

CLACKMANNANSHIRE COUNCIL



Alva from the Ochil Hills during the Flood Event of 10th January 2005

FLOOD PREVENTION AND LAND DRAINAGE (SCOTLAND) ACT 1997

BIENNIAL REPORT – November 2005

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1.0 Introduction

This report is published to meet Clackmannanshire Council's duty under section 6A of the Flood Prevention (Scotland) Act 1961 as inserted by section 3 of the Flood Prevention & Land Drainage (Scotland) Act 1997. The report covers the time elapsed since the production of the last report in November 2003.

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 2003;
- the measures that the Council has taken since November 2003 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 - Council staff carrying out dead wood debris cutting in Alva Glen

The report will also:

- summarise legislation and 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 obstructions within, watercourses, inadequate capacity of watercourses or surface water drainage systems and increasingly through the effects of climate change.
- Although possible causes of flooding of property are referred to and offered as examples in this report, it is important to note that the Council has limited funds to improve the physical capacity of watercourses. The Flood Prevention & Land Drainage (Scotland) Act 1997 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 recently revised its methodology in carrying out maintenance 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 & 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 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 extended the powers of the 1961 Act and placed 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 that they require to take 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 watercourse maintenance. This includes inspection and clearance of watercourses and planned sediment and vegetation removal. The compilation of an inventory of related infrastructure and ancillary apparatus is underway and an inspection programme will follow. The following section describes progress on policy and action plans.

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. The responsibility lies within Development & Environmental Services and in particular with the Roads & Transportation Unit. The Policy and Partnership 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 provision of new infrastructure aimed at preventing / limiting further flooding and reducing the need for maintenance.

Development of Flood Prevention Strategy

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.

Policy FP1

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

Clearing of Debris

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*¹ was developed. This will be 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 removing silt and coarse sediments from watercourses where these were considered to be affecting the capacity of the watercourse channel. A *Coarse Sediment Removal Programme*² has been developed to ensure that the resulting works have minimal adverse affect on local biodiversity.

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'

Maintenance of Banks, Walls, Culverts and other Infrastructure

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 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. The Council will now undertake regular surveys of all watercourses to assess the structural integrity of banks, walls, culverts and other infrastructure. A *Watercourse Vegetation Management Programme*³ has been developed through discussion with SEPA. An initial survey will populate a *Watercourse Infrastructure Database*⁴ and subsequent analysis will generate a programme of *Prioritised Maintenance of Infrastructure*⁵.

This survey and assessment work is underway and the Council has commissioned a number of reports relating to specific watercourses or sections of watercourses. *Inglewood at Tullibody – Flood Risk Assessment*⁶ (2003) and *Gavins Road, Alloa – Flood Risk Assessment*⁷ (2004) suggest suitable improvement works at particular problem locations. Studies of prominent watercourses have been carried out. *Flood Management in the Brothie Burn*⁸ (2003) identified burn clearance priorities and long-term recommendations relating to the removal of culvert and wall sections and replacement trash screens. Improvements to the main burns affecting Menstrie, Alva, Tillicoultry and Dollar are recommended in *Flood Management in the Hillfoots Burns*⁹ (2004). This work has been expanded on by further hydraulic assessments of the principal burns in the Hillfoots. The study, *Hydraulic Assessment of Bridges in Alva and Alva Burn*¹⁰ (2005), highlights locations on Alva Burn where there may be capacity problems and constraints caused by bridges and other structures. *Flooding in the Menstrie Foothills*¹¹ (2005) looks into the reasons for the flood event of 9th August 2004 and was used to develop mitigation measures to minimise the likelihood of a repeat event. A study of the hydraulic capacity of Tillicoultry Burn and its catchment has been commissioned and will be produced early next year.

Policy FP3

‘The Council shall 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’

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. 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*¹² (2003), 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 Fossoy Bridge. A hydrology consultant has been commissioned to monitor the river gauges and the data supplied by the gauging station over a suitable period and to 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, 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. The automated Flood Warning system 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*¹³ (section 8.0).

Policy FP4

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

Flood Alleviation Works

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 and inspection and clearance regimes are in place the Council intends to assess the watercourse channels to identify areas where overtopping of banks either occurs or may be likely to occur during an high rainfall event.

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’

References

1. *Prioritised Inspection and Clearance Regime* (Section 6.2)
2. *Coarse Sediment Removal Programme* (Section 6.3)
3. *Watercourse Vegetation Management Programme* (Section 6.4)
4. *Watercourse Infrastructure Database* (under development)
5. *Prioritised Maintenance of Infrastructure* (under development)
6. *Inglewood at Tullibody – Flood Risk Assessment* (2003) (Clackmannanshire Council Roads & Transportation Library)
7. *Gavins Road, Alloa – Flood Risk Assessment* (2004) (Clackmannanshire Council Roads & Transportation Library)
8. *Flood Management in the Brothie Burn* (2003) (Clackmannanshire Council Roads & Transportation Library)
9. *Flood Management in the Hillfoots Burns* (2004) (Clackmannanshire Council Roads & Transportation Library)
10. *Hydraulic Assessment of Bridges in Alva and Alva Burn* (2005) (Clackmannanshire Council Roads & Transportation Library)
11. *Flooding in the Menstrie Foothills* (2005) (Clackmannanshire Council Roads & Transportation Library)
12. *Flood Generation Processes in Clackmannanshire Council Area* (2003) (Clackmannanshire Council Roads & Transportation Library)
13. *Flood Warning Procedures and Action Plans* (Section 8.0)

3.0 Inventory of Watercourses

The following are the principal named 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

Descriptions of Principle Named 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.

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).



Photo 2 - River Devon looking northeast showing flood storage – 10/01/05

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 River Devon floodplain. It is this later development that is at risk from overtopping of the watercourses.

The Hillfoots Burns

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 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.



Photo 3 – Dollar Burn at Old Railway Line looking south - 10/08/04

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 at Shillinghill Culvert, Alloa – 10/05/04



Photo 5 – Brothie Burn at Shillinghill Culvert, Alloa – recently replaced trash screen - 04/11/05

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 northeastern edge of Clackmannan. It is culverted beneath the 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.

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 Dollar 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.

4.0 Incidences of Flooding & Known Problems

4.1 Flooding Events

Alloa

AL-01 Donaldson Avenue (NS 873 944)

No flood events recorded since November 2003. Watercourse ref. U-15 (see section 3.0).

AL-02 Engelen Drive (NS 889 922)

No flood events recorded since November 2003. Watercourse ref. B-01

AL-03 Forrester Grove (NS 878 941)

Reports, from time to time, of flooding to houses, property and the public road in Forrester Grove had been recorded prior to 2002. Watercourse ref. U-01. The following flooding threats to houses were subsequently recorded;

- 23/01/02 Water reported flowing through gardens and into foundations of two houses.
- 15/06/02 Recurrence of above situation.
- 30/07/02 Recurrence of above situation.
- 16/01/03 Recurrence of above situation. Water freezing on road surface and causing difficulties for vehicles.

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 2003. The location was inspected during the high rainfall events of 21/10/04, 10/01/05 and 11/10/05 and no problem noted. Watercourse ref. U-04.

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

Flood events recorded last year affecting the rear of properties in Woodside Road. The location was inspected during the high rainfall events of 21/10/04, 10/01/05 and 11/10/05 and no problem noted. Watercourse ref. U-04.

AL-06 Ormiston Drive (NS 874 945)

Small problem arose when drain blocked in garage area and affecting one garden. No other flood events recorded since November 2003. Watercourse ref. U-02.

AL-07 Dunmar Drive (NS 873 940)

Report, in October 2005, of minor water seepage into garden of house in Dunmar Drive. Watercourse ref. U-03.

AL-08 Lambert Terrace (NS 893 932)

09/08/04 Minor flooding from Brothie Burn affecting gardens to northeast of Lambert Terrace.

18/08/04 Recurrence of above situation. Watercourse ref. B-01.

AL-09 Former Brewery Car Park (NS 890 930)

No flood events recorded but site is prone to dumping and collection of natural debris from upstream. Due for redevelopment.

Alva

AV-01 Brook Street (NS 883 972)

No flood events recorded. Watercourse ref. B-07.

