

3. Catchment description

3.1 Management Units

There are six major rivers within Ayrshire and many smaller coastal burns. For the purposes of the FMP the following catchment management units have been identified by ART.

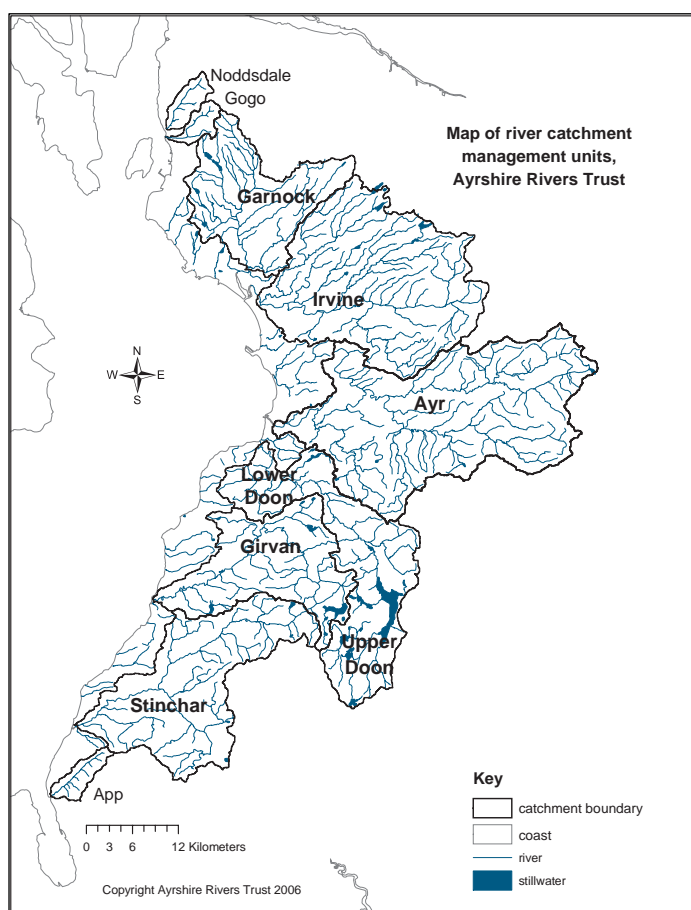
- River Stinchar catchment
- River Girvan catchment
- Lower River Doon catchment, downstream of Loch Doon dam
- Upper River Doon catchment, upstream of Loch Doon dam
- River Ayr catchment
- River Irvine catchment
- River Garnock catchment
- Largs Burns

Coastal Burns, such as the Pow Burn or Milton Burn, form a significant part of the Ayrshire freshwater resource although not from a fisheries perspective. ART has limited data on any of the coastal burns and they will be excluded from this current FMP.

The map below shows the locations of the management units. Each of the main catchments form a management unit with the exception of the Doon catchment which has been divided at Loch Doon dam. The nature of the Doon catchment changes significantly at that point and the pressures are quite different in the upper catchment to those affecting the lower Doon catchment.

Ayrshire Fishery Management plan management units

Derived from OS 1:50,000 Panorama data with the permission of the controller of Her Majesty's Stationery Office © Crown copyright



