Upper Heyford (Duns Tew FMZ) Modelling Report

Upper Heyford Development - Modelling Impact Assessment

October 2012

Produced for

Thames Water

Document Control Sheet

Project Title	Upper Heyford Development – Modelling Impact Assessment
Report Title	Upper Heyford (Duns Tew FMZ) Modelling Report
Report ref no.	
Version	Final
Status	
Report Date	9th October 2012

Record of Issue

Version	Status	Author	Date	Checked by	Date	Approved by	Date
v1	Issue	Dan Stirling	27/09/12	Will Rickard	27/09/12	Ian Towner	27/09/12
v2	Issue	Dan Stirling	01/10/12	Will Rickard	01/10/12	Ian Towner	01/10/12
V3	Issue	Dan Stirling	04/10/12	Will Rickard	04/10/12	Ian Towner	04/10/12
Final	Issue	Dan Stirling	09/10/12	Jo Stringer	09/10/12	Andrew Farrow	09/10/12

Distribution

Date	Organisation	Contact	Format	Copies
27/09/12	Thames Water (Network Modelling)	Andrew Farrow	Electronic email (MS Word)	1
09/10/12	Thames Water (Developer Services)	Karl Tuchscherer	Electronic email (MS Word)	1

Contents

1 Introduction

Developer Services (DS) requested a modelling study to investigate the impact of a proposed development of 760 residential units at the former RAF Upper Heyford, (RAF Upper Heyford was a major operational air base until 1994) in Upper Heyford, Bicester, Oxfordshire OX25. The site is located to the east of Upper Heyford village and is within the Duns Tew Flow Monitoring Zone (FMZ) and District Meter Area (DMA) ZDNSTW04.

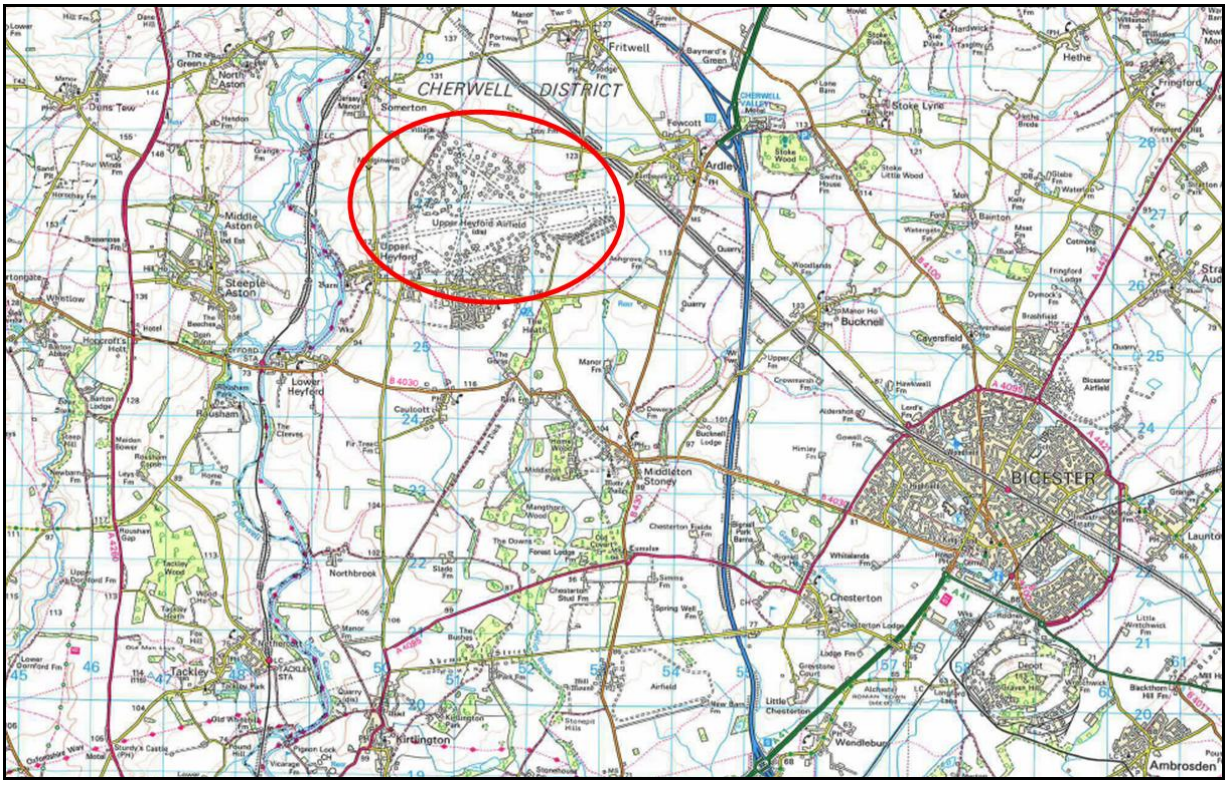

Figure 1 – Area Map

1.1 Supply Configuration

There are two feeds to ZDNSTW04: DM00978 connected to the Angelinos to Banbury trunk main and DM00979 connected to the 15” Duns Tew Reservoir (DTR) In/Out main. The latter is also connected to the 27” main but downstream of the Middle Aston Control Valve (MAV). The supply to this district meter will either be Angelinos or DTR, or both depending on the Angelinos output and MAV status.

