

CLACKMANNANSHIRE COUNCIL



River Devon at Elistoun Drive, Tillicoultry 25/01/08

BIENNIAL REPORT – November 2007
As required by
THE FLOOD PREVENTION AND LAND DRAINAGE
(SCOTLAND) ACT1997

Contents

1.0	Introduction	Page
2.0	Legislation & Policy	Page
2.1	Interpretation of Covering Legislation	Page
2.2	Statement of Policy & Actions	Page
3.0	Inventory of Watercourses	Page
4.0	Flooding Occurrences and Problems	Page
4.1	Flooding Occurrences (by Town)	Page
4.2	Flooding Problems and Mitigation Measures Installed since November 2007 (by Town)	Page
5.0	Proposed Mitigation Measures	Page
5.1	Maintenance Programmes	
5.2	Prioritised Watercourse Inspection and Clearance Regime	Page
5.3	Principal Watercourse Audits and Work Implementation Plans	Page
5.4	Proposed Works	Page
6.0	Environmental and Sustainability Issues.	Page
7.0	Flood Warning for Clackmannanshire	Page
7.1	Development of Flood Warning System.	Page
7.2	Updated Flood Warning Procedure and Action Plans.	Page
8.0	Investment Since April 2007	Page

1.0 INTRODUCTION

This report is published to meet Clackmannanshire Council's duty under section 6A of *The Flood Prevention (Scotland) Act 1961*¹ as inserted by section 3 of *The Flood Prevention & Land Drainage (Scotland) Act 1997*². The report covers the time elapsed since the production of the last *Biennial report (November 2005)*³.

The report will specify:

- all known occurrences of flooding of land, not being agricultural land, within the Council area since the last biennial report in November 2007;
- the measures that the Council has taken since November 2007 to prevent or mitigate flooding of such land; and
- the measures that the Council considers it requires to take to prevent or mitigate the flooding of land in the Council area.



Photo 1 – River Devon over tops its north bank at Sterling Mills, Tillicoultry – 14/12/06

The report will also:

- summarise legislation and current Council policy;
- provide an inventory of watercourses;
- consider associated environmental issues; and
- describe the flood warning measures presently under development.

Points to note:

- In broad terms, flooding of non-agricultural property in Clackmannanshire can normally be attributed to blockage of, or obstruction within, watercourses, inadequate capacity of watercourses or surface water drainage systems and increasingly through the effects of climate change.

Points to note (cont):

- Although possible causes of flooding of property are referred to and offered as examples in this report, it is important to note that although the Council has a duty to inspect and maintain watercourses, it has limited funds to improve the physical capacity of watercourses. *The Flood Prevention & Land Drainage (Scotland) Act 1997*² bestows a duty on Local Authorities to ensure the maintenance of those watercourses likely to affect non-agricultural property. There is no duty to instigate new works to increase the capacity of a watercourse; however the local authority is given the necessary powers to implement such measures as may be appropriate.
- The Council has adopted a “prioritised watercourse assessment” methodology in carrying out maintenance functions to improve inspection and maintenance regimes. However, it should be noted that the “riparian” duties of all landowners still apply in Scotland. This means that all landowners retain the responsibility to ensure their land is protected from flooding, but in doing so, they must not act in a manner that may increase flood risk to other landowners. Where appropriate, works may be carried out by the Council in partnership with landowners.

2.0 LEGISLATION AND POLICY

2.1 Interpretation of Covering Legislation

Prior to 1997 it had become apparent that much of the flooding in Scotland was caused as a result of poor maintenance of watercourses. The, often innumerable, riparian landowners along a watercourse could not always be relied upon to carry out appropriate and regular maintenance works. The result was that many areas suffered from localised flooding during extreme weather events, most instances of which might have been averted had appropriate maintenance been carried out. This situation highlighted a need to place the statutory responsibility to ensure the maintenance of watercourses onto a single body.

*The Flood Prevention (Scotland) Act 1961*¹ gave Local Authorities the necessary powers to carry out measures for the prevention or mitigation of flooding of non-agricultural land. The Act bestowed powers to enter land and to carry out maintenance works to watercourses with further powers to improve and alter a watercourse under a Flood Prevention Order.

The introduction of *The Flood Prevention & Land Drainage (Act) 1997*² amends the powers of the 1961 Act and places the following duties on Local Authorities:

- assessment of watercourses in their area from time to time to ascertain whether any watercourse is in a condition that may cause flooding to non-agricultural land;
- cleansing, repairing and otherwise maintaining watercourses, barriers, embankments, other flood defence infrastructure and other ancillary apparatus such as screens, overflow runs etc.

- preparation and publishing of biennial reports specifying; the measures which they consider necessary to prevent or mitigate the flooding of non-agricultural land in their area; the measures which they have taken since the date of publication of their previous report to prevent or mitigate the flooding of such land and all occurrences of flooding of such land since that date.

The 1997 Act does not apply where failure to maintain a watercourse would cause flooding to land in the same ownership as the said watercourse.

The Council has adopted a programme of cyclical watercourse inspection and maintenance. This includes inspection and clearance of watercourses and at times planned sediment and vegetation removal. An inventory of watercourse infrastructure and ancillary apparatus has been completed for most of the principal watercourses in the council area and works implementation plans have been prepared. The following section describes progress on policy and actions.

2.2 Statement of Policy & Actions

Introduction

The purpose of this statement is to explain the methods used by Clackmannanshire Council to comply with its duties under *The Flood Prevention and Land Drainage (Scotland) Act 1997*². The responsibility lies within Development & Environmental Services and in particular with the Roads & Transportation Unit. The Policy and Implementation Unit has responsibility for promoting sustainable flood prevention through the planning process.

The 1997 Act places the responsibility for the assessment and maintenance of watercourses on the Local Authority. There is, however, no duty placed on the local authority to improve the capacity of watercourses.

The maintenance work currently carried out by Clackmannanshire Council, as a result of the assessment of watercourses, falls into the following four categories; clearing of debris from watercourses ; maintenance of walls, banks and other structures that form watercourses ; development of a flood warning system and improvement of infrastructure aimed at preventing / limiting further flooding and reducing the need for maintenance.

Development of Flood Prevention Strategy

Policy FP1

'The Council shall develop watercourse assessment and inspection procedures annually building on the previous year's progress'

Subsequent to the 1997 Act, Clackmannanshire Council took advice from flood prevention consultants regarding the best way to develop a watercourse maintenance and flood prevention strategy. The Council was advised that the development of such a strategy would take a number of years. The recommended course of action was to start by identifying and listing the watercourses, assessing the flood risk and the propensity of each section of watercourse to be affected by debris and hence to set up a cyclical programme of watercourse inspection and clearing. Each year the scope of assessment should be widened incrementally to gather more information.

Clearing of Debris

Policy FP2

'The Council shall take appropriate action to ensure that watercourses are routinely cleared of loose debris to reduce the risk of flooding to non-agricultural land'

Between 1997 and 2002 the entire lengths of all watercourses that could potentially affect non-agricultural land were inspected at least once each year. This inspection regime resulted in appropriate clearance works being carried out. During this time ad hoc inspections of known problem sites were carried out at regular, short intervals. During 2003 this information was analysed and together with an increasing understanding of the local hydrological characteristics it was possible to identify the appropriate priority to be placed on particular sections of each watercourse. From this a "Prioritised Inspection and Clearance Regime" ⁴ was developed. This is continually monitored and amended to ensure that all watercourses receive optimum attention.

Initially the clearance operations involved the removal of loose vegetation, tree material and the detritus from fly tipping. During 2002 this was extended to assessment of silt and coarse sediments within watercourses where these were considered to be adversely affecting the capacity of the watercourse channel. *Watercourse Audits and Work Implementation Plans* ⁵ were developed during 2006 for the principal watercourses in the Council area with the clear principle in mind to ensure that any resulting site works have minimal adverse affect on local biodiversity. Similar improvement Audits will be completed for priority un-named watercourses during 2007/08.

Maintenance of Banks, Walls, Culverts and other Infrastructure

Policy FP3

'The Council shall continue to develop a database of watercourse walls, banks and other infrastructure and set up a programme of routine maintenance where lack of maintenance might increase the risk of flooding to non-agricultural land'

The Council carries out two yearly inspections of all bridges that carry adopted roads and three yearly inspections of all other bridges with spans greater than 2

metres, over watercourses. These inspections assess the structural integrity of the bridges, the condition of adjacent banks and training walls and any issues relating to debris in the adjacent section of watercourse. This information is utilised in the watercourse assessment and clearance regime.

Prior to the 1997 Act the watercourses had suffered from an extended period of poor maintenance by riparian landowners. This left a legacy of problems for the local authority. Initially maintenance work was carried out mainly at sites where structural failure had already occurred. As already mentioned, the Council has now completed the *Watercourse Audits and Work Implementation Plans*⁵ for the principal burns in the Council area assessing the structural integrity of banks, walls, culverts, vegetation and coarse sediments within or affecting watercourses. A Watercourse Vegetation Management Plan for the audited watercourses has been developed as a result of these audits and although the resultant vegetation clearance works do not require direct authorisation from the Scottish Environment Protection Agency (SEPA) through *The Water Environment (Controlled Activities) (Scotland) Regulations 2005*¹⁶ prior consultation will take place with other interested parties to ensure best practice. These *Watercourse Audits and Work Implementation Plans*⁵ have helped populate a “Watercourse Infrastructure Database” and also generate watercourse maintenance improvement programmes. The production of these documents were aims set out the Council’s *Biennial Report of 2005*³.

Watercourse and flood related survey and assessment work is continuing and the Council has commissioned a number of reports relating to specific watercourses or sections of watercourses. *Tillicoultry Burn Flood Assessment (2006)*⁶ *Elistoun Drive Flood Alleviation Study - Tillicoultry (2007)*⁷ and *Gavins Road / Woodburn Drive Flood Alleviation Study – Alloa (to be published 2007)*⁸ call for suitable improvement works at these particular locations to reduce flood risk. Subsequent more detailed hydrological studies have been completed for the Alva and

Tillicoultry Burn catchments since November 2005, namely *Alva School Site Flood Risk Assessment (2006)*⁹ and *Tillicoultry Burn Flood Assessment (2006)*⁶.

Flood Warning System

Policy FP4

'The Council shall develop a flood warning system and related action plans'

The Clackmannanshire Council area is significantly influenced by the catchment of the River Devon and to a lesser degree by the catchment of the River Black Devon. The geomorphology of the River Devon catchment means that rain falling on the Ochil Hills reaches the urban areas very quickly via the steep escarpment above the Hillfoots towns and villages. This renders the provision of, nationally recommended, effective three-hour flood warning to some parts of Clackmannanshire impractical.

Nevertheless Clackmannanshire Council has instigated the development of a Flood Warning System. Utilising the recommendations of a study of the *Flood Generation Processes in Clackmannanshire Council Area (2003)*¹⁰ a system of river gauges was installed during 2003 and an automated river gauging station has been installed on the upper reaches of the River Devon at North Fossoway Bridge. A hydrology consultant has been monitoring these river gauges and the data supplied by the gauging station for several years and has analysed the data with a view to developing a robust flood warning system for the River Devon and its catchment. The final automated alarm system will be installed and be operational before the end of 2007.

The above report highlighted that the burns through Menstrie, Alva and Tillicoultry are likely to be most susceptible to flash events and it is therefore unlikely that reasonable advance warning can be provided for these towns.

Until the automated Flood Warning system comes into use, the Council will utilise the various flood warnings and adverse weather warnings issued by the media, SEPA and the Met Office to inform its actions in accordance with its *Flood Warning Procedures and Action Plans* (section 7.0) ¹¹.

Flood Alleviation Works

Policy FP5

'The Council shall develop a prioritised list of flood prevention works aimed at minimising the risk of flooding to non-agricultural land and reducing cyclic maintenance costs'

Small-scale flood alleviation works aimed at maintaining the functional integrity of watercourse channels are carried out where required. The works were initially mainly generated as a result of flood events. Now that the watercourses have been identified, inspection and clearance regimes are in place and an audit of the principal watercourses have been undertaken, the Council intends to assess potentially problematic watercourse channels to identify areas where overtopping of banks, either occurs or may be likely to occur, during high rainfall events.

3.0 INVENTORY OF WATERCOURSES

The following are the principal watercourses, which flow through the Clackmannanshire Council Area: -

Ref	Watercourse	Affected Community	OS Ref U/S End	OS Ref D/S End	Length (Km)
R - 01	River Devon	South side of Dollar, Tillicoultry, Alva, Menstrie and Cambus	963 976	853 940	6.8km
R - 02	River Black Devon	Clackmannan and east of Alloa	916 923	906 923	1.3km
B - 01	Brothie Burn	Alloa	912 939	887 915	4.0km
B - 02	Sauchie Burn	Sauchie	885 944	896 933	1.5km
B - 03	Fairy Burn	Alloa	871 944	889 929	2.2km
B - 04	Goudnie Burn	Clackmannan	924 914	915 923	1.4km
B - 05	Menstrie Burn	Menstrie	849 971	850 959	1.2km
B - 06	Dams Burn	Victoria Terrace, east Menstrie	856 971	857 968	0.2km
B - 07	Alva Burn	Alva	886 976	883 962	1.0km
B - 08	Carnaughton Burn	West side of Alva	878 975	877 965	0.3km
B - 09	Spring Burn	East side of Alva	888 969	889 965	0.5km
B - 10	Silver Burn	East side of Alva	892 974	889 965	0.6km
B - 11	Tillicoultry Burn	Tillicoultry	912 977	910 964	1.0km
B - 12	Kirk Burn	East side of Tillicoultry	923 978	926 967	1.1km
B - 13	Quarrel Burn	West side of Dollar	954 984	954 987	0.7km
B - 14	Dollar Burn	Dollar	961 989	964 969	1.6km
B - 15	Kelly Burn	East side of Dollar	970 990	965 973	1.6km

3.1 Descriptions of Principal Watercourses

River Devon

The River Devon rises in the Ochil Hills to the north of the area and flows east to west. The catchment comprises a mountainous upper catchment and a lower floodplain. The main river and some smaller tributaries on the upper catchment have been developed as part of the public water supply by forming three large reservoirs (Upper Glen Devon (NN 908 045), Lower Glen Devon (NN 931 048) and Castlehill (NN 996 033)). These reservoirs are operated and controlled by Scottish Water. The River Devon floodplain is confined by the Ochil Hills to the north and by low hills to the south. The River Devon flows off the upper catchment of the Ochil Hills as an energetic and turbulent river but slows rapidly when it reaches the floodplain.



Photo 2 – High River Levels on the River Devon south of Alva – 13/12/06

River Black Devon

The River Black Devon flows from east to west through the northern edge of Clackmannan. It rises as a series of small tributaries in low lying hills to the east and outwith the Council area. The river flows through a steeply incised valley as it passes through Clackmannan (the River Black Devon is culverted beneath the A907, Clackmannan By-pass (NS 915 923)) with the majority of development being set away from its banks. It then flows into the River Forth through agricultural land to the south of Clackmannan (NN 896 904).

