



**NORTH AYRSHIRE
COUNCIL**



DESIGN AND INFRASTRUCTURE SERVICES, ROADS

NORTH AYRSHIRE FLOOD PREVENTION (MANAGEMENT) BIENNIAL REPORT 2009

(Seventh Public Report, May 2010)

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Front cover photograph: Corrie, Isle of Arran, 26 March 2009

NORTH AYRSHIRE COUNCIL

INFRASTRUCTURE AND DESIGN SERVICES, ROADS

NORTH AYRSHIRE FLOOD PREVENTION (MANAGEMENT) REPORT 2009

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1. INTRODUCTION

1.1 This Report is the seventh such document to be published by North Ayrshire Council and is presented in the same format as in previous years. This document reports on the activities of North Ayrshire Council over the previous two years up to 26th November 2009 in respect of its duties under the Flood Prevention and Land Drainage (Scotland) Act 1997, and specifies:

- the measures which North Ayrshire Council consider are required to be taken to prevent or mitigate the flooding of non-agricultural land in North Ayrshire;
- the measures which North Ayrshire Council has taken since the date of publication of the previous report to prevent or mitigate such flooding;
- all occurrences of such flooding since that date.

1.2 The purpose in publishing such reports is to inform members of the public and other interested parties on flooding issues within North Ayrshire. As well as the statutory information listed above, the report outlines the Council's interpretation of its flood prevention duties under various Acts and the Council's flood prevention strategy with respect to both fluvial and coastal flooding. It also gives details of progress on flood prevention schemes and studies and provides information on additional activities and national developments in flood management since the previous report.

1.3 The Council would be interested to hear from any organisation or individual who may have information in respect of known or potential flooding risk locations with the North Ayrshire Council area.

1.4 The Council officer who should be contacted initially either to give or receive further information is:

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1.5 Flooding can have serious effects on people, homes, businesses, and health. Flood risk is impossible to eliminate, but can be minimised and managed to safeguard people, their properties and their livelihoods.

1.6 Historically Scotland has not faced the same degree of river and coastal flooding as England, due mainly to its different topography. Climate change is expected to increase flood risk, potentially doubling it in some areas in Scotland before the end of the century.

1.7 Current Knowledge

- 1.7.1 There is an underlying concern that such events will become more frequent with climate change and that lessons learnt from such events over the country must be learned by all responsible bodies and associated bodies. North Ayrshire Council is a responsible body under the enactment of the Water Framework Directive and more recently with the introduction of the Flood Risk management (Scotland) Act 2009.
- 1.7.2 Local infrastructure such as electrical sub stations, gas governors and sewage pumping stations are likely to be affected. Although the Council may be able to identify locations where flooding will occur, only the utilities themselves will be able to advise whether their plant will remain operational during a flood event. The Council does not have locations of vital utility plant.
- 1.7.3 Other critical infrastructure are Care Homes, Schools, Hospitals, Health centres, Fire and Ambulance Stations. Some of these may be designated as 'rest centres' during flooding emergencies as they may have previously been assessed as not being at risk of fluvial flooding. Their appropriateness may now be in doubt as even if not at risk they may be inaccessible due to flooding of roads.
- 1.7.4 Of major importance is identifying which roads will be impassable during these events. Given past experience of similar events such as in 1998, many of the roads on the mainland and on Arran were affected such as the A78 and A841 coastal roads, the A737, the A760 and B777 into Kilbirnie and Glengarnock. Landslips as well as flooding are likely during extreme rainfall events.
- 1.7.5 It is almost certain that train services will not be operating within North Ayrshire. The level of rainfall encountered will flood the tracks at known critical locations such as Fairlie, West Kilbride and Glengarnock having the same result as when coastal storms affect the line at Sandylands Promenade in Saltcoats.

1.8 What Can We Do?

- 1.8.1 Flooding consultants have advised that, depending on the level of topographic information available, they can screen large areas quickly to identify potential areas at risk from pluvial flooding, producing maps with indicative flood depths, extents and show the impact of climate change. The main benefit of this is to identify what critical infrastructure is at risk and how the emergency response should be organized.
- 1.8.2 Under a consultancy agreement, Royal Haskoning has provided specialist knowledge and advice on coastal protection and flood prevention to Roads and Transportation Services for a number of years, and since 2003 by way of a consultancy agreement. This has strengthened the Services' ability to provide a more comprehensive and effective coast protection and flood prevention service within limited staff resources. In order to comply with EC legislation, this agreement has now been terminated and a new term commission was tendered during 2009. Three new term consultants will now assist the Council in taking forward it's flood prevention strategy. They are, Grontmij, Mouchel and URS Corporation.

2. NORTH AYRSHIRE COUNCIL'S INTERPRETATION OF FLOOD PREVENTION DUTIES

2.1 The Council's flood prevention duties are governed by 4 principal sources:-

1. The Flood Risk Prevention (Scotland) Act 1961 as amended by the Flood Prevention and Land Drainage (Scotland) Act 1997;
2. The Flood Risk Management (Scotland) Act 2009 (gradually superceding the 1961 Act and the 1997 amendments to that Act);
3. SPP7, National Planning Policy Guideline 7 "Planning and Flooding"; and
4. Delivering Best Value in Highway Maintenance, code of Practice for Maintenance Management based upon The Roads (Scotland) Act 1984.

2.2 Flood Risk Management (Scotland) Act 2009

2.2.1 The Flood Risk Management (Scotland) Act 2009 received royal assent on the 16 June 2009. Initially, only sections 3 to 6, 55, 71, 94, 95 and 97 of the Act were commenced. These are mainly interpretative provisions. The Government is now in the process of setting in place a timetable for commencing different Parts and Sections of the Act. The commencement order covering parts 1-3, 5, 8 and some of part 6 came into force on 26 November 2009 to ensure that the EC floods Directive is transposed.

2.2.2 The Act will introduce a more sustainable approach to flood risk management to meet the needs of the 21st century and begin to address the effects of climate change. It recommends a joined up approach to flood risk management with cross boundary co-operation and co-ordinated working between agencies. Of key concern is creating a seamless transition from the 1961 Act to the new duties and processes set out in the Flood Risk Management (Scotland) Act 2009.

2.2.3 The Act will be implemented in stages over the coming year and, until Section 70, which repeals the Flood Prevention (Scotland) Act 1961, amended by the Flood Prevention and Land Drainage (Scotland) Act 1997, has commenced, current flooding legislation will remain in place.

2.2.4 Of particular relevance to the Council is part 4 and schedule 2 of the Act, dealing with the statutory process for flood protection work (flood prevention schemes), which is unlikely to be commenced before June/July 2010. The new Act contains a less onerous process than the current Act, which accords "deemed planning consent" for approved schemes and allows the local authority to use coercive powers to take schemes forward.

2.2.5 Under the new Act the responsibilities for flood risk management will be:

1. Property owners

The Scottish Government makes it clear that individual owners have primary responsibility for the prevention of flooding to their property. In addition, an individual with a watercourse within the boundary of their property, including piped watercourses, have what is termed 'riparian' responsibilities under Common Law. In brief this means as a riparian owner you must allow the unrestricted flow of water through their property. This will require watercourses to be kept clear of obstruction that are liable to pose a risk of

flooding. As a landowner, North Ayrshire Council has the same duty to maintain watercourses on its land.

2. North Ayrshire Council

North Ayrshire Council has a duty under the new Act to:

Assess relevant bodies of water “from time to time” for the purpose of ascertaining whether the condition of any such body of water gives rise to a risk of flooding.

Where a flood risk is perceived and it is considered that clearance and repair works would substantially reduce the risk, a schedule of these works must be prepared. This must be made publicly available.

Carry out the works within the schedule.

North Ayrshire Council will also be required to provide information to SEPA in order for them to carry out their responsibilities under the new Act and to work with other local authorities to produce local flood risk management plans. In addition to these responsibilities, the Council will have powers to undertake flood protection works where it sees fit and where there is adequate funding. There is no duty imposed upon the Council to carry out such works.

The Roads (Scotland) Act 1984 imposes further responsibilities on the Council to maintain road drainage systems and to clear roads of flooding.

North Ayrshire Council will continue to publish a biennial flood report (this document) until such time as the Flood Prevention (Scotland) Act 1961 is repealed, under Section 70 of the new Act.

3. Scottish Environment Protection Agency (SEPA)

The new Act names SEPA as the competent authority for flood risk management. They will have a responsibility to produce Catchment Flood Management Plans for Scotland by December 2015 to meet the requirements of the EU Flood Directive 2007/60/EC.

Other responsibilities placed on SEPA by the Act are:

SEPA must prepare a Preliminary Flood Risk Assessment by December 2011 for Scotland

SEPA must prepare flood risk and hazard maps by December 2013 for Scotland

SEPA must, when requested by a Planning Authority, give the authority advice as to flood risk in the authority's district

SEPA must, where it considers that a flood is occurring or likely to occur in the near future, make available warnings in relation to flood. The “Floodline” scheme gives warning information for Scotland 24 hours a day, 365 hours a day.

SEPA to be enforcement authority under the Reservoirs Act 1975

4. Scottish Water

Scottish Water must identify areas where it considers a flood is likely to originate from a sewerage system.

- 2.2.6 The Act was the subject of a report to the Executive of North Ayrshire Council on 17 November 2009.

2.3 Flood Prevention (Scotland) Act 1961

North Ayrshire Council assumed responsibility for the implementation of the Flood Prevention (Scotland) Act 1961 within North Ayrshire in 1996. This Act gave the Council **powers** to carry out measures for the prevention or mitigation of flooding of non-agricultural land including:

- Cleansing any watercourse or embankment
- Repairing any watercourse or embankment
- Maintenance of any watercourse or embankment

These powers are permissive and discretionary only, i.e. the Council may exercise the powers but does not have to. No work, other than maintenance can be carried out under the Act without the promotion of a flood prevention scheme by the Council (flood prevention schemes are agreed and supported by the Scottish Executive if they comply with the approved cost/benefit ratio).

2.4 Flood Prevention and Land Drainage (Scotland) Act 1997

The Flood prevention and Land Drainage Scotland Act (Scotland) Act 1997 came into force on 26 May 1997 and amended the Flood Prevention (Scotland) Act 1961 by placing **statutory duties** on local authorities to maintain watercourses within their area. The main sections of the 1997 Act can be summarised as follows:

- The Act requires the local authority to assess flood risk from watercourses;
- The local authority has a statutory duty to assess and maintain the watercourse in certain circumstances e.g. where it becomes aware of an obstruction which may give rise to flooding. The Scottish Executive makes clear, however, that individual owners, who live in areas prone to flooding, have primary responsibility for the prevention of flooding to their property;
- The Act requires the local authority to assess, from time to time, whether or not any watercourse is in a condition likely to cause flooding of non-agricultural land. When, in our opinion, work is required to alleviate the threat of flooding, we have the powers to carry out that work. For instance, if a wall has fallen into a burn, we can, and will remove it. The majority of flooding is caused not by inadequate maintenance, but by a lack of capacity in watercourses or culverts;
- The Act does not apply where failure to maintain would result only in flooding of land in the same ownership as the watercourse requiring maintenance;
- The act does not place any duty to undertake capital works;
- The Act requires the local authority to publish biennial reports.

2.5 Scottish Planning Policy, Sections 196 - 211 Flooding and Drainage

The Scottish Executive expects developers and planning authorities to err on the side of caution in decision making whenever flooding is an issue. Flood risk will be a material consideration in a range of cases.

New development should not take place if it would be at significant risk of flooding from any source or would materially increase the probability of flooding elsewhere. The storage capacity of functional floodplains should be safeguarded, and works to elevate the level of a site by landraising should not lead to a loss of flood water storage capacity.

Where built up areas already benefit from flood defences, redevelopment of brownfield sites should be acceptable but greenfield proposals will extend the area of built development at risk and should preferably be considered in the light of alternatives through the development plan process. Water resistant materials and forms of construction may be required. Generally, drainage will be a material consideration and the means of draining a development should be assessed. Sustainable drainage will be required whenever practicable and watercourses should not be culverted. Where culverts are already in place, these should be opened if possible. Flood prevention and alleviation measures should respect the wider environmental concerns and appropriate engineering solutions recognise the context provided by the development plan. Whilst it is preferable for open spaces to flood rather than buildings it may not always be acceptable.

For coastal and watercourse flooding a Risk Framework characterises areas for planning purposes by their annual probability of flooding and gives the planning response:

- **Little or no risk area** in which the annual probability of watercourses, tidal or coastal flooding is less than 0.1%;
- **Low to medium risk area** in which the annual probability of watercourses, tidal or coastal flooding is in the range 0.1% to 0.5%;
- **High risk area** in which the annual probability of watercourses, tidal or coastal flooding is greater than 0.5%.