The existing connection to RAF Upper Heyford is at the junction of Somerton Road and Camp Road, at the western extent of the site which connects to on site ground storage at the eastern end of the site via 7” and 9” mains. The on-site potable water system which includes ground storage tanks, pumps and a water tower will be decommissioned after the proposed connection is made, with all properties subsequently being supplied directly from the Duns Tew network.

Currently, there are commercial properties and 315 occupied households on the base which are fed via the original private site supply network, with a combined average demand of 5.6l/s.

2 Scope of Work

The modelling brief provided is as follows:

Mouchel have been requested to undertake the following scope of works, on behalf of the Thames Water Network Modelling Group, for this Developer Services project :

I. Carry out field testing and hydraulic modelling to re-calibrate the Duns Tew FMZ model.

II. Assess the impact on the distribution network in the Duns Tew zone, as well as checking the effect on the overall resource zone and transmission mains capabilities.

III. Carry out a point of connection pressure evaluation under 2012PDPW (Peak Day Peak Week) demands.

IV. Identify any new mains and existing network reinforcement, if required, for the proposed development.

V. Liaise with Operational staff, as necessary.

3 Methodology

The hydraulic analyses of the impact of the proposed development was carried out using the Duns Tew FMZ 'all mains' model, originally built and calibrated using data from a field test carried out in July 2011. The Duns Tew model was again field tested and re-calibrated as part of this study.

Historic data was also evaluated to calculate the various peaking factors for the area which were then applied to the model to facilitate critical demand scenarios to be assessed.

The impact of the development on the water distribution network was evaluated for the 2012 Peak Day Peak Week (2012 PDPW), with and without the proposed development incorporated. The network was also assessed with the requisite fire flows for the new development added to the Average Day Demand (ADD) scenario to ensure that sufficient water is available for fire fighting purposes.

4 Development Site

4.1 General Topography

The entire airfield site covers a large area with the extent of the site, north to south, being estimated as 2km and east to west at around 3.5km. This proposed development of 760 residential properties is to be located in the vicinity of Camp Rd.

Ground elevations of the air base site range from approximately 110m AOD to 139m AOD, but the maximum ground height of the properties on the Upper Heyford site that are to be supplied directly from the network has been taken as 127m AOD

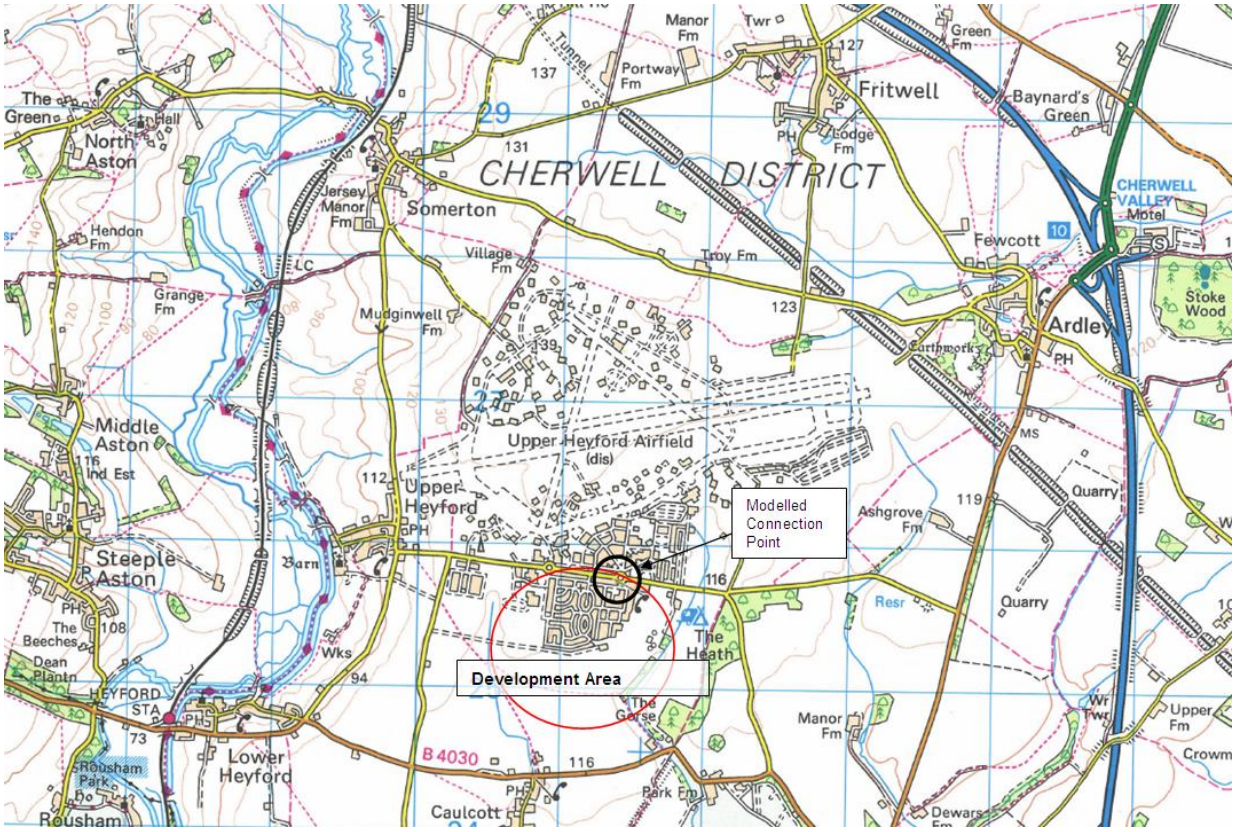

Figure 2 – Area Topography

4.2 Site Supply

The point of connection (POC) for the new and existing properties has been taken at the eastern end of Camp Rd at the end of the 355PE main. For modelling simulations, the proposed connection point is made from the 355mm diameter main which encircles the majority of the Upper Heyford air base. The elevation of the modelled connection point is approximately 123m AOD.

