Essex County Council
Flood Investigation Report

Thaxted
Uttlesford District

Rev	Date	Details	Author	Checked and Approved By
01	May 2015	Draft report for stakeholder consultation	**Ed Clarke** Flood Investigation Engineer	**Lucy Shepherd** Lead Local Flood Authority Manager
02	July 2015	Final revisions based on consultation response	**Ed Clarke** Flood Investigation Engineer	**Lucy Shepherd** Lead Local Flood Authority Manager

Introduction

Purpose and Requirements of the Flood Investigation Report

Essex County Council as the LLFA has a responsibility to record and report flood incidents as detailed within Section 19 of the FWMA 2010:

Section 19
(1) On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers it necessary or appropriate, investigate-

(a) which risk management authorities have relevant flood risk management functions, and

(b) whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.

(2) Where an authority carries out an investigation under subsection (1) it must-

(a) publish the results of its investigation, and

(b) notify any relevant risk management authorities.

Essex County Council has established criteria for Section 19 Flood Investigation Reports as follows:

- The internal flooding* of a property on more than one occasion

OR

- The internal flooding* of five or more properties in a single event

AND

- An ambiguity surrounding the source or responsibility of a flood incident.

*Internal flooding does not include the flooding of gardens and garages; only properties where internal flooding is above threshold level.

Site Information

Site Location

Thaxted (Grid Ref: 561227, 230910)

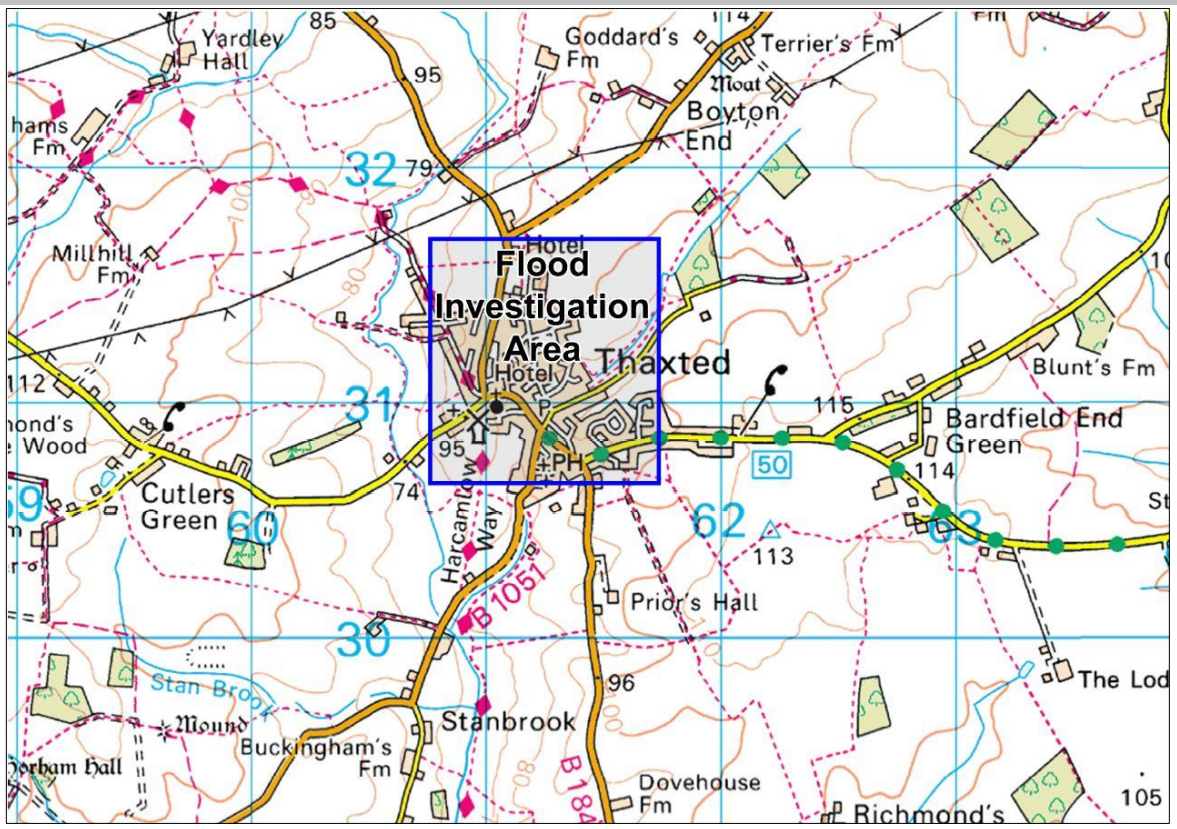

Figure 1 – Indicative location of Flood Investigation Area (Base Map: Ordnance Survey, 2014).