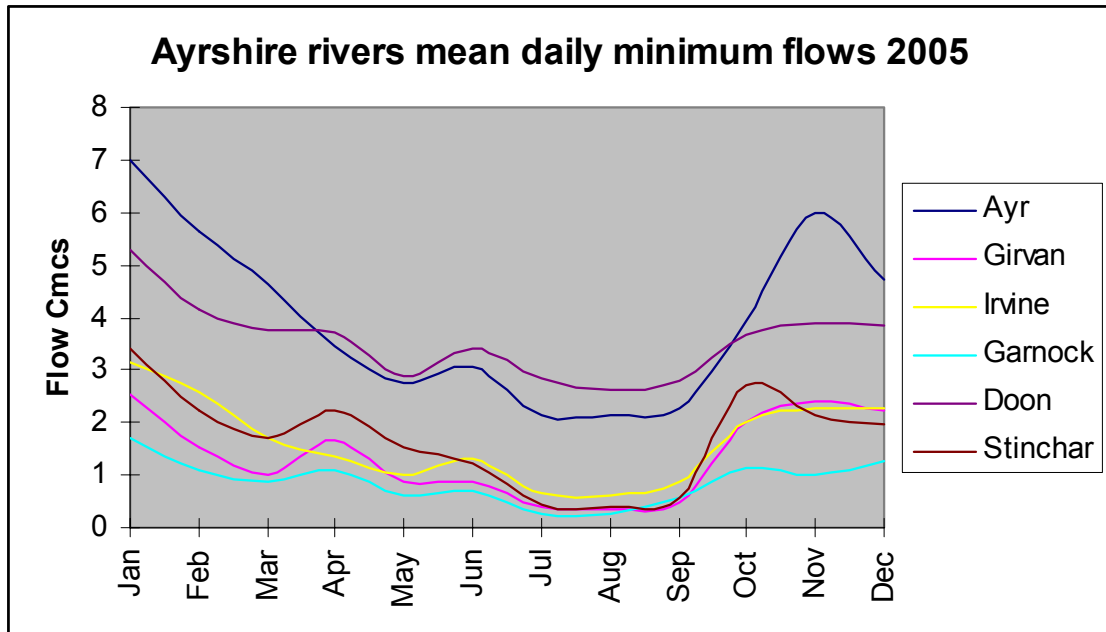
3.2 Catchment statistics and water flows

The catchment sizes, mean water flow and Q95 (low flow) levels for the six principal Ayrshire rivers are shown below. Data was obtained from SEPA river levels web page http://www.sepa.org.uk/data/river_levels/data.htm. The long term average flows are based on 18 to 40 years data for each site.

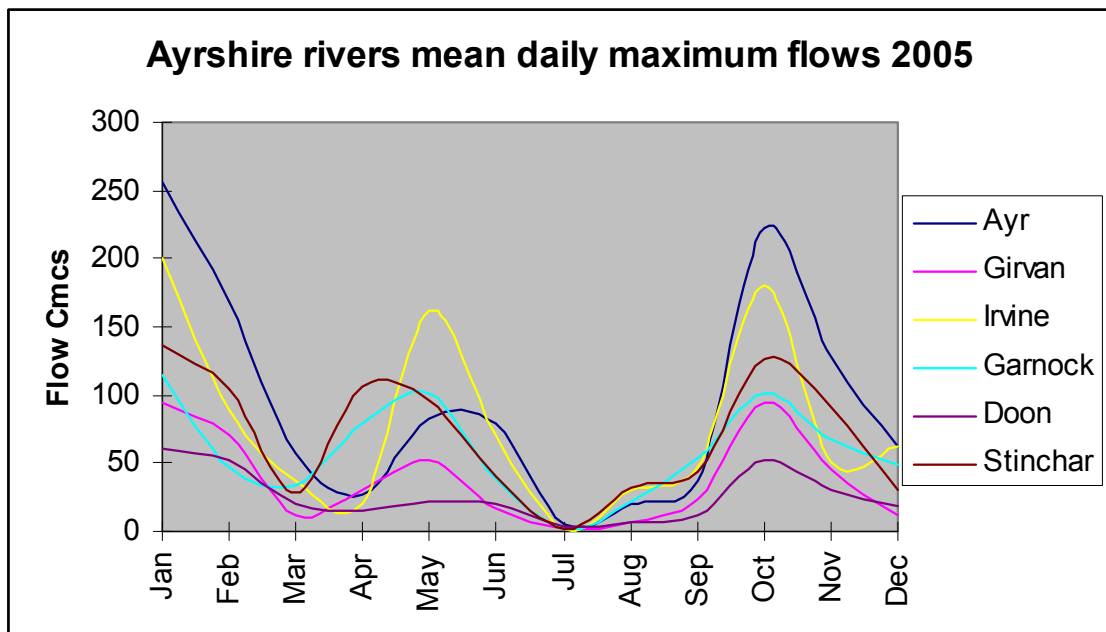
Catchment	Area km ²	Average flow m ³ /s	Q95 (low water flow) m ³ /s	Mean rainfall mm
Garnock	238	8.1	0.4	1504
Irvine	471	13.1	0.79	1247
Ayr	574	16.0	1.55	1214
Doon	328	7.5	2.76	1581
Girvan	245	6.7	0.46	1373
Stinchar	341	10.6	0.54	1507

The mean annual flow will be affected by catchment size, rainfall and topography. All rivers except the River Ayr are subject to some degree of abstraction for water supply purposes. However, abstraction is much more significant on the River Doon as the outlet from Loch Doon has been dammed and is used as a storage and water supply reservoir for the Galloway Hydro Electric Power Scheme. Loch Doon dam controls water flow from 39% of the entire Doon catchment. The Stinchar and Doon catchments are similar in size and topography but the mean annual flow in the Doon is approximately 30% less than in the Stinchar. This difference reflects the water lost from the catchment via the hydropower scheme. There is a compensation flow agreement in place to offset the water lost from the catchment.