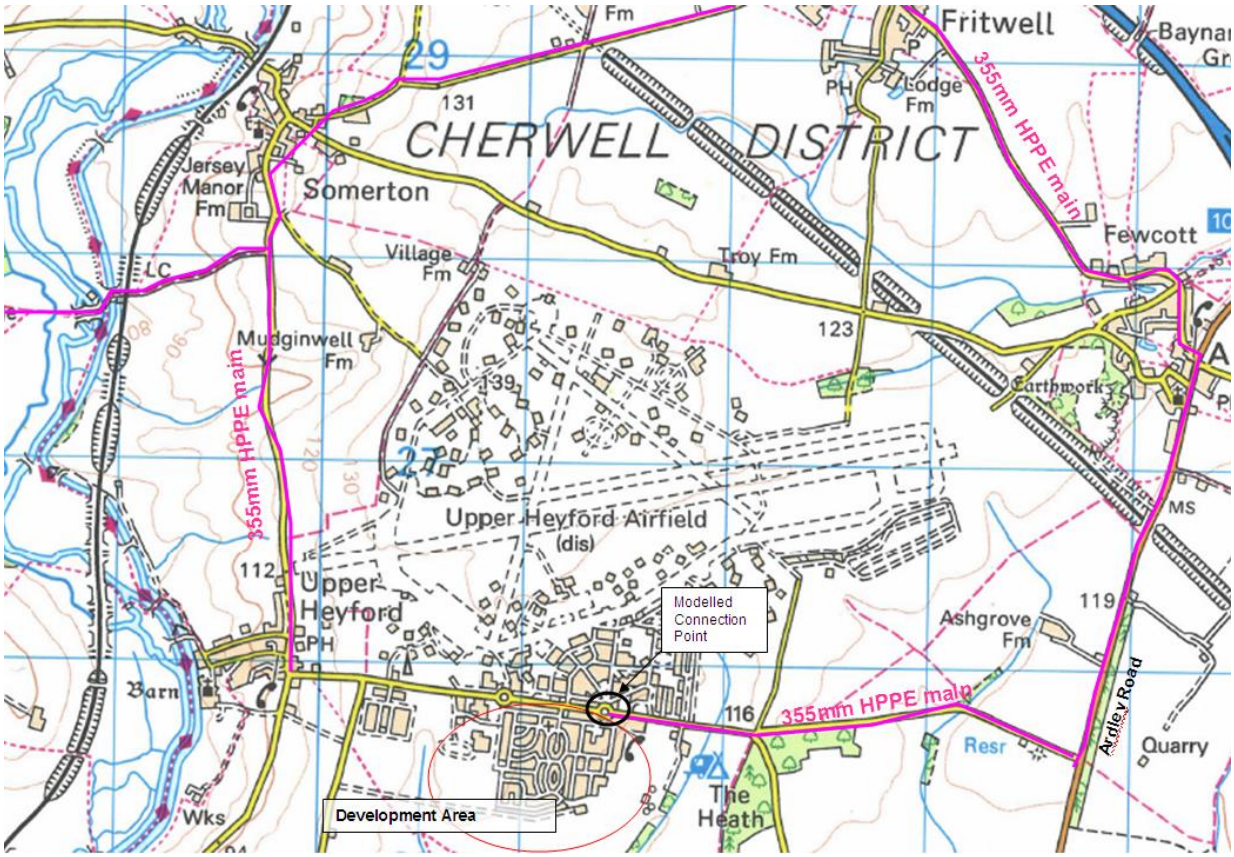

Figure 3 – Proposed Development Area

5 Model Build

5.1 Model Area

The Duns Tew model includes the Upper Heyford DMA 04 (ZDNSTW04) which is supplied either directly from the 27" trunk main that is fed from Angelinos Booster Pumping Station, or by gravity back fed from Duns Tew reservoir, when Angelinos booster pumps are off.

The network consists primarily of the DTR 15" inlet/outlet main (0.7km) to the 27" Angelinos to Banbury pumping main at MAV and continues with a 355mm polyethylene main around the majority of the perimeter of the Upper Heyford site.