The Hillfoots Burns

The principal Hillfoots Burns are, **Menstrie Burn, Alva Burn, Tillicoultry Burn and Dollar Burn**. They rise in the Ochil Hills and typically flow southwards down steep channels, often through sections of inaccessible gorge, over the major escarpment that forms the south face of the Ochil Hills. The burns meet the floodplain at their eponymous towns. The channels of some of these burns have been greatly modified on their passage through the Hillfoots settlements. Most of this work was carried out during the development of the former mills so that water could be drawn off the burns to provide for the industry. The mills are now closed but the burns remain largely in their modified condition with straightened channels, banks protected with masonry walls, sills constructed across the burn beds and bridges and culverts constructed across the channels. Menstrie, Alva and Tillicoultry were originally constructed on the alluvial fans at the base of the escarpment but in later years development has moved south onto the upper reaches of the Devon floodplain. It is this later development that is at risk from overtopping of the watercourses.

The other named burns rising in the Ochil hills and passing through the settlements below include **Dams Burn (Victoria Terrace, Menstrie); Balquharn Burn, Carnaughton Burn and Silver Burn (Alva); Kirk Burn (Tillicoultry); Quarrel Burn and Kelly Burn (Dollar).**

Flood flows in the Hillfoots burns are generated by a range of climatic conditions including intense, but short lived, storms, prolonged rainfall and snow melt events. The upper catchments are steep with little natural attenuation generating flood flows that can occur over a very short period of time but can equally quickly recede. When these flows tumble over the escarpment they are highly energetic and concentrated into deep gullies forming a series of chutes and falls with very few pools to slow the flow. At the base of the escarpment the flows naturally dispersed over the floodplain, forming delta shaped fans over which, prior to the development of the early mill towns, the burns could lose much of their energy. The Hillfoots towns are clearly constructed on a highly dynamic part of the river systems and through their construction and the subsequent modification of the watercourse channels any natural attenuating effects have been lost. This makes parts of each settlement vulnerable to flood events.



Photo 3 – Alva Burn looking south – 26/10/06

Brothie Burn

Brothie Burn drains a catchment located between the River Devon and the River Black Devon. The burn rises as a series of small tributaries in low lying hills before flowing into Gartmorn Reservoir (NS 912 939), it then flows through an open channel to the A907 where it becomes culverted for the remainder of its length through the urbanised area of Alloa before flowing to the River Forth (NS 887 915). In the urban section, the burn is joined by Sauchie Burn (NS 896 933) and further downstream by Fairy Burn (NS 889 929). Each of the three burns having been heavily modified by industrial development in the past.

Gartmorn Dam was constructed in 1785 on top of a former structure dating from 1713 and originally supplied water to power the area's mining industry. The reservoir became a public water supply in 1820 and was enlarged and raised in level in 1894. The reservoir is no longer used as a public water supply, although ownership remains with Scottish Water.



Photo 4– Brothie Burn Trash Screen at Shillinghill Culvert, Alloa

Fairy Burn

Fairy Burn flows generally west to east and is one of several smaller, but important watercourses that drain the residential areas of Alloa. Fairy Burn is an open watercourse emanating to the west of Donaldson Avenue (NS 871 944) but becomes culverted a short distance to the south (NS 873 943). The large culvert containing Fairy Burn provides the main surface water drainage for much of this part of Alloa. This culvert extends, with a few minor open sections, until it reaches an open confluence with Brothie Burn (NS 889 929) immediately east of its crossing under the A908, Whins Road, Alloa. The un-named burns to the north of Ormiston Drive (NS 874 945), Inglewood (NS 879 942) and Inglewood Pond (NS 878 940) flow into Fairy Burn, as well as, it is likely, many other unknown piped drainage systems in the area.

Goudnie Burn

Goudnie Burn is a tributary of the River Black Devon and flows along the north eastern edge of Clackmannan. It is culverted beneath the A907 Clackmannan By-pass (NS 915 923).

Sauchie Burn

Sauchie Burn passes through and beneath Sauchie from the west. It enters a culvert immediately west of Ten Acres (NS 885 944) and remains underground for the majority of its length through Sauchie and Alloa before appearing as an open channel approximately 300 metres before joining Brothie Burn (NS 896 963). It appears briefly but significantly beside Parkhead Road (NS 892 939) where it is joined by an unnamed, and unidentified, pipe from the north.

3.2 Descriptions of Un-Named Watercourses

The following are un-named watercourses which have the propensity to affect land, other than agricultural land, in the Clackmannanshire Council Area: -

(U-01) - Burn to the north of Inglewood, Alloa.

This burn issues into woodland to the north of Inglewood House (NS 879 942). The burn flows from a small pond above the woodland and flows south through the wood. As a result of recent intervention by the Council to reduce flood risk in the area, the burn now flows into a short section of piped drainage system then into an open watercourse, thereby diverting its recent course away from existing houses in Forrester Grove back to its original outlet into Inglewood Pond (NS 878 940).

(U-02) - Burn at Ormiston Drive, Alloa.

This burn issues from woodland (lower slopes of Gubber Hill) to the north of Ormiston Drive. It enters a culvert just north of Ormiston Drive (NS 874 945) and thereafter flows in to the culvert carrying Fairy Burn (NS 877 940).

(U-03) - Gean House, Alloa.

This burn issues from the woodland in the grounds of Gean House, to the east of Dunmar Drive, flows in to a small pond (NS 873 939), then to an open watercourse and pipe installed by the Council in 2001/02 to reduce a reported flood risk.

(U-04) - Ditch System to north of Woodburn Drive and Gavins Road, Alloa.

The ditch system to the north of Woodburn Drive and Gavins Road collects over-land water flows from the Gubber Hill area to the north of the houses. The ditches do not flow during dry periods but when wet, they flow to the rear of, and parallel to, terraced housing backing on to Gubber Hill then into a 225mm pipe drainage system (NS 876 942) which itself leads to the culverted section of Fairy Burn (NS 875 941).

(U-05) - Burn / ditch at Whiteyetts

This watercourse begins in the golf course at (NS 899 948) crosses under the disused railway (cycle track) (NS 895 947) then re-enters agricultural land at (NS 893 947).

(U-06) - Burn to west of Glenochil Terrace, Glenochil

This burn gathers several drains and over-land flow into a small piped system, which is culverted beneath the B9140. It then passes, in an open channel, to the west of Glenochil Terrace (NS 870 957), then northwards across agricultural land towards the River Devon.

(U-07) - Burn to east of Bards Way, Tillicoultry

This is a small burn that flows virtually along the boundary between the house gardens on Bards Way and the wooded area to the east. It outfalls into a culvert beneath the A91 (NS 928 971) then flows south towards the River Devon.

(U-08) - Burn to north of Stalker Avenue, Tillicoultry.

This small open watercourse issues from the Ochil Hills to the north and passes adjacent to Fir Park Primary School. It enters a culvert (NS 920 972) under the housing area at Stalker Avenue then continues through the piped system, which in turn outfalls to the River Devon (NS 922 966). It appears briefly in the garden of house No. 6 Dollar Road (A91) (NS 921 970).

(U-09) - Burn to south of Marchglen.

This is a small burn which emanates from field and roadside drainage to the south of the A908 (NS 910 960). The watercourse then passes through a wooded area to the south of Marchglen and through piped systems serving the former railway line. These piped systems outlet to the River Devon just east of the River Devon Bridge (NS 910 964).

(U-10) - Burn to the south of Drummie Road, Devonside, by Tillicoultry.

This is a sizeable burn that issues from elevated land to the south of Drummie Road. The watercourse is open and steep before falling over a small cliff and into a culvert just south of Drummie Road (NS 922 962). This culvert was upgraded in 2002/03 to reduce flood risk in the adjacent properties. The culvert enters the River Devon (NS 922 964) immediately north of Drummie Road.

(U-11) - Burn at The Glen, Devonside.

This burn flows in wet weather conditions through an incised but short valley known as The Glen. The burn then enters a culvert (NS 920 963) (the inlet structure was upgraded in 2003 by the Council to reduce flood risk to property to the north), which in turn outfalls to the River Devon.

(U-12) - Burn on north side of A91, west of Bryanston Drive, Dollar.

This is a small open burn emanating in the Ochil Hills to the north, which then passes in to a roadside drainage system (NS 953 980). It then discharges into Quarrel Burn to the north of the disused railway.

(U-13) - Burn to north of Kirkhill, Muckhart.

This burn emanates from a wooded area on the south slopes of the Ochil Hills. The burn flows along the southern edge of the wood and then westwards towards a culvert at Kirkhill and Cairns Place (NO 000 008). The culvert was upgraded in 2001/02 to increase its capacity.

(U-14) - Thornbank Road, Dollar (NS 958 980)

Emanates from the Ochil Hills runs under Back Road, through the grounds of Dollar Academy then under Thornbank Road. It then enters a pipe under A91 then outfalls into Quarrel Burn.

(U-15) - Donaldson Avenue, Alloa (NS 873 944)

This is a shallow swale to the south of the houses in Donaldson Avenue. Generally dry but gathers significant over-land flow from time to time. It then enters the open (rural) section of Fairy Burn.

(U-16) - Back Road, Dollar (NS 957 983)

A small burn that issues just north of No. 32 Back Road during wet periods. The burn passes into a small diameter pipe through the garden of No. 32 then discharges into the roadside ditch on Back Road.

(U-17) - Back Road (Private), Dollar (NS 955 982)

A number of small, ephemeral watercourses issue to the north of the houses served by the private section of Back Road. They are gathered into roadside ditches on the north side of Back Road. The ditches discharge into Quarrel Burn. The ditches are piped under driveway accesses and are prone to blockage.

(U-18) - Long Row, Menstrie (NS 851 970)

A small burn issues low in the Ochil Hills and passes through the garden of No. 32 Long Row before entering a piped system just north of the house. It then connects into the surface water drainage system.

(U-19) - Driving Range, Tillicoultry (NS 928 971)

This is a small watercourse that flows to the east of the urban boundary. Piped under the A91.

(U-20) - Glen Affric, Alva (NS 875 973)

A number of small, ephemeral burns flowing off the lower slopes of the Ochil Hills and collected by ditches associated with Alva Golf Course. The resulting watercourse meets another small watercourse at the north boundary of the house 'Glen Affric' where it enters a pipe. It continues under Back Road then into the main surface water drainage system for the residential area.

(U-21) - House Lade, Rackmill (NS 960 969)

The disused lade served the former mill building at Rackmill House, taking water from the adjacent River Devon. It starts east of the B913 bridge passes below the road then re-enters the River Devon to the west.

(U-22) – Rhodders Grove, Alva (NS 889 973)

Rises in the Ochils passes through a culvert under Back Road. Open watercourse between MacLean Crescent and Alva Cemetery then it sinks at a pipe to the NE of Rhodders Grove.

(U-23) – Rear of 58/60 Main Street West, Menstrie (NS

A small watercourse emerges from the Ochil Hills, falls to a private road side ditch, before sinking just north of nos. 58/60 Main Street West.

(U-24) – East of Kennet Lodge, Clackmannan (NS

A small watercourse flows east of Kennet Lodge sinking thru a culvert beneath the public road between Kennet and Clackmannan.

4.0 FLOODING OCCURRENCES AND KNOWN PROBLEMS

4.1 Flooding Occurrences (by Town)

Alloa

AL-01 Donaldson Avenue (NS 873 944)

17/11/06 Minor flood threat recorded from watercourse to rear of new house at no 2 Donaldson Avenue. Watercourse ref. U-15.

AL-02 Engelen Drive (NS 889 922)

No flooding recorded since November 2005. Watercourse ref. B-01

AL-03 Forrester Grove (NS 878 941)

Although reports of flooding to houses, property and the public road in Forrester Grove had been recorded prior to 2002, none have been recorded since the last instance on 16/01/03 and following the installation of a flood alleviation system in 2004 . Watercourse ref. U-01.

AL-04 Gubber Hill – Gavins Road / Woodburn Drive (NS 875 942)

Reports, from time to time, of non-significant flooding to the foundations of houses, gardens and the public road in Gavins Road had been recorded prior to 2003. No flood events recorded since November 2005. Watercourse ref. U-04.

AL-05 Gubber Hill – Woodburn Drive / Woodside Road (NS 877 942)

17/11/06 &

13-14/12/06 Flood events recorded during 2006 affecting the rear of properties in Woodburn Drive and Woodside Road. The location was inspected during these high rainfall events. Flood flows were evident during these periods but no flooding to houses noted. Watercourse ref. U-04.

AL-06 Ormiston Drive (NS 874 945)

17/11/06

Minor problem arose when the trash screen blocked and watercourse over-flowed to garage area. Watercourse ref. U-02.



Photo 5 - Trash Screen, handrail and access installed at culvert entry north of Ormiston Drive, Alloa - 12/12/06

AL-07 Dunmar Drive (NS 873 940)

No flooding recorded since November 2005. Watercourse ref. U-03.

AL-08 Lambert Terrace (NS 893 932)

No flooding recorded since November 2005. Watercourse ref. B-01.

- AL-09 New ALDI Superstore Site (NS 890 930)**
Site recently re-developed as an ALDI superstore. Brothie Burn diverted into new culvert structure. No flood events since November 2005.
- AL-10 Archray Court (NS893 924)**
Flooding occurred to footpaths, threatening houses for a short time during a severe storm event on 13-14/12/06.
- AL-11 Longcarse Farm (NS868 924)**
26/10/06,
13-14/12/06,
19-20/01/07. Three separate instances of flooding from over-land flows occurred in agricultural fields which then flowed to threaten houses at converted farm steading.
- Alva**
AV-01 Brook Street (NS 883 972)
No flooding recorded since November 2005. Watercourse ref. B-07.
- AV-02 Henry Street (NS 884 969)**
Previous flood prone site. No flood events recorded since November 2005. Watercourse ref. B-07.
- AV-03 Alva Primary School (NS 884 968)**
Previous flood prone site. No flooding recorded since November 2005. Watercourse ref. B-07.
- AV-04 Greenhead Farm (NS 884 966)**
Previous flood prone site. No flooding recorded since November 2005. Watercourse ref. B-07.

- AV-05 Back Road – Glen Affric (House) (NS 875 973)**
No flooding recorded since flood relief system in 2005.
Watercourse ref. U-20.
- AV-06 Back Road (NS 875 973)**
No flooding recorded since flood relief system in 2005.
Watercourse ref. U-20.
- AV-07 Cochrane Crescent / Back Road (NS 874 973)**
No flooding recorded since flood relief system in 2005.
Watercourse ref. U-20.
- AV-08 Wharry Road (NS 875 971)**
No flooding recorded since flood relief system in 2005.
Watercourse ref. U-20.
- AV-09 Cochrane Park (NS 876 972)**
No flooding recorded since flood relief system in 2005.
Watercourse ref. U-20.

AV-10 Rhodders Grove (NS 889 971)

13-15/12/06 Flood flows from blocked watercourse flowed towards bog area and threatened houses to south. Watercourse ref. U-22



Photo 6 - Flooding to north of Properties at 41 to 55 Rhodders Grove, Alva – 14/12/06

AV-11 Blindwells / Southcroft (NS 879 969)

Previous flood prone site. No flood events recorded since November 2005.

AV-12 C110 – Shavelhaugh Loan (NS893 963)

13-15/12/06 Flooding to public road. Road closed during period. Watercourse ref. R-01.

AV-13 Cleuch Drive (NS871 971)

17-20/11/06 Over-land flows affected garden ground of houses on urban / rural boundary during heavy rain fall event.