Flood Risk

Figure 2 shows the updated Flood Map for Surface Water (uFMfSW). As is demonstrated on the map, Thaxted exhibits a high level of susceptibility to surface water flooding, with some areas predicted to flood in a 1 in 30 year event or greater (3.3% probability of occurring any given year). The flood depth in some of the locations during this event is predicted to be in excess of 900mm.

There are three main flow paths of significant flood risk shown in Figure 2, in addition to the flood risk associated with the main river to the west of the map. The first area is related to an open watercourse running from the north of the town, south of the B1051, which then continues south towards the centre of the town. There is also an additional flow path running east to west, then a main open watercourse which runs from north east of the town. The detailed drainage network is shown in Figure 4.

The locations of the highest risk areas for surface water flooding shown on the map demonstrate that the town is situated on a significant natural drainage path towards the River Chelmer (shown in white on Figure 2). This means that historically it is likely that a series of uninterupted open watercourses would have existed, carrying flow through the present location of the town. These watercourses have since been culverted in multiple locations to allow development and the construction of roads.

Whilst the uFMfSW is a good general indicator of risk, due to lack of specific detail on the local drainage system and permeability it is not suitable for a detailed assessment of individual properties which are at risk from surface water flooding.

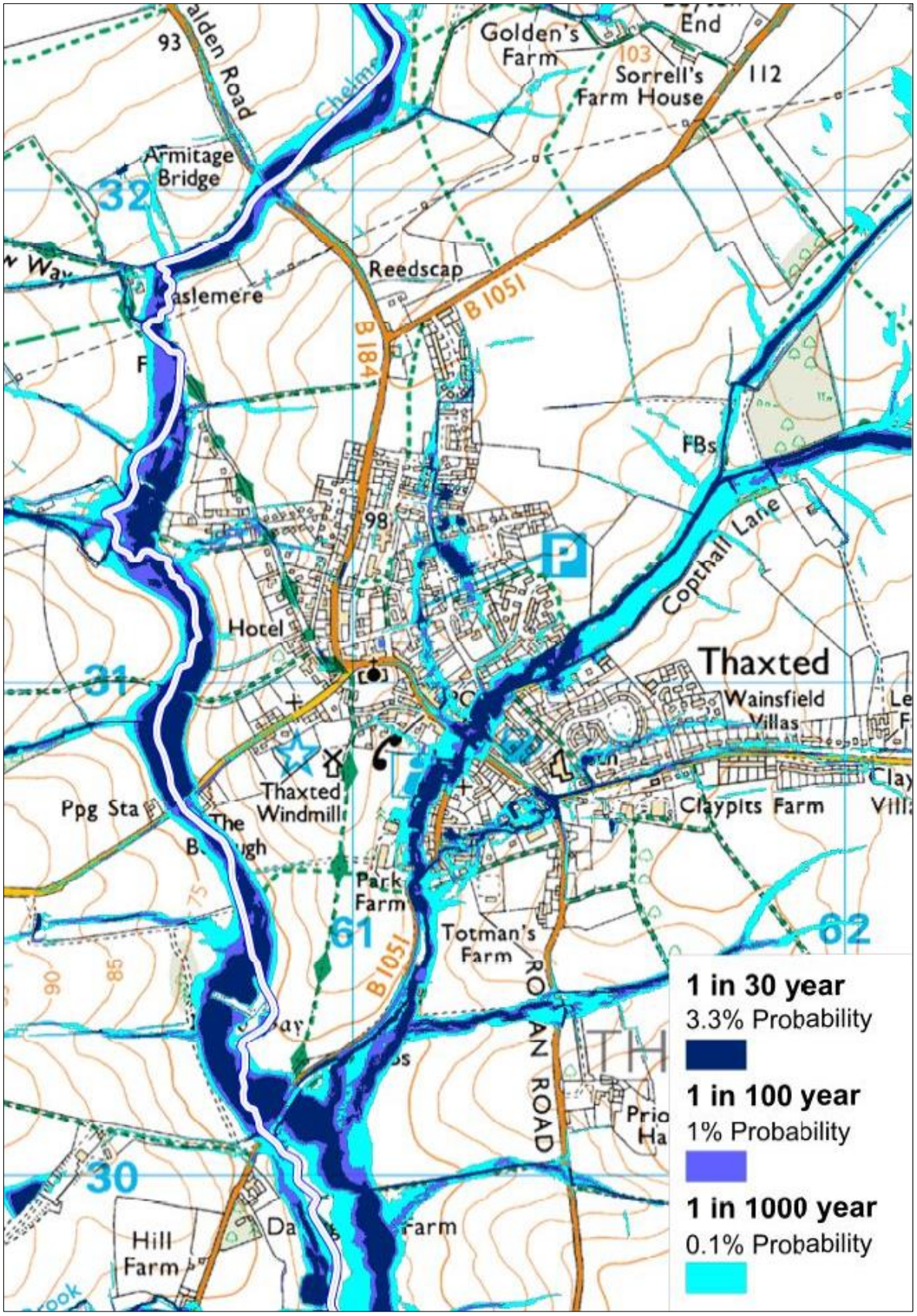

Figure 2 – Updated Flood Map for Surface Water (uFMfSW), (Environment Agency, 2013; Base Map: Ordnance Survey, 2014).

Flood History

Thaxted has experienced flooding on several occasions, with the most significant event experienced in recent years taking place on 28th July 2014. During this event a very large storm reportedly led to the flooding of in excess of 10 properties. The majority of the flooding was centred around two areas in the town, to the north and east, roughly corresponding with the area demonstrated in Figure 2. In the north of the town the source of flooding was from the ordinary watercourse running from north to south, whilst in the east of the town the source was reportedly runoff from the fields. Anecdotal evidence from residents suggested that in some locations floodwaters reached in excess of 20-30cm within residential properties and caused substantial damage, resulting in some residents requiring temporary alternative accommodation.

An approximate indication of the flooded areas based on reports from residents, Thaxted Parish Council and partner authorities is shown in Figure 3. Photos from the event are shown in Appendix A.

Figure 3 – Indicative flood area during the events [Not to be used as indication of individual properties experiencing internal flooding]. (Base Map: Ordnance Survey, 2014).

