggest any error in the simple method used in the conclusion to convert an impact on Crag head to an impact on inflow to the Fen.

- *Nothing in the data collated here clearly indicates that licences 0141C and 0144B should not be renewed to the appropriate CAMS common end date. However, the uncertainties involved might prompt further investigation of licence 0141C and a shorter renewal of that licence in the meantime.*

It is presumably mainly this conclusion, and particularly the first sentence of it, that is felt to be a “sizeable jump” from the data presented and its interpretation.

It is accepted that uncertainties remain despite the data available. The causes of these uncertainties include a lack of monitoring of Crag head at the eastern edge of the Fen, and the need for a better understanding of the impact of a small reduction in Crag head beneath the Fen on the Fen’s ecology. With reference to the data presented in the Sharpin (2010) report, the reductions in surface water levels as measured by the Catfield Hall Estate are not, by themselves, considered to be persuasive evidence that the increased abstraction in the past two years is causing reductions in Fen water level. The other data analysed in the report does not support the hypothesis that the abstractions are the main cause of the low water levels.

Without more evidence and further investigation, refusal of the renewals of the AW Alston abstraction licences is not considered to be justifiable. However due to the uncertainties associated with the abstractions the precautionary approach has been applied and the licences can currently only be renewed for an additional 2 years.

Natural England have confirmed that they agree with our decision of a short term renewal and that this allows us to reach a conclusion of no adverse effect. Natural England asked us to consider placing a cessation condition on the licences, linked to water levels in the Fen. As discussed earlier this week at the present time we do not feel that such conditions are appropriate until we have a better understanding of the impact of these abstractions on the Fen. Any RSA project will address the imposition of further conditions. The renewal determination report will recommend that the possibility of applying a cessation condition to the licence is re-considered at the next licence renewal in light of the conclusions from the proposed RSA investigation.

It is also important to note that in order for additional monitoring to be meaningful, we would require abstraction to be taking place in order to assess it’s impact on water levels in the Fen.

Letter 3. Reference: Review of Alston Licences

Regarding your request for the full Entec RoC report, apologies that you have yet to receive a copy of the report, we will be able to respond to your request within our normal customer charter time of 20 working days (with any additional time added between payment request and receipt).

As discussed previously the information and data contained in the report you have requested has been considered in our decision making process for these renewals, as detailed in the consultation papers.

In relation to progressing your request, we have to take into account costs incurred in supplying and licensing your use of our information. Charges are based on:

i) the time spent by our staff in providing you with the information requested, current rates being £25.00 per hour. These charges are not subject to VAT;
ii) a standard charge of £10 for the extra permission to use our information commercially. VAT is applicable to this charge.

We estimate that the information you have requested will cost £86.75 to supply. This charge has been determined as follows:

2 hours of staff time at £25.00 per hour	=	£50.00
Payment processing cost at £25 per enquiry	=	£25.00
Commercial re-use charge	**=**	***£10.00***
VAT	**=**	***£ 1.75***
Total cost	**=**	**£86.75**

Please note that this is an estimate of the amount of time it will take us to search our records and gather the information you have requested. If your enquiry takes us less time we will refund the difference. Any extra time taken will be charged for.

Please make your cheque payable to the Environment Agency and send it to Corporate Services, at the address shown in the footer of page 1. **Please be aware that we are unable to process your request for information until your payment has cleared our bank account.** We also accept credit card payments by telephone at a reduction of £20 for payment processing cost. Please call (01473) 706720 to make payment.

Please note that if we have not received payment within 2 months of this letter being issued the request for information will be deemed to have been withdrawn.

Your final point relates to the land area highlighted on the AW Alston application map. Thank you for pointing out the issue, it would be useful to know which field this relates to for our records. The requirement for providing land area on licence maps was removed by the Water Act 2003. However land area is useful in assessing the justification of a licence. Bearing in mind the reduced land area (by 28 acres) the application is still considered to be justified.

I hope this letter addresses your queries sufficiently and provides reassurance that we are taking your client's concerns seriously. We are in the process of setting up a project to investigate the impact of abstraction on water levels in the Fen. As discussed earlier this week, we will of course keep you posted on any developments in this project and allow you client the opportunity to comment on and be involved in it.

If you have any further queries please do not hesitate to contact me on the details shown below, otherwise we will be in contact shortly regarding the arrangements of the RSA project.

Kind regards

HANNAH GOODFIELD
Senior Permitting Officer – Water Resources

Direct dial: 01473 706826
Direct fax: 01473 724205
Direct email: hannah.goodfield@environment-agency.gov.uk

Appendix 4

Review of monitoring for renewal of licence 7/34/09/*G/0141C

Scope

The scope of this paper is to investigate whether recent monitoring around abstraction licences 7/34/09/*G/0141C and 7/34/09/*G/0144B and in Catfield Fen show that those abstractions are impacting upon water levels in the Fen.

Abstraction licence 0141C authorises maximums of 800 m^3/day and 22,700 m^3 per year between April and October (inclusive), to be pumped from a 33 metres-deep borehole into the Crag at National Grid Reference TG 386 206 and used for spray irrigation. Licence 0144B authorises maximums of 1,090 m^3/day and 68,000 m^3 per year between April and October, to be pumped from a 20.7 metres-deep borehole into the Crag at National Grid Reference TG 382 223 and also used for spray irrigation.

Catfield Fen has been assessed as 'Low Risk' in Stage 4 of the Environment Agency's Review of Consents, and the Review concluded that licence modifications were not required (see Entec (2007)). This paper does not attempt to repeat the work carried out under that study, but to review recent empirical data to assess whether the abstractions, which, as time-limited licences are dealt with under Regulation 48 of the Habitats Directive, are impacting upon water levels in the Fen. It is also not within the scope of this paper to consider the environmental impacts of reduced water levels or groundwater flows around the Fen.

A report has recently been completed summarising the hydrology of Catfield Fen as investigated by previous studies (Gilvear, 2010). It is referenced in this paper to provide an audit trail for future investigations.

A map of the area showing the location of abstraction 7/34/09/*G/0141C and the nearby Anglian Water Services Ludham source, the location of abstraction 7/34/09/*G/0144B, and the monitoring locations for which data has been collated, is given in Figure 1. All figures are given at the end of the paper.

Background

The geology in the Catfield area consists of Chalk overlain successively by London Clay, Norwich Crag and glacial deposits. The Crag is in excess of 30 metres thick and is composed of layers of sands, gravels and clays, some having a silty content. There is thought to be substantial vertical anisotropy in the Crag, with the clay strata acting as aquitards (Martin, 2001). The glacial deposits are restricted to the upland areas.

The abstraction borehole for licence 0141C is located on the upland between Catfield Fen and Barton Broad to the west and Hickling Broad to the east. It is close to the groundwater divide between catchments 34/9 and 34/10, although this is poorly defined due to the shallow groundwater gradients in this area. The abstraction borehole for licence 0144B is to the north-west of Catfield, close to drains feeding Sutton Broad. Natural groundwater gradients between the licences and the water features to the west of the boreholes are shallow, but appear from piezometry to follow the topography of the area (Goodfield, 2006).

The transmissivity of the Crag around abstraction 0141C was calculated to be approximately 450 m²/day, based on pumping and recovery tests. The storativity is considered to be approximately 0.05, based on other Crag sources in the area (Martin, 2001). The transmissivity around abstraction 0144B was estimated to be 800 m²/day and 3000 m²/day, based on analyses of different data, with storativity of 0.25. It was concluded that the cone of depression of abstraction 0144B extends mainly to the north, where transmissivity appears to be higher, away from Catfield Fen to the south-west. The large variation in transmissivity in the tests reflects the complexity of the aquifer conditions around the abstractions, which do not fulfil the assumptions of conventional analysis techniques.

Details of the hydrological functioning of Catfield Fen are provided by Green (1998), Entec (2007) and Gilvear (2010). The Gilvear report should be referred to directly, since it is itself a summary report of other investigations. Brief summaries of the pertinent sections from Green and Entec are presented here.

Green (1998):

- The maximum predicted drawdown in the Crag due to the abstraction is 0.11 metres at the fen margin and the predicted radius of influence is 900 metres (based on Theis, and likely to be an over-estimate).
- The fen deposits are separated from the Crag by a layer of clay, which is laterally fairly persistent, although there may be a few areas of limited extent where it is absent (clay “windows”) and it may also have been removed in some of the drains.
- These factors, together with the absence of any observed upward gradients within the peat, suggests that any upward leakage across the clay will only wet the base of the peat and that the fen water table is controlled primarily by rainfall and horizontal movement of water from the dykes. The impact of the abstraction on the fen water table is therefore likely to be immeasurably small.
- There is a potential for a reduction in the summer dyke levels in the perimeter and linked dykes due to either direct depletion or water being drawn into the fen to compensate for any drawdown in the fen water table.
- There is also a potential for a reduction in the groundwater flow to the dykes. This may result in a change in the water quality balance within the dyke system, with more nutrient-rich water from the river being drawn further into the dykes. Given the relatively small volume of the abstraction [under 7/34/09/*G/0141C], the impact is also likely to be small.

Entec (2007, p.38 of volume 1):
Catfield Fen ‘Internal’ system is separated from Catfield Great Fen by the Commissioner’s Rond. There are two sluices in the Rond which allow for exchange of water with the external system. Under normal conditions, water levels in the internal system are higher than those in the external system and hence flow through the northern sluice is towards the Broad/River. The sluices are primarily used to maintain water levels during the summer. The second structure (a flapped culvert) allows for water to flow (via Ant Dyke) southwards through the Rond from Catfiled Internal Fen towards Irstead Fen.”

Data availability

Observations were available from monitoring points for the periods and frequencies shown in Table 1, presented after the text in this paper. Data were collated in the following figures covering the period April to October 2009:

- Daily abstraction for licence 7/34/09/*G/0141C (Figure 2a);
- Daily abstraction for licence 7/34/09/*G/0144B (Figure 2b);
- Daily rainfall as measured at Barton Hall, approximately 2 km to the northwest of Catfield Fen (Figures 2a and 2b);
- Daily abstraction for Anglian Water Services' nearby Ludham source (Figure 3), the location of which is shown on the map in Figure 1;
- Monthly dips in TG32/801 and TG32/805 between April and October 2009, and 15-minute logger data from TG32/801 from the 24th June to the end of October 2009 (Figure 4a). Unfortunately, the logger data from TG32/801 prior to the 24th June was unusable due to vandalism, and all logger data from TG32/805 from April until the 28th October 2009 cannot be found. Note that the data are all in units of metres below ground level, as the piezometers have not been levelled in to Ordnance Datum;
- Logger measurements in the 15 metre and 3.5 metre piezometers close to abstraction licence 7/34/09/*G/0144B (Figure 4b);
- Daily averages from logger data for NTG3261 P1, monthly dips in NTG 3261 P2, NTG3261 P3, NTG3270 P4, NTG3270 P5, and weekly readings of water level in Catfield Fen taken by staff at the Catfield Hall Estate (Figure 5). Note that the data are in Ordnance Datum except for the Catfield Fen water levels, for which the conversion to Ordnance Datum is not known.

The figures all have the same x-axis timescale to allow easy comparison of the data they present.

There are also three figures showing data for the period January 2004 to December 2009:

- Monthly abstraction rates under licences 7/34/09/*G/0141C and 7/34/09/*G/0144B (and the predecessor licences) and monthly rainfall as measured at Barton Hall (Figure 6);
- The same data as shown in Figure 5, but with monthly readings of the Catfield Fen water level in the years 2004, 2004, 2007 and 2008 (Figure 7). Data for 2006 were not provided;
- Monthly dips in piezometers TG32/616a, TG32/616b, TG32/616d, TG32/617, TG32/617a, TG32/617b and water levels in Catfield Fen as measured by the Catfield Hall Estate, showing all data available from those sites in the years 2004 to 2009 (Figure 8).

Again, these figures have the same x-axis timescale to allow comparison of the data.

- One further figure is given covering 2004, to allow comparison of the gaugeboard data measured at NTG3261 G1, NTG3261 G2 and NTG 3261 G3 with the levels measured by the Catfield Hall Estate throughout the only period for which both are available (Figure 9). This figure does not show much of interest, especially since the lack of a datum for the water levels measured by the Catfield Hall Estate does not allow direct comparison of levels. It is included to indicate whether further measurements at the gaugeboards, if they are still present, would be instructive.

Data analysis

The following points are noted about the data (with figure numbers given at the end of each point to direct the reader to the relevant figures):

- Abstraction licence 7/34/09/*G/0141C is not particularly large. In comparison, the AWS Ludham source 600 metres to the south abstracted approximately fifteen times as much in the period April to October 2009 - approximately 350,000 m³ compared to 22,100 m³ - and also abstracts during winter (Figures 2a and 3).

- Abstraction under licence 7/34/09/*G/0144B was significantly higher in 2009 than in previous years. Table 2 below shows the annual total abstraction rates over the past six years.

Year	Abstraction under 7/34/09/*G/0141C (m³)	Abstraction under 7/34/09/*G/0144B (m³)
2004	13,663	8,033
2005	10,026	5,051
2006	21,412	23,501
2007	4,160	15,912
2008	22,910	21,332
2009	22,100	65,210

Table 2: Annual abstraction under licences 7/34/09/*G/0141C and 7/34/09/*G/0144B. (The annual maxima are: 0141C – 22,700 m³ and 0144B – 68,000 m³.)

Licence 0144B is approximately 1200 metres from Catfield Fen, as is Anglian Water Services' Ludham source. Even at its fully licensed rate of 68,000 m³, abstraction under 0144B would take approximately one fifth as much as the Anglian Water Services source took between April and October 2009 (Figures 2b and 3).

- The monthly dips from TG32/801 and TG32/805 are of limited value. They show a summer recession, as would be expected, but it is not possible to distinguish the impacts of the nearby abstraction under licence 0141C (Figures 4a and 2a).

- The logger data from TG32/801 (Figure 4a) show at least three shorter-term reductions of approximately 0.05 m each superimposed on the recession, around 22 – 30/08/2009, 16 - 18/09/2009, and 01 – 03/10/2009. These water level reductions coincide with the three main periods of abstraction under licence 0141C during the period for which logger data were available (Figure 2a). These short-duration reductions in the water level record also coincide with periods of low rainfall (also shown in Figure 2a). Although the water level decreases are small, the rate of decline suggests that they are not the consequence of dry weather. (Higher abstraction for irrigation will obviously tend to take place during drier periods, and this can lead to difficulties in disentangling the causes of water level reductions.) A simple Theis analysis suggests that a drawdown of 0.05 m could result from the abstraction taking place approximately 400 m away, using T = 450 m³/day and S = 0.05, though the hydrogeology of the area requires that such analyses are used with caution here.

- It is unfortunate that the logger record for TG32/805 is not available for a period covering abstraction, though it is not certain that it would show a significant impact from the abstraction. Martin (2001) reports that the piezometer does not respond much to the abstraction, despite being located very close to it and despite the depth of the piezometer having been plumbed to 16.2 metres. A lack of response could result from the presence of low permeability clay strata between the depth of the abstraction bore

and the depth of the piezometer. It is difficult to deduce anything about the impact of the abstraction on Catfield Fen from a lack of response in piezometer TG32/805.

- The logger data from the Plumsgate Road 15 metre-deep piezometer show at least four short-term drawdowns of approximately 0.1 m resulting from the nearby abstraction under licence 0144B (Figure 4b), in late May, late June, mid-August and mid-September. These drawdowns correspond to the four periods when abstraction was taking place at the highest rate in the 2009 irrigation season (Figure 2b), and are superimposed on the summer recession. There is possibly a fifth drawdown corresponding to the less intensive abstraction in late April. The impact of the abstraction is not clearly distinguishable in the record of the 3.5 metre-deep piezometer, partly due to the gap in the data.

- All measurements taken on Catfield Fen between April and October 2009 show a summer recession (Figure 5). There is a short-term reversal of the trend in all points around early July. The cause of this is likely to be the 25 mm of rainfall that was recorded on the 7th July (Figure 2a). It is interesting to note that as well as affecting surface water levels and levels in the near-surface peat and drift, the heavy rainfall also affected levels in the Upper Crag, as measured in P1. The upward hydraulic gradient in the Fen appears from the monthly reading of P3 to have been maintained, though. This could indicate that the Crag is being recharged elsewhere and the head increase is being transmitted to beneath the Fen. Alternatively, the rise in the Crag might result from compression of the matrix under semi-confined conditions. The record of water level in P1 shows other similar increases during the summer recession in the longer record shown in Figure 7, and these can also be attributed to rainfall events of 20 mm or more.