AV-02 Henry Street (NS 884 969)

09/08/04 Alva Burn overtopped and flowed into Henry Street. Waters did not reach gardens or property. Watercourse ref. B-07.

AV-03 Primary School (NS 884 968)

09/08/04 Alva Burn overtopped and flooded the school playground. No flooding to school building. Watercourse ref. B-07.

AV-04 Greenhead Farm (NS 884 966)

09/08/04 Alva Burn overtopped its banks and flooded farm buildings and house. Overtopping due to bridge on farm track being significantly below capacity to carry the burn. Dam created sending overflow water towards farm buildings. Bridge, burn and land in same ownership. Watercourse ref. B-07.

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

Number of incidents of flooding to the garden and foundations of the house 'Glen Affric' emanating from the hillside to the north; all incidents reported prior to November 2003. Watercourse ref. U-20.

AV-06 Back Road (NS 875 973)

Number of incidents of flooding to the gardens of ten houses on the north side of Cochrane Crescent, flooding to Cochrane Park and flooding to Back Road. This emanated from a manhole located at the south boundary of the house 'Glen Affric' forming part of the same watercourse described in AV-05; all incidents reported prior to November 2003. Watercourse ref. U-20.

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

Number of incidents of flooding to the gardens of ten houses on the north side of Cochrane Crescent and flooding to the public road (Cochrane Crescent). This emanated from a manhole located at the opposite side (south side) of Back Road to the manhole mentioned in AV-06 and forming part of the same watercourse described in AV-05; all incidents reported prior to November 2003. Watercourse ref. U-20.

AV-08 Wharry Road (NS 875 971)

No flood events recorded since November 2003. Watercourse ref. U-20.

AV-09 Cochrane Park (NS 876 972)

09/08/04 Flooding to parkland.
21/10/04 Prolonged flooding on parkland.
10/01/05 Flooding to parkland. Watercourse ref. U-20.

AV-10 Rhodders Grove (NS 889 971)

Seepage into gardens from marshy area to north of houses.

AV-11 Blindwells / Southcroft (NS 879 969)

Number of occurrences of pipe system surcharging in heavy rain events. Flooding to a number of gardens but no threat to buildings.

Cambus

CA-01 Forth Street (NS 854 938)

No flood events recorded since November 2003. Watercourse ref. R-01.

Clackmannan

CL-01 Duke Street (NS 917 915)

Reports, from time to time, of non-significant flooding to a garage attached to the house at no. 1 Duke Street. Caused by overland flow. Specific reported occurrence;

24/03/03 Garage under 50mm deep water. Water does not enter garage.

CL-02 Brucefield Crescent (NS 917 918)

Manhole surcharging and flooding garden of one house.

Coalsnaughton

No flood events recorded.

Devonside

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

09/08/04 Natural debris and household rubbish blocked trash screen. Burn overtopped onto A908 and flowed into Devonpark Industrial Estate. Flooding to warehouse causing damage to stored goods. It is likely that the warehouse would have flooded in any case as the local road (private) drainage system would not have coped with the heavy rainfall. Watercourse ref. U-11.

DS-02 Drummie Road (NS 922 962)

No flood events recorded. Watercourse ref. U-10.

DS-03 Alexandra Street at West End (NS 916 961)

Water ingress into garden and house No. 109 from land behind at recently constructed house.

DS-04 Bain Street, (NS 918 962)

Foul water surcharging from piped water system into garage area and into gardens.

Devon Village

No flood events recorded.

Dollar

DL-01 A91 Muckhart Road (NS 966 980)

09/08/04 Road gullies exceeded capacity resulted in flooding to road. No reports of flooding to properties.

21/10/04 Leaf fall and road gullies at capacity resulted in flooding to road. No reports of flooding to properties.

DL-02 Thornbank Road (NS 958 980)

21/10/05 Culvert overtopped. Floodwaters entered basement of St. James the Great church. No report of damage. Watercourse ref. U-14.

DL-03 Back Road (Private) (NS 955 982)

25/05/05 Minor flooding event occurred affecting some gardens in Strachan Crescent and also the public road (Strachan Crescent). Watercourse ref. U-17.

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

21/10/04 Floodwaters from the River Devon reached the caravan site. The site is located on the operational floodplain of the river. No report of damage.

10/01/05 Floodwaters from the River Devon again reached the caravan site. No report of damage. Watercourse ref. R-01.

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

10/01/05 Flood waters from high River Devon reached house along lade. No report of damage to property. Watercourse ref. U-21.

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

June 2003 Culvert under Cycle Way (disused railway) blocked by debris. Large and deep pond formed behind gardens in Bryanston Drive. No flooding threat to property but depth of pond created hazardous situation. Watercourse ref. B-13.

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

Small culvert under A91. Reports, pre 2003, of overtopping onto main road. Watercourse ref. DL-08.

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

Reports of overtopping of culvert prior to 2003. Watercourse ref. U-16.

Fishcross

No flood events recorded.

Forestmill

No flood events recorded.

Glenochil Village

GL-01 Glenochil Terrace (NS 870 957)

Prior to 2003 water overtopping watercourse and flooding gardens to rear of Glenochil Terrace. Watercourse ref. U-06.

Kennet

No flood events recorded.

Marchglen

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

This section of road immediately south of the River Devon bridge regularly floods as the river rises. The last recorded occurrence was on 10/01/05. There is no damage to property but the road is effectively closed to traffic until the floodwaters abate. Watercourse ref. R-01.

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

No flood events recorded since November 2003. Watercourse ref. U-09.

Menstrie

ME-01 Burnside Road (NS 848 967)

09/08/04 Significant flood event. Large tree trunks and other natural debris from upstream created dams at a footbridge then a privately owned small concrete road bridge. Footbridge swept away and debris gathered at concrete road bridge. Severe overtopping waters flowed into Burnside Road flooding the ground floor of more than 20 houses and flooding gardens on all properties on the south side of the street. The flow continued into Craigomus Crescent (NS 845 967) flooding gardens and into Willow Grove (NS 844 967) affecting two houses. Significant silt, mud and other natural debris deposited in these streets. The concrete bridge was lifted off its abutments. There was also flood damage to a number of vehicles in the street. Floodwaters also reached farm yard on east side of burn. Watercourse ref. B-05.

ME-02 Back Road (NS 848 970)

Minor, but ongoing, flooding of the public road from hillside.

Muckhart

MK-01 Kirkhill (NO 000 007)

No flood events recorded since November 2003. Watercourse ref. U-13.

Sauchie

SA-01 Parkhead Road (NS 892 940)

No flood events recorded since November 2003. Watercourse ref. B-02.

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

No flood events recorded since November 2003. Watercourse ref. B-02.

SA-03 A908 Whiteyetts (NS 899 948)

Flooding, from time to time, of half carriageway of A908 at Whiteyetts. Watercourse ref. U-05.

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

Flooding to allotments and footpath although no reports since 2003. Watercourse ref. B-02.

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)

10/01/05 Flooding to 6 no. houses at the east end of Elistoun Drive. Water surcharging from piped drainage system in the road.

25/11/05 Report of flooding from householder. Inspection discovered no problem with drains in street, all running freely, no standing water. Report related to waters emanating from house, garden and drive and affecting garage in same garden. Responsibility of householder.



Photo 6 – Flooding of Elistoun Drive, Tillicoultry - 10/01/05

TI-03 A908 Moss Road (NS 920 968)

No flood events recorded since November 2003.

TI-04 Stalker Avenue (NS 920 972)

No flood events recorded since November 2003. The trash screen, immediately north of Stalker Avenue is easily blocked by playground litter and household rubbish and forms a deep pond. The pond forms in the school grounds. Watercourse ref. U-08.

TI-05 6 Dollar Road (NS 921 970)

No flood events recorded since November 2003. Recent evidence from nearby householder suggests that foul pipe is connected into this watercourse. Watercourse ref. U-08.

Tullibody

TU-01 Banchory Place (NS 861 949)

No flood events recorded since November 2003.

TU-02 Delph Pond (NS 861 949)

No flood events recorded.

TU-03 Westview Crescent (NS 864 948)

No flood events recorded since November 2003.

4.2 Known Problems

Alloa

AL-01 Donaldson Avenue

Problem prior to 2003 with water overtopping SUDS pond adjacent to the first house.

