# BISHOP TAWTON

## INITIAL ASSESSMENT

## FOR FLOOD MANAGEMENT OPTIONS

## FEBRUARY 2014

**Initial Assessments for Project Mandates – February 2014**

**Bishops Tawton**

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| **Version** | **Amendments made:** | **Date** | **Authored** | **Reviewed** |
| 1.0 | Original version – for Consultation with BTPC | 19/02/2014 | Simon Dart | |
| | | | | |

# 1.0 Background

## 1.1 Introduction

Bishop Tawton is a village 2 miles southwards of Barnstaple along the River Taw. Approximately 20 properties lie along the Venn Stream and are risk of flooding from the River Taw (tidal and fluvial) and Venn Stream.

## 1.2 Existing Flood Defences

Bishop Tawton flood scheme was built in the 1980's to protect against tidal flooding with some adjustment at the top near Mill Cottages to take account of the fluvial risks. These defences were built as part of the overall scheme for the River Taw Banks and Barnstaple. The design defence level was 6.3mAOD [(metres above ordnance datum) (6.00mAOD flood level+0.3m freeboard)] which provided a 1 in 30 year standard of protection (SOP - as thought at that time). Most of the current defences have a level between 6.4-6.5mAOD.

Note: - 1 in 30 year storm has a 3.33% chance of happening in any one year. It can happen more than once in a year or every year for 10 years. A 1 in 100 year flood has a 1% chance of happening each and every year.

## 1.3 Modelling available

The Barnstaple flood modelling (2010) covers both the tidal and fluvial effects of the River Taw and Venn Stream. The different scenarios model Qmed floods (annual event) against large tidal events and fluvial events against HAT (Highest Astronomical Tide). The scenarios also include flooding taking into account sea level rise (in the year 2070 & 2115) and increasing fluvial flows (+20%) to allow for the impact of climate change

## 1.4 Recent, ongoing or planned work on the existing scheme

Minor works/repairs by our AP (Asset Performance) team are being carried out in the Mill Cottage area. This includes he build of a new wall adjacent to Valley Cottages.

# 2.0 Problem

## 2.1 2012 Flood details (report outputs)

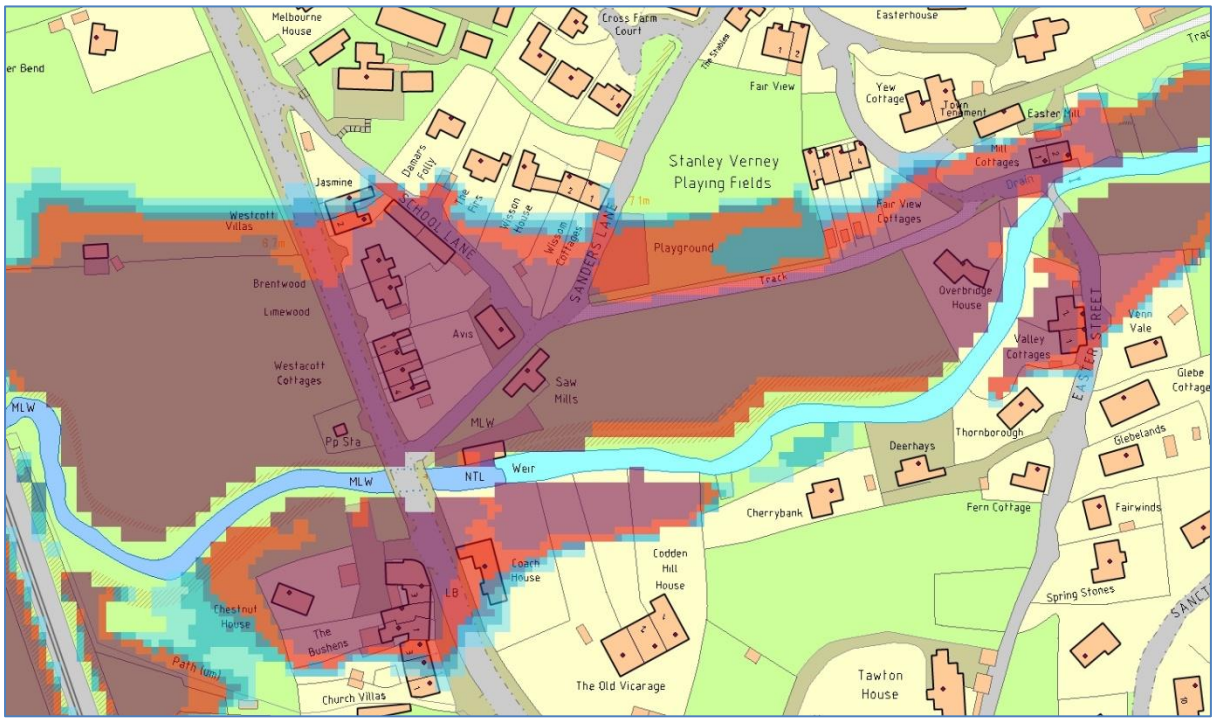
See flood report Appendix

## 2.2 Properties at risk – details

Over the past 15 years 16 properties have been affected more than once, from a combination of tidal, fluvial and surface water flooding to significant depths (greater than 300mm).

Flood mapping shows 21 properties (plus garages) are at risk in a current combined tidal or fluvial design event (100yr River –Taw and Venn or 200yr Tidal Storms).