Drainage System

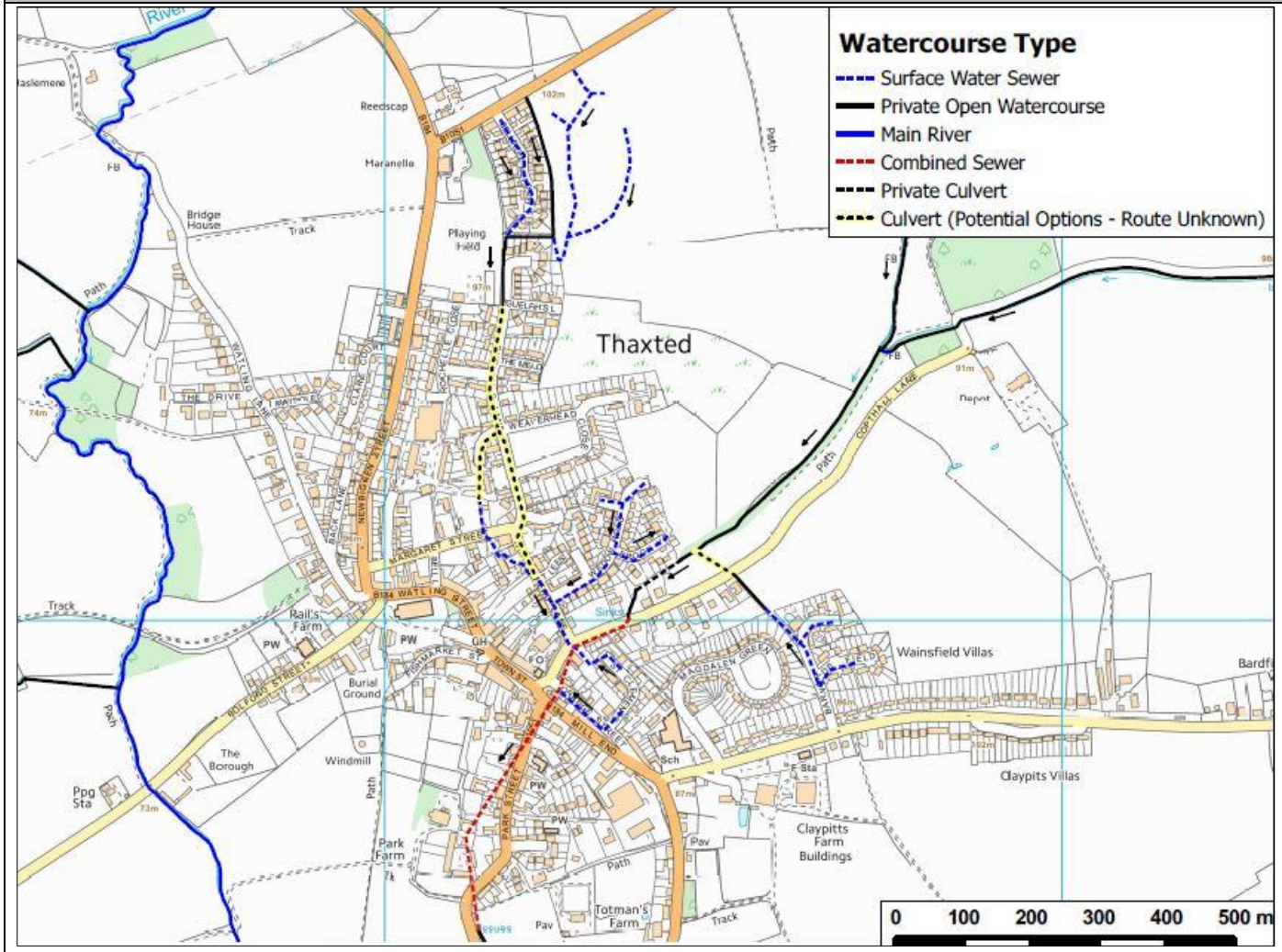

Figure 4 – Indicative Drainage Layout (Ordnance Survey, 2014).

The main drainage network in Thaxted comprises of several main sections of adopted surface water sewer, which eventually join with the large diameter culverted watercourse which runs through the centre of the town. The predominant direction of drainage is from north east to south west, with the sewer sections mainly following natural drainage paths as shown in Figure 2.

There are only limited areas in which the watercourses have remained open. These are found to the north and east of the town, with additional small sections of roadside ditch still present on Bardfield Road to the south east. Limited information has been available on the route of the ordinary watercourse to the north of the town once it becomes a culvert, and as such two potential scenarios are delimited by the yellow/black dashed line on Figure 4. Similarly, the connection between the surface water sewer/ordinary watercourse in the Barnards Fields area (south east of the map) to the main open watercourse has also been estimated. The flow direction is demonstrated by the arrows, whilst more detailed information on each area can be found in Appendix B.

Possible Causes

Rainfall/Antecedent Moisture Conditions	The rainfall data from the local EA observer recorded a daily figure of 91mm for the approximate period of 09:00 on 27th July 2014 – 09:00 on 28th July 2014. The closest Met Office weather station (located at Andrewsfield, approximately 7 miles south east) records the monthly rainfall average for July as 49.4mm, with a 20% probability that the monthly rainfall for July will exceed 70.2mm in any given year. Consequently it is clear that the daily rainfall total significantly exceeded even the upper end of the monthly rainfall totals estimated by the Met Office. The Hyrad data provided by the Environment Agency, which is collected from Met Office radar rain rate product, recorded far higher readings. The overall rainfall for the storm 01:00-05:30 (GMT) was recorded as approximately 207mm, which is in excess of 4 times the average monthly rainfall. Given