



WEST OXFORDSHIRE
DISTRICT COUNCIL

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Parish Flood Report: **Brize Norton**

May 2008



Contents

1.0	INTRODUCTION.....	3
2.0	THE DISTRICT COUNCIL'S ACHIEVEMENTS OVER THE PAST 12 MONTHS.....	6
3.0	EXECUTIVE SUMMARY	7
4.0	SURVEY.....	9
5.0	PROBLEMS AND CAUSES.....	14
6.0	OPTIONS	18
7.0	CONCLUSIONS AND RECOMMENDATIONS	23
	Appendix 1: Photographs.....	25
	Appendix 2: Maps.....	34
	Appendix 3: Glossary	37

1.0 INTRODUCTION

On the 20th July 2007 large parts of the South of England were subjected to intensive storms. The scale and speed of the rainfall was unprecedented and took most communities by surprise causing widespread flooding of highways and property. On this occasion, unlike previous storms / flooding experienced, this impacted on many properties that had never been affected before, due to much of the flooding coming in the form of rain water run off from land.

A swathe of the district was particularly badly affected by the massive storms, which commenced in the morning and subsided in the evening. During the following days further disruption occurred due to rising river levels. At RAF Brize Norton, the records show that over 125 mm (5 inches) of rain fell in 12 hours, and this is a record going back over 100 years. Not only that, but the period from May to July had been the wettest on record since 1903 and meant that the ground was saturated and unable to absorb any more water.

On the 10th October 2007, the District Council's Cabinet considered a report and approved additional resources in order that a review of the affected areas could be carried out and further reports be prepared for the Council's considerations.

1.1 Purpose of the report

In response to requests from both the Parish and Town Councils and the general public West Oxfordshire District Council has produced a number of reports that identify each individual cause of flooding within the Parish / Town, what work is being carried out by external agencies (Environment Agency, Thames water etc); what the potential options are for future mitigation - and who might be best placed to fund such schemes. The reports themselves reflect the series of water systems that all played a part in the flooding experienced in July 2007 and will help all the organisations involved understand the need to sequence their activities.

This report has been prepared by a qualified Engineer in consultation with the key external agencies and seeks to explore the main reason behind why the floods happened in July 2007 and give an overview of the event itself. It will also provide an understanding of the different roles and levels of responsibility for the agencies involved.

This report should be used to make sure that all the agencies involved with flood prevention – like the Environment Agency, Thames Water, Oxfordshire County Council, Town / Parish Councils and private land owners – work in true partnership for the good of everyone in the local community.

A key outcome of the reports is that residents are given a broad overview of the complex linkages between the different organisations involved and also the range of options available.

1.2 Roles and responsibilities

One of West Oxfordshire District Councils key ongoing roles is to continue to lobby National agencies / Government on behalf of the residents and businesses of the district to secure funding and/or additional resources to assist with flood prevention and other relevant activities. The Council will also work closely with other agencies and organisations in order to highlight the local issues and actions identified in the report.

The legal responsibility for dealing with flooding lies with different agencies and is complex, so below is a simplified summary.

Environment Agency (EA) – permissive powers¹ for main rivers

Oxfordshire County Council (OCC) – Responsible for adopted highways and highway drainage.

Thames Water (TW) – Responsible for adopted foul and surface water sewers.

West Oxfordshire District Council (WODC) – duties as a riparian² land owner, and permissive powers¹ under Land Drainage Act 1991, Public Health Act 1936, Highways Act 1980 and Environmental Protection Act 1990.

Private land owners - duties as a riparian land owner.

1.3 Consultation and consent

The key organisations mentioned above are currently carrying out their own investigations, but operate independently of each other, have different methods of prioritisation and different funding criteria. The District Council has consulted with these agencies together with Parish Councils, Town Councils and individual property owners in order to prepare this report.

It is recognised that the majority of the options proposed in this report require further investigations / feasibility studies and / or consultation before they are carried out. Therefore these options may not be appropriate in every case when full costings, environmental, landscaping, biodiversity, built environment and historic factors are fully considered.

When considering protection against future flooding, it must be emphasised that the risk and impact of flooding can be mitigated against but in some cases not fully removed.

1.4 Response to this report

The options section of this report highlights the potential areas of work / activities under the responsible agency, for example the Environment Agency, West Oxfordshire District Council etc. If you have any specific questions relating to these activities please contact the relevant agency using the contact details provided at the top of the chart.

If you have any general questions please contact your Parish / Town Council who have been a key contributor to the production of the report and have agreed to act as the first point of contact.

The Council is also planning to hold a series of road shows in the Parish areas where representatives from all the relevant areas will be available to answer any questions local residents have as well as provide more information on ways residents may help themselves.

¹ Permissive powers are when an organisation may choose whether or not to exercise their powers. I.e. they are NOT under a duty. In making this choice account must be taken of any factors required by the legislation, plus for example how urgent, how necessary they are, cost, likely result, etc

² Riparian owners are responsible for the maintenance of any watercourse within or adjacent to the boundaries of their property.

1.5 Legal

No part of this report is to be reproduced, copied or used by any third party without the prior express written consent of West Oxfordshire District Council in its absolute discretion. All those reading this report acknowledge that any conditions, warranties or other terms implied by statute or common law are excluded to the fullest extent permitted by law. Without limiting the scope of the foregoing, West Oxfordshire District Council does not give any warranty, representation or undertaking as to the efficacy or usefulness of the information contained within this report, nor that any advice contained within this report will produce satisfactory results if followed. West Oxfordshire District Council hereby excludes liability to the fullest extent permitted by law for any reliance placed in this report by third parties.