Photo 7 - Overland flow affecting Cleuch Drive, Alva – 20/11/06

AV-14 B908 (Section between Junction with A91 and River Devon Road Bridge)

13-17/12/06 Flooding to public road due to operation of River Devon floodplain. Road closed during period. Watercourse ref.R-01



Photo 8 - B908 inundated by River Devon floodplain – 14/12/06

Cambus

CA-01 Forth Street (NS 854 938)

Previous flood prone site. No flooding recorded since November 2005.

Clackmannan

CL-01 Duke Street (NS 917 915)

Previous flood prone site. No flooding recorded since November 2005.

CL-02 Brucefield Crescent (NS 917 918)

Previous flood prone site. No flood events recorded since November 2005.

Coalsnaughton

No flood events recorded.

Devonside

DS-01 Alexandra Street at The Glen (NS 920 963)

Previous flood prone site. No flood events recorded since upgrading works to culvert inlet, prior to November 2005. Watercourse ref. U-11.

DS-02 Drummie Road (NS 922 962)

Previous flood prone site. No flooding recorded since November 2005. Watercourse ref. U-10.

DS-03 **Alexandra Street at West End (NS 916 961)**
Intermittent over-land flows of surface water into gardens of no. 103/105 Alexandra Street alleged to be worse during 2006 as a consequence of erection of new house south of 109 Alexandra St. Unknown watercourse, possibly existing intermittently in no defined channel during periods of heavy rain.

DS-04 **Bain Street, (NS 918 962)**
Previous flood prone site. No flooding recorded since November 2005.

Devon Village

No flood events recorded.

Dollar

DL-01 **A91 Muckhart Road (NS 966 980)**
Previous flood prone site. No flood events recorded since November 2005 or subsequent to works to improved road drainage system installed at location.

DL-02 **Thornbank Road (NS 958 980)**
Previous flood prone site. No flood events recorded since November 2005. Watercourse ref. U-14.

DL-03 **Back Road (Private) (NS 955 982)**
Previous flood prone site. No flood events recorded since November 2005. Watercourse ref. U-17.

DL-04 Caravan Site, Rackmill (NS 962 969)

13-14/12/06 Minor amount of floodwaters from the River Devon reached the caravan site. The site is located on the operational floodplain of the river. No reports of any damage. Watercourse ref. R-01.



Photo 9 - River Devon, Rackmill Caravan Site, by Dollar – 14/12/06

DL-05 House Lade, Rackmill (NS 962 969)

Previous flood prone site. No flood events recorded since November 2005. Watercourse ref. U-21.

DL-06 Bryanston Drive (Cycle Way) (NS 954 977)

Previous flood prone site. No flood events recorded since November 2005 and works to improve trash screen / railway culvert entry and access point. Watercourse ref. B-13.

DL-07 A91 Opposite Bryanston Drive (NS 953 980)

Previous flood prone site. No flood events recorded since November 2005. Watercourse ref. DL-08.

DL-08 Back Road (No. 32) (NS 957 983)

Previous flood prone site. No flood events recorded since November 2005. Watercourse ref. U-16.

Fishcross

No flood events recorded.

Forestmill

No flood events recorded.

Glenochil Village

GL-01 Glenochil Terrace (NS 870 957)

Previous flood prone site. No flooding recorded since November 2005. Watercourse ref. U-06.

Kennet

No flood events recorded.

Marchglen

MA-01 C99 River Devon Bridge (NS 910 963)

12-16/12/06,

10/01/07 The section of road immediately south of the River Devon bridge heading to Alva regularly floods as part of the operational floodplain. Watercourse ref. R-01.

MA-02 No.1 Marchglen (NS 909 962)

Previous flood prone site. No flood events recorded since November 2005. Watercourse ref. U-09.

Menstrie

ME-01 Burnside Road (NS 848 967)

Previous flood prone site. No flood events recorded since November 2005 and installation of flood alleviation measures and replacement footbridge in 2005. Watercourse ref. B-05.

ME-02 Back Road (NS 848 970)

27/10/06

Ongoing uncontrolled drainage problems to private section of road and properties from occasional over-land flows from hillside to north. Ongoing landslip issue involving affected landowners, Scottish Water and Stirling Council.

Muckhart

MK-01 Kirkhill (NO 000 007)

12/01/07 &

13-14/12/06 Flood to garden ground and foundations of number 7 Kirkhill. 13-14/12/06 event primarily due to new fence constructed over watercourse by resident. 12/01/07 event caused by partial blockage of culvert at headwall entry point south of number 7. Watercourse ref. U-13.

Sauchie

SA-01 Parkhead Road (NS 892 940)

No flooding recorded since November 2005. Watercourse ref. B-02.

SA-02 Branshill Road (2 sites) (NS 885 944 / NS 885 942)

No flooding recorded since November 2005. Watercourse ref. B-02.

SA-03 A908 Whiteyetts (NS 899 948)

No flooding recorded since November 2005. Watercourse ref. U-05.

SA-04 Cat's Close (NS 895 936)
Previous flood site at allotments and footpath although no flooding since 2005. Watercourse ref. B-02.

SA-05 Devon Valley Drive / Craigview
Flood flows in heavy rain and blockages to culvert beneath new public footpath can occur in watercourse between Craigview and Whiteyetts development to north.

Tillicoultry

TI-01 Hareburn Road (NS 912 967)
09/08/04 Overtopping of Tillicoultry Burn flowed onto Lower Mill Street and into Hareburn Road before collecting at the low point outside houses nos. 85 / 87. Gardens flooded and waters up to the top step at front doors. Exacerbated by lack of capacity in joint (surface water and foul) piped drainage system at this location. Watercourse ref. B-11.

TI-02 Elistoun Drive (NS 922 967)
27/03/06 Flooding to private road end due to lack capacity in strategic drainage systems to the north and east (serving Melloch Crescent), and high river levels at system outlet to River Devon. Watercourse ref. R-01 and U-08.

13-15/12/06 Flooding to houses (nos. 6 an 8) Drive due to surcharging of drainage system, due to lack of system capacity and high river levels at outlet. Watercourse ref. R-01 and U-08.

11/01/07 Flooding to private road due to surcharging drainage system. Watercourse ref. R-01 and U-08.



Photo 10 - Flooding of Elistoun Drive, Tillicoultry – 14/12/06

TI-03 A908 Moss Road (NS 920 968)

14/12/06 Flooding to carriageway just south of Sterling Mills due to surcharging drainage systems.

TI-04 Stalker Avenue (NS 920 972)

No flood events recorded since November 2005. Trash screen, immediately north of Stalker Avenue is easily blocked by playground litter and household rubbish. Watercourse ref. U-08.

TI-05 6 Dollar Road (NS 921 970)

Minor flooding to garden ground occurred to rear of 6 Dollar Road May 2007. Watercourse ref. U-08.

Tullibody

No Flood Events recorded since November 2005

4.2 Flooding Problems and Mitigation Measures Installed since November 2005 (by Town)

Alloa

AL-01 Donaldson Avenue (NS 873 944)

17/11/06 Threat due to minor trash screen blockage, but exacerbated by construction of boundary fencing across watercourse to rear of house by current resident. Resident alerted to flood risk to his property. Discussions are ongoing. Watercourse ref. U-15.

AL-02 Engelen Drive (NS 889 922)

No flooding recorded since November 2005. Watercourse ref. B-01.

AL-03 Forrester Grove (NS 878 941)

No flooding recorded since November 2005. Watercourse ref. U-01.

AL-04 Gubber Hill – Gavins Road (NS 875 942)

Although no flooding problems have affected this area since November 2005, this catchment is linked to that which affects Woodburn Drive (AL-05) hence this area is to be included in the flood study report, *Gavins Road / Woodburn Drive Flood Alleviation Study*⁸, which is being prepared on behalf of the Council and is due for publication before the end of 2007. Remedial works to resolve this issue are included in the Council's 2008/09 budgets. Watercourse ref. U-04.

AL-05 Gubber Hill – Woodburn Drive / Woodside Road (NS 877 942)

17/11/06,

13/12/06 Flood waters affected garden ground and threatened buildings of 17 and 19 Woodburn Drive. Woodland area to rear regularly discharges flows during severe storm events which can affect property. This area is included in a flood study report being prepared on behalf of the Council and due for publication Autumn 2007. Remedial works to resolve this issue are included in the Council's 2008/09 budgets. Watercourse ref. U-04.

AL-06 Ormiston Drive (NS 874 945)

17/11/06 Minor blockage due to collection of urban and rural debris at former trash screen. New trash screen, handrail and access footpath installed from road, 11/12/06. Watercourse ref. U-02.



Photo 11 - New Trash screen, handrail and access footpath at Ormiston Drive, Alloa – 12/12/06

AL-07 Dunmar Drive (NS 873 940)

No flooding recorded since November 2005. Watercourse ref. U-03.

AL-08 Lambert Terrace (NS 893 932)

No flooding recorded since November 2005. However, new lockable access gates on boundary fence installed September 2007 to allow burn maintenance functions. Watercourse ref. B-01.

AL-09 New Aldi Store Site (NS 890 930)

Site recently re-developed as an ALDI superstore. Brothie Burn diverted to new 4m x 2m culvert structure. Detailed design of inlet and outlet screens, new flood storage pond and culvert maintenance programme (adopted by developer) agreed with developer October 2007. Acquisition of Controlled Activities Regulation approval also still to be sought by developer from SEPA. No flooding recorded since November 2005.



Photo 12 – New holding pond (ALDI site) on the Brothie Burn at Shillinghill 25/10/07

AL-10 Archray Court (NS893 924)

13-14/12/06 Flooding occurred due to lack of capacity of local drainage system during a storm event. Although responsibility for maintenance of systems is unclear, systems jetted and cleared of blockages shortly after event by Council staff. Issue notified to Scottish Water.

AL-11 Longcarse Farm (NS868 924)

26/10/06,

13-14/12/06,

19-20/01/07. Flood threat to houses occurred apparently as a consequence of heavy storm events generating over-land flows from fields and also due to apparent non-operation of emergency pumps associated with a nearby surface water pump station / pond. Pump management system re-evaluated and management agreement system in place.

Pump Station pumps checked and now operational. Remote failure alarm system to be operational end of 2007.



Photo 13 - Flooding from watercourse resulting in over land flow threat to Longcarse Farm, Alloa – 26/10/06

Alva

AV-01 Brook Street (NS 883 972)

No flooding recorded since November 2005. However, repairs to retaining wall to east side (to west of Ochilview) carried out July 2006. No flooding recorded since November 2005. Works also completed November 2007 to remove excessive build up of sediments within A91 road bridge (CAR approval gained from SEPA October 2007). Watercourse ref. B-07.

AV-02 Henry Street (NS 884 969)

No flooding recorded since November 2005. Watercourse ref. B-07.

AV-03 Alva Primary School (NS 884 968)

No flooding recorded since November 2005. However, works to renew footbridge and raise soffit level outwith burn cross section completed March 2006. Also, concrete sill across burn just south of north boundary wall crossing burn repaired and lowered to reduce scour potential and improve capacity July 2006. Watercourse ref. B-07.

AV-04 Greenhead Farm (NS 884 966)

No flooding recorded since November 2005. Watercourse ref. B-07.

AV-05 Back Road – Glen Affric (House) (NS 875 973)

No flooding recorded since flood relief system completed in 2005 and since November 2005. Watercourse ref. U-20.

AV-06 Back Road (NS 875 973)

No flooding recorded since flood relief system completed in September 2005 and since November 2005. Watercourse ref. U-20.

AV-07 Cochrane Crescent / Back Road (NS 874 973)

No flooding recorded since flood relief system completed in September 2005 and since November 2005. Watercourse ref. U-20.

AV-08 Wharry Road (NS 875 971)

No flooding recorded since flood relief system completed in September 2005 and since November 2005. Watercourse ref. U-20.

AV-09 Cochrane Park (NS 876 972)

No flooding recorded since flood relief system completed in September 2005 and since November 2005. Watercourse ref. U-20.

AV-10 Rhodders Grove (NS 889 971)

13-15/12/06 Watercourse became blocked at watercourse inlet trash screen. Resultant flood flows gathered at bog area to west of inlet resulting in a build up of ponding water which threatened houses to south of bog area. Watercourse U-22. Partial blockage within underground culverted watercourse system to south of inlet cleared and newly found manholes on system cleared and brought to surface.



Photo 14 - Watercourse clearance and culvert system upgrade works, east of Rhodders Grove, Alva – 25/10/06

AV-11 Blindwells / Southcroft (NS 879 969)

Previous flood prone site. No flood events recorded since November 2005.

AV-12 C110 – Shavelhaugh Loan (NS893 963)

13-15/12/06 Flooding to public road due to inundation from River Devon Flood Plain. Road closed during period. Closure inevitable during inundation by river floodplain. No realistic solution possible here. Watercourse ref. R-01.

AV-13 Cleuch Drive (NS871 971)

17-20/11/06 Flooding primarily due to apparent deliberate breach of small bund. This bund was formed at a field boundary to protect against such an occurrence. Residents notified of need to repair bund protecting property. The bund was subsequently repaired August 2007.

AV-14 B908

13-17/12/06 Flooding to public road due to inundation from River Devon Flood Plain. Road closed during period. Closure inevitable during inundation by river floodplain. No realistic solution possible here. Watercourse ref. R-01.

Cambus

CA-01 Forth Street (NS 854 938)

Previous flood prone site. No flood events recorded since November 2005.



Photo 15 – High and low water marks on the River Forth at Cambus - 21/03/07

Clackmannan

CL-01 Duke Street (NS 917 915)

Previous flood prone site. No flood events recorded since November 2005.

CL-02 Brucefield Crescent (NS 917 918)

Previous flood prone site. No flood events recorded since November 2005.

Coalsnaughton

No flood events recorded since November 2005.

Devonside

DS-01 Alexandra Street at The Glen (NS 920 963)

Previous flood prone site. No flooding recorded since upgrading works to culvert inlet, prior to November 2005. Reshaping of a bund area to train surface water flows at downstream inlet structure completed in October 2006. Watercourse ref. U-11.

DS-02 Drummie Road (NS 922 962)
Previous flood prone site. No flooding recorded since November 2005. Watercourse ref. U-10. Access path formed no 20/22 ? Drummie Road to trash screens July 2007.

DS-03 Alexandra Street at West End (NS 916 961)
Investigation and report by Roads Section confirmed no action required by Council in terms of its legislative duties. However, no definitive evidence could be found to substantiate allegations by residents. It is understood that a civil court action is underway involving the affected residents.

DS-04 Bain Street, (NS 918 962)
Previous flood prone site. No flood events recorded since November 2005.

Devon Village

No flood events recorded.

Dollar

DL-01 A91 Muckhart Road (NS 966 980)
Previous flood prone site. No flooding recorded since November 2005 or subsequent to works carried out to improve road drainage system in area.

DL-02 Thornbank Road (NS 958 980)
Previous flood prone site. No flooding recorded since November 2005. Watercourse ref. U-14. New trash screen installed at culvert entry point May 2007.