The impact of the compensation flow can be seen in both the minimum and maximum flow levels for each river. The graphs below show the minimum and maximum flow levels for each river in 2005¹. The Doon catchment is the fourth largest of the six rivers however the minimum flow on the Doon was the highest for the entire summer period.



The controlling influence of the water regulation at Loch Doon reservoir is also apparent in the maximum flow levels. The graph below shows that in 2005 the mean maximum flows on the River Doon were consistently the lowest of the six principal rivers.

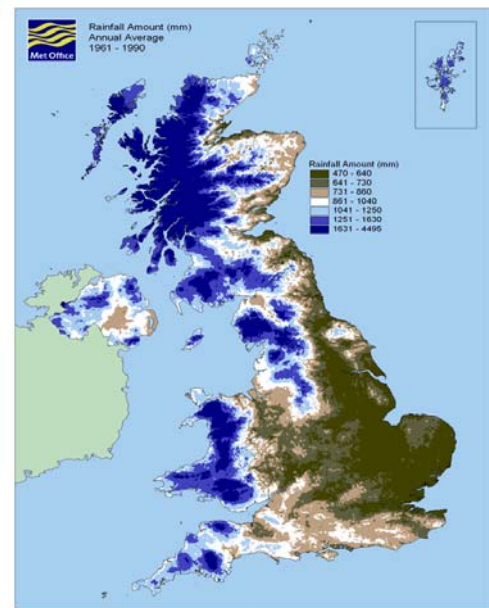


The net effect of Loch Doon Reservoir is to reduce the magnitude of high and low water events on the River Doon. This has far reaching effects on the ecology of the River Doon in comparison to the more natural flow regimes of the other major rivers in Ayrshire.

3.3 Climate

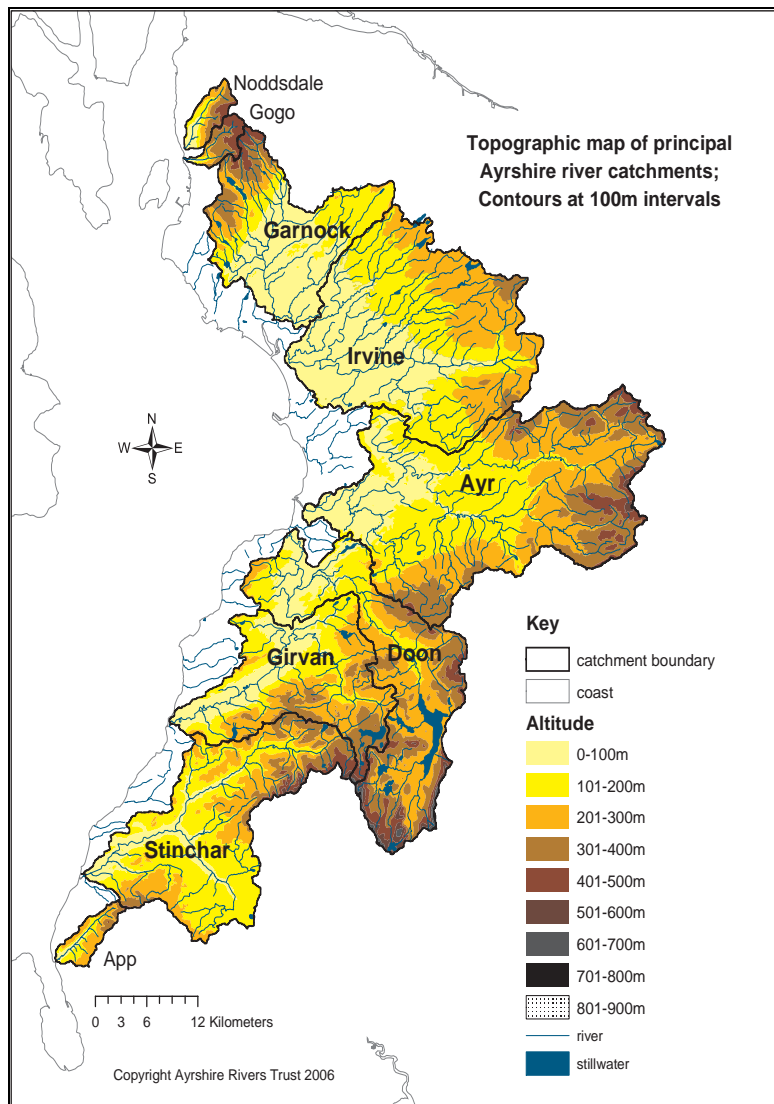
The climate of Ayrshire could be described as mild and oceanic with the influence of the Gulf Stream ensuring that there is a low incidence of frosts and snow cover except on the high ground.

