

Background Report

Renfrewshire Strategic Flood Risk Assessment



Renfrewshire Local Development Plan Background Report X

Renfrewshire Strategic Flood Risk Assessment 2011

[December 2011]



**Renfrewshire
Council**

Planning and Transport Service

Introduction

Flooding from rivers and water sources is a natural process that is important in shaping the environment. However the impacts of flooding can have a significant effect on individuals, communities, businesses, properties and infrastructure. A considerable number of people live and work within areas that are susceptible to flooding and ideally development should be moved away from these areas over time. It is recognised however that this is often not a practicable solution. For this reason, careful consideration must be taken of the measures that can be put in place to minimise the risk to property and life posed by flooding.

Climate change predictions suggest that the number and severity of storm events across Scotland is likely to increase and therefore a more sustainable proactive approach to tackling the risk from flooding and the causes requires to be deployed. The UK Government investigations into the potential impact from climate changes showed that flood damage in urban areas from surface water was likely to increase five fold by 2080 and that these further increases could be expected as a result of new development. The present day challenges are likely to grow considerably into the future and current approaches to flood risk management will become unsustainable. Therefore flood risk management requires to be taken into account at every stage in the planning process to reduce and ultimately avoid inappropriate development in areas at risk to flooding and direct development to areas of less risk.

When preparing a Development Plan, the probability of flooding from all sources including coastal, fluvial (water course), pluvial (surface water), groundwater, sewers and blocked culverts, etc, requires to be assessed when setting out the overall vision for the area and the direction of development.

Flood Risk Management (Scotland) Act 2009

The Flood Risk Management (Scotland) Act 2009 (the FRM Act) introduces a new approach to managing flooding by aiming to reduce the negative effects from all sources of flooding on human health, economic activity, the environment and cultural heritage.

The FRM Act promotes management of flooding in a sustainable manner by using rural and urban landscapes, green spaces and permeable areas as interventions to store and slow water where required and to protect the most potentially vulnerable areas from the effects of flooding. It also aims to improve the general understanding of flood risk so that everyone can try and implement sustainable approaches to protecting themselves from flooding.

In implementing the FRM Act it is hoped that the following outcomes are achieved:

- A reduction in the number of people, homes and property at risk of flooding as a result of public funds being invested in actions that protect the most vulnerable and those areas at greatest risk of flooding;
- The creation of rural and urban landscapes with space to store and slow down the progress of floods;
- Integrated drainage that decreases burdens on the existing sewer systems while also delivering reduced flood risk and an improved water environment
- A well informed public who understands flood risk and takes actions to protect themselves, their property or their businesses; and
- Flood management actions being undertaken that will stand the test of time which are adaptable to future changes in the climate.

The delivery of sustainable flood risk management is the responsibility of everyone, however the FRM Act places a statutory duty on Scottish Ministers, Scottish Environment Protection Agency (SEPA), Local Authorities, Scottish Water and other responsible authorities to undertake particular functions in relation to the requirements of the FRM Act. However all landowners are also responsible for protecting their land and property against flooding. They are also responsible for managing the drainage of their land so that they do not adversely impact upon adjoining properties.

In particular the primary responsibilities for local authorities are as follows:

- Contribution to the national assessment of flood risk by working in partnership with SEPA and Scottish Water to share data providing a good information exchange;
- Establishment of collaborative working by being a part of the Local Advisory Groups, stakeholder engagement and input to National Communication Strategy;
- Raising awareness of flooding issues, adaptation measures to deal with the impact of flood risk and the promotion of Strategic Flood Risk Management;
- Create a schedule of watercourse clearance and repair, to be publicly available;
- Create a map of Sustainable Urban Drainage Systems (SUDS) and watercourses;
- Create a register of Flood Prevention Schemes;
- Draft a new Flood Prevention Scheme approval process;
- Assist the Lead Authority in creation of the Local Flood Risk Management Plans (LFRMP), to achieve consistency with the National Plan;
- Review all flood risk management plans on a six yearly basis, implement measures and objectives in collaboration with responsible bodies in relation to flood risk management plans;
- Reduce Overall Flood Risk;
- Agree maintenance regimes for sustainable drainage systems in new developments; and
- Dealing with emergency flood events.

The key milestones to be implemented as a result of the FRM Act are the production of National Flood Risk Assessment that is to be undertaken by SEPA by the end of December 2011. By December 2015, a flood hazards and flood risk strategy is to be in place for Scotland and by June 2016 there is to be the production of Local Flood Risk Management Plans.

The FRM Act's aim is to provide a strategic joined up approach to managing flood risk across all boundaries, with the strategic plans setting the overall direction of flood risk management across Scotland.

The undertaking of a national flood risk assessment should create a broad-scale overview of the causes and impacts of flooding across the whole of Scotland. The assessment should identify particular areas that are considered to be Potentially Vulnerable Areas (PVAs) where further work along with targeted action and investment will be carried out to try and reduce the risk of flooding within these areas. These assessments will provide an evidence base on which to co-ordinate measures across catchments and boundaries allowing for a strategic and holistic overview as well as a direction of flood risk management in Scotland.

The Local Flood Risk Management Plans will be published by lead authorities providing a local expression of the strategic plans that are prepared by SEPA. It will be at this point that all Development Plans being produced will require to have regard to the details in the strategic and local flood risk management plans and maps.

In the intervening period, given that flooding is a matter of major importance and a high priority within Renfrewshire, primarily due to historic flood events and predicted future flood risk, it is considered good planning practice to have regard to the framework of the FRM Act and the duties placed on local authorities to successfully deliver and implement the sustainable flood risk management when producing a new Local Development Plan (LDP). This Background Paper provides a stage 1 strategic flood risk assessment to inform the Renfrewshire LDP Main Issues Report and the Strategic Environmental Assessment (SEA), Environmental Report.

Planning Context

Although the statutory context for assessing and managing flood risk is set out in the Flood Risk Management (Scotland) Act 2009, land use planning strategies and decisions are known to be one of the most powerful tools available to manage flood risk. This approach has been adopted in Scottish Planning Policy (SPP) as it highlights that planning authorities must take account of the likelihood and consequence of flooding from all sources when preparing Development Plans and determining planning applications.

SPP indicates that LDPs should:

- Identify sites or areas constrained by flood risk on the basis of the risk framework (little or no risk, low to medium risk, medium to high risk areas);
- Safeguard the flood storage and conveyancing capacity of functional flood plains;
- Indicate circumstances where a freeboard allowance should apply;
- Indicate where a drainage assessment will be required because of flood risk; and
- Indicate when water resistant materials and forms of construction will be appropriate.

National Planning Framework 2 (NPF2) also sets out the Scottish Government's commitment to an integrated approach to the management of water. This approach not only covers flood risk management but also aims to ensure that the quality of the water environment is improved. This integrated approach is to facilitate healthier ecosystems, deliver and implement improved amenity and recreational benefits and contribute to regeneration. There is a need for a greater understanding of flood risk and how to deploy more sustainable approaches to taking the risks and the principle way of doing this is through the preparation of the Development Plan.

The introduction of the Water Framework Directive (European Directive 2000/60/EC) has set out an alternative approach to the way the water environment is managed and set up a framework for the sustainable management of water resources. This sustainable framework became law in Scotland through Water Environment and Water Services (Scotland) Act 2003. The aim of implementing a system that promotes sustainable water use is to protect and improve the water environment working towards a target of 98% of all Scotland's waters to be in a good condition by 2027. To implement this framework throughout Scotland, a river basin management plan for Scotland's river basin district has been developed based on an analysis of all human impacts on water systems.