In the future (in the year 2115) 23 properties and additional garages are at risk during a 1 in 200 year storm or 0.5% chance of happening in any year. These depths are an extreme flood hazard and shown below.




## 2.3 Sources of flooding

The area is at risk from tidal, fluvial and surface water flooding. Most historical events have featured a surface water element, which becomes trapped behind the defence (along with any overtopping entering the low lying areas). The River Taw (tidal or fluvial) also has a major effect on flows along the Venn Stream by 'backing up' the smaller stream flows.

## 2.4 Flooding history

Bishops Tawton has a long history of flooding with our records going as far back as the 1960's. In the past 15 years parts of the village have flooded in 2000, 2008, and 2012 from a combination of surface water, fluvial and tidal flows. The Barnstaple modelling suggest a less than 20 year SOP, whilst the flood history back to the 1960's suggest 1 in 5 - 10 year standard even with the current defences (20-10% chance each year of flooding). The flood defence scheme has a substantial gap in the defences in front of Westcott cottages. The A377 main road acts as the defence and is as low as 5.9mAOD in places letting water weir over into the lower village.

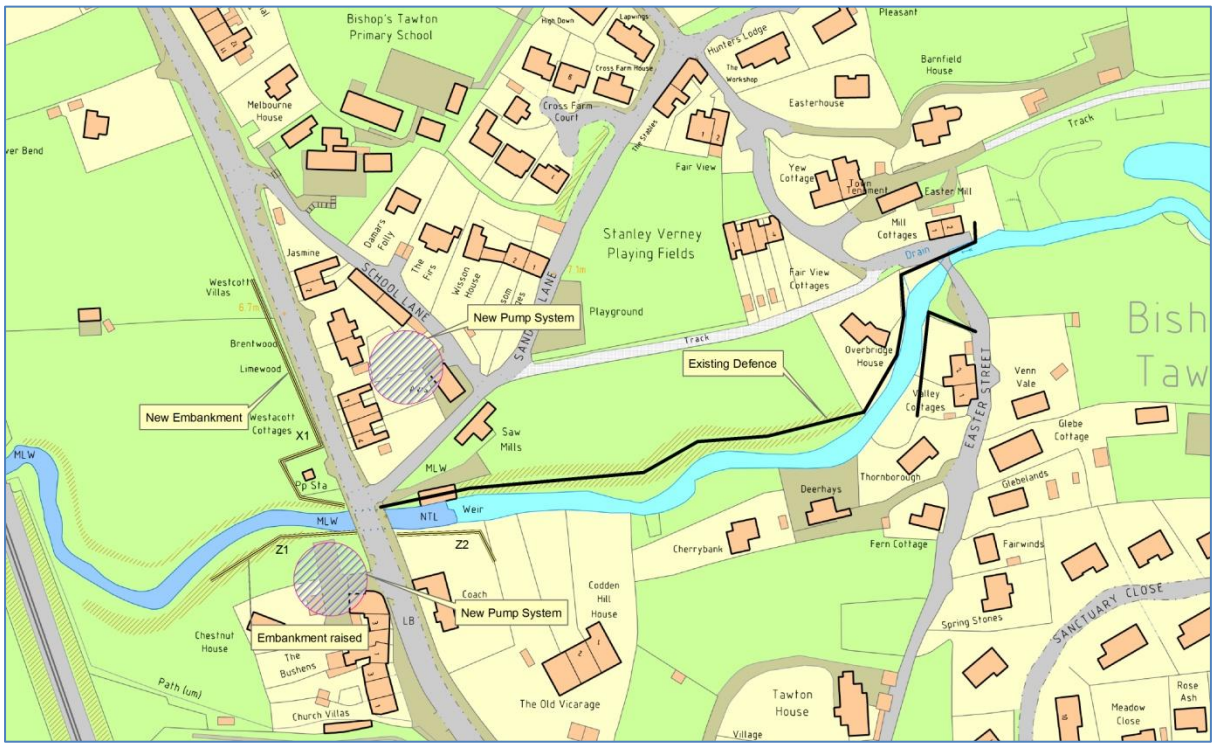
The combined fluvial risks from the River Taw and Venn Stream are worse than the tidal risks alone.

## 3.0 Potential options/solutions

Numerous options have been looked at in the previous flood reports (1990 & 2002). This report has only looked at the feasible (technical/financial) options, that also deals with the surface water flooding. The appendix discusses the issues of bridge capacity, dredging and embankment removal. All options below are only indicative and defence lines are an approximation.

### 3.1 Option 1

This will provide a new flood barrier (wall or embankment) alongside the Main Road on the field side (same level as the current scheme 6.5mAOD). Minor land raising on the southern bank is also required. Surface water will be dealt with by others with SW pumps but costs are included in this option. The black lines show current defences that will remain the same




### 3.2 Options 2 - 4

These 3 options offer increasing standard of protections (inc. climate change) with new/raised flood defences, and surface water 'defences' based on the three sub options (A, B & C). Option 2 – 30yrCC SOP (3.33% chance), Option 3 – 50yrCC SOP (2% chance), Option 4 – 100yrCC SOP (1% chance).