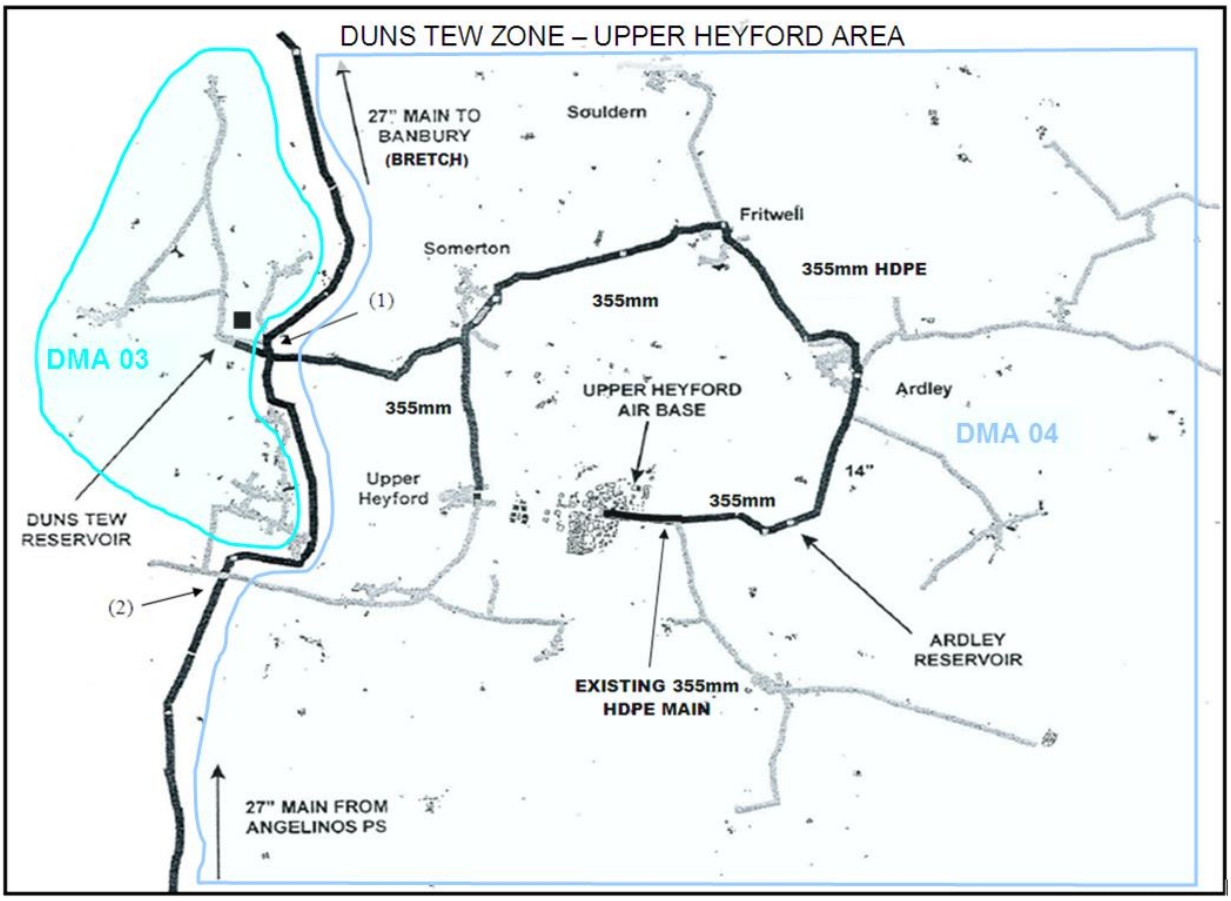

Figure 4 – Duns Tew (Part) Zone

5.2 Calibration & Field Test

The model was field tested during the week 13th August to 17th August 2012 with hydrants logged and District Metered Area flow, reservoir inflows/outflows and level data being extracted from TW telemetry systems. Flow data was also logged at the site meter which currently supplies the ground tanks on the site.

The zonal demand for the calibration day of Tuesday 14th August 2012 was 3.16 Ml/day compared with an average day demand for the current year of 3.17 Ml/day.

6 Supply and Demand Data

Analysis of the impact of the Upper Heyford development takes into account the performance of the distribution network. In order to ensure that the impact was correctly assessed against realistic peak demand conditions, the area's Average Daily Demand was determined in conjunction with the Peak Day Peak Week (PDPW) factor for 2012. The area schematic for the Duns Tew Zone (ZDUNST) is shown in figure 5.

