



## **Messing Flood Study Report**



Rev B  
January 2015

LEFT BLANK FOR DOUBLE-SIDED PRINTING

**Document control sheet**

**BPP 04 F8**

**version 16 Oct 2013**

<b>Project:</b>	<b>Messing Flood Study</b>		
<b>Client:</b>	<b>Essex CC Highways</b>	<b>Project Number:</b>	<b>B3553J00 Task 5</b>
<b>Document Title:</b>	<b>Flood Study Report</b>		
<b>Ref. No:</b>			

	<b>Originated by</b>	<b>Checked by</b>	<b>Reviewed by</b>
<b>REVISION</b>	NAME	NAME	NAME
<b>A</b>	<b>R Horlor</b>	<b>R Farrar</b>	<b>M Symons</b>
<b>Approved by</b>	NAME	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I <b>approve them for issue</b>	INITIALS
	<b>R Collins</b>		
DATE	<b>14/10/14</b>	<b>Document status – For Comment</b>	

<b>REVISION</b>	NAME	NAME	NAME
<b>B</b>	<b>R Horlor</b>	<b>R Farrar</b>	<b>M Symons</b>
<b>Approved by</b>	NAME	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I <b>approve them for issue</b>	INITIALS
	<b>R Collins</b>		
DATE	<b>13/01/14</b>	<b>Document status – For Comment</b>	

**Jacobs U.K. Limited**

This document has been prepared by a division, subsidiary or affiliate of Jacobs U.K. Limited ("Jacobs") in its professional capacity as consultants in accordance with the terms and conditions of Jacobs' contract with the commissioning party (the "Client"). Regard should be had to those terms and conditions when considering and/or placing any reliance on this document. No part of this document may be copied or reproduced by any means without prior written permission from Jacobs. If you have received this document in error, please destroy all copies in your possession or control and notify Jacobs.

Any advice, opinions, or recommendations within this document (a) should be read and relied upon only in the context of the document as a whole; (b) do not, in any way, purport to include any manner of legal advice or opinion; (c) are based upon the information made available to Jacobs at the date of this document and on current UK standards, codes, technology and construction practices as at the date of this document. It should be noted and it is expressly stated that no independent verification of any of the documents or information supplied to Jacobs has been made. No liability is accepted by Jacobs for any use of this document, other than for the purposes for which it was originally prepared and provided. Following final delivery of this document to the Client, Jacobs will have no further obligations or duty to advise the Client on any matters, including development affecting the information or advice provided in this document.

This document has been prepared for the exclusive use of the Client and unless otherwise agreed in writing by Jacobs, no other party may use, make use of or rely on the contents of this document. Should the Client wish to release this document to a third party, Jacobs may, at its discretion, agree to such release provided that (a) Jacobs' written agreement is obtained prior to such release; and (b) by release of the document to the third party, that third party does not acquire any rights, contractual or otherwise, whatsoever against Jacobs and Jacobs, accordingly, assume no duties, liabilities or obligations to that third party; and (c) Jacobs accepts no responsibility for any loss or damage incurred by the Client or for any conflict of Jacobs' interests arising out of the Client's release of this document to the third party.

## Contents

<b>1</b>	<b>Introduction</b>	<b>5</b>
1.1	Background	5
1.2	Site Visits and Drainage surveys	6
1.3	Flood Study Approach	6
1.4	Photos of Site Features	7
<b>2</b>	<b>Option Development - Measures to Reduce Flood Risk</b>	<b>11</b>
2.1	Overview of drainage issues	11
2.2	Preliminary Measures and Option Assessment	12
2.3	Measures Development	13
<b>3</b>	<b>Feasibility of Measures</b>	<b>21</b>
3.1	Option Analysis	21
3.2	Location 1 - Village Hall Catchment	21
3.3	Location 2 – Messing Green	22
3.4	Location 3 – Field Ditches	23
<b>4</b>	<b>Option Selection</b>	<b>27</b>
4.1	Options - the Basket of Measures	27
4.2	Option Appraisal	27
4.3	Preferred Option	27
<b>5</b>	<b>Conclusion and Recommendation</b>	<b>33</b>
5.1	Conclusion	33
5.2	Recommendation	33

## Appendices

Appendix A	Survey Scope Results
Appendix B	Topographic Survey
Appendix C	Preliminary Options Assessment
Appendix D	Calculation Report
Appendix E	Messing Green Cross-sections

# 1 Introduction

## 1.1 Background

A plan with general layout of the site is provided in Figure 1.

The site is the village of Messing in Essex, centred on the Village Hall in ‘The Street’ (NGR TL896 189). The existing highway drainage runs down the hill, within surface water sewers, from School Road along The Street and discharges into a culvert at the junction with Harborough Hall Road. The highway drainage system receives flows from The Street and School Road, which is on a long steep hill, new properties near Messing Green and from ditches/ponds near Bouchiers Hall.

Newer properties on School Road, to the south of Messing Green, appear to have been designed with drainage based on infiltration using block-paving which then drains to the Anglian Water surface water system, however, runoff is essentially direct to the surface-water drainage network as infiltration is minimal. The drainage pipe run adjacent to the Green has been upgraded to 225mm diameter along School Road but as this reduces back to 150mm (6”) downstream at the Village Hall (Old School House), which is also the location of a depression in the ground, exceedance of the drainage system is expected to occur at this location.

There is a history of flooding at this site and surface water regularly floods Messing Village Hall internally following heavy rainfall. Various remedial works have been carried out by the Parish Council and Essex Highways to try and alleviate the problem, but flooding persists. Further residential property is reported to have been affected in The Street.



Messing Village Hall depression flooded 17 January 2014

Jacobs has been appointed by Essex County Council (ECC) to investigate and assess the flood risk at this site.

## 1.2 Site Visits and Drainage surveys

In December 2013 John Everitt (Jacobs), Rob Lee (Essex CC) and Richard Horlor (Jacobs) visited the site for a walkover survey of the Messing drainage system and lifted several covers to confirm the operation of the drainage system. Further visits were undertaken.

A detailed topographical survey was undertaken by Atkins in March 2014 to determine property threshold levels, confirm the surface water pipe invert levels along the drainage runs in the Village and establish the drainage route along Lodge Road, however the latter was not fully achieved. The survey results are included in Appendix A.

During subsequent visits, various measures were developed to address the direct flood risk to the village hall and the wider risk to the village as a whole.