The map opposite (reproduced from www.metoffice.gov.uk) shows the average annual rainfall for Great Britain and Northern Ireland (1961-1990). Annual rainfall in Ayrshire is above average for Britain as a whole, similar to Cumbria or Wales but not quite as high as some other areas of western or northern Scotland. Even the driest parts of Ayrshire (low-lying areas around Ayr) have an average annual rainfall in the range 861-1040mm. Over half of Ayrshire receives more than a metre of rain (1000mm) every year, with around a quarter receiving more than 1600mm. The wettest parts of Ayrshire are in hilly areas, typically with an altitude over 250m.



3.4 Topography

Ayrshire is the largest of Scotland's lowland counties and with a low lying central basin surrounded by hills rather like a half saucer. It has a very diverse landscape and as a result the character of each river is quite different. The east side of the Garnock, and much of the Irvine and Ayr catchments are relatively low lying. The Irvine has the second largest catchment in Ayrshire but much of the catchment is below 100m and there is very little land above 400m. In contrast the Stinchar, Doon, and Girvan all rise in the Galloway hills and have headwaters over 500m altitude.

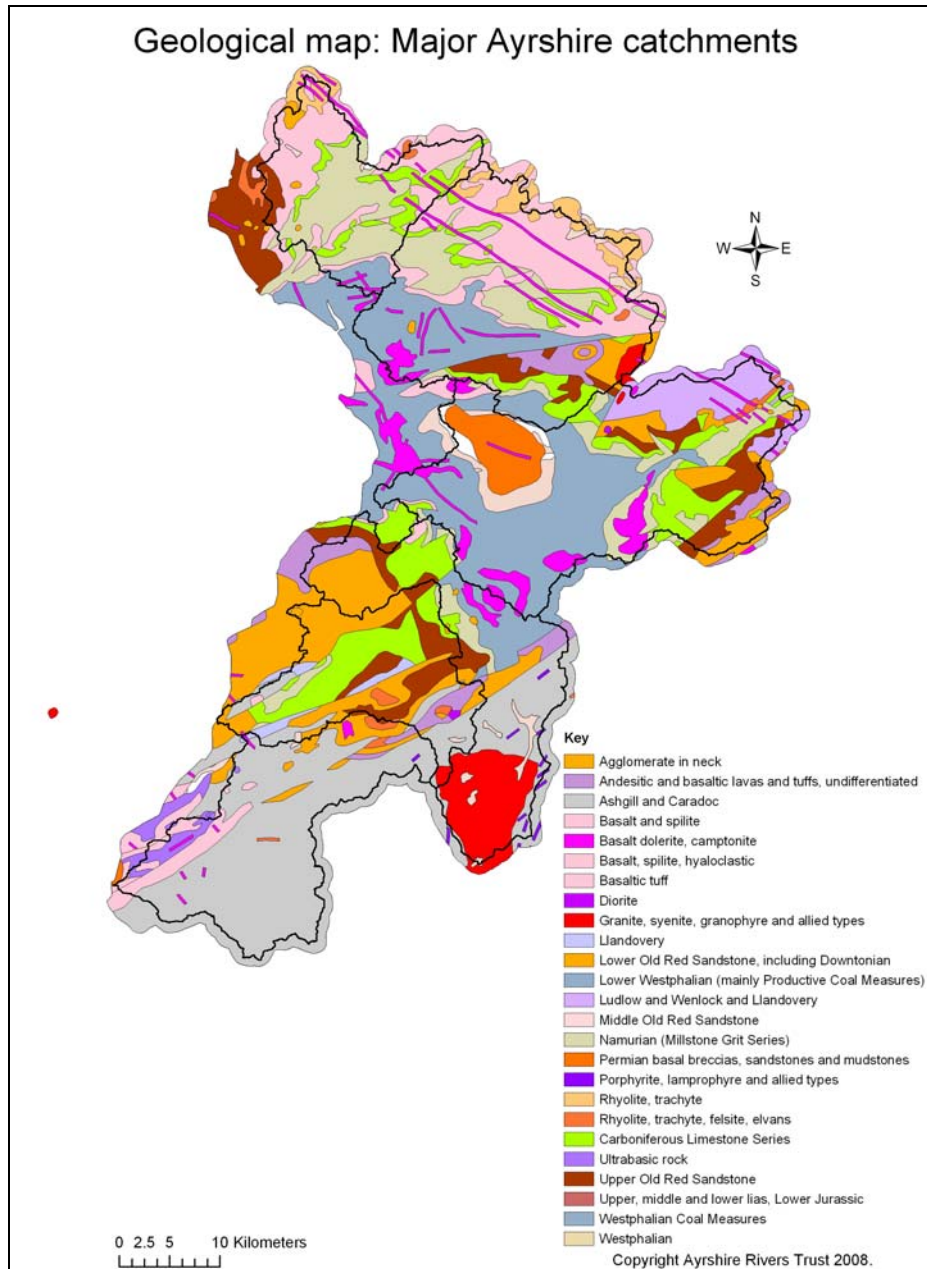


Topographical map Ayrshire catchments

Derived from OS 1:50,000 Panorama data with the permission of the controller of Her Majesty's Stationery Office © Crown copyright

3.5 Geology

Scotland is renowned for its complex geology and a diverse range of rock types are found in Ayrshire. The underlying geology has a major influence on water chemistry and river form. Two of the most significant features in Ayrshire are the extensive limestone and coal measures in central and north Ayrshire and the granite outcrop in the upper Doon catchment. The Southern Upland Fault crosses Ayrshire running up the centre of the Stinchar catchment and the upper Doon. South of the fault lie the Southern Uplands where the rocks are Silurian and Ordovician and are