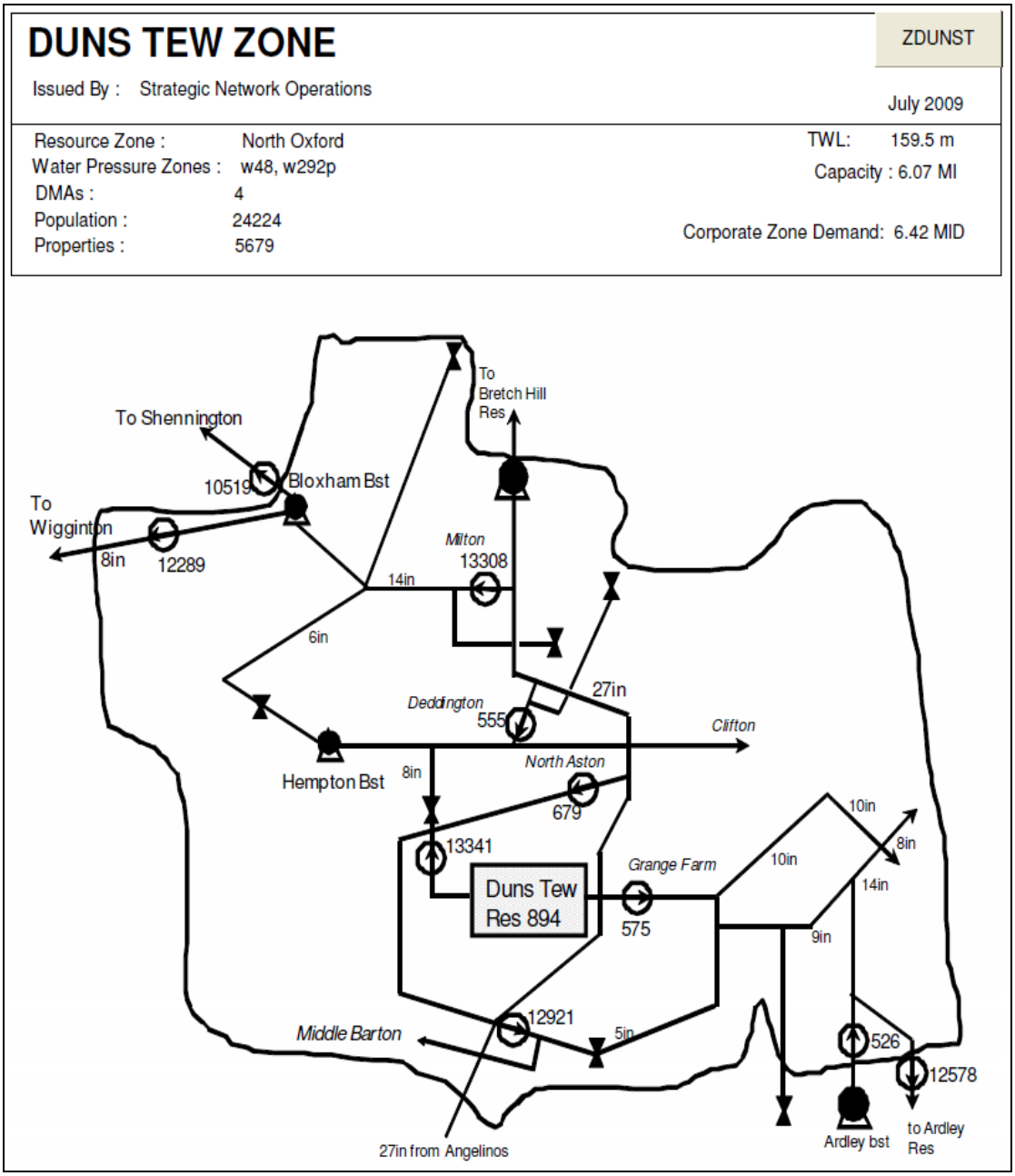

Figure 5 - Area Schematic

6.1 Demand Data

A review of the historic demand data for DMA04 Upper Heyford (ZDNSTW04) was carried out. Individual profiles were utilised for each of the DMAs with updated peak demands. Table 1 below summarises the average daily demands together with the annual ADPW and PDPW peaking factors.

Table 1 – Demand & Peaking Factors for the ZDNSTW04

Year	Demand Type	Daily Demand (Mld)	Peaking Factor
2012	ADD	1.79	
	ADPW	1.94	1.08
	PDPW	2.06	1.15

The additional demands and supply requirements attributed to the development are tabulated below.

Table 2 – New Development Demand / Fire Flow Requirement

Number of new residential properties.	760
Residential property demand	450 l/prop/day
Fire flows – residential 2 storey housing	8 l/s minimum flow through any single hydrant.
Fire flows - industrial.	20 l/s (150mm minimum nominal diameter mains.)

No analysis has been carried out in regard to the impact of the additional demand on the Angelinos to Banbury trunk main system. However, this development represents a relatively small percentage increase in the overall supply and therefore is not seen as an issue for the overall system supply/demand mass balance.

7 Model Results & Discussion

The following Sections 7.1 to 7.3 detail the analyses carried out and the results obtained.

7.1 Baseline Model 2012 PDPW

To assess the most critical scenario the model has been configured to operate with Angelinos (Banbury) high lift pumps off and the trunk main system, including DMA ZDNSTW04, supplied directly from Duns Tew reservoir.

The impact assessment has been made utilising the Peak Day Peak Week demand scenario models with minimum pressures related to the instantaneous peak hour demand.

The salient critical pressure locations within the DMA ZDNSTW04 that are at greatest risk of the pressure falling below the minimum service level requirement have been used to benchmark the impact of the development (Figure 6). The two locations have been identified as:

(i) Tusmore Park (Grid ref. 456442/231528), elevation 125.5 m.

(ii) Fewcott Road, (Grid ref. 452893/229235), elevation 129.5 m, near to the Fritwell booster (suction main).

Table 3 Baseline PDPW Demand - Model Minimum Pressures

DMA Ref	Location	2012 PDPW demand
DMA_04	(i) Tusmore Park	18.8m
DMA_04 (booster suction)	(ii) Fewcott Road, Fritwell	19.2m