The Risk Framework will be applied using the most accurate flood extent maps available to the Council.

2.6 The Roads Scotland (Act) 1984

In order to fulfill the Council's duties under the Roads Scotland (Act) 1984, North Ayrshire Council will be guided by the principals contained within the document 'Delivering Best Value in Highway Maintenance, Code of Practice for Maintenance Management'. With regard to flood prevention, North Ayrshire Council regards the following maintenance activities to be important and, where possible and subject to financial constraints and availability of human resources, will endeavor to act in accordance with the requirements of the Code of Practice:

- Routine inspection, cleansing and repair of all drainage systems including gullies, pipes and filter drains;
- More frequent inspection of areas that may be particularly susceptible to risk of flooding either from topographical factors outside the highway or from frequent silting of systems;
- Annual cleansing of gullies and kerb offlets, cutting of grips and digging out of ditches;
- Prompt investigation of flooding of the highway with implications for safety or serviceability and urgent consideration of action to permanently relieve the problem.

3. TYPES OF FLOODING AND CONDITIONS UNDER WHICH IT CAN OCCUR

- 3.1 Extremely high tides, with or without surges and high waves (coastal flooding). Usually extremely high tides associated with a deep depression to the west and often accompanied by a surge and high winds. The potential impact of coastal flooding is significantly higher than for other types of flooding, with a greater probability of loss of life and inundation, especially if larger-scale coast defences fail.
- 3.2 High water levels in watercourse (fluvial flooding). Normal type of flooding following persistent prolonged heavy rain. Affects properties adjacent to watercourse (in floodplain).
- 3.3 Overland or surface water flooding (pluvial flooding) is caused by the build up of water on land following heavy rainfall or by a high water table causing ponding or standing water in low lying areas. Such flooding is hard to predict and is not directly related to flow in watercourses and is the responsibility of the landowner concerned. It occurs when natural and man-made drainage systems have insufficient capacity to deal with the volume of rainfall, where it falls and its intensity.
- 3.4 During these types of events there is also a strong likelihood of sewer flooding which can cause serious problems in built up areas. The expected risk as a result of climate change will increase the potential for sewers to overflow unless action is taken.
- 3.5 Flash floods are characterised by rapid rise and fall of floodwaters with peak flows occurring within hours of heavy rain. They can be either fluvial or pluvial in nature and are normally associated with steep catchments affected by periodic heavy rainfall and can be influenced by inadequate or badly maintained storm water drainage, the build-up of water behind bridges and culverts or the overtopping and/or breach of flood defences or reservoir dams. They also occur in urban catchments when the intensity of rainfall within a limited period is such that water run-off overwhelms the drainage capacity of the land and the storm water drainage systems. Developments in natural hollows, which rely on artificial or man-made drainage systems, are most at risk.
- 3.6 Groundwater flooding occurs when the level of water underground (the 'water table') rises and water emerges above the natural surface. It generally happens in low-lying areas.
- 3.7 Sewer flooding can cause serious problems in built up areas. The expected increase in flood risk as a result of climate change will increase the potential for sewers to overflow unless action is taken. The Scottish Executive have indicated they will seek to reduce the risk of sewer flooding by continuing to encourage the use of sustainable urban drainage systems (SuDS) and working with Scottish Water to ensure that such systems are properly maintained. Scottish Water will invest significant sums in investigating sewer flooding and in resolving sewer flooding problems. As with other types of flooding, the risk is impossible to eliminate but it is vital that it is minimised and managed to safeguard people, their properties and their livelihoods.

4. FLOOD RISK MANAGEMENT STRATEGY

- 4.1 The Council's flood prevention strategy outlined in previous reports will be replaced with a Local Flood Risk Management Plan in accordance with the 2009 Act.
- 4.2 Until the Local Flood Risk Management Plan is in place the Council will continue to uphold its previous strategy.

5. ASSESSMENT OF WATERCOURSES

5.1 Over the last few years the Council has commissioned a number of studies of watercourse systems. These are detailed in the following paragraphs.

5.2 River Irvine and Annick Water

5.2.1 The hydraulic model of the River Irvine and Annick Water catchment area was originally constructed in 1993 by Bullen Consultants and subsequently re-calibrated to the December 1994 flood event and the original model findings revised accordingly. The model was converted to current industry standard software and updated using Flood Estimation Handbook methodology in 2001. Flood extent maps were then prepared for a variety of design events including the 1 in 200 flood event, i.e. a flood with a 0.5% chance of being equalled or exceeded in any year. These odds remain the same each year, regardless of any recent severe occurrences. The model also considered the latest governmental advice on the effects of climate change. The report indicates that the flood prevention scheme at Waterside continues to provide its designed level of protection and also existing development alongside the Rivers Irvine and Annick Water are not at risk of flooding from a 1 in 100-year flood event, i.e. a flood with a 1% chance of being equalled or exceeded in any year.

5.2.2 The model was extended in 2004 to cover those urban areas immediately upstream of Perceton Bridge, such as Old Perceton and Perceton Mill. The flood extents maps did not show any properties to be at risk of direct flooding from overtopping of the riverbanks. An unquantified risk of flooding is always present should Perceton Bridge become blocked with debris.

5.3 River Garnock and its Tributaries

The River Garnock and its tributaries had not previously been modelled and there was little documentary evidence of the flooding history of the catchment although there were known to be many instances of flooding. There was also only one operational flow gauging station at Kilwinning. In response to many concerns about the possibility of flooding along the reaches of the River Garnock and its tributaries, particularly near Kirkland Road in Glengarnock and the Ryeside Mill area of Dalry, the Council commissioned Babbie Group to carry out a flood risk assessment of the catchment. The study involved a hydrological assessment of the River Garnock and its tributaries, a topographical survey and construction of a mathematical river model to the same standards as the River Irvine model. The study was completed in July 2003.

5.4 Dundonald Burn

5.4.1 The Council was concerned that, whilst the Institute of Hydrology 1 in 100 year return period indicative flood maps show flooding on Dundonald Burn, no detailed study had been carried out on this tributary of the River Irvine to accurately establish the extent of flooding. When constructing the hydraulic model of the River Irvine the flows from tributaries were only computed as inputs to the model at confluence points. Dundonald Burn flows through a low-lying industrial area of significant economic importance to North Ayrshire. The Council therefore commissioned its consultants to carry out a flood risk assessment of the catchment. The study involved a hydrological assessment of the Dundonald Burn, a topographical survey and the construction of computational hydraulic model to determine flooding levels for a variety of design conditions.

- 5.4.2 The study was wide reaching in scope and was completed in 2005. The study showed that a few commercial properties adjacent to the burn in Riverside Business Park and Oldhall West Industrial Estate were at risk of flooding. This is caused by water backing up from the River Irvine. With lower levels in the River Irvine, the Dundonald Burn is able to discharge the majority of floodwater passing through Long Drive Road Bridge. The bridge embankments limit the amount of water that can pass downstream and the excess is contained in the floodplain between Beechams, Long Drive and Moss Drive.
- 5.4.3 Flooding can also occur in Riverside Business Park, Oldhall West Industrial Estate and Beechams complex due to surcharging of surface water systems.

5.5 Red Burn

- 5.5.1 North Ayrshire Council has been involved in the formulation of a master plan of basic road and other infrastructure for the Montgomerie Park site on the edge of Irvine consisting of some 800-1000 houses and other related developments. The site is bounded by the B7080 to the north and east, the A78 trunk road to the west and the Red Burn to the south. SuDS have been adopted for the surface water drainage from the site, discharging into two ponds, one as part of an existing wetland area at the south-western corner of the site and the other at the southeast corner adjacent to the B7080. These SuDS will attenuate the flow to pre-development levels or better. The Red Burn has also been realigned close to the latter pond to allow the SuDS features to be fully integrated into the landscape.
- 5.5.2 The Red Burn is a tributary of the River Garnock flowing through Irvine before joining the River Garnock near Nethermains in Kilwinning. The catchment is predominantly urban and the burn has been culverted over a substantial length. The burn was not hydraulically modelled as part of the Garnock hydraulic model but was included in the model as an input at its confluence.
- 5.5.3 There is documentary evidence of the flooding history of the system. Flooding has occurred at various locations in Castlepark and also at Dykehead Cottage, in this instance due to a back grade in the open channel section between the A78 trunk road at Nethermains and the culvert under Watercut Road. The culvert under Watercut Road was replaced in 1997 and the open channel regraded to eliminate the back grade, however the water through the culvert and open channel is slow moving. The Garnock at its confluence with the Red Burn is tidal.
- 5.5.4 As part of the flood risk assessment for the masterplan for the Montgomerie Park development, the Council's consultants carried out a flood risk assessment of the catchment. The study involved a hydrological assessment of the Red Burn, a topographical survey and the construction of computational hydraulic model to determine flooding levels for a variety of design conditions.
- 5.5.5 Initially, areas upstream of the A78 were examined and flood extent maps produced. This allowed the Council to follow 'best practice guidelines' and ensure that all development within Montgomerie Park would be sited outwith the 1 in 200 year flood extents, including an allowance for climate change. A draft report was received which has identified a number of issues, which require further investigation prior to finalising the report. These issues have generally been addressed within the River Garnock Catchment report (see section 9.2). The report confirms a flood risk from surcharging manholes in Castlepark and from overtopping downstream of the A737 and discusses options to address the potential flooding.

5.6 Benlister and Monamore Burns

- 5.6.1 At the time of the last report, the Council had been concerned that the Institute of Hydrology 1 in 100 year return period indicative flood maps did not include coverage of Arran. Benlister and Monamore Burns flow through low lying urban areas in Lamlash which is also at risk of coastal flooding. The Council therefore commissioned a fluvial flood risk assessment of both catchments. The study involved hydrological assessments of Monamore Burn and Benlister Burn, a topographical survey and the construction of computational hydraulic model to determine flooding levels for a variety of design conditions. The study was wide reaching in scope and was intended to highlight those areas potentially at risk from flooding. It also included a condition survey of the bank structures and defences along both burns the identification of any maintenance works required.
- 5.6.2 The study was completed in May 2005. The study shows that there is a risk of flooding from both burns, with the Monamore Burn posing the most severe risk. Large areas of Lamlash will flood at or above the 1 in 50 year event. The volumes of water spilled are not high, and, due to the sloping terrain water will flow over a large area downstream. This results in flooding for a limited period of time and in some places the depth of flooding will be a maximum of 100mm.
- 5.6.3 The flood risk assessment modelling was undertaken assuming the culverts and bridge structures were clear from obstructions and debris. As previous flooding has occurred due to debris travelling downstream causing blockages at the bridge structures, Royal Haskoning were asked to recommend any maintenance measures they considered necessary to prevent similar flooding occurring in the future. They concluded that the riverbank must be maintained to prevent undercutting which may de-stabilise trees causing them to fall across the river channel causing further debris to build up. In addition, they identified, that upstream of the Benlister Burn, several small wooden bridges had been constructed presumably by the local farmer for sheep or other livestock. These may become easily dislodged during heavy river flows and may travel downstream causing further blockages leading to a similar flooding problem as before (and as witnessed recently at Auchrannie in June 2005). Due to the height of these structures above the Benlister Burn being very low, the Council will be contacting owners with regard to their either being removed or requesting a more permanent solution which alleviates this problem.

5.7 Ladeside Area of Lochranza

- 5.7.1 Following 3 flood events in the winter of 2003/04, affecting several properties in the Ladeside area of Lochranza, the Council's consultants carried out a preliminary investigation of the flooding mechanisms. At the same time the island office began a programme of channel clearance and other maintenance works.
- 5.7.2 Two watercourses, namely Glen Chalmadale and Gleann Easan Biorach, approach Lochranza from south westerly and southerly directions respectively. The confluence of these two rivers is at the south western edge of the area of low lying flat land. The river running through Lochranza is referred to as Chalmadale Waters. The outlet from the reservoir above Lochranza (Loch a' Mhuilinn) enters a lade that descends through the Millhill area of Lochranza before running parallel to Chalmadale Waters. A second lade runs along the rear of the Lochranza Field Study Centre and the adjacent Church. The head of this lade is close to the northern edge of Loch a' Mhuilinn and its confluence with the other Lade occurs immediately after it passes below the A841.