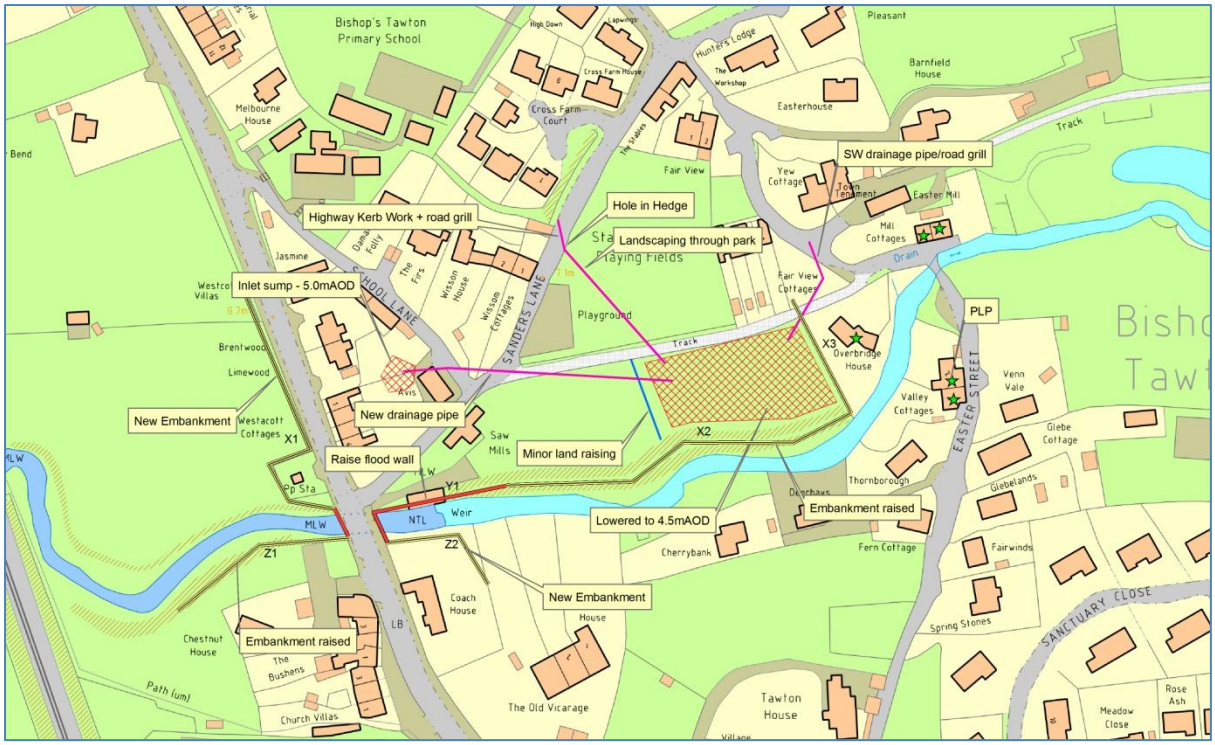
The number of properties protected ranges from 17 – 23 depending on the option and sub option chosen.

### 3.3 Sub option A – River Bend

The upper village (Mill Cottages, Valley Cottages and Overbridge house) is not offered any betterment in this sub option. Flood risk improvement would be through additional Property Level Protection (PLP), separate to this scheme.