It was within Jacobs' original scope to undertake hydrological and hydraulic modelling of the Village drainage but as this would be relatively complex and as the drainage in Lodge Road, which determines the downstream control, is still uncertain, in agreement with ECC, the project decided to focus on investigating measures which could alleviate much of the problem without the need for a full mathematical model.

## 1.3 Flood Study Approach

As a result of the uncertainty regarding the drainage system and the analysis of the available site, topographic and anecdotal evidence, the following study scope was agreed with ECC following initial discussions:

1. Visit site and make preliminary assessment of Messing village drainage system (carried out in Dec 2013);
2. Undertake a topographic survey of the surface water system (carried out March 2014);
3. Develop outline options to alleviate the immediate problem at the Village Hall (Old School House) and the wider issues in the Village particularly at Messing Green;
4. Consult with the Parish Council, ECC Highways and Landowners to gauge their views on potential mitigation measures.

**1.4 Photos of Site Features**

<p>Messing Village Hall depression</p>	<p>Messing Village Hall gate</p>
<p>Gully at Village Hall entrance</p>	<p>Village Hall's Garden depression site of tank</p>
<p>School Road looking south (uphill)</p>	<p>Messing Green potential SuDS site</p>
<p>Maker Cottage, Lodge Road – view along the line of drainage pipe</p>	<p>Maker Cottage, Lodge Road – drainage pipe 350mm max</p>

LEFT BLANK FOR DOUBLE-SIDED PRINTING

Figure 1 - Flood Study Area- Preliminary Findings

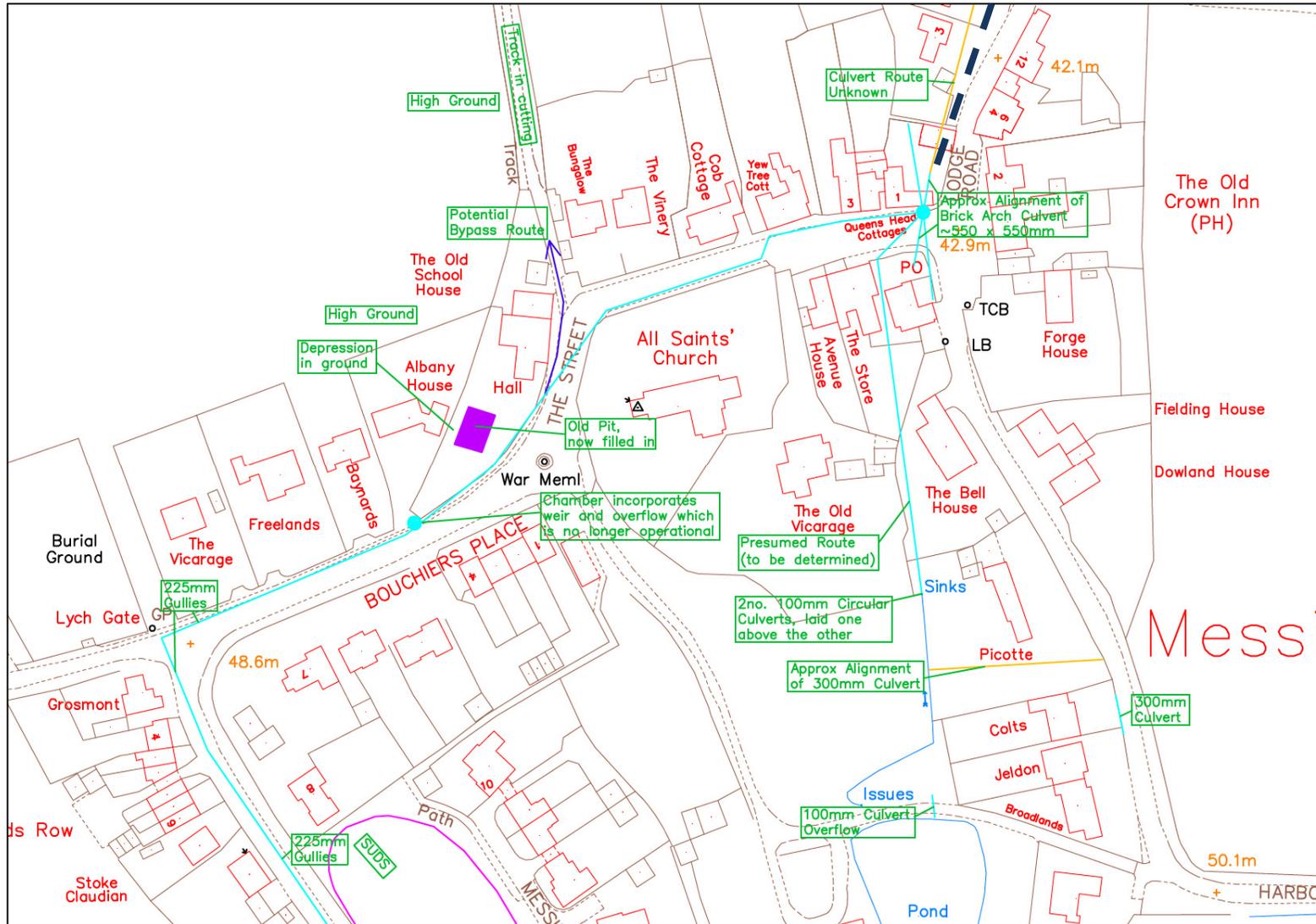
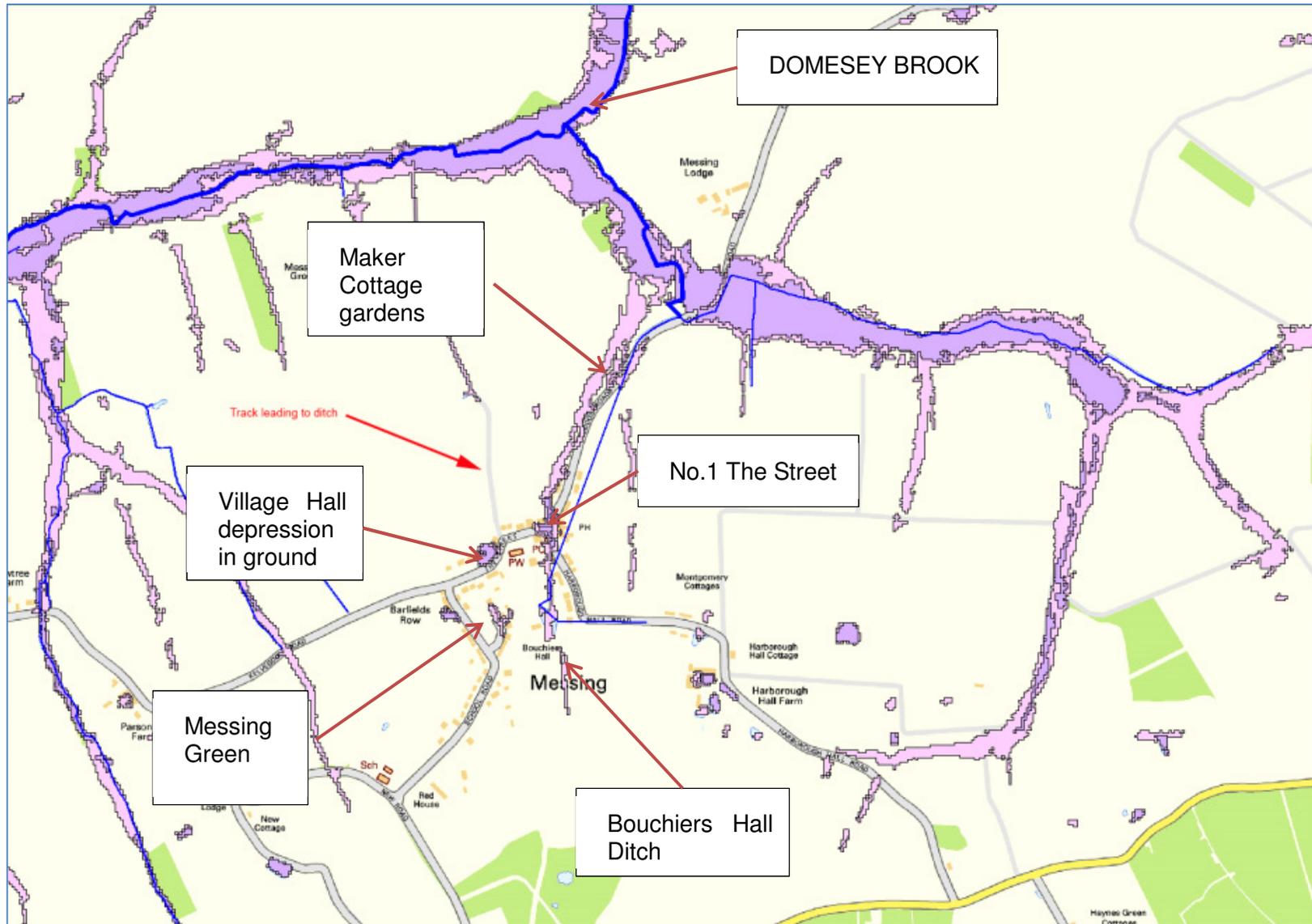