2.0 DISTRICT COUNCIL'S ACHIEVEMENTS OVER THE PAST 12 MONTHS

Ditch Clearance

- 1731 Linear metres WODC owned ditches cleared overall
 - 105 Linear metres WODC owned ditches cleared in Brize Norton
- 1923 Linear metres Privately owned ditches cleared overall
- Overall 2.27 miles of ditches have been cleared

Flood Grants

- 1137 WODC Flood Grants totalling £284,250 given out overall
 - 38 (£9,500) for Brize Norton
- 40 Red Cross Flood Grants totalling £80,929 administered by WODC overall
 - 1 (£375) for Brize Norton
- 301 Hardship Grants totalling £155,050 given out overall

Reports

- Interim Flooding Report published October 2007
- 12 Parish Flood Reports completed by June 2008, 1 report for Brize Norton

Actions from the Council's Interim Report published in January 2008

The table below provides a summary of some of the completed actions identified in the report

Bronze command procedure to be updated to recognise the need for ensuring shift rotas are in place in the early stages of an emergency
Consider producing a revised warning system that identifies a higher category of risk that is only issued in exceptional circumstances
The emergency plan specifically addresses the need to keep in regular contact with elected members
That in future emergency situations District Councils ensure that they have a representative present at Silver Command from the start of the emergency to act as a conduit for information between Silver Command and the District Councils
The council should encourage all residents residing in the flood plain and in areas at risk of flooding to sign up to the EA Flood Alert system.
Provide clear information to residents and businesses about what type of waste we can collect and how it will be collected
Explanations to residents of our need for bulky waste to be placed on the roadside for collection
Commence a review of the mapping of the many thousands of privately owned ditches and culverts, and ensure they are kept clear and well maintained in accordance with the new policy (2 TOR 3)
Lobby central government for a single agency to take control of all land drainage issues
WODC continues to act in a coordination capacity with key external agencies
Continue to liaise with EA to ensure that procedures relating to planning consultations are robust. Seminar being arranged to take place early in 2008 to progress this
Progress the Strategic Flood Risk Assessment
Consider producing a revised warning system that identifies a higher category of risk that is only issued in exceptional circumstances
Approaches to be made to the EA and Metrological Office with regard to improving their predictive capability
During emergency events, have an external media person (BBC) in Bronze Command
Purchase digital TVs to assist with reviewing weather, local and national news to assist emergency management

3.0 EXECUTIVE SUMMARY

Following the flooding events of July 2007, West Oxfordshire District Council (WODC) has responded to requests from both Town and Parish Councils to aid the coordination of all the agencies and bodies that were undertaking their own investigations into the floods through the production of Parish Flood Reports.

This document is the Parish Flood Report for the market town of Witney and has been prepared by the Council's Engineering team. It pulls together information from external agencies and individual property owners and seeks to identify the causes of flooding in Brize Norton during July 2007 and potential mitigating solutions.

Brize Norton is a rural parish located approximately 4km south west of Witney in the heart of the Cotswolds. The parish sits in the catchment of the Highmoor Brook which rises to the north of Manor Farm in Brize Norton and runs south, parallel to Manor Road (A4095). The main river flows behind and through the rear gardens of Station Road, it exits to the roadside (A4095) for a short distance at 109 Station Road before turning east at the southern end of the village the river then turns south and crosses under the A4095 near a small industrial unit (Viscount Court). The Highmoor Brook then joins the Shillbrook north of Bampton but does not enter RAF Brize Norton.

A second un-enmained ditch flows through Brize Norton which receives flows from the Carterton North East Development and associated attenuation pond, highway drainage including Kilkenny Lane, land drainage including the catchment to the north of the Masons Arms to the A40 and surface water drainage from the RAF Brize Norton air base. This ditch converges at the entrance to the RAF base where it enters 2 x 900mm diameter pipes to flow under a section of the airbase before entering open channel again in farm land opposite the TW pumping station on Station Road. The ditch then re-enters 2 x 900 mm pipes to flow under the runway, to a lagoon (primarily a oil/heavy metal trap) prior to discharging to a ditch running along field boundaries and its confluence with the Highmoor Brook.

Visual walkover surveys have been undertaken of the flooded areas and properties. Meetings have been held with some affected residents and the Parish Councillor. The number of applications for Grant Aid has also been investigated.

Flooding in Brize Norton has been assessed in four separate areas (see section 5.1) comprising:

- Kilkenny Lane/Rocky Banks (Area 1)
- Masons Arms (Area 2)
- Carterton Road crossing to RAF Brize Norton (Area 3)
- Highmoor Brook and Station Road (Area 4)

Kilkenny Lane/Rocky Banks (Area 1) has 6 claims for flood relief aid following the July 2007 event. Flooding at this location was partly attributed to overland flow from surrounding land and inadequate drainage. The Kilkenny Lane area experiences regular flooding.

In the Masons Arms area (Area 2) WODC have record of 2 properties claiming flood grant aid. Flooding in this area is due to overland flow from surrounding farmland and flooding from a drain which serves land to the north of the Masons arms to the A40. At the Masons Arms, the land drain enters a culvert flowing under property which surcharges and floods surrounding land.

The Lower Farm area (Area 3) includes properties to the west of the Bampton Road which suffered flooding as a result of backing up of the unnamed land drain which enters the RAF Brize Norton base via 2 x 900mm diameter culverts. During times of flood these culverts become surcharged flooding surrounding land including these properties. WODC have record of 5 properties claiming flood grant aid in this area.

The final area, includes properties to the east of the station Road (Area 4) that were affected by flooding from the Highmoor Brook. The channel at this location is narrow with a shallow bed and it flows in close proximity to houses on Station Road and adjacent cul-de-sacs. A number of the properties have driveway accesses which cross the Highmoor Brook and restrict flow further increasing flood risk.

Flooding problems and how each public and private body is affected, effectiveness of each solution, affects on adjacent land and cost, are included in Section 5. Priority ranking is included in Section 6.

Conclusions and recommendations, including maintenance and flood defence improvement measures and programme, are shown in Section 7.

Mitigation measures which are implemented hastily may exacerbate flooding, and therefore their effects on both upstream and downstream flows , need to be analysed carefully.

4.0 SURVEY

4.1 Description of Area

Brize Norton is a rural parish located approximately 4km south west of Witney in the heart of the Cotswolds. The parish sits in the catchment of the Highmoor Brook which rises to the north of Manor Farm in Brize Norton and runs south, parallel to Station Road. The main river flows behind and through the rear gardens of Station Road, it exits to the roadside (A4095) for a short distance at 109 Station Road before turning east at the southern end of the village the river then turns south and crosses under the A4095 near a small industrial unit (Viscount Court). The Highmoor Brook then joins the Shillbrook north of Bampton.

A second un-enmained ditch flows through Brize Norton which receives flows from the Carterton North East Development and associated attenuation pond, highway drainage including Kilkenny Lane, land drainage including the catchment to the north of the Masons Arms to the A40 and surface water drainage from the RAF Brize Norton air base. This ditch converges at the entrance to the RAF base where it enters 2 x 900mm diameter pipes to flow under a section of the airbase before entering open channel again in farm land opposite the Thames Water pumping station on Station Road. The ditch then re-enters 2 x 900 mm pipes to flow under the runway, to a lagoon (primarily a oil/heavy metal trap) prior to discharging to a ditch running along field boundaries and its confluence with the Highmoor Brook.