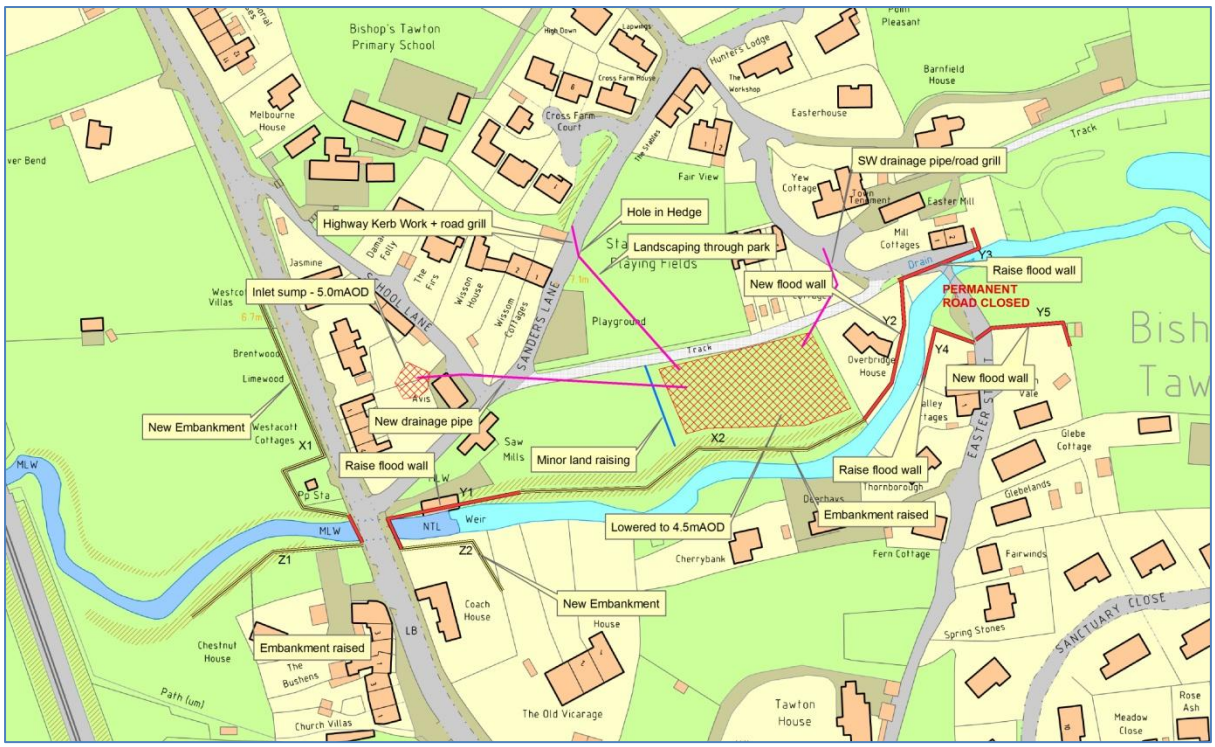

### 3.4 Sub Option B – Paddock

The upper village (Mill Cottages, Valley Cottages and Overbridge house) is not offered any betterment against fluvial/tidal flooding in this sub option. Flood risk improvement would be through additional Property Level Protection (PLP), separate to this scheme. Although some surface water flooding betterment is offered to the area near Mill Cottages.



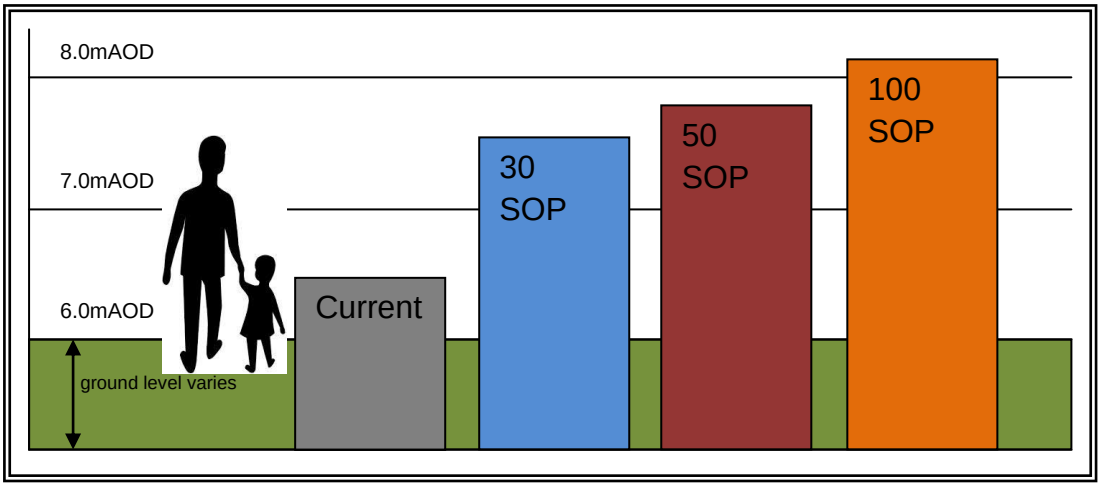

## 3.5 Sub Option C – Paddock + Road Closure Upper Village Protected

The upper village (Mill Cottages, Valley Cottages and Overbridge house) is covered within the scheme. However this would require Easter Street to be permanently blocked for vehicular traffic. Pedestrian access over the walls would be retained.



### 3.6 Required Defence Level/Heights

| | Option 1 Current scheme | 30 yr SOP | 50 SOP | 100 SOP |
|---|---|---|---|---|
| Current Average level mAOD | 6.0-6.5 | | | |
| Required Defence Level mAOD | 6.5 | 7.5 | 7.7 | 8.1 |
| Average height above the ground - m | 0.5- 1m | 1-2.5m | 1.2 -2.7 | 1.6 -3.1 |




### 3.7 Surface Water Drainage

It seems technically feasible that an area could be created in the River Bend field or the Paddock where surface water from behind Westacott Cottages (5.0mAOD) could drain to. The fields would have to be lowered by about a metre (to 4.5mAOD) but the spoil could be used to create embankments. Potential housing/village developments may offer significant contributions, if the current proposals continue.

The area contributing surface water flow is approximately 8 hectares with, say 45mm of rain in an event gives a volume of 3600m3. Option A River Bend has an approximate capacity at 0.5m deep of 750m3, Options B & C Paddock have an approximate capacity at 0.5m deep of 1000m3. Further work would be required on the overall design of the surface water issues. This may include redirecting some highway water outside of the 'protected' area, from the northern side of the village.

The surface water works will isolate the properties from the foul/combined system, using non return values, temporary storage areas and pumps.

The houses to the south of the river would need works to the current tidal flaps/pipes. However if the current local system is given relief from the works on the other side of the river, then any betterment should be passed on to this side of the river.

Surface water runoff down Sanders Lane will be redirected towards the playing fields and into the paddock in options B and C.

## 3.8 Flood warning

In may be feasible to offer a flood warning option based on Swimbridge (Venn Stream), Umberleigh (River Taw) and predicted/recorded tide levels. It would have to be based on IF..AND..OR system The Venn stream is a fast responding river but would offer some warning perhaps 0.5 hours. However this will require better analysis of past events, upgrading of the Swimbridge monitoring station and perhaps a new monitor in the village. This option has not been costed or explored in any greater detail at this stage.

## 4.0 Technical, site constraints, assumptions

No discussion with land owners has taken place, and no costs for any land purchases/compensation have been included in the total cost. The options only show the indicative location of new defences, based upon current known information.