the discrepancy between the two datasets it is difficult to speculate as to the most accurate figure but even if the more conservative data is used it is clear how exceptional the event was. The Hyrad data means that the period of the storm and the times of highest intensity can be more accurately understood. The data shows that only minimal rainfall was recorded until approximately 01:00 (GMT) and the vast majority of the rainfall fell in the period between 01:00-02:30 (GMT), although intermittent light rainfall was recorded in the hours shortly after this. This corresponds with the data recorded at the nearest EA High Resolution rain gauge in Great Sampford (approximately 3.5 miles north east of Thaxted), which recorded lower but still significant rainfall throughout the same period of time. Even if the lower value from the EA observer is judged to be more accurate, based on the storm profile established from the Hyrad and Great Sampford datasets it is very likely that a high proportion of the 91mm recorded fell within the period between 01:00-02:30 (GMT). It is reasonable therefore to assume that approximately 1-2 times the average monthly rainfall for July fell within 90 minutes, which constitutes an exceptionally extreme rainfall event. Due to the uncertainties in the data it is difficult to be precise about the probability of the storm but it is believed to have been in excess of a 1 in 400 year event (less than 0.25% chance of occurring any given year).
Highway/Surface Water Drainage System	Current design standards set out in the Sewers for Adoption guidance are for surface water sewers on new developments to be designed to carry rainfall from up to a 1 in 30 year event (3.3% probability of occurring any given year), plus an additional allowance for climate change. As such, with the magnitude of the rainfall experienced it is very unlikely that even new infrastructure would have been sufficient to prevent the scale of flooding which occurred on 28th July 2014. In addition to this a large amount of the drainage infrastructure in Thaxted pre-dates the introduction of design standards and it is very likely that this is of a lesser standard.