Figure 2 - Surface Water Flood Risk



## 2 Option Development - Measures to Reduce Flood Risk

### 2.1 Overview of drainage issues

An initial analysis of the drainage issues informed the scope of the topographic survey, which is included in Appendix B. An analysis of the topography and the drainage system within the Village indicated the following sub-catchments for which flood risk measures could be applied as necessary:

#### 2.1.1 School Road to Kelvedon Road (Messing Green)

This catchment commences at Messing Primary School at the top of the hill, with water entering the surface water drainage system (150mm diameter at this point) via gullies in School Road, the drainage system increases to 225mm diameter pipes adjacent to Messing Green and then enters Kelvedon Road toward The Street. When the drainage system is overwhelmed; flood water in School Road will follow the topography and flow on the surface of the road toward the Village Hall.

Flow from the Messing Green development will drain to Bouchiers Hall track, where it enters a 225mm diameter pipe and flows towards the Village Hall. This pipe connects into the surface water drainage system in The Street, close to the Village Hall, exacerbating the flooding problem in this area. The older drainage in the area is in pipes and open ditch down to the Bouchiers Hall ditch. No property flooding is recorded due to steep gradients but the runoff from this catchment impacts on The Street.

#### 2.1.2 To the West of School Road

Runoff from the northern side of the hill drains across fields toward Messing Green. Most of the original field ditches have been encroached upon by properties in School Road resulting in poor field drainage. Rather than water draining to the north, as the original drainage had within the ditches, the short length of remaining ditch is connected to the surface water network draining to School Road, close to Messing Green; this increases the volume of water in the system at this point and in turn increases flood risk in this area.

#### 2.1.3 The Street to Lodge Road

This catchment commences in 225mm diameter pipes at the junction of Kelvedon Road and School Road but the diameter reduces to 150mm at the overflow chamber just upstream of the Village Hall Garden. When the 150mm drainage system surcharges, it backs up the gully outside the Village Hall entrance, flooding the depression in the road and the Hall itself. Eventually as the level rises, flood water spills over the crest of the hill by All Saints' Church and down The Street to Lodge Road.

#### 2.1.4 Bouchiers Hall

This catchment commences in fields to the south of the village and includes drainage from Harborough Hall Road. Some of the field drainage is attenuated in Bouchiers pond, with the whole sub-catchment being attenuated by two 100mm diameter pipes which flow under the Old Post Office (on the corner of The Street and Harborough Hall Road). No flooding occurs upstream in the ditch or Harborough Hall Road so no measures are required. This area acts as natural storage so provides a benefit to the Village.

#### 2.1.5 Lodge Road to the Sewage Treatment Works

This catchment begins at the confluence of the drainage network from The Street and Bouchiers Hall at No. 1 The Street opposite the Old Crown Pub. Here the drainage network consists of a 450x450mm brick culvert but survey was unable to confirm the

route to the Treatment Works. The drainage may cross the road or continue under a series of properties, including Maker Cottage, where there is a manhole, but the pipe is much too small and near the surface here to convey flow from The Street's culvert.

Part of the catchment flows from The Bungalow near the Village Hall towards the northeast, behind properties on Lodge Road where there is a significant roadside ditch that is now blinded. Drainage continues on the old valley through the backs of gardens including Maker Cottage. These gardens were extended into the field so that the old field ditch has infilled thus the gardens flood instead. No flooding over property threshold has been reported to date.

