

## 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. 9<sup>th</sup> March 2009 – spring water levels, prior to any abstraction
2. 16<sup>th</sup> July 2009 – summer water levels, 8 days since last abstraction
3. 28<sup>th</sup> 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.

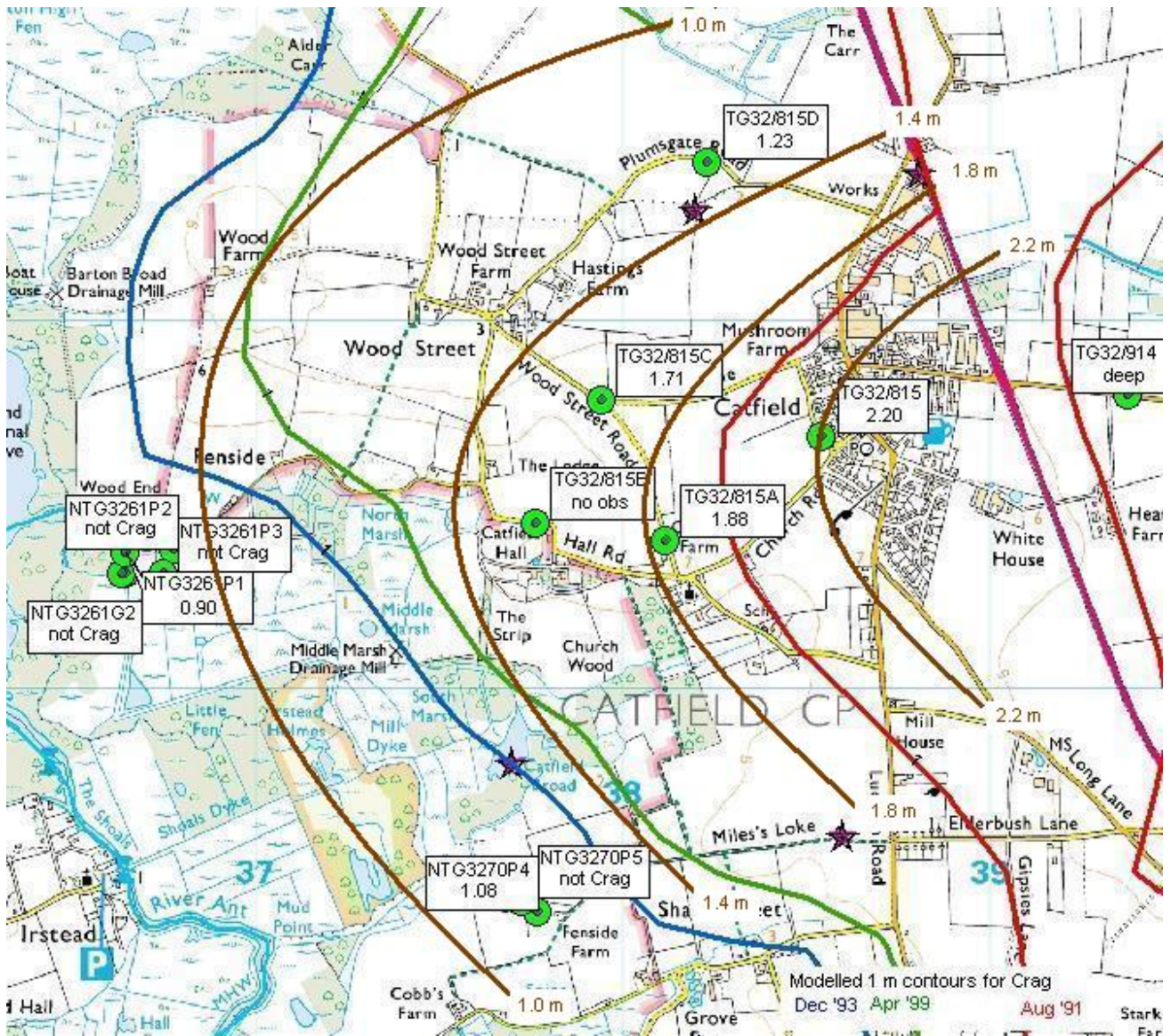


Figure 1: Contouring for shallow Crag water levels on 9<sup>th</sup> March 2009. There was no abstraction under 7/34/09/0144B in 2009 prior to this date.