- 5.7.3 The consultant's report was received in June 2004 and their main recommendation is that a much clearer picture needs to be established as to the mechanisms of flooding before any flood alleviation measures can be recommended with any confidence. Due to the nature of the catchment of each watercourse and the fact that all watercourses share the same floodplain area within Lochranza, it is not always possible to identify the source of floodplain water. Without this information there could be much wasted effort and indeed the potential to make the situation worse. For similar reasons, although mathematical modelling of the watercourses is feasible, in this instance the confidence levels of any model would be low.
- 5.7.4 It is nevertheless essential that every practical measure is taken to reduce the risk of flooding and the Council continues with its programme of maintenance works and encourages private landowners to carry out similar works on watercourses on their land. To determine if these maintenance works have had a beneficial effect on reducing flood risk and to establish the mechanisms of flooding, the frequency and nature of any flooding that occurs is recorded. This is not always an easy task as heavy rainfall usually has an almost immediate effect on water levels and often occurs in the middle of the night. Nevertheless, the Council's island office staff collate this information whenever possible. The Council appreciates the involvement of the local community who provide the island officers with every assistance in recording these necessary details.
- 5.7.5 The Council recognizes that there will be a continued risk of flooding within Lochranza, however, it is important that a full understanding of the problem is obtained to avoid embarking on inappropriate solutions. Further investigations will be carried out when resources allow.

5.8 Isle of Arran Watercourse inspections

- 5.8.1 Further to the studies of the Benlister and Monamore Burns and the Ladeside Area of Lochranza detailed in the previous 2 sections, the Council instructed its consultants to carry out watercourse assessments at the most significant locations on the Isle of Arran, namely:
- Brodick
 - Corrie
 - Sannox
 - Lochranza
 - Catacol
 - Pirnmill
 - Dougarie
 - Machrie
 - Blackwaterfoot
 - Shiskine
 - Lagg
 - Kildonan
 - Whiting Bay
 - Lamlash
- 5.8.2 The assessments considered those watercourse that flow through the main residential areas and those that are adjacent to two or more properties. The extent of study along each watercourse in the study area has been determined by the location of properties that are potentially at risk.

- 5.8.2 It should be noted that the assessments consider the flood risk from, and the flood mechanisms associated with specific watercourses. Many of the incidences of flooding on Arran are a consequence of high intensity rainfall events causing overland flow. This run-off is typically outside the established network of drainage channels and as such is unpredictable and results in localised flooding. As such, these assessments do not consider flooding of this nature.
- 5.8.3 These assessments consider the effects and potential impacts of fluvial flooding or a combined tidal and fluvial effect.
- 5.8.4 Where a watercourse is not named on the 1:25,000 scale Ordnance Survey map of Arran, it has been named according to either the name of a property or road in the vicinity. It is also referred to as a watercourse to distinguish it from the named burn.
- 5.8.5 Each watercourse has been classified as small, medium or large. This description is based upon the length of watercourse identified on the 1:25,000 scale Ordnance Survey map of Arran. Small watercourses have a length of 1 km or less, medium between 1 km and 4 km and large greater than 4 km.
- 5.9 Hydraulic models are expensive to construct, being highly dependent on the accuracy of the topographical information available and the data recorded during flood events. It is the Council's policy to revise and refine these models as more precise survey information becomes available and research findings on the effects of climate change are published, however, the exact nature will be dependent on SEPA's requirements to provide information to inform the Flood Risk Management Plan.

6. MAINTENANCE OF WATERCOURSES

- 6.1 All channels for the conveyance of water whether naturally occurring or engineered require maintenance to ensure their efficiency and integrity. Blockages formed by water borne debris and natural silting during low flow conditions are the most common problem and, due to the dynamic nature of watercourses, will be a recurring problem in both urban and rural areas. Susceptible watercourses will continue to be monitored regularly. Fallen trees or trailing branches can trap floating debris, which in turn can build up to form a dam. Illicit dumping continues to be a big problem in some areas, with shopping trolleys, bicycles, mattresses, and washing machines being common. A few years ago, dishwasher was removed from deep inside a culverted watercourse in Largs.
- 6.2 Poorly designed trash screens or missing trash screens and poorly maintained culverts, screens and headwalls can all reduce capacity of watercourses during peak flow and can contribute to the risk of flooding.

7. MEASURES REQUIRED

Appendix A gives a listing of the maintenance measures identified to date as necessary to reduce the risk of flooding.

8. MEASURES TAKEN

Maintenance works, which have been carried out since the previous report, are listed in Appendix B.

9. FLOOD PREVENTION WORKS - CAPITAL SCHEMES

9.1 River Irvine, Waterside Flood Bund

- 9.1.1 Some flood prevention schemes were promoted prior to local government reorganisation. One such scheme was the works next to the River Irvine to protect properties at Waterside in Irvine. This consisted of raising the existing flood embankments along the riverbank and the fitting of non-return valves on all outfalls.
- 9.1.2 Over time these works have suffered from erosion both natural and manmade. Of particular concern to many local residents has been the section of earth bund below the bridge carrying Marress Road over the river. In 2001 consulting engineers carried out a full inspection of the works as part of the review of the River Irvine and Annick Water hydraulic model which also included an underwater inspection of the foundations of the training works. Subsequently the bund below the bridge was re-constructed in concrete and further maintenance works were carried out during the summer of 2004. These works consisted of repairs to the masonry training walls, and supporting walls for the flood bund. Debris was also removed from the bed of the River between the shopping mall bridge and the A737 road bridge. The owners of the shopping mall contributed to the cleaning of the riverbed. Repairs were also carried out to the brick walls supporting the flood embankment along Waterside Street.
- 9.1.3 The review also addressed the adequacy of the flood prevention works to cope with any predicted increase in water levels in the River Irvine due to the effects of climate change. Although water levels were predicted to increase, the works still currently provide the minimum standard of defence for flood prevention schemes and it is not considered that a flood prevention scheme purely to marginally raise the level of protection would achieve the necessary benefit-cost analysis required by the Scottish Executive. There has been no change since the previous report and this remains under review.

9.2 River Garnock Catchment

- 9.2.1 In November 2000, in response to many concerns about the possibility of flooding along the reaches of the River Garnock and its tributaries, the Council commissioned Babbie Group to carry out a flood risk assessment of the catchment. The study involved a hydrological assessment of the River Garnock and its tributaries, a topographical survey and the construction of computational hydraulic model to determine flooding levels for a variety of design conditions. The study was wide reaching in scope and was intended to highlight those urban areas potentially at risk from flooding. These areas could then be studied in greater detail.
- 9.2.2 Floodplain maps were prepared for a variety of design events including the 1 in 200 year flood event, i.e. a flood with a 0.5% chance of being equalled or exceeded in any year. The model also included the latest governmental advice on the effects of climate change
- 9.2.3 The initial study indicated that, as shown on the Institute of Hydrology Indicative 100-year flood maps, many areas were at risk from flooding. As an initial priority, more accurate survey work was carried out for the upstream areas of Kilbirnie and Glengarnock. The hydraulic model was then revised and the floodplain maps refined and the final report on the study was received in July 2003.

- 9.2.4 As well as the priority areas of Kilbirnie and Glengarnock, the report suggested that flood prevention works may be necessary at a number of locations, including in Dalry and Kilwinning.
- 9.2.5 The Council's flood prevention consultant, Royal Haskoning was commissioned to carry out a feasibility study to examine the viability of flood alleviation measures to protect the communities of Kilbirnie and Glengarnock and Babbie were instructed to carry out further detailed survey work for all other areas downstream of Glengarnock. An interim report was received in 2005 that summarised the findings of this appraisal. It identified that based on a technical, environmental and economic assessment the option of flow containment was the most beneficial. In addition to providing defences along the watercourse the preferred option included measures to address surface water flooding, increased downstream flows and blockage risk.
- 9.2.6 The Water Environment and Water Services (Scotland) Act 2003 sets out the key principles and instruction for Water Framework Directive implementation in Scotland and imposes on the North Ayrshire Council a duty to promote sustainable flood management. The Council supports this holistic approach and in order to ensure that any scheme for Kilbirnie and Glengarnock is fully consistent with the aims of sustainable flood management within the context of the Water Framework Directive the Council commissioned Royal Haskoning to further assess the issue of flood defence within the catchment. This will consider the flooding issues within the catchment, but focuses upon the communities alongside the River Garnock, namely Kilbirnie and Glengarnock, Dalry and Kilwinning. The flood defence Strategy that is produced will enable the preferred solutions to be identified for the communities at risk, and which provide a consistent approach to the entire catchment.
- 9.2.7 The aim of the Strategy is to consider the problem of flood defence along the length of the River Garnock and its tributaries and to undertake a high level appraisal of flood defence solutions. The output from the Strategy will be preferred flood alleviation options for the locations presently at risk of flooding such that the hydraulic, environmental and geomorphological effects of each option had been strategically considered. It is anticipated that these preferred options will be taken forward for detailed appraisal to confirm their viability.
- 9.2.8 The Strategy will include the following elements:
- A review the River Garnock and Tributaries Flood Risk Study and the more recent modelling undertaken within the catchment to establish the areas currently at risk;
 - A broad scale assessment of the flood defence benefits within each community if a flood defence scheme was implemented;
 - The production of a statement that clearly defines the problem within each community;
 - An assessment of how the problems within each community are related;
 - Undertake a baseline environmental appraisal of the catchment;
 - Undertake a baseline geomorphological review of the catchment;
 - Identify viable approaches to flood defence within the catchment to determine a set of basic options; and
 - Evaluation of the basic options assessing their technical advantages and disadvantages and commenting upon their environmental and geomorphological impacts.
- 9.2.9 The final report was received at the end of December 2007. The report provides a flood defence strategy for the River Garnock catchment and a framework within which flood

alleviation works for the individual communities can be assessed. The strategy has been developed from an initial review of the present flood risk and an outline evaluation of environmental, geomorphological, technical, economic and strategic aspects of a likely range of flood alleviation options.

- 9.2.10 The strategy has focused upon the main urban areas in the River Garnock catchment, and has found that there is the potential for viable schemes in four locations, based upon flow containment in conjunction with flood storage. In addition, flood risk areas on the tributaries have also been assessed, but it is concluded that they should be considered on an individual basis, as they do not appear to have strategic benefit.
- 9.2.11 An interim appraisal report for the provision of flood defence to Kilbirnie and Glengarnock was produced in September 2005. The preferred options identified within the recent report for the two most upstream communities are containment for Kilbirnie and Glengarnock and storage for Dalry. As the attenuation for Dalry has the potential to also mitigate the impacts within Kilbirnie and Glengarnock the report recommends that a single appraisal is prepared to address the flooding to these three communities. Accordingly, subject to approval by the Council Executive, a single flood prevention scheme for Kilbirnie, Glengarnock and Dalry will now be progressed.
- 9.2.12 Addressing all of these issues have meant that progress on this work was slower than anticipated. Furthermore the recession and the resulting financial pressures on the Council's Capital budget along with the continued uncertainty over funding of major flood prevention schemes during the passage of the Flood Risk Management (Scotland) Bill through the Scottish Parliament has delayed the project. Although the main funding issue has not been resolved, the Council has allocated sufficient funding in its Capital Plan to move the project forward.
- 9.2.13 The flood protection (prevention under previous legislation) scheme is currently being progressed by flooding consultants Mouchel under the Service's current consultancy services framework agreement. The various options and the strategy will form the basis for informal public consultation. This will take the form of a series of exhibitions in each area, which will be manned by representatives of the Council's Roads Service and Mouchel. The first of these exhibitions, in Kilbirnie, Glengarnock and Dalry, is likely to be held in the latter months of 2010.
- 9.2.14 Any timescale for the construction of a flood prevention scheme is very much governed by the new legislation. Outlined below are the main stages of the project and, although it is difficult to set an exact timescale, a draft timetable based on a construction start in early Autumn 2012 would be as follows:

Present - July 2010	Review Kilbirnie and Glengarnock Flood Prevention Appraisal – Interim Report and River Garnock Catchment Flood Defence Strategy Report
July 2010 - Oct 2010	Project Appraisal Report
Oct 2010 - Dec 2010	Preparation for public exhibitions
Feb 2011	Public exhibitions and consultations
Mar 2011	Prepare report on public consultation
Mar 2011 - Aug 2011	Design Stage 1 (Preliminary)
Mar 2011 - Aug 2011	Environmental Statement
Sept 2011	Prepare scheme documentation, submit the Planning Application, publish the Flood Protection Scheme and submit Technical Report to the Scottish Government.

- Mar 2011 - Aug 2011 Obtain landowner agreements
- Feb 2012 Publish Notice of Conformation of Scheme (date dependent on whether any objections are received and whether a Public Local Inquiry is required)
- Feb 2012 - Jun 2012 Design Stage 2
- Jun 2012 - Sept 2012 Potential period for Tender Process
- Oct 2012 - Feb 2013 Potential period for Construction phase

Should there be a requirement for a public local inquiry, this would add at least a year to the dates for Design Stage 2, Tender process and Construction phase.