Renfrewshire is part of the Clyde Area River Basin Management Plan which also takes in the Glasgow and the Clyde Valley area, Ayrshire as well as Loch Lomond and The Trossachs National Park. The Clyde Area Management Plan supplements the river basin management plan for Scotland focusing on local actions and setting out a framework at the local level to encourage partnership working to improve the water environment.

The Glasgow and the Clyde Valley Strategic Development Plan Proposed Plan sets out a vision and objectives which aim to secure improvements to water and drainage capacity and water quality as

well as reducing flood risk in supporting long term sustainability of the Glasgow and the Clyde Valley area. This vision and the objectives have been translated into the Renfrewshire LDP Main Issues Report and form the basis of the sustainability approach used in setting out the preferred strategies in the Development Plan.

Flooding was seen as a matter of major importance in the Renfrewshire Local Plan (2006) and this was reflected in the local plan policies that aimed for an integrated approach to managing flood risk and the promotion of measures to protect against flooding. The new Renfrewshire LDP will aim to carry on the integrated approach to managing flood risk in line with the FRM Act and also to focus on water quality to work towards the target of achieving the protection and improvement in the water environment by 2027.

A Strategic Flood Risk Assessment should provide valuable baseline information to inform the appraisal of different options through the Renfrewshire Main Issues Report (MIR) and the SEA process. The vision promoted through the Renfrewshire LDP is to encourage sustainable development through the integration of social, economic and environmental considerations. Flood risk is one of many factors that influences the spatial planning process and therefore it is necessary to maintain a balance between flood risk considerations and other factors. The SEA is central to ensuring that a careful balance is achieved and there is a clear and robust evidence base upon which informed decisions can be made through the LDP.

Aims of a Strategic Flood Risk Assessment

The primary purpose of a Strategic Flood Risk Assessment (SFRA) is to determine the variation of flood risk across the area. It is for the purposes of specifically informing the development planning process in that the assessment involves collecting, analysing and presenting all of the existing information, available at that time, to provide an overview across the likelihood and consequence of flooding across the area.

It is important at this early stage in the preparation of the LDP to identify areas under pressure from future development that are at risk from flooding. The overview provided by the SFRA allows informed decisions to be made between the possible risk posed by flooding and other planning related constraints.

Strategic Flood Risk Assessment Approach

The stage 1 SFRA will present all existing and readily available flood risk information with an overall aim of providing a strategic overview of flood risk without going into too much detail as would be expected in a detailed flood risk assessment.

Robust information on flood risk is essential to inform and support the Renfrewshire's LDP preferred strategies and provide some direction for development within the area. In terms of sustainable flood management, the Renfrewshire LDP will aim to promote development in locations that avoid flood risk as this represents the most sustainable solution.

It is hoped that by the development of a SFRA that this will present a consistent approach to decision making as well as present an effective tool in the management of flood risk throughout Renfrewshire.

It should be noted that data and information on flooding and drainage is updated regularly and therefore a SFRA is an evolving document which will be updated as the LDP is prepared and develops.

Objectives

The main objectives of the SFRA are to:

- Promote flood risk avoidance in the first instance;
- Provide flood risk analysis for the Renfrewshire area;
- Identify development proposals that do not result in significant flood risk from any source and do not materially increase the probability of flooding elsewhere;
- Detail how unavoidable impacts may be mitigated and delivered without significant flood risk; and
- Provide a baseline for the SEA Environmental Report.

Data Collection & Sources

This stage 1 Strategic Flood Risk Assessment has been undertaken by using the following sources of information and data:

- Topographical maps;
- Light Detection and Ranging (LIDAR) data;
- Internally generated 1 in 200 year fluvial, pluvial and tidal hazard maps;
- Historic flood event data; and'
- Road grade data.

Flood Sources

In terms of what constitutes a flood as far as the historic records of events provided, the following definition would be appropriate:

"The temporary covering by water of land not normally covered by water from any source, other than solely from a sewer, resulting in affects on human health, the environment, cultural heritage and economic activity, or combinations thereof."

The potential sources of flooding which presents the greatest risk are fluvial, pluvial and coastal, however there are also other sources of flooding such as sewer, groundwater, reservoir and flooding from other infrastructure. The definition of these flooding sources are outline below:

- River (Fluvial) flooding – occurs when the water draining from the surrounding land exceeds the capacity of the watercourse;
- Surface water (pluvial) flooding – is caused when rainfall ponds or flows over the ground before it enters the drainage system or watercourse, or when it cannot enter the drainage system because the system is already at capacity;
- Coastal flooding – is caused by a combination of high tides and stormy conditions where the sea breaks over a sea wall or embankment;
- Sewer flooding – this occurs when combined sewers are overwhelmed by heavy rainfall. Sewer flooding is often closely linked to surface water flooding;
- Groundwater flooding – this occurs when water levels in the ground rise above surface levels;

- Reservoir flooding and flooding from other infrastructure – failure of infrastructure such as dams, could result in a large volume of water being released very quickly.¹ Although the risk posed by such a hazard is high, the frequency of this happening is low due to statutory inspection and maintenance of reservoirs.

Renfrewshire maps flood risk for three sources of flooding, pluvial, fluvial, and coastal. The estimation of flood risk involves the evaluation of the statistical probability and the scale of the potential consequences of flooding. The degree of risk is calculated from historical data and expressed in terms of the expected frequency of a flood of a given magnitude. The risk is expressed in terms of return periods to comply with Scottish Planning Policy.

The Renfrewshire Area

Renfrewshire is an area of contrast with densely urbanised towns such as Paisley and Renfrew and large expanses of rural land to the south and west. The landscape is generally low lying, however, there are a number of higher areas such as the Renfrewshire Heights. The River Clyde and its tributaries are essential to the character of the area. As the River Clyde flows west from the City of Glasgow into Renfrewshire it enters its final stages. As the river flows through Renfrewshire it widens to form the Clyde Estuary before reaching the Firth of the Clyde beyond Erskine Bridge.

The principle watercourses that flow through or around Renfrewshire are the River Clyde, River Cart and the River Gryffe these are shown spatially on the map below (Figure 1), all watercourses within Renfrewshire are shown on the map contained in Appendix 1.