relatively unreactive. North of the fault lies the Midland Valley where the rocks are primarily sedimentary in origin, mainly Old Red Sandstone in Ayrshire with limestone and coal measures. The soils in the Midland Valley are some of the most fertile in Scotland and this part of Ayrshire is intensively farmed.



Geological map showing major catchments

Derived from data held under licence by ART. Bedrock data, Digital Geological Map of Great Britain 1:625 000 (DiGMapGB-625), British Geological Survey (2003), © and database right NERC

The limestone and sedimentary rocks underlying most of Ayrshire mean that the freshwater environment is relatively fertile with alkaline conditions and high productivity.

3.6 Soils

The characteristic soils of central and northern Ayrshire are gleys and non-calcareous gleys with brown forest soils. Gleys can only develop under conditions of intermittent or permanent water logging. The combination of the high clay content of Ayrshire soils and the wet climate provide ideal conditions for gley soils. Peat occurs in pockets in the upper reaches of all catchments whilst there are localised areas of lighter soils such as the sand deposits near Darvel in the upper River Irvine.

The fine particles of cultivated topsoil's in Ayrshire are readily mobilised during heavy rain. This can be observed during the first flush of spate waters in the Ayr, Irvine, Doon and Girvan when huge quantities of suspended solids are transported giving the rivers a very turbid appearance.

Sources of instream sediment have never been researched in Ayrshire although data published on the sources of river transported sediment in a variety of catchments in

England found that the relative importance of surface derived (field run-off) and channel erosion sediment varies considerable depending on the topography and predominant form of agriculture ². The intensive agriculture and relatively fine soils present in lowland Ayrshire suggest that surface derived sources are likely to be important sources in Ayrshire.