	There is currently no specific evidence of any one blockage or constriction being the primary cause of the flooding issues in Thaxted on 28th July. Subsequent investigations by Anglian Water have shown that several areas of the foul sewerage system were partially blocked during the flooding event due to foreign deposits being present such as fat, oil, grease and unflushable items. No blockages were found on the public surface water sewer system. Although the capacity of these sewers would have been far exceeded during this time, it is recommended that these sewers are cleaned and added to a planned preventative maintenance regime to ensure future operation and reduce the risk of flooding during non-extreme storm events.
Culvert Conditions	There are a number of private culvert sections throughout the town which may have contributed to the flooding on 28th July 2014. As shown in Figure 2, the town is situated on several natural drainage paths towards the River Chelmer and there is evidence that these previously open watercourses have been historically culverted to allow for development in several areas. Whilst some of the culverts are of a large diameter, the fact that these previously open watercourses have been culverted would restrict the capacity for flow and increase flood risk upstream. Covering an open watercourse also means that sustaining an adequate level of maintenance becomes problematic. Any necessary clearance or replacement of drainage infrastructure becomes a relatively specialist task and unless an inspection schedule is adhered to it can be difficult to recognise when maintenance is required until flooding occurs. There are several key locations where blockages in culverts would have caused issues, in particular in the section of culvert alongside Guelph's Lane, which takes a substantial amount of water from the upstream watercourse. Whilst the sewer discharging into the open watercourse upstream is shown to be 600mm diameter on Figure B1 in Appendix B, the inlet of the culvert on Guelph's lane is estimated to be approximately 225-300mm in diameter. As such this would cause a substantial constriction on the system, and is particularly important that it is kept clear and free running. It is therefore recommended that a CCTV survey be undertaken to establish the condition, route and capacity of the culvert with a view to considering any options for improvement/maintenance accordingly.
Open Watercourse Conditions	During initial inspection a number of sections of open watercourse were found to be in relatively poor condition, with overgrown vegetation, leaf litter and substantial levels of silt reducing the capacity of the watercourse running alongside Guelph's Lane to the north end of the town. During subsequent inspection the other major watercourse sections were found to be in reasonable condition and since the initial inspection the north section of watercourse has been cleared (Figure C2, Appendix C), although there is evidence of significant volumes of silt entering the watercourse (shown in Figure C3, Appendix C) which has the potential to cause problems if not properly controlled.

System at Capacity	Whilst it is evident that the open watercourse section in the north of the town was overgrown at the time of flooding in July 2014, it is not clear whether the rest of the system was free from blockages and able to operate at capacity. However, given the magnitude of rainfall involved in this event, it is exceptionally unlikely that even an entirely clear and fully operational system would have been able to reach the discharge rates necessary to drain the area and prevent flooding.

Responsibilities and Recommendations

Lead Local Flood Authority (ECC)	• To ensure that the owners of land on which a culvert, watercourse or drainage system is present are aware of their responsibility to keep the feature clear and functioning effectively. Consider using enforcement powers under Section 25 of the Land Drainage Act 1991 if necessary • Facilitate sharing of information and collaboration between RMAs and the local community. • Record and inspect any significant drainage features identified on the site as part of the Flood Risk Asset Register required under Section 21 of the Flood and Water Management Act 2010. • With the assistance of Essex Highways, undertake further investigation as to the route and condition of the culvert running alongside Guelph's Lane. • Consider undertaking further study into mitigation options, including potential attenuation on the public land to the west of Guelph's Lane and north of Bardfield Road. • Examine potential sources of funding and partnership working to reduce flood risk in Thaxted.
Essex Highways	• Consider use of powers under Section 100 of The Highways Act 1980 to prevent surface water flowing onto the public highway and/or to properly drain the highway. • Continue to work in partnership with other RMAs, providing information and comments and funding when appropriate and to support hydraulic modelling work, the recommendations of which should address/consider the flood risk on the public highway. • Inspect and clear highway drainage in the area on a regular basis to reduce flood risk. • Consider improvements to the highway drainage system, either by installing additional drainage infrastructure or improving the capacity of existing infrastructure.
Anglian Water	• Check and clear the adopted sections of sewer where necessary and where appropriate add to a planned preventative maintenance regime. • Provide information on the capacity of the main sewer in the area to the LLFA. • Work with ECC on schemes to reduce the pressure on AW surface water sewers where applicable.
Uttlesford District Council	• Support LLFA in raising awareness of riparian landowner responsibilities. • Continue to share information held on drainage layouts with all RMAs.
Riparian Landowners	• Ensure that watercourses or culverts on, or adjacent to, their land are kept clear and free flowing. • Provide information to the ECC on surface water drainage systems which may contribute to/from the infrastructure identified in this report.
Residents/Business Owners	• Take measures to protect themselves and their property when flooding is imminent. • Document and photograph flood incidents where possible, report flooding to ECC.