- The measurements around Catfield Fen in Figure 7 covering the period 2004-9 (and in Figure 5 covering the 2009 irrigation season) show a clear correlation between levels in the Upper Crag (P1) and the surface water levels (as measured by the Catfield Hall Estate). The other piezometers appear to correlate too, although there are several dips that are probably erroneous and the correlation is not as clear because those piezometers were only monitored monthly.

  The upward gradient between the Crag and peat appears to be maintained throughout the period, although the gradient decreases in the driest periods, indicating reduced upward groundwater flows from the Crag. These observations support Gilvear's (2010) characterisation of the Fen as being supported by groundwater.

  Despite the correlation, the relationship between groundwater head in the Crag as shown by NTG3261 P1 and water levels measured by the Catfield Hall Estate appears to differ in 2008 from that in 2004-5 (Figure 7). Levels in P1 are comparable between 2004, 2005 and 2008, but surface water levels show a marked decline in the summer of 2008 that they do not show in 2004 or 2005. This suggests that one of the other factors influencing water level in the Fen was different in 2008. Since evapotranspiration is unlikely to be significantly different, it could be that drainage of the Fen via the sluices was higher. Without site-specific knowledge, it is not possible to draw definite conclusions.

- Levels in the Crag near the Fen were particularly low for 2009, coinciding with low surface water levels on the Fen and high total abstraction from 0141C and 0144B (Figures 7 and 6, and Table 3 below). The January to September rainfall in 2009

measured in Barton Hall raingauge was particularly low, as Table 3 shows. Data from 2009 is therefore not comparable to that from any previous years and it is therefore not possible to identify any impact of the significant increase in uptake of licence 0144B. Even if rainfall comparable to previous years had occurred it is unlikely that it would be possible to see the impact of increased abstraction under 0144B in the observations on Catfield Fen.

Year	January - September rainfall (mm)	Rank for minimum rainfall	Minimum water level in NTG3261 P1 (mAOD)	Rank for lowest water level	Abstraction under licences 141C and 0144B (m^3/year)	Rank for highest annual abstraction
2004	592	5	0.540	3	21,696	4
2005	499	3	0.583	5	15,077	6
2006	447	2	0.407	2	44,913	2
2007	677	6	0.727	6	20,072	5
2008	504	4	0.549	4	44,242	3
2009	315	1	0.388	1	87,310	1

Table 3: Antecedent rainfall, water levels in Crag piezometer NTG3261 P1, and annual abstraction at 7/34/09/*G/0141C

- As construction details are not available for the TG32/616 and TG32/617 piezometers for which observations are shown in Figure 8, it is not possible to draw conclusions from them, other than that they do not appear to contradict the other available observations.

- As details about the locations of the gaugeboards are not available – in particular, whether they are inside or outside the rond – it is not possible to draw conclusions from the observations shown in Figure 9.

Conclusions

Given the complex hydrogeology of the area, it is not possible to use standard analytical solutions to accurately estimate the drawdown in the Crag beneath Catfield Fen that results from abstraction under licences 0141C and 0144B. There is also uncertainty as to the impact on surface water levels of a given drawdown in the Crag, partly due to the apparent difference in the hydrological relationship in the summer of 2008 compared to that in the summers of 2004 and 2005. An appropriate model informed by a more detailed site investigation would be required to understand the impact of varying the influences on water level in the Fen, and to quantify the impact of varying abstraction under licences 0141C and 0144B.

However, the following conclusions are drawn from the data presented here:

- There appears to be a flow of groundwater from the Crag to the Fen. The upward hydraulic gradient persisted throughout the period 2004 to 2009, even during the very dry summer of 2009 when the two abstraction licences were utilised almost to their fully licensed quantities and uptake of the Anglian Water Services Ludham licence was high.

- No signal from either abstraction is visible in the piezometry or surface water level monitoring in the Fen.

- Any impact of abstraction 0144B on Crag groundwater levels beneath the Fen is likely to be insignificant.

- Gilvear (2010) reports that an estimate of groundwater inflow from the Crag was made as part of a study in the 1980s based on a water balance. Over a 15-month period the average monthly inflow was estimated to be 6 mm per month. The hydraulic gradient between the Crag (P1) and the peat in the Fen (P3) appears to be approximately 0.2 m (Figure 7). Levelling in the surface water observations made by the Catfield Hall Estate to Ordnance Datum or determining what piezometers TG32/616a, 616b, 616d, 617, 617a and 617e show would give a more accurate hydraulic gradient between the Crag and surface water in the Fen. But assuming the gradient is approximately 0.2 m, carrying out a simple rearrangement of the Darcy equation with these speculative figures, a 2 cm decrease in Crag levels might equate to a 0.6 mm (i.e. 10 per cent) decrease in upward groundwater flow to the Fen. It is likely to be decrease in Crag water level of this order of magnitude that is to be considered in assessing the impact of licence 0131C on the Fen, though this approximation is clearly sensitive to errors in all of the variables estimated.

  The implications of a specific decrease in groundwater flow on the ecology of the Fen is beyond the scope of this paper.

- Nothing in the data collated here clearly indicates that licences 0141C and 0144B should not be renewed to the appropriate CAMS common end date. However, the uncertainties involved might prompt further investigation of licence 0141C and a shorter renewal of that licence in the meantime.

Gavin Sharpin, 20th January 2010

References

Entec, Habitats Directive Review of Consents – Stage 4 Site Option Plan: Ant Broads and Marshes SSSI / Alderfen Broad SSSI, 2007

Gilvear, David, January 2010, Current Understanding of the hydrology of Catfield Fen, Norfolk; implications regarding hydrological vulnerability to groundwater abstraction.

Goodfield, Hannah, September 2006, Determination Report for 7/34/09/*G/0144B.

Green, Adrian, February 1998, Determination Report for 7/34/09/*G/0130.

Martin, Marion, June 2001, Determination Report for 7/34/09/*G/0130 (which became licence 7/34/09/*G/0141).

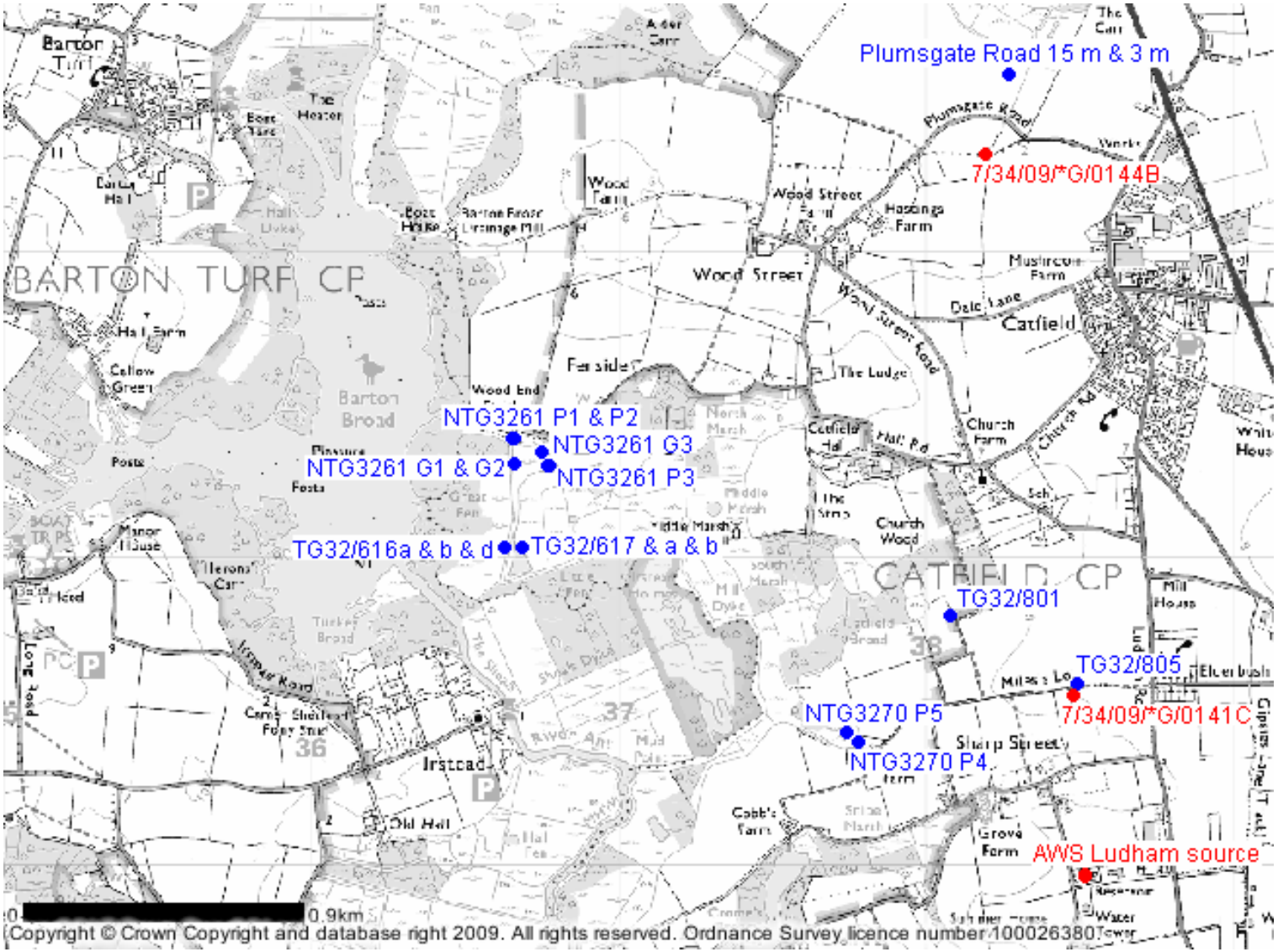


Figure 1: Map showing the location of abstractions and monitoring points.

Monitoring point	NGR	Variable monitored	Depth	Data available for	Frequency	Datum	Comments
TG32/801 Catfield Hall piezo	TG 38100 20798	Upper Crag	not known	March 2009 - present	monthly dips	not known	Borehole was logged from March 2009 but logger data up to 24/06/2009 is invalid due to vandalism.
TG32/805 Catfield Pump piezo	TG 38528 20588	Upper Crag	16.2 mbgl	March 2009 - present	monthly dips and logged	not known	Borehole was logged from March 2009 but data prior to 28/10/2009 cannot be found.
Plumsgate Road 15 m	TG 3831 2262	Crag	15 m	March - October 2009	Hourly logged	not known	Submitted to the Agency by A. Alston in November 2009
Plumsgate 3.5 m	TG 3831 2262	Drift?	3.5 m	03/03/2009 - 28/05/09, 04/09/09 - 30/10/09	Hourly logged	not known	Submitted to the Agency by A. Alston in November 2009
NTG3261 P1	TG 3665 2137	Upper Crag	5-9 mbgl	2003 - present	logged (15 mins) and monthly dips	2.217 maOD	Near Barton Broad. Nested with P2.
NTG3261 P2	TG 3665 2137	Drift/Crag	0.4 - 0.9 mbgl (?)	1996 - present	monthly dips	2.129 mAOD	Depth of the borehole correct? Nested with P1.
NTG3261 P3	TG 3675 2131	Peat	0.4 - 1.5 mbgl	1996 - present	monthly dips	1.506 mAOD	
NTG3270 P4	TG 3777 2039	Upper Crag	8-9.9mbgl	2003 - present	logged (15 mins) and monthly dips	2.568 mAOD	Level might be influenced by AWS' Ludham abstraction.
NTG3270 P5	TG 3773 2042	Alluvial Sand	0.45-0.7 mbgl	2003 - May 2009 (logger) and 2003 - present (dips)	logged (15 mins) and monthly dips	1.59 mAOD	Level might be influenced by AWS' Ludham abstraction.
NTG3261 G1	TG 3665 2131	Surface water	n/a	1996 - 05/10/2004	monthly readings	1.116 mAOD	On the western side of the Rond, i.e. 'external' (?)
NTG3261 G2	TG 3664 2131	Surface water	n/a	1996 - 05/10/2004	monthly readings	0.120 mAOD	On the eastern side of the Rond, i.e. 'internal' (?)

Table 1: Monitoring locations around Catfield Fen and abstraction licences 7/34/09/*G/0141C and 7/34/09/*G/0144B
(continued on next page)

Monitoring point	NGR	Variable monitored	Depth	Data available for	Frequency	Datum	Comments
NTG3261 G3	TG 3678 2138	Surface water	n/a	1996 - 05/10/2004	monthly readings	1.160 mAOD	
TG32/616a	TG 36690 21164	?	?	2006 - present	monthly readings	1.380 mAOD	Also known as ABM18d. Details of depth and geology measured not available on Wiski or in Entec (2007).
TG32/616b	TG 36672 21164	?	?	1980(?) - present	monthly readings	1.446 mAOD	Also known as ABM18e. Details of depth and geology measured not available on Wiski or in Entec (2007).
TG32/616d	TG 36662 21383	?	?	2006 - present	monthly readings	1.872 mAOD	Details of depth and geology measured not available on Wiski or in Entec (2007).
TG32/617	TG 36740 21169	?	?	2006 - present	monthly readings	1.503 mAOD	Also known as ABM18a. Details of depth and geology measured not available on Wiski or in Entec (2007).
TG32/617a	TG 36727 21167	?	?	2006 - present	monthly readings	1.480 mAOD	Also known as ABM18b. Details of depth and geology measured not available on Wiski or in Entec (2007).
TG32/617b	TG 36709 21166	?	?	2006 - present	monthly readings	1.531 mAOD	Also known as ABM18c. Details of depth and geology measured not available on Wiski or in Entec (2007).
Catfield Fen	not known	Surface water	n/a	2004, 2005, 2007, 2008, 2009	monthly 2004-8, but date measured not provided; weekly for 2009	not known	
Barton Hall	TG 354 223	Rainfall	n/a	1980 - present	daily	n/a	Met Office Quality-controlled record used for Jan 2004 - Aug 2009. Sept - Oct 2009 rainfall is from the same gauge but not q.c.'ed by the Met Office.

Table 1 (continued from previous page): Monitoring locations around Catfield Fen and abstraction licences 7/34/09/*G/0141C and 7/34/09/*G/0144B