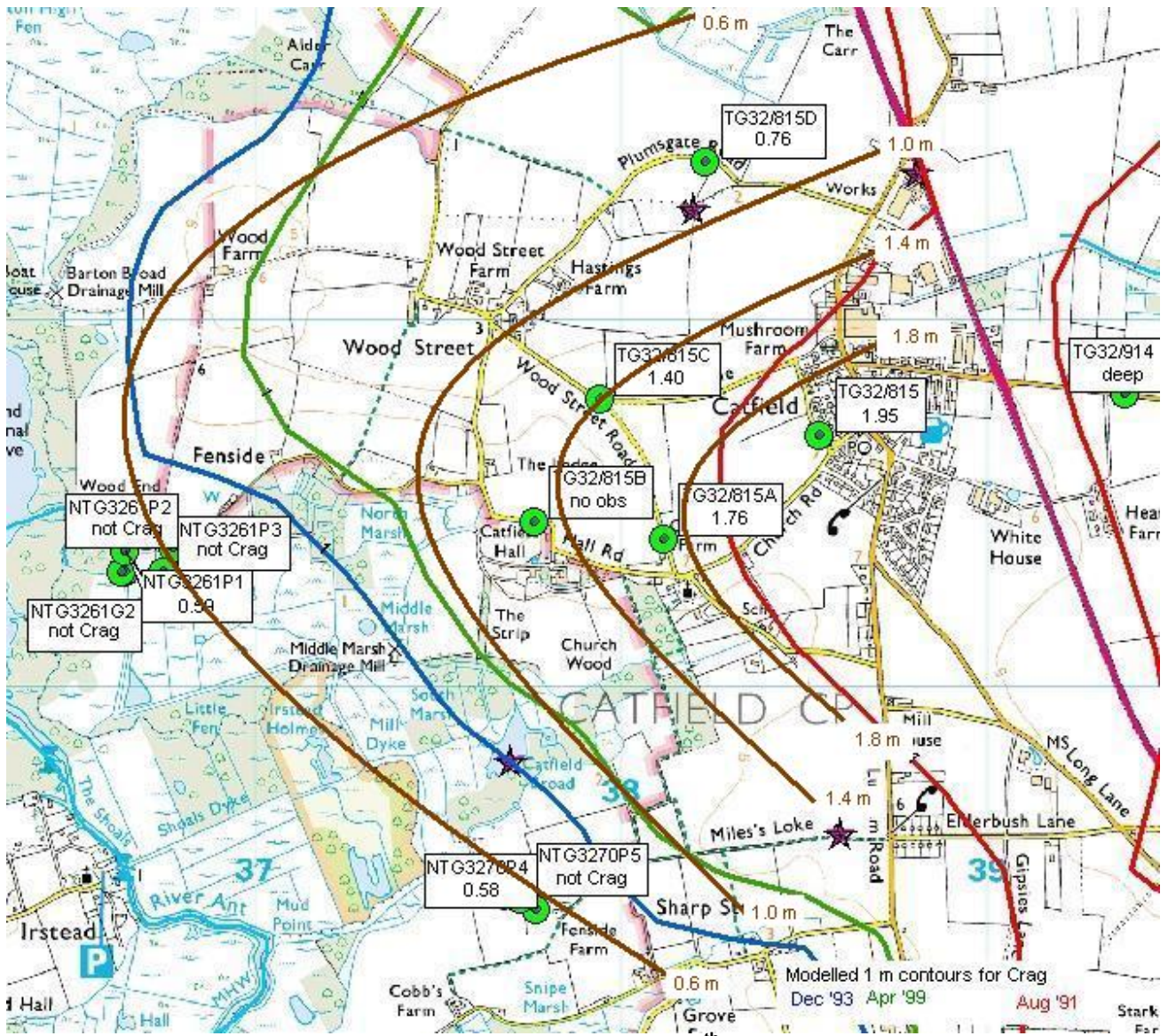
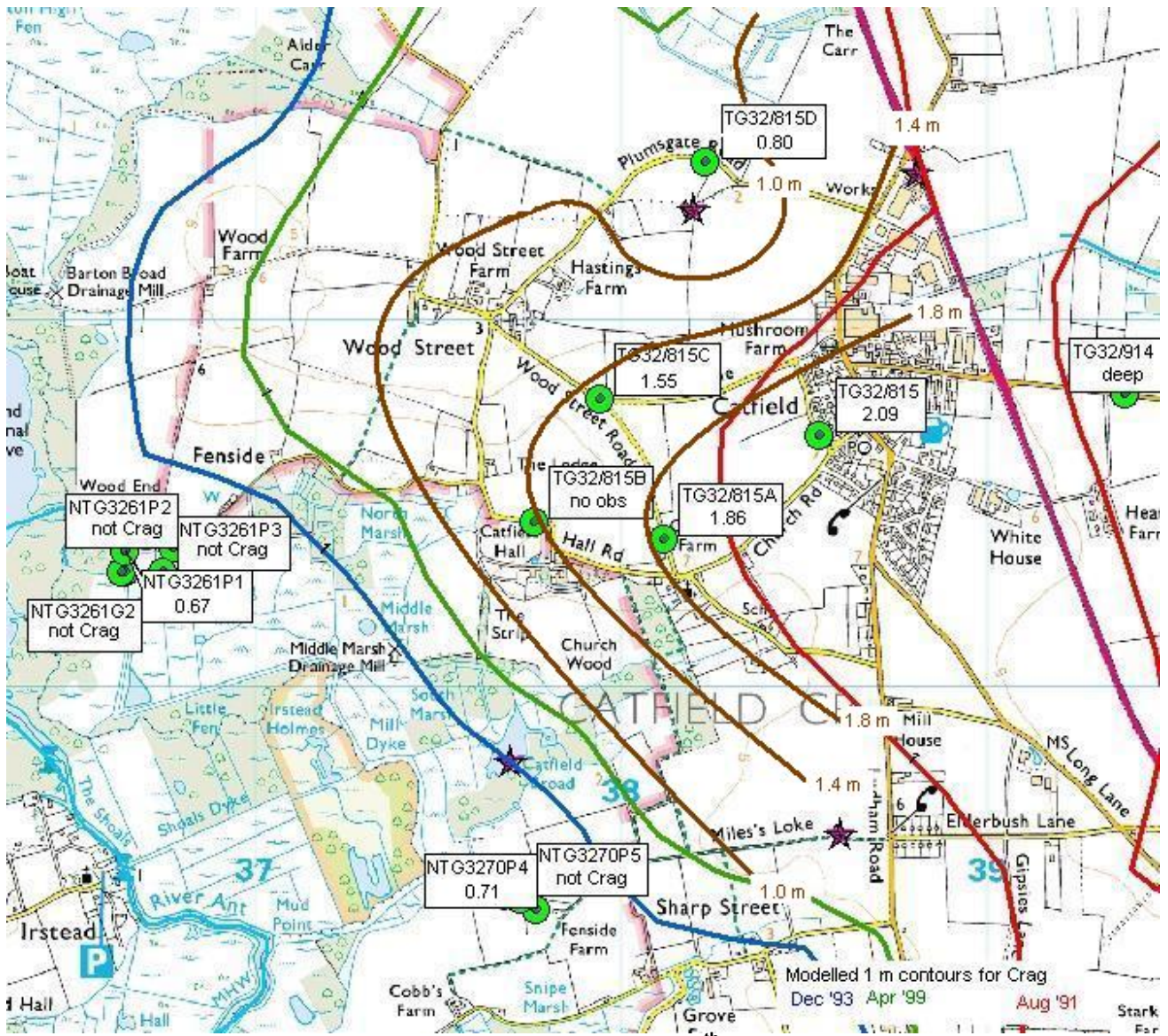


Figure 2: Contouring for shallow Crag water levels on 16<sup>th</sup> July 2009. There was no abstraction under 7/34/09/0144B on this day or the 8 previous days.



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

- 28<sup>th</sup> May: 420 m<sup>3</sup>
- 27<sup>th</sup> May: 805 m<sup>3</sup>
- 26<sup>th</sup> May: 811 m<sup>3</sup>

(cf. the maximum daily licensed quantity of 1,090 m<sup>3</sup>/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 (28<sup>th</sup> 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 28<sup>th</sup> May are between the levels recorded on the 9<sup>th</sup> March and the 16<sup>th</sup> 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.