12 WATER RESOURCES

12.1 Introduction

12.1.1 Purpose and Scope of the Assessment

This Chapter addresses the potential effects on water resources as a result of the proposed Scheme. Water resources include surface waters (e.g. rivers, burns, static water bodies, tidal waters, etc.) and groundwater (e.g. shallow and deep aquifers). The assessment process comprised of characterisation of the existing water resources, identification and prediction of potential effects, and inclusion of any secondary mitigation measures (i.e. those not already included in the Scheme outline design or thought of as standard practice) required to offset any significant residual effects.

12.1.2 Planning Framework

Apart from general statutory and planning requirements for a scheme of this nature, the water resources aspects are regulated by a number of EU, Scottish and Local instruments, comprising but not limited to:

- EU Directive 2000/60/EC (Water Framework Directive (WFD)), transposed into the Water Environment and Water Services Act (Scotland) 2003;
- The Water Environment (Controlled Activities) (Scotland) Regulations 2005 in respect of discharges to surface or groundwater;
- SPP 7 (Planning and Flooding), policy for flood prevention and planning controls;
- SEPA Policy No.22 (Flood Risk Assessment Strategy);
- SEPA Policy No. 41 (A SEPA – Planning Authority Protocol, Development at Risk of Flooding: Advice and Consultation);
- SEPA Policy No. 19 (Groundwater Protection Policy for Scotland) and
- Structure Plan and Local Plan.

The resultant influence of this statutory and planning regime is discussed in Section 1.4.8 in deriving a set of key issues and constraints for the water resource aspects of this Scheme.

12.1.3 Study Area

The section of the A77 under consideration is situated to the southwest of Kilmarnock in relatively flat countryside and predominantly runs through agricultural areas. The general topography is such that the A77 and the surrounding land falls from Kilmarnock towards the sea. All surrounding surface water features tend to drain in parallel with the road towards the sea, and there are no watercourses shown on 1:50,000 mapping that actually cross the road alignment.

In the context of these proposals, there are five water resources features that have been identified as part of this assessment. Within the 250m boundary considered

either side of the proposed Scheme there are three surface watercourses, one small lake, and the remaining feature identified is the groundwater beneath the proposed Scheme. All of these features are shown on Figure 12.1.

12.1.4 Water Resources Related Proposals

A full description of the Scheme is included in Chapter 2 – Scheme Description, but details that will have an effect on this assessment are highlighted / expanded upon under the following headings.

Road Drainage and Outfalls

It is understood that the existing road surface water drainage infrastructure drains to local watercourses, but no plans of this infrastructure have been available for this assessment.

SEPA have requested that Sustainable Urban Drainage System principles are applied to all new stretches of road. SEPA have noted that the format of the drainage scheme should be in accordance with the technical guidance set out in CIRIA Report C521 "Sustainable Urban Drainage Systems (SUDS) – a design manual for Scotland and Northern Ireland". It is understood that SEPA have not yet formally commented on the detailed surface water drainage proposals for the Scheme; these are presently under development.

Watercourse Crossing

It is understood that no bridges are intended to be constructed as part of the improvements, however minor culverting may be required.

12.2 Methodology

The assessment methodology used in this Chapter is based on the generic methodology presented within Chapter 1 of this ES. Into this methodology, the guidance and techniques presented within the Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 10 "Road Drainage and the Water Environment" have been incorporated. The following section gives further detail in regard to how the potential effects on the water resources, which may arise from the construction and operation of the Scheme, were assessed.

12.2.1 Baseline Conditions

Water resources features around the Scheme were identified initially from Ordnance Survey maps, a desktop review of previous reports, and survey data collected for the study area during the preparation of this ES. This initial desktop review was supplemented by consultations with statutory organisations and further consideration of available data. The study area assessed extends 250m either side of the Scheme (and further downstream where required) for surface water features, whilst groundwater features were considered over 1km either side of the Scheme.

Surface Waters

Geomorphological and Hydrological Data

Geomorphological conditions of each watercourse were evaluated from Ordnance Survey mapping, data collected during the field surveys for this ES and the information within Chapter 13, Geology and Soils.

Hydrological data was collected for the surrounding watercourses from the National River Flow Archive, which is accessed through the SEPA website. Where data was not available an assessment of the flow was made using standard low flow hydrology techniques. It is noted that these flows have been derived for the purposes of this assessment only, and the designers of the watercourse crossings will be responsible for assessing the flows and providing crossings with adequate flow capacity.

Where available, flood mapping was also collected for the surrounding watercourses to enable an assessment of whether the proposals may affect any floodplains.

River Water Quality

SEPA have developed a River Water Quality Classification system, which is applied to all significant watercourses in Scotland. This system is based on an assessment of chemical and biological indicators. The Water Quality Classification system categorizes rivers into A1 – excellent, A2 – Good, B – Fair, C – Poor, and D – Seriously Polluted, and a full description of this system is available on the SEPA website.

The evaluation of baseline water quality in this Chapter for the Pow Burn is based on the classification advised by SEPA. The evaluation of the baseline water quality for the other watercourses crossing or in close proximity to the proposed Scheme is based on a visual / qualitative assessment using the River Classification Scheme criteria. This assessment is based on the presence of List A (faeces, toilet paper, oils, non natural foam, sewage or oily smells) and List B (builders waste, gross litter (furniture, motor vehicles, road cones, etc.) contaminants (see Table 1 Aesthetic Contaminants – River Classification Scheme). The evaluation also takes into account the setting of each of these watercourses e.g. the presence of surrounding infrastructure that may influence water quality.