Conclusion

We have investigated which Risk Management Authorities have relevant Flood Risk Management Functions in accordance with the FWMA as part of this study. Those RMAs and relevant functions are referenced above within the recommendations section.

It is the conclusion of this report that the flooding which occurred on 28th July 2014 in Thaxted was due to the exceptional volume and intensity of rainfall experienced, combined with the location of the town on a natural drainage path and the historic culverting of open watercourses.

As referenced previously in the assessment of the possible causes, the rainfall is recorded to have been the equivalent of 1-2 times the average monthly total for July and is estimated to have fallen within approximately 90 minutes. Whilst there is a discrepancy between the datasets, even with the more conservative reading the rainfall volume is extremely high and the return period for an event of that magnitude is likely to exceed 1 in 400 years (0.25% chance occurring any given year). The design standard of sewers for new development would not have been sufficient to prevent flooding in such an event, and given that large parts of the drainage system in Thaxted pre-date the introduction of these standards it is very likely that they are of a lesser capacity and therefore would have been even less capable of coping with the rainfall.

The current condition and capacity of the drainage system, particularly the sections of culvert which are privately owned, is relatively unknown. Whilst it is unlikely given the volume of rainfall that a blockage or constriction in any one section of culvert was the primary factor in this flood event, if investigation determines that any such problems exist they could be exacerbating the flood risk in the local area. As such, it is recommended that further investigation is undertaken, in particular an assessment of the condition, route and capacity of the culvert shown as unknown in Figure 4 and Figure B1 (Appendix B).

Whilst the rainfall on this event was exceptional, it is clear from the evidence presented that the area does exhibit a significant level of residual flood risk. As is demonstrated in Figure 2, three separate flow paths which carry water from a large catchment area converge in the centre of the town in a system which has experienced widespread culverting to allow for development and road building. The volume of water draining through the town is substantial and is indicated by the presence of a large diameter culvert (estimated to be 1470mm) through the centre of the town. Whilst this culvert is very large the culverting of watercourses commonly causes a loss of capacity and increases the likelihood of blockages occurring. Therefore the presence of a culvert is more likely to create a constriction on flow and cause flow to back up in open sections, increasing flood risk. As such, many areas in the town are predicted to be at risk of surface water flooding in a 1 in 30 year flood event (3.3% chance of occurring each given year), with flood depth exceeding 900mm in some locations.

The town is effectively divided into three separate catchments by the topography, with two smaller catchments to the north and south east, and a large channel draining a wider catchment to the east. This means that any alleviation options that involve upstream attenuation would only address the flood risk in the local area and not throughout the town. That said if the downstream capacity is increased so as to effect more rapid passage of flow through the system this could potentially cause problems further downstream. It is therefore recommended that any options which are identified in further study are modelled to establish their overall impact and feasibility.

These conclusions are based on the information available at the time of investigation and may be subject to change as a result of further study or works.

Acronyms

AW	Anglian Water
EA	Environment Agency
ECC	Essex County Council
EH	Essex Highways
FIR	Flood Investigation Report
FW	Foul Water
FWMA	Flood and Water Management Act 2010
LDA	Land Drainage Act
LLFA	Lead Local Flood Authority
LHA	Local Highway Authority
RMA	Risk Management Authority
SW	Surface Water
UDC	Uttlesford District Council
uFMfSW	updated Flood Map for Surface Water

Glossary of Terms

Term	Definition
Culvert	Covered channel/pipeline
Main River	All watercourses shown as such on the statutory main river maps held by the Agency and DEFRA or Welsh Office, as appropriate.
Ordinary Watercourse	All rivers, streams, ditches, drains, cuts, dykes, sluices, sewers (other than public sewers) and other passages through which water flows that are not designated as main rivers.
Surface Water	Rainwater which is on the surface of the ground (whether or not it is moving), and has not entered a watercourse, drainage system or public sewer.