### 4.1 Cost and benefit estimates and PF (Partnership Funding) calculations

A full cost breakdown of each option is available in the appendix.

The following table assumes a £200k local levy, £100k from DCC (£50k)/SWW (£50k) and £100k from private developers.

Note :-* These figure assume a lower unit cost for the embankment fill, which is used in all other options.

| | **Option 2 30 SOP** | Option 2 30 SOP* Local levy £129k | **Option 3 50 SOP** | Option 3 50 SOP* Local levy £175k | **Option 4 100 SOP** |
|---|---|---|---|---|---|
| **Sub Option A River Bend** | | | | | |
| PV Total Cost £k | **477** | 382 | **546** | 428 | **573** |
| PV Total Benefit £k | **1211** | 1211 | **1211** | 1211 | **1438** |
| B/C Ratio | **2.54** | 3.17 | **2.22** | 2.82 | **2.51** |
| PV Max FDGiA £k | **77** | 53 | **122** | 28 | **173** |
| Raw Score % | **25.63** | 32.04 | **22.42** | 28.56 | **32.24** |
| PF % | **158.8** | 230.7 | **84.04** | 433.6 | **106.77** |
| Local Levy to gain PF230% | **224** | - | **292** | - | **293** |
| | | | | | |

| **Sub Option B - Paddock** | **Option 2 30 SOP** | | **Option 3 50 SOP** | | **Option 4 100 SOP** |
|---|---|---|---|---|---|
| PV Total Cost £k | **502** | | **570** | | **761** |
| PV Total Benefit £k | **1211** | | **1211** | | **1438** |
| B/C Ratio | **2.41** | | **2.12** | | **1.89** |
| PV Max FDGiA £k | **102** | | **122** | | **185** |
| Raw Score % | **24.36** | | **21.45** | | **24.28** |
| PF % | **119.88** | | **71.93** | | **51.19** |
| Local Levy to gain PF230% | **249** | | **317** | | **481** |
| | | | | | |
| **Sub Option C Paddock + Road Closure** | **Option 2 30 SOP** | | **Option 3 50 SOP** | | **Option 4 100 SOP** |
| PV Total Cost £k | **819** | | **907** | | **1070** |
| PV Total Benefit £k | **1629** | | **1648** | | **1921** |
| B/C Ratio | **1.99** | | **1.82** | | **1.8** |
| PV Max FDGiA £k | **138** | | **163** | | **241** |
| Raw Score % | **16.91** | | **17.94** | | **22.49** |
| PF % | **33.04** | | **32.1** | | **35.92** |
| Local Levy to gain PF230% | **559** | | **636** | | **765** |
| | | | | | |
| **Option 1 -Existing Defence + SW pumps** | **Option 1 10 SOP** | | | | |
| PV Total Cost £k | **115** | | | | |
| PV Total Benefit £k | **806** | | | | |
| B/C Ratio | **7.0** | | | | |
| PV Max FDGiA £k | **45** | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Raw Score % | **38.9** | | | | |
| PF % | **68.78** | | | | |
| Local Levy to gain PF230% | **46** | | | | |
| **Assumes a £50k contribution from DCC/SWW and no local levy** | | | | | |

### 4.2 Issues and risks

**Individual options**

Option 1 only provides a small increase in the standard of protection to perhaps 1 in 10 years. The surface water drainage pumps although provided in the costing, would have a large ongoing maintenance cost (not included). The future ownership (and ongoing cost) is very unclear as neither SWW nor DCC are likely to take on this added duty. The Environment Agency is not responsible for surface water flooding. Other interest parties (Parish Council/local residents) may have to take on this responsibility.

This option would reduce flood frequency, but if a similar sized event to those in 2000 and 2012 happened again the defence would be overtopped significantly. The scheme would not affect the NaFRA banding which are used in insurance company's assessments.

Option 4 will provide the best protection but the height (1.6-3m) of the flood walls/embankments is large. This would affect properties and may not be acceptable to local residents.

Sub Options A and B do not offer any flood risk betterment to the Upper Village. Additional PLP (Property Level Protection) measures may need to be investigated by Devon County Council.

Sub Options C would require the permanent closure of a Highway. DCC have not been consulted on this possibility and works to the old bridge may be difficult.

**Issues effect all options**

No negotiations/consultants with landowners have taken place and no cost for purchases/rent etc included in the calculations.

Any negotiations with landowners who are losing their garden space may require flood walls in place of embankments which will increase costs.

Contributions may not arrive on time or at all from certain parties

The new drainage pipes may have technical difficulties with underground services and other obstructions.

The PLP (Property Level Protection) may be complicated or required building's walls to be made watertight, and DCC may not be able to offer assistance for several years, if at all.

### 4.3 Partnership/contributions opportunities

Given that both surface water, highway water and foul water causes flooding, contribution from South West Water and Devon County Council/North Devon Council should be feasible. We have assumed a contribution of £50K from DCC/NDC Highways/flood management and £50k SWW.

It may also be feasible to gain contributions from nearby developments. One proposal may be able to contribute a substantial amount (cash or works carried out ~£100K). Other potential sites could offer a "Local Infrastructure Contribution" as their surface water may run down into this area. This may work upon a levy of £/m2 on all new development within the village. This would need to be agreed between the Parish and District Councils.

## 5.0 Conclusions and recommendations

Discussions with the Parish Council and affected owners may refine the 'best options'.