- DL-03 Back Road (Private) (NS 955 982)**
Previous flood prone site. No flood events recorded since November 2005. Watercourse ref. U-17.
- DL-04 Caravan Site, Rackmill (NS 962 969)**
13-14/12/06 Out of bank flooding from the River Devon was observed to reach the caravan site during this event. The site is located within the 0.5% probability operational floodplain of the river as identified by SEPA's *Indicative River and Coastal Flood Maps*¹². No reports of any damage to caravan site. Watercourse ref. R-01.
- DL-05 House Lade, Rackmill (NS 962 969)**
Previous flood prone site. No flooding recorded since November 2005. Watercourse ref. U-21.
- DL-06 Bryanston Drive (Cycle Way) (NS 954 977)**
Previous flood prone site. No flooding recorded since November 2005. Works carried out to improve maintenance access to inlet points completed March 2007. Watercourse ref. B-13.
- DL-07 A91 Opposite Bryanston Drive (NS 953 980)**
Previous flood prone site. No flooding recorded since November 2005. Watercourse ref. DL-08.
- DL-08 Back Road (No. 32) (NS 957 983)**
Previous flood prone site. No flooding recorded since November 2005. Watercourse ref. U-16.

Fishcross

No flood events recorded since November 2005.

Forestmill

No flood events recorded since November 2005.

Glenochil Village

GL-01 Glenochil Terrace (NS 870 957)

Previous flood prone site. No flood events recorded since November 2005. Watercourse ref. U-06.

Kennet

No flood events recorded since November 2005.

Marchglen

MA-01 C99 at River Devon Road Bridge (NS 910 963)

13-15/12/06 Road closure inevitable during inundation by river floodplain. No damage reported to property. No realistic solution possible here. Watercourse ref. R-01.

MA-02 No.1 Marchglen (NS 909 962)

Previous flood prone site. No flooding recorded since November 2005. Works completed to install a new trash screen and safe maintenance access to a former railway line culvert (reference P2-01) in the woods to the south of Marchglen in January 2007. Watercourse ref. U-09.

Menstrie

ME-01 Burnside Road (NS 848 967)

Previous flood prone site. No flooding recorded since November 2005 and installation of flood alleviation measures, retaining walls, and replacement footbridge in 2005 (detailed in 2005 Biennial Report). Watercourse ref. B-05.

ME-02 Ochil Road (NS 848 970)

25/12/05

& 27/10/06 Ongoing landslip issue affecting house owner remains unresolved. Problems appear to be triggered by high overland and sub-surface water flows from the hillside to north. Affected parties include Northern Hydroseeding Ltd, Scottish Water and owners of the property “Deafhills” Ochil Road, Stirling and Clackmannanshire Councils.

Muckhart

MK-01 Kirkhill (NO 000 007)

13-14/12/06

& 12/01/07 Flood to garden ground and foundations of number 7 Kirkhill. 13-14/12/06 storm event primarily due to new fence line constructed across watercourse by resident. Fence cut by Council staff during emergency works to relieve flood.

12/01/07 Flood during this storm event caused by partial blockage of culvert at headwall entry point south of number 7. New trash screen installed at headwall February 2007. Watercourse ref. U-13.



Photo 16 - Flooding to Properties at Kirkhill, Muckhart from watercourse to north – 12/01/07



Photo 17 – Flooding issue being resolved by Council staff at Kirkhill, Muckhart – 12/01/07

Sauchie

SA-01 Parkhead Road (NS 892 940)

No flood events since November 2005. Watercourse ref. B-02.

SA-02 Branshill Road (2 sites) (NS 885 944 / NS 885 942)

No flood events since November 2005. Watercourse ref. B-02.

SA-03 A908 Whiteyetts (NS 899 948)

No flood events since November 2005. Watercourse ref. U-05.

SA-04 Cat's Close (NS 895 936)

Previous flood site at allotments and footpath although no reports since November 2005. Watercourse ref. B-02.

SA-05 Devon Valley Drive / Craigview

Location added as a Priority 3 site to the "Prioritised Inspection and Clearance Works Regime". Watercourse ref. U-05.

Tillicoultry

TI-01 Hareburn Road (NS 912 967)

Previous flood site resulting from minor “out of bank” flows from Tillicoultry Burn during 2004. Further reports of flooding to garden property at no. 85/87 Hareburn Road due to failure of drainage systems. This issue was investigated and resolved by Scottish Water during 2005. No reports since November 2005. Watercourse ref. B-11.

TI-02 Elistoun Drive (NS 922 967)

27/03/06 Flooding to private road due to lack of drainage system capacity and high river levels at outlet. Watercourse refs. R-01 & U-08.

13-15/12/06 Flooding to property (nos. 6 and 8 Elistoun Drive) due to surcharging of drainage system, due to lack of system capacity and high river levels at outlet. Watercourse ref. R-01 and U-08.

11/01/07 Flooding to private road due to surcharging drainage system. Watercourse ref. R-01 and U-08.



Photo 18 – Flooding of Elistoun Drive, Tillicoultry – 14/12/06



Photo 19 – River Devon Floodplain in operation at Elistoun Drive – 27/03/06

The event of 13-15/12/06 resulted in considerable flooding to property at 6 and 8 Elistoun Drive and required emergency intervention by the Fire Service, Council staff and Scottish Water. Further temporary measures were employed to protect the site until a more permanent scheme could be installed. Detailed hydrological and hydraulic investigations of the area have been jointly undertaken by Scottish Water and the Council (*“Elistoun Drive Flood Alleviation Study–June 2007”*)⁷ in order to identify the nature of the mechanisms which can lead to flooding at this location. Agreement has recently been reached between both parties to jointly fund a permanent engineered solution at this location to increase the level of protection against such surface water and sewer flooding.

TI-03 A908 Moss Road (NS 920 968)

14/12/06 Flooding to carriageway south of Sterling Mills due to surcharging drainage systems. Outlet to river submerged during event and system capacity exceeded. Drainage systems will be considered under the study report produced in association with issue TI-02.

TI-04 Stalker Avenue (NS 920 972)

No flood events recorded since November 2005. The trash screen, immediately north of Stalker Avenue is easily blocked by playground litter and household rubbish and can form a small but deep pond. Regular inspection as part of the *Prioritised Inspection and Clearance Regime*⁴ by Council has reduced instances of flood threat at this location. Watercourse ref. U-08.

TI-05 6 Dollar Road (NS 921 970)

CCTV investigations of culverted system were carried out in July 2007 by the Council ("*Stalker Avenue – Glebe Crescent, Tillicoultry – CCTV Survey Report No. 1 – July 2007*")¹³ and revealed further blockage problems at various points due to urban debris within pipes and some silting. Investigations also revealed the system consists of a variety of pipe sizes presumably installed by various owners in the past. This contributes to capacity and surface flooding problems. One section of the system exists beneath a more recent building extension to No. 6 Dollar Road. Clearance work to the culvert and some minor ditch clearing within garden grounds of no. 18 / 20 Dollar Road are programmed before end of 2007. Watercourse ref. U-08.

Tullibody

No flood events recorded since November 2005.

5.0 PROPOSED MITIGATION MEASURES

5.1 Maintenance Programmes

This section of the report explains the methods used by the Council to comply with its duties under the Flood Prevention and Land Drainage (Scotland) Act 1997 ² (the 1997 Act) and to report on the works undertaken on watercourse maintenance throughout the Council area. The Council's legislative responsibility lies with Development and Environment Services and in particular with the Roads and Transportation Section.

The 1997 Act places the responsibility for the assessment and maintenance of watercourses on the local authority. This applies to watercourses that would affect non-agricultural land, but does not apply where failure to maintain would result in flooding of land in the same ownership as the watercourse requiring maintenance. Importantly, the 1997 Act does not place a duty on the local authority to improve the capacity of watercourses.

The maintenance work currently carried out by Clackmannanshire Council, as a result of the assessment of watercourses, falls into three categories :-

1. Clearing of urban debris from watercourses
2. Maintenance of walls, banks and other structures that form watercourses
3. Provision of flood alleviation works i.e. new infrastructure to prevent and limit further flooding and reducing the need for maintenance.

Clearing of Urban Debris

Between 1997 and 2002 the entire lengths of all watercourses that could potentially affect non-agricultural land were inspected once each year. This inspection regime resulted in appropriate clearance works being carried out.

During this time ad hoc inspections of known problem sites were carried out at regular, short intervals. During 2003 this information was analysed and together with an increasing understanding of the local hydrological characteristics it was possible to identify the appropriate priority to be placed on particular sections of each watercourse. From this a *“Prioritised Watercourse Inspection and Clearance Regime”*⁴ (section 6.2) was developed and initiated during 2004/05. This regime is continually monitored and where necessary amended to ensure that all watercourses receive optimum attention.

Initially the clearance operations involved the removal of loose vegetation, tree material and the detritus from fly tipping. Between 2002 and 2005 this was extended to removing silts and some coarse sediments from watercourses where these were considered to be affecting the capacity of the watercourse channel. During 2007 *“Watercourse Audit and Works Implementation Plans”*⁵ were produced for the Principal burns in the Council area. These reports itemise all structural, vegetation and coarse sediment works considered necessary on the principal urban burns (see *Watercourse Audit and Implementation Report*⁵ in section 5.3). The production of these watercourse audits and improvement plans were a policy commitment of the Council’s 2005 Biennial Report³ (Policy FP3).

Maintenance of Banks, Walls, Culverts and other Infrastructure

Roads and Transportation carries out two yearly inspections of all bridges that carry adopted roads and three yearly inspections of all other bridges, with spans greater than 2m, over watercourses. These inspections assess the structural integrity of the bridges, the condition of adjacent training banks and walls and any issues relating to debris in the adjacent section of watercourse. This information is utilised in the *“Prioritised Watercourse Inspection and Clearance Regime”*⁴.

Prior to the 1997 Act watercourses had suffered from an extended period of poor maintenance by riparian landowners. This left a legacy of problems for the local authority. Initially, maintenance work was carried out mainly at sites where structural failure had already occurred.

The aforementioned “*Watercourse Audit and Works Implementation Plans*”⁴ have now been produced (see section 5.3) and these itemise all necessary structural maintenance (and vegetation and coarse sediment removal) works required on along the principal urban burns.

As with any works within watercourses, examination of *The Water Environment (Controlled Activities) (Scotland) Regulations 2005*¹⁴ will be undertaken to determine where any necessary approvals from the SEPA will be required to ensure that resulting works have minimal adverse affect on local biodiversity.

Flood Alleviation Works

Small-scale flood alleviation works aimed at maintaining the functional integrity of watercourse channels are also carried out where required. The works were initially mainly generated as a result of flood events. Now that the watercourses have been identified, prioritised inspection and clearance regimes are in place and burn Audits have been completed, the Council can now assess watercourse channels to identify areas where over-topping of banks either occurs or may be likely to occur during an event with significantly heavy rainfall.

5.2 Prioritised Watercourse Inspection & Clearance Regime

Method of Site Prioritisation

Due to the variable nature of the environmental factors that can contribute to flood risk, every watercourse will have different hydrological and hydraulic characteristics. These characteristics also change over time. To facilitate these variances and to maximise efficiency of watercourses throughout the Council area, all known watercourses have been carefully assessed and critical locations identified. Three levels of inspection and maintenance priority cover these critical locations (see Tables 1, 2 and 3 on pages 58 to 63). The priority ratings given to each location reflect the propensity of the watercourse to become blocked with debris (man-made or natural materials) and also take account of the severity of flood risk to adjacent non-agricultural land. “Ad hoc” inspections also cover the lower priority stretches of watercourses. Feedback from the inspections carried out by Council staff, and indeed from other sources, is analysed regularly and priorities altered or new sites added as necessary.

Priority 1 Sites for Inspection and Maintenance

Watercourses and other sensitive locations to be inspected and subsequently cleared of debris, to be carried out on a monthly basis.

Table 1

Priority Ref.	W/course Ref.	W/course Name	Location	OS Ref (NS)
P1 – 01	B – 05	Menstrie Burn, Menstrie.	North of Ochil Rd Bridge to A91	849 970 to 848 969
P1 – 02	B – 05	Menstrie Burn, Menstrie.	A91 to south of Brook St. bridge	848 969 to 851 969
P1 – 03	B – 05	Alva Burn, Alva.	From nature walk car park to Beauclerc St.	884 975 to 883 973
P1 – 04	B – 07	Alva Burn, Alva.	Beauclerc St to A91 bridge	883 973 to 884 970
P1 – 05	B – 07	Alva Burn, Alva.	From A91 bridge south of School site.	884 970 to 884 966
P1 – 06	B – 11	Tillicoultry Burn, Tillicoultry	Upper Mill St. Bridges	914 974 to 914 970
P1 – 07	B – 11	Tillicoultry Burn, Tillicoultry	Lower Mill St. Bridges	914 970 to 910 965
P1 – 08	B – 11	Dollar Burn, Dollar	Adjacent to golf club.	961 989 to 964 969
P1 – 09	B – 14	Dollar Burn, Dollar	Bridges and Burn between Back Rd and A91.	963 983 to 963 979
P1 – 10	B – 14	Dollar Burn, Dollar.	Bridges and Burn between A91 and former railway line.	963 979 to 963 975
P1 – 11	U – 08	Stalker Avenue, Tillicoultry	Hake at south east corner of school grounds	920 972
P1 – 12	U – 01	Forrester Grove / Inglewood, Alloa	New system north of Forrester Grove	878 942 to 878 940

Priority Ref.	W/course Ref.	W/course Name	Location	OS Ref (NS)
P1 – 13	U – 14	Thornbank Road, Dollar	System east of St. James Church	958 980
P1 – 14	U – 11	The Glen, Devonside	Watercourse, new hake / manhole system in the Glen between Coalsnaughton and Devonside	920 962 to 920 963
P1 – 15	U – 10	Drummie Road, Devonside	New system and hakes south of Drummie Road	922 962
P1 – 16	B – 01	Brothie Burn, Alloa	At Railway Bridge	891 931
P1 – 17	B – 01	Brothie Burn, Alloa	Hake at Shillinghill Roundabout	889 929
P1 – 18	B – 01	Brothie Burn, Alloa	Culvert system through new ALDI car park	891 931 to 889 929
P1 – 19	B – 03	Fairy Burn, Alloa	Outlet of Fairy Burn into Borthie (in ALDI pond area)	889 929
P1 – 20	U – 02	Ormiston Drive, Alloa	Hake to north west	874 945
P1 – 21	U – 04	Woodburn Drive, Alloa	New hake and ditch system to rear of 17/19 Woodburn Drive	876 942

Priority 2 Sites for Inspection and Maintenance

Watercourses and other sensitive locations to be inspected and subsequently cleared of debris, to be carried out on a two monthly basis.