Useful Contacts and Links

Essex County Council

Highways Incident Line	0845 603 7631 (24hrs)
Flood Investigation Engineer	01245 430430 (Mon-Fri, 9am - 5pm)

All calls may be charged

Legislation

Highways Act 1980: http://www.legislation.gov.uk/ukpga/1980/66/contents
Water Resources Act 1991: http://www.legislation.gov.uk/ukpga/1991/57/contents
Land Drainage Act 1991: http://www.legislation.gov.uk/ukpga/1991/59/contents

EA - 'Living on the Edge' a guide to the rights and responsibilities of riverside occupation:
http://www.environment-agency.gov.uk/homeandleisure/floods/31626.aspx

EA - Prepare your Property for Flooding: Reducing flood damage; flood protection products and services
http://www.environment-agency.gov.uk/homeandleisure/floods/31644.aspx

ECC – Flood and Water Management in Essex:
http://www.essex.gov.uk/flooding

National Flood Forum – Blue Pages: Advice and contacts for flood protection products
http://www.bluepages.org.uk/

Six Steps to Flood Resilience: Step-by-step guidance and advice for property owners interested in Property Level Protection
http://www.smartfloodprotection.com

Appendix A – Photos from 28th July 2014

Figure A1 (Above) – Flooding in Thaxted on 28th July 2014 (Stephen Huntley, 2014)

Figure A2 – Damage caused by flooding to Bolford Street (Vikki Lince, 2014).

Appendix B – Detailed drainage network diagrams

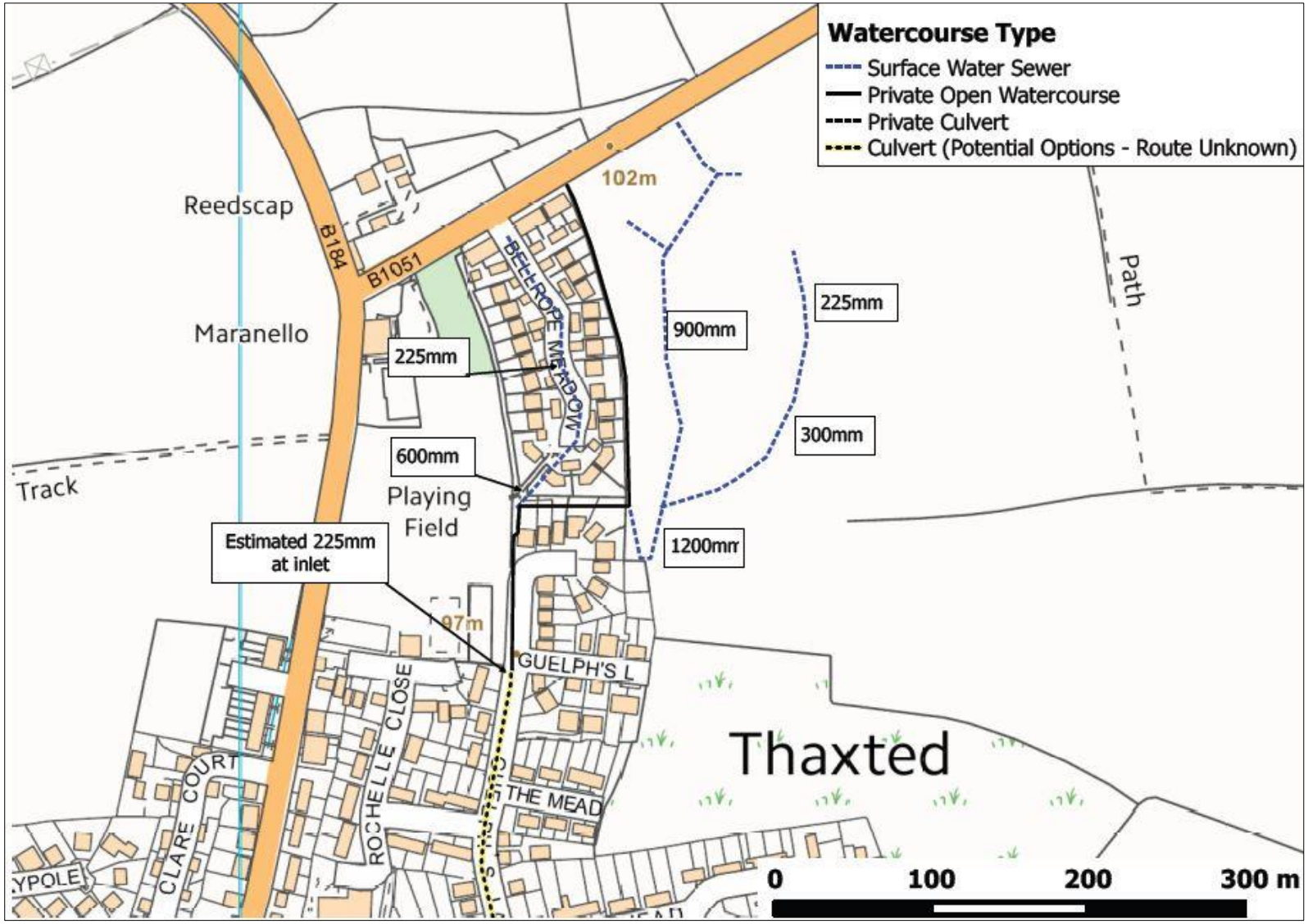

Figure B1 – North Thaxted Drainage Network. Data from digdat.co.uk, site observations and estimated culvert routes based on natural drainage paths (Pipe diameter indicated where available).