9.3 Largs Flood Prevention Scheme 2002, Old Fish Quay to Gogo Burn

- 9.3.1 The process undertaken in promoting the Largs Flood Prevention Scheme was extensively covered in previous reports. The scheme cost just under £1 million and received some £400,000 funding from the Scottish Executive. It was aimed at reducing the flood risk to 13 residential and 53 commercial premises in the town's commercial center by providing formidable long-lasting defences against floods and storms.
- 9.3.2 The contract was awarded to local contractor, Kelburne Construction Ltd of Kilmarnock with supervision being carried out by the Council's flooding consultants, Royal Haskoning (formally Posford Haskoning). Construction work began on 17 February 2003 and the majority of the works were complete by mid June, before the main summer tourist season. The work, which included additional promenade areas, seating, handrails and upgrading of the promenade lighting was completed in November 2003 and has been well received by locals and tourists alike.
- 9.3.3 The scheme was officially opened on 1 December 2003 by the local MSP, Allan Wilson who was the Deputy Minister for the Environment and Rural Development at the time.
- 9.3.4 On the 31st December 2006, however, flooding again occurred to the town center of Largs. The areas affected were Bath Street and Fort Street. The properties affected by flooding were 7 and 10 Bath Street and retail premises on the corner of Bath Street and Main Street. In particular, the Sugar and Spice retail premises and the Clachan Bar were identified as having been affected. The maximum depth of floodwater was estimated to have been 300mm.
- 9.3.5 In response to the obvious concerns highlighted by the flooding incident, the Council instructed the designers of the scheme, Royal Haskoning, to examine the conditions leading up to the flooding incident, assess these in relation both to other flood events and to the existing flood defence and drainage systems; in particular to assess the performance of the recently completed scheme, with the aim of identifying the source and pathways for flooding with respect to the incident. The Council also asked Royal Haskoning to provide recommendations for any additional works, which may be required to further minimize flooding to Largs town center.
- 9.3.6 A final report was received from Royal Haskoning in December 2007. In accordance with best practice, the Council engaged independent flooding consultant, Dr John Riddle, to carry out a peer review of the report. Dr Riddle lives in Fairlie and has extensive local

knowledge and experience of coastal conditions in the area and is an advisor to the Scottish Government on flooding issues.

- 9.3.7 The report considers the main cause of the flooding to have been overtopping of the sea defences constructed in 2003. The heavy rainfall at the time of the incident together with blockage of the drainage system by wave-borne debris may have exacerbated the depth of floodwater, however, without better information the report has to assume that all flooding occurred due to overtopping of the sea defences.
- 9.3.8 The report draws a number of conclusions with respect to the original design parameters and the performance of the sea defences and makes recommendations with regard to improvements to the existing flood prevention scheme and further investigation of the drainage system in Largs Town center.
- 9.3.9 Dr Riddle has completed his peer review and submitted his report. As the new flooding legislation is now in place, any amendments, which may be required to the Largs Flood Prevention Scheme, will be included in the draft Local Flood Risk Management Plan for public consultation.

9.4 Saltcoats Flood Prevention Scheme

- 9.4.1 The town of Saltcoats has suffered from severe coastal flooding in the past, most notably in 1926 and 1991, with serious economic and social consequences to those whose properties and livelihoods have been affected. During the last event in 1991, the town centre was inundated to depths in excess of 500mm and properties in the Winton Circus area were also flooded.
- 9.4.2 The process undertaken in promoting the Saltcoats Flood Prevention Scheme was extensively covered in the previous report. The overall cost of the project was just under £2.4 million and received some £1.8m funding from the Scottish Government. It was aimed at reducing the flood risk to 13 residential and 53 commercial premises in the town's commercial center by providing formidable long-lasting defences against floods and storms.
- 9.4.3 Since the work was of a specialist nature an advert was placed in the national press seeking expressions of Interest from contractors who wished to be considered for inclusion on a select list to receive tender documents. Consequently six Contractors, selected from prequalification submissions, were invited to tender for the works.

Following approval from the Executive of North Ayrshire Council on 2007 and the offer of grant from the Scottish Government on 2007, a contract was awarded to R J McLeod.

- 9.4.4 Construction of the scheme started on 14th January 2008 and was completed by August 2009.
- 9.4.5 The scheme will protect some 300 residential properties and 20 commercial properties from the predicted increased risk of serious flooding in the future. The scheme has provided the opportunity for amenity improvements to the Saltcoats seafront, some of which have already been proposed by the local regeneration company and will help maintain community safety. It will also aid social and economic regeneration of the town.

10. ADDITIONAL ACTIVITIES

10.1 Co-ordination of Action by Council Services

North Ayrshire Council also has watercourse maintenance obligations as riparian owner. Educational Services and Property Services all hold significant land under their accounts. Where watercourse assessments identify maintenance requirements in these areas, the respective Service is informed and appropriate action is initiated. Where watercourses have been particularly abused with illegal dumping and neglect the flood risk might be limited but the environmental benefit of any clean up cannot be understated. Any work will again be co-ordinated with other Services with funding contributions shared between these Services.

10.2 Planning Policy and Consultation Process

- 10.2.1 The susceptibility of land to flooding is material consideration in planning decisions. Roads Services as flood authority act as a consultee in the planning process to advise on flood risk and measures required to be taken with new development to prevent increasing flood risk to other areas. Scottish Planning Policy, Sections 196 - 211 Flooding and Drainage gives guidance to Planning Authorities for both development plan and development control purposes when dealing with development in flood risk areas. The exercising of effective planning policy and development control powers is a major mechanism for controlling the location of development and, therefore, managing the threat of flooding and flood risk.
- 10.2.2 The Council also works closely with SEPA to ensure that development control decisions are taken with full consideration of any potential flood risk. The Council has endorsed a formal SEPA - Planning Authority Protocol on flooding issues. The protocol contains principals and procedures that will be followed by SEPA and the Planning Authorities regarding advice and consultation on flood risk issues. It is intended to enable Planning Authorities and SEPA to work together effectively on planning matters, particularly in the assessment of planning applications for development where there is considered to be a flood risk. The assessment of risk is a specialist subject and the protocol has been developed to promote consistency in provision of advice and to assist in the decision-making process for development where there is considered to be a flood risk. In line with current guidance on flood risk the Council will require flood risk assessments to consider the 1 in 200 year event as a minimum level of protection. The Council will also require an additional allowance for climate change wherever practicable.
- 10.2.3 An example of the Council's current planning policy on flooding taken from the North Ayrshire Local Plan (excluding Isle of Arran), adopted 4th November 2005, is given below.

Policy INF 6 Flooding

(a) Within existing built up areas, at locations that are known to have flooded in the past and/or are identified in the Council's flood risk consultation maps, development which will not significantly increase the number of people occupying/visiting the area shall accord with the Local Plan.

(b) Applicants for developments, within areas that are known to have flooded in the past and/or are identified in the Council's flood risk consultation maps, may be required to submit a flood risk assessment

which demonstrates that any risk of flooding can be satisfactorily mitigated without affecting the flood risk elsewhere.

Developers are advised to seek pre-planning application consultation with the water authority, NAC Roads, and SEPA in this respect.

- 10.2.4 North Ayrshire Council actively promotes sustainability to protect and enhance the environment. The Council has reinforced that commitment in relation to sustainability and improvement of Scotland's water environment by formally acknowledging the principles of Sustainable Urban Drainage Systems (SuDS) as outlined in the SuDS Design Manual for Scotland and Northern Ireland. The manual encourages development that does not result in pollution of the aquatic environment. SuDS can also be used to reduce the risk of flooding. The principles of SuDS have been incorporated into North Ayrshire Council's Local Plan policies and are implemented through the development control system. The council, however, does recognise that these principles have implications for all new development in terms of construction costs and maintenance obligations and a standing officers working group meets regularly to consider and advise on the impact of SuDS.
- 10.2.5 The database of information and hydraulic models of river catchments held by Roads Services helps provide a reference of existing flood risk necessary for consultation. Roads Services also adds to the database and models any additional information gathered through flood risk assessments provided by applicants. The range of information is expanding and, through time, will provide a comprehensive record of flood risk and flooding incidents throughout North Ayrshire.
- 10.2.6 The Council is currently preparing a new Local Development Plan (LDP), which replaces the existing Structure and Local Plans. The LDP will be accompanied by Supplementary Guidance on SUDS, Drainage and Flooding. This will be informed by ongoing engagement with the Council's Flooding Officer, Roads Services, Scottish Water, SEPA and other stakeholders.

10.3 Council Policy on Culverting of Watercourses

- 10.3.1 Culverting of rivers and streams is a long-standing practice commonly associated with urban expansion and often regarded by those undertaking a development as an acceptable means of gaining land by removing landscape features seen as inconvenient. Because culverting is a well-established approach to dealing with watercourses during development, the justification for it is rarely questioned.
- 10.3.2 As a result of the water quality impacts, flooding problems and habitat loss caused by culverts, SEPA wish to encourage a shift from tacit acceptance of culverting to a presumption against it. SEPA also encourages the requirements for rigorous justification in cases where culverting is presented as being unavoidable.
- 10.3.3 North Ayrshire Council strongly supports SEPA in their aims and has adopted a presumption against culverting when dealing with planning applications. Following assessments of culverted watercourses where flooding is shown to be caused by culverts, the Council will, if appropriate and cost effective, promote de-culverting and habitat restoration proposals. The Council's experience so far is that this is rarely appropriate due to engineering difficulties, in particular.
- 10.3.4 This policy was adopted by the Council on 13th December 2005.

10.4 Council Policy on Access to Watercourses

- 10.4.1 Access to watercourses is very variable and the Council, when considering new development adjacent to watercourses will require the developer to ensure that adequate access for maintenance is provided.
- 10.4.2 The developer will also be encouraged to fully integrate the watercourse into their developments by considering the potential of watercourses as public open space and also improving the riverbank's potential as a wildlife corridor.
- 10.4.3 The Council will also seek to promote the inclusion of riverside walkways within developments wherever possible.
- 10.4.4 This policy was adopted by the Council on 13th December 2005.

10.5 Ayrshire Strategic Flood Liaison and Advice Group (FLAG)

- 10.5.1 In approving the Ayrshire Joint Structure Plan, a request was made by the Scottish Ministers to investigate whether further policies on flooding should be brought forward as a future alteration to the plan. This, together with the Scottish Executive's request that local authorities actively seek a strategic approach to tackling climate change through adapting policies at a local level, led to the formation of a joint Ayrshire Strategic Flood Appraisal Group in 2000. (The name was later changed to FLAG in accordance with the advice in Scottish Planning Policy 7).
- 10.5.2 The Group provides East, North and South Ayrshire Councils with practical guidance and information on flood risk and climate change and its implications for development. Working through the Ayrshire Joint Planning Steering Group they:
- Provide forward planning input to the development plan process on the implications of flooding and climate change;
 - Co-ordinate the assembly of information and data about flooding and climate change;
 - Co-ordinate the dissemination of information among the three Councils on flooding and climate change issues;
 - Monitor the implementation of flood management schemes and provides a forum for the discussion of best practice;
 - Monitor the impact of climate change through the development of indicators;
 - Provide a forum for the discussion of significant development proposals with implications for flooding and climate change issues;
 - Review any forthcoming legislation on flooding and climate change;
 - Identify and co-ordinate any future research requirements on flooding and climate change; and
 - Maximise the opportunity for future funding initiatives through partnership working.

10.6 Society of Chief Officers of Transportation in Scotland (SCOTS)

- 10.6.1 North Ayrshire Council is represented on the Flood Risk Management group, which examines the statutory position of local authorities regarding flooding. The remit of the group is to share knowledge and experience and to provide guidance to Scottish Local Authorities with regard to best practice in terms of issues related to flooding and water legislation. The group has produced relevant guidance on best practice and has issued reports on various topics.

10.6.2 The Group has been extremely active in the progress of the new flooding legislation and is represented on a number of advisory groups providing advice to the Scottish Government on the implementation of the Act and in drawing up guidance.

10.7 Preparing for Flooding

10.7.1 The Council has emergency planning arrangements in place so that we are prepared in the event of major flooding. However, as the law states, the primary responsibility for dealing with floods and avoiding them lies with the property owner. It is important that owners are aware of their responsibilities and take appropriate action.