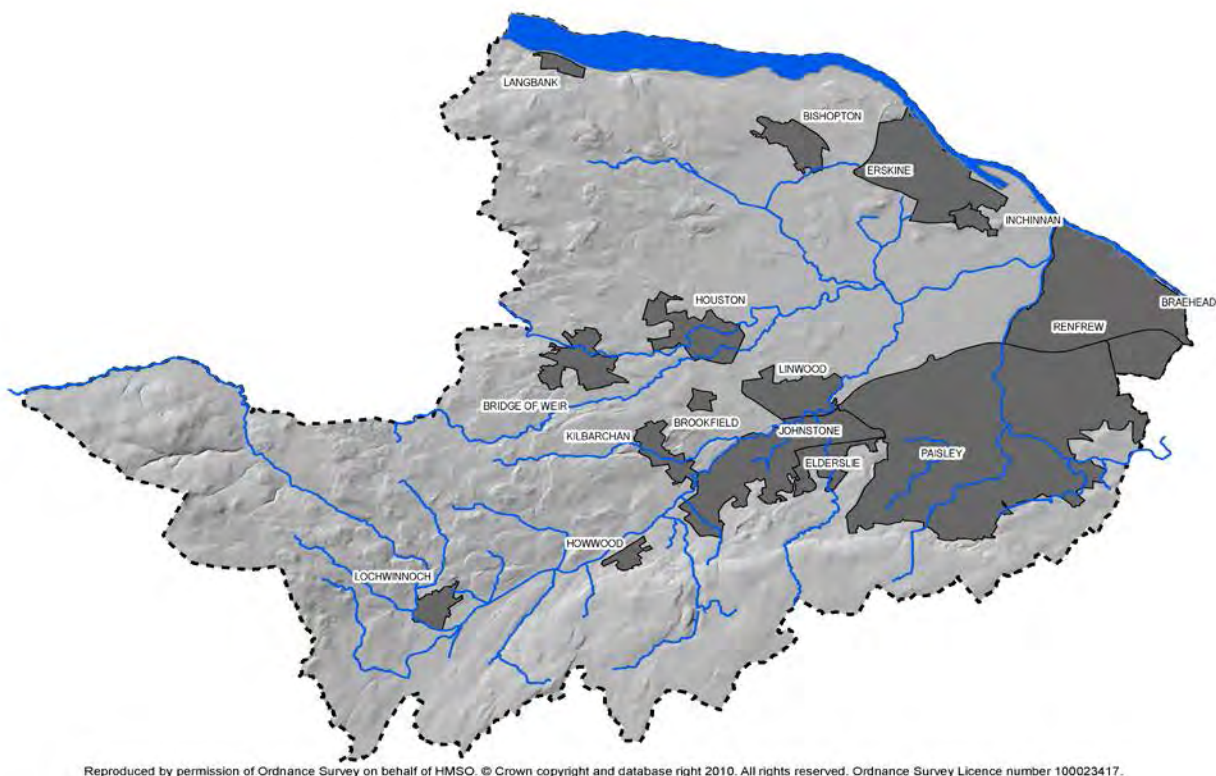


Figure 1: Renfrewshire’s principle watercourses.

¹ Flood Risk Management (Scotland) Act 2009: Delivering Sustainable Flood Risk Management, The Scottish Government (June 2011)

Average rainfall within Renfrewshire has generally increased over the last 125 years. Figure 2 details the total annual rainfall in Paisley during the last 20 years. This graph demonstrates a recent slight downwards trend, however, it should be noted that rainfall amounts have been variable during this period, ranging between 1424mm and 842mm per year. Total rainfall was recorded as 1240mm in 2009.

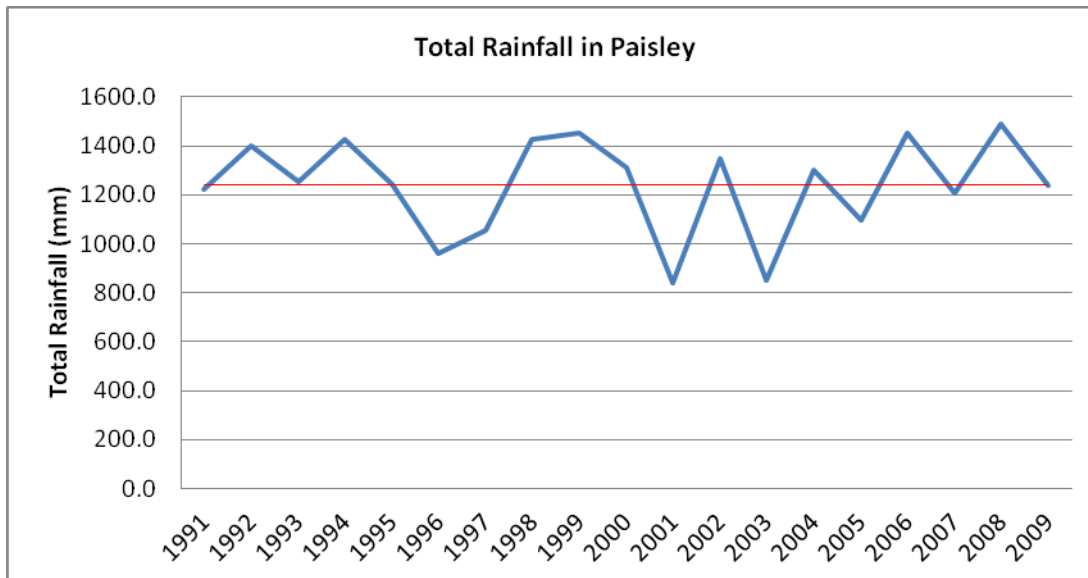


Figure 2: Changes in rainfall amounts within Paisley
(Creating using data provided by Coats Observatory, Paisley)

While rainfall is an important factor in river flow rates it should be noted that river flows are the combined result of the many climatological and geographical factors which interact within a drainage basin.

Figure 3 outlines the number of ground floor properties that are at risk of flooding within Renfrewshire. Ground floor properties are outlined to solely address direct flooding effects and costs. It identifies that there are 13,610 ground floor properties (14.7%) in Renfrewshire identified through the 1/200 year flood risk mapping that are at risk of flooding. Of the 13,610 ground floor properties that are at risk, 94% are at risk of pluvial flooding. This is flooding from rainfall generated overland flow before the runoff enters any watercourse or sewer. It is usually associated with summer thunderstorms or high intensity rainfall within longer duration events. There are 1,930 ground floor properties in Renfrewshire at risk of fluvial flooding, this equates to 2.2% of the total property in Renfrewshire. The risk of coastal flooding is less widespread with 252 ground floor properties identified within the 1/200 year coastal flooding area.

| | Pluvial | Fluvial | Coastal | Total* |
|--|--------------|-------------|------------|--------------|
| Commercial / Industrial | 1304 | 349 | 66 | 1503 |
| Residential | 11508 | 1581 | 185 | 12107 |
| Total | 12812 | 1930 | 251 | 13610 |
| *Total number of properties is less than sum of flood zones due to some properties at risk from multiple flood sources. | | | | |

Figure 3: Properties at risk from flooding within Renfrewshire

Historical Flood Events

A considerable amount of knowledge exists with respect to flood risk within Renfrewshire including information relating to both historical flooding and the predicted extent of flooding under extreme weather conditions. This information has been used to provide a robust and transparent evidence base for promoting development in certain areas and prevent development in other areas.

Properties and infrastructure are at risk of flooding from a range of sources not only tidal and rivers but also surface water flooding, surcharging of the existing sewer system and blockages of culverts and gullies. Evidence of localised flooding of this nature has also been recorded and mapped to ensure there is a complete overview for Renfrewshire.

Major flooding has taken place in Paisley, Johnstone and Houston in the recent past and the north of Renfrew has been subject to regular flooding from the River Clyde. Renfrewshire experienced major flood events in 1994, 1999 and more recently in December 2006. Flood events in Renfrewshire are typically characterised by a complex interaction between intense rainfall events, watercourses exceeding peak flow capacities, surface water run-off from developed areas and a lack of capacity in the sewerage system and the tidal influence of the Clyde.

The key flooding issue in the urban area within Renfrewshire, as seen in December 2006, relates to the lack of capacity in the sewerage system and local watercourses which is exacerbated by overland flow, where water becomes concentrated and flows across land after heavy or persistent rainfall.