## **2.2 Preliminary Measures and Option Assessment**

A preliminary assessment of measures and options is tabulated at Appendix C and includes the opportunities and constraints identified. A summary of the measures with a brief description is included below:

1. Increase pipe capacity in The Street and Lodge Road:
  - a. Increase capacity of the 150mm pipe in the Street from the Village Hall to Lodge Road;
  - b. Construct a new culvert in Lodge Road to provide the additional capacity to the 450x450mm brick culvert until it can enter ditch system. The culvert could be located to the west of the existing ditch and extend the ditch behind Josslyns, Maker Cottage and Jode, to swales beyond Pump House.
2. Messing Green SuDS Attenuation
  - a. Above-ground storage over most of the Green up to approximately 0.5m deep by cut and fill work across 1.5m slope, with a bund on the lower slope maximum 1m high with shallow 1 in 3 slopes;
  - b. Below-ground storm crate type cellular storage system, raising ground level above by a maximum of 1m.
3. Village Hall Exceedance Measures
  - a. Drain the exceedance flow which occurs by the Village Hall in a pipe and possibly surface gully to a soakaway in the verge 15m along the adjacent farm track;
  - b. Drain The Street into an enlarged attenuation tank/soakaway in the Village Hall Garden.
4. School Road sewer exceedance
  - a. Drain the 225mm surface water sewer in School Road into an easement between the Vicarage and Cemetery in a french drain and swale as ground slopes away. Kelvedon Road may need profiling to direct flows across the road. A control would be needed on the pipeline to divert flows.
5. Sherwood Field Ditches and Habitat Creation - Kelvedon Road, The Street and Lodge Road
  - a. Reinstate and extend ditches in the field to the west of School Road. Approximately 230m of ditch excavation is required and a pipe crossing under Kelvedon Road to connect to a ditch/swale in the fields to the north.
  - b. Create a surface water swale and ditch approximately 150m long to drain surface water from School Road at Kelvedon Road into the cemetery easement away from The Street. The ditch would continue

behind properties including the Old School House/Village Hall. The ditch can terminate in a pond with an overflow to the soakaway (Option 1b) or a field ditch could extend in the field boundary above the track some 400m northward to an existing pond.

- c. Create a field ditch connecting two existing ditches in Lodge Road to intercept and convey surface water around Josslyns, Maker Cottage, Jode and the Pump House works.
- d. The ditch excavation may be approached in two ways: one by conventional excavation with an excavator with soil arising transported and spread on the fields or two; by a rotary ditcher available through the RSPB. The rotary ditcher spreads spoil as a spray as it excavates distributing soil more evenly. However, this machine is only available for use if habitat is created that is positive to species identified in the UK Biodiversity Action Plan (UKBAP) species and Habitats. One of the species specifically mentioned is Water Voles so that the ditches could be designed to retain water in places as ponds as well as drainage. Provided that the landowner agreed to the habitat creation, the cost saving using the ditcher can be significant. Other species could be selected. The full UKBAP list may be found at <http://jncc.defra.gov.uk/page-5717>.

All of these measures were carried forward for detailed assessment except for no. 1: increase pipe capacity. This option was discounted because it could move the problem on downstream. It is a general departure from sustainable practice to effectively move the problem on downstream unless one can be assured that there is no increase to flood risk to others. Any increase of capacity in The Street would increase flood risk to the Lodge Road junction. The drainage in Lodge Road is not well enough understood to allow this and would require new culverts for the length of Lodge Road to the Sewer Treatment Works and some attenuation storage prior to discharge into Domsey Brook.

The focus of measures development would be on control as close to the source as practicable and utilising land within the Parish Council control first and then ECC Highways second. Flood water would be stored first and diverted second where feasible.

### **2.3 Measures Development**

Measures are the individual components of an overall Option which may consist of one or more measures in combination. The development of measures is concentrated on two principle storage solutions:

- 1. Messing Green – to attenuate exceedance in School Road
- 2. Village Hall Garden – to attenuate runoff from Kelvedon Road which would exceed the 150mm pipe capacity even if Messing Green Storage were in place.

In addition to storage, exceedance measures are also required at the cemetery and the Village Hall. Field drainage was also considered to the west of School Road.

The short list of measures are listed in Table 1.

**Table 1 – Short list of Measures**

Location	Measure	Description
1 – The Street	1a – Village Hall Attenuation	Water to be diverted into an infiltration trench in Village Hall’s garden
	1b – Exceedance Drainage to Track	Drains the depression by the Village Hall to the track and has flood door on the Hall
2 – School Road	2a – Messing Green FSA	Compensates for the un-attenuated historic development in School Road using the Green as a flood storage area
	2b – Cemetery Path Infiltration Trench	Directs School Road exceedance across Kelvedon Road into a soakaway swale on unused ground between the Vicarage and Cemetery. The exceedance flow is re-directed via a pipe and using a speed bump in Kelvedon Road to direct overland flow.
3 – Sherwood field ditches	3a – School Road Ditch	Restore field ditches around the field perimeter and drain across Kelvedon Road into the existing field ditches to the north
	3b – Cemetery Easement and Ditch	Same principle as 2b but with a ditch and no soakaway in the easement. This ditch will continue eastwards, along the field boundary to the north of the easement and connect to 1b at the track or be extended 400m northward as a simple boundary ditch to an existing pond.
	3c – Maker Cottage Ditch	This measure reinstates field ditches around several properties on Lodge Road to drain via a wetland to Domsey Brook

Following consultation the Parish Council had reservations about Measure 2a on Messing Green due to concerns about blighting the amenity. Following consultation with the principle landowner, Mr David Sherwood a shift in emphasis away from Parish-only assets became possible. Mr Sherwood is open to considering the use of his field drainage to convey water around the properties. To this end Measures 3b and 3c were added.

Messing Green attenuation (Measure 2a) was designed to store exceedance up to 3.33% (1 in 30) AEP<sup>1</sup> event with an allowance for climate change, with exceedance directed to an infiltration swale in the cemetery easement (Measure 2b); the aim being to prevent exceedance flow progressing into either The Street or onto Sherwood land to the north of The Street, particularly where there are no ditches. If Mr Sherwood accepts the flood flow, as an alternative measure new field ditches will