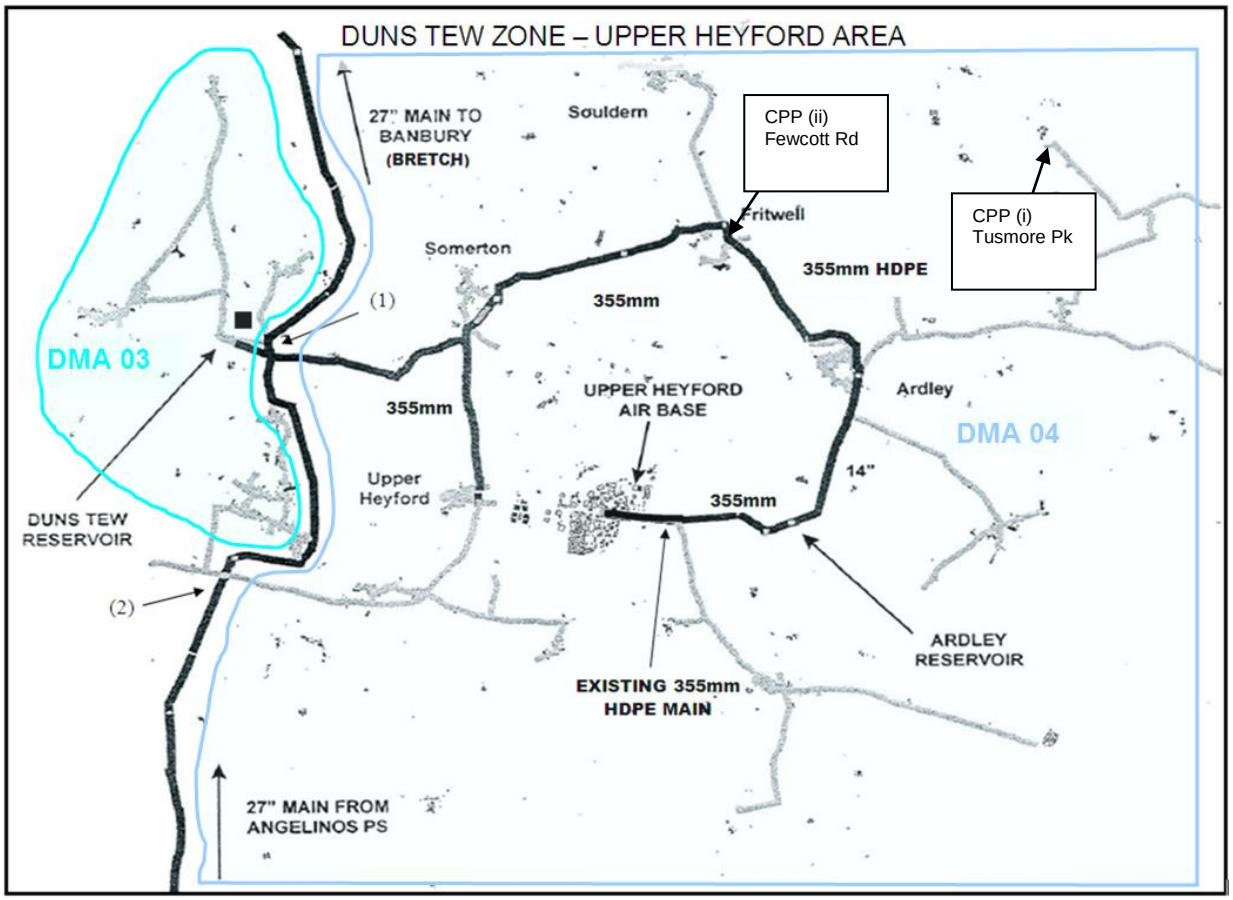

Figure 6 – Critical Pressure Locations

7.2 Development Impact

The development demand was added to the model at the connection point in Camp Rd as shown in Figure 3. The elevation of the POC has been taken as 123.0 m, however, the maximum elevation adopted for this development, in the vicinity of Camp Rd is 127.0mAOD

The results from the initial analysis indicated that a minimum pressure of less than 15m is predicted at Tusmore Pk, but only slightly above this value at Fritwell. The pressure at the POC was only 0.2m above the service level requirement with regard to minimum pressure, but is not met at the adopted highest elevation adopted for the site, excluding the allowance of 2m/km headloss attributed to on-site mains.

Table 4 Minimum Pressures - PDPW Demand Including Development

DMA Ref	Location	2012 PDPW + dev demand
DMA_04	(i) Tusmore Park	13.4m
DMA_04 (booster suction)	(ii) Fewcott Road, Fritwell	15.2m
DMA_04	Camp Road, POC	15.2m
	Location on-site (Max Elev 127m AOD) [#1]	11.2m

[#1] No allowance for losses in on-site mains

7.2.1 Fire Flow Analysis

The National Guidelines on flow requirements for fire fighting suggests 8 l/s minimum flow for residential 2 storey housing and 20 l/s minimum flow for areas with up to 1 hectare classed as industrial.

Taking into account the head loss from the Thames Water main to the fire tender for flowrates of 8l/s and 20l/s, residual pressures of 2.0m and 11.0m respectively are required at the hydrant/s. However, to minimize impact on customers and to ensure that high fire flows can be met even under peak demands, the total hydrant head loss should be less than 10m; the use of additional hydrants, in consultation with the fire brigade, should therefore be considered to meet this criterion.

The fire demand analysis has therefore been performed in conjunction with an average daily demand scenario. With this additional flow rate added to the model, modelled minimum instantaneous peak hour pressures at the critical points within the DMA are shown in Table 4. The existing network can provide the 8l/s; however, with a minimum pressure of 1.3m at the POC the minimum requirement for the 20l/s supply rate is not met.

Table 5 – Minimum Pressures for Fire Demand

DMA Ref	Location	2012 ADD + fire demand (8 l/s)	2012 ADD + fire demand (20 l/s)
DMA_04	(i) Tusmore Park	13.0m	3.8m
DMA_04 (booster suction)	(ii) Fewcott Road, Fritwell	15.1m	8.6m
DMA_04	Camp Road, POC	13.3m	1.3m

Figure 7 shows the modelled DMA 04 total inlet flows for each of the scenarios (8 l/s fire flow case). Figure 8 illustrates the graphs of the predicted pressures at the proposed connection point for the respective scenarios.