Figure 2a: Daily rainfall and daily abstraction under licence 7/34/09/*G/0141C

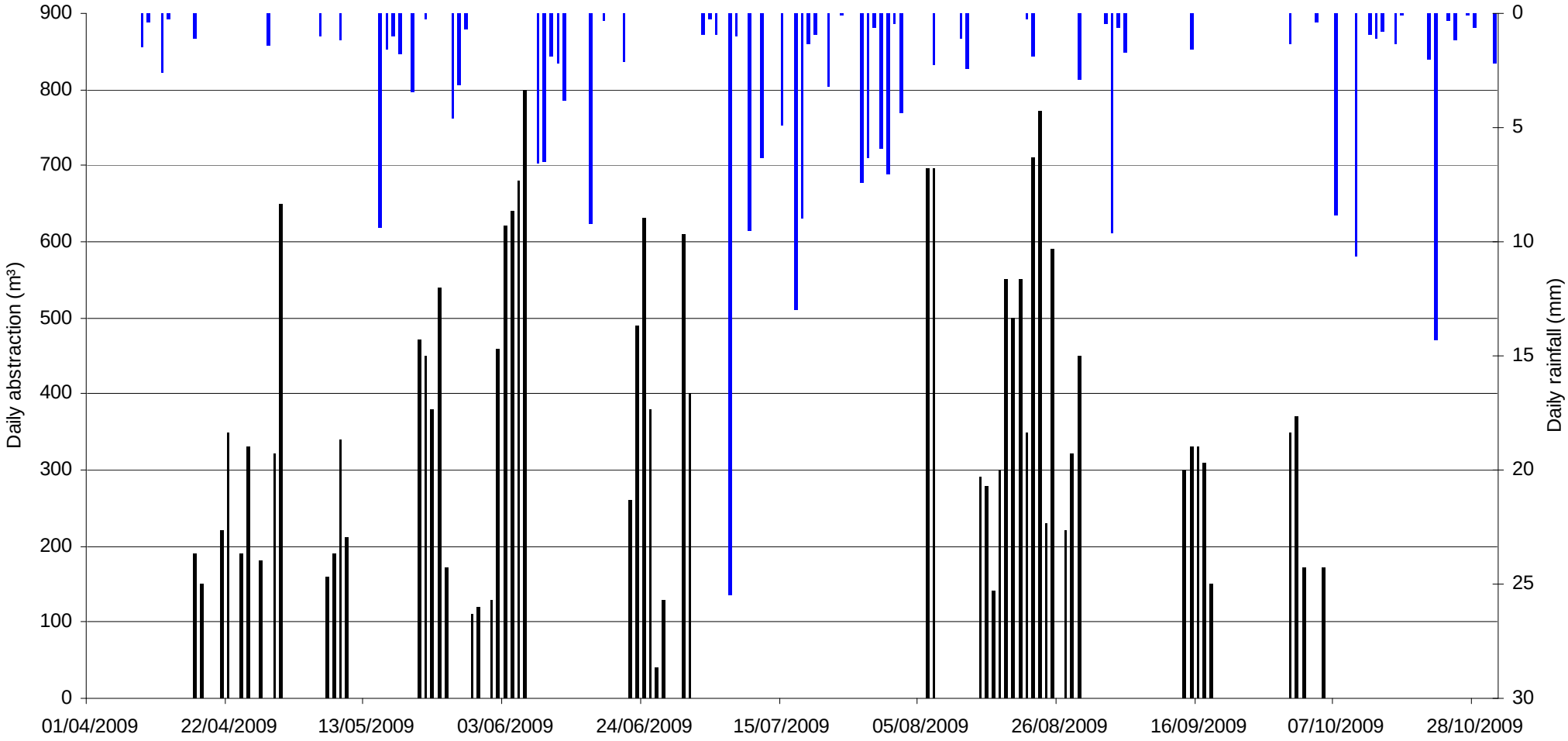


Figure 2b: Daily rainfall and daily abstraction under licence 7/34/09/*G/0144B

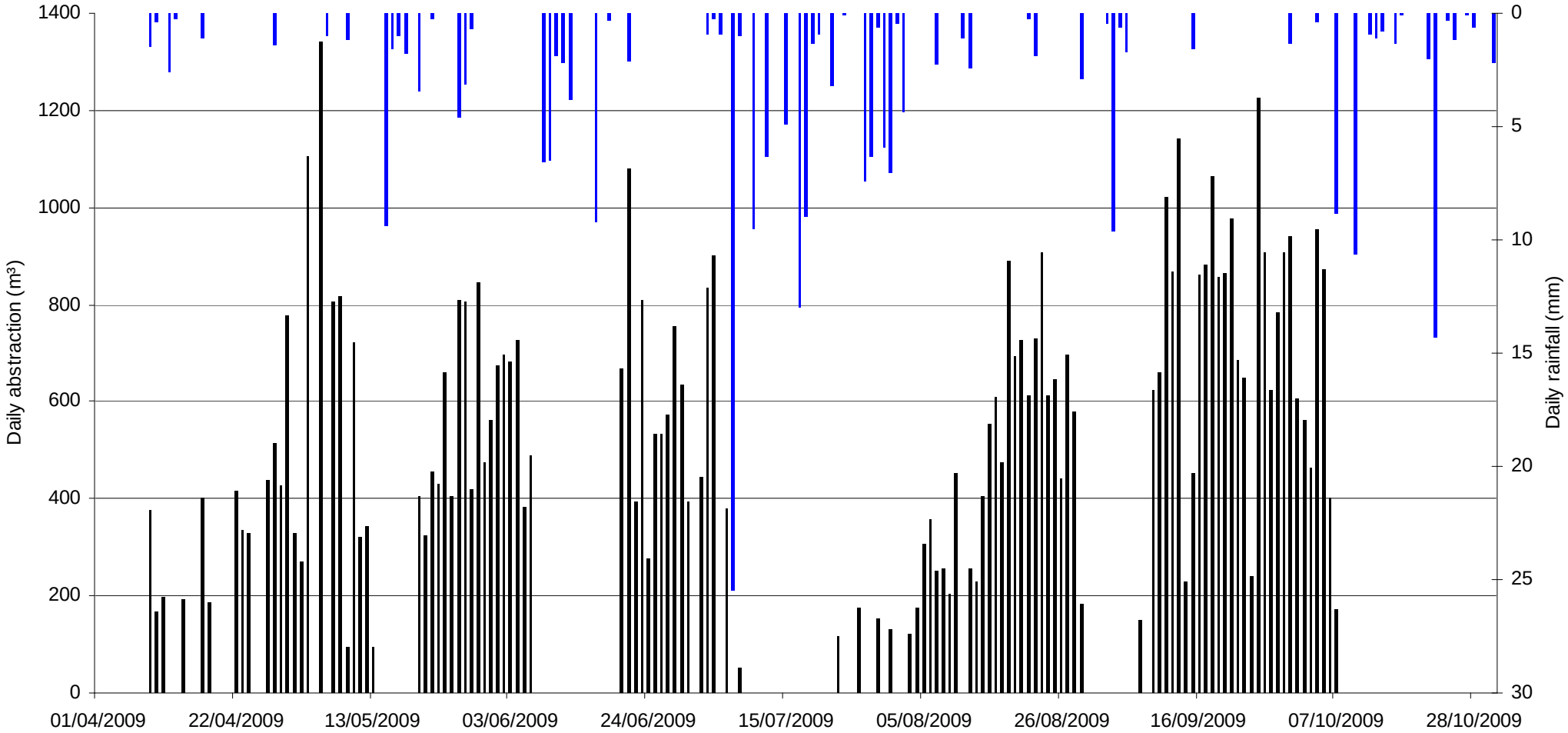


Figure 3: Daily abstraction at Anglian Water Services' Ludham source (m³/day)

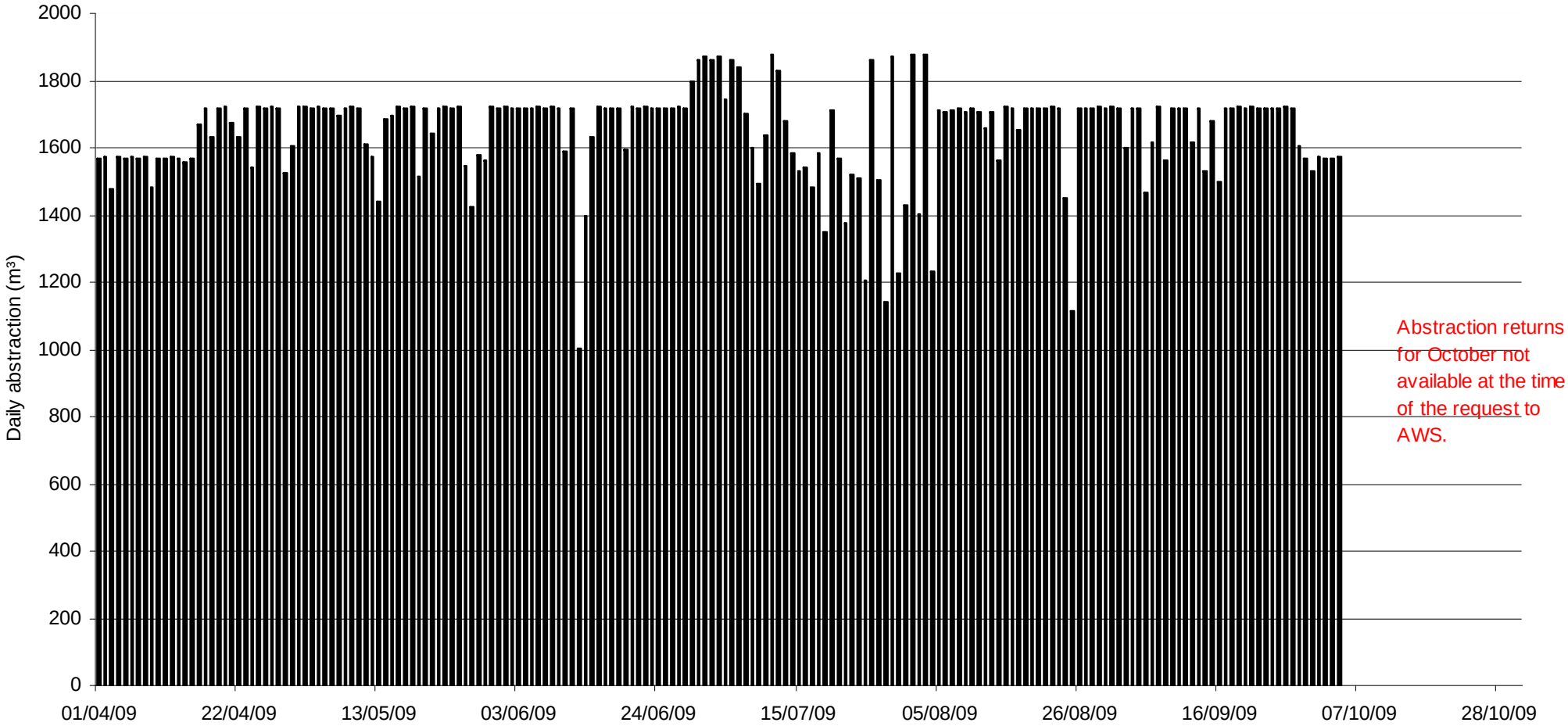


Figure 4a: Water levels in piezometers close to abstraction licence 7/34/09/*G/0141C

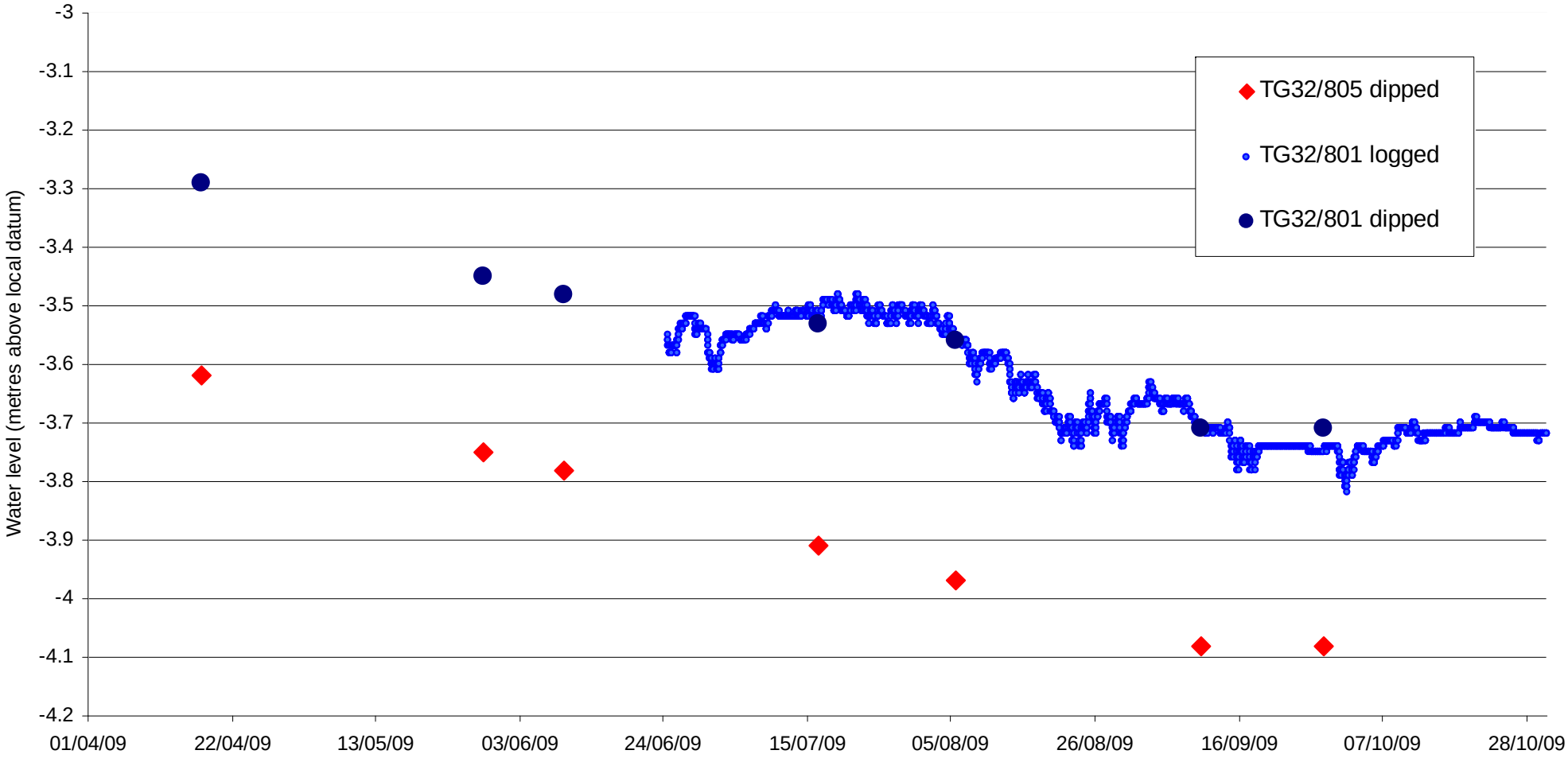


Figure 4b: Water levels in piezometers close to abstraction licence 7/34/09/*G/0144B

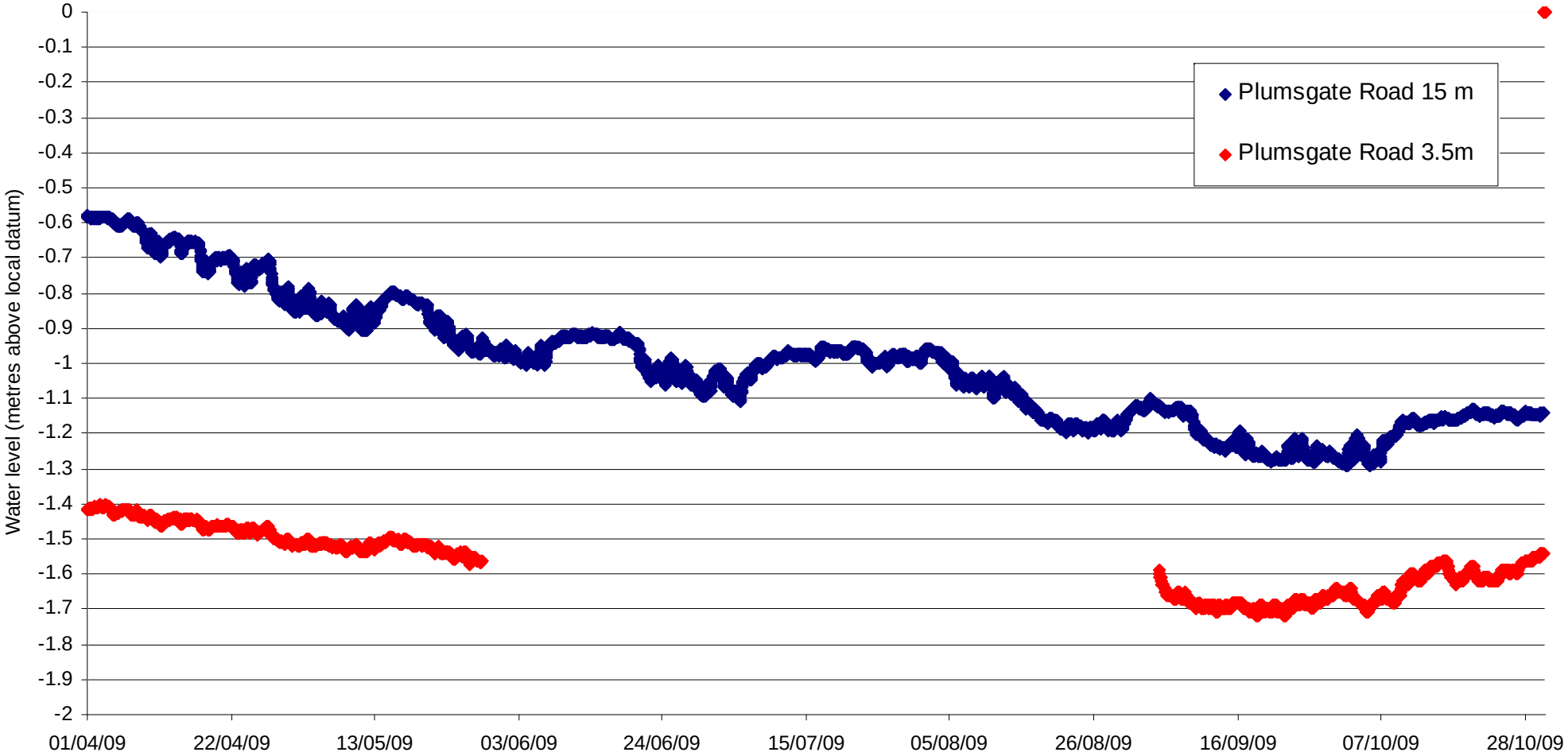


Figure 5: Water levels in piezometers around Catfield Fen and as measured by Catfield Hall Estate