Base Map: Ordnance Survey, 2014.

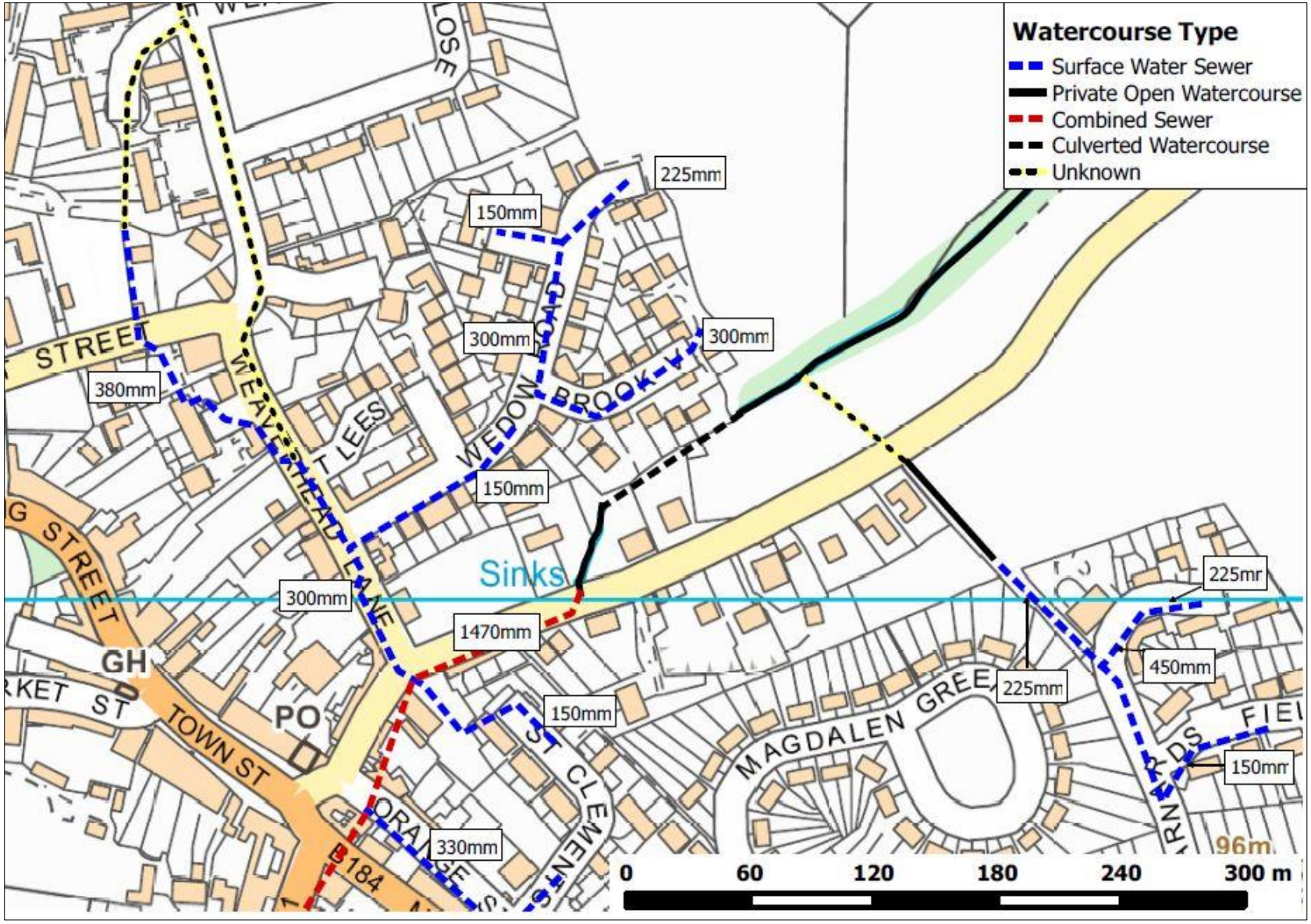

Figure B2 – Central Thaxted Drainage Network. Data from digdat.co.uk, site observations and estimated culvert routes based on natural drainage paths (Pipe diameter indicated where available).

Base Map: Ordnance Survey, 2014.

Appendix C – Site Investigation Photos

Figure C1 – Culvert inlet on Guelph's Lane (from north)

Figure C2 – Culvert inlet on Guelph's Lane (from south)

Figure C3 – Watercourse south of Bellrope Meadows