Table 2

Priority Ref.	W/course Ref.	W/course Name	Location	OS Ref (NS)
P2 – 01	U – 09	Marchglen	Hakes on former railway line to south east	910 962
P2 – 02	B – 12	Simpson Court, Tillicoultry	Culvert of Kirk Burn beneath Simpson Court	927 973
P2 – 03	B – 02	Roundelwood, Sauchie	Hake on burn at culvert entry point from rural area.	885 944
P2 – 04	B – 03	Inglewood, Alloa Pond Outlet	Outlet from Pond to Fairy Burn culvert	877 940
P2 – 05	B – 03	Fairy Burn, Parkway, Alloa	Hake to south of Parkway in Greenfield Grounds	884 932
P2 – 06	B – 01	Brothie Burn, Alloa	From Hilton Road bridge to Lambert Terrace Bridge	893 931
P2 – 07	B – 01	Brothie Burn, Alloa	From Lambert Terrace to access to Hamilton & Brydie	893 932 to 892 931
P2 – 08	B – 01	Brothie Burn, Alloa	From access to Hamilton & Brydie to Railway Br.	892 931 to 891 931
P2 – 09	U – 04	Gavins Road, Alloa	Ditch in woodland to rear of houses	875 942
P2 – 10	U – 15	Donaldson Av, Alloa	Hake to south of No. 2 Don. Avenue	873 943
P2 – 11	B – 06	Dams Burn Menstrie	Hake north of Victoria Terr.	859 970
P2 – 12	B – 10	Silver Burn Alva	Open section from A91 to Alva Ind. Estate Rd	892 969 to 892 968

Priority Ref.	W/course Ref.	W/course Name	Location	OS Ref (NS)
P2 – 13	B – 10	Silver Burn, Alva	Open section from Alva Ind. Estate Rd south for 100m	892 968 to 892 967
P2 – 14	U – 06	Glenochil Terrace, Glenochil	Ditch west of Glenochil Terrace	870 957
P2 – 15	B – 02	Cats Close, Alloa	Hake at end of Cats Close	895 936
P2 – 16	U – 03	Dunmar Drive, Alloa	Pond and to watercourse south of Dunmar Drive	873 939
P2 – 17	U – 23	58/60 Main Street West, Menstrie	Small Ditch and headwall north of 58/90 MSW	846 969
P2 – 18	U – 20	Rhodders Grove, Alva	Short section of watercourse west of 16 McLean Crescent	889 972
P2 – 19	U – 13	Kirkhill, Muckhart	Open ditch, culverted system between nos 3 and 5 Kirkhill	000, 008
P2 – 20	B – 03	Fairy Burn, Alloa	Section through Greenfield grounds	884 932

Priority 3 Sites for Inspection and Maintenance

Watercourses and other sensitive locations to be inspected and subsequently cleared of debris, to be carried out three times annually, at the beginning of June, October and February.

Table 3

Priority Ref.	W/course Ref.	W/course Name	Location	OS Ref (NS)
P3 – 01	B – 12	Kirk Burn, Tillicoultry	Section through Heathwood Crescent	924 974 to 925 975
P3 – 02	B – 12	Kirk Burn, Tillicoultry	Section through Tillicoultry Mains	925 975 to 927 974
P3 – 03	U – 08	6 Dollar Rd, Tillicoultry	Pipe system forming part of U-08 in property of 6 Dollar Rd	921 970
P3 – 04	U – 12	Un-named small burn, Dollar	North side of A91, west of Bryanston Drive	953 980
P3 – 05	B – 13	Quarrel Burn, Dollar	Section through Bridge.	955 980
P3 – 06	B – 15	Kelly Burn, Dollar	Section through A91 Bridge	966 980
P3 – 07	U – 16	Un-named burn, Dollar	32 Back Rd,	957 983
P3 – 08	U – 17	Back Rd, Dollar .	Public/private sections. Watercourse, all driveway culverts and gully above Strac. Cres	954 981
P3 – 09	B – 13	Bryanston Drive, Dollar	Culvert to rear of Bryanston Drive beneath former railway line.	954 977
P3 – 10	N/A	Dollar-Crook of Devon Rd, Muckhart .	New drainage system taking over-land flow from fields.	000 999

Priority Ref.	W/course Ref.	W/course Name	Location	OS Ref (NS)
P3 – 11	U – 03	Dunmar Drive, Alloa.	Culvert to east +system from pond in wooded area	873 939
P3 – 12	U - 15	Donaldson Dr. Alloa.	Partly dry ditch south Dunmar Drive	871 942
P3 – 13	B – 04	Goudnie Burn, Clackmann.	B910 Bridge over burn	915 922
P3 – 14	R – 02	Black Devon, Clackmann.	A907 culvert Tree Grid	916 923
P3 – 15	N/A	Duke St./ Marquis Dr. Clackman.	Drainage system	917 915
P3 – 16	U – 18	Long Row, Menstrie.	Drainage system from hill to north thru' 35/37	851 970
P3 – 17	B – 08	Carnaughton Burn, Alva.	Section from Back Rd to A91 culvert	877 971
P3 – 18	B – 10	Burnside Road, Alva.	Silver Burn adjacent to Burnside road	892 970
P3 – 19	B – 09	Spring Burn, Alva	A91 Culvert	888 970
P3 – 20	U – 19	Un-named burn, Tillicoultry	A91 culvert, east of golf driving range access	928 971
P3 – 21	U – 05	Un-named watercourse, Sauchie	Between Diverswell and Whiteyetts	897 947
P3 – 22	U – 07	Watercourse, Tillicoultry	Piped system east of Bards Way	928 976
P3 – 23	U – 20	Cochrane Crescent / Back Road, Alva (Clear manhole Chamber in north east corner of 40 Cochrane Crescent.	875 973
P3 – 24	U - 24	Kennet Lodge, Clackmanan	New hake to east of Kennet Lodge.	920 914

5.3 Principal Watercourse Audit and Improvement Plans

Information on Coarse Sediment in Watercourses

During the course of the cyclical inspection of watercourses and through examination of the watercourses during and immediately after significant rainfall events it is clear that coarse sediments play an important part in the nature of most watercourses. The Council commissioned report, *Flood Management in the Hillfoots Burns (2004)*¹⁵ expands on this stating that due to the steep topography of the adjacent Ochil escarpment, which forms the catchment of each of the Hillfoots Burns, these burns have a highly dynamic nature. Large amounts of sediments move through these watercourses and the retention of excessive coarse sediments in the watercourse channels can lead to three particular issues, each of which, either singularly or cumulatively, have the potential to exacerbate the likelihood of flooding to non-agricultural land.

Coarse sediments such as boulders in the watercourse bed will allow finer sediments to gather creating banks and islands. More often than not the build up of sediments enhance the watercourse, slowing down the speed of the water thereby creating some attenuation for downstream areas and providing habitat for flora and fauna. There will however be locations where sediment accumulates and alters the fall line of the stream. This can lead to scouring of banks, damage to walls and potentially to collapses and damming of the watercourse.

A second problem is that of coarse sediments gathering in any watercourse for extended periods leading to a general increase in the watercourse bed level. This is particularly problematic at bridges and culverts where the channel capacity can be significantly reduced.

Areas where excessive coarse sediment gathers may also create snagging points for vegetation and other debris creating dams and changing the flow line.

Sediments in watercourse beds are essential for insects and fish and it is not appropriate to clear sediments from watercourses without prior consideration of the biodiversity impacts. Through consultation with the Scottish Environmental Protection Agency (SEPA) and other groups, such as the Forth District Salmon Fisheries Board (FDSFB) and local angling clubs, it has been agreed that removal of sediments can be essential in certain circumstances but shall be carried out in a sensitive manner and always under cover of an appropriate authorisation, as required by *The Water Environment (Controlled Activities) (Scotland) Regulations 2005*¹⁶. As finer sediments are of most importance to biodiversity, only the coarse sediments will be removed from open watercourses and only where a clear flooding hazard would be alleviated. The dynamic nature of watercourses will ensure that finer sediments will move downstream naturally once the larger boulders have been removed. There will be locations where finer sediments gather in large quantities, e.g. weirs, bridge piers and on bends, and this will be removed if it appears to be retarding fine sediment movement, or if it might potentially lead to over topping, or significant capacity reduction. Coarse sediment removal will only be carried out over limited lengths of watercourses to minimise impact on biodiversity.



Photo 20 – Excessive build up of Sediments upstream of and beneath the A91 Road Bridge, Alva Burn Alva. – 02/10/05



Photo 21 – “CAR” consented works to remove sediment from A91 Road Bridge, Alva Burn, Alva – 09/11/07

The urban sections of the following watercourses, which have not been assessed as part of the *Watercourse Audit and Improvement Plans* ⁵, will be routinely inspected, initially every six months, to identify areas which may require removal of coarse sediment and locations of excessive build up of finer sediments.

- Carnaughton Burn, Alva
- Silver Burn, Alva
- Quarrel Burn, Dollar
- Kelly Burn, Dollar
- Drummie Road, Devonside
- The Glen, Devonside
- Sauchie Burn, Sauchie

Vegetation Removal in Burns

During the course of the annual cyclic inspection of watercourses and through consideration of the Council commissioned report, *Flood Management in the Hillfoots Burns (2004*¹⁵, it is clear that vegetation growing in watercourse channels may have adverse effects on flood prevention.

There is, however, an important balance to be struck between reducing flood risk and maintaining habitat. Advice received from the Scottish Environmental Protection Agency (SEPA) suggests that management of watercourse vegetation should minimise potential environmental effects. Therefore the following criteria must be met preceding any works: -

- Vegetation will only be removed where there is a clearly identified flood risk to sensitive non-agricultural land, or where vegetation is likely to cause damage to walls, bridges, embankments etc.
- No more than one third of vegetation identified for clearance on any stretch of watercourse should be removed annually. The vegetation should be thinned evenly along the watercourse to ensure that no section is unduly denuded.
- The stability of watercourse embankments should not be compromised during, or as a result of, removal of vegetation.
- Although application to SEPA, under *The Water Environment (Controlled Activities) (Scotland) Regulations 2005*¹⁶, is **not** required for vegetation removal, prior notification will still be given to all other interested parties.

Principal Watercourse Audit and Implementation Plans

*Watercourse Audit and Implementation Plans*⁵ have been prepared by the Council for the Principal Hillfoots Burns (see section 5.4). The function of these plans is to identify and prioritise current maintenance issues and defects relating to flood prevention within the principal burns examined and then to prioritise these works for subsequent implementation. A similar plan is in place for the Fairy Burn in Alloa, which can be viewed separately on the Council's web site (www.clacksweb.org.uk). The Plans for the Brothie Burn and the Sauchie Burn, are being prepared at present and will be published early 2008.

5.4 Principal Hillfoots Burns Audit and Implementation Plan – 2007/2008

Overview

The following improvements plans for each of the principal Hillfoots Burns have been developed from site investigations in the last few months and audit reports initiated by the Council from appropriately qualified hydrological consultants. They summarise what is considered to be key infrastructure improvements along the length of each burn needed to sustain the burn and maximise its efficiency all with a view to maintaining the burn in good condition.

General Description of the Hillfoots Burns and Flood Generating Processes

The principal Hillfoots Burns are, Menstrie Burn, Alva Burn, Tillicoultry Burn and Dollar Burn. They rise in the Ochil Hills and typically flow southwards down steep channels, often through sections of inaccessible gorge, over the major escarpment that forms the south face of the Ochil Hills. The burns meet the floodplain at their eponymous towns. The channels of some of these burns have been greatly modified on their passage through the Hillfoots settlements. Most of this work was carried out during the development of the former mills so that water could be drawn off the burns to provide for the industry. The mills are now closed but the burns remain largely in their modified condition with straightened channels, banks protected with masonry walls, sills constructed across the burn beds and bridges and culverts constructed across the channels. Menstrie, Alva

and Tillicoultry were originally constructed on the alluvial fans at the base of the escarpment but in later years development has moved south onto the upper reaches of the River Devon floodplain. This later development that is at risk from overtopping of the watercourses.

The other named burns rising in the Ochil hills and passing through the settlements below include Dams Burn; Balquharn Burn, Carnaughton Burn and Silver Burn (Alva); Kirk Burn (Tillicoultry); Quarrel Burn and Kelly Burn (Dollar). Flood flows in the Hillfoots burns are generated by a range of climatic conditions including intense, but short lived, storms, prolonged rainfall and snow melt events. The upper catchments are steep with little natural attenuation generating flood flows that can occur over a very short period of time but can equally quickly recede. When these flows tumble over the escarpment they are highly energetic and concentrated into deep gullies forming a series of shoots and falls with very few pools to slow the flow. At the base of the escarpment the flows naturally dispersed over the floodplain, forming delta shaped fans over which, prior to the development of the early mill towns, the burns could lose much of their energy. The Hillfoots towns are clearly constructed on a highly dynamic part of the river systems and through their construction and the subsequent modification of the watercourse channels any natural attenuating effects have been lost. This makes parts of each settlement vulnerable to flood events.

A1. Flood Prevention Improvement Audit for the Menstrie Burn

General Burn Information :-

Burn Ref.	= B-05
Grid Ref.	= N849 971 E850 959
Urban Length	= 1.2km
Catchment	= 12.07 km ²
0.5% return period flow	= 24.2cumecs (JBA report April 2005)
Chainage 0m	= North side of Ochil Road Bridge

1. Audit Results - Embankment / Wall Repairs
 - a. Chg -28.5m to -36m - Repair partially collapsed retaining wall on east side
 - b. Chg - 28m to -31m - Severe scour of embankment to be re-built on west side
 - c. Chg. – 18m to –11.5 – Unstable wall to be re-built on west side.
 - d. Chg. 5m to 10m - Masonry wall on east bank south of Ochil Rd bridge (Pointing / re-con. works carried out 2006.
 - e. Chg. 13.8m to 15m – Partial wall collapse on east side.
 - f. Chg. 30m to 58.5m – Partial failure of low stone wall at toe of earth bank on east side.
 - g. Chg. 45.7m – Pointing failing on masonry wall.
 - h. Chg. 123m to 130.5m - Low concrete wall washed out on east side
 - i. Chg. 188m to 195m – Scouring of concrete wall found on west side + poor pointing.
 - j. Chg. 296m to 300.5m - New training wall west side north of footbridge.
 - k. Chg. 421m to 426m - Scouring to earth embankment
2. Audit Results - Structural Upgrades
 - a. Chg. 236.5m to 294.5m - Bottom of boulder wall on east side failing in several places between mature trees roots.
3. Audit Results - Coarse sediment removal - None
4. Audit Results - Vegetation Removal
 - a. Chg. -23m to –20m - General scrub to be removed + 2 rooted saplings to come away.
 - b. Chg. 149.3m - Large Bush on west side.
 - c. Chg. 218.5m – Large dead tree trunk to be removed
5. Audit Results - Other maintenance Works
 - a. Chg. 114m to 139m - Former fence posts and founds on burn west embankment No. 5.