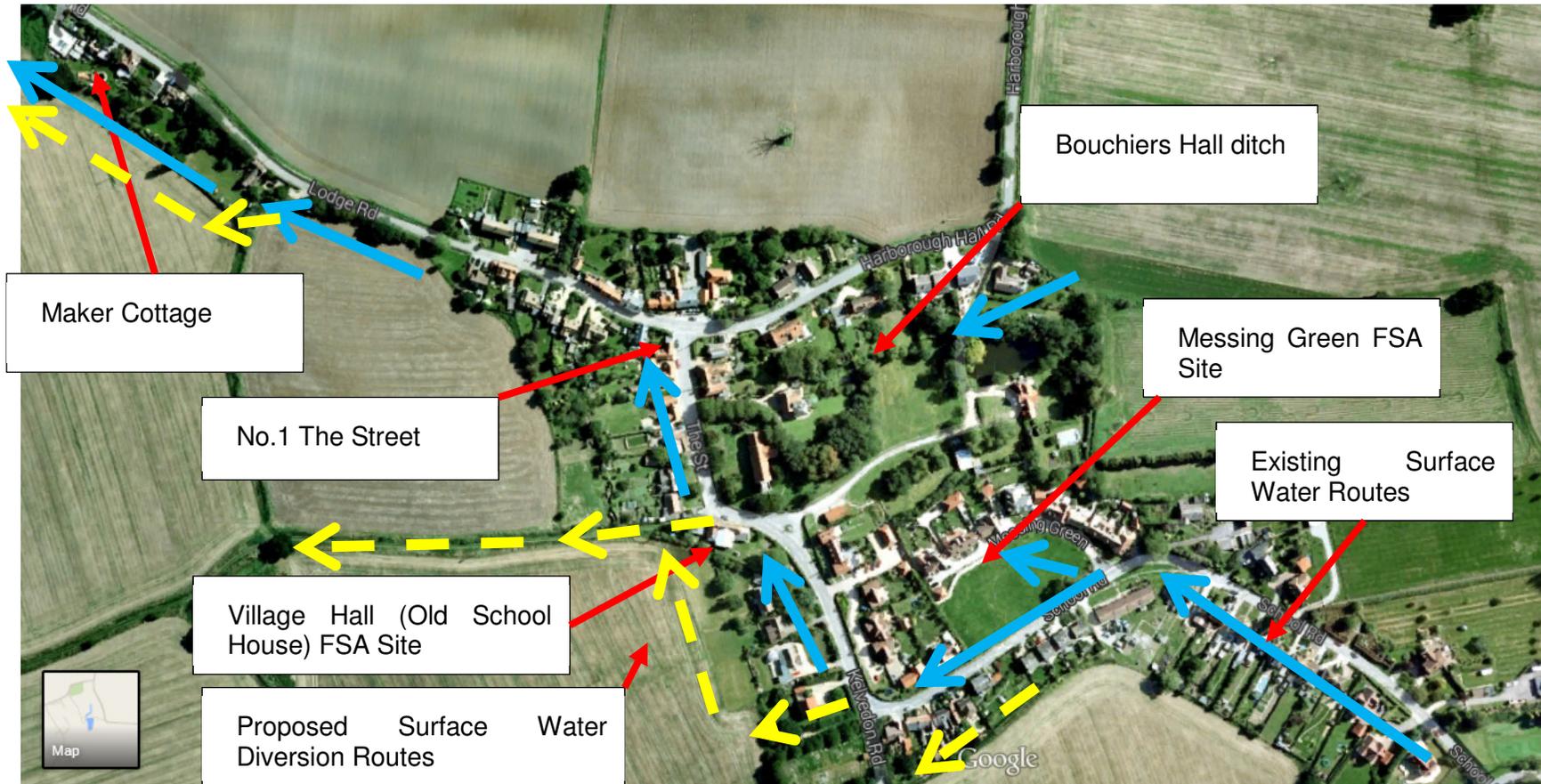
<sup>1</sup> Annual Exceedance Probability (AEP) is the probability of an event occurring in any given year, i.e. 3.33% is the equivalent of 1 in 30 probability of flooding in a year.

receive and carry flow around the back of properties (Measure 3b) behind the Vicarage and Village Hall to the track where a new ditch has already been constructed. Measure 3c will convey flow behind Maker Cottage.

Exceedance measure 3b will be similar to 2b in directing surface water below and, in extremis, on the surface, across Kelvedon Road to a ditch connecting to a new field ditch. A speed bump will keep water on the crest of the hill. Measure 3 ditches would have built-in silt-traps and attenuation so as not to increase flood flow to Domsey Brook above the Greenfield runoff rate. If the Rotary Ditcher is used, permanent wetland/ponds will be created at a number of points along the line of the ditch. These may take the form of over-deepening the ditch below the grade line to retain a minimum of 300mm of water. Details would be agreed with ECC Conservation officer and the RSPB. The plan of existing and proposed surface water flow routes is shown at Figure 3. The plans of the short-listed measures are included in Figure 4 and Figure 5.

LEFT BLANK FOR DOUBLE-SIDED PRINTING

Figure 3 – Messing Surface Water Existing and Proposed Routes



LEFT BLANK FOR DOUBLE-SIDED PRINTING





## 3 Feasibility of Measures

### 3.1 Option Analysis

The feasibility of measures was determined using simple hydrological calculations to determine the volume of rainfall runoff expected within each sub-catchment for a range of storm events. This enabled the determination of the capacity of the existing drainage network and the design of potential storage, infiltration and conveyance swales and ditches.

The Calculation Report is included in Appendix D, which details the hydrology for the design for the two principle storage areas - Measure 1a at the Village Hall and Measure 2a at Messing Green, exceedance at the Village Hall, Measure 1b and the infiltration trench, Measure 2b. The conveyance for the field ditches in Measure 3a, b and c are also included.

The calculations for the attenuation flood storage areas (FSAs) assume no infiltration as a Ground Investigation could not be carried out during this phase of the study. Consequently the volumes stored may be conservative as some infiltration should be achieved but the actual depth to permeable soils is uncertain.

### 3.2 Location 1 - Village Hall Catchment

#### *Excluding Messing Green and Bouchiers Hall)*

#### 3.2.1 Measures 1a and 1b

Calculations for just Kelvedon Road (not including flow from School Road) suggest that the drainage system will be at full capacity, with excess water above ground (i.e. flooding), for close to a day during a 3.33% (1 in 30) AEP year rainfall event (with allowance for climate change). This discounts any flow from Messing Green, Bouchiers Hall or the fields to the west of School Road. The exceedance from the drain floods the depression in the road outside the Village Hall as it cannot flow away over land due to the crest of the road between the Bungalow and the Church.

It is understood there was once an underground storage tank which has now been in-filled beneath the garden of the Village Hall. In the manhole at the southwest tip of the garden (at the end of Albany House's driveway) there is a side weir that once directed water from the drainage system into the storage tank; it is at this point that the drainage pipe decreases from 250mm diameter to 150mm. There have since been 2 small soakaway units installed within the Garden to receive drainage from the Acco drain at the gate to the Hall entrance and are located in the grass south of the Village Hall. The exact levels of these units are unknown, they are approximately 1.2 x 1.2m, it is not thought that these significantly reduce flooding.