Option 1 (although the cheapest) offers the smallest long term overall benefit to the Village. Climate change would soon reduce the SOP to its current levels and the surface water drainage problems may not be resolved.

Option 2A would reduce flood risk and the frequency of flooding to a far better level. It would also change the NaFRA banding which would aid insurance calculations. This scheme is also the cheapest (options 2-4 and sub option A, B & C) and could tie in with proposed new development in the river bend area.

**We recommend that following consultations with the Parish Council/residents, options 2A and 2B are progressed to the feasibility/design stage. Options 3 & 4 and sub option C should be also explored if funding is available.**

**Any new scheme would not stop flooding, it should however lessen the frequency (or chance) of it happening to those properties in the flood risk area.**

## 6.0 Appendices

### 6.1 December 2012 Flood Report

**See separate document.**

### 6.2 Dredging – "Extracts from *2012 position statement*"

The benefits of dredging on flood flows can be mixed depending on the river type and location. Any flooding will change the shape and level of stone/silt in the watercourse. The benefits of dredging done in one month can be removed the following month during a storm.

Without maintenance works, rivers will find their natural course and size. If a channel that has been made unnaturally wide is allowed to recover naturally, it will tend to narrow as silt and materials are deposited. As the channel narrows, velocity will increase until the material is no longer deposited. It is important to consider the natural fluvial processes when we are assessing the best way to maintain a river channel.

If the risk of flooding to people and property can be reduced by channel maintenance work then we will consider doing it. We will also look at other benefits, such as environment and infrastructure. We decide where to carry out channel maintenance work by considering if the works are:

- technically sound,
- economically viable,
- environmentally acceptable and sustainable.

When we decide to maintain a river we have to be sure that the work is necessary to reduce flood risk.

The Venn stream in the upper village could increase the channel capacity with some channel maintenance (including dredging). Dredging could lower parts of the stream by around 400mm and perhaps improve normal (non flood) flows (by say 25%). Any betterment during flood flows would significantly less perhaps as low as 1-5%. The backing up effect from the River Taw (or tide) would reduce most or all of the betterment, during a combined storm.

Dredging the Venn Stream would initially cost in the order of £30-40k, with expensive ongoing maintenance costs. These moneys cannot be justified on their own due to the limited benefits they might temporarily provide. The moneys as part of an overall scheme would be better spent providing permanent flood defences.

The River Taw dredging would initial cost £1-1.5m, with massive ongoing cost. The impact on the catchment would be enormous and offer little benefit to flood risk. The balance between benefit (lowering flood damage and frequency) and cost (spending of public taxes) is unviable.

### 6.3 Capacity of Bridges

A377 Main Road Bridge – There is concern that the capacity of the bridge is not enough to take the Venn Stream flood flows. If we consider just the Venn stream flows (no effect from the River Taw) then the bridge has a capacity of 40 m3/s (cubic metres per second). This would have an upstream water level of 6.3mAOD (just below the current defences). This offers a good standard of protection against the Venn Stream flooding alone.

However the River Taw does have an effect on the amount of water that can flow down the Venn Stream near the bridge. The River Taw water level prevents the bridge arch from working at its best capacity. Increasing the capacity of the existing arch or installing a second arch would have the same backing up problem, no matter how large it is. The cost of a second arch/culvert would be around £350k for little or no benefit in most types of flooding.

The upper village bridge "Landkey Bridge" adjacent to mill Cottages has a very small capacity, with flood water already bypassing it via the adjacent field. An additional arch/culvert would remove part of the overland flood route, and increase risks locally.

### 6.4 Removal of the Taw Banks

The removal of the river embankments on the Tawstock side has been explored more than once. The owner has been approached (several times) but is not interested in the proposal.

The project to remove existing flood banks throughout the River Taw is ongoing. However it is a complex project involving many landowners, interest parties and funding sources. The Agency may choose to stop maintaining some of the banks, however this would not prevent existing owner from carrying on their own maintenance.

To offer significant flood benefits to property, a significant length of flood bank would have to be removed. This would only help in smaller storm (say 5-10% chance) as they would be already overtopped during larger events (i.e. no new areas of storage)

### 6.5 Upstream Development and Runoff

All new development upstream in Landkey and Swimbridge (since May 2001 at least) must **have been designed not to increase rainfall runoff into the drainage system** (watercourses

or mains surface water systems). They keep the runoff rates the same as current by storing runoff rainwater in above or below ground 'tanks'. They have a control device which slows the runoff down to an agreed pre development rate. This spreads the runoff over a much larger period but at no faster than current runoff rates. During the planning application process the developer must produce a Flood Risk Assessment (or drainage statement) which provides details on the proposed drainage system (current runoff rates, storage volumes and future runoff rates) which are in accordance with national technical standards/guidance.

### 6.6 Increasing the floodplain along the Venn stream

Lowering the entire River bend field or removing the flood embankments around the paddock would increase flood storage. However this would only contain around 1-2% of the flood volume from just the Venn Stream (previous study in 1990s) and have minimal/small effect on the flood level. The River Taw or Tidal flooding would not be affected in any way by the increase in storage.

The embankment in sub option A could be moved closer to the stream to increase surface water storage, without a detrimental effect of the flood water levels. Although construction and maintenance costs would be increased as there would be a longer length to maintain.