A silt laden spate in the lower River Ayr

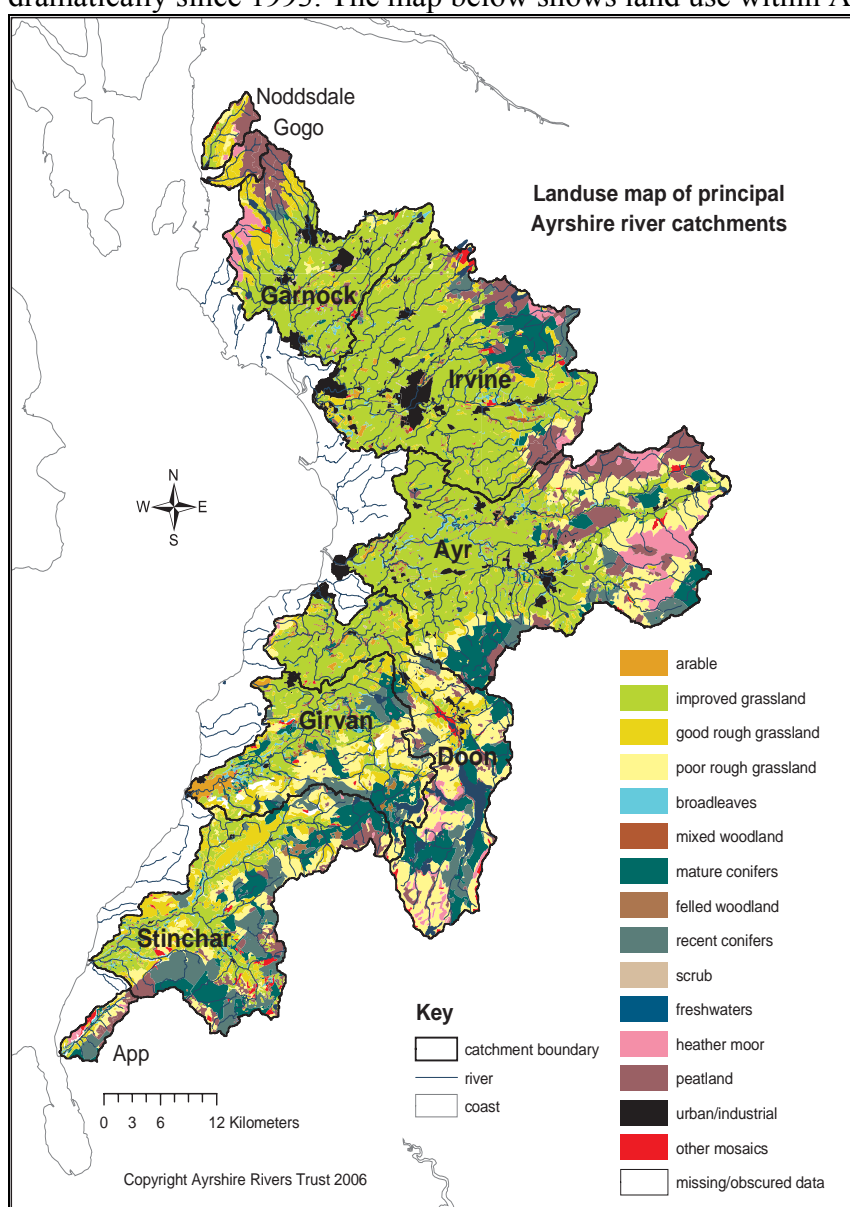
The picture opposite shows a common situation, a field flooded with dirty brown water, all derived from surface run-off. There are no surface drainage channels present in this field. This water ultimately finds its way into rivers and burns.

Waterlogged field with brown silty water derived from surface run-off



3.7 Land use

Land use, combined with the underlying geology, are the two major factors influencing the nature of waterbodies. ART holds data on landuse for the main Ayrshire river catchments. This was supplied to the Trust under licence through the Scottish Fisheries Coordination Centre (SFCC). This information is derived from Land Cover of Scotland data. Since the information is now at least 13 years old, there will be inaccuracies in the map produced due to changes in landuse since that time. For instance, some areas of forestry will have been felled and replanted. Some areas marked as urban/industrial will have expanded. However, the maps do provide a useful overview of landuse across the region which does not appear to have changed dramatically since 1993. The map below shows land use within Ayrshire.



Derived from data held under licence by ART: Land Cover of Scotland data, 1:25,000, MLURI 1993

It can be seen from the maps that there are a number of large towns within the Irvine catchment. Data from the 2001 census ³ found that the human population within the Irvine catchment is approximately 112,000 people, representing

a density of 295 people/km². For comparison the Stinchar catchment has a human population density of 4 people/km². The impacts of the high population density on the River Irvine can be seen in the degree of urbanisation and river morphology modifications throughout the catchment.