AL-02 Engelen Drive

Problem prior to 2003 due to insufficient capacity in drainage system where it connects with Brothie Burn culvert.

AL-03 Forrester Grove

The flood events reported in Forrester Grove emanated from the land rising steeply to the north. Some years ago a new office development was built to the northeast of the houses. Initial investigation suggested that the construction work had involved piping a section of watercourse. This watercourse runs nearly dry for most of the year, although due to the steepness of the land and the source at an old curling pond significant flows are experienced after high levels of rainfall. It appears that the designer underestimated the stream's discharge rate under flood conditions and the resulting piped system had inadequate capacity. During flood events the piped system became inundated and the floodwaters dispersed over land towards Forrester Grove. This was confirmed by a hydrological study. This study recommended appropriate works to reinstate the capacity of the watercourse and to re-direct it to its original outfall in Inglewood Pond.

AL-04 Gubber Hill – Gavins Road / Woodburn Drive

Gavins Road is situated along the lower slopes of a small hill. A band of woodland separates the houses from a field further up the hillside. Overland flow from the field concentrates in the woodland and is captured by two large ditches leading to a pipe at the rear boundary of the houses nos. 17 / 19. The pipe connects with the main drain in Woodburn Drive and outfalls into Fairy Burn culvert. The ditches lie dry throughout the year but flow full in heavy rainfall events. The pipe does not have the capacity to deal with these high discharge rates leading to overtopping of the ditches at a number of places. Prior to 2003 water has entered the foundations of three of the houses, two in Gavins Road and one in Woodburn Drive.

AL-05 Gubber Hill – Woodburn Drive / Woodside Road

Overland water from the source described above concentrates in the woodland to the northeast of the east end of Woodburn Drive and is channeled by informal paths in the woodland towards the undeveloped strip of land between the rear of Woodside Road and Forrester Grove. There is no outlet for this water and it dissipates through four or five of the gardens of houses in Woodside Road.

AL-06 Ormiston Drive

An un-named watercourse (U-02) enters a culvert immediately north of Ormiston Drive. In the past this has been blocked by natural debris and household rubbish. Floodwaters arrive in three gardens on Ormiston Drive.

AL-07 Dunmar Drive

The houses on the east side of Dunmar Drive back onto the wooded grounds of Gean House. The excess water from a severely neglected small ornamental pond previously flowed into the woods via a similarly neglected tile drain. This water affected five gardens in Dunmar Drive. It appears that the old tile drain may still be carrying a limited amount of water into one of the gardens.

AL-08 Lambert Terrace

The flooding has been exacerbated by excessive bank-side vegetation growing into the watercourse.

AL-09 Former Brewery Car Park (NS 890 930)

Site is prone to dumping and collection of natural debris from upstream. Due for redevelopment. Trash screens under railway bridge (NS 891 931) and at Shillinghill Roundabout (NS 889 929) were in poor condition and inaccessible.

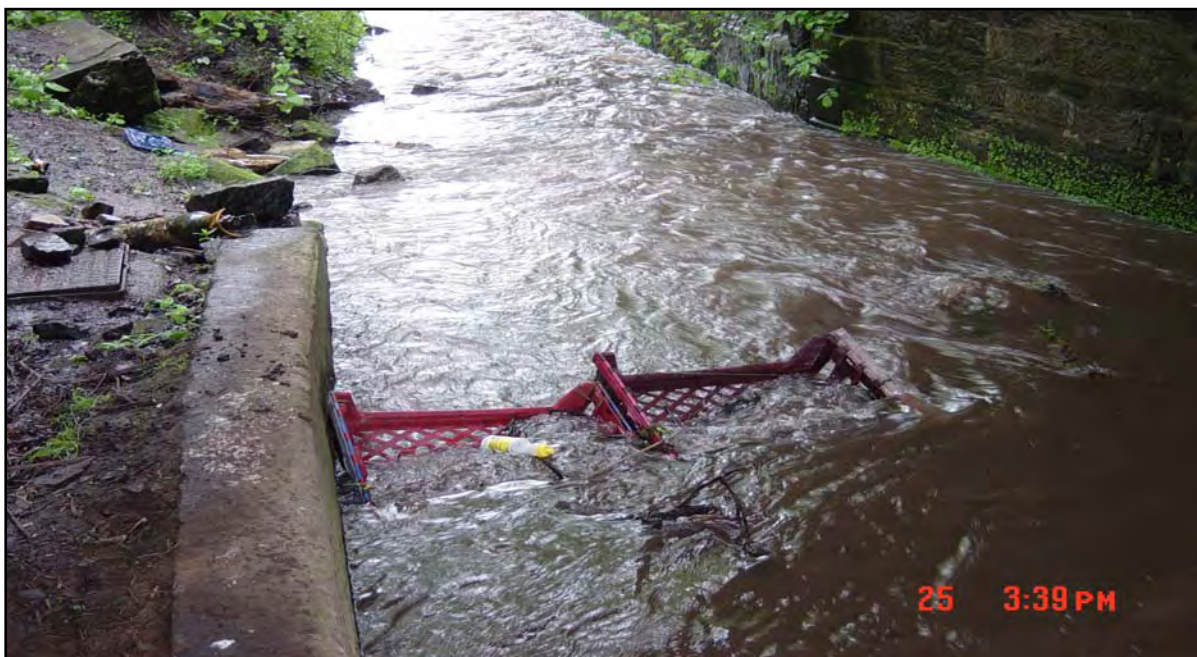


Photo 7- Brothie Burn Alloa looking east - 25/05/05

Alva

AV-01 Brook Street

- This section of Alva Burn is immediately north of the A91 Stirling Road. Random rubble walls and sections of mass concrete wall heavily channelise the burn. The burn walls

have suffered years of neglect and have collapsed at two locations. The wall supporting the garden and outhouse to the rear of house nos. 81 - 85 was repaired in 2003, the cost being shared between the property owners and the Council. Immediately upstream of the new section of wall undercutting / scouring damage has been noticed through visual inspection. This is the same action that caused the initial collapse.

- During the flood event of 09/08/04, part of the wall on the east bank opposite house no.48 collapsed. Several tones of material from the high earth bank supported by the wall fell into the burn causing the stream to change course leading to weakening of some downstream sections of wall.

AV-02 Henry Street

The capacity of this concrete box culvert is regularly reduced by medium coarse sediment. In severe rainfall events it overtops onto the public road. In the only recorded event the road gullies coped with the overflow. Severe overtopping could affect a number of low-lying properties located on the southwest side of Henry Street.

AV-03 Primary School

There are two problem structures at this location. The boundary wall at the north side of the playground limits capacity and a debris grill immediately downstream of the wall exacerbates the problem. There is the potential for this high wall to collapse under a damming effect.

The support beams of a small footbridge a few metres downstream limits the channel capacity. Mesh sides on the footbridge (to stop schoolchildren gaining access to the stream) collect debris and act as a dam in periods of high burn flows. The diverted water enters the school playground at this location.

AV-04 Greenhead Farm

Bridge on farm track is significantly below capacity to carry the burn when in spate. Bridge, burn and land in same ownership therefore does not fall under the responsibility of Local Authority.

AV-05 Back Road – Glen Affric (House)

Confluence of two burns that fall down the Ochil escarpment to the north of the boundary of the house 'Glen Affric' and enters a small piped drainage system. For most of the time these burns are dry channels but during high rainfall events they frequently overtopped and inundated the garden and house foundations. The water bypassed the small headwall and pipe.

AV-06 Back Road

Manhole at the south boundary of the house 'Glen Affric' overtopping due to capacity problem of culvert crossing Back Road. This is the same watercourse as AV-05.

AV-07 Cochrane Crescent / Back Road

Manhole in the rear gardens of Cochrane Crescent (immediately south of Back Road) surcharging in heavy rainfall events. Investigation discovered that downstream pipe system had collapsed.

AV-08 Wharry Road

Main drainage pipes severely restricted with sediments.

AV-09 Cochrane Park

Flooding in the public playing fields due to collapse of sections of the main carrier drain through the park and collapse of outlet drain under Glenwhinnel (private and public sections of this street). Also severe silting in infiltration drains in the park.

AV-10 Rhodders Grove

Outlet drain carrying water from marsh area at north boundary of gardens prone to silting.