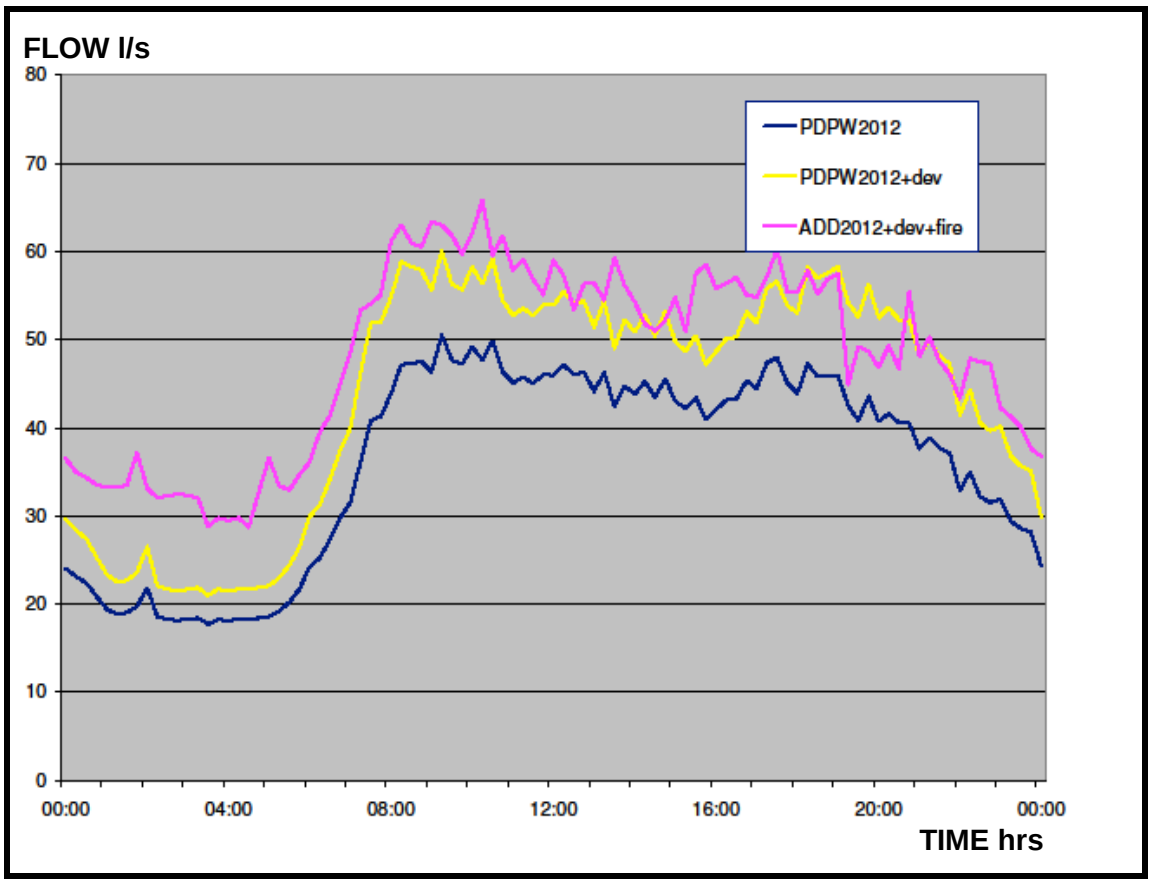

Figure 7– Predicted Flows for DMA04

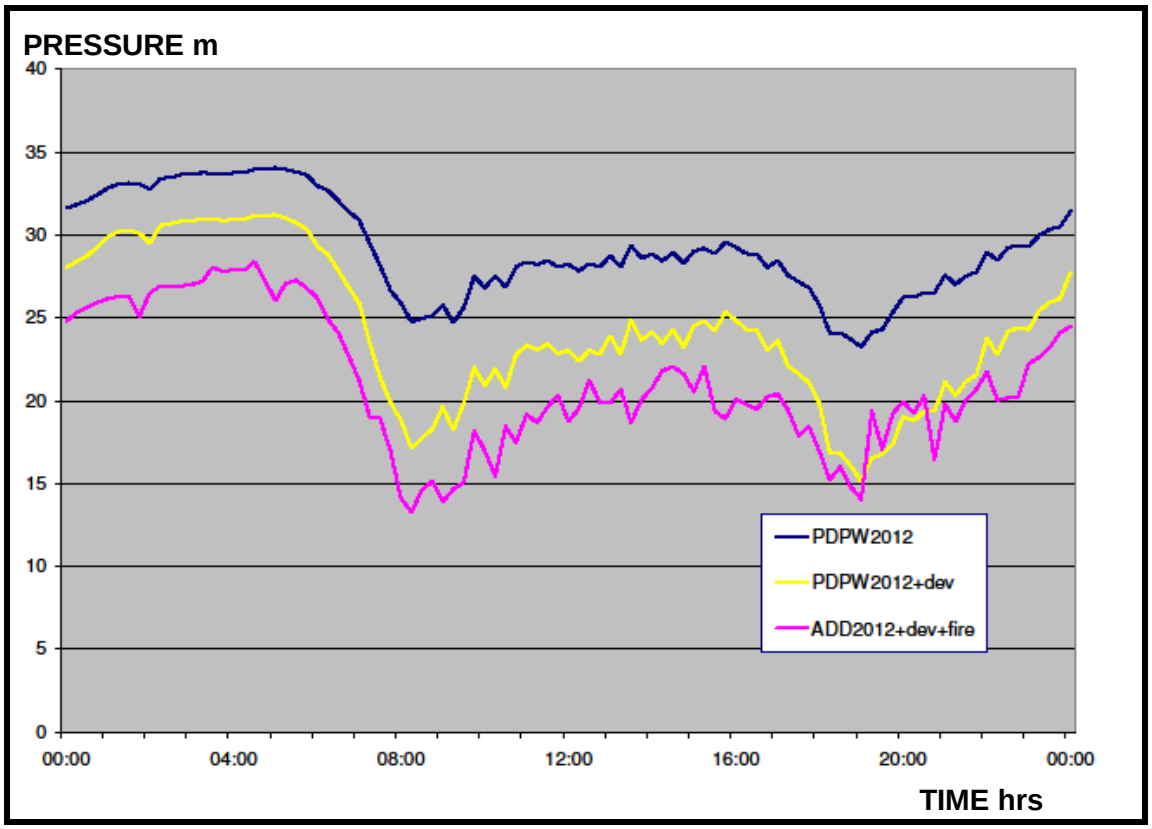

Figure 8 – Predicted Pressure at the Proposed Connection Point

7.3 Development Impact with Proposed Link Main

The impact assessment substantiates the need for the addition of a new link main. It is proposed that a new main is therefore connected from the existing 355mm PE main in Somerton Road to the 355mm PE in Camp Rd at the Heyford Park roundabout, a distance of approximately 1.7 km connecting as shown in Figure 9.

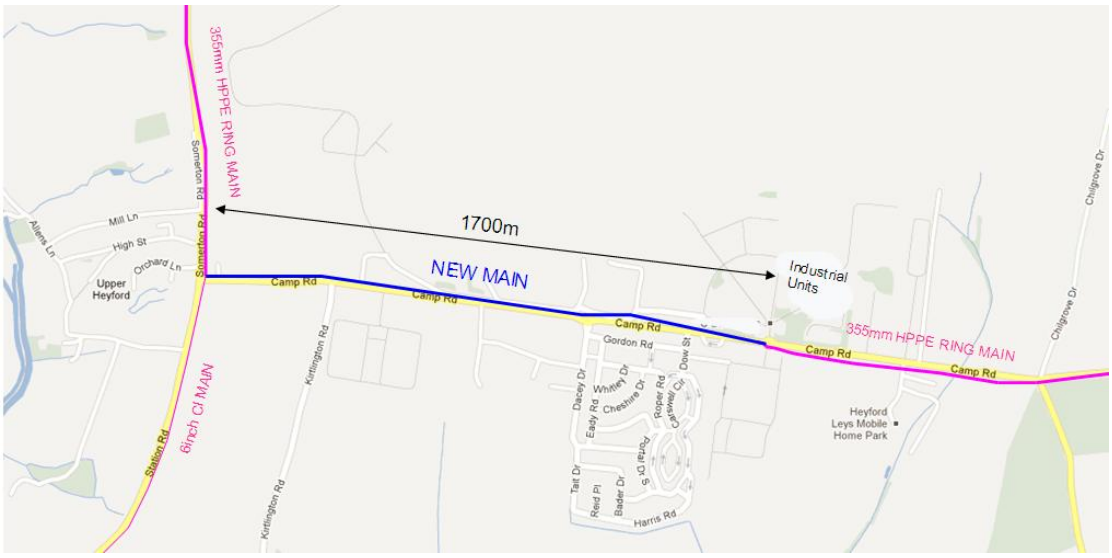

Figure 9 – Proposed New Main

The hydraulic analyses for the PDPW demand case with the development has been re-run with the inclusion of the link main (table 6). The addition of a 355 PE link main restores the pressures within ZDNSTW04 to values observed in the baseline PDPW demand case.

Table 6 – Minimum Pressures - PDPW Demand Including Link Main

DMA Ref	Location	2012 PDPW + dev demand + New 355mm PE main (290 mm int.)
DMA_04	(i) Tusmore Park	19.7m
DMA_04 (booster suction)	(ii) Fewcott Road, Fritwell	19.1m
DMA_04	Camp Road, POC	23.0m
	Location on-site (Max Elev 127m AOD) [#1]	19.0m

[#1] No allowance for losses in on-site mains

7.3.1 Fire Flow Analysis

The hydraulic analyses for the fire flow of 20l/s has been re-run with the inclusion of the link main. The results are detailed in table 7.

Table 7 – Minimum Pressures for Fire Demand Including Link Main

DMA Ref	Location	2012 ADD + fire demand (20l/s) + New 355mm main (290 mm int.)