- Where property adjoins a river or a watercourse the owner is probably responsible for the area around the banks. The owner, before autumn, should check that any garden rubbish etc. along their boundary is removed and not liable to slip into the water and create a blockage.
- Large items which may cause a blockage, such as trees or masonry should be reported to Roads Services on 01294 225200.
- If a boundary wall or fence is in poor repair, the owner should have it repaired. Collapsed walls have often caused floods with serious effects for neighbours.
- If a property owner lives in an area which has experienced flooding, or if a property owner is concerned, they should take the time to identify where water might enter their house or garden and think ahead about how to deal with it.
- As part of a property owner's preparations they may wish to have some sandbags to hand. They are available from most large DIY stores or can easily be made from binbags and earth.
- Owners should check the weather forecast during particularly wet periods for any severe weather warning and in particular phone the national **FLOODLINE on 0845 988 1188** which is available 24 hours a day, 7 days a week, 365 days a year. The service is run by SEPA, The Scottish Environment Protection Agency.

10.8 Council Policy on the Deployment of Sandbags

The deployment of sandbags to prevent or contain floodwaters can be an effective way of mitigating the effect of a flood, however the lead time for filling and deployment can be lengthy, as a large number of bags cannot be filled in advance due to storage problems. Therefore, an early decision must be taken to sandbag, to avoid a subsequent waste of time and effort. The deployment of sandbags will be decided with regard to the following priorities:

1. To prevent loss of life or serious injury
2. Maintenance of access for the emergency services
3. Protection of vital facilities within the community
4. Protection of transportation routes
5. Protection of NAC property
6. Protection of private dwelling houses

The decision to deploy sandbags will be made by appropriate officers in Building Services, Cleansing, Roads Services or the Island Officer on Arran in accordance with the Services' callout/emergency procedures.

- Notes:
1. Sandbags will not normally be deployed to protect commercial property;
 2. Appropriate stocks of empty and filled sandbags will be held by the Services mentioned above, based on previous usage and experience.

The above policy mainly relates to tidal, fluvial and watercourse flooding. Where flooding occurs as a result of a blocked, damaged or ineffective Council owned drainage systems, sandbags will be deployed as required to mitigate the effects of flooding (and reduce the likelihood of claims against the Council) including the protection of commercial property.

The policy was adopted by the Council on 13th December 2005.

11. NATIONAL DEVELOPMENTS/INITIATIVES

11.1 Water Framework Directive

The Water Framework Directive (WFD) was formally adopted across Europe in December 2000. The main purpose of the Directive is the effective co-ordination of water environment policy and regulation across Europe to prevent deterioration and enhance status of aquatic ecosystems, including groundwater; promote sustainable water use; reduce pollution and, in relation to this report, contribute to mitigation of floods and droughts. Since then Member States have been busy working towards meeting the deadlines and timetabling requirements set out in the Directive; the most immediate of these being the transposition of the Directive requirements into national law by December 2003. Implementation of the full WFD is currently set as 2015. The latest information on the implementation of the WFD is available at:

<http://www.scotland.gov.uk/Topics/Environment/Water/15561/14925>

11.2 Water Environment and Water Services (Scotland) Act 2003

The introduction of the Water Environment and Water Services (Scotland) Act 2003 was covered in the previous report. Further information on can be found at:

<http://www.scotland.gov.uk/Topics/Environment/Water/15561/14925>

11.3 Water Environment (Controlled Activities) (Scotland) Regulations 2005

11.3.1 The Water Environment and Water Services Act also outlines SEPA's duties to:

- protect and improve the water environment;
- promote efficient water use;
- have regard to the social and economic impacts of exercising its functions;
- act in the best way to contribute to the achievement of sustainable development;
- promote sustainable flood management; and
- co-ordinate the delivery of its functions with others

11.3.2 In fulfilling these duties, SEPA regulate activities such as abstraction, impoundment and engineering activities, as well as pollution, from 1 April 2006 under the Water Environment (Controlled Activities) (Scotland) Regulations 2005 (CAR).

The Scottish Parliament approved the Regulations on 1 June 2005, setting in place a transitional period from 1 July 2005 until 31 March 2006.

From 1 April 2006, the following activities are now controlled:

- abstractions from surface and groundwater;
- impoundments of rivers, lochs, wetlands and transitional waters;
- groundwater recharge;
- engineering in rivers, lochs and wetlands;
- engineering activities in the vicinity of rivers, lochs and wetland which are likely to have a significant adverse impact upon the water environment;
- activities liable to cause pollution;
- direct or indirect discharge of List I substances to groundwater; and

- any other activities which directly or indirectly is liable to cause a significant adverse impact upon the water environment.

11.3.3 Further information on CARs and the Water Framework Directive can be found on the website:-

www.sepa.org.uk/wfd

11.4 Sewers for Scotland²

This was covered in the previous report.

11.5 River Basin Management Plan

The introduction of river basin management planning was covered in previous reports. Further information on the implementation and progress, including consultations can be found on:

www.sepa.org.uk

11.6 ICZM

The topic of integrated coastal zone management was covered in previous reports. Further information can be found at:

<http://www.scotland.gov.uk/Topics/Environment/Scottish-Coastal-Forum>

11.7 National Flooding Framework

11.7.1 In October 2002 an *Ad Hoc* Committee of Ministers, chaired by the Deputy First Minister, was set up to consider the arrangements for addressing flood risk and how advice and support is provided to those at risk from, and affected by, flooding. In February 2003 Cabinet agreed a Statement of Commitments and an action plan in the form of the National Flooding Framework. The National Flooding Framework aims to address the problems of flooding through four areas of action, namely, Awareness, Avoidance, Alleviation, and Assistance.

These can be broken down as follows:

1. **Awareness** - by assisting SEPA in the dissemination of flood risk information and warnings, and by supporting the preparation of the second generation indicative flood map. The Executive also commissions research (detailed in this website) to increase our knowledge of all aspects of flooding.
2. **Avoidance** - by publishing **planning** guideline (Scottish Planning Policy 7, **SPP7**) which discourages unnecessary development in areas prone to flood risk.
3. **Alleviation** - by providing local authorities with logistical and financial assistance in preparing flood prevention schemes. The Executive has raised the level of grant to local authorities from 50% of eligible costs to 80%.
4. **Assistance** - the Executive is committed to assisting and supporting people affected by flooding. In particular, the Executive aims to increase the take up of home insurance, especially in the social rent sector.

Its key aims are to ensure the public is better protected from flooding and to ensure better national co-ordination of flood management measures.

- 11.7.2 Section 2(4) of the Water Environment and Water Services (Scotland) Act 2003 says that Scottish Ministers, SEPA and other stakeholders should work in an integrated fashion and co-operate with each other.

The *Ad Hoc* Committee also recommended that a National Technical Advisory Group on Flooding Issues be set up to provide technical advice to local authorities and other parties on flood prevention schemes. The National Technical Advisory Group on Flooding Issues (NTAG) was set up with this in mind, it brought together the Scottish Executive, local authorities, SEPA, Scottish Water, Scottish Natural Heritage, the Association of British Insurers, Industry, Environmental NGOs, Academia, the Environment Agency and DEFRA.

NTAG was tasked with the following:

- offer advice to the Executive on producing technical guidance for local authorities to take forward flood prevention schemes;
- offer advice to the Executive on a definition of sustainable flood management;
- offer advice on the production of a Second Generation Flood Map and
- provide a forum for expert discussion on the impacts of climate change on flooding, the links between flood prevention schemes and planning and the social impacts of flooding.

NTAG set up three sub-groups to take forward this work, on sustainable flood management, guidance and mapping and hydrometric data. For full details of the agendas, minutes and papers of these sub-groups and the full final report of the NTAG final report can be found on the website

www.scotland.gov.uk/Topics/Environment/Water/Flooding/16919/15078

- 11.7.3 The work of NTAG has been carried forward by the Flooding Issues Advisory Group and now by the Scottish Advisory and Implementation Forum on Flooding

11.8 Scottish Advisory and Implementation Forum on Flooding

- 11.8.1 To support the implementation of the Flood Risk Management (Scotland) Act 2009 and the development of accompanying legislation and policies, the Scottish Government has established a Scottish Advisory and Implementation Forum on Flooding (SAIFF). SAIFF comprises representatives from the government, government agencies, local authorities and other stakeholders. In addition to supporting the work of the Scottish Government, SAIFF will provide technical support to all parties involved in the implementation of the Act and the EC Floods Directive. The Act and SAIFF embrace the principles set out by the National Flooding Framework.

- 11.8.2 The Council is represented on all of SAIFF's working groups through SCOTS (Society of Chief Transport Officers in Scotland) Flood Risk management Group. Although the working groups have met on a number of occasions and seminars and workshops have been held, no firm guidance has yet been produced.

11.9 Flood Maps for Scotland

- 11.9.1 SEPA published the Indicative River and Coastal Flood Map (Scotland) in October 2006. The map covers all Scotland and shows areas at risk of fluvial and coastal flooding from floods with a 1 in 200 year return period.
- 11.9.2 The map shows an estimate of the areas of Scotland that SEPA predict have a 0.5% chance or greater probability of being flooded in any given year, or put another way, the areas estimated to have a 1 in 200 or greater chance of being flooded in any given year. The map shows risk to land, not property, and covers both fluvial and tidal flood risk.
- 11.9.3 Under the Flood Risk Management (Scotland) 2009, SEPA must prepare a Preliminary Flood Risk Assessment by December 2011 for Scotland and flood risk and hazard maps by December 2013 for Scotland which will replace the Flood Map.

12. FLOODING SINCE NOVEMBER 2007

- 12.1 Since the report of February 2008, there have been a number of flooding events in North Ayrshire including one serious event in Kilbirnie and Glengarnock.
- 12.2 Heavy rain in the Kilbirnie and Glengarnock area caused the River Garnock to burst its banks on the morning of 1 August 2008 causing flooding at locations in Kilbirnie and Glengarnock. Along with other Council services involved on the day, Roads Services responded quickly to the incident.
- 12.3 The response included sandbagging properties as required; repairing the breach in the riverbank at the site of the former dye works site at Muirend Street, Kilbirnie; using gully emptiers to draw water out of areas of ponding on the carriageways; and sweeping debris off the footways and carriageways and some of the pathways into houses.
- 12.4 Subsequently, Roads Services commissioned flooding consultant, Royal Haskoning, to provide a formal record of the flood by way of a detailed description of the event, the number of private and commercial properties affected, approximate flood depths, indicative flood extent maps and flood mechanisms. The consultant's report, entitled *Kilbirnie 1st August 2008 Flood Event Report*, was appended to the report. As well as the Flood Event Report, Royal Haskoning was asked to undertake a more detailed study to provide additional flood risk management advice and services relating to the flood event. A copy of the consultant's report entitled *Kilbirnie, 1st August 2008 Flood Investigation report* was also appended to the report.
- 12.5 Since the flood event of 1 August, Roads Services have continued to monitor the condition of the riverside walls along the site of the former dye works site at Muirend Street and further works have been undertaken to reinforce the riverbank using rock armour. As an additional safeguard, a flood bund has been constructed along the whole length of the site. These measures are intended to restore the level of flood defence to that existing prior to the flood of 1 August but not increase it in order that flood risk to adjacent properties is not altered. The final flood protection will either be provided as part of the development of the site or as part of a future flood protection scheme for the town.
- 12.6 A complete listing of incidents of flooding, based on the information available, is contained in Appendix C.