### 6.7 Full Option Cost breakdown.

**Option 1 - Main Road Current Scheme + SW pumps**
**5-10yr Standard of Protection**

| Item | Type | unit | Cost per unit | Cost |
|---|---|---|---|---|
| X1 | New embankment - 100m | 352 | | |
| Z1 & 2 | Raise ground - 0-0.5m high 117m | 70.9 | | |
| | Total Volume | 422.9 | 94 | £ 39,753 |
| | | | | |
| | | | | |
| SW | Pump 1 - Lower Village North | 1 | 22000 | 22000 |
| | Pump 1 - Lower Village South | 1 | 22000 | 22000 |
| | | Total | | £ 44,000 |
| | | | **Option Cost** | **£ 83,753** |

**Option A - River Bend**

**30 Standard of Protection (inc. Climate change)**

| Item | Type | unit | Cost per unit | Cost |
|---|---|---|---|---|
| X1 | New embankment - 122m | 1665 | | |
| X2 & 3 | Raise Embankment - 80m | 726 | | |
| Z1 & 2 | Raise ground - 1- 1,45m high 117m long | 786 | | |
| | Total Volume | 3177 | 94 | £ 298,638 |
| | | | | |
| Y1 | Raise Wall - 1.0m high - 40m | 40 | 1500 | £ 60,000 |
| SW | Pipe 1 - 55m - complex install | | | 18000 |
| | Pipe 1 - Inlet/outlets | 2 | 2000 | 4000 |
| | Pipe 2 - 60m - easy install | | | 5000 |
| | Pipe 3 - Inlet/outlets | 2 | 2000 | 4000 |
| | | Total | | £ 31,000 |
| | | | **Option Cost** | **£ 389,638** |

**Option A - River Bend**

**50 Standard of Protection (inc. Climate change)**

| Item | Type | unit | Cost per unit | Cost |
|---|---|---|---|---|
| X1 | New embankment - 122m | 2000 | | |
| X2 & 3 | Raise Embankment - 80m | 897 | | |
| Z1 & 2 | Raise ground - 1.25-1.65m high 117m long | 1013 | | |
| | Total Volume | 3910 | 94 | £ 367,540 |
| | | | | |
| Y1 | Raise Wall - 1.2m high - 40m | 40 | 1500 | £ 60,000 |
| SW | Pipe 1 - 55m - complex install | | | 18000 |
| | Pipe 1 - Inlet/outlets | 2 | 2000 | 4000 |
| | Pipe 2 - 60m - easy install | | | 5000 |
| | Pipe 3 - Inlet/outlets | 2 | 2000 | 4000 |
| | | Total | | £ 31,000 |
| | | | **Option Cost** | **£ 458,540** |

**Option A - River Bend**
**100 Standard of Protection (inc. Climate change)**

| Item | Type | unit | Cost per unit | Cost |
|---|---|---|---|---|
| X1 | New embankment - 122m | 2760 | | |
| X2 & 3 | Raise Embankment - 80m | 1297 | | |
| Z1 & 2 | Raise ground - 1.65-2.02m high 145m long | 1926 | | |
| | Total Volume | 5983 | 64 | £ 382,912 |
| | | | | |
| Y1 | Raise Wall 1.6m high- 40m | 40 | 1800 | £ 72,000 |
| SW | Pipe 1 - 55m - complex install | | | 18000 |
| | Pipe 1 - Inlet/outlets | 2 | 2000 | 4000 |
| | Pipe 2 - 60m - easy install | | | 5000 |
| | Pipe 3 - Inlet/outlets | 2 | 2000 | 4000 |
| | | Total | | £ 31,000 |
| | | | **Option Cost** | **£ 485,912** |

**Option B - Paddock**
**30 Standard of Protection (inc. Climate change)**

| Item | Type | unit | Cost per unit | Cost |
|---|---|---|---|---|
| X1 | New embankment - 122m | 1625 | | |
| X2 & 3 | Raise Embankment 194m | 2655 | | |
| Z1 & 2 | Raise ground - 1- 1,45m high 117m long | 786 | | |
| | Total Volume | 5066 | 64 | £ 324,224 |
| | | m3 | | |
| Y1 | Raise Wall - 1.0m high - 40m | 40 metres | 1500 | £ 60,000 |
| SW | Pipe 1 - 110m - complex install | | | 18000 |
| | Pipe 1 - Inlet/outlets | 2 | 2000 | 4000 |
| | new inlet | 1 | 2000 | 2000 |
| | Hedge works + highway kerbs | | 6000 | 6000 |
| | | Total | | £ 30,000 |
| | | | **Option Cost** | **£ 414,224** |

**Option B - Paddock**

**50 Standard of Protection (inc. Climate change)**

| Item | Type | unit | Cost per unit | Cost |
|---|---|---|---|---|
| X1 | New embankment - 122m | 1952 | | |
| X2 & 3 | Raise Embankment - 194m | 3166 | | |
| Z1 & 2 | Raise ground - 1.25-1.65m high 117m long | 1013 | | |
| | Total Volume | 6131 | 64 | £ 392,384 |
| | | | | |
| Y1 | Raise Wall - 1.2m high - 40m | 40 | 1500 | £ 60,000 |
| SW | Pipe 1 - 110m - complex install | | | 18000 |
| | Pipe 1 - Inlet/outlets | 2 | 2000 | 4000 |
| | new inlet | 1 | 2000 | 2000 |
| | Hedge works + highway kerbs | | 6000 | 6000 |
| | | Total | | £ 30,000 |
| | | | **Option Cost** | **£ 482,384** |