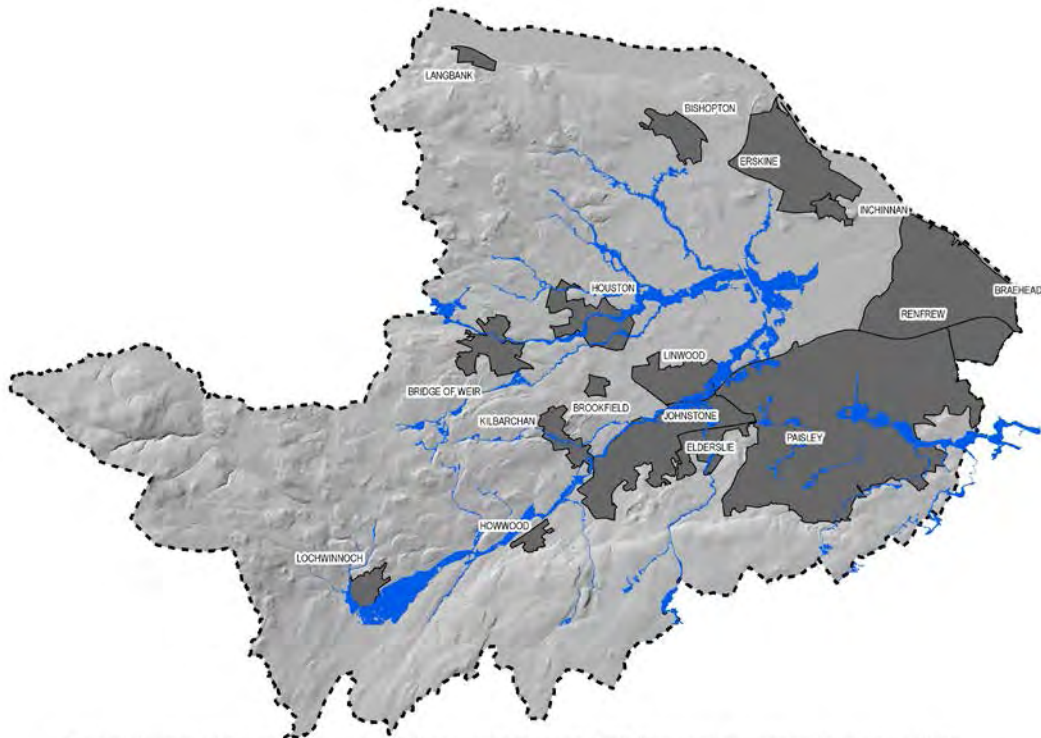
There were a total of 345 flood incidents across Renfrewshire recorded between 1st January 2000 and 1st October 2010. It should be noted that not every temporary covering by water of land not normally covered by water constitutes a flood. Renfrewshire Council only records a flood when it is considered to result in affects on human health, the environment, cultural heritage and economic activity, or combinations thereof.

The recording of flooding incidents forms the basis of the FRM Act and resulting management measures to be undertaken through the Local Flood Risk Management Plan promotion in 2015/16, coupled with data on likely future flood risk, restrictive river structures, major future developments and existing flood defences.

The capturing of historical incidents of flooding within Renfrewshire is important when developing a design and a layout that will seek to ensure that similar problems do not reoccur in the future.

Fluvial (river) Flood Risk

An overview of flooding from rivers in Renfrewshire is provided in Figure 4. The map highlights the primary source from fluvial flooding within Renfrewshire is from the Calder in Lochwinnoch, the Black Cart, the Candren, Hawkhead and Espedair Burns in Paisley, the Kilbarchan Burn, the Gryffe at Crosslee, the Spateston, Auchengreoch Floors and Peochland Burns in Johnstone, the Old Patrick Water and smaller water tributaries in Langbank.



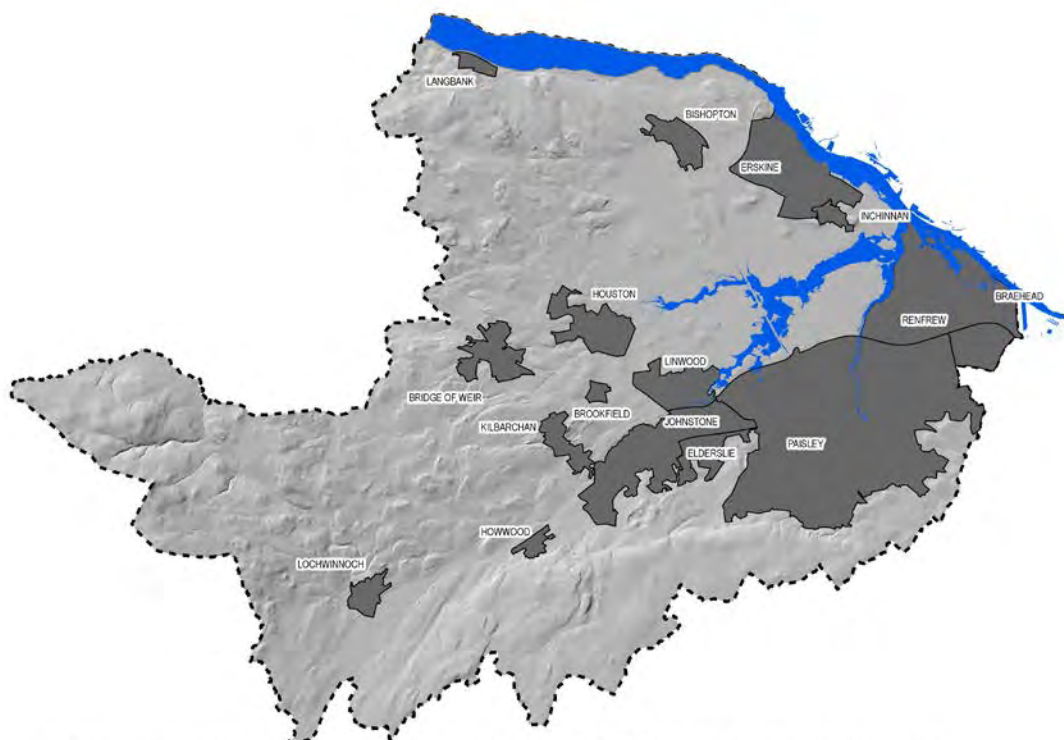
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Figure 4: Fluvial flood map

Tidal Flood Risk

The Clyde also results in flood risk to around 252 ground floor properties, however this is from tidal surge rather than flow from the Clyde. The North Renfrew Flood Prevention Scheme (phase 3) is to address the tidal risk posed by the River Clyde will reduce the number of ground floor properties at risk substantially. Figure 5 shows the extent of potential tidal flooding within Renfrewshire.

Figure 5: Risk from tidal flooding



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Pluvial (surface water) Flood Risk

A record of all the localised flooding incidents has been statutorily recorded by Renfrewshire Council since 1997. The risk caused by pluvial floor risk has been mapped and can be shown spatially in Appendix 2.

In general incidences of a localised nature can be addressed and managed sustainably through designing drainage solutions at sites surrounding areas which are at risk of flooding from non river sources. The presence of a localised flood risk will typically not restrict development but it is likely that there will be a requirement to consider flood risk management measures early in the development process to minimise the potential risk associated with localised flooding. It is important to ensure that not only that the site itself is not placed at risk of localised flooding, but also that the likelihood of localised flooding to adjacent sites is not significantly affected by development. In line with Scottish Planning Policy risk framework, land rising policy and compensation may apply. Sustainable Urban Drainage Systems (SUDs) require to be an integral part of all developments wherever the site conditions and the size of site permits, as do measures to mitigate land raising within pluvial flood zones as well as for fluvial flood zones.