There is considerable variation in land use between catchments. The table below shows the percentage landuse in the Ayr, Doon and Garnock catchments.

Table 1: Percentage landuse occurrence Ayr, Doon and Garnock catchments

Landuse	Ayr	Doon	Garnock
Improved grassland	44.5	23.9	60.4
Rough pasture	18.6	35.5	14.7
Moorland	18	7.5	11.7
Conifers	11.7	21.5	2.3
Broadleaf/mixed woodland	2.7	1.9	2.4
Urban & Industrial	3.7	2.2	6.5
Other	0.8	7.5	2

Improved grassland (ploughed agricultural land) is the largest land use in the Ayr and Garnock catchments whilst it is much less important in the Doon. The largest single landuse on the Doon is rough pasture representing over one third of the catchment. Conifer plantations are a feature in the upper Doon catchment with 21% of the entire catchment subject to this landuse. In all three catchments broadleaf and mixed woodlands forms a relatively low percentage being under 3% in all catchments. Indeed there is a higher percentage of urban and industrial land in all three catchments than there is broadleaf/mixed woodland

There are a total of 95 SSSI's, SPA's or SAC's within Ayrshire ⁴. Only two of these are cited primarily due to freshwater issues, Loch Doon (SSSI) for its arctic charr population and Martnaham Loch (SSSI) as a good example of a mesothropic loch.

3.8 Water quality

Section 3.5 Geology, suggests that the underlying geology in Ayrshire should result in productive and fertile freshwaters. In the more pristine parts of Ayrshire, e.g. the upper Ayr tributaries this is certainly the case and these watercourses are very productive and support high fish densities. In agricultural parts of Ayrshire or in heavily populated areas inputs, primarily run-off from farms or farmland and urban drainage, but also from septic tanks can result in enrichment or pollution. This can result in poor water quality, often with low oxygen levels, reduced invertebrate and fish diversity, although productivity of pollution sensitive species can be high.

There are a some parts of Ayrshire where the burns are more akin to the lower productivity streams found in the Scottish Highlands e.g. Loch Doon tributaries and some of the upper Stinchar tributaries but these are few in number. ART do not consider that natural productivity is a limiting factor in the majority of Ayrshire watercourses.

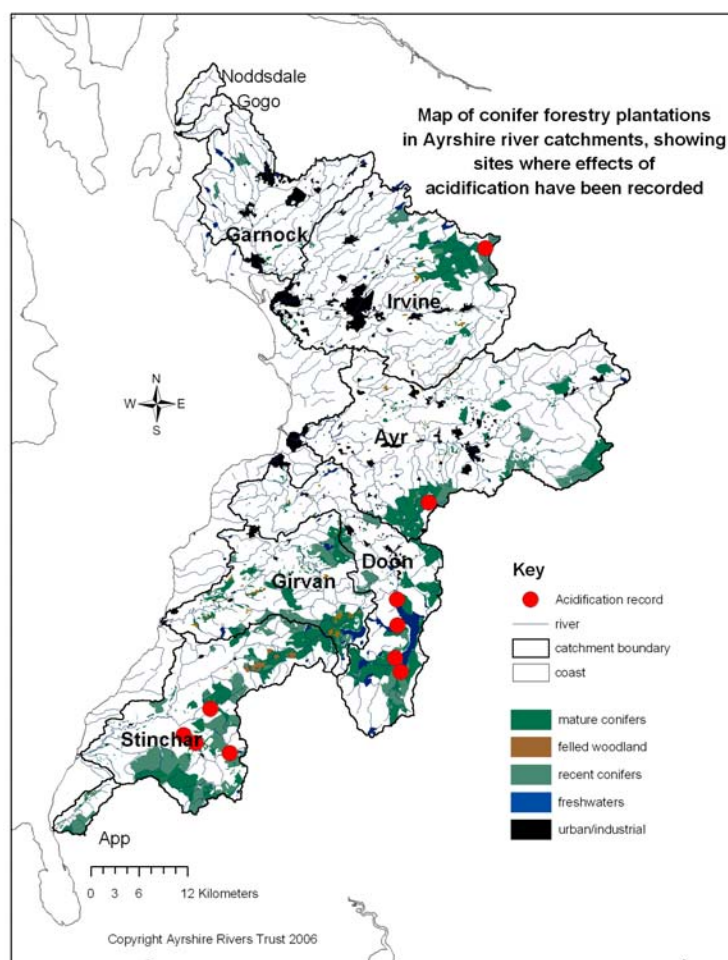
Diffuse pollution from agricultural land is considered to be the most important cause of diffuse pollution in Scotland's watercourses ⁵. Invertebrate and fish population