WODC commissioned Peter Brett Associates to carry out an assessment into drainage and flooding issues in Brize Norton. As part of this an assessment of catchment sizes were made as follows:

Rocky Banks	2.66 km ²
Masons Arms	3.66 km ²
Carterton Road	5.70 km ²
Brize Norton Airfield	8.36 km ²

Using the Flood Estimation Handbook, the catchment for the Highmoor Brook is estimated to be approximately 1.15 km²

4.2 Survey

A visual walk-over survey of properties affected by the July 2007 flooding has been undertaken including Kilkenny Lane, Masons Arms, Carterton NE development, Lower Farm, Highmoor Brook and surrounding watercourses.

See Appendix I – Photographs.

4.3 Meetings

Details of the meetings about the flooding Brize Norton experienced in July 2007 are given in Table I.

Table I: Summary of meetings and flooding descriptions

Date	Location	Description
01/08/07	Highmoor Brook	<ul style="list-style-type: none">Local residents commenting on properties that have extended gardens and driveways over the stream. This causes debris to collect and the

Date	Location	Description
		backing up of flow. Some local residents keep the culverts clear but there is concern when people are away flooding may be caused. i.e. concern over ditch maintenance.
06/09/07	RAF Brize Norton	<p>Flood Prevention working group meeting</p> <ul style="list-style-type: none"> • WODC continue chasing consent from Quarry but confirmed that it was not thought that the quarry contributed to flooding. WODC to check compliance with EA consent. • WODC stated that there had been an increase in clearing of culverts and ditches on Kilkenny Lane and surrounding area. • RAF Brize Norton awaiting results of CCTV survey of 2 x 900mm pipes that run underneath the airbase to farmers field but had been made aware that there appeared to be an obstruction in the pipes but water was still flowing. • RAF Brize Norton confirmed that ditch clearance on their land was to take place. • OCC to investigate improvements to drainage on Station Road. • Concerns raised over future development on RAF Brize Norton and how this will impact on Brize Norton.
01/11/07	RAF Brize Norton	<p>Flood Prevention working group meeting</p> <ul style="list-style-type: none"> • WODC confirmed that they did not think the quarry was contributing to flooding. • WODC confirmed that they are responsible for ditches alongside balancing pond on Carterton Raod. WODC suggest that if water was diverted into the large balancing pond, it may reduce the overall flow to RAF Brize Norton and help to reduce localised flooding. • It was suggested that WODC take ownership of balancing pond from TW. • TW stated that flow monitors have been put in place on main sewer through Brize Norton village. • EA confirmed that the area from South Bampton to Shilbrook along Highmoor Brook to Brize Norton Village was due Jul/Aug 07. This has been delayed. • WODC agreed to look into historical data to establish if any ditches had been lost due to new builds etc. • Concerns raised about attenuation tank at crash gate 5. It was confirmed that the tank has no natural drainage and would need to be emptied using a vac and disposed of.
05/11/07	Local resident letter to WODC	<ul style="list-style-type: none"> • Concerns that watercourses that run through Brize Norton village have not been maintained.
10/01/08	RAF Brize Norton	<p>Flood Prevention working group meeting</p> <ul style="list-style-type: none"> • WODC still chasing consent from Burford Quarry. • WODC confirmed that a verbal agreement in principal had been made with TW re; ownership of balancing pond on Carterton Road. • RAF Brize Norton confirmed that a modelling survey of the lagoon is to take place. • EA confirmed that clearance of sections on Highmoor Brook had started. • OCC to look into increased concrete grips on Station Road. • It was confirmed that the discharge from the new area would not exceed pre-development runoff and will include a flow control device and inlet

Date	Location	Description
		<p>shut of valve. EA have been made aware of proposals and planning permission obtained.</p> <ul style="list-style-type: none"> RAF Brize Norton to undertake pro-active maintenance over next few months to include re-profiling of ditches on east side of camp.
Jan 08	Paper report	<ul style="list-style-type: none"> Local parish councils prepared a paper voicing concern over surface water drainage expected from the new 'ASP' hard standing at RAF Brize Norton.
18/01/08	Local resident email to WODC	<ul style="list-style-type: none"> WODC have completed clearance of watercourse at 43 Chichester Place and is no problem in this area. However, the water now moves faster downstream and surcharges between 101 and 109 Station Road which is EA responsibility.
28/01/08	Local resident letter to WODC	<ul style="list-style-type: none"> Letter stating that property on Burford road was again flooded on 15th January 2008 and has been flooded 3 times in the last 12 months. Water from highways (Burford Road) is flowing onto land and property. Road grips have become blocked.
06/03/08	RAF Brize Norton	<ul style="list-style-type: none"> Flood Prevention working group meeting EA confirmed that consent at Quarry had been revoked and EA are looking into continued discharge. WODC confirmed that permission from OFWAT was required before balancing pond ownership could be transferred, clearance of transfer would be expected in the next couple of weeks. TW stated that the balancing pond is critical to them. WODC is to chase TW to confirm that transfer of ownership would proceed. RAF Brize Norton to install 2 new security grills, 1 on Shill Brook and 1 at High Moor Brook. EA to be involved in design process. Clearance of grills to be completed by RAF Brize Norton. EA confirmed that clearance of Highmoor Brook is planned for Autumn 08 WODC confirmed that more concrete grips are in place on Station Road ASP attenuation design to be reviewed by EA WODC plan to proceed with attenuation work at Country Park, Kilkenny Lane, Summer 08
01/04/08	Letter to Rt Hon David Cameron MP from Brize Norton Parish Council	<ul style="list-style-type: none"> Letter to voice concerns over TW assets in Brize Norton. 1 – Balancing pond – outlining the historically agreed discharge rate from the balancing pond which is now considered to be in excess of Greenfield runoff. 2 – TW pumping station – outlining that the pumping station does not have sufficient capacity to cope in times of moderate to heavy rainfall resulting in sewerage backup and flooding.
07.05.08	WODC Offices	<ul style="list-style-type: none"> Meeting with WODC drainage engineer to discuss flooding issues associated with Brize Norton.
12.05.08	Brize Norton	<ul style="list-style-type: none"> Meeting with Keith Glazier to discuss flooding mechanisms in Brize Norton. This included a site walkover and visual inspection of local watercourses.

WODC has liaised with the Environment Agency, Oxfordshire County Council, Thames Water and representatives of Burford Quarry and RAF Brize Norton.

4.4 Stakeholder communication and actions

Details of conversations and actions between October 2007 and February 2008 are included in Table 2.