**Option B - Paddock**

**100 Standard of Protection (inc. Climate change)**

| Item | Type | unit | Cost per unit | Cost |
|---|---|---|---|---|
| X1 | New embankment - 122m | 2694 | | |
| X2 & 3 | Raise Embankment - 194m | 4315 | | |
| Z1 & 2 | Raise ground - 1.65-2.02m high 145m long | 1926 | | |
| | Total Volume | 8935 | 64 | £ 571,840 |
| | | | | |
| Y1 | Raise Wall 1.6m high- 40m | 40 | 1800 | £ 72,000 |
| SW | Pipe 1 - 110m - complex install | | | 18000 |
| | Pipe 1 - Inlet/outlets | 2 | 2000 | 4000 |
| | new inlet | 1 | 2000 | 2000 |
| | Hedge works + highway kerbs | | 6000 | 6000 |
| | | Total | | £ 30,000 |
| | | | **Option Cost** | **£ 673,840** |

**Option C - Paddock + road closure**

**30 Standard of Protection (inc. Climate change)**

| Item | Type | unit | Cost per unit | Cost |
|---|---|---|---|---|
| X1 | New embankment - 122m | 1625 | | |
| X2 | Raise Embankment 194m | 2604 | | |
| Z1 & 2 | Raise ground - 1- 1,45m high 117m long | 786 | | |
| | Total Volume | 5015 | 64 | £ 320,960 |
| | | m3 | | |
| Y1 | Raise Wall - 1.0m high - 40m | 40 | 1500 | £ 60,000 |
| Y2 | New Wall - 1.2m high - 55m | 55 | 1500 | £ 82,500 |
| Y3 | Raise Wall - 1.0m high - 46m | 46 | 1500 | £ 69,000 |
| Y4 | Rasie Wall - 1.0m high - 65m | 65 | 1500 | £ 97,500 |
| Y5 | New Wall - 2m high - 40m | 40 | 1800 | £ 72,000 |
| | | metres | | £ 381,000 |
| SW | Pipe 1 - 110m - complex install | | | 18000 |
| | Pipe 1 - Inlet/outlets | 2 | 2000 | 4000 |
| | new inlet | 1 | 2000 | 2000 |
| | Hedge works + highway kerbs | | 6000 | 6000 |
| | | Total | | £ 30,000 |
| | | | **Option Cost** | **£ 731,960** |

**Option C - Paddock + road closure**

**50 Standard of Protection (inc. Climate change)**

| Item | Type | unit | Cost per unit | Cost | |
|---|---|---|---|---|---|
| X1 | New embankment - 122m | 1952 | | | |
| X2 & 3 | Raise Embankment - 194m | 3166 | | | |
| Z1 & 2 | Raise ground - 1.25-1.65m high 117m long | 1013 | | | |
| | Total Volume | 6131 | 64 | £ | 392,384 |
| | | | | | |
| Y1 | Raise Wall - 1.0m high - 40m | 40 | 1500 | £ | 60,000 |
| Y2 | New Wall - 1.5m high - 55m | 55 | 1600 | £ | 88,000 |
| Y3 | Raise Wall - 1.5m high - 46m | 46 | 1600 | £ | 73,600 |
| Y4 | Rasie Wall - 1.5m high - 65m | 65 | 1600 | £ | 104,000 |
| Y5 | New Wall - 2.5m high - 40m | 40 | 1800 | £ | 72,000 |
| | | metres | | £ | 397,600 |
| SW | Pipe 1 - 110m - complex install | | | | 18000 |
| | Pipe 1 - Inlet/outlets | 2 | 2000 | | 4000 |
| | new inlet | 1 | 2000 | | 2000 |
| | Hedge works + highway kerbs | | 6000 | | 6000 |
| | | Total | | £ | 30,000 |
| | | | **Option Cost** | **£** | **819,984** |

**Option C - Paddock + road closure**

**100 Standard of Protection (inc. Climate change)**

| Item | Type | unit | Cost per unit | Cost |
|---|---|---|---|---|
| X1 | New embankment - 122m | 2694 | | |
| X2 & 3 | Raise Embankment - 194m | 4315 | | |
| Z1 & 2 | Raise ground - 1.65-2.02m high 145m long | 1926 | | |
| | Total Volume | 8935 | 64 | £ 571,840 |
| | | | | |
| Y1 | Raise Wall - 1.0m high - 40m | 40 | 1500 | £ 60,000 |
| Y2 | New Wall - 1.2m high - 55m | 55 | 1500 | £ 82,500 |
| Y3 | Raise Wall - 1.0m high - 46m | 46 | 1500 | £ 69,000 |
| Y4 | Rasie Wall - 1.0m high - 65m | 65 | 1500 | £ 97,500 |
| Y5 | New Wall - 2m high - 40m | 40 | 1800 | £ 72,000 |
| | | metres | | £ 381,000 |
| SW | Pipe 1 - 110m - complex install | | | 18000 |
| | Pipe 1 - Inlet/outlets | 2 | 2000 | 4000 |
| | new inlet | 1 | 2000 | 2000 |
| | Hedge works + highway kerbs | | 6000 | 6000 |
| | | Total | | £ 30,000 |
| | | | **Option Cost** | **£ 982,840** |