AV-11 Blindwells / Southcroft

Scottish Water attended. No report of repeat occurrence.

Cambus

CA-01 Forth Street

At times of extremely high tide on River Forth combined with exceptional discharge on River Devon flooding has occurred on Forth Street.

Clackmannan

CL-01 Duke Street

Inadequate outlet for ground water on grassed communal areas adjacent to houses.

CL-02 Brucefield Crescent

Damage to pipe caused by fence post penetrating the pipe and root ingress when householder fenced in garden.

Coalsnaughton

CN-00

Devonside

DS-01 Alexandra Street at The Glen

The Glen is used for fly tipping (further upstream). Combination of household rubbish and natural debris brought down the steep glen by flood waters causes blockage at poorly formed pipe inlet (culvert under A908).



Photo 8 – The Glen, Devonside - 21/10/04

DS-02 Drummie Road

This area is used for fly tipping and is at the bottom of a steep heavily wooded glen. Combination of household rubbish and natural debris brought down the steep glen by flood waters causes blockage at poorly formed pipe inlet (culvert under houses and under Drummie Road).

DS-03 Alexandra Street at West End.

Currently being dealt with privately between the two landowners.

DS-04 Bain Street, Devonside

Under capacity drainage system is a Scottish Water responsibility. Scottish Water took action at the time and there has been no recurrence.

Devon Village

DV-00

Dollar

DL-01 A91 Muckhart Road

Road gullies prone to blockage by leaves.

DL-02 Thornbank Road

Culvert prone to blockage under Thornbank Road. CCTV survey indicated silting due to blockage at bend in pipe. Blockage due to poor workmanship of old repair.

DL-03 Back Road (Private)

Roadside ditch is piped under driveways. Prone to blockage at these pipes.

DL-04 Caravan Site, Rackmill

Caravan site located on natural, working floodplain.

DL-05 House Lade, Rackmill

Householder provided with sandbags on 10/01/05.



Photo 9 - The burn at Thornbank Road, Dollar looking west - 25/05/05

DL-06 Bryanston Drive (Cycle Way)

Culvert, no trash screen, under cycle way (disused railway) is prone to blocking by natural debris.

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

Small culvert under A91. Easily blocked by debris particularly windfall from apple tree in garden.

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

Small diameter culvert will block if not maintained.

Fishcross

FS-00

Forestmill

FM-00

Glenochil Village

GL-01 Glenochil Terrace

Wall and fence constructed across watercourse by landowner, which created severe limit on burn capacity.

Kennet

KN-00

Marchglen

MA-01 C99 River Devon Bridge

River level in flood events higher than adjacent road. This is a minor road used only by local drivers who are aware that the road will be closed from time to time. No property is affected and there are alternative routes.

MA-02 No.1 Marchglen

Drainage pipe adjacent to cycle track (disused railway) blocked.

Menstrie

ME-01 Burnside Road

Significant flood event, SEPA estimated that it was a 1 in 27 year rainfall event (3.7% probability of recurrence in any one year). Exceptional short-term rainfall washed numerous large tree trunks out of the deep, inaccessible gorge section of the Menstrie Burn in the Ochil Hills. This debris appears to have been lying high up in Menstrie Glen for many years. The tree trunks and other debris managed to clear the old stone arch bridge at Back Road and the A91 road bridge. Initially, the large pieces of debris gathered at a footbridge and formed a dam. The water pressure soon washed the bridge away and the debris then gathered at a low, privately owned, concrete road bridge. The resulting dam led to severe overtopping with the waters flowing into Burnside Road and into properties and other nearby streets. The concrete bridge was lifted off its abutments. Four main issues arose from this event.

- The footbridge broke away partly because the wire mesh infill in the gap under the

handrail trapped relatively small debris creating an impervious dam.

- The concrete bridge was too low in the burn channel and the problem was exacerbated by the steel I-beams supporting the deck. These enabled large tree trunks to be wedged under the bridge hence creating a dam across the burn channel.
- The channel walls had been eroded, mainly by people taking pedestrian access to the burn, allowing the floodwaters to spill into the adjacent street.
- Dead vegetation, including large tree trunks and boughs, will gather in the deep glens in the Ochil Hills and may be brought down into the town by particularly severe weather events.

ME-02 Back Road

The water emanates from a leaking water tank on the hillside to the north. The tank is one of a system of abandoned water tanks owned by Scottish Water.

Muckhart

MK-01 Kirkhill

Drainage pipe that accepts the small burn at the north boundary of Kirkhill / Cairns Place was under capacity.

Sauchie

SA-01 Parkhead Road

This is a low point in the road and a brief opening in Sauchie Burn. Under spate conditions the outlet pipe reaches capacity and the overflow water floods the road to a significant depth. There is no impact on property but the road becomes impassible.

SA-02 Branshill Road (2 sites)

- Previous flooding caused by overland flow on a recently harvested field missing the Sauchie Burn channel and flowing on to Branshill Road. The old trash screen at the culvert was prone to blockage and very difficult to clear. Council and landowner worked together to construct an earth bund in the field to direct overland flow into the burn channel. Council replaced the trash screen with a new trash screen and access platform.
- Overland flow from field affects two houses.

SA-03 A908 Whiteyetts

Emanates from water coming from Golf Course and flowing down gravel track. Sediment from the track blocks the road gullies. Flood partially closes road.

SA-04 Cat's Close

Trash screen blocks with urban and natural (allotment) debris. Watercourse ref. B-02.

Tillicoultry

TI-01 Hareburn Road

Scottish Water carried out CCTV survey of piped drainage system. Found and subsequently repaired a blockage. No repeat occurrence.

TI-02 Elistoun Drive

The primary cause of this flooding seemed to be from existing surface water drainage systems from the north. These systems were unable to cope with the volumes of surface water generated during the storm. However, the severity of flooding was exacerbated by the failure of apparatus, which controls the system's outfall to the River Devon. This allowed water from the river to back up the system and discharge water to Elistoun Drive. The Council has been, and continues to, investigate this serious issue with Scottish Water who, as far as the Council is aware, is the authority responsible for the operation and maintenance of these surface water drainage systems.

TI-03 A908 Moss Road

Lack of capacity in Scottish Water drainage system in times of extreme rainfall.

TI-04 Stalker Avenue

Screen is easily blocked by urban debris and when flooded is difficult to access for cleaning purposes.

TI-05 6 Dollar Road

Problems in the past with manhole on watercourse ref U-08 surcharging. Investigation indicated blockage in pipe. Householder excavated and removed a couple of bricks. Bricks appear to have been dropped during construction of manhole. Watercourse, manhole and flooding are all located in the same property. No occurrence since remedial action taken.

Tullibody

TU-01 Banchory Place

Historical flooding appears due to under capacity of Scottish Water drainage system.

TU-02 Delph Pond

Pond outlet was investigated and found to be partially blocked by a number of collapsed sections.

TU-03 Westview Crescent

Overland flow emanating from residential development (construction site). Water affects six gardens and public road but no significant effect on houses. Persimmon Homes in partnership with the Council commissioned a hydrological assessment that identified the issues and proposed appropriate mitigation measures.

5.0 Mitigation Measures Installed Since November 2003

Alloa

AL-01 Donaldson Avenue

Minor repairs to pond wall and clearance of outlet pipe by housing developer.

AL-02 Engelen Drive

No recurrence reported.

AL-03 Forrester Grove

The Council intervened on several occasions (emergency basis as a result of calls from residents of Forrester Grove) to attempt to capture flood flows generated by this watercourse. Works had little effect because the drainage system receiving the watercourse did not have sufficient capacity to capture even limited flows.

The Council determined that a permanent and sustainable solution was required to provide additional capacity and to redirect the burn waters back to its original outlet in Inglewood Pond to the south. This was confirmed by a hydrological study. This study recommended appropriate works to reinstate the capacity of the watercourse and to re-direct it to its original outfall in Inglewood Pond. It was also recognised that excessive silting problems seem to affect water quality in the Inglewood Pond and it was suspected that this might be because the pond was no longer receiving regular flushing out from the diverted watercourse. The issue was assessed in detail by consultant hydrologists and following detailed discussions with all adjacent landowners and affected householders, a solution was proposed, designed and a contract let to install a diverting drainage system. This system generally consists of an open concrete channel to capture flood flows in the existing watercourse, a section of piped watercourse to capture and permanently divert flows away from houses and pass the flows through adjacent developed land (the Forrester Lodge Business Complex) and then to a re-formed open grassed and planted channel to take flows to the Inglewood Pond. The grassed channel is shaped and lined to attenuate flows to minimise the impact on Fairy Burn (outlet of Inglewood Pond). The new system has been in operation since July 2004 and no further incidences of flooding have been reported since that time.