Table 2: Summary of Telephone Calls/Emails/Correspondence made with EA, TW and OCC.

Company	Comments
EA	<ul style="list-style-type: none"> The area from South Bampton to Shilbrook along Highmoor Brook to Brize Norton village was due to start Jul/Aug 07. Foot & Mouth scares affected this. EA confirmed that clearance of Highmoor Brook is planned for Autumn 08
OCC	<ul style="list-style-type: none"> OCC do not think that the quarry is contributing to flooding in Brize Norton. EA are to liaise with the Quarry to pursue a discharge consent, this is on-going. OCC to build more concrete grips along the Station Road to speed surface water to adjacent drainage ditches. This has been completed – May 2008 OCC have diverted water from the 375mm pipe in the ditch to the south side of Masons Arms into a ditch to re-connect directly to the stream. OCC have completed works on the Carterton Road culvert to increase capacity.
WODC	<ul style="list-style-type: none"> WODC confirmed that a verbal agreement had been made between WODC and TW regarding ownership of the Carterton NE balancing pond. Once this is in WODC ownership, they can control discharge to RAF Brize Norton WODC have contacted OCC to maintain clearance of grips on Kilkenny Lane & Burford Road WODC plan to proceed with attenuation work at Country Park, Kilkenny Lane, Summer 08 WODC have completed clearance of watercourse at Chichester Place . WODC to contact OCC to create grips on Kilkenny lane.
RAF Brize Norton	<ul style="list-style-type: none"> Proactive and re-active jetting and clearance of surface water culverts and conduits to aid flows (on-going) Proactive clearance, maintenance and grounds maintenance of on-site surface water ditches (on-going) Eastern water course confirmed in Defences Estates & Aquatrine scope in November '07 Survey undertaken on eastern watercourse – inclusive of discharge lagoon. A capital ditch maintenance and asset improvement scheme as in development for critical areas (1,2 &3 – see sketch Appendix 3). This is with a view to implementing one large scheme to encompass all problems within this area to stabilise the flow rate/capacity of the system and to reduce future maintenance of the system. High levels of engagement with technical designers of future development projects to ensure no net increase of flows to the already over subscribed system. RAF Brize Norton confirmed that they are carrying out regular maintenance on trash screens on watercourses entering the base A survey is being completed of the 2 x 900mm diameter pipes that flow into RAF Brize Norton RAF Brize Norton have confirmed that the discharge runoff from additional impermeable areas in the base would not exceed the pre-development runoff rate and attenuation systems will include a flow control and inlet shut off valve. 09/07 RAF Brize Norton confirmed that ditch clearance on their land was to take place.

Company	Comments
Burford Quarry	<ul style="list-style-type: none"> • 05/12/06 reported flooding of properties (assumed Kilkenny Lane) • Pumping ceased from 4/12/06 – quarry keen to comply to discharge licence as do not want to be responsible for flooding problems. • 21/05/07 Ditch clearance work on Kilkenny Lane completed in line with condition 43 of discharge licence. • 04/02/08 OCC contacted by Burford Quarry to advise that they are to start 24 hr pumping to de-water the quarry. EA have provided a temporary discharge and residents of Kilkenny Lane informed. • 04/02/08 Quarry confirmed that no pumping takes place when water channels at rock edge area full
TW	<ul style="list-style-type: none"> • TW have stated (30.01.08) that flow monitors have been put in place on the main sewer through Brize Norton. • 15.05.08 TW are planning to install a penstock valve to the balancing pond on Carterton Road. Work should be complete by the summer. • TW have completed a study and are proposing a new rising main and increased pumping station. There is no funding for this work to be completed this AMP cycle so it will be put forward to the next for the period 2010 to 2015.

4.5 Application for Grant Aid

The District Council has distributed a range of financial support to the residents of district in the form of;

- Emergency Flood Relief Grant Aid of £250
- 'Hardship' Grants
- Red Cross Grants

There have been 38 applications for Grant Aid from Brize Norton. Many locations have been surveyed to verify the claim. All claimants have been given a sum of £250 towards Emergency Aid.

Whilst the Emergency Flood Relief Grant Aid was not paid to industrial and commercial properties, the Council did provide advice and support to local business affected by the flooding on funding available from Business Link and other organisations.

5.0 PROBLEMS AND CAUSES

5.1 Plans

Figure 1, in appendix 2, shows areas in Brize Norton where flood damage occurred during 2007. The flooding can be broadly split into four areas being:

- Kilkenny Lane (Area 1)
- Masons Arms (Area 2)
- Carterton Road crossing to RAF Brize Norton (Area 3)
- Highmoor Brook and Station Road (Area 4)

A flood zone map as described below can be found in appendix 2:

- 1% annual probability of flooding - Flood Zone 3 (previously referred to as 1 in 100 year flooding)
 - a plan showing the 2008 Environment Agency 1% probability Flood Zone, this is the area defined by the EA as the extent of a flood with a 1 per cent chance happening in any year. This is the high probability risk zone.
- 0.1% annual probability of flooding – Flood Zone 2 (previously referred to as 1 in 1000 year flooding)
 - a plan showing the 2008 Environment Agency 0.1% probability Flood Zone. This is the area defined by the EA as the extent of a flood with a 0.1 per cent chance happening in any year. This is the medium probability risk zone

A Sketch to illustrate project areas (such as the ASP etc) inside the RAF camp is also included in Appendix 2.

5.2 Area 1 – Kilkenny Lane/Rocky Banks

At the head of the system, dewatering discharge from the Burford Quarry flows into a drainage ditch which runs along the north side of the Kilkenny Road.

Surface water flow from surrounding farmland and the Country Park on the south side of Kilkenny lane also drains to Burford road where it finds its way to the drainage ditch running along the north side. The Peter Brett Associates report calculates this catchment to be 2.66km².

At the junction with the Burford Road (Photo 3) this ditch crosses under the road in a 600mm diameter pipe culvert which then exits in a 675mm diameter pipe culvert. This culvert feeds into a ditch and in turn into a second culvert system conveying flow under the new A40 link road before re-entering open flow in a ditch on the south side of the Burford Road flowing towards the Masons Arms and Grange Farm.

Currently the trash screen on the 600mm culvert at the end of Kilkenny Lane is cleared by local residents but debris regularly collects.

In 2007, 6 properties located in Kilkenny Lane/Rocky Banks area claimed flood damage grants. All of these properties reside in the Environment Agency Flood Zone 1 being at low risk of flooding from fluvial sources.