TABLE A1 – Works Arising from Audit of Menstrie Burn (Ref No. B-05)

Audit Ref.	Chainage (0m at	OS NS Grid	Work Description /	Cost Estimate	Priority by Site	Priority by	Completion Date
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No.	Ochil Rd Bridge.)	Ref.	Chainage	(£)	Rating 1= low 10=high	Date	
1. Embankment / Wall Repairs							
1/a	-36m to -28.5m East side	NS8493, 9709	Repair partially collapsed retaining wall.	800	6.5		
1/b	-31m to -28m. West side	NS8493, 9710	Severe scour to earth emb. To be re-built by appro. stone packing	500	7.5		
1/c	-18m to -11.5	NS8492, 9707	Unstable wall to be re-built	1000	5.5		
1/d		(NS8491 9704 to NS8488 9698)	Pointing of masonry wall, east side, Sth of Ochil Rd Brig.	1500	8		November 2006
1/e	13.8m to 15m East side .		Partial boulder wall collapse, to be re-built	600	5		
1/f	30m to 58.5m. East side	From NS8490, 9702 to NS8490 to 9700.	Partial failure of low stone wall at toe of emb. slope. Re-build	3000	3.5		
1/g	45.7m west side	NS8490, 9702.	Re-point masonry wall failing	50	2		
1/h	123m to 130.5m west side	NS8487, 9694 to NS8487, 9693	Reconstruct washed out low wall	1500	4		
Audit Ref. No.	Chainage (0m at Ochil Rd Bridge.)	OS NS Grid Ref.	Work Description / Chainage	Cost Estimate (£)	Priority by Site Rating 1= low 10=high	Priority by Date	Completion Date
1/i	188m to 195m west side	NS8484, 9688 to NS 8485, 9687	Re-construct found of conc. Wall + minor pointing	2000	6		
1/j	296 to 300.5m	NS8484, 9677	Repair to failing pointing	250	4		

	west side		on footbridge training wall				
1/k	421m to 426m east side	NS8485, 9665.	Replace existing boulders at scouring	500	3		
2. Structural Upgrades							
2/a	236.5m to 294.5m on east side		Reconstruction of failing boulder retaining wall between tree roots	8000	7		
3. Coarse Sediment – None							
4. Vegetation Removal							
4/a	-23m to – 20m west side	NS8491, 9709	General scrub to be removed + various saplings	100	4		
4/b	149.5m west side		Large bush to be cut back	75	3		
4/c	218.5m west side		Large tree trunk to be removed	100	6		
5. Other Main. Works							
5/a	114m to 139m West side		Remove former Conc. fence posts	700	6		

Note

Average Rating for Menstrie Burn - Embankment / Wall Repairs = 5
Average Rating for Menstrie Burn – Structural Upgrades = 7
Average Rating for Menstrie Burn – Coarse Sediment = N/A
Average Rating for Menstrie Burn – Vegetation Removal = 4.33
Average Rating for Menstrie Burn – Other Works = 6

A2. Flood Prevention Improvement Works Audit for the Alva Burn

General Burn Information :-

Burn Ref. = B-07
Grid Ref. = from NS8849 9750 to NS8833 9627
Urban Length = 1.0km
Catchment Area = 8.03km²
0.5% return period = 19.1cumecs (JBA report June 2006)
Chainage 0m = Southside of Footbridge, Golf Club Car Park.

1. Audit Results - Embankment / Wall Repairs
 - a. Chg. 45m to 49m - Minor loss of mortar to Masonry wall, west side
 - b. Chg. 102.3m - Minor deterioration of masonry wall + mortar loss, west side.
 - c. Chg. 118m to 123m - Minor deterioration of masonry wall + mortar loss, west side
 - d. Chg. 121m to 159m - Loss of mortar over reach, west side
 - e. Chg. 172.5 to 181m - Partial loss of stone work within wall, west side.
 - f. Chg. 181m to 192m - Significant failure of retaining wall, west side
 - g. Chg. 192 to 202m - Partial loss of some stone work to wall face, west side
 - h. Chg. 202m to 216m - Scouring of retaining wall base, west side
 - i. Chg. 220m to 244.5m - Minor failure of mortar at wall face, west side
 - j. Chg. 232m to 239m - Minor failure of mortar at wall face, east side
 - k. Chg. 252m to 262m - Scouring at base of retaining wall, west side
 - l. Chg. 283.5m to 289.5m - Severe scouring of wall base + wall defect, west
 - m. Chg. 287.4m to 327m - Embankment and wall bases scouring badly over reach, east side.
 - n. Chg. 357m to 361m - Failing section of retaining wall, east side.
 - o. (0m - From A91 Bridge) Chg. 25.4m to 30.7m – Minor failure of wall, east
 - p. (0m - From A91 Bridge) Chg. 45m to 61.2m – Scouring of emb beneath concrete sill, east side.
 - q. (0m From Henry Street culvert) Chg. 49m to 54m,– Bottom layer of gabion baskets just south of boundary wall deforming, east side.
 - r. (0m From Henry Street culvert) Chg. 60m – Minor failure of wall, east side

2. Audit Results - Structural Upgrades
 - a. Chg. 263.1m to 272m - Major failure of retaining wall, west side
 - b. Chg. 278m to 282m – Major failure of retaining wall, west side
 - c. Check condition of sediment bars and consider new bar locations
 - d. Consider means to reduce blockage risk at Beauclerc St. bridge
 - e. Consider means to reduce blockage risk at Henry street bridge (possible advance hake)
 - f. Consider removal or alteration to northern school boundary wall across burn (as per JBA report March 2005).
 - g. Consider means to reduce blockage risk at northern footbridge (bridge replaced, Feb. 2007)
 - h. Consider means to reduce blockage risk at southern footbridge (JBA report March 2005)
 - i. Consider removal / upgrade of Armco bridge to Greenhead Farm
 - j. Consider means to reduce blockage risk at B908 bridge (JBA report)

3. Audit Results - Coarse sediment removal
 - a. Sediment to be removed on approach to and within A91 box section bridge (already with DLO – not achieved yet)
 - b. Sediment to be removed from within Henry Street culvert.

c. Sediment removed from Henry Street Bridge, November 2006.

4. Audit Results - Vegetation Removal

- a. Chg. 28m Over grown tree branches across burn, east side
- b. Chg. 39m – Remove small dead tree across burn, east side
- c. Chg. 49m to 70.5m – Heavy shrubbery growth over burn width, east side
- d. Chg. 86m to 96m – Section of shrubbery growth across burn, west side
- e. (From Henry street Culvert, southside) Chg. 24m – Overgrown bush across burn, west side

5. Audit Results - Other maintenance Works - None

TABLE A2 – Works Arising from Audit of Alva Burn, Alva (Ref No. B-07)

Audit Ref. No.	Chainage (0m -Golf Club Car Park Footbridge.) NS8840,9741	OS NS Grid Ref.	Work Description	Cost Estimate (£)	Priority by Site Rating 1= low 10=high	Priority by Date	Completion Date
1. Embankment / wall repairs							
1/a	45m to 49m	NS8837, 9738	Minor pointing to masonry wall	100	4.5		
1/b	102.3m, west side	NS8835, 9732	Minor re-con to wall + pointing	400	4		
1/c	118m to 123m, west side	NS8836, 9731	Minor re-con to wall + pointing	750	4		
1/d	121m to 159m, west side	NS8835, 9731 to NS8836, 9727	General pointing to wall	500	4		
1/e	172.5m to 181m west side	NS8837, 9725	Stone work patching to wall	800	4.5		
Audit Ref. No.	Chainage (0m -Golf Club Car Park Footbridge.) NS8840,9741	OS NS Grid Ref.	Work Description	Cost Estimate (£)	Priority by Site Rating 1= low 10=high	Priority by Date	Completion Date
1/f	181m to 192m, west side	NS8838, 9725 to NS8838, 9724	Major reconstruction required of wall	3000	8		
1/g	192m to 202m, west side	NS8838, 9724 to NS8839,	Stone work patching required	1000	5		

		9724					
1/h	202m to 216m, west side	NS8839, 9724 to NS8840, 9722	Re-construct retaining wall base to reduce scouring potential	2500	6		
1/i	220m to 244.5m, west side	NS8840, 9722 to NS8840, 9719	General re-pointing beneath cope	250	3		
1/j	232m to 239m, east side	NS8840, 9721 to NS8840, 9720	General re-pointing to wall face	300	4		
1/k	252m to 262m, west side	NS8839, 9719 to NS8839, 9718	Re-construct at wall base to reduce scour	1500	6		
1/l	283.5m to 289.5m, east side	NS8839, 9716 to NS8839, 9714	Re-construct retaining wall base to reduce scouring potential	1500	6		
1/m	287.4 to 327m, east side	NS8839, 9716 to NS8838, 9713	Place boulders at emb. / wall bases to stabilise scouring	2000	6		
1/n	357m to 361m, east side	NS8839, 9711	Re-construct retaining wall	1200	3		
1/o	25.4m to 30.7m east side	NS8842, 9702	Minor re-con. to wall	500	4		
Audit Ref. No.	Chainage (0m at Ochil Rd Bridge.)	OS NS Grid Ref.	Work Description / Chainage	Cost Estimate	Priority by Site Rating 1= low 10=high	Priority by Date	Completion Date
1/p	45m to 61.2m	NS8843, 9700 to NS8844, 9699	Place boulders at foot of sill to prevent scouring	1000	5		
1/r	60m, east side	NS8845, 9697	Minor re-con of wall (1m2)	250	3		

2. Structural Upgrades							
2/a	263.1m to 272m, west side	NS8839, 9716 to NS8839, 9717	Major re-con. of failed section of retaining wall	3000	7.5		
2/b	278m to 282m, west side	NS8838, 9716	Major re-con. of failed retaining wall	2000	7.5		
3. Coarse Sediment							
3/a	Chg. 368m	NS8841, 9706	Coarse sediment build up to be removed from within A91 bridge	4000	8		
3/b	Chg. 0m	NS8845, 9620	Remove sediment build up within Henry Street culvert	1500	6		
4. Vegetation Removal							
4/a	28m, east side	NS8839, 9739	Prune back tree branches	50	4		
4/b	39m, east side	NS8838, 9738	Remove dead tree over burn	50	3		
4/c	49m to 70.5m, east side	NS8837, 9737 to NS8836, 9735	Cut back shrubbery over grown across burn	300	6		
4/d	86m to 96m, west side	NS8835, 9734	Cut back burn growth	100	4		
4/e	24m, west side	NS8845, 9688	Remove bush	100	3		
5. Other Main. Works - None							

Note

Average Rating for Alva Burn - Embankment / Wall Repairs = 8.5
 Average Rating for Alva Burn – Structural Upgrades = 7.5
 Average Rating for Alva Burn – Coarse Sediment = 7.0
 Average Rating for Alva Burn – Vegetation Removal = 4.25
 Average Rating for Alva Burn – Other Works = N/A

A3. Flood Prevention Improvement Audit the Silver Burn

General Burn Information :-

Burn Ref. = B-10
 Grid Ref. = NS 9132 9630 to NS8922 to 9699
 Length = 0.65km
 Catchment Area = 2.8km²
 0.5% return period flow = 6.6cumecs (JBA report June 2006)
 Chainage 0m = north of Silverburn Gardens

1. Audit Results - Embankment / Wall Repair
 - a. Check section to east of new housing estate
 - b. Check gabion basket wall on east side between Back Road bridge and A91 culvert
2. Audit Results - Structural Upgrades
3. Audit Results - Coarse sediment removal
 - a. Check level of sediment level within A91 culvert.
4. Audit Results - Vegetation Removal
 - a. Check any growth from gabion basket wall.
 - b. Regular annual pruning, as required, recommended by ME report, but large trees and bushes to be left on banks if needed for structural stability reasons.
5. Audit Results - Other maintenance Works

Table A3 - Works Arising from Audit of Silver Burn, Alva (Ref No. B-10)

Audit Ref. No.	Chainage 0m	OS NS Grid Ref.	Work Description / Chainage	Cost Estimate	Priority by Site Rating 1= low 10=high	Priority by Date	Completion Date
No actions Arising from Audit of Silver Burn							

A4. Flood Prevention Improvement Audit for the Tillicoultry Burn

General Burn Information :-

Burn Ref. = B-11
 Grid Ref. = NS 9141 9753 to NS 9100 9674
 Urban Length = 1.0km
 Catchment Area = 6.6km²
 0.5% return period flow = 16.2 cumecs (JBA report June 2006)
 Chainage 0m = North side of Shillinghill Bridge.

1. Audit Results - Embankment / Wall Repair
 - a. Chg. -47.4m to -43.8m – Loss of mortar to failing wall on west side
 - b. Chg. -34m to 0m - Loss of mortar in boundary walls on both sides
 - c. Chg. 16m to 18m – Scouring to wall base, east side
 - d. Chg. 23.1m – Partial loss of mortar under footbridge on west side – 1m²
 - e. Chg. 31.1m to 39.1m – Loss of mortar over full height of wall, east side
 - f. Chg. 53.4m to 58.1m – Loss of coping stones and failure of section of wall, east side
 - g. Chg. 62.8m to 65.1m - Loss of mortar, east side – 1m²
 - h. Chg. 109.1m – Missing coping stone on east side
 - i. Chg. 115.5m to 118.5m – Failure of section of wall, east side – 3m²
 - j. Chg. 258.4m – Failed wall base on both sides (existing stone available)
 - k. Chg. 312m –Failed wall section (deep hole), east side. – 1m²
 - l. Chg. 329.4m - Failed wall section, east side – 1m²
 - m. Chg. 392.1m to 394m – Failed section of wall on east side – 2m²
 - n. Chg. 449m to 452m – Failed section of concrete to top of wall, east side
 - o. Chg. 454.9m to 458.1m – Failed section of wall on east side – 2m²
 - p. Chg. 466.6m to 467.8m – Scouring to wall base, east side.
 - q. Chg. 478.7m to 483m – Scouring to wall base, east side.
 - r. Chg. 518m to 520.2m – Missing coping stones, east side
 - s. Chg. 532.1m to 533.1m – Scouring at wall base, east side
 - t. Chg. 545.2m – Significant crack full height of wall face, east side.
 - u. Chg. 648m – Failed section of wall on east side - 1m²
 - v. Chg. 764m (Oakmill north access)– Missing coping stone, east side
 - w. Chg. 852.4m to 854m – failed wall base on west side

2. Audit Results - Structural Upgrades
 - a. Chg. 145m – Failed sill (wooden battens and stone) across burn to reduce scour on east side
 - b. Chg. 229.6m – Failed sill across burn (wooden battens and stone) across burn
 - c. Chg. 381.2m to 388m – Failed sill + wall repair on west side + scour to east side
 - d. Chg. 697.6m - Existing steps to burn provide unnecessary escape route for flood flows, east side
 - e. Chg. 852.4m to 857.1m – Failing embankments to east side at 30mph signs (DLO job issued)
 - f. Chg. 857.6m – Severe failure of supporting wall on west side at south most industrial area access. bridge
 - g. Consider provision of fish pass at weir just north of A91 bridge (as per discussions with GR / Angling Society) (NS9141, 9708)
 - h. Consider means to reduce blockage risk at Shillinghill Road Bridge (JBA report, September 2006) (NS9143, 9748)
 - i. Consider means to reduce blockage risk at Upper Mill Street Pedestrian Bridge (JBA report, September 2006) (NS9144, 9726)

- j. Consider means to reduce blockage risk at A91 Road Bridge (JBA report, September 2006) (NS 9141, 9707)
3. Audit Results - Coarse sediment removal
 - a. Chg. 438m – Remove sediment build up within A91 box culvert Bridge. (NS9141, 9707)
 - b. Check level of coarse sediment south of A91 bridge (ME report suggest this is reducing capacity thru' reach) (NS9141, 9704)
 4. Audit Results - Vegetation Removal
 - a. Chg. –53m to –34m – Over grown shrubbery to east side
 - b. Chg. –33m to 0m – Shrubby growth out of retaining walls, east side
 - c. Chg. 34.8m to 46.3m – 3 saplings growing out of retaining wall, west side
 - d. Chg. 62.8m to 88.4m – 4 saplings growing out of retaining wall, east side
 - e. Chg. 93.6m to 95.9m – Two large saplings in retaining wall, east side.
 - f. Chg. 127.8 to 132m – Two saplings in retaining wall, west side
 - g. Chg. 185m to 192.1m – Large shrubby bush in retaining wall on east side
 - h. Chg. 229.6m - Sapling growth out of retaining wall, west side
 - i. Chg. 273.8m - Two large saplings in retaining walls, both sides.
 - j. Chg. 285.1m to 299m – Tree root / new sapling growth
 - k. Chg. 318.9m - Sapling growth out of retaining wall, west side
 - l. Chg. 322.8m - Sapling growth out of retaining wall and minor wall failure, east side
 - m. Chg. 332.5m to 349.3m – 4 Saplings growing out of retaining wall, east side
 - n. Chg. 365.2m - Large sapling root in wall + failure of adjacent section of wall, east side.
 - o. Chg. 373.2m to 403.4m – Two bushes + sapling growing out of base of retaining wall, west side
 - p. Chg. 455.5m to 464.4m – 2 Large sapling roots in wall + wall failing at two locations, east side
 - q. Chg. 478.7m to 481.6m – 2 Saplings in retaining wall, east side
 - r. Chg. 500.4m to 694m – Various Saplings in retaining wall over reach, east side.
 - s. Chg. 837m – Rotten tree root contributing to failure / scour of embankment, east side
 - d. Regular annual pruning, as required, recommended by ME report, but large trees and bushes to be left on banks if needed for structural stability reasons.
 5. Audit Results - Other maintenance Works
 - a. Check need for low footbridge to rugby fields. ME report suggest this should be removed as it acts as a trap for fly tipping.