Photo 10 – Part of New Watercourse Capture System at Inglewood, Alloa - 21/10/04

AL-04 Gubber Hill – Gavins Road / Woodburn drive

No works to date. Initial survey carried out. Hydrological investigation to follow.

AL-05 Gubber Hill – Woodburn Drive / Woodside Road

No works to date.

AL-06 Ormiston Drive

Council solved capacity problem in small drain and routinely clears trash screen. No flood problem since.

AL-07 Dunmar Drive

Ditch watercourse system constructed in grounds of Gean House, to carry water from pond to existing watercourse and inlet to culvert under B9096 Alloa Road (prior to 2003). Further works required to deal with minor issue.

AL-08 Lambert Terrace

This section of watercourse was thinned of vegetation in March 2005.

AL-09 Former Brewery Car Park

Trash screen under railway bridge replaced 2003 and trash screen and platform at Shillinghill Roundabout replaced 2005 (photo 5).

Alva

AV-01 Brook Street

- The wall supporting the garden and outhouse to the rear of house nos. 87 - 91 was repaired in February 2003, with the cost being shared between the property owners and the Council.
- Council has repaired the upstream section of wall.
- No works to date at bank collapse opposite house no. 48.

AV-02 Henry Street

No works to date.

AV-03 Primary School

- At wall: debris grills removed.
- At footbridge: no works to date.



Photo 11 – Alva Burn looking north in Alva Primary School - 09/08/04

AV-04 Greenhead Farm

No works to date.

AV-05 Back Road – Glen Affric (House)

Council reconstructed small headwall and provided bunded sides to watercourses to direct water into pipe through garden. No repeat flooding problem.

AV-06 Back Road

Manhole re-pointed, culvert replaced with larger pipe. No repeat flooding problem.

AV-07 Cochrane Crescent / Back Road

New manhole constructed, old pipe through gardens abandoned and new pipe laid in Back Road footway. No repeat flooding problem.

AV-08 Wharry Road

All drainage pipes cleared of sediment by Scottish Water.

AV-09 Cochrane Park

Council replaced main carrier drain through the park and connected Back Road drainage systems into the new drain. Separate project to replace pipe in Glenwhinnet (public road / private drive). Infiltration drains cleared out. System running clear.

AV-10 Rhodders Grove

Cleaned out drain and added to maintenance schedule.

AV-11 Blindwells / Southcroft

Scottish Water attended. No report of repeat occurrence.

Cambus

CA-01 Forth Street

Long term project to study River Devon valley and create major water retention schemes to reduce the occurrences of high river levels. This will have a very limited affect at this location as the flooding is primarily due to extreme high tides in the Forth Estuary.

Clackmannan

CL-01 Duke Street

Filter drain with non-positive outlet and small bund created.

CL-02 Brucefield Crescent

Blockage removed and pipe repaired.

Coalsnaughton

CN-00

Devonside

DS-01 Alexandra Street at The Glen

New manhole and inlet to road culvert constructed. New trash screen and access platform added. This location is a Priority 1 maintenance site.

DS-02 Drummie Road

New trash screens and access platforms constructed at two culvert inlets. Channel constructed at first inlet to gather overtopping water and re-direct to second culvert inlet. Large wing walls constructed at second inlet to capture waters from flat area. No repeat flooding problem.

DS-03 Alexandra Street at West End.

Currently being dealt with privately between the two landowners.

DS-04 Bain Street, Devonside

Under capacity drainage system is a Scottish Water responsibility. Scottish Water took action at the time and there has been no recurrence.

Devon Village

DV-00

Dollar

DL-01 A91 Muckhart Road

No action to date.

DL-02 Thornbank Road

Section of pipe at bend removed and replaced. Pipe jetted and silt cleared. No repeat occurrence.

DL-03 Back Road (Private)

Householders instructed to clear pipes regularly.

DL-04 Caravan Site, Rackmill

No Council action taken. Caravan site operator has responsibility to minimise effect on caravans and other site infrastructure.

DL-05 House Lade, Rackmill

No action to date. Property and flooding source in same ownership.

DL-06 Bryanston Drive (Cycle Way)

Added to maintenance regime.

DL-07 A91 Opposite Bryanston Drive

Added to maintenance regime.

DL-08 Back Road (No. 32)

Added to maintenance regime.

Fishcross

FS-00

Forestmill

FM-00

Glenochil Village

GL-01 Glenochil Terrace

Wall and fence removed by Council. No repeat occurrence.

Kennet

KN-00

Marchglen

MA-01 C99 River Devon Bridge

No action to date.

MA-02 No.1 Marchglen

Drainage pipe cleared and reconnected to old railway drainage system.

Menstrie

ME-01 Burnside Road

- New footbridge with improved clearance constructed.
- Concrete bridge removed.
- Channel walls re-instated to appropriate height.
- Investigation by Council of upper sections of the burn but there appears to be no practical way of reaching deep sections of gorge to remove natural debris. Glen is relatively clear of large debris after 09/08/04 event.

ME-02 Back Road

Awaiting response from Scottish Water.

Muckhart

MK-01 Kirkhill

Drainage pipe replaced, improved capacity. No repeat problem.

Sauchie

SA-01 Parkhead Road

No action to date.

SA-02 Branshill Road (2 sites)

- Council and landowner worked together to construct an earth bund in the field to direct overland flow into the burn channel. Council replaced the trash screen with a new trash screen and access platform, including ladder access to culvert (photo 12).
- No action.



Photo 12 - New Trash Screen at Sauchie Burn Culvert - 10/08/04

SA-03 A908 Whiteyetts

Water from Golf Course re-directed into adjacent watercourse.

SA-04 Cat's Close

Trash screen replaced with easier to maintain trash screen.

Tillicoultry

TI-01 Hareburn Road

Scottish Water carried out CCTV survey of piped drainage system. Found and subsequently repaired a blockage. Council repaired local low point in burn channel wall to restore channel capacity. No repeat occurrence.

TI-02 Elistoun Drive

Scottish Water carried out works to clear system and re-direct foul pipe to nearby foul system. Scottish Water also repaired flap valve at outlet of system into River Devon.

TI-03 A908 Moss Road

No action to date.

TI-04 Stalker Avenue

On maintenance rota, Priority 1.

TI-05 6 Dollar Road

Householder excavated and removed a couple of bricks. Bricks appear to have been dropped during construction of manhole. Watercourse, manhole and flooding are all located in the same property. No occurrence since remedial action taken.

Tullibody

TU-01 Banchory Place

No action to date.

TU-02 Delph Pond

Outlet pipe excavated and all collapsed sections replaced.

TU-03 Westview Crescent

Persimmon Homes in partnership with the Council commissioned a hydrological assessment that identified the issues and proposed appropriate mitigation measures.

Constructed appropriate temporary attenuation ponds, collector ditches and new pipe to connect into outlet pipe from Delph Pond.

6.0 Proposed Mitigation Measures

6.1 Maintenance Programmes

This section of the report explains the methods used by Clackmannanshire Council to comply with its duties under the Flood Prevention and Land Drainage (Scotland) Act 1997 (the 1997 Act) and to report on the works undertaken on watercourse maintenance throughout the Council area. The legislative responsibility (see Section 2.1) of the Council lies with Development 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 only to watercourses that would affect non-agricultural land. The 1997 Act, however, 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 the following three categories; clearing of debris from watercourses; maintenance of walls, banks and other structures that form watercourses and provision of flood alleviation works i.e. new infrastructure aimed at preventing / limiting further flooding and reducing the need for maintenance.