Overland flow paths follow natural undulations in the topography of areas and where surface water flooding is caused by heavy rainfall and over capacity drainage systems, certain areas are at higher risk to pluvial flooding. It is important to highlight that the design capacity of the existing drainage system within Renfrewshire varies, typically it is assumed that a local storm event that exceeds a 1 in 2 year design event will cause problems in the local drainage network resulting in increased overland flow that may pose a risk of flooding to local properties. It is recognised that the risk of flooding from surface water and/or the sewer network is difficult to predict accurately, and is heavily dependent upon local conditions during heavy rainfall events. Intense rainfall will also typically result in debris being washed overland resulting in blockage to existing culverts and gullies which will also add to a surcharge in or no entry of flow to, the drainage system, resulting in pluvial flooding.

There are some areas in Renfrewshire that are at the base of the overland flow paths and are considered as receiving areas or receptors to many of the flood risk associated with localised flooding. A change in land form due to the development of a site has the potential to change the overland flow routes which may result in changes to areas that are at risk from flooding. The development of sites that are situated near to a receptor site or that may have an impact on sites downstream should be mindful of the need to provide storage and aim to slow and control the water flow, aiming to achieve betterment not only for the site and immediate surrounding area but also those affect by overland flow downstream of the development. The map in appendix 2 outlines the areas at greatest risk from localised flood risk.

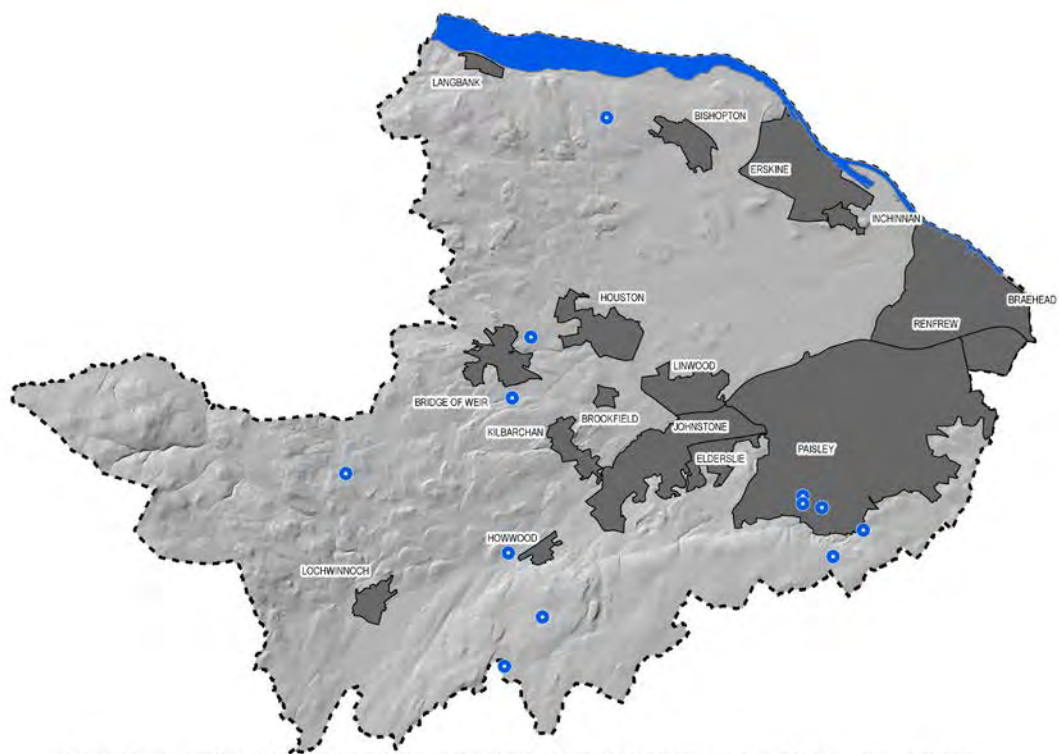
Flood Risk from Reservoirs

Renfrewshire has 13 large raised reservoirs, these are shown in Figure 6 and the details of each reservoir are outline in Figure 7.

| Name of reservoir | Max height of dam in metres | Capacity of reservoir in cubic metres | Water surface area at top water level (square metres) |
|--------------------------|------------------------------------|--|--|
| Barcraigs | 18 | 5.533 | 730,000 |
| Bowfield Dam | 6.2 | ? | ? |
| Elliston Weir | 1.2 | 1.254 | 841,000 |
| Glenburn (Paisley) | 9.75 | 360K | 110,000 |

| | | | |
|-----------------|-----|--------|---------|
| Houstonhead Dam | 3.7 | 135K | 63,000 |
| Kaim | 8.5 | 480K | 167,000 |
| Locher Dam | 9.1 | 37.75K | 25,000 |
| Moredun | 5.6 | 25.5K | 22,600 |
| Rowbank | 12 | 2.25 | 320,000 |
| Stanely (Large) | 11 | 696K | 147,000 |
| Stanely (Small) | 9.5 | 184K | 28,000 |
| Thornley | 8 | 38K | 22,190 |
| Whitemoss Dam | 3.5 | 94.7 | 41,200 |

Figure 6: Reservoirs in Renfrewshire



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Figure 7: Location of reservoirs in Renfrewshire

The revised Reservoir (Scotland) Act will provide regulations for the construction, alteration and management of reservoirs capable of holding 10,000 cubic metres or more of water. In particular, the key principle changes that the new Reservoir Bill is to introduce is in relation to the risk of flooding from reservoirs and also to try and facilitate more environmental objectives that are set out in river basin management.

The current Reservoir Act 1975 is to be repealed and replaced. Under the proposed legislation, reservoirs would fall into three categories, 'High', 'Medium' or 'Low' risk. There will also be the creation of a new Scottish panel of engineers to supervise and inspect reservoirs in consultation with the Institution of Civil Engineers (ICE). Panel engineers will have a key role in ensuring public safety, by supervising reservoirs which pose a risk to the public during construction and their operating life,

by undertaking regular inspections, completing reports for the enforcement authority and advising on measures to be taken in the interest of safety.

The likelihood of any reservoir failing is relatively low however should failure occur, the consequence of such an event can be particularly severe with potentially devastating effect. As recent as 2008 the Maich Fishery Dam in Lochwinnoch almost failed. This was not a regulated reservoir as it held less than 25,000 cubic metres of water. However, the near breach of the dam required the evacuation of properties downstream, the closure of public roads and the activation of emergency works to prevent an uncontrolled release of water. This is an issue where a proactive approach is required to ensure that reservoirs do not pose risk to life and livelihood. Under the new reservoir legislation larger reservoirs, with a capacity of 10,000 cubic metres or more, will be registered with the Scottish Environment Protection Agency and categorised according to risk.

Under the new proposed Reservoir Act there is an emphasis on ensuring that Scotland's reservoirs are structurally sound, properly monitored and well maintained. The proposals mean that people living close to reservoirs will be better protected as a result of a new proportionate inspection regime. It is to provide the best of both worlds building on the measures of the Flood Risk Management Act to protect the public from flooding from all sources but also makes sure that reservoir owners are fairly treated through a proportionate system.

Where the potential for reservoirs to come under the likely duties of the new reservoirs act has been identified, assessment of the likely downstream flood risk will be undertaken on the basis that such reservoir may require to be removed in order to avoid any potential future increased operational cost under the new reservoir act.

Planned Infrastructure Investment

Measures implemented within Renfrewshire, have included major flood prevention schemes such as at North Renfrew, two major flood barriers at Collier Street, Johnstone and Crosslee, and one major storage scheme at Moredun / Stanely Reservoirs (Moredun stores 25,000 m3).