DMA_04	(i) Tusmore Park	16.4m
DMA_04 (booster suction)	(ii) Fewcott Road, Fritwell	15.6m
DMA_04	Camp Road, POC	18.7m

The model indicated that it is possible to provide the required fire flow at the point of connection. However, it has not been feasible to extend this analysis to the locality of the industrial area as details of the on-site mains configuration was not available at the time of carrying out the analysis. Adequate pressures are maintained throughout the DMA.

8 Conclusion

The existing on-site storage tanks limit the supply rate to Upper Heyford site to 25l/s. Removal of this facility means that the demand loading of the existing and additional 760 new properties, including fire supply requirement, is transferred upstream through the network to Duns Tew reservoir. This has a significant impact with the increased flowrates, consequently reducing pressures throughout the DMA 04.

The current infusion at Ardley reservoir of 0.5Ml/d is only a sweetening flow, but the facility allows an increased flow from Duns Tew in an emergency event. The addition of the proposed Upper Heyford development should not constrain the operational flexibility that currently exists. Therefore the sizing of the link main is based on the criterion that the addition of the Upper Heyford development has effectively little or no detriment to the existing network performance.

It is recommended that a 1.7km main is laid in Camp Rd linking the existing 355PE main to form a ring main. It is recommended that this is also 355PE pipe.