Table A4 – Works Arising from Audit for Tillicoultry Burn (Ref No. B-11)

Audit Ref. No.	Chainage (0m – Shillinghill Bridge– Northside)	OS NS Grid Ref.	Work Description	Cost Estimate (£)	Priority by Site Rating 1= low 10=high	Priority by Date	Completion Date
1. Embankment / wall repairs							
1/a	-47.4m to – 43.8m, west side	NS9142, 9749	Pointing to walls on both sides	500	3		
1/b	-34m to 0m	NS9142, 9751 to NS9142, 9748	General Pointing to walls on both sides	750	3		
1/c	16m to 18m, east side	NS9143, 9751 to NS9143, 9746	Pack stones to wall base to prevent scour	100	5		
1/d	23.1m, west side	NS9143, 9746	Pointing to wall beneath footbridge bridge.	100	2		
1/e	31.1m to 39.1m, east side	NS9144, 9745 to NS9146, 9744	Pointing over full height of wall	200	8		
1/f	53.4m to 58.1m, east side	NS9144, 9743 to NS9144, 9742	Replace coping stones + reconstruct section of wall	700	6		
1/g	62.8m to 65.1m, east side	NS9144, 9742	Pointing of wall – 1m ²	150	5		
1/h	109.1m, east side	NS9144, 9737	Replace coping stone	100	4		
Audit Ref. No.	Chainage (0m – Shillinghill Bridge– Northside)	OS NS Grid Ref.	Work Description	Cost Estimate (£)	Priority by Site Rating 1= low 10=high	Priority by Date	Completion Date
1/i	115.5m to 118.5m, east side	NS9144, 9737	Re-con. wall – 3m ²	500	5		
1/j	258.4m, east side	NS9144, 9722	Re-con wall base using existing dislodged stones	300	5		
1/k	312m, east	NS9144,	Re-con wall	500	7		

	side	9717	- 1m2				
1/l	329.4m, east side	NS9143, 9716	Re-Con wall (deep)	700	7		
1/m	392.4m to 394m, east side	NS9142, 9710	Re-con deflected wall+remove sapling	500	7		
1/n	449.3m to 452m, east side	NS9140, 9704	Re-apply concrete haunch to wall top	250	3		
1/o	454.9m to 458.1m, east side	NS9140, 9704	Re-con deflected wall	500	7		
1/p	466.6m to 467.8m, east side	NS9139, 9703	Pack stones at wall base to prevent scour	200	4		
1/q	478.7m to 483m, east side	NS9139, 9702	Re-con wall base to prevent scour	500	4		
1/r	518m to 520.2m, east side	NS9137, 9698	Replace coping stones	300	5		
1/s	532.1m to 533.1m, east side	NS9137, 9697	Re-con scoured wall base	500	4		
1/t	545.2m, east side	NS9136, 9695	Repair large wall crack	100	4		
Audit Ref. No.	Chainage (0m – Shillinghill Bridge– Northside)	OS NS Grid Ref.	Work Description	Cost Estimate (£)	Priority by Site Rating 1= low 10=high	Priority by Date	Completion Date
1/u	648m, east side	NS9132, 9686	Recon. Wall – 1m2	200	6		
1/v	764m, east side	NS9125, 9776	Replace coping stone	100	5		
2. Structural Upgrades							
2/a	145m	NS9144, 9733	Recon failed sill across burn in wooden	1200	4		

			battens and stone pitching				
2/b	238.2m	NS9144, 9724	Recon failed sill across burn in wooden battens and pitching	1200	4		
2/c	381.2m to 388m		Recon failed sill across burn + wall and wall base repair on east side	2000	7		
2/d	697.6m, east side		Reinstate existing steps to burn – construct wall and block off to rear	2000	6		
2/e	852.4m to 857.1m, east side		Recon failed / scoured embankment (with DLO)	2500	6		
2/f	857.6m		Recon supporting wall base	1500	9		
3. Coarse Sediment Removal							
3/a	438m		Remove sediment build up with A91 bridge	2000	8		
4. Vegetation Removal							
4/a	-53m to – 34m, east side		Cut back over grown shrubbery	200	4		
Audit Ref. No.	Chainage (0m – Shillinghill Bridge– Northside)	OS NS Grid Ref.	Work Description	Cost Estimate (£)	Priority by Site Rating 1= low 10=high	Priority by Date	Completion Date
4/b	-33m to 0m, east side		Remove overgrown shrubbery from wall + weedkill	300	4		
4/c	34.8m to 46.4m, west side		Remove 3 saplings from wall + weedkill	100	4		

4/d	62.8m to 88.4m, east side		Remove 4 saplings from wall + weedkill	100	4		
4/e	93.6m to 95.9m, east side		Remove 2 large sapling trees from wall + weedkill	100	4		
4/f	127.8m to 132m, west side		Remove saplings from wall + weedkill	100	4		
4/g	185m to 192.1m, east side		Remove large bush + root from wall +weed kill	100	4		
4/h	229.6m, west side		Remove sapling from wall +weedkill	50	4		
4/i	273.8m		Remove 2 large saplings from walls on both sides +	100	4		
4/j	285.1m to 299m, east side		Remove various saplings from wall + weedkill	100	4		
Audit Ref. No.	Chainage (0m – Shillinghill Bridge– Northside)	OS NS Grid Ref.	Work Description	Cost Estimate (£)	Priority by Site Rating 1= low 10=high	Priority by Date	Completion Date
4/k	318.9m, west side		Remove sapling from wall + weedkill	50	4		
4/l	322.8m east side		Remove sapling, weedkill + repair wall	300	5		
4/m	332.5m to		Remove 4	100	4		

	349.3m, east side		saplings trees from wall + weedkill				
4/n	365.2m, east side		Remove large sapling root + weedkill + recon failing wall – 1m2	400	6		
4/o	373.2m to 403.4m, west side		Remove 2 saplings + bushes + weedkill	100	4		
4/p	455.5m to 464.4m, east side		Remove 2 large saplings + weedkill	100	4		
4/q	478.7m to 481.6m, east side		Remove saplings + weedkill	100	4		
4/r	500.4m to 694m, east side		Remove various saplings +weedkill over reach	300	4		
4/s	837m, east side		Remove rotten tree + recon of emb. needed	500	6		
5. Other Main. Works – None							

Note

Average Rating for Tilly Burn - Embankment / Wall Repairs = 4.95
Average Rating for Tilly Burn – Structural Upgrades = 7.33
Average Rating for Tilly Burn – Coarse Sediment = 8.0
Average Rating for Tilly Burn – Vegetation Removal = 4.26
Average Rating for Tilly Burn – Other Works = N/A

A5. Flood Prevention Improvement Audit for the Kirk Burn

General Burn Information :-

Burn Ref. = B-12
Grid Ref. = NS 923 978 E 926 967
Length = 1.1km
Catchment Area = unknown
0.5% return period flow = unknown
Chainage 0m = Northside of Heathwood Crescent Culvert.

1. Audit Results - Embankment Repair

- a. Chg –5m - Scour to former concrete retained embankment, west side
- b. Chg 57m – Minor scour to small concrete apron on west side at two locations
- c. Chg 393m – Small section of wall close to collapse, east side
- 2. Structural Upgrades
 - a. Chg –12m to –20m – Substantial collapse of lengths of former concrete embankment, both sides
 - b. Chg 131m – Significant collapse of old bridge structure and at exit of burn
- 3. Audit Results - Coarse sediment removal
 - a. Chg 0m to 11m - Significant sediment build up at advance hake, at culvert mouth and within culvert at west end of Heathwood Crescent.
 - b. Chg 96m to 103m – Sediment build up at hammerhead end of Heathwood Crescent.
 - c. Chg 271m to 313m– Significant sediment build up in culvert beneath Armour Place.
 - d. Chg 448m – Sediment build up in culvert.
- 4. Audit Results - Vegetation Removal
 - a. Chg 170m – Minor over grown vegetation on north side
- 5. Audit Results - Other maintenance Works - None

Table A5 – Works Arising from Audit of Kirk Burn Tillicoultry (Ref No. B-12)

Audit Ref. No.	Chainage (0m – Shillinghill Bridge– Northside)	OS NS Grid Ref.	Work Description	Cost Estimate (£)	Priority by Site Rating 1= low 10=high	Priority by Date	Completion Date
1. Embankment / wall repairs							
1/a	-5m west side	NS9244, 9754	Pack boulders to reduce scour potential beneath concrete apron	1000	6		

1/b	57m, west side	NS9249, 9751	Reconstruct two low emb. areas of scour	700	3		
1/c	393m	NS9275, 9738	Re-build section of collapsed wall	1000	2		
2. Structural Upgrades							
2/a	-12m to -20m, both sides	NS9243, 9755	Reconstruct broken concrete embankment aprons	4000	5		
2/b	131m,	NS9256, 9752	Reconstruct failed parapet wall at burn exit	2000	3		
3. Coarse Sediment Removal							
3/a	0m to 11m	NS9244, 9754	Remove sediment build up at advance hake, culvert mouth and within culvert pipes	1000	7		
3/b	96m to 103m	NS9253, 9752	Remove sediment build up within culvert	500	5		
3/c	271m to 313m	NSNS9269, 9749 to 9271, 9745	Remove large sediment build up within culvert	1000	7		
Audit Ref. No.	Chainage (0m – Shillinghill Bridge– Northside)	OS NS Grid Ref.	Work Description	Cost Estimate (£)	Priority by Site Rating 1= low 10=high	Priority by Date	Completion Date
3/d	448m	NS9276, 9733	Remove sediment build up in culvert	500			
4. Vegetation							
4/a	170m, north side	NS9260, 9752	Remove minor shrubbery growth	100	3		

5. Other Maintenance Works – None

Note

Average Rating for Kirk Burn - Embankment / Wall Repairs	= 3.67
Average Rating for Kirk Burn – Structural Upgrades	= 4
Average Rating for Kirk Burn – Coarse Sediment	= 6
Average Rating for Kirk Burn – Vegetation Removal	= 3
Average Rating for Kirk Burn – Other Works	= N/A

A6. Flood Prevention Improvement Audit for the Dollar Burn

General Burn Information :-

Burn Ref.	= B-14
Grid Ref.	= NS 961 989 E 964 969
Urban Length	= 1.6km
Catchment Area	= 7.87 km ²
0.5% return period flood flow	= 9.6cumecs (JBA report June 2006)
Chainage 0m	= North side of Back Road Bridge.

1. Audit Results - Embankment Repair
 - a. Chg. 35.7m to 36.9m – Minor failure of wall, east side
 - b. Chg. 49.9m – Minor wall failure, east side
 - c. Chg. 75.5m to 81.3m – Minor scour to wall base
 - d. Chg. 507.9m – Minor scour to embankment, west side (just downstream of footbridge)
 - e. Check condition of low stone walls supporting embankments between Back Rd bridge and A91 bridge.

2. Audit Results - Structural Upgrades
 - a. Chg. –37.1m to –21.9m – Severe scour to earth embankment, west side (golf club car park)
 - b. Chg. 394.2m – Minor scour to A91 bridge abutment footing, north east corner.
 - c. Chg. 615m – Scouring at brick built structure + reset iron sill, west side.
 - d. Chg. 745m - Failing stepped sills north of former railway bridge.

3. Audit Results - Coarse sediment removal
 - a. Chg. 760m - Remove sediment build up in former railway line culvert (NS9634, 9761).

4. Audit Results - Vegetation Removal
- Chg. 0m to 90m – Various saplings growing out of retaining wall, east side
 - Chg. 08m to 0m – Over hanging foliage on east side.
 - Chg. 49.9m – Sapling growing in wall (see emb. repair 1/b), east side
 - Chg. 98.3m – Sapling growing in wall, west side
 - Chg. 98.3 to 109.7m – Several saplings in wall, east side
 - Chg. 117.3m – Large sapling in wall, east side
 - Chg. 460.8m to 505.9m – Various saplings in retaining wall, east side
 - Check need for pruning of growth on islands (from NS 9631, 9833 to NS9630 to 9796)
 - Regular annual pruning, as required, recommended by ME report, but large trees and bushes to be left on banks if needed for structural stability reasons.
5. Audit Results - Other maintenance Works
- Chg. 6m - Large section of concrete in Back Road bridge to be removed, east side
 - Chg 722m – Failing sill (wooden sleepers) across burn.