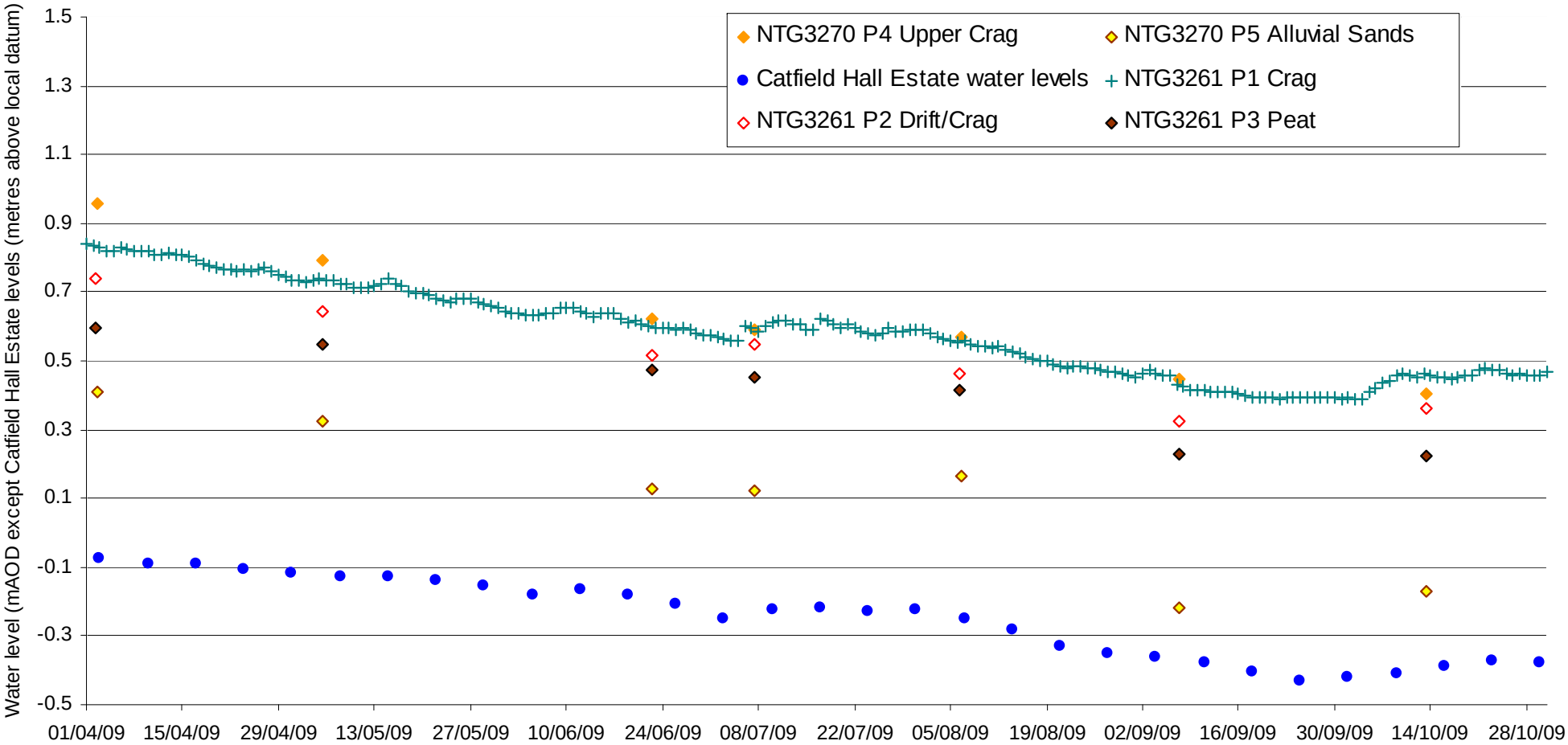


Figure 6: Monthly rainfall and monthly abstraction under licences 7/34/09/*G/0141C and 7/34/09/*G/0144B

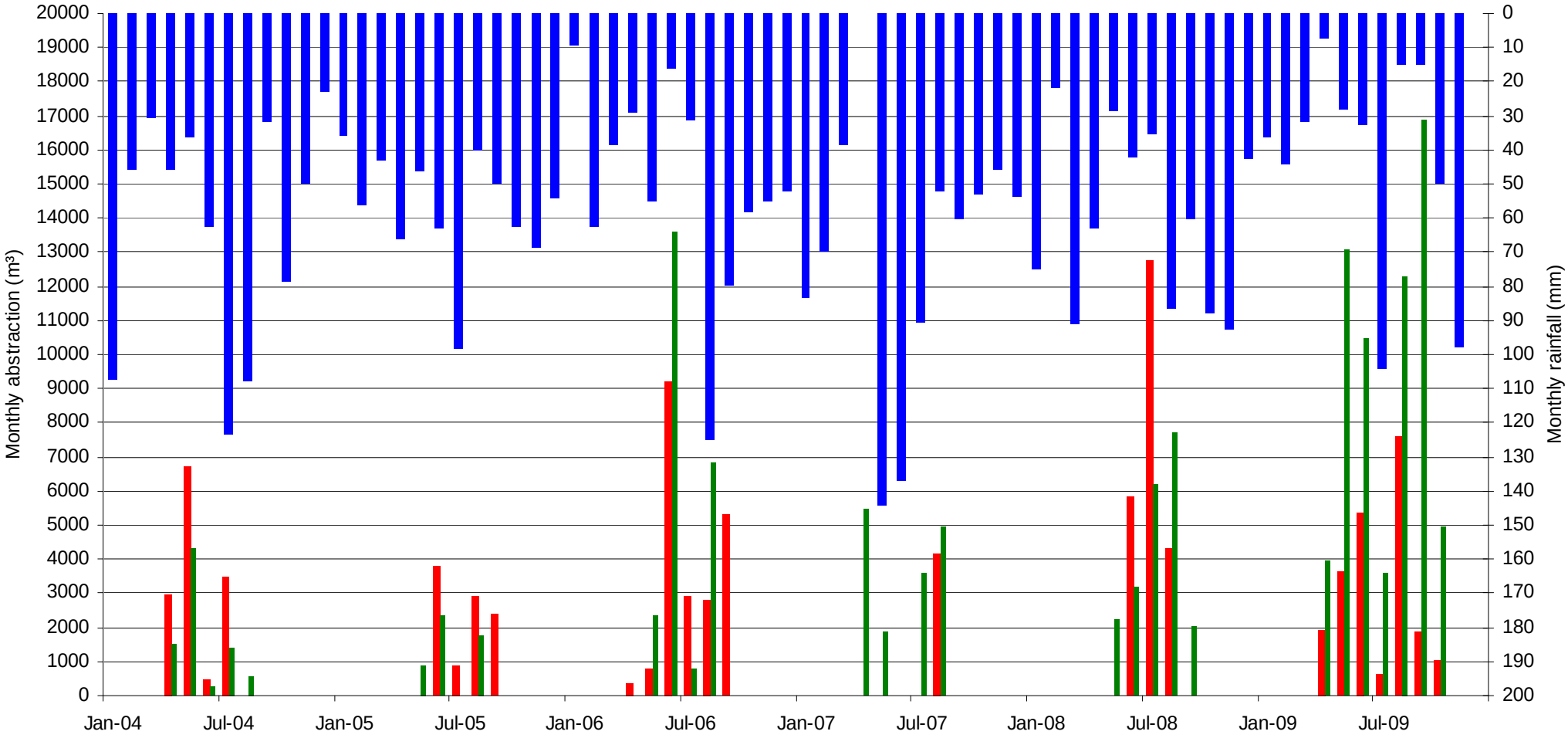


Figure 7: Water levels in piezometers around Catfield Fen and as measured by Catfield Hall Estate

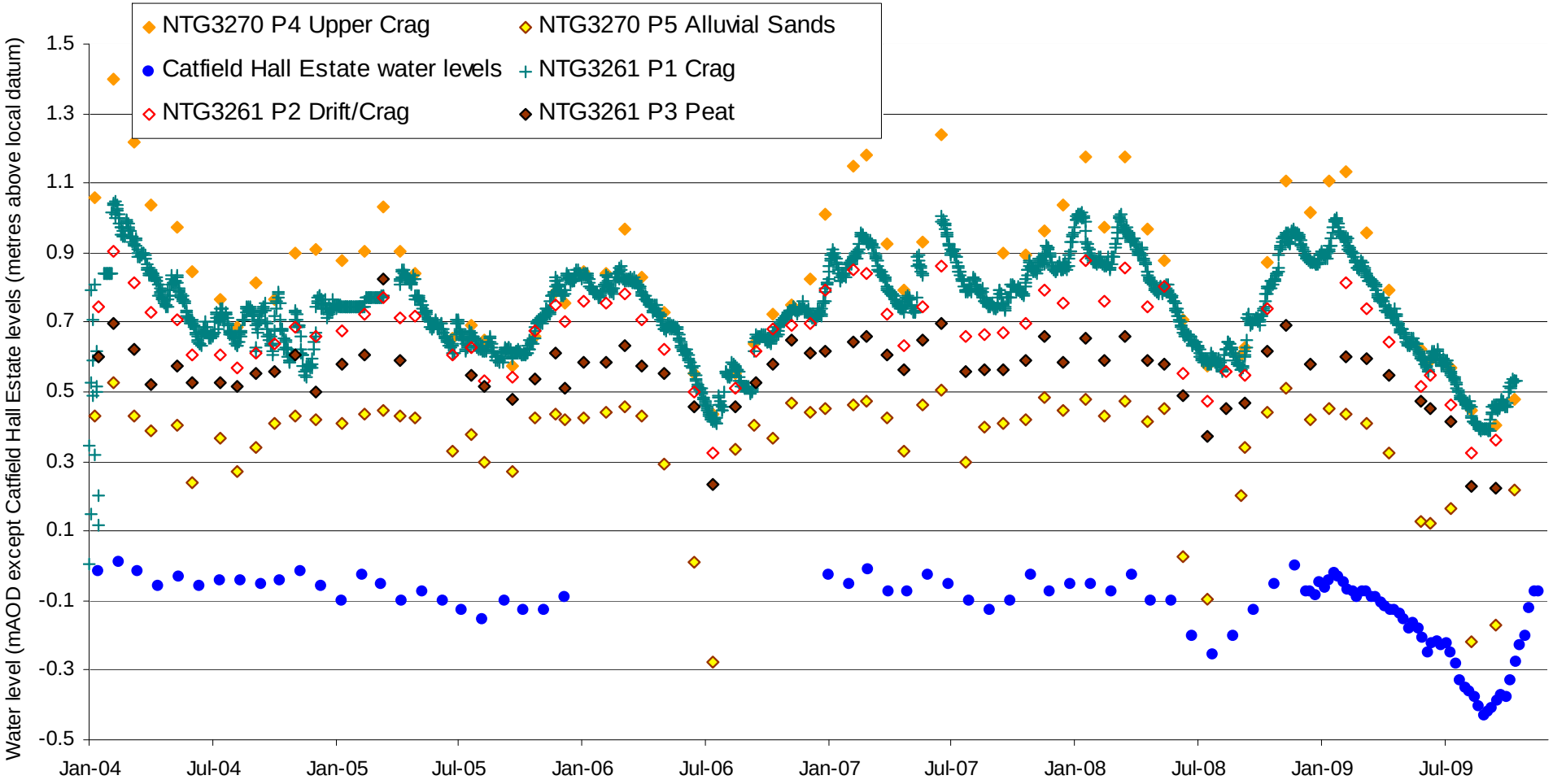


Figure 8: Water levels in piezometers around Catfield Fen and as measured by Catfield Hall Estate

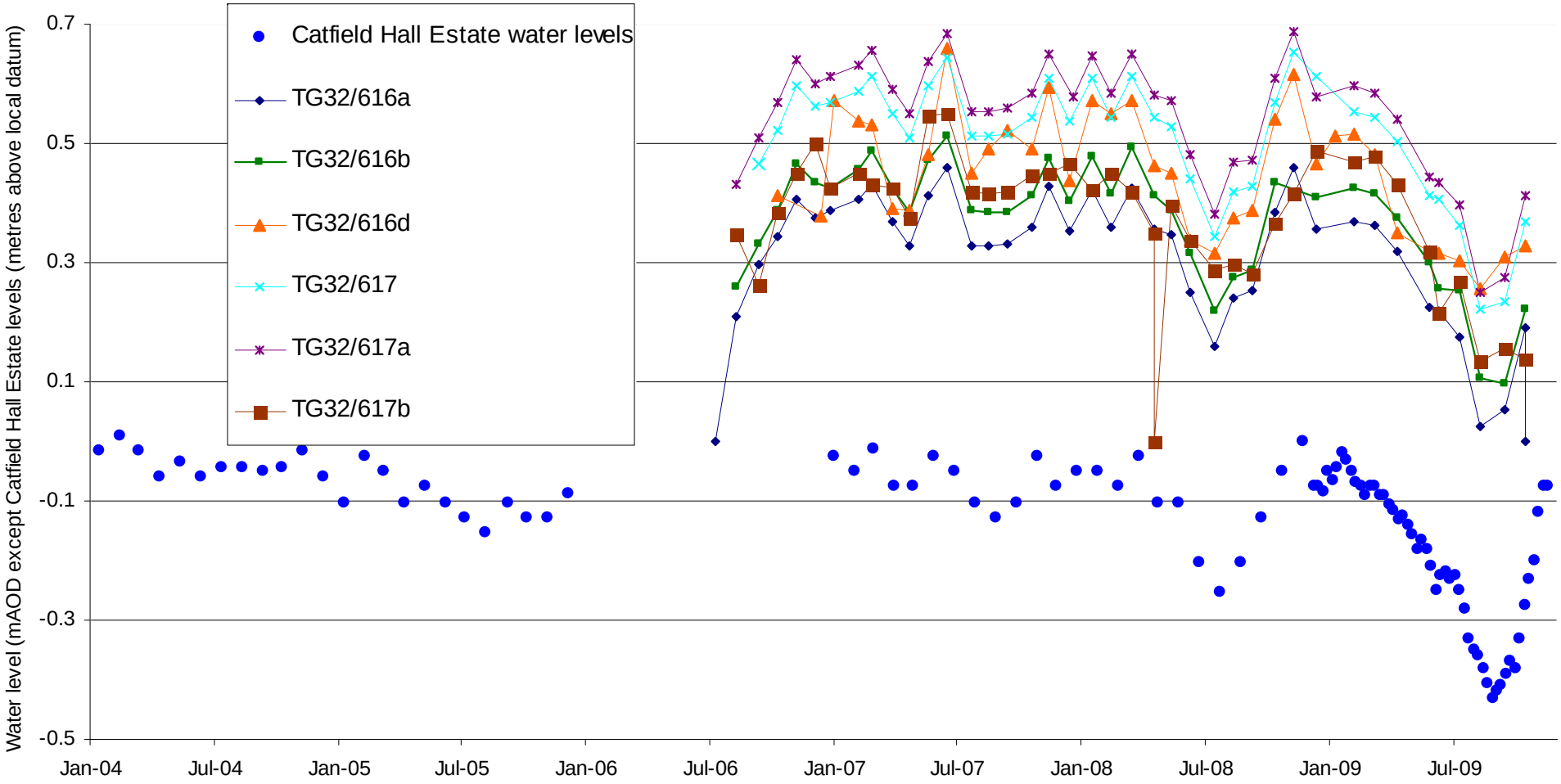
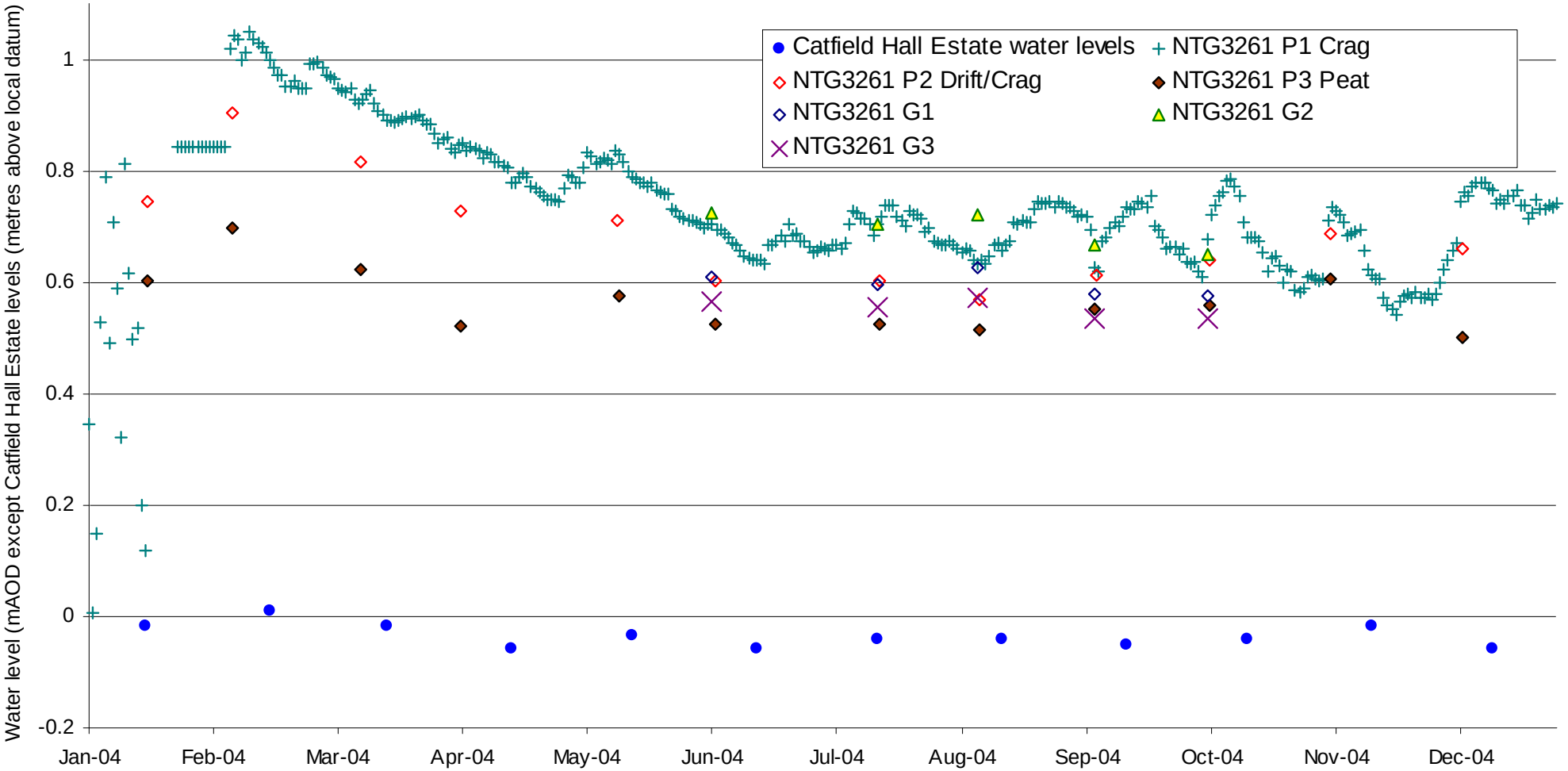