Clearing of Debris

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 Watercourse Inspection and Clearance Regime' (section 6.2) has been developed. This will be continually monitored and improved 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 removing silts and

coarse sediments from watercourses where these were considered to be affecting the capacity of the watercourse channel. A 'Coarse Sediment Removal Programme' (section 6.3) and a 'Watercourse Vegetation Management Programme' (section 6.4) is being developed in consultation with the Scottish Environmental Protection Agency (SEPA) to ensure that the resulting works have minimal adverse affect on local biodiversity.

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 banks and 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. Roads and Transportation will now undertake regular surveys of all watercourses to assess the structural integrity of banks, walls, culverts and other infrastructure. An initial survey will populate a "Watercourse Infrastructure Database" and subsequent analysis will generate a programme of "Prioritised Maintenance of Infrastructure".

This survey and assessment work is underway and the Council has commissioned a number of reports relating to specific watercourses or sections of watercourses. For example, the "Inglewood at Tullibody – Flood Risk Assessment (2003)", the "Gavins Road, Alloa – Flood Risk Assessment (2004)" and the "Flooding in the Menstrie Foothills (2005)", all suggest suitable improvement works at particular problem locations. Studies of prominent watercourses have been carried out. "Flood Management in the Brothie Burn (2003)" identified burn clearance priorities and long-term recommendations relating to the removal of culvert and wall sections and replacement trash screens. Improvements to the main burns affecting Menstrie, Alva, Tillicoultry and Dollar are recommended in "Flood Management in the Hillfoots Burns (2004)". This has been supplemented by individual studies of Alva and Tillicoultry Burns.

Flood Alleviation Works

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 and inspection and clearance regimes are in place, the Council intends to assess the 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.

6.2 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. 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

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

Priority Reference	Watercourse Reference	Watercourse Name	Location	OS Ref (NS)
P1 – 01	B – 01	Brothie Burn, Alloa	Trash screen & channel under railway bridge at Whins Road	891 931
P1 – 02	B – 01	Brothie Burn, Alloa	Sections of channel & culverts in disused car park at Whins Road	890 930
P1 – 03	B – 01	Brothie Burn, Alloa	Trash screen & channel at Shillinghill Roundabout at Whins Road	889 929
P1 – 04	B – 03	Fairy Burn, Alloa	Outlet into Brothie Burn in disused car park at Whins Road	889 929
P1 – 05	B – 02	Sauchie Burn, Alloa	Trash screen at end of Cat's Close	895 936
P1 – 06	B – 05	Menstrie Burn, Menstrie	North of bridge at Ochil Road to bridge at A91	849 970
P1 – 07	B – 05	Menstrie Burn, Menstrie	Open section from bridge at A91 to south of Burnside Road	848 967
P1 – 08	B – 07	Alva Burn, Alva	Open section from Alva Glen car park to bridge at Beauclerc Street	883 972
P1 – 09	B – 07	Alva Burn, Alva	Open section from bridge at Beauclerc Street to bridge at A91	884 971
P1 – 10	B – 07	Alva Burn, Alva	Open section from bridge at A91, Stirling Street to Primary School	884 968
P1 – 11	B – 11	Tillicoultry Burn, Tillicoultry	All bridges & channel adjacent to Upper Mill Street to bridge at A91	914 972
P1 – 12	B – 11	Tillicoultry Burn, Tillicoultry	All bridges & channel from A91 bridge to 30mph S of Hareburn Rd	912 967
P1 – 13	B – 14	Dollar Burn, Dollar	Open channel north of Back Road bridge for 150 metres	963 984
P1 – 14	B – 14	Dollar Burn, Dollar	Open channel & bridges between Back Road and bridge at A91	963 981
P1 – 15	B – 14	Dollar Burn, Dollar	Open channel & bridges between bridge at A91 & disused railway line	963 978
P1 – 16	U – 01	Inglewood, Alloa	Open channel, trash screen &	878 941

			culvert between woodland & Inglewood Pond	
P1 – 17	U – 02	Ormiston Drive, Alloa	Trash screen to NW of Ormiston Drive garage area	874 945
P1 – 18	U - 03	Gean House, Alloa	Pond, outlet, trash screen & ditch in grounds of Gean House east of Dunmar Drive	873 940
P1 – 19	U - 08	Stalker Avenue, Tillicoultry	Trash screen at SE corner of school grounds	920 972
P1 – 20	U - 10	Drummie Road, Devonside	Two trash screens & channel to S of gardens on Drummie Road	922 962
P1 – 21	U - 11	The Glen, Devonside	Trash screen, manhole & 200 metres of the burn south of A908, Alexandra Street	920 963
P1 – 22	U - 14	Thornbank Road, Dollar	Trash screen & culvert to E of Thornbank Road & St. James the Great Church	958 980

Priority 2 Sites

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

Priority Reference	Watercourse Reference	Watercourse Name	Location	OS Ref (NS)
P2 – 01	B – 01	Brothie Burn, Alloa	From Hilton Rd bridge to bridge at Lambert Terrace	893 932
P2 – 02	B – 01	Brothie Burn, Alloa	From bridge at Lambert Terrace to bridge at access to Hamilton & Brydie	892 932
P2 – 03	B – 01	Brothie Burn, Alloa	From bridge at access to Hamilton & Brydie to trash screen under railway bridge	891 931
P2 – 04	B – 03	Fairy Burn, Alloa	Trash screen to S of Parkway in grounds of Greenfield House	884 932
P2 – 05	B – 03	Fairy Burn, Alloa	Outlet from Inglewood Pond to trash screen at culvert under B9096	877 940
P2 – 06	B – 02	Sauchie Burn, Alloa	Trash screen at end of ditch in field to west of Ten Acres	885 944

P2 – 07	B – 06	Dams Burn, Menstrie	N of Victoria Terrace	859 970
P2 – 08	B – 10	Silver Burn, Alva	Open section from bridge at A91 to Alva Industrial Estate bridge	892 968
P2 – 09	B – 10	Silver Burn, Alva	Open section from Alva Industrial Estate bridge S for 100 metres	892 967
P2 – 10	B – 12	Kirk Burn, Tillicoultry	Culvert beneath Simpson Court and sections of open channel to N & S	927 973
P2 – 11	U – 04	Woodburn Drive, Alloa	Ditches & trash screen behind houses nos. 17 / 19	877 942
P2 – 12	U – 04	Gavins Road, Alloa	Ditch in woodland behind houses on Gavins Road.	875 942
P2 – 13	U – 06	Glenochil Terr, Glenochil	Open channel to west of gardens on Glenochil Terrace	870 957
P2 – 14	U – 07	Bard's Way, Tillicoultry	Open channel & pipe to E of Bard's Way / Chalmers Place	929 974
P2 – 15	U – 09	Marchglen	Trash screen, & pipes and channel on disused railway SE of Marchglen	909 962
P2 – 16	U – 15	Donaldson Ave, Alloa	Trash screen on Fairyburn to rear of No. 2 Donaldson Avenue	873 944

Priority 3 Sites

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.

Priority Reference	Watercourse Reference	Watercourse Name	Location	OS Ref (NS)
P3 – 01	R – 02	River Black Devon	Tree grid on N side of A907, access from B910 (require 360° machine)	915 923
P3 – 02	B – 03	Fairy Burn, Alloa	Open channel within grounds of Greenfield House	884 932
P3 – 03	B – 04	Goudnie Burn, Clackmannan	Check approaches and under bridge	915 923
P3 – 04	B – 08	Carnaughton Burn, Alva	From Back Road to culvert under A91	877 971