APPENDIX A
FLOOD PREVENTION AND LAND DRAINAGE (SCOTLAND) ACT 1997
MAINTENANCE MEASURES REQUIRED

GENERAL LOCATION	WATERCOURSE	IDENTIFIED PROBLEM LOCATION	IDENTIFIED PROBLEM	MEASURES REQUIRED
Skelmorlie	Un-named burn	Station Road	Blocked screen	Clear screen regularly
Skelmorlie	Un-named burn	Eglinton Terrace, centre	Blocked screen	Clear screen regularly
Skelmorlie	Un-named burn	Eglinton Terrace, south end	Blocked screen	Clear screen regularly
Largs	Noddsdale Water	Between A78 100 : Noddsdale Bridge and new bridge	Blockage or narrowing of watercourse due to collapse of training walls on south side, gravel build up.	Inspect and notify owners if repairs become necessary Inspect and remove gravel from riverbed if excessive.
Largs	Noddsdale Water	New bridge and twin culverts	Blockage and gravel build up	Inspect regularly and clear when necessary
Largs	Noddsdale Water	Upstream of new bridge	Overhanging vegetation and dead trees on riverbanks for some distance	Inspect and notify owners to trim and maintain trees in good condition. Remove trees if threat of blockage is imminent.
Largs	Gogo Burn	Between A78 110 : Gogo Bridge and sea	Stability of retaining wall Low soffit of railway bridge	Inspect and clear debris regularly
Largs	Gogo Burn	Upstream of A78 110: Gogo Bridge	Overhanging vegetation and vegetation in riverbed, gravel build up	Inspect and remove when excessive
Largs	Moor Burn	Culverted section in Glenacre Drive	Blockage in culvert	Inspect from inlet, outlet and access chambers and remove debris when necessary
Largs	Moor Burn	Moor Burn Road to sea	Siltation/debris	Clear d/s channel and culvert under Greenock Rd regularly
Largs	Un-named Burn	Meadowbank Road and Holehouse farm access	Blockage in poorly laid section of culverted watercourse causing manholes to surcharge resulting in flood risk to properties in Meadowbank Road.	Inspect and clear debris from culvert system until section of culvert can be re-laid to improved gradient.
Largs	Kil Burn	Brisbane Glen Road, east side	Blocking of inlet of culvert	Inspect and clear screens regularly
Largs	Raillies Burn	Culverted section from Raillies Ave to Noddsdale Water	Blocking of inlet of culvert	Inspect and clear screen regularly

GENERAL LOCATION	WATERCOURSE	IDENTIFIED PROBLEM LOCATION	IDENTIFIED PROBLEM	MEASURES REQUIRED
Fairlie	Ridgeglen Burn	Culvert under A78	Flat invert	Inspect and clear any debris at culvert entrance
Fairlie	Ridgeglen Burn	Culvert through gardens	Culvert entrance	Inspect and clear any debris at culvert entrance
Fairlie	Un-named Burn	Culvert under properties	Culvert entrance	Construct headwall and trash screen Inspect and clear any debris regularly
Fairlie	Keppen Burn	Culvert under A78	Rubbish, culvert entrance	Inspect and clear screen regularly
Fairlie	Keppen Burn	Culvert d/s of railway	Rubbish/vegetation	Clear entrance regularly
Fairlie	Bourtrees Burn	Culvert under A78	Choked inlet chamber/screen/ collapsed wall	Clear chamber and screen regularly
Fairlie	Bourtrees Burn	Foxcote House	Debris from A78 culvert	Clean A78 culvert regularly
Fairlie	Bourtrees Burn	Beach House culvert	Vegetation debris	Culvert entrance is cleared by owner
Fairlie	Fairlie Burn	A78 140 : Burnfoot Bridge	Low soffit	Inspect and remove any debris regularly
Fairlie	Fairlie Burn	Footbridge and Wall at shore	Low soffit/tidal flow	Inspect and remove any debris regularly
Fairlie	Southannan Burn	Private access bridge, 42 Montgomerie Drive	Low soffit, construction debris from upstream of railway	Inspect and remove any debris regularly
Fairlie	Southannan Burn	Montgomerie Drive Culvert	Low soffit, kerb and channel grids	Inspect and remove any debris regularly
Fairlie	Southannan Burn	UNC.TF/20 : Montgomerie Drive Culvert	Low Soffit	Inspect and remove any debris regularly
Fairlie	Southannan Burn	UNC.TF/10 : Station Road Culvert	Low soffit	Inspect and remove any debris regularly
Fairlie	Un-named Burn	Culvert at rear of Keppensburn Avenue	Culvert entrance	Inspect and clear any debris at culvert entrance

GENERAL LOCATION	WATERCOURSE	IDENTIFIED PROBLEM LOCATION	IDENTIFIED PROBLEM	MEASURES REQUIRED
Stevenston	Un-named Burn	Culverted section under Ashgrove Road and through field	Blocked trash screen at inlet	Inspect and remove debris regularly
Stevenston	Quarrel Burn	A78 250 : Stevenston Bridge	Rubbish dumping	Inspect and clear rubbish regularly
Stevenston	Stevenston Burn	A738/30 : Stevenston Burn Covering	Screen arrangement	New trash screen with tighter bar spacing and split level platforms Debris below culvert to be removed
Stevenston	Stevenston Burn	D/s of Stevenston Burn Covering to footbridge	Siltation/vegetation	Remove siltation and vegetation, mainly left hand side
Stevenston	Stevenston Burn	Footbridge to Cemetery Footbridge	Siltation/vegetation	Inspect and clear rubbish regularly
Stevenston	Stevenston Burn	D/s of Cemetery Footbridge	Rubbish dumping/vegetation	Remove vegetation and rubbish regularly
Stevenston	Stevenston Burn	C7 (57) /10 : Stevenston Burn Culvert, Moorpark Road West	Culvert entrance	Inspect and remove debris regularly.
Stevenston	Un-named Burn	Various locations although mainly rear gardens in Morrison Drive	Silting, poor gradients and collapses in old masonry sections of culvert	On-going inspection, jetting and repair programme of culverted watercourse running from Halkhill Cemetery to Stevenston Burn

GENERAL LOCATION	WATERCOURSE	IDENTIFIED PROBLEM LOCATION	IDENTIFIED PROBLEM	MEASURES REQUIRED
Lugton	Lugton Water	A736/90 : Lugton Inn Bridge	Flooding of house on right hand bank	Clear and widen channel d/s
Gateside	Powgree Burn	Private Bridge to Bogg Hall	Risk of flooding to property	Clear entrance to culvert regularly Heavy vegetation requires cleaning out
Gateside	Powgree Burn	B777/20 : Gateside Bridge	Scour of bank	Inspect and repair if necessary Heavy vegation u/s of bridge requires clearing out
Gateside	Powgree Burn	U9/10 : Bogside Bridge	Heavy vegetation	Inspect and clear any debris regularly Heavy vegetation causing islands in middle of burn, requires cleaning out
Gateside	Powgree Burn	C19/21 : Culvert adjacent to BR Bridge	Siltation and vegetation in channel, u/s and d/s	Remove siltation and vegetation
Longbar	Powgree Burn	UNC.NH/30 : Auchengree Bridge	Risk of flooding to property u/s	Inspect and clear any debris at bridge face regularly Build up of stone requires cleaning out
Barmill	Dusk Water	B706/50 : Giffenmill Bridge	Low soffit	Inspect and clear any debris at bridge face
Barmill	Un-named Burn	Rear and side of 7 Beith Road	Culvert system between field and ditches along Beith Road	Inspect and clear blockages when necessary
Beith	Culverted watercourses		To be assessed	CCTV surveys
Kilbirnie	River Garnock	Lynn Drive	Part demolished weir	
Kilbirnie	River Garnock	Former Dyeworks and Bakery site (now cleared)	Erosion of riverbank and temporary ground level restoration works	Inspection of riverbanks, remaining training walls and temporary embankments
Kilbirnie	River Garnock	C78/10 : Holmhead Bridge	Low soffit level/risk of flooding to property u/s	Inspect and clear any debris regularly
Kilbirnie	River Garnock	B777/40 : Kirkland Bridge	Low soffit level/risk of flooding to property u/s	Inspect and clear any debris regularly
Kilbirnie	Un-named Burn	U/s of U8/10 : Culvert at Balgray Cottage	Culvert entrance	High vegetation, not causing concern at present
Kilbirnie	Pundeavon Burn	Footbridge at Safeway	Risk of blockage by debris	Inspect and clear debris regularly Debris to be removed
Kilbirnie	Pundeavon Burn	UNC.NM/10 : Milton, Townhead Bridge	Risk of blockage by debris	Inspect and clear debris regularly
Hessilhead Town	Dusk Water	U/s of UNC.NH/10 : Hessilhead Branch	To be assessed	
Glengarnock	River Garnock	UNC.XG/210 : Footbridge No.1 Balgray Road	Heavy vegetation	Regular channel maintenance Non-return valves required on outfalls
Glengarnock	River Garnock	UNC.XG/220 : Footbridge No.2 Holmes Road	Heavy vegetation	Regular channel maintenance Non-return valves required on outfalls
Glengarnock	Mill Lade	Channel u/s of Knoxville Road	Culvert screen	Inspect and clear any debris regularly
Glengarnock	Powgree Burn	UNC.TG/220 : Glengarnock, Kersland Road Bridge	Blockage of twin culverts, risk of flooding to properties u/s	Inspect and clear debris regularly

GENERAL LOCATION	WATERCOURSE	IDENTIFIED PROBLEM LOCATION	IDENTIFIED PROBLEM	MEASURES REQUIRED
Dalry	Rye Water	B780/40 : Rye Bridge	Poor state of banks	Inspect banks
Dalry	Rye Water	Pipe Bridge	Debris collection at pipe/risk of flooding to adjacent properties	Inspect and clear debris regularly
Dalry	Rye Water	Drakemyre Bridge	Heavy surrounding vegetation and overhanging trees	Inspect and remove vegetation Trim trees when necessary
Dalry	Putyan Burn	UNC.TD/30 : West Park Wind	Trash screen	Inspect and clear debris regularly
Dalry	Putyan Burn	B780/30 : Burnhouse Bridge	Low soffit Siltation of bed	Inspect and clear debris regularly Remove silt
Dalry	Putyan Burn	Putyan Road	Poor state of gabions Siltation of bed	Remove silt
Dalry	Putyan Burn	UNC.TD/20 : Shaw Place	Low soffit Siltation of bed	Inspect and clear debris regularly Remove silt
Dalry	Putyan Burn	UNC.TD/10 : St. Margaret's Avenue	Low soffit siltation of bed	Inspect and clear debris regularly Remove silt
Dalry	Putyan Burn	A737 90 : Putyan Bridge	Low soffit Siltation of bed Narrowing of watercourse	Inspect and clear debris regularly Remove silt Trim banks
Dalry	Un-named Burn	Rear of Netherlee Crescent	Trash screen	Inspect and clear trash screen regularly
Dalry	Un-named burn	36 Pedan Av	Siltation of bed	Remove silt Investigate culvert
Dalry	Caaf Water	A737/90 : Caaf bridge	Gate d/s of bridge	
Dalry	Pitcorn Burn	B780/50 : Burnside Bridge	Siltation of bed of watercourse under bridge Collapse of 'kerb' training wall d/s LHS of bridge	Inspect and remove silt when required
Kilwinning	River Garnock	A737/60 : Garnock Bridge	Debris collection at central pier	Inspect and remove debris regularly
Kilwinning	Bannoch Burn	UNC.TK/480 : Bannoch Burn Culvert behind houses in Redstone Avenue	Blocked screen, Collapsed walls	Inspect and remove debris regularly Rebuild walls and check trash screen design
Kilwinning	Bannoch Burn	Fergushill Road	Culvert entrance/risk of flooding to adjacent properties	Inspect and clear debris regularly Remove coping stones from bed of burn
Kilwinning	Wood Burn	Culvert under A737	Culvert entrance/risk of flooding to adjacent properties	Inspect and clear debris regularly Construct new headwall and trash screen
Kilwinning	Wood Burn	The Meadows	Open Channel and footbridge	Inspect and clear debris regularly
Kilwinning	Un-named Burn	Open channel section in McCluckie Drive	Litter blocking trash screen	Inspect and remove litter regularly
Kilwinning	Un-named Burn	Footpath and gardens of properties in McLuckie Drive	Culverted watercourse	Investigation culvert and cleanse if necessary.
Dalgarven	Un-named Burn	Between U55/10 : Burnside Culvert and A737	Culvert entrances	Inspect and clear debris regularly

GENERAL LOCATION	WATERCOURSE	IDENTIFIED PROBLEM LOCATION	IDENTIFIED PROBLEM	MEASURES REQUIRED
Auchentiber	Un-named Burn	Between A736/52 : Auchentiber Bridge and Auchentiber Farm Bridge	To be assessed	
Irvine	Annick Water	Immediate confines of watercourse		Inspect condition of existing flood defences
Irvine	Annick Water	Perceon Bridge	Potential blockage	Inspect and clear as necessary
Irvine	River Irvine	Immediate confines of watercourse	Flooding at Waterside in particular	Remedial works required to training walls supporting flood embankment at Waterside
Irvine	River Irvine	Piers of Northern Approach Road, River Irvine Bridge	Flooding at Waterside	Remove debris from piers regularly
Irvine	Red Burn	Open watercourse between Littlestone Road and Long Drive	Siltation of channel	Inspect and clear as necessary
Irvine	Red Burn	UNC.TK/470 : Culvert at Watercut Road	Culvert entrance and siltation of channel u/s	Inspect and clear channel regularly
Irvine	Red Burn	A78 310 C61 : Dykehead Culvert	Blocked screen	Inspect and clear screen regularly
Irvine	Red Burn	A737/45 : Redburn Culvert under Volvo Roundabout	Culvert entrance	Inspect and clear debris regularly heavy vegetation growth and tree across burn holding back water through culvert behind Redburn Hotel
Irvine	Red Burn	Culvert behind Fairways development	Culvert entrance and siltation of culvert	Inspect open channel upstream and remove debris when necessary. Remove silt from culvert if bed of open channel downstream can be lowered sufficiently.
Irvine	Red burn	A737/40 : Redburn Culvert	Culvert exit and downstream under numerous culverts serving private properties	Inspect regularly for clear flow and inform residents to clear their own sections
Irvine	Gailes Burn	Gateside area	Flat grade of burn, pipe under railway upstream of burn very badly silted	Inspect regularly and clear silt
Shewalton	Dundonald Burn	C9/10 : Shewalton Bridge	Low soffit of bridge and vegetation growth u/s and d/s, risk of flooding to commercial properties	Inspect and clear debris regularly