The causes of flooding in July 2007 at Kilkenny Lane are assumed to be the following:

5.2.1 Direct runoff from surrounding area

The Country Park area located to the north of the Carterton North East development has no designed drainage system. Therefore during periods of prolonged or heavy rainfall, surface water flows to the Kilkenny Lane where it forms a river flowing to the Rocky Banks Area causing flooding of property.

5.2.2 Culvert capacity at Burford Road / Kilkenny Lane

The capacity of the 600mm diameter culvert at this location has been estimated at the 1 in 50 year return period (Peter Brett report). The rainfall event of July 2007 for Southern England is thought to have been in excess of the 1:100 return period.

5.2.3 Inadequate surface water drainage Kilkenny Lane/ Burford road

A lack of kerbing and road gullies on Kilkenny Lane and Burford Road mean that surface water that collects in this area, can not quickly drain away to a drainage system. Existing drainage under passing places are under capacity and easily get blocked resulting in the lane flooding.

5.2.4 Inadequate maintenance of Drainage Ditch

All surface water in this area outfalls to a drainage ditch on the northern side of Kilkenny lane. Inadequate maintenance of this ditch and clearance of trash screen on the entrance to the culvert at the Burford Road junction could lead to increased flooding.

5.3 Area 2 – Masons Arms

The drainage ditch described in Area 1 carrying water from the Kilkenny Road flows towards the Masons Arms area on the south side of the Burford Road. This ditch originally entered a 375mm diameter pipe culvert near to the Masons Arms which ran for approximately 55m before re-entering an open ditch (Peter Brett report). This system has since been re-designed and now flow enters a piped field crossing before flowing to an open ditch downstream. Water can still flow to the 375mm culvert during flood conditions where it provides extra capacity to the system.

Behind the Masons Arms water flowing from the catchment south of the A40 enters a culvert which discharges to the same ditch system flowing south away from the Masons Arms towards the Carterton Road as described above.

In 2007, 2 properties in the Masons arms area claimed flood grant aid. All of these properties reside in the Environment Agency Flood Zone 1 being at low risk of flooding from fluvial sources.

The causes of flooding at The Masons Arms are assumed to be the following:

5.3.1 Culvert surcharging at Masons Arms

Surface water drainage from farmland to the north of the Masons Arms area enters a drainage ditch which flows into a culvert under properties at the Masons Arms. The size of this culvert is unknown but it is believed that water backs up behind the culvert and floods surrounding property (Photograph 6/7)

5.3.2 Inadequate highway drainage

Historically flooding was caused in this area by water from Kilkenny Lane entering the 375mm pipe at Masons Arms, this has since been removed.

5.3.3 Lack of Maintenance of drainage ditches

Highway drainage in this area flows to the low point located at the Masons Arms where historically there was a pond which has become overgrown.

5.4 Area 3 – Carterton Road crossing to RAF Brize Norton

Seven properties in this area claimed flood damage grants, all located in Environment Agency Flood Zone 1.

Water from the Masons Arms area drains in a southerly direction past the old ski slopes and onto the Carterton Road. On reaching the Carterton Road, the ditch, now with a sizeable flow passes under the Carterton Road in a culvert, surfaces briefly and then flows under a stone wall to private properties of the Old Vicarage and Painswick House where it continues southward.

The stream is joined by the overflow outfall from the Carterton North East development drainage system and a tributary serving part of the RAF Brize Norton air base.

This combined flow then enters 2 x 900mm diameter culverts flowing under the RAF Brize Norton base.

Following a study into drainage issues commissioned by WODC, the original twin openings used to convey flow under the dry stone wall south of Carterton Road have been replaced by a larger box culvert (works completed in 2004) This has reduced the potential for blockage of the system at this point.

The causes of flooding to properties in the area of Carterton Road are assumed to be the following:

5.4.1 Direct runoff from surrounding land

Overland flow from farmland to the north of Carterton Road inundated properties during the July 2007 flood event.

5.4.2 Culvert surcharging at RAF Brize Norton

Site walkovers indicated that the 2 x 900mm culverts would not be sufficient to convey flood flows as culverts in the headwaters of the system at Kilkenny Lane are 600mm diameter serving a fraction of the catchment area. Local residents confirmed that during July 2007 waters backed up from the RAF culverts, flowed in a easterly direction, crossing farmland and inundating properties to the west of Station Road.

5.4.3 Inadequate surface water drainage of Carterton North East Development

In June 2003, WODC commissioned a report into flooding and drainage issues for Brize Norton and North East Carterton. As part of the study, visits were made to the EA offices and a copy of the drainage strategy for the Carterton NE development dated December 1998 was obtained. Findings showed that there has been a long standing agreement dating back at least a decade involving the Ministry of Defence and the EAs predecessors which agreed two discharge points to a ditch on the south of the Carterton Road. Findings showed that while the balancing pond restricts major events such as a 100 year flow, it is less effective in restricting flows from lesser events.

Two further attenuation ponds contain flow from the Industrial Estate on Norton Way. These discharge to the drainage ditch flowing along Carterton road and appear to function well during flood conditions. The July 2007 flood event highlighted that while widescale flooding was experienced downstream in Brize Norton, the attenuation pond at Carterton Road did not fill to capacity. This has raised concerns over the design and discharges from this attenuation pond.

5.4.4 Lack of maintenance of drainage ditches

While maintenance of ditches flowing to the attenuation pond on Carterton Road have been frequent it is important to highlight how important regular maintenance at this location is. Due to the on-going construction at NE Carterton an increased amount of rubbish is washed through the drainage channels leading to the attenuation pond which collect on trash screens and may lead to flooding if not managed.

5.5 Area 4 - Highmoor Brook and Station Road

In 2007, 17 properties claimed flood grant aid in the vicinity of Highmoor Brook. 6 of these properties are located in the Environment Agency 0.1% (1 in 1000 year) probability Flood Zone.

The cause of flooding to properties on Station Road and to the east of the village was:

5.5.1 Lack of maintenance of Highmoor Brook

The Highmoor Brook is enmained and is the responsibility of the EA. Regular maintenance was not carried out leading to a reduction in channel capacity and flooding of surrounding properties.

5.5.2 Multiple crossings of the channel for access to property

There are a large number of crossings of various size across the Highmoor Brook. These cause surcharging and flooding of surrounding property.

5.5.3 TW pumping station

The sewerage pumping station located in Brize Norton Village does not have sufficient capacity to cope in times of moderate to heavy rainfall this results in sewerage backing up to houses overflowing manholes near property and in roadways and residents being unable to flush toilets and empty sinks.