Work commenced in 2008 to create a flood prevention scheme for the north of Renfrew in accordance with the Flood Prevention (Scotland) Act 1961. Phase 1 of the work involved the construction of flood embankments and retaining walls as well as the diversion of the Mill Burn culvert. The embankments have been created between the Scottish Water sewage pumping station off North Lodge Road and Meadowside Street/Neil Street. Phase 2 involved the dredging of 10,000 tonnes of sediment from the river's bed before the foundations are laid for the new pumping station. Phase 1 and 2 work is now complete. Phase 3 will see the creation of a pumping station. This will ensure that the waters of the Mill Burn will be discharged into the River Clyde for up to a 1 in 200 year tidal surge - decreasing flood risk from these sources. Work is due to commence during 2012 and it is expected that this phase will take 12 months to complete. Once Phase 3 is complete the £8m flood prevention work will ensure that the area will have a 1 in 200 year level of flood protection from the combined risks of Mill Burn flow and tidal surge from the River Clyde. This is particularly important to protect Renfrew Town Centre in addition to realising the significant development that is currently taking place to transform Renfrew North in line with the Council's policy of sustainable development.

Prior to the measures to be implemented through the pending FRM Act in 2015 flood plans, the majority of mitigatory work for the Council and other responsible authorities will continue to be watercourse inspection and clearance and repair work, pump maintenance, flood defence scheme maintenance, promotion of sustainable development through co-ordinated work within

Development Planning and Development Management and preparation of assessments and maps to inform post 2015 FRM Act flood plans.

The Council has also been part of a project sponsored and funded by the European Union - Interreg North West Europe Urban Water, which has examined best practice in sustainable flood management. As part of the Interreg project the Council has developed an integrated model of the sewers and watercourses within the Johnstone pilot area. It has also acquired Light Detection and Ranging (LIDAR) topographic data which provides very accurate height data for the whole of Renfrewshire. This has the potential to provide lower cost modelling for other flood risk areas in Renfrewshire. This is likely to play an important role in the Council's future approach to managing flood risk and the development of sustainable flood management. The availability of LiDAR data for the majority of Renfrewshire offers improved ground topographic data to map the fluvial, pluvial and coastal elements of the mapping and allows new pluvial effects to be accurately defined.

Detailed modelling undertaken through, and in conjunction with, the Interreg project has produced more accurate and detailed flood risk maps for particular areas within Renfrewshire. The Johnstone catchment is one of these areas and with the implementation of Johnstone South West Community Growth Area, it was considered that this detailed information would help sustainably masterplan the growth area integrating drainage, flood risk and water quality from the outset.

Johnstone south West Community Growth Area (CGA) will provide for 500 new residential units. The objective is to implement a holistic, design lead approach to the site. This will incorporate the understanding of the existing water opportunities and constraints at the site and to ensuring that appropriate decisions are made in developing areas where future communities will be able to thrive and be engaged. Background Paper 14: Green Networks Integrated Urban Infrastructure Surface Water Management Strategy for Johnstone South West, which accompanies the Renfrewshire MIR and SEA, provides more detail on this project.

The FRM Act encourages a co-ordinated approach to share services and seek economies of scale when tackling flood risk management. A very good example of putting this co-ordinated partnership working into practice is through the Metropolitan Glasgow Strategic Drainage Partnership (MGSDP) which involves a number of agencies including several local authorities, SEPA, Scottish Water and Scottish Enterprise. The partnership approach aims to deliver sustainable flood risk management, better water quality, manage surface water at the source, improve sewerage capacity, watercourse capacity and manage surface water above ground.

The MGSDP should ensure that future drainage improvements enable new urban development and brownfield redevelopment to alleviate flooding and control pollution in the most sustainable way possible. The MGSDP hope to achieve this by integrated drainage plans and local surface water management plans delivering a range of integrated measures across the Metropolitan Glasgow area, which includes Renfrewshire. The main aims of the partnership are as follows:

- manage flood risk to an appropriate level in a sustainable way;
- manage extreme events through creating manageable surface flood pathways and sacrificial storage areas;
- identify opportunities for managing pollution inputs into receiving waters help create a better urban environment through improving amenity and biodiversity;
- account for the potential effects of climate change and new development;
- integrate with the planning and development process in order to remove development constraints;
- account for the current regulatory, legislative and funding framework;

- identify stakeholder responsibilities for implementation and future operation and maintenance.

It is hoped that this partnership will support organisations in fulfilling their obligations under the FRM Act, and adapting to a changing climate with a higher frequency of extreme events.

Renfrewshire LDP vision and strategy

The vision and the strategy for Renfrewshire's LDP is set out by the Glasgow and the Clyde Valley Strategic Development Plan (GCVSDP). The GCVSDP sets the vision for the Glasgow and the Clyde Valley area to 2035. The vision and the strategy has five key components and five development frameworks.

These are:

- Economy;
- Urban fabric;
- Infrastructure;
- Environment;
- Energy.

In particular, flooding and drainage are considered to play a central role in the key components of infrastructure and the environment. The MGSDP is considered crucial to the implementation of measures to combat potential flooding and drainage issues given that it provides a model for co-ordinated action, aims to ensure there is strategic investment in infrastructure in areas where problems and issues are identified. The GCVSDP highlights the needs for improvements in water and drainage capacities to support the long term sustainable development of the Glasgow and the Clyde Valley area. There is the promotion of soft engineering solutions and the implementation of SUDS as well as the opening up of blue corridors and creating integration of water corridors with green network corridors.

In terms of environment, green corridors such as the Glasgow and the Clyde Valley Green Network, joining and connecting to the Central Scotland Green Network, play an important role within the environment. Existing water courses and corridors are considered to present an opportunity to integrate green spaces and water infrastructure and flood risk management measures, together providing routes for people and species to enjoy, creating new habitats and linkages.

This key components of this vision and strategy require to be translated into Renfrewshire's LDP and have been taken forward in the LDP objectives, translated into the preferred strategies and set the framework for the site assessments that have been carried out for individual sites that have come forward or been identified for inclusion in the proposals for the LDP.

Renfrewshire LDP Objectives

The objectives put forward in the Renfrewshire LDP Main Issues Report (MIR) are as follows:

- Development locations supported by existing or planned physical infrastructure and services;
- Regeneration and renewal of existing urban areas as energy efficient, health and safe places;
- Development that neither individually nor cumulatively causes significant environmental impacts;

- An enhancement in the natural and built heritage environment of Renfrewshire in support of the health of its communities, attractiveness of its places and setting for economic recovery;
- The regeneration and evolution of SDP Strategic Centres and other town and village centres as places of municipal, commercial and community value;
- A framework for local solutions to energy needs and waste generation;
- Measure to reduce and mitigate the effects of climate change.

Sustainable flood risk management will be an integral component in achieving many of the objectives put forward for the new Renfrewshire LDP. The significance of this role will be set out in the policies and proposals of the LDP and this will be identified in the next stage of the LDP preparation process known as the Proposed Plan stage.

In terms of the individual LDP objectives, the location of development which can be supported by existing or planned physical infrastructure is key to sustainable economic development. In achieving that objective, developments are likely to be accepted where there is existing capacity in the water network or there is likely to be resources available for the implementation of future water infrastructure to support development and the development will not have a significant impact to flood risk. In the current economic uncertainty and the deliverability of development is a key consideration as to whether certain development sites should be identified in the LDP. The identification of potential flooding and drainage issues early in the process is therefore essential. By highlighting fluvial, pluvial and tidal flood risk within Renfrewshire through this Stage 1 SFRA, as well as individually assessing sites at the MIR stage in the LDP preparation process, it is hoped that this will provide an indication of the areas where development of a site will require further detailed assessment and possible implementation of drainage infrastructure or flood mitigation measures to support development.