GENERAL LOCATION	WATERCOURSE	AREA AT RISK	CRITICAL SCENARIO	LEVEL OF RISK	MEASURES REQUIRED
Brodick	Cloy Burn	Upstream of A841 Cloy Bridge	Overhanging and dead vegetation, waterbourne debris from further upstream, gravel and silt banks, blockage at bridge	High	Further assessment of upland areas, removal of dead and overhanging branches, removal of gravel and silt banks, inspect bridge regularly
	Un-named Burn	Culvert at Post Office	Trash screen	High	Clear trash screen regularly
	Cnocan Burn Tributary	Gardeners Cottage and Cladach Sawmill	Blockage of culverts causing water to overtop banks.	Low	
	Glenrosa Water	Glenrosa Campsite	Situated on low lying flood plain, prone to flooding during wet weather	High	
	Glenshurig Burn	Millhouse	Large event causing burn to overtop its left-hand bank	Low	
	Glencloy Water	Auchrannie Road, Glen Road and Glen Place, and the A841.	Blockage of Cloy Bridge causing watercourse to overtop the left-hand bank.	High	
	Knowe Road Watercourse	Properties along north-western side of Knowe Road	Blockage of culvert causing water to run along Knowe Water and through properties to Glencloy Water	Low	
	Heathfield Road Watercourse	The Rustics and the Sports Club	Blockage of culverts causing the watercourse to overtop its banks	Low	
	Mayish Road Watercourse	Genista and adjacent properties.	Overtopping of right-hand bank along ditch around field at top of Mayish Road	Low	
	Brathwic Place Watercourse	15a Alma Park, Alma Park properties backing onto watercourse	Overtopping of left-hand bank due to blocked culverts or large events	Low	
Corrie	High Corrie Burn	End property of High Corrie Terrace	Overtopping of right-hand bank between culverts, due to either high flows or backing up due to culvert blockage.	Low	Inspect culverts and open channels regularly and clear gravel and waterbourne debris
	Tyn Angorfa Watercourse	Tyn Angorfa	Overtopping of right-hand bank due to high flow events.	Low	
	Rock Cottage Watercourse	Rock Cottage	Blockage to culverts and overland flows	Medium	
	March of Achadh Burn	Property on right-hand bank	Overtopping of right-hand bank upstream of culvert due to high flows.	Low	
Sannox	Sannox Burn	Right-hand bank property	At lower level than the A841, but only at risk if the bridge became completely blocked	Low	
	Sannox Burn	Golf Club	If the bridge became blocked and water either overtopped the left-hand bank or flowed down the driveway	Low	

GENERAL LOCATION	WATERCOURSE	AREA AT RISK	CRITICAL SCENARIO	LEVEL OF RISK	MEASURES REQUIRED
Whiting Bay	Kingscross Burn	Property on left bank	Development on low lying land	Medium	
	Kingscross Burn	Fen Place	Development on low lying land	Low	
	Knockenkelly Burn	Sandbraes Holiday Park	Static caravans on low lying land	Medium	
	Knockenkelly Burn	Sandbraes Villa & Lodge	Flows overtopping A841 entering driveway	Low	
Lochranza	Chalmadale Water	Property opposite Apple Lodge	Overtopping of left-hand bank; property is close to edge of watercourse on the outside of a bend	Medium	
	Newton Road	Properties on northern side	Floodplain flows during high flow events	High	
	Distillery Watercourse	Distillery	Overtopping of left-hand bank due to backing up behind blockage at Ballarie Bridge	Low	
	Millhill Watercourse	Field Studies Centre	Overtopping of channel alongside A841, due to blockage of enclosed sections or high flows	Medium	
	Millhill Watercourse	Larkspur and adjacent properties	Overtopping of right-hand bank in-between culverts due to high flow events or blockages at culvert	Medium	
	Achadh an Teampuill Watercourse	Ladeside	Blockage of A841 culvert causing overtopping of right-hand bank	Low	
	Achadh an Teampuill Watercourse	Field Studies Centre	Overtopping of right-hand bank during high river flows	Low	
Catacol	Abhainn Bheag	There are no properties in the Catacol area which are likely to be at risk of flooding from the watercourse assessed, Abhainn Bheag. The main residential area of Catacol does not have any watercourses running through or close to it			
Pirmill	Allt Gobhlach	Mill Cottage and Post Office	Overtopping of right-hand bank and water running down the access track.	Low	
	Penrioch Watercourse	Right bank property	Blockage of A841 culvert causing overtopping of right-hand bank.	Low	
	Braerioch Watercourse	Braerioch and Dunmaghlas	Overtopping of right-hand bank and water running down slope in-between properties.	Low	
Dougarie	Lorsa Water Auchencar Burn	The two areas assessed, Dougarie Lodge and Auchencar, are not likely to be at risk of flooding from Lorsa Water or Auchencar Burn.			
Machrie	All	There are no areas within Machrie that are likely to be at risk of flooding from any of the three watercourses assessed.			

GENERAL LOCATION	WATERCOURSE	AREA AT RISK	CRITICAL SCENARIO	LEVEL OF RISK	MEASURES REQUIRED
Blackwater-foot	Black Water	Harbour Shop	Water backing up and spilling over the right bank	Low	
	Black Water	Donald L. Galbraith Butchers	Water backing up and spilling over the right bank	Medium	
	Allt Gille Ghagaich	Garage of Westholme Cottage	Backing up from the A841 road culvert	Low	
	Allt Eoin	Laggian	Water overtopping right bank upstream of meander and spilling into back of property	Low	
Shiskine	Black Water	Silver Brae & Allt Beag	Overtopping of left bank	Low	
	Allt na Glaic	Silver Brae & Allt Beag	Overtopping of right bank	Low	
	Allt na Glaic	The Lade & adjacent property	Water flowing down access track due to overland flow at the Lade Culvert	Medium	
	Millbank Cottage Watercourse	Ladeside Terrace property.	Lowest point in right bank coinciding with entry to pipe culvert	Low	
Corriecravie	All	To be assessed			
Lagg	Torrylinn Water	Kilmory House and left bank property downstream of Lagg Bridge	Overtopping of left bank	Medium	
Kidonan	Allt na Ceardaich	Left bank property	Overtopping of left bank	Low	
	Kildonan Hotel Watercourse	BT Building and right bank properties	Flood flows overtopping road	Low	
	Kildonan House Watercourse	Kildonan Cottage	Overtopping of right bank	Low	
Whiting Bay	Kingscross Burn	Property on left bank	Development on low lying land	Medium	
	Kingscross Burn	Fen Place	Development on low lying land	Low	
	Knockenkelly Burn	Sandbraes Holiday Park	Static caravans on low lying land	Medium	
	Knockenkelly Burn	Sandbraes Villa & Lodge	Flows overtopping A841 entering driveway	Low	
	Allt Ceirde	Garden centre	Flows overtopping A841 flowing along A841	Low	
	North Kiscadale Road Watercourse	Joshua's Café Bar Bistro	Flows overtopping A841	Low	
	Glenashdale Burn	Montrose Terrace and properties upstream	Development on low lying land	Medium	
	Un-named burn	Culvert at Kiscadale Hotel	Blocked/undersized culvert		

GENERAL LOCATION	WATERCOURSE	AREA AT RISK	CRITICAL SCENARIO	LEVEL OF RISK	MEASURES REQUIRED
Lamlash	Monamore Burn	Waterside development	Eroding riverbanks, bankside trees	Medium	Removal of gravel and silt banks, undercut, dead and overhanging trees.
	Benlister Burn	Waterside development	Eroding riverbanks, bankside trees, informal low farm bridges	Medium	Removal of gravel and silt banks, undercut, dead and overhanging trees. Owners of informal bridges to be contacted with regard to their either being removed or requesting a more permanent solution which alleviates this problem.
	Altachorvie Road Watercourse	Dalruadh	Flood flows overtopping the right bank and flowing through property	Low	
	Bayview Cottage Watercourse	Glenisle Hotel	Overtopping from Glenisle Hotel Culvert	Medium	
	Bayview Cottage Watercourse	Glenisle Hotel and Bayview Cottage	Overtopping of the A841 Culvert	Medium	
	Aldersyde Corner Watercourse	Thomson Garage	Flood flows within access road	Low	
	Aldersyde Corner Watercourse	Aldersyde Hotel and Ship House	Out of channel flows ponding in low point	Medium	
Aldersyde Corner Watercourse	Glenisle Hotel	Out of channel flows ponding in low point	Low		
Millport	Un-named burns	To be assessed			
	Un-named burn	Kames St, Balloch Crescent Ferry Road area	Blockages in culverts	High	Investigate culvert system and provide new headwall, trash screen and improved channel into headwall
	Mill Burn	Crawford Street	Blocked/collapsing culvert	Medium	Investigate culvert with a view to renewing

APPENDIX B
FLOOD PREVENTION AND LAND DRAINAGE (SCOTLAND) ACT 1997
MAINTENANCE MEASURES TAKEN

GENERAL LOCATION	WATERCOURSE	IDENTIFIED PROBLEM LOCATION	MEASURES TAKEN
Skelmorlie	All	Various	Ongoing, including 10/12/08 Various culverts and trash screens throughout Skelmorlie jetted and cleared, on going maintenance work until full assessment can be carried out
Skelmorlie	Un-named Burn	C118 Meigle near Burnfoot Cottage	-/03/08 Excavate, locate and clear blockage in culverted watercourse
Skelmorlie	Un-named Burn	Culvert below Eglinton Terrace	-/02/09 Remove debris and silt from sump at trash screen 16/05/09 High pressure water jetting of twin culvert
Largs	Kil Burn	Brisbane Glen Road, east side opposite Raillies Ave	Ongoing, including 17/01/08
Largs	Un-named Burn	Brisbane Glen road, east side and various locations in housing estate to west	15/01/08 Clear ditch
Largs	Un-named Burn	Culvert from Raillies Cottage to Noddsdale Water	06/09/08, 09/10/08, 19/11/08, -/04/09, 30/07/09, 26/08/09 Clear trash screen at Raillies Cottage
Largs	Un-named Burn	Culvert under Routenburn Road and through Kelvin Walk Estate	26/10/06 Clear trash screen upstream of culvert system
Largs	Noddsdale Water	Noddsdale Meadow Bridge	14/07/09 Clear debris and silt from overflow culverts 03/09/09 Removal of tree from watercourse upstream of bridge
Largs	Gogo Burn	A78 Gogo Bridge	29/07/08 Remove fallen tree from watercourse rear of 64-66 Waterside Street.
Largs	Moor Burn	Glenacre Gardens	-/09 Re-build masonry training wall
Largs	Moor Burn	Trash Screen at Alexander Avenue	? Repair vandalized trash screen 18/11/09 Clear trash screen
Largs	Un-named Burn	Routenburn Road	-/09 Headwall improvements
Largs	Un-named Burn	Culvert under 2 Meadowbank Road	05 & 06/11/08, 28/11/08, 30/07/09, 26/08/09, 15/09/09, 18/11/09 High pressure water jetting to clean out culverted watercourse 03/12/08 Clear blockage and repair pipe, construct access chamber
Fairlie	Keppen Burn	Culvert under A78	Trash screen cleared as necessary (trunk road operator)
Fairlie	Un-named Burn	Culvert behind Keppernburn Avenue	Ongoing, including 17/01/08, 19/11/08, -/04/09, 30/07/09, 26/08/09 Clear trash screen
Fairlie	Un-named Burn	Culvert under Castlepark Gardens	-/04/08 CCTV survey of culvert
West Kilbride	Kilbride Burn	Springside Nursery	03/09/09 Construct manhole chamber and cover on culvert opposite Springside Nursery
West Kilbride	Un-named Burn	Culvert under C26?	18/08/08 Clear blockage from mouth of culvert, repair eroded upstream headwall. -/11/08 Repair upstream pipe, construct headwall, install trash screen, renew d/s half of culvert.