An option has been developed involving two measures at the Village Hall which are a combination of: storage within the Village Hall's garden and draining water from the depression outside of the Hall gate and then diverting it down the track alongside the Village Hall and The Bungalow (where The Street bends 90 degrees).

#### 3.2.2 Measure 1a - Village Hall Attenuation

The existing weir that spills into the garden from the manhole in Albany House's driveway is set at 45.41mAOD. The elevation of the drainage system outside the Village Hall (at the northeast corner of the garden) is at 44.46mAOD, therefore this could provide a storage depth of 0.95m and it could be positively drained into the original system.

Two options were considered to provide storage in the garden: Aquavoid-ECO Storage blocks and 900mm diameter pipes in series. The key difference between the two options is the cost of the raw materials. The storm-crates being 15% more expensive than pipes (£78k as compared to £67k). Both measures require tree removal, play furniture removal and reinstatement and landscaping and both will have some surface ponding in the play area which will drain through sand.

### **3.2.3 Measure 1b – Exceedance Drainage to Track**

An additional measure to Measure 1a is the provision of a drain from the depression in The Street outside the Village Hall to permit water to flow down the track between the Village Hall and The Bungalow within a pipe and enter a new drainage ditch adjacent to the track.

Initially it had been proposed to construct a soakaway to receive this flood water but the landowner has constructed a drainage ditch within the track and has agreed to receive this flow. Consideration will be given to trapping silt and attenuation prior to floodwater arriving at the river approximately 800m away.

The low point in The Street is outside the entrance to the Village Hall at 45.34mAOD; the road elevation is 45.4mAOD at the bend in the road (with a maximum elevation prior to this of 45.45mAOD). It is expected that the drain would be a 300mm diameter pipe as it passes through the crest avoiding a BT cable; the location of the cable will be confirmed using service record drawings and trial pit survey as necessary.

The cost would be in the order of £28k.

If a combination of the options was implemented, with the whole of the garden utilised for storage and a 375mm diameter pipe or equivalent installed down the track to the ditch this should drain the area around the Village Hall, and can accommodate the 2% (1 in 50) AEP event, with larger events, flooding the adjacent track, which presently occurs during a flood event. Subject to survey, it is likely that only a 300mm diameter pipe and Acco drain equivalent will be installed and therefore in some intense rainfall events flooding may still occur. A flood door is recommended for the Village Hall to increase confidence.

The combined cost of measures at Location 1 would be in the order of £100k.

## **3.3 Location 2 – Messing Green**

### **3.3.1 Measure 2a – Messing Green – FSA**

Messing Green Flood Storage Area (FSA) would be designed to attenuate surface water draining down School Road to protect properties in Messing Green and Kelvedon Road/The Street.

The Messing Green catchment (to be managed on Messing Green) includes School Road and its housing, from the high point near Red House, to the southwest. Outline calculations, using design parameters result in a greater than 3.33% (1 in 30) AEP (with an allowance for climate change) standard of protection. This does not allow for infiltration and based on an assumption that 3.6l/s will outfall into the drainage network, either in School Road (which is likely to be surcharged purely from the Village Hall catchment) or into the local soakaways. Note this assumes all excavated material will be moved off site.

Cross-sections through these proposals are included at Appendix E.

### **3.3.2 Measure 2b - Cemetery Path – Infiltration Trench**

An infiltration trench is proposed for the strip of land between the Cemetery and the Vicarage. This will take excess flows from Messing Green FSA during an extreme event, with the runoff entering the small area to the northwest of Messing Green, on

the corner of School Road and Kelvedon Road covering 0.3ha. The intention for this measure was to accommodate exceedance from Messing Green Measure 2a without detriment to surrounding farm land i.e. keeping flow within the cemetery easement. However, subsequent consultation suggests that exceedance could be drained to drainage ditches in the field. See Measure 3b.

The cost for Measures 2a and 2b are £51k and £63k respectively totals £114k. The high cost for implementing measure 2b reflects the assumption that the easement is required for access to the field. If this can be constructed as an open ditch/infiltration swale without pipes then the cost significantly reduces by over £22k.

### **3.4 Location 3 – Field Ditches**

*(See Figure 6)*

#### **3.4.1 Measure 3a – School Road ditch**

Reinstates a field ditch lost to encroachment by gardens and improves field drainage.

#### **3.4.2 Measure 3b – Cemetery ditch**

Construct a field ditch to convey exceedance from School Road to an existing ditch. Silt traps and attenuation to be included prior to discharge to the Domsey Brook.

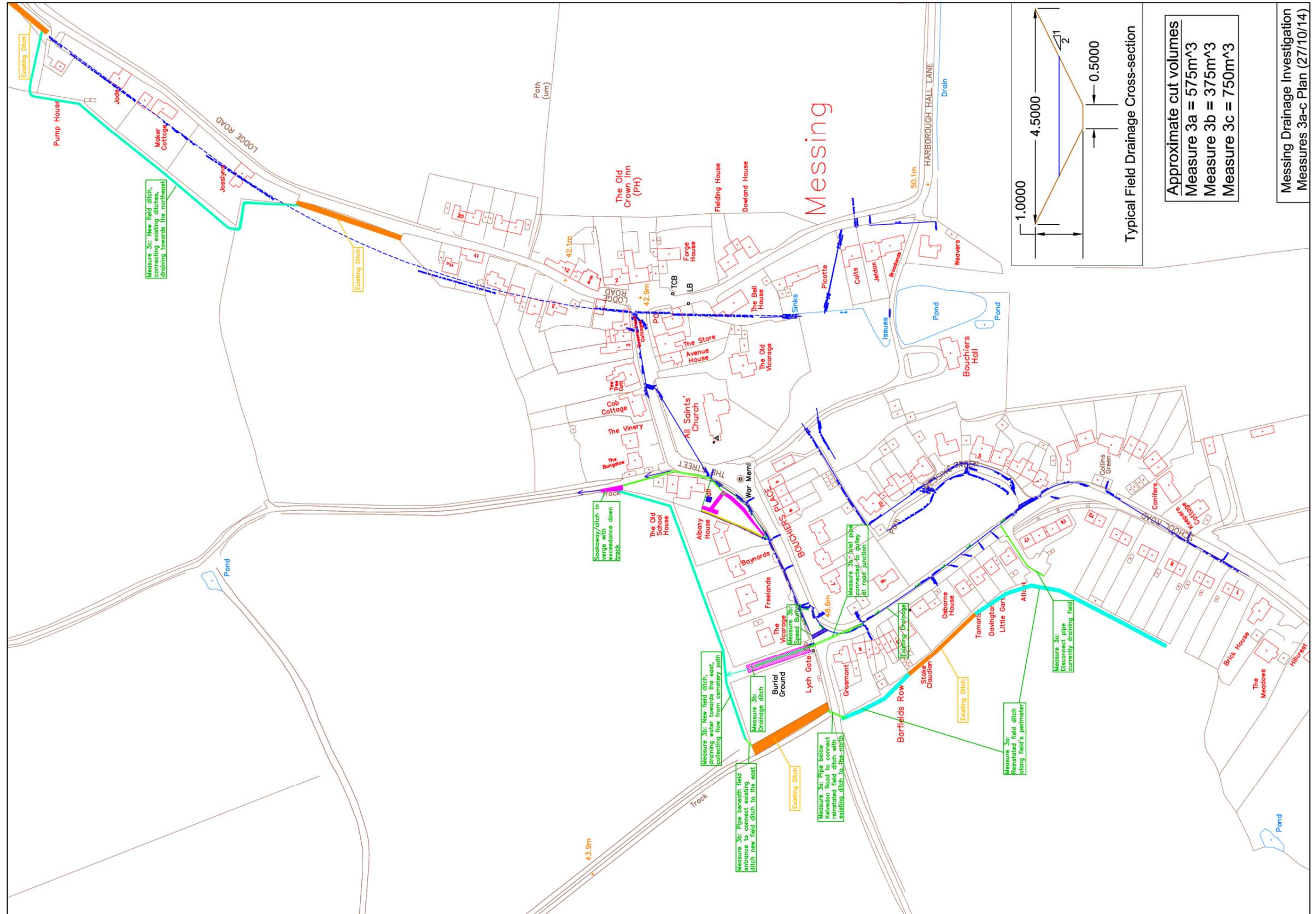
#### **3.4.3 Measure 3a – Maker Cottage ditch**