P3 – 05	B – 09	Spring Burn, Alva	Culverted section from Lovers Loan to south of farm access.	888 969
P3 – 06	B – 10	Silver Burn, Alva	Open channel & bridges adjacent to Burnside Road	885 944
P3 – 07	B – 12	Kirk Burn, Tillicoultry	Trash screen, advance trash screen & culvert under Heathwood Crescent	926 974 927 972
P3 – 08	B – 12	Kirk Burn, Tillicoultry	Trash screen at Armour Place & culvert under A91	927 973
P3 – 09	B – 13	Quarrel Burn, Dollar	A91 bridge over burn	955 980
P3 – 10	B – 15	Kelly Burn, Dollar	A91 bridge over burn	966 980
P3 – 11	U – 03	Gean House, Alloa	Culvert E of Dunmar Drive / B9096 junction	874 941
P3 – 12	U – 08	Stalker Avenue, Tillicoultry	Piped drain to rear of No. 6 Dollar Road	921 971
P3 – 13	U – 12	Bryanston Drive, Dollar	Channel & trash screen to N of A91 NW of Bryanston Drive junction	953 980
P3 – 14	B – 13	Quarrel Burn, Dollar	Culvert to N of disused railway to rear and W of Bryanston Drive	953 978
P3 – 15	U – 13	Kirkhill, Muckhart	Inlet to culvert & culvert between houses nos. 3 / 5 Kirkhill	NO 000 008
P3 – 16	U – 15	Donaldson Ave, Alloa	Open channel behind houses nos. 28 / 30 Donaldson Avenue	871 943
P3 – 17	U – 16	32 Back Road, Dollar	Open channel & culvert within garden	957 983
P3 – 18	U – 17	Back Road (Private), Dollar	Ditch, driveway pipes & gully (top of steps) to Quarrel Burn	955 982
P3 – 19	U – 18	Long Row, Menstrie	Open channel from hill past houses nos. 35 / 37.	851 971
P3 – 20	U – 19	Driving Range, Tillicoultry	Culvert under A91 E of driving Range access	928 971
P3 – 21	N / A	Duke Street, Clackmannan	Clean French drain in grassed area at Duke Street / Marquis Drive	917 915
P3 – 22	N / A	Golf Course Rd, Muckhart	Filter drain taking overland flow from fields	NT 002 999
P3 – 23	U – 20	'Glen Affric', Alva	Inspect inlet to N of property and manhole on SW corner of garden	875 973

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P3 – 24	U – 20	Back Road, Alva	Inspect manhole in rear garden and 2 manholes in Back Road.	874 973
P3 – 25	U – 20	Rhodders Grove Alva	Inspect pipe and remove silt.	889 972

6.3 Coarse Sediment Removal Programme

During the course of the annual cyclical inspection of watercourses and through examination of the watercourses during and immediately after significant rainfall events it is clear that coarse sediment plays an important part in the nature of most watercourses. The Council commissioned report, "Flood Management in the Hillfoots Burns (2004)", 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 and 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 fall line of the water flow.

Sediments in watercourse beds are essential for insects and fish and it is therefore not appropriate to clear sediments from a watercourse 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, where possible, in a controlled and sensitive manner. As it is the finer sediments that are of most importance to

biodiversity, only the coarse sediments will be removed from watercourse channels and only where a clear flooding hazard would occur if left. The stream's dynamic nature will ensure that the 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 inside of bends, and this will be removed if it appears to be retarding the movement of fine sediments downstream, or if it might potentially lead to over topping, or significant capacity reduction at that location. Coarse sediment removal will only ever be carried out over a limited section of the watercourse to minimise impact on biodiversity. Any action will be preceded by consultation with SEPA, particularly with a view to complying with the forthcoming Water Environment (Controlled Activities) (Scotland) Regulations 2005 (CAR) due for implementation in relation to watercourses in April 2006.

The urban sections of the following watercourses will be routinely inspected, initially every six months, to identify areas requiring removal of coarse sediment and locations of excessive build up of finer sediments.

- Menstrie Burn, Menstrie
- Carnaughton Burn, Alva
- Alva Burn, Alva
- Silver Burn, Alva
- Tillicoultry Burn, Tillicoultry
- Kirk Burn, Tillicoultry
- Quarrel Burn, Dollar
- Dollar Burn, Dollar
- Kelly Burn, Dollar
- Fairy Burn, Alloa
- Brothie Burn, Alloa
- Drummie Road, Devonside
- The Glen, Devonside

Sediment removal plans will be determined utilising the information gathered during the cyclic inspections and during flood events. These will be regulated by CAR approvals issued by SEPA.

6.4 Watercourse Vegetation Removal Programme

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)", 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.
- Consultation with SEPA will be required through the forthcoming CAR regulations that will apply to watercourses from April 2006.

Inspection Programmes

The urban sections of the following principal watercourses will be routinely inspected, initially annually, to identify areas requiring removal of vegetation.

- Menstrie Burn, Menstrie
- Carnaughton Burn, Alva
- Alva Burn, Alva
- Silver Burn, Alva
- Tillicoultry Burn, Tillicoultry
- Kirk Burn, Tillicoultry
- Quarrel Burn, Dollar
- Dollar Burn, Dollar
- Kelly Burn, Dollar

- Fairy Burn, Alloa
- Brothie Burn, Alloa
- Goudnie Burn, Clackmannan
- Drummie Road, Devonside
- The Glen, Devonside
- Thornbank Road, Dollar

Long-term programmes will be determined utilising the information gathered during the cyclic inspections.

6.5 Proposed Works

Alloa

AL-01 Donaldson Avenue

No further action proposed. Inspection ref. P2-16; P3-16 (see section 6.2)

AL-02 Engelen Drive

No further action proposed.

AL-03 Forrester Grove

No further action proposed. Inspection ref. P1-16; P2-05

AL-04 Gubber Hill – Gavins Road

Initial survey carried out. Hydrological investigation to follow. Improve outlet pipe capacity. Inspection ref. P2-12

AL-05 Gubber Hill – Woodburn Drive

Initial survey carried out. Hydrological investigation to follow. Improve outlet pipe capacity. Inspection ref. P2-11

AL-06 Ormiston Drive

Added to maintenance regime. No further action proposed. Inspection ref. P1-17

AL-07 Dunmar Drive

Further minor works required. Inspection ref. P1-18; P3-11

AL-08 Lambert Terrace

Vegetation & coarse sediment inspection. Inspection ref. P2-01; P2-02

AL-09 Former Brewery Car Park

Awaiting details of redevelopment proposals at this site. Inspection ref. P1-01; P1-02 & P1-03.

Alva

AV-01 Brook Street

- No further action proposed. Vegetation & coarse sediment inspection.
- Rebuild wall to support burn bank. Vegetation & coarse sediment inspection. Inspection ref. P1-08; P1-09

AV-02 Henry Street

Potentially raise dropped kerbs to allow overflow waters to flow away from properties along public road and into road gullies. Vegetation & coarse sediment inspection. Inspection ref. P1-10

AV-03 Primary School

- Proposal to increase clearance under wall. Vegetation & coarse sediment inspection.
- No further action proposed. Inspection ref. Vegetation & coarse sediment inspection. Inspection ref. P1-10

AV-04 Greenhead Farm

Potential to replace bridge as part of proposed new secondary school development in adjacent land. Vegetation & coarse sediment inspection.

AV-05 Back Road – Glen Affric (House)

No further action proposed. Inspection ref. P3-23

AV-06 Back Road

No further action proposed. Inspection ref. P3-24

AV-07 Cochrane Crescent / Back Road

No further action proposed. Inspection ref. P3-24

AV-08 Wharry Road (GR 875 971)

No further action proposed. Scottish Water to maintain sewer.

AV-09 Cochrane Park

Opportunity to properly drain the park utilising the new carrier drain. These works would not fall under the scope of this report.

AV-10 Rhodders Grove

Added to watercourse inspection and clearance regime. Inspection ref. P3-25

AV-11 Blindwells / Southcroft

No further action proposed. Scottish Water responsibility.

Cambus

CA-01 Forth Street

Long term project to study River Devon valley and create major water retention schemes to reduce the occurrences of high river levels.

Clackmannan

CL-01 Duke Street

No further action proposed. Inspection ref. P3-21

CL-02 Brucefield Crescent

This system has an inadequate outfall. Investigate and provide new outfall.

Coalsnaughton

CN-00

Devonside

DS-01 Alexandra Street at The Glen

No further action proposed. Vegetation & coarse sediment inspection. Inspection ref. P1-21

DS-02 Drummie Road

No further action proposed. Vegetation & coarse sediment inspection. Inspection ref. P1-20

DS-03 Alexandra Street at West End.

No action proposed. Planning enforcement required.

DS-04 Bain Street, Devonside

Under capacity drainage system is a Scottish Water responsibility.

Devon Village

DV-00

Dollar

DL-01 A91 Muckhart Road

No further action.

DL-02 Thornbank Road

No further action proposed. Vegetation inspection. Inspection ref. P1-22

DL-03 Back Road (Private)

Householders instructed to clear pipes regularly. No further action proposed. Inspection ref. P3-18

DL-04 Caravan Site, Rackmill

No further action proposed.