5.5.4 Lack of highway drainage and maintenance

During the July 2007 flood event, highway drainage on Station Road could not cope with volume of water experienced.

6.0 OPTIONS

The following table shows the possible options available for flood alleviation schemes throughout the Parish, and their potential effectiveness, as assessed by the District Council Engineers. The areas affected by flooding within the Parish have been given unique area numbers, i.e. Area 1. Several options for flood alleviation projects are identified for each area as “Actions” or “Options”.

Many of these options will require further detailed investigation along with the agreement of the responsible landowner, identification of budget and a cost benefit analysis to be carried out before they could be implemented.

Some of the options shown are also mutually exclusive, that is if one option is carried out then another will not be necessary, to find if this is the case for an option, please look at the detailed description in the Conclusions and Recommendations Section [\(7.0\)](#).

If you require further information regarding a particular option, please contact the agency that would be responsible for implementation of the proposal, where this has been shown, using the contact information at the top of the column. If no contact details are shown, there may be a private landowner responsible. If this is the case the District Council will ensure that private landowners are made aware of their responsibilities.

Parish Flood Options										
Brize Norton										
Version I – May 2008										
Option ref	Flood Overview	Description of work required					Key issues			Comments
	Options	Environment Agency For queries Tel 08708 506 506 Or email enquiries@environment-agency.gov.uk	Oxfordshire County Council Highways: 0845 310111 Or e-mail online@oxfordshire.gov.uk	Thames Water Enquiries: 08459 200 800	WODC Switchboard: 01993 861000	Private Brize Norton Parish Council; Keith Glazier top@tincatinca.fsnet.co.uk	Effectiveness	Affects on adjacent land	Cost	
Area I – Kilkenny Lane/Rocky Banks										
	Flooding of Kilkenny Lane and Kilkenny Lodge as a result of direct runoff from surrounding areas (Photo 1)									
A	Construct swale/flood bypass channel to the south of Kilkenny Lane within the Country Park.	EA advice to be sought on design and maintenance. Land Drainage consent may be required for temporary works.			WODC to undertake works and maintain new channel.	Landowner contribution to works in terms of land availability.	Will allow more flood water to be stored/attenuated in area. Reduction of flooding frequency to Kilkenny Lane.	Increase of flooding to Country Park to south of Kilkenny lane.	£20,000 to £50,000	This will also contribute to reducing flood waters reaching Brize Norton Village.
B	Flood- resilient measures on properties.					Homeowners to provide protection against flooding to their properties e.g. flood boards, flood proofing of exterior walls, sand bags.	Only effective if flood boards are put in place before water levels rise.	None	Up to £5,000	Home owners have not been directly approached regarding flood resilient measures.
	Culvert surcharging at junction of Kilkenny Lane and Burford Road causing flooding of highway and adjacent land (Photo 2)									
C	Increase capacity of existing 600mm culvert via culvert deepening or through the insertion of extra flood relief culverts.		OCC to investigate feasibility of works		WODC to provide a co-ordination role		This will increase capacity and reduce culvert surcharging	None	£5,000 for feasibility	
	Inadequate surface water drainage on Kilkenny Lane (Photo 3)									
D	Replacement of small diameter culverts under passing places along Kilkenny Lane.		OCC to undertake works				Will reduce frequency of flooding to Kilkenny Lane and also to Kilkenny Lodge.		£5,000 to £20,000	
E	Carry out Highway improvement works at junction of Kilkenny Lane and Burford Road so any water that collects there has a method of disposal to ditch on Northern side of Burford road.		OCC to undertake works				Will reduce flooding of Burford road area.		£5,000 to £20,000	
	Lack of maintenance of drainage ditch and culvert									
F	Maintain road drainage on Burford Road and Kilkenny Lane – ditch clearing and inspection of gullies, investigate current grip provision		OCC to fulfil regular highway maintenance regime		WODC to provide a co-ordination role		Future maintenance will reduce surface water run-off	Reduced flood flow entering surrounding farm land and Kilkenny lodge.	up to £5,000	

Parish Flood Options										
Brize Norton										
Version I – May 2008										
Option ref	Flood Overview	Description of work required					Key issues			Comments
	Options	Environment Agency For queries Tel 08708 506 506 Or email enquiries@environment-agency.gov.uk	Oxfordshire County Council Highways: 0845 310111 Or e-mail online@oxfordshire.gov.uk	Thames Water Enquiries: 08459 200 800	WODC Switchboard: 01993 861000	Private Brize Norton Parish Council; Keith Glazier top@tincatinca.fsnet.co.uk	Effectiveness	Affects on adjacent land	Cost	
Area 2 – The Masons Arms										
	Culvert running under house to right of Masons Arms pub surcharges and floods surrounding land and property via flood flow route									
A	WODC to investigate ownership of culverted section with a view to re-route course via new open channel flood relief channel.	EA to be consulted for design advice. Land Drainage consent may be required for temporary works.			WODC to provide a co-ordination role with riparian owner	If the culvert is located under the house, it will be the responsibility of the riparian owner to carry out works.	Will provide potential to re-route drainage via larger capacity, open ditch		Up to £5,000 for investigative works. £5,000 to £20,000 for provision of new open flood relief channel.	Riparian owner has not been approached regarding these works.
B	On Monahan Way to Minster Road link road, reduce size of culvert under road that watercourse flows through to throttle flows from upstream catchment and attenuate flood flows.	EA to be consulted for design advice. Land Drainage consent may be required for temporary works.	OCC to undertake works.		WODC to investigate riparian ownership of land and provide a co-ordination role where required	Landowner agreement required to allow land to flood more frequently.	Will reduce volume of water flowing downstream towards Brize Norton and reduce frequency of flooding.	Will increase frequency of flooding to land upstream of road.	£5,000 to £10,000 for works to reduce culvert capacity.	
C	Flood- resilient measures on properties.					Homeowners to provide protection against flooding to their properties e.g. flood boards, flood proofing of exterior walls, sand bags.				Homeowners have not been approached regarding these measures.
	Inadequate Highway Drainage									
D	Maintain existing drainage ditch along Burford road		OCC to clear and maintain drainage ditch		WODC to confirm ownership of ditch	Landowners to clear ditch in identified sections	Will improve drainage capacity of system during flood flows	Will reduce frequency of flooding to Burford road.	£5,000 to £20,000	375mm dia culvert replaced in 2004 by diversion as per Peter Brett Report
E	Re-instate and widen old pond for use as offline storage during flood events. Install new grips to connect to the pond.				WODC to investigate riparian ownership of land and provide a co-ordination role where required.		Will allow for attenuation of flood waters and can contribute to a reduced frequency of flooding.		£5,000 to £10,000	
Area 3 - Carterton Road to RAF Brize Norton										
	Direct runoff from surrounding land									
A	Create a storage area in land to the north of Carterton road. This will contain flood flows arriving from the Masons Arms area, reducing flows to RAF Brize Norton. Ditches to be created as part of this work to connect land drainage from affected properties to the storage area.	EA to be consulted for design advice. Land drainage consent may be required for temporary works.			WODC to investigate riparian ownership of land and provide a co-ordination role where required	Landowner agreement required to allow land to flood more frequently.	Will reduce volume of water flowing downstream towards Brize Norton and reduce frequency of flooding.	Will increase frequency of flooding to land upstream of road.	£5,000 to £20,000 for provision of new storage area	Funding of these works is yet to be agreed, it may be a joint venture
	Surcharging of culvert crossing under									