Regeneration and renewal of existing urban areas is important for an area such as Renfrewshire, as there is a high level of vacant and derelict land which has been quite stagnant for several years. Promoting and focusing development within urban areas is likely to put some pressure on existing water infrastructure and therefore working closely with Key Agencies and using the comprehensive information and data that Renfrewshire Council collect and monitor will be important in identifying what areas are appropriate for regeneration and what additional support will be required to develop certain areas or sites.

The SEA Environmental Report (ER) that accompanies the MIR has assessed whether the objectives, preferred and alternative strategies and the individual development sites that have been put forward, individually or cumulatively cause significant environmental impacts. To protect and enhance the water environment and promote sustainable flood risk management was one of the SEA objectives. The individual, cumulative and also cross boundary impact to the environment have been considered within the ER. Flooding and drainage impacts were considered as part of this assessment and are documented in the ER. The next stage in the LDP preparation is the production of a Proposed Plan, where policies and proposals will be put forward. It is anticipated that an updated ER will require to be produced to assess the environmental consequences of policies and firm proposals and this will provide another opportunity to assess the impact from flood risk.

The focus on enhancing the environment of Renfrewshire in support of the health of its communities, attractiveness of its places and setting for economic recovery, provides an opportunity for softer water engineering solutions, combined with opening up of culverts to open water courses and an aspiration to have sustainable surface water management integrated into the design of new developments and the regeneration and renewal of areas. Through the policy framework of the Renfrewshire LDP, there will be a focus on promoting sustainable water management in all

appropriate developments in order to work towards enhancing the environment, making it more attractive and accessible for those who live, work and visit the area.

Measure to reduce and mitigate the effects of climate change is central to most of the recent legislation and regulations in relation to flooding and drainage. The implementation of sustainable water management techniques will be important in working towards reduction, adaptation and mitigation of the impacts from climate change and again this will be supported by the policies and proposals put forward in Renfrewshire LDP.

Site Assessments

As a part of the LDP preparation process, the Council looks to identify future development opportunities that are likely to come forward during the duration of the plan period between 2013 and 2018. The identification process was undertaken by various approaches such as through an exercise titled 'Suggestions for Land Use Change', by outlining existing sites that are known as effective and established in the Renfrewshire Housing Land Audit, other housing sites identified in the Urban Capacity Study as well sites which are in the industrial and business land supply and are considered to be legacy sites requiring a rethink of their land use designation. The suggestions for land use change exercise encouraged developers and land owners to submit sites that could possibly be rezoned for a particular use. All of the individual sites have been assessed against environmental criteria through the SEA and wider planning considerations through sustainable development criteria.

The individual site assessments are contained in Background Papers 15 and 19 which are technical reports which accompanies the MIR and SEA. All of the individual sites have been assessed in terms of their impact on flooding and drainage.

The areas selected for development and put forward as part of the Council's preferred strategy as well as those not selected for any strategy have been evaluated using a flood risk based approach and current planning policies. This assessment from a strategic viewpoint does not rule out a particular site from development, the assessment simply highlights that more detailed site-specific flood risk assessment is required and potential mitigatory measures may also be required.

The Way Forward – A Proactive Approach

It is considered that the most proactive approach to effectively managing flood risk is promote and focus development out with area liable to flooding or likely to add to the risk of land downstream of the development. Avoidance of flood risk in the first instance is the first principle when producing a new development plan as this is considered to be more sustainable and therefore central to achieving sustainable economic growth. Although the favoured approach it can sometimes be difficult to fully achieve over the lifetime of a plan and development sites can gain planning approval in areas where there may be a risk to flooding. Although these developments will still require to comply with Scottish Planning Policy and implement mitigatory measures which will result in betterment.

Through the preparation of the LDP, the approach will be to allocate land for development in areas with the lowest risk to flooding and only when this is not possible and there are overriding factors which require to be factored in to the decision making process will it be necessary to consider development of higher flood risk areas. However layout and potential mitigatory measures will be central to this consideration.

It is important to recognise that some areas that are under pressure from future development can be at risk from flooding. It is therefore essential that the Council are in a position to take informed decisions, providing a careful balance between the risk of flooding and other planning constraints that may be in place. Therefore it is extremely important that all information is available to make that informed decision. Not only is the risk from flooding posed to new development, but that it also seeks to positively reduce the risk of flooding posed to existing properties.

Within the planning process there should always be early consideration given to assessment of the flood risk and possible mitigatory measures, which may in fact result in betterment for land surrounding development sites or downstream. Future flood risk management should look to provide benefits to the water and natural environment, reduce existing flood risks and provide capacity for adaptation to climate change.

As a minimum, the implementation of SUDS must be designed into each development, as practicably can be accommodated, in particular this must be an integral part of the design of the development. Developers should be able to demonstrate that their proposal will deliver a positive reduction in flood risk. Layout is also central to a more proactive approach, wherein careful consideration is given to avoiding obstructing overland flow routes with buildings and ensuring that landscaping and spaces provide soft sustainable solutions to the slowing of water.

By ensuring that flood risk management along with river basin management is considered from the outset in the planning process, this should aim not only reduce the risk of flooding to new development, but that it also seeks to positively reduce the risk of flooding posed to existing properties within Renfrewshire.

The aim of planning policy on development and flood risk are to ensure that flood risk is taken into account at all stages in the planning process. Council policy is essential to ensure that when advising or considering a planning proposal that there is a consistent framework and an adopted approach at the planning application stage. It is considered that an adequate policy framework is essential to achieve future sustainable development with respect to flood risk management. The policy framework will be set out in the Renfrewshire LDP Proposed Plan, the next stage in the preparation of the plan. The consultation and the comments received at the MIR stage will be important to inform the policy framework for the Proposed Plan.

A partnership approach involving SEPA, Scottish Water as well as neighbouring local authorities will be an important element in the delivery of sustainable flood management ensuring that best use is made of expertise and information so that plans and effective decisions can be delivered. Continuous effective consultation will also ensure that developments are promoted in the right locations.