Figure 9: Water levels in piezometers and gaugeboards around Catfield Fen



Appendix 5

Influence of abstraction under 7/34/09/*G/0144B on Crag groundwater levels

This short paper investigates the influence of abstraction under licence 7/34/09/*G/0144B (Andrew Alston's Plumsgate Road abstraction) on groundwater levels in the Crag as measured in six piezometers to the south, as part of the investigation into the potential impact of the abstraction on Catfield Fen.

The details of the piezometers in the area are given in Table 1 below. Only shallow Crag piezometers in the area were used, and only where the conversion to metres above Ordnance Datum was available. Some of these were from the fish refuge project and some were from monitoring of Catfield Fen. All were dipped by the Agency's Field Monitoring and Data team. Borehole TG32/914 was excluded from the contouring because it measured water levels much deeper in the Crag (~30 mAOD). Other monitoring was excluded because it does not specifically measure Crag water levels and/or is not levelled in to Ordnance Datum.

Piezo	Depth (mbgl)	Datum (mAOD)	Max depth (mAOD)
TG32/815	5.94	7.07	1.13
TG32/815A	8.31	7.41	-0.9
TG32/815C	8.5	6.75	-1.75
TG32/815D	4.71	1.63	-3.08
NTG3270 P4	8 - 9.9	2.57	-7.33
NTG3261 P1	5 - 9	2.13	-6.87

Table 1: depths of piezometers used for contouring of Crag groundwater levels.

Monitoring of most of these piezometers is carried out on a monthly dip round, so there were water levels available for all piezometers approximately once per month. Three dates were chosen for contouring, covering the following situations:

1. 9th March 2009 – spring water levels, prior to any abstraction
2. 16th July 2009 – summer water levels, 8 days since last abstraction
3. 28th May 2009 – late spring / early summer water levels, while abstraction was taking place.

The contouring is shown in Figures 1, 2 and 3 on the following pages. Points to note are:

- The observed water levels for each day are shown in the figures beneath the piezometer number (all in MAOD).
- The shape of the contouring has been informed by modelled Crag water levels taken from the Yare and North Norfolk groundwater model as shown in each of the three figures (as the blue, green and red lines, with a key in the bottom-right-hand corner of the figure). The contouring follows the modelled general trend of falling groundwater levels from east to west across the area contoured, but with a slight ridge on the slightly higher ground between Catfield Fen to the south and Sutton Broad to the north.
- The dates have been chosen so that contouring without abstraction taking place has been done to cover conditions either side of the date on which abstraction was taking place.

- When abstraction was taking place, it was not at the fully licensed rates. The abstraction rates for the date of monitoring and two days prior are given below Figure 3.
- Contours in steps of 0.4 m are drawn. Not all figures have the same contours shown on them.

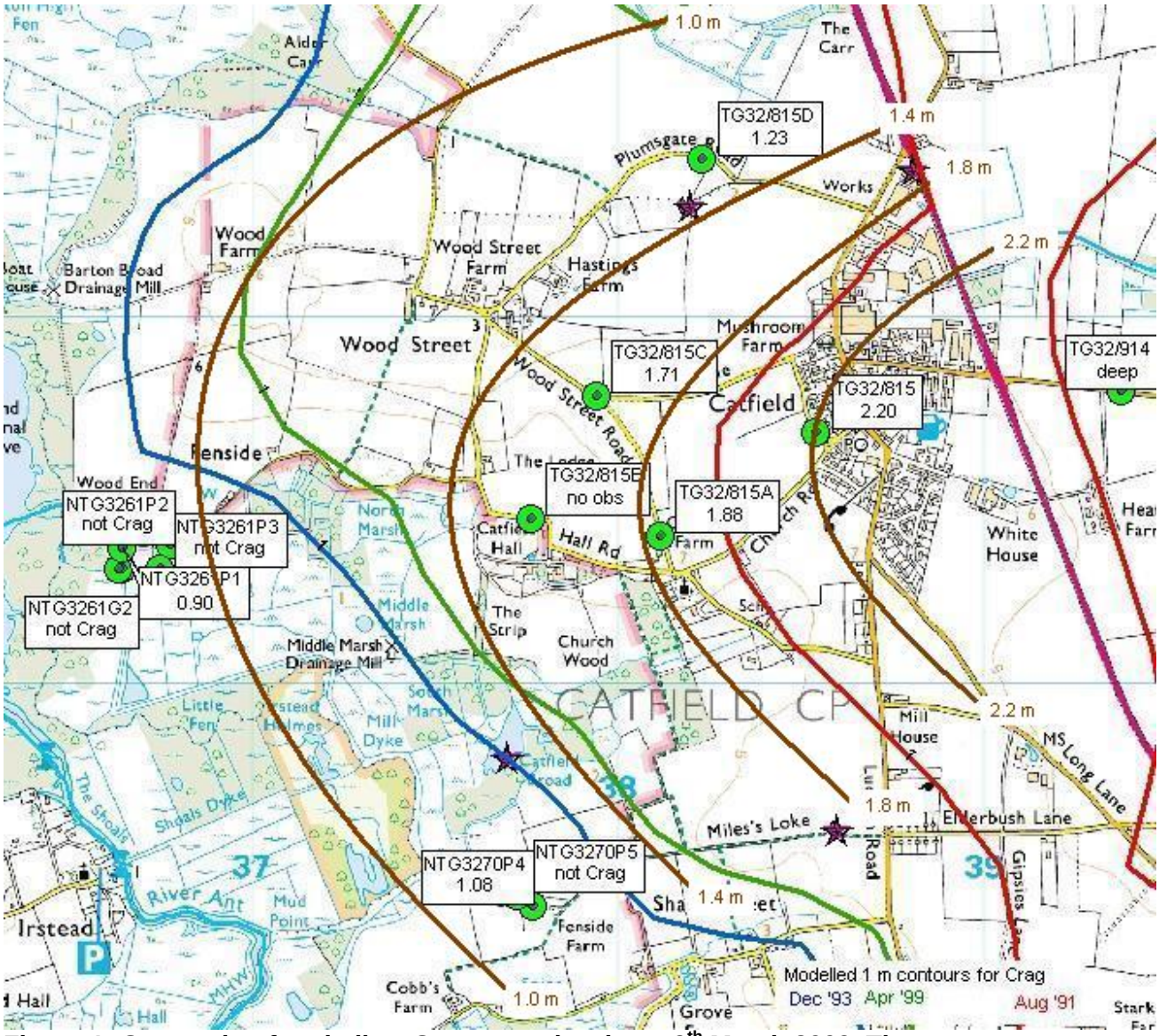


Figure 1: Contouring for shallow Crag water levels on 9th March 2009. There was no abstraction under 7/34/09/0144B in 2009 prior to this date.

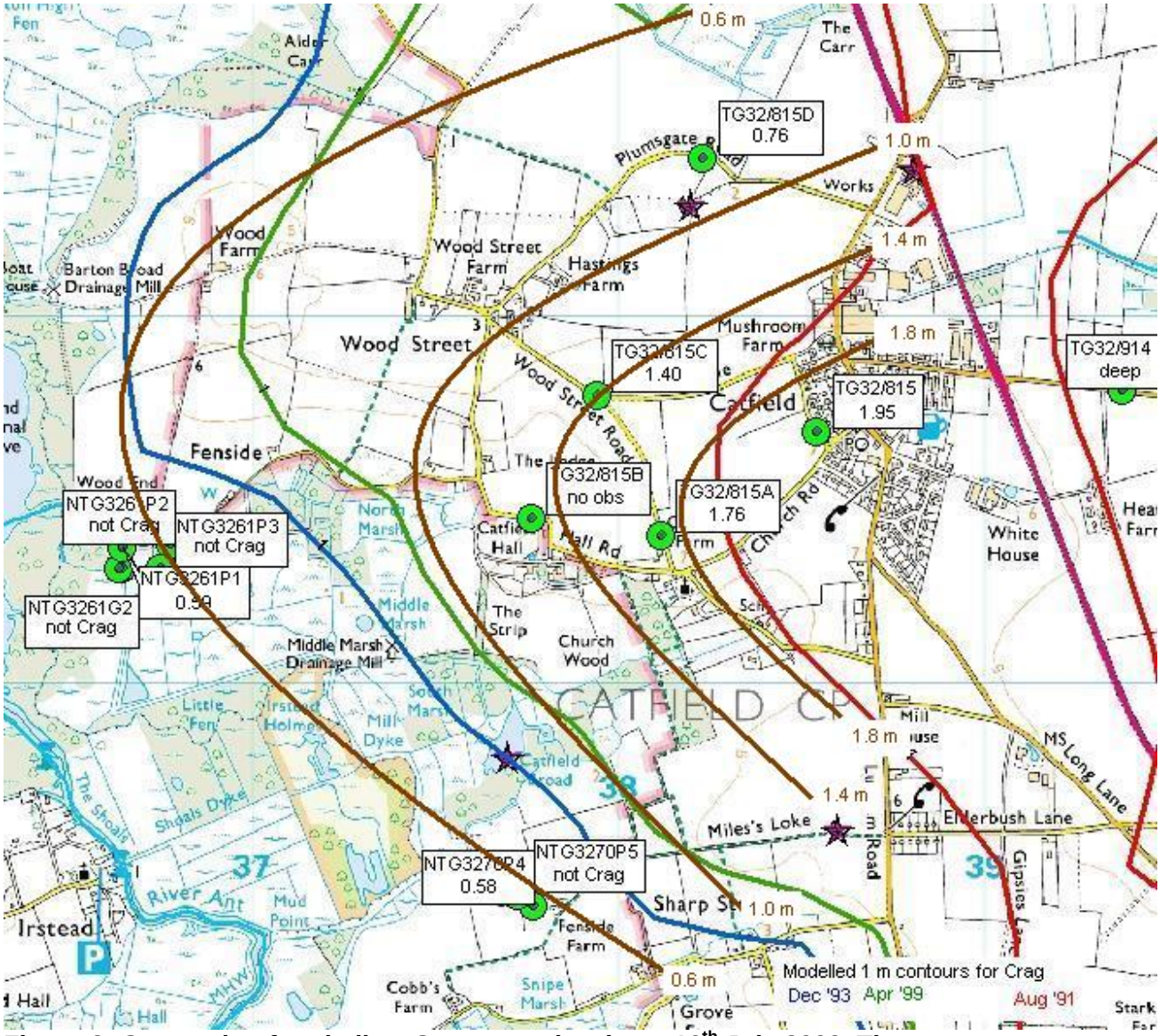


Figure 2: Contouring for shallow Crag water levels on 16th July 2009. There was no abstraction under 7/34/09/0144B on this day or the 8 previous days.

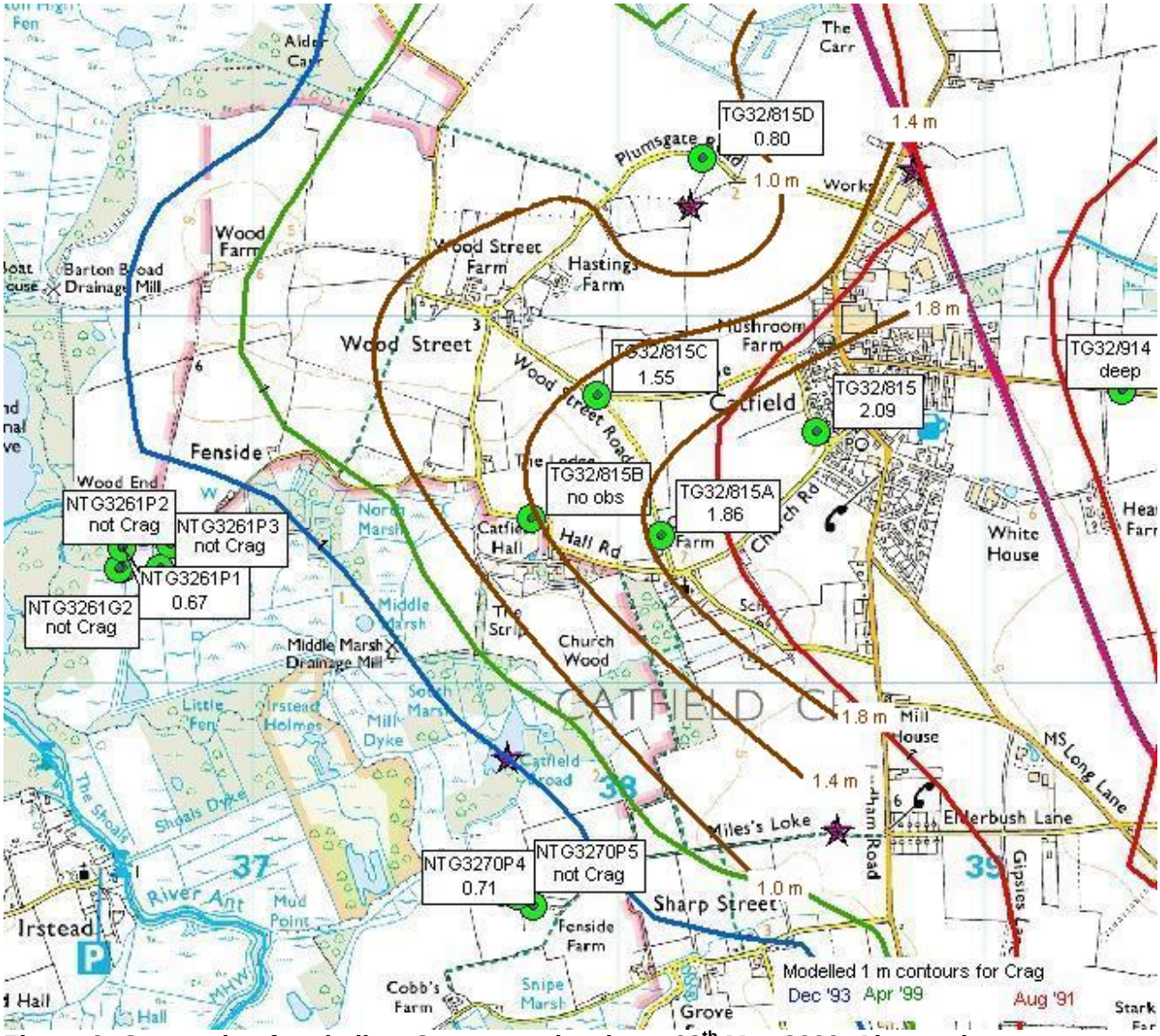


Figure 3: Contouring for shallow Crag water levels on 28th May 2009. Abstraction under 7/34/09/0144B during that day and prior to it was:

28th May: 420 m³
27th May: 805 m³
26th May: 811 m³

(cf. the maximum daily licensed quantity of 1,090 m³/day)

Analysis / Conclusions

The following conclusions are drawn:

- The drawing of contours has been done subjectively, and the monitoring is not dense enough to preclude slightly different interpretations of groundwater contouring. The contouring has been drawn to fit the general shape of the Crag water level output from the Yare and North Norfolk groundwater model, and is considered to be an acceptable approximation based on the data available.
- Contouring for the date on which abstraction was taking place (28th May, Figure 3) has clearly been drawn to take the abstraction into account in representing a cone of depression. The abstraction is evident in the original data, but only as a drawn-down water level in TG32/815D. Water levels in other piezometers are not clearly influenced though, when compared to the levels recorded when abstraction was not taking place. In other words, the levels recorded on the 28th May are between the levels recorded on the 9th March and the 16th July, and are consistent with the summer recession that is evident from all piezometers. The closest of the uninfluenced piezometers, TG32/815C and TG32/815, are approximately 500 m and 550 m away respectively.
- The data presented here shows that there was not a measurable drawdown in the Crag beneath Catfield Fen from abstraction under 0144B in May 2009. The data is based on abstraction at approximately half the daily maximum licensed rate for 2-3 days prior to the measurements. No data exists for higher abstraction rates.
- It is of limited validity to extrapolate a cone of depression into a wider area due to the complexity of the layering within the Crag and uncertainty over groundwater-surface water interactions. But it is considered unlikely that abstraction will take place at a rate high enough, and for enough days in succession, for a measurable drawdown in the Crag beneath Catfield Fen at a distance of 800 m or more to be attributed to abstraction under licence 0144B. That would suggest that a renewal of the licence with monitoring of the Fen is unlikely to provide evidence that the abstraction is lowering Crag groundwater levels in the Fen, even if lowered Crag groundwater levels were thought to be the cause of significant reductions in surface water levels on the Fen.