Parish Flood Options										
Brize Norton										
Version I – May 2008										
Option ref	Flood Overview	Description of work required					Key issues			Comments
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	Carterton Road									
B	Increase culvert capacity		OCC have completed works to upsize the culvert crossing of Carterton Road.				Will increase flows downstream	Will reduce potential flood risk to adjacent land from culvert		
Area 3 - Carterton Road to RAF Brize Norton (cont....)										
	Surcharging of 2 x 900mm culverts at RAF Brize Norton									
C	Create a bypass channel/secondary ditch or swale to link flows from the Masons Arms/Carterton road area to the ditch downstream of the 2 x 900mm culverts.	EA to be consulted for design advice. Land drainage consent may be required for temporary works.			WODC to investigate riparian ownership of land and provide a co-ordination role where required	Landowner agreement required to allow land to flood more frequently.	Will allow flood flows to bypass the first set of 900mm culverts.		£5,000 to £20,000 for new swale/ditch	Funding of these works is yet to be agreed, it may be a joint venture
D	Carry out survey of 2 x 900mm culverts to assess their function.				WODC to be provided with results at flood forum meeting.	RAF Brize Norton are currently completing a survey of the culverts (May 08)				
	Improper design of balancing pond associated with Carterton North East development causing flows to run through pond unchecked apart from during very large flood events.									
E	Reduce main outflow diameter to lower return period capacity so that water is stored in basin for a larger range of flood events. Allow for drainage overflow provision at higher water levels, sized to give low rate discharge back into watercourse downstream of basin. May require further excavation to deepen/reshape basin to give optimum storage			TW currently own basin and propose to install a Penstock/Valve to control discharge from pond and increase storage volume.	WODC and TW to liaise to confirm if ownership of attenuation basin can transfer to WODC. OFWAT to be contacted regarding ownership		Effective at delaying flood flow progression through stream system and reduce frequency of flooding downstream at Brize Norton.	May require additional land take	£5,000 for feasibility. £5,000 to £20,000 for installation of flow control structure & supporting works.	
F	Connect drainage from adjacent West Oxon industrial park to attenuation pond			TW currently own system and will not accept flows from other systems	This can not go ahead while the attenuation pond is responsibility of TW. WODC to progress talks with TW.		Will allow further attenuation of flows and reduction of flood volume at the 2 x 900mm culverts			
	Lack of maintenance of drainage ditches									
G	Maintain existing ditches that run through the air base				WODC to provide co-ordination role where required. RAF Brize Norton to report at Flood forum meetings	RAF Brize Norton carry out pro-active and re-active clearance of surface water ditches on site and have a capital ditch maintenance scheme in place – see Figure 1 Appendix 3.			£5,000 to £20,000	
Area 4 – Highmoor Brook										
	Insufficient capacity of Highmoor Brook often caused by lack of maintenance									
A	Carry out channel and bed maintenance	EA to maintain watercourse where it is en-mained				Riparian owners to maintain ditches flowing to Highmoor	Will improve flow capacity of channel	None	£5,000 to £20,000	EA confirmed that clearance of

Parish Flood Options										
Brize Norton										
Version I – May 2008										
Option ref	Flood Overview	Description of work required					Key issues			Comments
	Options	Environment Agency For queries Tel 08708 506 506 Or email enquiries@environment-agency.gov.uk	Oxfordshire County Council Highways: 0845 310111 Or e-mail online@oxfordshire.gov.uk	Thames Water Enquiries: 08459 200 800	WODC Switchboard: 01993 861000	Private Brize Norton Parish Council; Keith Glazier top@tincatinca.fsnet.co.uk	Effectiveness	Affects on adjacent land	Cost	
						Brook				Highmoor Brook is planned for Autumn '08
B	Create a secondary, larger channel in the farmers field to allow storage of flood flows. This would then connect into the second ditch running in a south easterly direction across farmland to the Highmoor Brook at the back of properties.	EA to be consulted for design advice and funding. Land drainage consent may be required for temporary works.			WODC to investigate riparian ownership of land and provide a co-ordination role where required		Will enable managed flooding of adjacent farmland and reduce potential flood risk to properties	Will increase flood frequency of adjacent farmland	£20,000 to £50,000	
Area 4 – Highmoor Brook (cont...)										
C	Flood- resilient measures on properties.					Homeowners to provide protection against flooding to their properties e.g. flood boards, flood proofing of exterior walls, sand bags.			up to £5,000	
	Multiple crossings of Highmoor Brook impeding flow									
D	Remove structures crossing Highmoor Brook where possible, re-size where required.	EA to assess identify those structures along watercourse which may be restricting channel capacity with a view to modifying or removing non-essential culverts/low bridges			WODC to provide a co-ordination role where required		Will allow more unimpeded flow through to downstream	Will reduce flood risk to adjacent land	Up to £5,000 per crossing	
E	Removal of dry stone wall crossing at end of properties on east of Station Road.	EA to enforce the removal of dry stone wall which is impeding flow along watercourse during times of flood.			WODC to provide a co-ordination role where required	Riparian owner to carry out work	Will allow more unimpeded flow downstream	Will reduce flood risk to adjacent land	Up to £5,000	Riparian owner has not been approached regarding works
	Insufficient capacity of TW pumping station serving Brize Norton									
F	TW to upsize the sewer system in Brize Norton		OCC may be required to assist in road closures etc when work is to be carried out	TW installed flow monitoring into sewer. Results show that the system is under capacity and a new rising main and pumping station are proposed.	WODC to provide a co-ordination role where required		TW installed flow monitoring into sewer. Results will be analysed following study. Recommendations to follow			TW do not have funding for this work during this AMP cycle. The work is to be completed in the next period – 2010 to 2015
	Lack of highway drainage and maintenance on Station Road									Investigate impact of impermeable surfaces on RAF site (ASP)
G	OCC to improve highway drainage		OCC have replaced grips with a larger number and concrete lined to protect them during periods of heavy rain.							