Conclusion

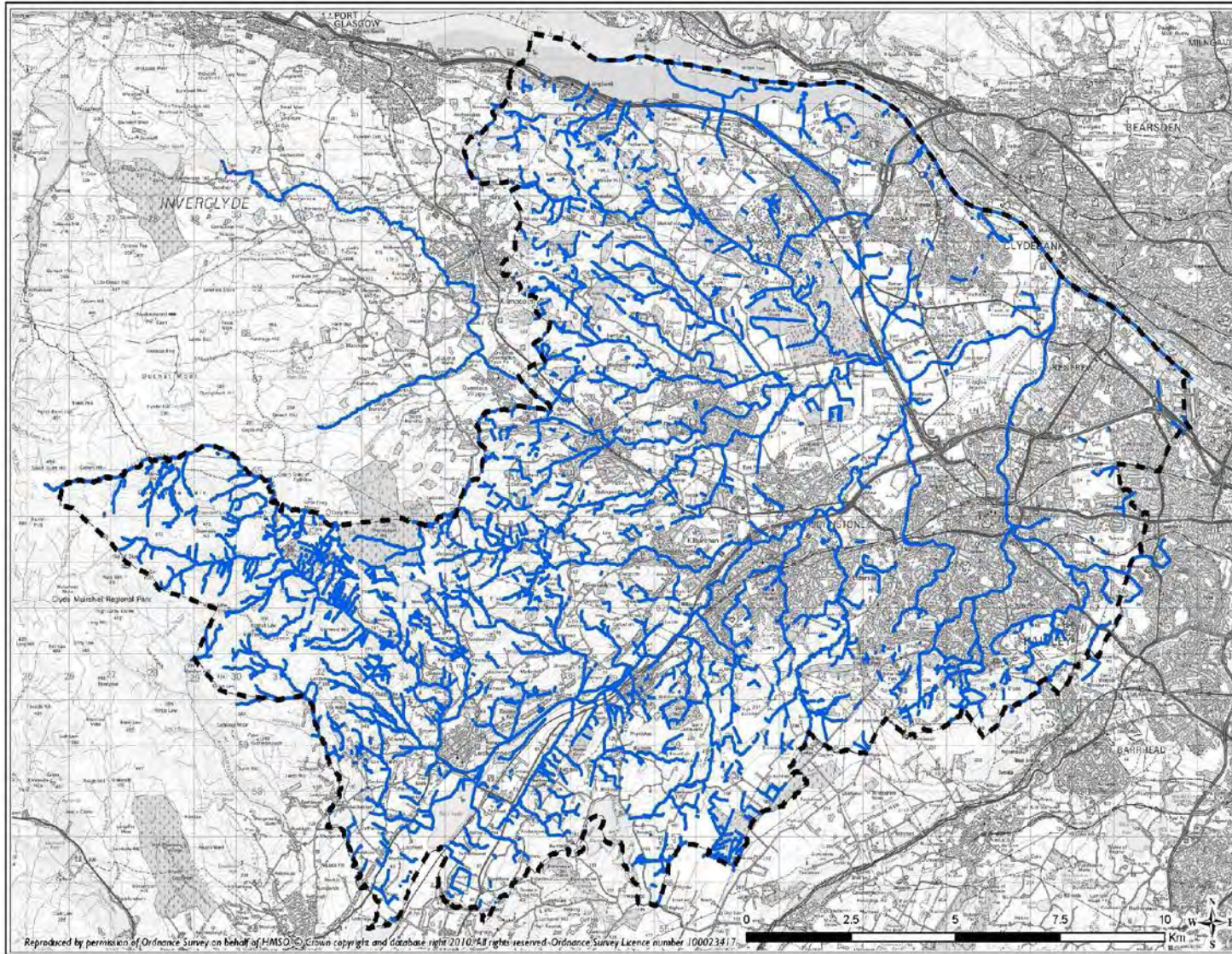
A stage 1 strategic assessment of flood risk across Renfrewshire has been carried out to assist the LDP preparation by providing a risk-based approach to the allocation of land for development.

Flooding had become a matter of major importance in the Renfrewshire Local Plan (2006), which was reflected in the four planning policies that were included within this plan. The forthcoming Renfrewshire LDP will need to manage flood risk and drainage as well as protect and enhance water quality. The policy approach aim to reflect the five overarching outcomes of 'Delivering Sustainable Flood Risk Management' as set out by the Scottish Government.

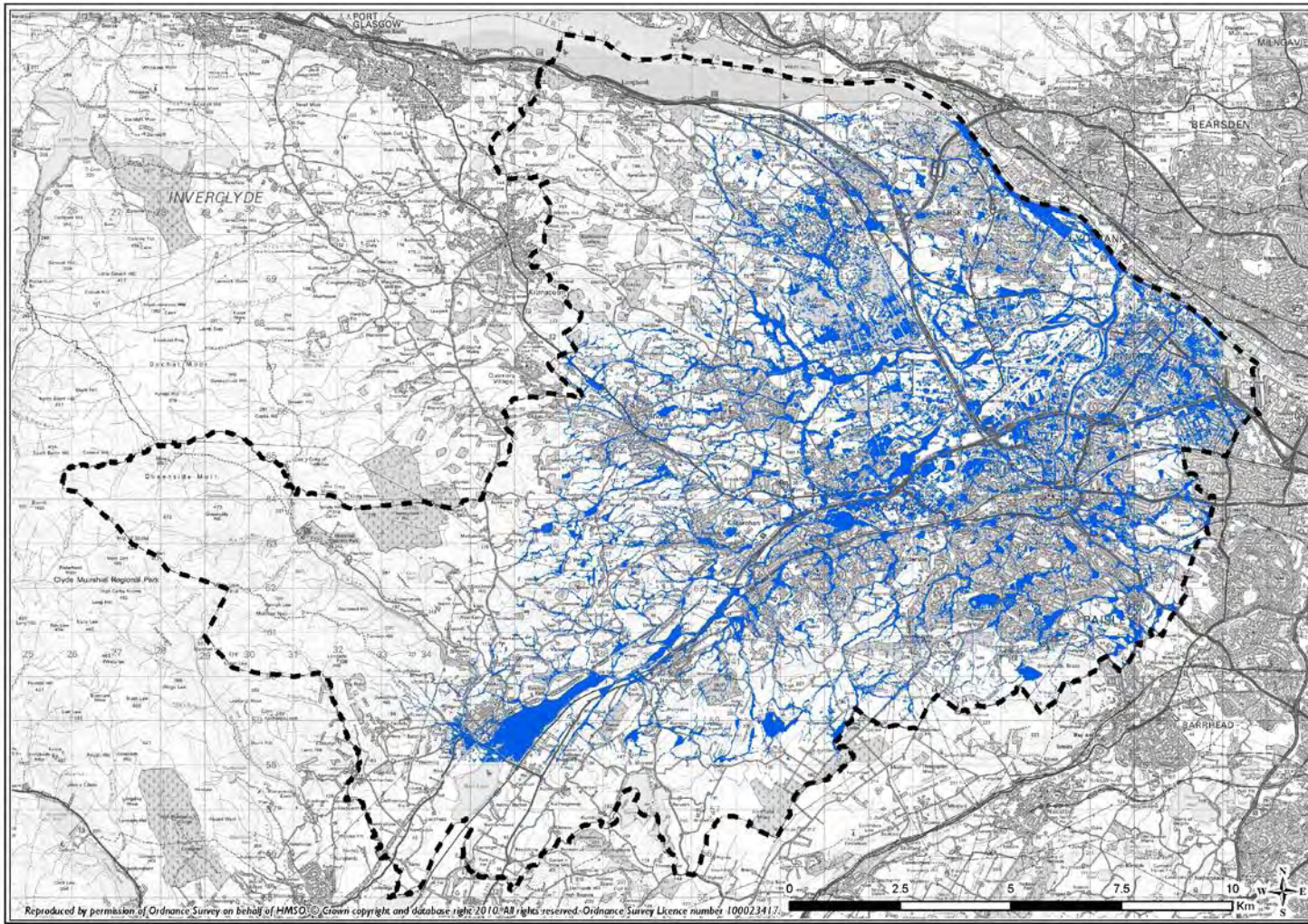
It is essential that the risk of flooding is minimised over the lifetime of the development plan in all instances. Although it is important to recognise that flood risk can never be fully mitigated and there will always be residual risk of flooding. The residual risk is associated with a number of potential risk factors including:

- A flood event that exceeds that for which the local drainage system has been designed;
- The result of flood defence failure through structural collapse or overtopping of a flood defence;
- General uncertainties inherent in the prediction of flooding given that the modeling of floods and flood levels is not an exact science and there are therefore uncertainties in the prediction of flood levels used in the assessment of flood risk.

Flood risk is one of many factors that will influence the spatial planning process however it is necessary to maintain a balance between flood risk considerations and other considerations such as through the integration of social, economic and environmental matters. A careful balance must be sought in these instances and the SFRA aims to assist in the plan preparation process, forming the basis for preparing appropriate policies for flood risk management for the Renfrewshire LDP and providing an evidence base upon which informed decisions can be made.



Appendix 1



Appendix 2