Appendix 6

CURRENT UNDERSTANDING OF THE HYDROLOGY OF CATFIELD FEN. NORFOLK; IMPLICATIONS REGARDING HYDROLOGICAL VULNERABILITY TO GROUNDWATER ABSTRACTION

By Professor David Gilvear

for

Mr and Mrs Harris
(owners of Catfield Hall estate)

9th January 2010

1.0 Rational for the report

This report summarise the current state of knowledge regarding the hydrology of the "internal system" of Catfield fen in the Broadland region of Norfolk. It also attempts to assess, via independent expert opinion, the sensitivity and vulnerability of the fen to local groundwater abstraction. The context to the report is that two groundwater abstraction licences at boreholes very close to the fen (< 500 metres) are up for renewal. Licence no 144c has a total volume of 22,700 cubic metres with a daily limit of 800 cubic metres. Licence no 141b has a total volume of 68,000 cubic metres with a daily limit of 1090 cubic metres. The owners of the Catfield Hall Estate Mr and Mrs Harris are concerned that groundwater abstraction for irrigation is impacting on surface water levels on the fen and compromising their interest in managing the land for nature conservation. The review procedure for renewal is governed by regulation 48 of the EU Habitat and Species Directive and The Environment Agency are prepared to receive relevant information to enhance their decision-making. In this respect it should also be noted that at Ludham, a couple of kilometres to the south, groundwater abstraction is also being undertaken for public water supply.

2.0 The expert opinion of Professor David Gilvear and information sources used

Professor David Gilvear first studied the hydrology of Catfield fen in 1987 and has over two decades of wetland hydrological research experience. The focus of much of this research had been on the role of hydrological connectivity between wetlands and underlying aquifers. As such he was commissioned to right a chapter on "Groundwater and Hydrological Connectivity" in a recently published research monograph titled The Wetlands Handbook (Maltby and Barker, 2009). He has also published a research paper titled "Hydrological monitoring and surveillance for wetland conservation and management; a UK perspective. Professor Gilvear is currently Professor of River Science at the University of Stirling.

In undertaking this work the following sources of information were used and analysed in the manner detailed:

- Water level data for Catfield fen from Mr and Mrs Harris and rainfall figures for Barton Hall from the Environment Agency for 2004 to present. This was analysed in Excel to ascertain whether the severity of the very low water levels in the summer of 2008 and whether the levels could be accounted for by the rainfall record.

- Local information and observations provided by Peter Riches of Rural Land Management. This was used to contextualise the study

- Gilvear, D.J. Tellam, J.H., J.W. Lloyd and D.N. Lerner (1989) The *Hydrodynamics of East Anglian Fen Systems*, Final report to the Nature Conservancy Council, National Rivers Authority and Broads Authority. This was used as the basis for summarising the hydrology of the site and its vulnerability to groundwater abstraction

- Gilvear, D.J, Sadlar, . P.J.K. , Tellam, J.H., and J.W. Lloyd (1997) Surface water processes and groundwater flow within a hydrologically complex floodplain wetland, Norfolk Broads, UK. *Hydrology and Earth Systems Sciences*, 1, 115-135. This was used as the basis for summarising the hydrology of the site and its vulnerability to groundwater abstraction

- Gilvear, D.J. Tellam, J.H., J.W. Lloyd and D.N. Lerner (1994). Wetland vulnerability in East Anglia; the range of validity of a generalised classification approach. *Aquatic Conservation,* 105-124. This was used to validate the decision to ignore the findings of a desk-based compilation of data and simple classification of the fen system as surface water dominated and not vulnerable to groundwater abstraction. This information may be the only readily available evidence available to The Environment Agency and English Nature.

- Hydrological Services International Limited (2002) *Catfield Hydrology Survey: contract No:Norfolk/2001/T01,* English Nature

3.0 The hydrology of Catfield fen

Catfield fen was the subject of an in-depth research study between 1987 and 1989 as part of a three year research project commissioned by the Nature Conservancy Council, National Rivers Authority and Broads Authority. This research conducted on Catfield fen involved monitoring of precipitation, evapotranspiration and surface and groundwater levels. A hydrochemical analysis of surface and groundwater and groundwater flow modelling was also undertaken. The primary aim of the overall study was to assess the vulnerability of East Anglian fens to groundwater abstraction.

Catfield fen in its entirety is an example of a floodplain fen and lies adjacent to Barton Broad on the River Ant system. The “external system” is in direct connectivity with the river system while the “internal system”, and the area of interest in this report is separated from the rest of the fen by a rond with two built-in sluices that potentially allows water movement to and from the fen. In reality water flow is always likely to be from the internal system to the external system.

The 1987 to 1989 study demonstrated that the internal system is a surface-water-dominated system fed primarily by precipitation with some input as a result of runoff from adjacent fields. In summer drawdown of the water tables will be principally by evaporation and evapotranspiration. However, the study also revealed that the fen is “groundwater-dependent” in that there is evidence that although the fen is separated from the underlying Crag aquifer by a thin layer of relatively impermeable clay, cover is discontinuous. Areas devoid of clay were found by probing to exist beneath North Marsh and along the line of a number of the drainage ditches that criss-cross the marsh. Direct contact between the fen peats and the underlying Crag is also believed to exist at the eastern fen margins and this is plausible. Groundwater heads during the study in the underlying Crag aquifer for much of the period of monitoring were above surface water levels and thus a upward head gradient exists. Thus it is speculated that groundwater input to the fen system is significant. Even with an absence of an upward head gradient the underlying groundwater will be critical in limiting groundwater recharge and loss of water from the fen system to the Crag. Water levels in the fen system at or close to the ground surface, especially in summer, are critical to the nature conservation interest of the site (Hydrological Services International Limited, 2002).

As part of the 1987 to 1989 study an attempt was made to estimate flows to and from the groundwater system to the fen for the period 1988 to 1989 based on the hydrological data collected and including measurements of the Crag, Clay and Peat hydraulic conductivity. It was acknowledged that in undertaking the calculations that

the water balance estimations were crude but that it was self-consistent. Overall it was deduced that groundwater flow from the Crag is relatively small and fairly constant throughout the year. Over a 15 month period the average monthly inflow was 6mm per month.

4.0 Assessment of the vulnerability of the "internal system" at Catfield fen to groundwater abstraction

During the 1987- to 1989 study a preliminary assessment of Catfield fen suggested it to be a surface-water dominated system with no hydraulic connection with the underlying Crag aquifer due to a impermeable clay beneath the peat. As such it was deemed no to be vulnerable to groundwater abstraction. However, these desk based studies were visualised as a rapid assessment technique with inherent uncertainty in the specified outcomes. Subsequently field based studies showed that there was hydraulic connection between the fen and the underlying Crag aquifer and thus the fen was potentially vulnerable to groundwater abstraction.

As an aid to investigating the sensitivity of Catfield fen to the local groundwater system a vertical 2 dimensional steady state groundwater flow model was constructed using the groundwater flow package MODFLOW. Groundwater heads in the Upper peat, lower peat, Clay and Crag were modelled along a transect that represented a north to south transect from the surrounding agricultural land to Barton Broad. The hydrogeology of the Crag was not considered in detail and hence the findings of the model are only indicative results with the emphasis being on determining the sensitivity of the system to groundwater. However the model "fit" was acceptable and reproduced the main characteristics of the wetland hydrological system as observed and monitored. Further information on the modelling approach and basic model inputs are available in the sources of information detailed above (Gilvear et al., 1989; Gilvear et al., 1997).

To provide a preliminary assessment of the effects of groundwater abstraction on the internal system the groundwater head in the aquifer was lowered by 1.95 metres in the model. Fen surface water levels under this scenario fell to that of the Crag piezometric surface despite the water levels in the model drainage ditches being kept constant due to presumed inflow from the Crag and runoff from adjacent fields. Thus the conclusion is that even though groundwater constitutes only a minor component of the water balance of the fen, a drop in Crag groundwater heads by abstraction would result in the wetland drying out. The caveat to this conclusion in that there are some uncertainties and simplifications in the modelling approach and the groundwater drawdown modelled was large. Nevertheless the modelling suggest the fen is vulnerable to groundwater abstraction.

Another potential strand of evidence of the vulnerability of Catfield fen to groundwater abstraction was that surface levels in 2008 dropped well below those of the previous four years. This it was thought may have been caused by greater groundwater abstraction by the neighbouring farm. A demand for greater quantities of water may have been necessary due to a change of cropping to intensive salad cropping on neighbouring land. Analysis of the monthly precipitation and fen water level record for the period 2004 to 2009 did show water levels for 2008 to be between 25 and 75 mm lower than previously recorded for the months of July and August. However the months of May, June and July had well below average rainfall; although March, April and August were well above average. A plot of summer (May to September) rainfall for the period 2004 to 2009 (Figure 1) shows however that the summer water levels recorded in 2008 have large residuals in relation to the

regression line of rainfall versus water level indicating that the limited summer precipitation alone may not account for the extent of surface water decline.

5.0 Summary of key points and recommendations

- Catfield fen is a surface water dominated fen but significant inputs of groundwater from the underlying Crag aquifer are important in maintaining surface water levels in the fen peat.

- With climate change scenarios predicting drier and hotter summers this dependency on groundwater may heighten.

- There are a number of uncertainties regarding the hydrology of Catfield fen that make environmental assessment a hazardous undertaking.

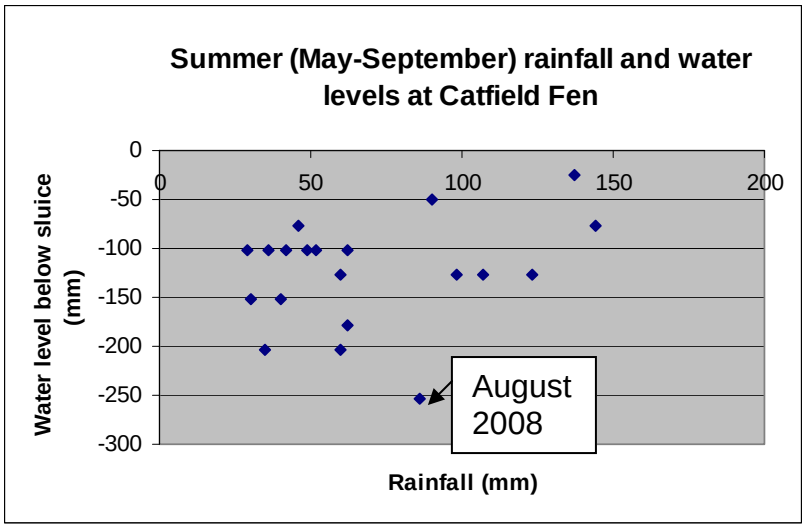
- The results of the groundwater flow modelling and the observation of a significant drop in water levels in the summer of 2008, that may not solely be due to the below average summer rainfall, indicates that the fen is likely to be vulnerable to a lowering of groundwater heads in the Crag aquifer.

- There is no information as to whether nearby groundwater abstraction has created a cone of depression which lowers groundwater heads below Catfield fen

- Crag groundwater heads should be measured monthly on Catfield fen to act as an early warning of any sudden drops in levels that lead to a sustained period of no potential groundwater inflow or groundwater recharge to the Crag from the fen. Due to an apparent absence of a long-term record of groundwater heads it will be difficult to unravel groundwater abstraction impacts but with a knowledge of surface water levels and precipitation and evapotranspiration data after a period of time the data may reveal whether there is and if so the level of hydrological impact of groundwater abstraction.

Given the potential vulnerability of the hydrology and the over-riding influence of hydrology of the nature conservation interest of Catfield fen and consequent nature conservation designations the precautionary principle should be followed. In this case the precautionary principle could be refusal of renewal of groundwater licences.

Figure 1



Appendix 7 – Information regarding previous issues related to derogation as a result of licence 7/34/09/*G/0144B (Plumsgate Road)

Taken from Determination report dated 25/09/2006 by H. Goodfield (Ref EN2048)

When a licence was first granted, in 1988, it was considered that no existing protected sources were at risk of derogation and no remedial works were required. More recently, representations have been made to the Agency by WF Overton that abstraction from Alston's borehole caused his wellpoints to dry up to the extent that he had to sink a crag borehole to replace the wellpoints.

The NRA was first notified of problems with the wellpoints by Wright Rain Ltd, agents for Mr Overton, in October 1990. A letter dated 18 October 1990 states that Mr Overton is not entirely happy with the wellpoint system and finds the operation of the scheme too complicated. There was no suggestion at that time that the yield of the wellpoints had fallen or that they were being affected by Alston's abstraction.

The following is a review of the relevant information:

(i) Mr Overton's wellpoints are 1100 metres from Alston's borehole.

(ii) During the 7-day pump test of Alston's borehole in 1987 there was no detectable impact on water levels in a shallow well 600 metres from the pumped borehole and between it and Overton's wellpoints. The base of this well is within a band of clay at approximately ODN, whereas the wellpoints, which are 10 metres deep, are open to the sands both above and below the clay. Alston's original borehole was cased through the sands above the clay but screened through the sands below.
The lack of an observed drawdown in the shallow well does not therefore necessarily preclude a drawdown in the wellpoints, which were not observed during the test, although bands of clay within the crag, such as this, are not usually very impermeable.

(iii) Derogation risk was assessed prior to the licence being granted in 1988 using a transmissivity value of 406 m^2/d, which was derived from the pump test results and a storativity value of 0.25. This was taken from analysis of Alston's other borehole at Plumsgate Road, Catfield as the lack of a suitable observation borehole meant that it was not possible to derive a storativity value from the Miles' Loke borehole test. Using these values, a maximum radius of influence of 450 metres was calculated for the operational abstraction. Overton's wellpoints are some distance outside this area and were not considered to be at risk.

(iv) The areal aquifer parameters were reviewed when Alston's licence was "renewed" in 1998. It was considered at that time that a transmissivity of 450 m^2/d and a storativity of 0.05 were more appropriate. The maximum predicted drawdown at Overton's wellpoints using these parameters is 0.02 metres. A similar result is obtained using a leaky aquifer model, which is indicated from the pump test on Overton's borehole.

(v) During the irrigation seasons in 1999 and 2000, Alston carried out water level monitoring in piezometers to the west of his irrigation borehole. One is close to the abstraction borehole and the others are approximately 500 metres distant, much closer than Overton's wellpoints although in the opposite direction. There was no reduction in water levels in any of these piezometers which could be attributed to Alston's abstraction. The maximum abstraction in these 2 years

was 9.2 tcma in 2000 but this is of the same order as abstractions prior to 1990, when Overton claims he experienced problems with his wellpoints.

(vi) Alston's abstraction returns for the years prior to, and including, 1990, when Overton decided to replace the wellpoints by a borehole, are:

1988	2.50 tcma
1989	13.10 tcma
1990	11.74 tcma

The maximum abstraction in 1989 represents only 16 days abstraction at the maximum licensed daily rate of 800 cmd. This is just over twice the length of the pump test and would not be expected to have resulted in impacts much greater than those which occurred during the pump test.