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Area 1 – Kilkenny Lane / Burford road

7.1.1 Maintenance

The following on-going maintenance is recommended:

- Maintain road drainage on Burford Road and Kilkenny Lane – ditch clearing and inspection of gullies, investigate current grip provision (Option F)

7.1.2 Flood defence improvement schemes

The following flood defence improvement schemes are recommended:

Immediate (under 1 year)

- Construct swale/flood bypass channel to the south of Kilkenny Lane within the Country Park (Option A)
- Flood- resilient measures on properties. (Option B)
- Removal/upgrading of small diameter culverts under passing places along Kilkenny Lane (Option D)
- Carry out highway improvement works at junction of Kilkenny Lane and Burford Road so any water that collects there has a method of disposal (Option E) towards ditch on North side of Burford road.

Mid-Term (under 1 -2 years)

- Increase culvert size at end of Kilkenny Lane (Option C)

7.2 Area 2 – Masons Arms

7.2.1 Maintenance

The following on-going maintenance is recommended:

- Maintain existing drainage ditch along Kilkenny Lane (Option D)

7.2.2 Flood defence improvement schemes

The following flood defence improvement schemes are recommended:

- Maintain existing ditch along Burford Road (OptionD)

Immediate (under 1 year)

- WODC/OCC to investigate ownership of culverted section with a view to re-route course via new open channel flood relief channel (Option A)
- Flood- resilient measures on properties (Option C)

Mid-Term (under 1 -2 years)

- On Monahan Way - Minster Road link road, reduce size of culvert that watercourse flows under to throttle flows from upstream catchment and attenuate flood flows downstream towards the Masons Arms pub and Brize Norton Village (Option B)
- Re-instate and widen old pond for use as offline storage during flood events. Install new grips to connect to the pond. (Option E)

7.3 Area 3 – Carterton Road

7.3.1 Maintenance

The following on-going maintenance is recommended:

- Maintenance of ditches running through air base (Option G)

7.3.2 Flood defence improvement scheme

Immediate (under 1 year)

- Reduce main outflow diameter from Carterton NE balancing pond to lower return period capacity so that water is stored in basin for a larger range of flood events. Allow for drainage overflow provision at higher water levels, sized to give low rate discharge back into watercourse downstream of basin. May require further excavation to deepen/reshape basin to give optimum storage (Option E)
- Connect drainage from industrial park to larger attenuation pond on Carterton Road (Option F)
- Increase culvert capacity of culvert under Carterton Road (Option B)
- Carry out survey of 2 x 900mm culverts (option D)

Mid-Term (under 1 -2 years)

- Create a storage area in land to the north of Carterton road. This will contain flood flows arriving from the Masons Arms area, reducing flows to RAF Brize Norton and Create ditches to connect land drainage from affected properties to the north of Carterton Road to the storage area (Option A)
- Create a bypass channel/secondary ditch/swale linking flows from the Masons Arms/Carterton road crossing to the ditch downstream of the 2 x 900mm culverts (Option C)

7.4 Area 4 – Highmoor Brook

7.4.1 Maintenance

- Carry out channel and bed maintenance of Highmoor Brook (Option A)

7.4.2 Flood defence improvement scheme

Immediate (under 1 year)

- Flood- resilient measures on properties (Option C)
- Remove structures crossing Highmoor Brook where possible, re-size where required (Option D)
- Removal of dry stone wall at end of properties on east of Station Road as this will impede flood flows (see photo 15) (Option E)
- OCC to improve highway drainage (Option G)

Mid-Term (under 1 -2 years)

- Create a secondary, larger channel in the farmers field which then connects into the second ditch running in a south easterly direction across farmland to the Highmoor Brook at the back of properties (Option B)

Long term (3 years or more)

- TW to upsize the sewer system in Brize Norton (Option F)

Appendix I: Photographs

Kilkenny Lane/Rocky Banks Area I

Photo 1 – Flood Waters on Kilkenny Lane



Drainage ditch

Photo 2 – 600mm diameter culvert at Kilkenny Lane/Burford Road



Culvert entrance

Kilkenny Lane/rocky Banks Area I (cont...)

Photo 3 Kilkenny Lane at junction with Burford road in flood



Photo 4 – Kilkenny Lane at junction with Burford Road, illustrating poor highway drainage



Masons Arms (Area 2)

Photo 5, upstream catchment looking north from new A40 relief road



Photo 6, Burford Road at Masons Arms Pub

Water flowing from the upstream catchment, Photo 5, enters a culvert at the Masons Arms pub as illustrated in Photo 6.



Masons Arms (Area 2 cont...)

Photo 7 – Burford Road at Masons Arms

The blue dashed line shows the approximate location of the culvert carrying flows from the upstream catchment as shown in Photo 5 and 6 above



Masons Arms
pub

Photo 8 - Carterton Road to RAF Brize Norton (Area 3)

Culvert crosses road and links to drainage ditch running parallel to the attenuation pond. The shows litter and debris that builds up quickly in ditches flowing from Carterton. WODC propose that this drainage ditch links to the attenuation pond if TW release ownership to WODC



Carterton Road to RAF Brize Norton (Area 3) (cont...)

Photo 9 – Carterton North East attenuation pond



Photo 10 – Carterton North East attenuation pond



Carterton Road to RAF Brize Norton (Area 3) (cont...)

Photo 11 – Attenuation ponds serving industrial estate on Norton Way



Photo 12 – Attenuation ponds serving industrial estate on Norton Way



Carterton Road to RAF Brize Norton (Area 3) (cont...)

Photo 13 – Attenuation ponds serving industrial estate on Norton Way



Photo 14 - New culvert crossing into private land south of Carterton Road



Area 4 – Highmoor Brook

Photo 15 - Highmoor Brook at end of properties on Station Road. The channel is shown to split with some flow branching left to follow the Highmoor Brook and some carrying forward to join the highway ditch on the left hand side of Station Road



Wall which currently restricts flood flow

Photo 16 – Station Road at crossing on runway.
OCC have installed concrete lined grips at this location to improve road drainage