Reinstates a field ditch lost to encroachment by gardens and redirects flow around properties to a wetland. Silt traps and attenuation to be included prior to discharge to the Domsey Brook.

The cost for Measures 3a, 3b and 3c are £41k, £36k and £33k respectively totalling £110k. £41k of which is for disposal of soil arisings off-site. Should this be spread on adjacent fields by the landowner the cost would reduce to say £61k.

LEFT BLANK FOR DOUBLE-SIDED PRINTING

Figure 6 - Plan of Measures 3a-c



LEFT BLANK FOR DOUBLE-SIDED PRINTING

## 4 Option Selection

### 4.1 Options - the Basket of Measures

Options are derived by the selection of one or more measures.

Normally a full economic analysis would be carried out to determine the Benefit to Cost ratio of measures and options possibly with multi-criteria analysis. However, in order to do this one would need to ascertain the damages and losses to property over a range of probable storm events (known as benefits as the reduction in damage by a measure would be a benefit). This calculation would require more comprehensive mathematical modelling and, as stated before, uncertainty in the drainage system does not lend to this approach.

The measures identified are all feasible, but some provide more direct short-term benefit and others longer-term sustainable benefits. Measures 1a and 1b provide immediate benefit to the Village Hall but also will reduce flood risk in The Street by attenuating and diverting flow from the Kelvedon Road catchment. The properties most benefitting are the Village Hall and those around the lower Street namely around No.1 The Street, the Old Post Office and the Old Crown Pub. However, without Option 2a and 2b or 3a and 3b the School Road catchment will exceed the capacity of Measures 1a and 1b and increase risk to the lower Street area. So it can be seen that the measures are incremental and benefits increase when combined.

Table 2 and Table 3 summarise the costs of individual measures and the basket of measures as 6 options.

### 4.2 Option Appraisal

The options may be combined into a basket the measures to achieve short, long or combined benefits. One key driver for the project is to resolve flooding at the Village Hall and so Options 1 and 2 both include this as do 4 and 6. Measures 1a and 1b provide the best assurance and provide additional benefits to properties downstream in The Street by attenuating and diverting flood flow from the lower village.

The most sustainable option is Option 3 (and 4) with Measures 2a and 2b combined because they offer the maximum control at source and cater for exceedance of the FSA. However, the Parish Council is not supportive of Measure 2a Messing Green as there is concern that there may be loss of amenity but this option should only be discarded if Option 3a and 3b are included.

Option 5, the reinstatement of old and construction of new drainage ditches offers opportunities to manage exceedance more cost effectively but required the agreement and cooperation of the principle landowner. On their own they do not reduce flood risk to the Village so Option 5 should be discarded as a stand-alone option but are highly recommended within a basket of measures.

The two most comprehensive options providing maximum benefit are Option 4 and Option 6. If Option 4 is not supported then Option 6 should be pursued, ideally including Measures 3a and 3c but 3b is critical.

### 4.3 Preferred Option

The preferred option is Option 6 as it provides the greatest overall benefit to the whole village as well as providing short-term benefit to the Village Hall. If this can be achieved with the cooperation of the principle landowner; David Sherwood, and he

agrees to spread soil arising on his fields, (as much will be topsoil) then this cost reduces significantly. Also the rates assumed are for a Civils contractor and this also could be reduced if the landowner undertakes the ditch-work himself.

Uncertainty remains with regard to the road crossings should service diversions be required but again, efficiencies may be gained if Essex Highways lead and undertake the road works.

**Table 2 – Estimated Cost of Individual Measures**

Measures	Description	Cost estimate	Cost estimate (including 30% optimism bias)	Maintenance (per annum)	Maintenance Frequency	Maintenance cost over 60years
1A	Village Hall Attenuation/Infiltration Trench	£66,861	<b>£86,920</b>	£1,000	5yrs	<b>£12,000</b>
1B	Road drainage to field track ditch & flood door	£26,986	<b>£35,082</b>	£1,000	5yrs	<b>£12,000</b>
2A	Attenuation Pond on Messing Green (muck away all excess)	£50,452	<b>£65,587</b>	£5,000	5yrs	<b>£60,000</b>
2B	Infiltration Trench and Pipes in Cemetery Easement	£62,541	<b>£81,304</b>	£1,000	5yrs	<b>£12,000</b>
3A	Field Drainage Ditch	£41,256	<b>£53,633</b>	£1,000	5yrs	<b>£12,000</b>
3B	Field Drainage Ditch & road pipework	£36,142	<b>£46,984</b>	£2,000	5yrs	<b>£24,000</b>
3C	Field Drainage Ditch around 'The Maker'	£32,956	<b>£42,843</b>	£1,000	5yrs	<b>£12,000</b>
3A, B & C	With Rotary Ditcher 2500m3 at 200m3/hr including ponds and rhizome planting (allow 5 days with contingency @ £1500/day, + transport)	£15,000	<b>£19,500</b>	£4,000	5yrs	<b>£ 48,000</b>