(vii) Although the Agency does not have any observation boreholes in the Catfield area with records which extend back to 1988, observations of the crag well at Brumstead Hall started in December 1988 and show some of the effects of the drought, although not the full extent. As a rough estimate, water levels in the Brumstead Hall well were some 0.2-0.3 metres below average by late summer 1990.

(viii) The AWS Ludham boreholes are approximately 1300 metres south west of Overton's wellpoints. The licence allows abstraction at maximum rates of 2273 cmd and 680 tcma, although water is drawn from greater depth than the irrigation boreholes.

In conclusion, it was considered that there is little evidence that abstraction from Alston's borehole at the previously and proposed licensed rates is having any significant effect on water levels in the vicinity of Overton's wellpoints and consequently causing the yield to fall. It is more likely that any problems between 1988 and 1990 were due to the drought, or possibly the PWS abstraction. Any reduction in the water table since then is likely to be due to abstraction from his own replacement borehole. It was and is considered that it is not necessary for Mr Alston to carry out any remedial works to safeguard Mr Overton's rights to abstract from his wellpoints.

Appendix8 – Ant Broads and Marshes Appropriate Assessment

Habitats Directive - Supporting document for Appendix 12 Form for Stage 3 Assessing adverse effect on site integrity (New Permissions)

Form HR02: proforma for stage 3 appropriate assessment

PART A: Technical consideration

1 Table 1 – Permission, plan or project details

Type of permission, plan or project:	Abstraction Licence (Formal Licence renewals)
Environment Agency reference no:	NPS/WR/003092 – Renewal of licence 7/34/09/*G/0141C NPS/WR/002725 – Renewal of licence 7/34/09/*G/0144B
National grid reference:	NPS/WR/003092 – TG 386 206 NPS/WR/002725 – TG 382 223
Site reference:	NPS/WR/003092 – AW Alston at Ludham Road, Catfield NPS/WR/002725 – AW Alston at Plumsgate Road, Catfield

2 Table 2 - Site details*:*

Name, legal Status, and priority of the European site:	Broads	SAC	Medium
	The Broadland	SPA	Medium

3 Table 3 - Features list:

I.D	Features	Application has associated hazards to which features are sensitive?	Details of Hazard/s
Broadland SPA			
3.4	Birds of lowland wet grasslands	Yes	Change in flow or velocity regime Change in surface flooding Changed water chemistry Changes in water levels or table Habitat loss Reduced Dilution capacity
3.6	Birds of lowland freshwaters and their margins	Yes	Change in flow or velocity regime Change in surface flooding Changed water chemistry Changes in water levels or table Habitat loss Reduced Dilution capacity
3.7	Birds of farmland	Yes	Change in surface flooding
The Broads SAC			
1.1	Fens & wet habitats (not sensitive to acidification)	Yes	Change in flow or velocity regime Change in freshwater flow to estuary Change in salinity regime Change in surface flooding Changed water chemistry Changes in water levels or table Habitat loss Reduced Dilution capacity
1.2	Bogs & wet habitats (sensitive to acidification)	Yes	Change in flow or velocity regime Change in surface flooding Changed water chemistry Changes in water levels or table

			Habitat loss Reduced Dilution capacity
1.5	Standing waters (not sensitive to acidification)	Yes	Change in flow or velocity regime Changed water chemistry Changes in water levels or table Habitat loss Reduced Dilution capacity
2.2	Vascular plants lower plants and invertebrates of wet habitats	Yes	Change in flow or velocity regime Change in surface flooding Changed water chemistry Changes in water levels or table Habitat loss Reduced Dilution capacity
2.9	Mammals of riverine habitats	Yes	Change in flow or velocity regime Change in surface flooding Changed water chemistry Changes in water levels or table Habitat loss Reduced Dilution capacity Entrapment

4 Report Content

Introduction

This appropriate assessment is considering the potential impacts of renewing two abstractions held by AW Alston on Ant Broads and Marshes SSSI, component part of the Broads SAC and Broadland SPA.

The abstraction details are as follows;

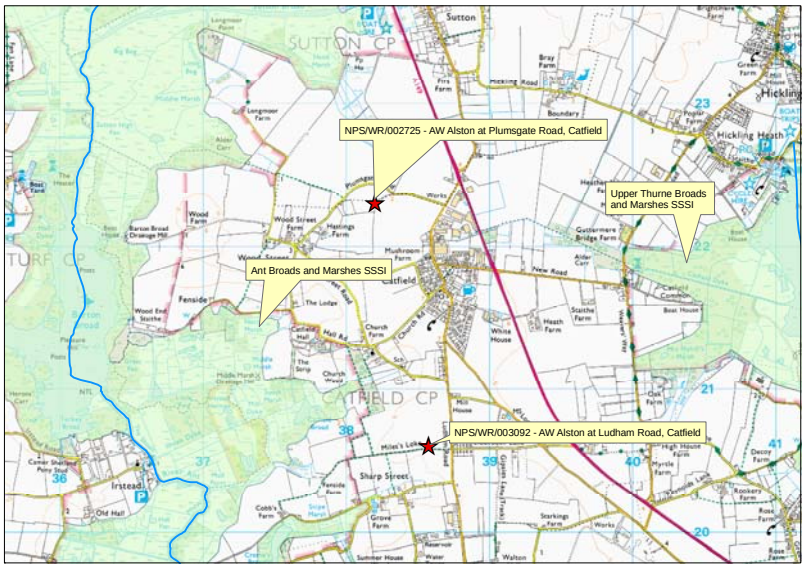
NPS/WR/003092 – Ludham Road, Catfield

This application is to renew licence 7/34/09/*G/0141C with no changes to the current conditions which otherwise is due to expire on 31 March 2010. The licence authorises abstraction from a crag borehole at NGR TG 386 206 for quantities of 45m³/hour, 800m³/day and 22,700m³/year at a rate of 12.5l/s between April and October for spray irrigation. There is a monitoring addendum attached which involves 3 piezometers to be maintained and monitored daily during the abstraction period and weekly the rest of the year at NGR TG 3850 2059, TG 3813 2078 and TG 3821 2029.

NPS/WR/002725 – Plumsgate Road, Catfield

This application is to renew licence 7/34/09/*G/0144B with no changes to licence conditions or quantities that would otherwise expire on 31 March 2010. The licence authorises abstraction from a crag borehole at NGR TG 382 223 between April and October for spray irrigation at quantities of 68,000m³/year, 1090m³/day at an instantaneous rate of 15l/s. The licence contains a monitoring addendum to monitor water levels in 3 piezo's in the vicinity of the borehole.

Location Map



Conservation Objectives for the Ant Broads and Marshes SSSI, component part of the Broads SAC and Broadland SPA;

The conservation objectives for the European interest on the SSSI are:

to maintain*, in favourable condition, the:

- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*.
- Calcareous fens with *Cladium mariscus* and species of the *Carex davallianae.*
- Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation.
- Transition mires and quaking bogs.
- Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp..
- *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*).

to maintain*, in favourable condition, the habitats for the population of:

- Fen orchid (*Liparis loeselii*).
- Desmoulin's whorl snail (*Vertigo moulinsiana*).
- Otter (*Lutra lutra*).

to maintain*, in favourable condition, the habitats for the populations of Annex1 bird species[+] of European importance with particular reference to:

- open water
- swamp
- fen
- reedbed
- fen meadow with ditches and water bodies.

+Bittern, Marsh harrier, Hen harrier.

to maintain*, in favourable condition, the habitats for the populations of migratory bird species[+] of European importance with particular reference to:

- open water
- swamp
- fen
- reedbed
- fen meadow with ditches and water bodies.

+ Gadwall and Shoveler.

to maintain*, in favourable condition, the habitats of the populations of waterfowl that contribute to the wintering waterfowl assemblage of European importance, with particular reference to,

- open water
- wet woodland
- swamp and fen
- fen meadow with ditches and water bodies.

* maintenance implies restoration if the feature is not currently in favourable condition.

Discussion of permission application

Alone impacts

The site's conservation objectives have been taken into account, including consideration of the site citation and conservation objectives. The likely effects of the proposal on the international nature conservation interests for which the site was designated may be summarised as:

Change in flow or velocity regime

NPS/WR/003092 – Ludham Road, Catfield

The Ant Broads and Marshes is approximately 0.65km to the west of this abstraction. At this distance there is potential for this abstraction to have an impact on water levels, and hence flows, in Catfield Fen and in the River Ant. The impact of abstraction will be attenuated by the clay, which separates the crag from the fen deposits. This is laterally fairly persistent, although there may be a few areas of limited extent where it is absent (clay 'windows') and it may also have been removed in some of the drains. There is therefore limited hydraulic connection between the crag and the surface water, with any flow depletion in the drains within Catfield Fen due to abstraction likely to be small. This is supported by measurements in piezometer clusters near to Catfield Fen sluice and at Sharp Street. At these locations there is an upward head gradient in the crag and overlying deposits which indicates a potential upward movement of groundwater from the crag towards the surface water.

To give some context to the relatively small size of the abstraction, the maximum flow depletion in the River Ant if the whole abstraction was taken directly from the river (averaged over a year) would be 0.41% of the Q95 flow at Honing Lock Gauging Station.

NPS/WR/002725 – Plumsgate Road, Catfield

The Ant Broads and Marshes is approximately 0.9km to the west of this abstraction. The abstraction point is approximately 0.4km distant from Sutton Broad which is a tributary of the River Ant. Monitoring piezo's located close to this tributary have shown there is a maximum drawdown of approximately 0.1m in the deeper crag piezo and no detectable drawdown in the shallow piezo as a result of abstraction. Sutton Broad receives water from IDB pumling, although water levels are mainly controlled by the tidal River Ant.

In terms of maximum impact even if the entire volume was abstracted directly from the river (averaged over the whole year), flow depletion based on flows in the River Ant with a Q95 of 174l/s as measured at Honing Lock Gauging Station this abstraction would equate to 1.2% of the Q95 flow.

Change in water levels or table

NPS/WR/003092 – Ludham Road, Catfield

The Ant Broads and Marshes is approximately 0.65km to the west of this abstraction. The fen deposits are separated from the crag by a layer of clay, which is laterally fairly persistent, although there may be a few areas of limited extent where it is absent (clay 'windows') and it may also have been removed in some of the drains. This will inhibit the upward propagation of any drawdown within the crag.

Water level monitoring in 2009 in observation borehole TG 32/801, located between this abstraction and Catfield Fen, shows a maximum drawdown due to abstraction of approximately 0.05m.

NPS/WR/002725 – Plumsgate Road, Catfield

This abstraction could affect water levels or table in the Ant Broads and Marshes by intercepting groundwater that would otherwise have reached the sites. By examining areal piezometry it appears that the cone of depression of this abstraction is not symmetrical and extends primarily to the north where a higher permeability is possibly encountered, therefore drawdown to the east and west is likely to be considerably smaller. As the Ant Broads & Marshes is located to the east of the borehole any impact of this abstraction on these European sites will be reduced further.

Other hazards

The abstractions are not considered to have an adverse effect on the remaining hazards as listed in Table 3 (changes in freshwater flow to estuary, salinity regime, surface flooding, water chemistry, entrapment, habitat loss and reduced dilution capacity) for the reasons stated previously and the low risk presented on the Ant Broads and Marshes when considered alone.

In-combination impacts

This application could be having an adverse effect on the Ant Broads and Marshes SSSI, component part of the Broads SAC and Broadland SPA when considered in combination with other plans or projects.

The RoC for the Ant Broads and Marshes has been completed, with these licences being listed within the Appendix 21 as "No Adverse Effect on Site Integrity Could Not be Shown, in-combination" at Stage 3. Stage 4 of the RoC has however concluded that there was a low risk that the environmental outcomes for the site could not be met and that there we do not need to pursue any licence modifications.

In September 2008 the owners of Catfield Fen reported unusually low water levels in the Fen Dykes, which the Agency has investigated during 2009. As part of the licence's addendum, the applicant has been undertaking water level monitoring, located between the abstraction bore's and Catfield Fen/Sutton Broad. The results of this monitoring and other monitoring undertaken by the Agency have been analysed by our Groundwater Team (Gavin Sharpin) – if you wish to see a full copy of this report please let me know.

In summary the conclusions of this report are that due to the complex hydrogeology of the area it has not been possible to establish with any certainty the impact of this abstraction on water levels and flows in the Fen. However, from the results the following conclusions are drawn;

- An upward hydraulic gradient (between the crag and the fen) has been maintained for the period of 2004 to 2009, despite 2009 being a very dry summer and abstraction taking place under these licences at virtually the whole quantity.
- No signal from either of these abstractions is visible in the water level monitoring of data in the Fen.
- Any impact of abstraction from the borehole at Plumsgate Road on crag groundwater levels beneath the Fen is likely to be insignificant.

Given the amount of uncertainty and some gaps in the data it is proposed to apply a precautionary approach and to renew the licences but to time limit both to 31 March 2012. This will allow an extra 2 year's of monitoring data to be collected and analysed.

As discussed above, this application could have an impact on the Ant Broads and Marshes SSSI, component part of the Broads SAC and Broadland SPA when considered in combination with other plans or projects. This includes 35 groundwater licences and 11 surface water licences as listed in the Broadland Rivers CAMS (RAM3 Ledger). This proposal represents 3% of the total annual groundwater abstraction within the CAMS groundwater catchment of the European site. Ongoing studies of the impacts of abstraction are being carried out as part of the Agency's Review of Consents process. Until this process is complete, we cannot be certain that the proposal, in combination with other abstractions, will not have an adverse effect on the integrity of the European site over the long term.

Although we consider that the risk to the European site is small, we propose to modify the proposal by time-limiting it to 31 March 2012. By issuing a short time limit it will also ensure that there is no adverse effect on integrity of the European site over the period of the licence.

Conclusions

This is a record of the appropriate assessment, required by Regulation 48 of the Habitats Regulations 1994, undertaken by the Environment Agency in respect of the above application, in accordance with the Habitats Directive (Council Directive 92/43/EEC). Having considered that the proposed abstraction would be likely to have a significant effect when considered in combination with other permissions on the Ant Broads and Marshes SSSI, component part of the Broads SAC and Broadland SPA and that the application is not directly connected with or necessary to the management of the site for nature conservation, an appropriate assessment has been undertaken of the implications of the proposal in view of the site's conservation objectives.

The assessment has concluded that the application as proposed cannot be shown to have no adverse effect on the integrity of the site when considered in combination with other plans or projects. The imposition of conditions or restrictions on the way the proposal is to be carried out has been considered and the imposition of a time limit to 2012 will avoid adverse affect as the risk to the site is low.

Name of officer undertaking appropriate assessment:

Signed: Hannah Goodfield
Date: 03/02/10

Natural England/CCW COMMENTS ON APPROPRIATE ASSESSMENT:
IS THERE AGREEMENT WITH THE CONCLUSION? YES/NO
(Please provide summary and explanation for answer given)

Signed: (Natural England local team manager/CCW local team manager)
Date:

Appendix 9 – Crow Assessment

CROW Appendix 4

The CROW Act 2000 and Environment Agency Permissions - Formal Notice

ENVIRONMENT AGENCY

Environment Agency Formal Notice To English Nature/Countryside Council For Wales

Requirements of section 28I of the Wildlife & Countryside Act 1981 as incorporated by the Countryside and Rights of Way Act (CROW) 2000.

Duty in relation to granting any consent, licence or permit for activities to be carried out in or capable of affecting Sites of Special Scientific Interest (SSSI).

To be completed by relevant technical/project officer in consultation with Conservation section, referring to the Agency Guidance and the flow chart in CROW Appendix 2 titled , ' The CROW Act 2000 and Environment Agency Permissions' .

NB: [1] It is expected that there has been preliminary Consultation with EN/CCW, where the application timetable permits. [2] Complete this form for <u>any</u> proposed permissions which the Agency is minded to approve, having taken account of the Agency's S28G duties. This applies to all proposed permissions within an SSSI which relate to operations listed on the OLD list, and to permissions outside an SSSI which are likely to damage its special features.