sampling undertaken by ART has found that there are very few good quality lowland burns within Ayrshire, and almost all are impacted by diffuse pollution and habitat degradation. Lowland burns are considered to be priority habitats by ART.

Other significant sources of water quality issues are discharges from sewage treatment works and combined sewage overflows.

Water quality problems arising from rural diffuse pollution and sewage discharges are of high importance everywhere but especially so in Ayrshire due to the number of bathing water beaches present along the coast. In 2007 four beaches in Ayrshire were recorded as having poor water quality i.e. Girvan, Ayr, Prestwick and Irvine, and high river flows was cited in each case⁶. The well established links between rural or urban bacterial contamination and bathing water quality provide an important driver for works aimed at improving river quality.

Acidification is a concern, particularly in the upper Doon, but also locally in the Stinchar, Ayr and Irvine catchments. ART has found that acidification is strongly associated with conifers planted on peat.



3.9 Habitat quality

ART have completed detailed habitat surveys of all the main rivers in Ayrshire with the exception of parts of the River Irvine catchment (including large tributaries such as the Cessnock Water, Annick Water, Kilmarnock Water) and the Water of Coyle in the River Ayr catchment. Reports are held in the ART office. Parameters recorded include suitability of the habitat for juvenile fish production, details of obstructions, pollution points, channel modifications, fencing requirements. These reports and the survey data gathered provide an invaluable resource for the prioritisation of habitat restoration works and other remedial works. The habitat data collected by ART could contribute to the North Atlantic Salmon Conservation Organisation (NASCO) Plan of action for the protection and restoration of Atlantic salmon habitat⁷.

Habitat degradation is a very significant issue in Ayrshire. This should be no surprise considering the human population density, the intensity of farming and industry within the area. In lowland agricultural areas there is extensive habitat degradation as a result of heavy grazing livestock trampling and stock access to watercourses. Some

catchments suffer from a high degree of urbanisation e.g. the Garnock and Irvine, resulting in a lack of habitat diversity. Upland areas are also suffering from habitat degradation. The area of moorland has shrunk in recent years with a switch to commercial forestry. The well established opencast mining industry in Ayrshire is also expanding, primarily in upland areas, or the higher altitude marginal farming land.

ART have been actively involved in small scale restoration projects throughout Ayrshire but there is considerable potential and opportunity for catchment scale projects. ART working on its own, or in conjunction with farm advisory groups such as FWAG, have been instrumental in initiating a number of habitat restoration schemes in heavily grazed agricultural land, normally involving fencing and provision of alternative stock watering points. Monitoring has demonstrated that it can be very successful in improving densities of juvenile salmonids. Agricultural environmental grant schemes such as the Scottish Rural Development Programme ⁸, provide an opportunity to target significant investment at measures to reduce diffuse pollution, e.g. improved slurry storage/application, bankside fencing, water troughs.

References

1. SEPA, data supplied electronically by Eddie Jow, SEPA Hydrologist Nov 2006.
2. Environment Agency. R&D Technical Report W2-046/TR3. Provenance of Interstitial Sediment Retrieved from Salmonid Spawning Gravels in England and Wales. 2003.
3. Scottish Census Results Online website (<http://www.scrol.gov.uk/scrol/common/home.jsp>)
4. Scottish Natural Heritage website (http://gateway.snh.gov.uk/portal/page?_pageid=53,910284,53_920284&_dad=portal&_schema=PORTAL)
5. SEPA. An Introduction to the significant water management issues in the Scotland river basin district. August 2007.
6. SEPA Scottish Bathing Waters 2007.
7. North Atlantic Salmon Conservation Organization. Format for reporting on Development and Implementation of Habitat Plans (<http://www.nasco.int>)
8. Scottish Government website (<http://www.scotland.gov.uk/Topics/Rural/SRDP>)