DL-05 House Lade, Rackmill

No further action proposed. Property and flooding source in same ownership.

DL-06 Bryanston Drive (Cycle Way)

No further action proposed. Inspection ref. P3-13; P3-14

DL-07 A91 Opposite Bryanston Drive

No action proposed. Inspection ref. P3 - 03

DL-08 Back Road (No. 32)

No further action proposed. Inspection ref. P3-17

Fishcross

FS-00

Forestmill

FM-00

Glenochil Village

GL-01 Glenochil Terrace

No further action proposed. Inspection ref. P2-13

Kennet

KN-00

Marchglen

MA-01 C99 River Devon Bridge

No action proposed.

MA-02 No.1 Marchglen

No further action proposed. Inspection ref. P2-15

Menstrie

ME-01 Burnside Road

- New footbridge with improved clearance constructed.
- Concrete bridge removed.
- Channel walls re-built to appropriate height.
- Investigation of upper sections of the burn but there is no practical way of reaching deep sections of gorge to remove natural debris. Glen is relatively clear of large debris after 09/08/04 event.
- Vegetation & coarse sediment inspection.
- Inspection ref. P1-06; P1-07

ME-02 Back Road

Awaiting response from Scottish Water.

Muckhart

MK-01 Kirkhill

No further action proposed. Inspection ref. P3-15

Sauchie

SA-01 Parkhead Road

No action proposed.

SA-02 Branshill Road (2 sites)

- No further action proposed. Inspection ref. P2-06
- No further action proposed. Inspection ref. P2-06

SA-03 A908 Whiteyetts

Ongoing remedial work.

SA-04 Cat's Close

No further action proposed. Inspection ref. P1-05

Tillicoultry

TI-01 Hareburn Road

No further action proposed. Vegetation & coarse sediment inspection. Inspection ref. P1-12

TI-02 Elistoun Drive

Scottish Water and Council to agree responsibilities. Investigation of piped watercourse required. Investigation of possibility of mitigation works to deal with surcharging water.

TI-03 A908 Moss Road

Scottish Water responsibility.

TI-04 Stalker Avenue

New screen and headwall required, possible grading of side slopes. Inspection ref. P1-19

TI-05 6 Dollar Road

No further action proposed. Inspection ref. P3-12

Tullibody

TU-01 Banchory Place

No further action proposed.

TU-02 Delph Pond

No further action proposed.

TU-03 Westview Crescent

No further action proposed.

7.0 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 came into force as of 1 October 2005, but will directly affect watercourse maintenance works from 1 April 2006. This legislation is essentially the regulatory means by which SEPA will introduce a structure of 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". The principle 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 Act 2003.

The FLAG is presently monitoring the performance of natural flood management techniques that are currently being employed in the ongoing the "River Devon Project". The project is a partnership between the World Wildlife Fund Scotland and Clackmannanshire Council. This project is a long-term, detailed study of 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 includes an undertaking to actively promote awareness of flood issues among the general public and

interested stakeholders within the Council area.

8.0 Flood Warning

8.1 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)", 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" (section 8.2).

8.2 Flood Warning Procedure and Action Plans

Stage 1 Procedure (Routine Weather Monitoring)

- From 9am each working day, monitor general weather information from TV, Radio and general web sources.
- 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 (Met Office Information)

- Monitor Met Office “Open Road” ‘web site - consult “precipitation rate forecast” information.
 - If the predicted rainfall rate is 8 - 16mm per hour, or above, over the following 24 / 48 hours, for the Clackmannanshire area, **initiate Action Plan A.**
 - If the predicted rainfall rate is less than 8 - 16mm per hour, over the following 24 / 48 hours, for the Clackmannanshire area, continue to monitor until the weather forecast improves.
- Initiate Stage 3 Procedure.

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>’
- If ‘Flood Warning’ has been issued by SEPA for Clackmannanshire Area, **initiate Plan A**, and
 - Continue to monitor SEPA “Live Flood Warning Information” web site.
 - Initiate Stage 4 (Telemetric flood warning station - not yet operational - 2006).
- If ‘Severe Flood Warning’ has been issued by SEPA for Clackmannanshire Area, **initiate Plan B**, and
 - Continue to monitor SEPA ‘Live Flood Warning Information’ web site.

- Initiate Stage 4 (Telemetric flood warning station - not yet operational - 2006).
- 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,
 - Continue to monitor SEPA "Live Flood Warning Information" web site.
 - Initiate Stage 4 (Telemetric flood warning station - not yet operational - 2006).

Stage 4 Procedure (Telemetric Flood Warning Station - not yet operational - 2006)

- Check River Level Flood Warning Telemetry Station output
- If the flood warning criterion is reached, **initiate Plan B**.

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 Plan B**.

Action Plan A

- Notify Emergency Planning Officer of actions.
- Roads Officer to carry out immediate inspection of Priority 1 Sites including Hillfoots Burns, Brothie Burn and Fairyburn (see Appendix B for list of priority sites).
- Instruct immediate response contractor to clear any blockages.
- If inspections indicate that a severe flood event is occurring or is likely to occur, **initiate Plan B**

Action Plan B

- Notify Emergency Planning Office (EPO) of actions and current situation.
 - Check with EPO that emergency services have been informed
- Contact immediate response contractor to initiate immediate inspection and clearance of Priority 1 Sites including Hillfoots Burns (see Appendix B for list of priority sites).

- Contact Forthbank Depot
 - prepare 1000 no. sandbags
 - prepare 4 no. water pumps
 - place appropriate lorries / drivers on stand by
 - place 'gulley emptier' on stand by
 - prepare 'flood' and 'road closed' signs and barriers
- Contact Kelliebank Depot to ensure contractor's Supervisor and stand-by squads availability for predicted period.
- Set up co-coordinator in Roads & Transportation Office – provide phone number to Roads Officers and Inspectors and contractors Supervisor and Foremen.
- Ensure Roads Officers / Roads Inspectors availability for Emergency Planning Core Group

9.0 Investment Since April 2003

Annual Council Spending on Flood Prevention – 2003/04 to 2005/06

	2003/04	2004/05	2005/06
Planned Maintenance Works	£12,000	£17,000	£20,000
Reactive (Emergency) Works	£25,000	£7,000	£1,000
Planned Structural Works	£33,500	£105,000	£100,000
Flood Prevention System Development	£8,500	£2,000	£2,000
Vegetation Removal Works	-	£2,000	-
Sediment Removal Works	-	£5,000	-
Trash screen Replacement	£2,500	£2,500	£3,000
Flood Studies	£6,500	£17,500	£15,000
Total	£88,000	£158,000	£142,000

It can be seen from the above that the cost of “Reactive (Emergency) Work”, which is essentially the cost of works undertaken in emergency circumstances, has fallen from £25,000 in 2003/04 to only £1,000 in 2004/05. In the same period “Planned Maintenance Works” costs have risen from £12,000 to £20,000. This is seen as an improving situation as the need to spend resources on reactive works has no real long-term benefit. The overall spend in this area has fallen by £16,000 from £37,000 to £21,000. Indeed, the reduction in “Reactive (Emergency) Works” costs demonstrates that the “Prioritised Watercourse Inspection and Clearance Regime” (section 6.2), i.e. planned regular inspection of key watercourses and sensitive locations, is having a positive effect. 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 2003/04 the main planned structural works were the replacement of collapsed pipes and manholes in Back Road and Cochrane Park in Alva and preliminary works at Forrester Grove, Alloa. In 2004/05 the main project was the reconstruction of the watercourse in the grounds of Inglewood House, Alloa. Further works were carried out in Cochrane Park, Alva and Glenwhinnel Alva. 2005/06 has seen the completion of the Cochrane Park and Glenwhinnel projects, the replacement of the footbridge and reinstatement of the channel walls at Burnside Road, Menstrie and works on Alva Burn wall at Brook Street.

A significant investment has been made in watercourse studies, detailed in section 2.2. These studies will influence works programmes in coming years.

A number of trash screens and cleaning platforms have been upgraded over the last 30 months including two on Brothie Burn, two on Sauchie Burn and two on Fairy Burn. Others are proposed at Thornbank Road, Dollar and Stalker Avenue, Tillicoultry.