LEFT BLANK FOR DOUBLE-SIDED PRINTING

**Table 3 - Costs of Measures and Options**

Options	Measures	Description	Capital Cost estimate	Capital Cost estimate (incl 30% optimism bias)	Maintenance Cost over (60 years)	Total
1	1A	Village Hall Attenuation/Infiltration Trench	£66,861	£86,920		
		<b>Total</b>	<b>£66,861</b>	<b>£86,920</b>	<b>£12,000</b>	
2	1A	Village Hall Attenuation/Infiltration Trench	£66,861	£86,920	£12,000	
	1B	Road drainage to field track ditch & flood door	£26,986	£35,082	£12,000	
		<b>Total</b>	<b>£93,848</b>	<b>£122,000</b>	<b>£24,000</b>	<b>£146,000</b>
3	2A	Attenuation Pond on Messing Green (muck away all excess)	£50,452	£65,587	£60,000	
	2B	Infiltration Trench and Pipes in Cemetery Easement	£62,541	£81,304	£12,000	
		<b>Total</b>	<b>£112,993</b>	<b>£146,900</b>	<b>£72,000</b>	<b>£218,900</b>
4	1A	Village Hall Attenuation/Infiltration Trench	£66,861	£86,920	£12,000	
	1B	Road drainage to field track ditch & flood door	£26,986	£35,082	£12,000	
	2A	Attenuation Pond on Messing Green (muck away all excess)	£50,452	£65,587	£60,000	
	2B	Infiltration Trench and Pipes in Cemetery Easement	£62,541	£81,304	£12,000	
		<b>Total</b>	<b>£206,841</b>	<b>£268,900</b>	<b>£96,000</b>	<b>£364,900</b>
5a	3A	Field Drainage Ditch	£41,256	£53,633	£12,000	
	3B	Field Drainage Ditch & road pipework	£36,142	£46,984	£24,000	
	3C	Field Drainage Ditch around 'The Maker'	£32,956	£42,843	£12,000	
		<b>Total</b>	<b>£110,354</b>	<b>£143,500</b>	<b>£48,000</b>	<b>£191,500</b>

Options	Measures	Description	Capital Cost estimate	Capital Cost estimate (incl 30% optimism bias)	Maintenance Cost over (60 years)	Total
5b	3A, B & C	With Rotary Ditcher 2500m3 at 200m3/hr including ponds and rhizome planting (allow 5 days with contingency @ £1500/day, + transport)	<b>£15,000</b>	<b>£19,500</b>	<b>£48,000</b>	<b>£67,500</b>
<b>PREFERRED OPTION</b>						
6	1A	Village Hall Attenuation/Infiltration Trench	£66,861	£86,920	£12,000	
	1B	Road drainage to field track ditch & flood door	£26,986	£35,082	£12,000	
	3A, B & C	Field Drainage Ditch With Rotary Ditcher	£15,000	<b>£19,500</b>	£48,000	
		<b>Total</b>	<b>£108,848</b>	<b>£141,500</b>	<b>£72,000</b>	<b>£213,500</b>

## 5 Conclusion and Recommendation

### 5.1 Conclusion

The study has demonstrated that there are measures available to reduce flood risk in Messing which can be implemented without the need to purchase land as the asset sites belong either to the Parish Council, ECC Highways or David Sherwood, the principle landowner. In the Preliminary Assessment it was expected that only Parish land would be available for measures but Mr Sherwood has since kindly demonstrated a willingness to assist using his land.

It was not found practicable to produce a hydraulic model to demonstrate the full risk of flooding for a range of probabilities which could have enabled accurate damages to be calculated for Benefit/Cost analysis but a simple prioritisation/cost approach has been taken which can be tailored according to available funds and the standard and/or extent of protection desired.

Of the short-term measures, protection to the Village Hall (Measures 1a and 1b) is the priority but this will only be reliable if the longer-term and wider ranging measures are also implemented either measures 2a and 2b or Measures 3a, 3b and 3c.

In effect the choice is Option 4 or Option 6. Although Option 4 is technically more sustainable in attenuating water close to source, it will require more maintenance. Option 6 has the benefit of taking water away from the built environment, and may be significantly cheaper, if carried out by the landowner, and if soil arising is spread on his fields. Ditches need to be maintained. In both Options some maintenance on the road pipework will be required.

Maintenance costs need to be confirmed by undertakers (ditches by landowner, roads and storage area by Highways) Option 6 £72k over 60 years.

### 5.2 Recommendation

The recommendation from this study is to proceed with the preferred option – Option 6 for a cost of approximately £213,500.00 including 30% Optimism Bias and maintenance for 60 years.

In addition it is recommended:

- That agreement is reached with the landowner over the construction and maintenance of the ditches and specifically the spreading of soil arising. If the Rotary Ditcher is used, the soil will be spread. The ECC Conservation Officer identifies the UKBAP species and habitat to be designed for and consults with RSPB and EA as required.
- That consultation is held with the Environment Agency relating to discharging surface water particularly with regard to any need for sediment control and attenuation upstream of Domsey Brook.
- That works are planned in advance to survey and manage ecological risk, bird nesting or bats and reptiles in the appropriate season. In particular, the shrubs and vegetation in the cemetery easement and the line of the ditches should have an ecological check and for clearance works to be carried out prior to the bird-nesting season and ground maintained clear until the works commence.
- That agreement is reached with Essex Highways to undertake the pipework in roads and road surfacing and agree to maintain Measures 1a, 1b and 3b as these are managing highway surface water exceedance.

LEFT BLANK FOR DOUBLE-SIDED PRINTING

**Appendix A Survey Scope Results**

LEFT BLANK FOR DOUBLE-SIDED PRINTING

**Appendix B Topographic Survey**

LEFT BLANK FOR DOUBLE-SIDED PRINTING

**Appendix C Preliminary Options Assessment**



LEFT BLANK FOR DOUBLE-SIDED PRINTING

**Appendix D Calculation Report**

LEFT BLANK FOR DOUBLE-SIDED PRINTING

**Appendix E Messing Green Cross-sections**

LEFT BLANK FOR DOUBLE-SIDED PRINTING