Agency Region and Area Office:	Anglian - Eastern
Name of SSSI(s):	Ant Broads and Marshes Upper Thurne Broads and Marshes
3. Type of permission:	Abstraction licences (Formal Renewals)
4. Date for Agency determination:	31 March 2010
5. Predicted 28 day date for EN/CCW Response (under S28 I(4)):	04 March 2010
Agency reference no:	NPS/WR/003092 – Renewal of licence 7/34/09/*G/0141C (AW Alston) NPS/WR/002725 – Renewal of licence 7/34/09/*G/0144B (AW Alston)
National Grid reference:	NPS/WR/003092 – TG 386 206 NPS/WR/002725 – TG 382 223
8. Description of proposal:	<u>NPS/WR/003092 – Ludham Road, Catfield</u> This application is to renew licence 7/34/09/*G/0141C with no changes to the current conditions which otherwise is due to expire on 31 March 2010. The licence authorises abstraction from a crag borehole at NGR TG 386 206 for quantities of 45m³/hour, 800m³/day and 22,700m³/year at a rate of 12.5l/s between April and October for spray irrigation. There is a monitoring addendum attached which involves 3 piezometers to be maintained and monitored daily during the abstraction period and weekly the rest of the year at NGR TG 3850 2059, TG 3813 2078 and TG 3821 2029. <u>NPS/WR/002725 – Plumsgate Road, Catfield</u> This application is to renew licence 7/34/09/*G/0144B with no changes to licence conditions or quantities that would otherwise expire on 31 March 2010. The licence authorises abstraction from a crag borehole at NGR TG 382 223 between April and October for spray irrigation at quantities of 68,000m³/year, 1090m³/day at an instantaneous rate of 15l/s. The licence contains a monitoring addendum to monitor water levels in 3 piezo's in the vicinity of the borehole.
9. Is the proposed activity within (wholly or partially) the SSSI boundary?	NO

10. If within the SSSI and on the OLD list, and/or outside the SSSI boundary, what aspect of the proposed permission is likely in the Agency view to adversely affect the notified interest of the SSSI?

According to the OLD listing the following operation is listed relating to abstraction licences;
"The changing of water levels and tables and water utilisation (including irrigation, storage and abstraction from existing water bodies and through boreholes)."

Ant Broads and Marshes SSSI

Change in flow or velocity regime

NPS/WR/003092 – Ludham Road, Catfield

The Ant Broads and Marshes is approximately 0.65km to the west of this abstraction. At this distance there is potential for this abstraction to have an impact on water levels, and hence flows, in Catfield Fen and in the River Ant. The impact of abstraction will be attenuated by the clay, which separates the crag from the fen deposits. This is laterally fairly persistent, although there may be a few areas of limited extent where it is absent (clay 'windows') and it may also have been removed in some of the drains. There is therefore limited hydraulic connection between the crag and the surface water, with any flow depletion in the drains within Catfield Fen due to abstraction likely to be small. This is supported by measurements in piezometer clusters near to Catfield Fen sluice and at Sharp Street. At these locations there is an upward head gradient in the crag and overlying deposits which indicates a potential upward movement of groundwater from the crag towards the surface water.

To give some context to the relatively small size of the abstraction, the maximum flow depletion in the River Ant if the whole abstraction was taken directly from the river (averaged over a year) would be 0.41% of the Q95 flow at Honing Lock Gauging Station.

NPS/WR/002725 – Plumsgate Road, Catfield

The Ant Broads and Marshes is approximately 0.9km to the west of this abstraction. The abstraction point is approximately 0.4km distant from Sutton Broad which is a tributary of the River Ant. Monitoring piezo's located close to this tributary have shown there is a maximum drawdown of approximately 0.1m in the deeper crag piezo and no detectable drawdown in the shallow piezo as a result of abstraction. Sutton Broad receives water from IDB pumling, although water levels are mainly controlled by the tidal River Ant.

In terms of maximum impact even if the entire volume was abstracted directly from the river (averaged over the whole year), flow depletion based on flows in the River Ant with a Q95 of 174l/s as measured at Honing Lock Gauging Station this abstraction would equate to 1.2% of the Q95 flow.

Changes in water levels or table

NPS/WR/003092 – Ludham Road, Catfield

The Ant Broads and Marshes is approximately 0.65km to the west of this abstraction. The fen deposits are separated from the crag by a layer of clay, which is laterally fairly persistent, although there may be a few areas of limited extent where it is absent (clay 'windows') and it may also have been removed in some of the drains. This will inhibit the upward propagation of any drawdown within the crag.

Water level monitoring in 2009 in observation borehole TG 32/801, located between this abstraction and Catfield Fen, shows a maximum drawdown due to abstraction of approximately 0.05m.

NPS/WR/002725 – Plumsgate Road, Catfield

This abstraction could affect water levels or table in the Ant Broads and Marshes by intercepting groundwater that would otherwise have reached the sites. By examining areal piezometry it appears that the cone of depression of this abstraction is not symmetrical and extends primarily to the north where a higher permeability is possibly encountered, therefore drawdown to the east and west is likely to be considerably smaller. As the Ant Broads & Marshes is located to the east of the borehole any impact of this abstraction on these European sites will be reduced further.

Upper Thurne Broads and Marshes

The Upper Thurne Broads and Marshes is located 1.5km and 1.9km to the east of the Ludham Road and Plumsgate Road abstractions respectively. At these distances there is not anticipated to be a significant impact on water flows or levels.

The groundwater modelling carried out at Stage 4 of the RoC process confirmed that these licensed abstractions are not contributing to an adverse impact on the integrity of the site.

(Continued overleaf)

10. In September 2008 the owners of Catfield Fen reported unusually low water levels in the Fen Dykes, which the Agency has investigated during 2009.

As part of the licence's addendum, the applicant has been undertaking water level monitoring, located between the abstraction bore's and Catfield Fen/Sutton Broad. The results of this monitoring and other monitoring undertaken by the Agency have been analysed by our Groundwater Team (Gavin Sharpin) – if you wish to see a full copy of this report please let me know.

In summary the conclusions of this report are that due to the complex hydrogeology of the area it has not been possible to establish with any certainty the impact of this abstraction on water levels and flows in the Fen. However, from the results the following conclusions are drawn;

- An upward hydraulic gradient (between the crag and the fen) has been maintained for the period of 2004 to 2009, despite 2009 being a very dry summer and abstraction taking place under these licences at virtually the whole quantity.
- No signal from either of these abstractions is visible in the water level monitoring of data in the Fen.
- Any impact of abstraction from the borehole at Plumsgate Road on crag groundwater levels beneath the Fen is likely to be insignificant.

Given the amount of uncertainty and some gaps in the data it is proposed to apply a precautionary approach and to renew the licences but to time limit both to 31 March 2012. This will allow an extra 2 year's of monitoring data to be collected and analysed.

11. Name & job title of Agency Officer: Hannah Goodfield (Senior Permitting Officer)		Date form sent to EN/CCW: 02/02/10

Appendix 10 – Upper Thurne Broads and Marshes assessment of likely significant effect on a European site

This document is being sent: for information only.

Form HR01- for new applications within Stage 2 criteria	Environment Agency

Environment Agency record of assessment of likely significant effect on a European site (Stage 2)

The new application for an abstraction licence (renewals) detailed below is within the Stage 1 criteria of the Habitats Directive Regulations, and in order to progress the application a Stage 2 assessment is required.

Part A
To be completed by relevant technical/project officer in consultation with Conservation/Ecology section and Natural England/CCW

1. Type of permission/activity:	Abstraction licence (Formal Renewals)
2. Environment Agency reference no:	NPS/WR/003092 – Renewal of licence 7/34/09/*G/0141C NPS/WR/002725 – Renewal of licence 7/34/09/*G/0144B
3. National grid reference:	NPS/WR/003092 – TG 386 206 NPS/WR/002725 – TG 382 223
4. Site reference:	NPS/WR/003092 – AW Alston at Ludham Road, Catfield NPS/WR/002725 – AW Alston at Plumsgate Road, Catfield
5. Brief description of proposal:	<u>NPS/WR/003092 – Ludham Road, Catfield</u> This application is to renew licence 7/34/09/*G/0141C with no changes to the current conditions which otherwise is due to expire on 31 March 2010. The licence authorises abstraction from a crag borehole at NGR TG 386 206 for quantities of 45m³/hour, 800m³/day and 22,700m³/year at a rate of 12.5l/s between April and October for spray irrigation. There is a monitoring addendum attached which involves 3 piezometers to be maintained and monitored daily during the abstraction period and weekly the rest of the year at NGR TG 3850 2059, TG 3813 2078 and TG 3821 2029. <u>NPS/WR/002725 – Plumsgate Road, Catfield</u> This application is to renew licence 7/34/09/*G/0144B with no changes to licence conditions or quantities that would otherwise expire on 31 March 2010. The licence authorises abstraction from a crag borehole at NGR TG 382 223 between April and October for spray irrigation at quantities of 68,000m³/year, 1090m³/day at an instantaneous rate of 15l/s. The licence contains a monitoring addendum to monitor water levels in 3 piezo's in the vicinity of the borehole.
6. European site name(s) and status:	<u>Component part of Broadland SPA –</u> Upper Thurne Broads and Marshes SSSI <u>Component part of The Broads SAC –</u> Upper Thurne Broads and Marshes SSSI

7. List of interest features:	Broadland SPA 3.4 Birds of lowland wet grasslands (Bewicks swan (3.4), Hen Harrier (3.4), Pink-footed goose (3.4), Ruff (3.4), Whooper swan (3.4) 3.6 Birds of lowland freshwaters and their margins (Bewicks swan (3.6), Bittern (3.6), Gadwall (3.6), Hen Harrier (3.6), Marsh harrier (3.6), Pink-footed goose (3.6), Ruff (3.6), Shoveler (3.6), Waterfowl(>20, 000) (3.6), Whooper swan (3.6) 3.7 Birds of farmland (Bewicks swan (3.7), Hen Harrier (3.7), Marsh harrier (3.7), Pink-footed goose (3.7), Whooper swan (3.7)) The Broads SAC 1.1 Fens & wet habitats (not sensitive to acidification) (Molinia meadows on chalk and clay, Residual alluvial forests (Priority Feature) 1.2 Bogs & wet habitats (sensitive to acidification) (Calcareous fens with Cladium mariscus and Carex davalliana (Priority Feature), Transition mires and quaking bogs 1.5 Standing waters (not sensitive to acidification) (Hard oligo-mesotrophic waters with benthic vegetation of Chara formations, Natural eutrophic lakes with Magnopotamion or Hydrocharition type vegetation 2.2 Vascular plants lower plants and invertebrates of wet habitats (Desmoulins whorl snail, Fen orchid 2.9 Mammals of riverine habitats (Otter)
8. Is the proposal directly connected with or necessary to the management of the site for nature conservation?	No
9.What potential hazards are likely to affect the interest features? (Refer to relevant sensitivity matrix and only include those to which the interest features are sensitive). **Are the interest features potentially exposed to the hazard?**	

Change in flow or velocity regime

Interest features - 3.4 Birds of lowland wet grasslands, 3.6 Birds of lowland freshwaters and their margins, 1.1 Fens & wet habitats (not sensitive to acidification), 1.2 Bogs & wet habitats (sensitive to acidification), 1.5 Standing waters (not sensitive to acidification), 2.2 Vascular plants lower plants and invertebrates of wet habitats (Desmoulins whorl snail, Fen orchid) and 2.9 Mammals of riverine habitats (Otter)

The Upper Thurne Broads and Marshes is located 1.5km and 1.9km to the east of the Ludham Road and Plumsgate Road abstractions respectively. At these distances there is not anticipated to be a significant impact on flows on the European site or River Thurne itself.

The groundwater modelling carried out at Stage 4 of the RoC process confirmed that these licensed abstractions are not contributing to an adverse impact on the integrity of the site. Both abstractions were represented within the modelling at the correct quantities and have been affirmed within the Appendix 19 for the site.

Change in surface flooding

Interest features - 3.4 Birds of lowland wet grasslands, 3.6 Birds of lowland freshwaters and their margins, 3.7 Birds of farmland, 1.1 Fens & wet habitats (not sensitive to acidification), 1.2 Bogs & wet habitats (sensitive to acidification), 2.2 Vascular plants lower plants and invertebrates of wet habitats (Desmoulins whorl snail, Fen orchid) and 2.9 Mammals of riverine habitats (Otter)

There are no significant impacts anticipated on surface flooding as a result of these renewal applications.

Changed water chemistry

Interest features - 3.4 Birds of lowland wet grasslands, 3.6 Birds of lowland freshwaters and their margins, 1.1 Fens & wet habitats (not sensitive to acidification), 1.2 Bogs & wet habitats (sensitive to acidification), 1.5 Standing waters (not sensitive to acidification), 2.2 Vascular plants lower plants and invertebrates of wet habitats (Desmoulins whorl snail, Fen orchid) and 2.9 Mammals of riverine habitats (Otter)

There are no significant impacts anticipated on water chemistry as a result of these renewal applications.

Changes in water levels or table

Interest features - 3.4 Birds of lowland wet grasslands, 3.6 Birds of lowland freshwaters and their margins, 1.1 Fens & wet habitats (not sensitive to acidification), 1.2 Bogs & wet habitats (sensitive to acidification), 1.5 Standing waters (not sensitive to acidification), 2.2 Vascular plants lower plants and invertebrates of wet habitats (Desmoulins whorl snail, Fen orchid) and 2.9 Mammals of riverine habitats (Otter)

The Upper Thurne Broads and Marshes is located 1.5km and 1.9km to the east of the Ludham Road and Plumsgate Road abstractions respectively. At these distances there is not anticipated to be a significant impact on water levels.

The groundwater modelling carried out at Stage 4 of the RoC process confirmed that these licensed abstractions are not contributing to an adverse impact on the integrity of the site. Both abstractions were represented within the modelling at the correct quantities and have been affirmed within the Appendix 19 for the site.

Entrapment

Interest features - 2.9 Mammals of riverine habitats (Otter)

There are no significant impacts anticipated on entrapment as a result of these renewal applications.

Habitat Loss

Interest features - 3.4 Birds of lowland wet grasslands, 3.6 Birds of lowland freshwaters and their margins, 1.1 Fens & wet habitats (not sensitive to acidification), 1.2 Bogs & wet habitats (sensitive to acidification), 1.5 Standing waters (not sensitive to acidification), 2.2 Vascular plants lower plants and invertebrates of wet habitats (Desmoulins whorl snail, Fen orchid) and 2.9 Mammals of riverine habitats (Otter)

There are no significant impacts anticipated on habitat loss as a result of these renewal applications.

Reduced dilution capacity

Interest features - 3.4 Birds of lowland wet grasslands, 3.6 Birds of lowland freshwaters and their margins, 1.1 Fens & wet habitats (not sensitive to acidification), 1.2 Bogs & wet habitats (sensitive to acidification), 1.5 Standing waters (not sensitive to acidification), 2.2 Vascular plants lower plants and invertebrates of wet habitats (Desmoulins whorl snail, Fen orchid) and 2.9 Mammals of riverine habitats (Otter)

There are no significant impacts anticipated on dilution capacity as a result of these renewal applications.

Change in freshwater flow to estuary

Interest features – 1.1 Fens & wet habitats (not sensitive to acidification)

There are no significant impacts anticipated on freshwater flow to estuary as a result of these renewal applications.

Change in salinity regime

Interest features - 1.1 Fens & wet habitats (not sensitive to acidification)

There are no significant impacts anticipated on the salinity regime within the European site as a result of these renewal applications.

10.Is the potential scale or magnitude of any effect likely to be significant?		
a) Alone? (explain conclusion, in relation to de minimis criteria)	No Both of these licences have been included, at the correct representation, within the RoC modelling process for the Upper Thurne Broads and Marshes. The groundwater modelling carried out at Stage 4 of the RoC process confirmed that these licensed abstractions are not contributing to an adverse impact on the integrity of the site. The abstractions have been affirmed within the Appendix 19 for the site.	
b) In combination with other Environment Agency permissions and/or other plans or projects? (Explain conclusion and which plans/projects have been included, as well as those associated with other functions).	No The groundwater modelling carried out at Stage 4 of the RoC process confirmed that these licensed abstractions are not contributing to an adverse impact on the integrity of the site. Both abstractions were represented within the modelling at the correct quantities and have been affirmed within the Appendix 19 for the site.	
c) In combination with permissions and/or plans/projects of other Competent Authorities?	As a result of its risk assessment, the Environment Agency can conclude that this application could not act in combination with permissions and/or plans/projects of other competent authorities, consultation has not been necessary. The Broads Authority will however be consulted as these abstractions are located within the Broads.	
11.Conclusion: **Is the proposal likely to have a significant effect 'alone and/or in combination' on a European site?** (Justification – attach any relevant supporting information and the reasons for coming to the particular conclusion)	The groundwater modelling carried out at Stage 4 of the RoC process confirmed that these licensed abstractions are not contributing to an adverse impact on the integrity of the site. Both abstractions were represented within the modelling at the correct quantities and have been affirmed within the Appendix 19 for the site.	
12. Justification for reduced consultation review process : A brief justification should be written outlining why each application is thought to be minor or large/complex, and thus why you are sending to Natural England for either information or consultation.	Information obtained through the RoC process has been used to assess these applications under Reg 48 for the Upper Thurne Broads, and are not being pursued for modifications.	
13. Name of Officer:	Hannah Goodfield	Date: 03/02/10