GENERAL LOCATION	WATERCOURSE	IDENTIFIED PROBLEM LOCATION	MEASURES TAKEN
Ardrossan	Un-named Burn	Culvert below A78, gardens of properties in Eglinton Road and North Crescent	21/07/08 Replace corroded trash screen at Seafield School, further investigate and clear blocked manhole and construct manhole over culvert 16/04/08 Excavate and locate buried culvert outfall, reinstate channel to sea 09/05/08 Clear blockage in pipe opposite 25 North Crescent using high pressure water jetting. 01/07/08 Clear blockage in culvert within 25 North Crescent using high pressure water jetting. 01-02/07/08 Provide manhole frame and cover over access chamber at 25 North Crescent
Ardrossan	Montfode Burn	Rear of Millglen Caravan Park	22/12/08, -/08/09 Remove silt and debris from burn
Saltcoats	Un-named Burn	Culvert under Burns Avenue	10/09/08, 23/10/08, -/04/09, 26/08/09 Clear trash screen, Knock Jargon Court/Moffat Wynd -/10/09 Repair headwall
Saltcoats	Un-named Burn	Open watercourse rear of Moffat Wynd	-/09/09 Remove vegetation, clear vegetation and remove silt from watercourse
Saltcoats	Un-named Burn	Rear of Auchenshangan Drive	05/12/08, 24/08/09 Clear silt from field ditches and divert back into existing watercourse.
Stevenston	Stevenston Burn	Upstream of Moorpark Road West	17 & 21/01/08 Clear trees from watercourse -/01/09 Remove silt from culvert entrance
Stevenston	Stevenston Burn	B780/70: Stevenston Burn Culvert	29/06/09 Clear debris from watercourse below upstream end of culvert, cut down tree growing out of training wall upstream of culvert
Stevenston	Stevenston Burn	Upstream of Stevenston Cross	30/06/09 Clear debris and remove tree from watercourse
Stevenston	Stevenston Burn	Rear of Canal Crescent	-/09/09 Remove vegetation from training wall
Stevenston	Un-named Burn	Between Halkhill Cemetery and Stevenston Burn	08/01/09 locate and inspect manholes on culverted watercourse to rear of Morrison Avenue 18 & 19/03/09, 04/06/09, 05/06/09, 08/06/09 CCTV survey plus high pressure waterjetting to clear blockages -/06/09 Repairs to masonry culvert at Millhill Road
Stevenston	Master Gott	Canal Crescent	-/03/09 Provide new manhole frame and cover to access chamber on culverted watercourse
Beith	Culverted watercourses		Culverts and trash screens throughout Beith jetted and cleared as necessary, on going maintenance work until full assessment can be carried out.
Kilbirnie	Mill Lade	Open channel sections at Mill Road and Paddockholm	28/08/09 Clear trash screen upstream of Paddockholm Road Culvert 14/09/09 Clear lade within housing development
Kilbirnie	Un-named Burn	Baillieston Farm	05/11/09 Clear blocked culvert 10/11/09 Investigation of collapsed culvert 12/11/09 Repairs to culvert 17/11/09 CCTV survey of culvert 18/11/09 High pressure water jetting to clear blockage

GENERAL LOCATION	WATERCOURSE	IDENTIFIED PROBLEM LOCATION	MEASURES TAKEN
Kilbirnie	River Garnock	Kirkland Bridge	5-7/02/09 Remove gravel from below bridge
Kilbirnie	River Garnock	Disused Bakery and Dyeworks site at Muirend Street	01 & 02/08/08 Emergency armour rock protection to riverbank immediately following flood of 01/08/08. 15/12/08 Strengthening of riverbank and restoration of ground levels as a result of the flood of 01/08/08. 15-16/12/08 Removal of trees and debris from watercourse
Kilbirnie	River Garnock	Maybole Bridge	05/08/08 Remove debris from below bridge and downstream of bridge following flood of 1/8/08
Gateside	Powgree Burn	C19/21 : Culvert adjacent to BR Bridge	-/02/08 Clear out feeder ditch, clear out tree braches from culvert
Glengarnock	River Garnock	B777 training wall opposite South Road	09/07/09 Remove trash screen and silt build up at non-return valve, refit trash screen
Glengarnock	Powgree Burn	Twin culverts under Kerstrand Road	11/08/08 Clear fallen trees and logs from upstream of culverts
Barmill	Dusk Water	B707, Giffenmill Bridge	-/-/08 Clear out debris in watercourse below bridge
Barmill	Un-named Burn	Rear of 7 Beith Road	-/08/08 Investigate culverted watercourse system using CCTV survey, clear outfalls and blockages in pipes under C5 and B706 Beith Road
Dalry	Putyan Burn	Culvert at West Park Wynd	16/05/08, 10/07/08, 10/09/08, 15/10/08, 23/10/08, 19/11/08, -/04/09, 30/07/09, 26/08/09, -/09/09 Removal of debris from trash screen -/06/09+ Repair trash screen
Dalry	Un-named Burn	Culvert at Peden Avenue	23/10/08, 19/11/08, -/01/09, -/04/09, 30/07/09, -/08/09 Removal of debris from trash screen
Dalry	Rye Water	Drakemyres	22/08/09 Remove tree from watercourse
Kilwinning	Bannoch Burn	UNC.TK/480 : Bannoch Burn Culvert behind houses on Redstone Avenue	10/07/08, 28/10/09, 19/11/09, -/04/09, 30/07/09, 26/08/09 Removal of debris from trash screen
Kilwinning	Penny Burn	Culvert opposite Fire station, Stevenston Road	1/10/08, 19/11/08, -/04/09, 30/07/09, 26/08/09, 28/10/09, 19/11/09 Clear debris from trash screen
Kilwinning	Annick Water	Sevenacres Mill	10/11/09 Clear trees and debris from watercourse
Kilwinning	Wood Burn	A737 Culvert	
Kilwinning	Un-named Burn	Culvert at Priory Wynd	-/01/09, -/04/09, 28/10/09 Remove debris from trash screen
Kilwinning	Un-named Burn	Twin culverts below A737 trunk road	05/06/09 CCTV survey of culvert under A737 trunk road, blockage cleared by Amey Highways

GENERAL LOCATION	WATERCOURSE	IDENTIFIED PROBLEM LOCATION	MEASURES TAKEN
Dreghorn	Annick Water	Dreghorn Bridge	19/05/08 Remove tree and debris from pier of bridge
Dreghorn	River Irvine	Holmsford Bridge	6/08/08 Remove tree from pier of bridge
Irvine	River Irvine	Shopping mall bridge to Waterside	16/10/08 Clear gullies and check operation of non-return valves at Waterside
Irvine	River Irvine	Piers of Northern Approach Road, River Irvine Bridge	31/10/09, 09/11/09 Clear debris from bridge pier and penstock gates at weir
Irvine	Red Burn	Open watercourse between Littlestane Road and Long Drive	? Remove silt from watercourse
Irvine	Red Burn	Castlepark Estate	? Remove manhole cover from culvert manhole
Arran, General Areas			As required, trash screens cleared, ditches cleaned by island squads
Lochranza	Mill Lade, un-named lade and minor watercourses	Ladeside area including A841, Main Road and Newton Road	As required, ditches cleaned by island squads
Lamlash	Corrie	High Corrie Burn	03/04/09, 08/04/09 Clear woody debris and loose masonry from burn following flooding incident As required Clear debris from below culvert and watercourse

APPENDIX C
FLOOD PREVENTION AND LAND DRAINAGE (SCOTLAND) ACT 1997
INCIDENCES OF RIVERINE FLOODING OF NON-AGRICULTURAL LAND
SINCE NOVEMBER 2007

GENERAL LOCATION	WATERCOURSE	INCIDENCES OF FLOODING SINCE NOVEMBER 2007
Largs	Un-named Burn	Various dates Blockage in culverted watercourse in rear garden of 2 Meadowbank Road causing manhole to surcharge and floodwater to run through garden and along edge of house. Floodwater did not enter house.
Saltcoats	Un-named Burn	Various dates Water from field ditches/drainage not reaching watercourse and flowing overground into rear gardens of Auchanshangan Drive. Floodwater does not enter houses.
Kilbirnie	River Garnock	01/08/08: Refer to Section 12 for details
Barmill	Un-named Burn	01/08/08 and 6 months previously Blockage in culverted watercourse system under the C5 and B706 Beith Road at junction, resulting in field flooding and then overflowing into rear gardens of properties in Beith Road and entering house at 7 Beith Road
Dalgarven	Un-named Burn	7/10/08 : Heavy rain One of the twin culverts below A737 trunk road became blocked with water-bourne debris causing burn to overflow and floodwater to enter 1 Burnside Cottage
Corrie	Un-named Burn	26/03/09 : Heavy rain Watercourse at back of disused quarry surcharged and overflowed culvert which had become blocked with debris, floodwater then flowed into back garden of 8 Corrie Terrace 1 Hillfoot Place then across road. Floodwater did not enter houses, however garage of 1 Hillfoot Place was flooded. 27/03/09 : Heavy rain. Watercourse at back of disused quarry surcharged and overflowed culvert which was still blocked with debris, floodwater then flowed into back gardens of 7 & 8 Corrie Terrace and across road.

The flooding incidents listed in the preceding tables are only those which Infrastructure and Design Services, Roads have so far been able to investigate in some detail since reports received during periods of flooding are by nature short in detail due to the requirement to respond as soon as possible. Many other locations in North Ayrshire have suffered flooding due to blocked gullies, ditches and culverts over the last 2 years since the previous report. The following is a list of dates and general locations for which flooding was reported to the Service.

Date	Locations
07/12/07	Beith
09/01/08	Irvine, Ardrossan, Stevenston, Largs, Kilwinning, Saltcoats
10/01/08	Irvine, Dreghorn, Saltcoats, Ardrossan, Dalry, Stevenston, Kilwinning, Largs
11/01/08	Kilwinning
14/01/08	Saltcoats, Largs, Kilbirnie, Irvine, Skelmorlie, Dreghorn, Stevenston, Kilwinning
17/01/09	Irvine, Kilwinning, Saltcoats, Ardrossan, Glengarnock, Springside, Barrmill, Largs
18/01/08	Largs, Skelmorlie, Ardrossan
21/01/08	Largs, Irvine, Dreghorn, Ardrossan, Saltcoats, Springside
29/01/08	Ardrossan, Irvine
10/03/08	Largs, Skelmorlie, Springside
20/03/08	Irvine
28/05/08	Irvine, Ardrossan
03/07/08	Largs, Irvine
01/08/08	Kilbirnie , Kilwinning, Irvine
14/08/08	Saltcoats, Stevenston, Dalry, Fairlie, Springside, Irvine, Kilwinning
25/08/08	Kilbirnie
01/09/08	Irvine
07/09/08	Kilwinning, West Kilbride, Dreghorn, Irvine, Springside
10/10/08	Dalry, Stevenston, Kilwinning, Dreghorn, Irvine, Kilbirnie
23/10/08	Skelmorlie, Largs, Dalry
13/11/08	Beith, West Kilbride
18/12/08	Irvine
19/12/08	Kilwinning, Irvine, Saltcoats, Beith, Ardrossan
19/01/09	Beith
26/03/09	Kilwinning
01/05/09	Saltcoats
18/06/06	Kilwinning
03/07/09	Stevenston
14/08/09	Kilwinning, Beith, Saltcoats
20/08/09	Largs, Saltcoats, Irvine, West Kilbride, Dalry, Klwinning, Ardrossan
08/09/09	Between Burnhouse and Lugton, Beith, Dalry, Irvine, Kilbirnie
27/10/09	Lamlash
19/11/09	Irvine, Kilwinning, Dalry, Portencross, Ardrossan
20/11/09	Skelmorlie, Irvine
24/10/09	Saltcoats, Ardrossan, Irvine
25/11/09	Ardrossan

APPENDIX D

INDEX OF MAJOR HYDRAULIC AND COASTAL STUDIES HELD BY NORTH AYRSHIRE COUNCIL

River Irvine Hydraulic Modelling (Model upgrade), September 2001, Bullen Consultants

Largs, Fort Street Seawall Feasibility Study, April 2001, Posford Haskoning

River Garnock and Tributaries Flood Risk Study, July 2003, Babbie Group

Kilbirnie and Glengarnock Flood Prevention: Appraisal Report, September 2005, Royal Haskoning

Red Burn Flood Risk Study: Modelling Report, August 2004, Royal Haskoning

Dundonald Burn Flood Risk Study, Summary Report, May 2005, Royal Haskoning

Irvine to Ardrossan Coastal Study, Royal Haskoning:

- Main Report, May 2005

- Ardrossan Harbour and Headland, December 2003

- North Ardrossan Local Study, July 2003

- Ardree Peninsula and Garnock and Irvine Estuaries, December 2003

- Saltcoats Bay and Harbour Feasibility, January 2005

Lamlash Flood Risk Assessment, Benlister and Monamore Burns, May 2005, Royal Haskoning

River Garnock Catchment – Flood Defence Strategy, December 2007