Table A6 – Works Arising from Audit of Dollar Burn, Dollar (Ref No. B-14)

Audit Ref. No.	Chainage (0m = Back Road Bridge–Northside)	OS NS Grid Ref.	Work Description	Cost Estimate (£)	Priority by Site Rating 1= low 10=high	Priority by Date	Completion Date
1. Embankment Repairs							
1/a	35.7m to 36.9m, east side		Reconstruct 1m2 section of wall	300	7		
1/b	49.9m, east side		Recon minor wall failure	300	4		
1/c	75.5m to 81.3m, east side		Pack scoured area with stones	200	5		
Audit Ref. No.	Chainage (0m = Back Road Bridge–Northside)	OS NS Grid Ref.	Work Description	Cost Estimate (£)	Priority by Site Rating 1= low 10=high	Priority by Date	Completion Date
1/d	507.9m, west side		Pack scoured area with stones	200	5		
2. Structural Upgrades							
2/a	-37.1m to -21.9m, west side		Construct. of retaining wall at required reach	5000	7		
2/b	394.2m, north east		Pack with suitable material	200	6		

	side		scoured area				
2/c	615m, east side		Recon embankment and brick structure + reset sill	1000	5		
2/d	745m		Reset dislodged sills + replace failed sills as required	1500	7		
3. Coarse Sediment Removal							
3/a	760m		Remove sediment build up within culvert	1000	8		
4. Vegetation Removal							
4/a	0m to 90m, east side		Cut out various saplings in wall over reach + weedkill	250	5		
4/b	-8m to 0m, east side		Cut back over hanging foliage	100	4		
4/c	49.9m, east side		Cut out sapling + weedkill	50	4		
4/d	98.3m, west side		Cut out sapling + weedkill	50	4		
4/e	98.3m to 109.7m, east side		Cut out several saplings in wall + weedkill	200	4		
4/f	117.3m		Cut out large sapling in wall + weedkill	100	4		
4/g	460m to 505.9m, east side		Cut out various saplings + weedkill	250	4		
5. Other Main. Works							
Audit Ref. No.	Chainage (0m = Back Road Bridge–Northside)	OS NS Grid Ref.	Work Description	Cost Estimate (£)	Priority by Site Rating 1= low 10=high	Priority by Date	Completion Date
5/a	6m		Remove section of concrete within Back Road Bridge	100	5		
5/b	722m		Recon sill across burn in wooden	600	4		

			sleepers				
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Note

Average Rating for Dollar Burn - Embankment / Wall Repairs = 5.25
Average Rating for Dollar Burn – Structural Upgrades = 6.25
Average Rating for Dollar Burn – Coarse Sediment = 8.00
Average Rating for Dollar Burn – Vegetation Removal = 4.14
Average Rating for Dollar Burn – Other Works = 4.50

Table A7 - Average Works Ratings - Hillfoots Burns

*****	Emb/Wall Works	Structural Upgrades	Coarse Sediment Removal	Vegetation Removal Works	Other Works
Menstrie Burn	5.0	7.0	N/A	4.33	6.0
Alva Burn	8.5	7.5	7.0	4.25	N/A
Tilly Burn	4.95	7.33	8.0	4.26	N/A
Kirk Burn	3.67	4.0	6.0	3.0	N/A
Dollar Burn	5.25	6.25	8.0	4.14	4.5

Note - Highest ratings shown in red

6.0 ENVIRONMENTAL AND SUSTAINABILITY ISSUES

The Council continues to be concerned that any works, adjacent to or within watercourses, are carried out in a manner that recognises the importance of biodiversity and the environment. Until recently certain works within watercourses have been carried out through liaison between the Council’s Development Services, its Biodiversity Officer and Scottish Environmental Protection Agency (SEPA). This is particularly the case where these works would involve the

removal of any sediments or vegetation in or around watercourses. The aim of such joint working is to ensure that resulting works are carried out in a manner that has minimal environmental impact.

Any intervention in the water environment will have some affect on the prevailing ecological status and as such will require approval from SEPA. *The Water Environment (Controlled Activities) (Scotland) Regulations 2005*¹⁶ came into force as of 1 October 2005, but directly affected watercourse maintenance works from 1 April 2006. This legislation is essentially the regulatory means by which SEPA will introduce controls over any use of, or intervention in, the water environment.

The Council continues to operate its “Flood Liaison and Advice Group” (FLAG) as encouraged by the Scottish Executive policy document, *Scottish Planning Policy 7 - Planning and Flooding*¹⁷. The principal purpose of the FLAG is to provide a forum for all interested parties to share knowledge and offer advice on flooding issues as they relate to the each party’s actions and responsibilities. The FLAG is aware of the need to promote sustainable flood management techniques, as required by *The Water Environment Water Services (Scotland) Act 2003*¹⁴ and regularly comments on the latest flooding legislation and other important related topics.

The FLAG is assessing the results of the natural flood management techniques that were being employed and investigated in the recently completed “River Devon Project”. The project was as a result of an effective partnership between the World Wildlife Fund Scotland and Clackmannanshire Council and had the aim of studying the effectiveness of a range of sustainable flood management techniques in the River Devon catchment. Sustainable flood management utilises topography, river dynamics and natural materials to restore and maintain natural flood regimes in rivers. It involves working at a catchment scale taking a wide view of the flooding regime and integrating a range of techniques and

developing individual sites and opportunities in the floodplain. The project undertook to actively promote awareness of flood issues among the general public and interested stakeholders within the Council area. The study resulted in the production of two key documents in 2006, *Flood Planner*¹⁸ and *Slowing the Flow*¹⁹ which are now widely recognised to have added to the knowledge available to flood managers in Scotland.



Photo 22 – Willow walling of the north bank of the River Devon between Tillicoultry and Dollar

7.0 FLOOD WARNING IN CLACKMANNANSHIRE

7.1 Development of Flood Warning System

The Clackmannanshire Council area is significantly influenced by the catchment of the River Devon and to a lesser degree by the catchment of the River Black Devon. Both rivers outflow into the Forth Estuary. The geomorphology of the River Devon catchment means that rain falling on the Ochil Hills reaches the urban areas very quickly via the steep escarpment above the Hillfoots towns and

villages. This renders the provision of, nationally recommended, effective three-hour flood warning to some parts of Clackmannanshire impractical.

Nevertheless Clackmannanshire Council has instigated the development of a Flood Warning system. Utilising the recommendations of a Council commissioned study *Flood Generation Processes in Clackmannanshire Council Area (2003)*¹⁰, a system of river gauges was installed during 2002 and an automated river gauging station was installed on the upper reaches of the River Devon at North Fossoway Bridge in 2004. A hydrology consultant has been commissioned to monitor the river gauges over a suitable period and analyse the data with a view to providing a robust flood warning system for the River Devon and its catchment.

The above report highlighted that the burns through Menstrie and Alva are likely to be most susceptible to flash events and it is also unlikely that reasonable advance warning can be provided for these towns.

The automated Flood Warning system for the River Devon will not be of practical use for some time. In the interim the Council will utilise the various flood warning / adverse weather warning issued by the media, SEPA and the Met Office through its "Flood Warning Procedures and Action Plans"²⁰ (section 7.2).

7.2 Flood Warning Procedure and Action Plans

Stage 1 Procedure (Routine Weather Monitoring)

From 9am each working day, monitoring general weather information from TV, Radio and general internet sources.

1.1 If adverse weather apparent or predicted for East, South East or Central Scotland over next 24 hours (Mon – Fri), or next 48 hours over weekend, initiate Stage 2 procedure

Stage 2 Procedure (Monitor Web Based Information)

Monitoring web page -<http://secure.wsiopenroute.co.uk/Falkirk/>, consult “precipitation rate forecast information”

2.1 If the predicted rainfall rate is 8mm to 16mm per hour, or above over the following 24/48 hour period, for the Clackmannanshire area, **initiate Flood Action Plan A** (see page 95)

2.2 If the predicted rainfall rate is less than 8mm to 16mm per hour over the following 24/48 hour period for the Clackmannanshire area, continue to monitor until weather forecast improves.

2.3 Initiate Stage 3 Procedure

2.4 Note Action in Duty Officer Log Report - Duty Officer to log times of checking stages 2, 3 and 4 and note situation

Stage 3 Procedure (SEPA information)

Check Scottish Environment Protection Agency (SEPA) “Live Flood Warning Information” web site “<http://www.sepa.org.uk/flooding/warnings/index.aspx>”.

3.1 If “Flood Warning” has been issued by SEPA for Clackmannanshire area, initiate Plan A and (see 3.2)

3.2 Continue to monitor SEPA “Live Flood Warning Information” web site.

3.3 Initiate stage 4 procedure (Telemetric Flood Warning Information – not yet operational – due to be operational late 2007)

3.4 If Severe Flood Warning has been issued by SEPA for Clackmannanshire area, **initiate Flood Plan B** (see page 95), and continue to monitor SEPA “Live Flood Warning Information” web site

3.5 Initiate stage 4 procedure (Telemetric Flood Warning Information – not yet operational – due to be operational late 2007)

If neither “Flood Warning nor Severe Flood Warning has been issued, continue to monitor SEPA “Live flood warning Information” web site.

If “Flood Watch” has been issued by SEPA for Clackmannanshire area

3.6 Continue to monitor SEPA “Live Flood Warning Information” web site

3.7 Initiate stage 4 procedure (Telemetric Flood Warning Information – not yet operational – due to be operational late 2007)

3.8 Note action in Duty Officer Log

Stage 4 Procedure (Telemetric Flood Warning Station – not yet operational)

4.1 Check River Level warning Telemetry output

4.2 If Flood Warning criterion is reached, **initiate Flood Plan B** (see page 95)

4.3 Note Action in Duty Officer Log

If Met Office “National Severe Weather Warning Service” information is received giving “Regional Risk Assessment” information, relating to rainfall, for Eastern Scotland with a likelihood of occurrence greater than 80%, **initiate Flood Plan B** (see page 95).

Flood Action Plan A

- Notify Emergency Planning Officer (Richard O’Grady - 07977 446349)
- Development and Flooding Officer (Kenny Jackson - 07792 952838) to carry out immediate inspection of Priority 1 Sites including Hillfoots Burns, Brothie Burn, Fairy Burn (see Appendix B for list of priority 1 sites)
- Instruct immediate response contractor to clear any blockages (Roads Contracts – Tom Davidson 07966 193652, Alan Hunter 07974 837 814)

- If inspections indicate that a severe flood event is occurring or is likely to occur, initiate Plan B

Flood Action Plan B

- Notify Emergency Planning Officer (EPO) of actions and current situation (Richard O’Grady - 07977 446349). Check with EPO that emergency services have been informed.
- If not already completed, contact immediate response contractor to initiate immediate inspection and clearance of Priority 1 sites including Hillfoots Burns, Brothie and Fairy Burns (see Appendix B for list of priority sites).
- Contact Forthbank Depot (Alan Hunter - 07974 837 814)
- Prepare 1000 sandbags
- Prepare 4 No. water pumps
- Place appropriate lorries / drivers on “standby” footing
- Place “gulley emptier” in “standby” footing
- Prepare “flood” and “Road Closed” signs and barriers
- Contact Kelliebank Depot (Tom Davidson 726491 or 07966 193652) to ensure contractor’s Supervisor and stand by squads availability for predicted period.
- Set up co-ordinator in Roads and Transportation Office – provide phone number to Roads Officers and Contractor’s Supervisor and Foremen.
- Ensure Roads Officers availability for Emergency Planning Core Group.

8.0 INVESTMENT SINCE APRIL 2005

Table Showing Annual Council Spending on Flood Prevention- 2003 to 2008

*****	2003/04	2004/05	2005/06	2006/07	2007/08*
	(£)	(£)	(£)	(£)	(£)
Planned Maintenance	12,000	17,000	20,000	29,000	18,000

Works					
Reactive (Emergency) Works	25,000	7,000	1,000	2,000	1,000
Planned Structural Works	33,500	105,000	100,000	37,000	200,000
Flood Prevention System Development	8,500	2,000	2,000	-	1,000
Vegetation Removal Works	-	2,000	-	1,000	2,000
Sediment Removal Works	-	5,000	-	-	6,000
Trash Screen Replacement	2,500	2,500	3,000	-	2,000
Flood Studies	6,500	17,500	15,000	51,000	1,000
Totals	88,000	158,000	142,000	120,000	231,000

* Projected

The cost of “Reactive (Emergency) Work”, which is essentially the cost of works undertaken in emergency circumstances, which was £25,000 in 2003/04 is now only £1,000 - £2,000 per annum. In the same period “Planned Maintenance Works” costs have risen from £12,000 to about £29,000. This is seen as an improving situation as the need to spend resources on relatively expensive reactive works has no real long term benefit. The overall spend in this area has fallen by £18,000 from £37,000 to £19,000. Indeed, the reduction in “Reactive (Emergency) Work” costs demonstrates that the *Prioritised Watercourse Inspection and Clearance Regime*⁴ (section 5.3), i.e. planned regular inspection of key watercourses and sensitive locations, is having a positive effect. More importantly perhaps there has been a significant reduction in “Flooding incidents” largely due to the “Planned Maintenance Works”. Although a “year to year” direct

comparison can be misleading as weather is changeable, this general improvement suggests that the adverse flooding effects of severe weather events have been minimised since the implementation of regular inspection and clearance works.

During 2005/06 the Cochrane Park, Alva and Glenwhinnel, Alva projects were completed. In the same year the replacement footbridge and reinstatement of the Menstrie Burn (watercourse reference B-05) channel walls at Burnside Road, Menstrie and works on Alva Burn (watercourse reference B-07) walls at Brook Street were carried out. 2006/07 saw further works on section of the Alva Burn including replacement of a footbridge in the Primary school Playground. Also, some access improvements at Bryanston Drive, Dollar (watercourse reference B-13) and Ormiston Drive, Alloa (watercourse reference U-02) were completed. The main project in 2007/08 is Elistoun Drive, Tillicoultry (watercourse reference which is a joint scheme with Scottish Water to renew the drainage systems in the residential streets immediately north of the River Devon.

A significant investment continues to be made in watercourse / hydrological studies (see references on page 98). These studies will influence works programmes during 2007/08 and 2008/09.

References

1. *Flood Prevention (Scotland) Act 1961 (HMSO).*
2. *Flood Prevention and Land Drainage (Scotland) Act 1997 (HMSO).*
3. *Clackmannanshire Council Biennial Report 2005 (Clackmannanshire Council web site address : <http://www.clacksweb.org.uk>)*
4. *Prioritised Inspection and Clearance Regime (Section 5.2 of this report).*
5. *Watercourse Audits and Work Implementation Plans (Section 5.3 of this report).*

6. *Tillicoultry Burn Flood Assessment (September 2006) (Clackmannanshire Council Roads & Transportation Library).*
7. *Elistoun Drive Flood Alleviation Study, Tillicoultry (2007) (Clackmannanshire Council Roads & Transportation Library).*
8. *Gavins Road / Woodburn Drive Flood Alleviation Study – Alloa (to be published 2007) (Clackmannanshire Council Roads & Transportation Library).*
9. *Alva School Site Flood Risk Assessment (2006) (Clackmannanshire Council Roads & Transportation Library).*
10. *Flood Generation Processes in Clackmannanshire Council Area (2003) (Clackmannanshire Council Roads & Transportation Library).*
11. *Flood Warning Procedures and Action Plans (Section 7.0 of this report) (Clackmannanshire Council Roads & Transportation Library).*
12. *SEPA Indicative River and Coastal Flood Map (SEPA web site address : <http://www.sepa.org.uk/flooding/mapping/index.htm>).*
13. *Stalker Avenue – Glebe Crescent, Tillicoultry – CCTV Report No. 1 – July 2007 (Clackmannanshire Council Roads & Transportation Library).*
14. *The Water Environment and Water Services (Scotland) Act 2003 – (HMSO).*
15. *Flood Management in the Hillfoots Burns (2004) (Clackmannanshire Council Roads & Transportation Library).*
16. *Water Environment (Controlled Activities) (Scotland) Regulations 2005 (SEPA Web site address : <http://www.sepa.org.uk/wfd/regimes/index.htm>).*
17. *Scottish Planning Policy 7 – Planning and Flooding (Scottish Government Web site address : <http://www.scottishexecutive.gov.uk/Publications>).*
18. *Flood Planner (WWF Scotland Web site address : wwf.org.uk/scotland).*
19. *Slowing the Flow (WWF Scotland Web site address: wwf.org.uk/scotland).*
20. *Flood Warnings Procedures and Action Plans (Section 7.2 of this report).*