For the purposes of this assessment, the present water quality objectives for all of the watercourses in this area are assumed to be the preservation of the current Water Quality Classifications. It is noted that the creation of River Basin Management Plans for the Water Framework Directive will influence future water quality objectives, however it is understood that the water quality objectives for individual watercourses have not yet been developed.

Groundwater

Groundwater data was sourced from:

- Consultations with SEPA in regard to any areas of groundwater pollution or groundwater abstraction within the study area;
- Geology and Soils Chapter of this ES;
- The following mapping derived by SEPA for the characterisation of groundwater for the WFD – "Groundwater Vulnerability Map", "Superficial Aquifer Map", and the "Bedrock Aquifer Map"; and
- The original, and now partially superseded, "Groundwater Vulnerability Map of Scotland" (1995) and "Hydrogeological Map of Scotland" (1988) published by the British Geological Survey.

12.2.2 Impact Identification

Identification of the possible range and location of potential impacts was based on:

- The guidance within DMRB Volume 11, Section 3, Part 10 "Road Drainage and the Water Environment";
- The professional experience of the assessment team;
- Consultation with relevant statutory and non-statutory organisations;
- Desk and site based research;
- An EIA scoping report and a DMRB Stage 2 report previously prepared; and
- Liaison with other chapter authors, and in particular the authors of the Ecology and Geology and Soils chapters.

From this work a distilled list of impacts thought to have potential to cause adverse effects on the water resource features was derived (see Section 12.5). It is noted that environmental effects on the water resource features may also lead to other impacts (such as changes to the aquatic ecology), which are addressed separately in this ES.

12.2.3 Impact Assessment

Impact assessment was based on the generic assessment methodology presented in Chapter 1 of this ES and the guidance within DMRB Volume 11, Section 3, Part 10 "Road Drainage and the Water Environment".

Impact Magnitude

The **magnitude** of a potential effect on the water resources features was evaluated using the criteria provided in Table 5.4 "Estimating the Magnitude of an Impact on an Attribute" (DMRB), with the addition of the following criteria to cover areas not specifically dealt with in the DMRB criteria. It is noted that impact magnitudes described below are all phrased assuming adverse impacts, but these general classifications have also been used to describe beneficial impacts from the Scheme:

Severe – (equivalent to "Major Adverse" in DMRB) – results in loss of attribute and / or quality and integrity of attribute. Additional criteria:

- Degrading of the existing water quality classification;
- Significantly increased flooding of residential or commercial properties ((this is in lieu of the DMRB increase in flood level >100mm);
- Loss of or serious effect on the integrity of a internationally or nationally designated aquatic ecological resource;
- Gross changes to geomorphological or hydraulic characteristics e.g. loss of natural bank and bed over a length of 50m or more, reduction in flow capacity of an existing river channel by 20% or more; and
- Widespread effect on groundwater movement with a gross change to overall groundwater transfer from up gradient to down gradient resources. Widespread and gross effects on groundwater quality.

Moderate – (equivalent to "Moderate Adverse" in DMRB) – results in effect on integrity of attribute or loss of part of attribute. Additional criteria:

- Degrading of either the combined water quality or biological quality indicators one or more classifications, but no change in overall classification;
- Slight increased flooding of residential or commercial properties (this is in lieu of the DMRB increase in flood level >50mm);
- Slight impact on an internationally or nationally designated aquatic ecological resource, or a loss or serious effect on the integrity of a nationally or locally important aquatic ecological resource that is not designated;
- Significant, but not gross, changes to geomorphological or hydraulic characteristics e.g. loss of natural bed and bank over a length of 20m or more, reduction in the area of an existing watercourse channel by less than 20%; and
- Widespread effects on groundwater movement with a measurable, but not gross, effect on overall groundwater transfer from up gradient to down gradient resources. Widespread, but not gross, effects on groundwater quality.

Slight – (equivalent to "Minor Adverse" in DMRB) – results in some measurable changes in attributes quality or vulnerability. Additional criteria:

- Degrading of two or more water quality or biological quality indicators, but with no change in either overall or the individual water or biological quality classifications;
- Some increased flooding in rural areas immediately adjacent to proposed Scheme, but not affecting property, infrastructure, or ecological resources (this is in lieu of the DMRB increase in flood level >10mm);
- Slight impact on a nationally or locally important aquatic ecological resource, or the loss of a moderate area of an abundant aquatic ecological resource;
- Minor changes to some geomorphological or hydraulic characteristics e.g. loss of natural bed and bank over a length of less than 20m, reduction in the area of an existing watercourse channel by less than 5%; and
- Localised effect on groundwater movement but no measurable effect on overall groundwater transfer from up gradient to down gradient resources.

Widespread or localised, measurable but not gross, effects on groundwater quality.

Negligible – (equivalent to "Negligible" in DMRB) – results in effect on attribute, but of insufficient magnitude to affect the use or integrity. Additional criteria:

- Degrading of one individual chemical or biological quality indicator, but with no change in either the overall or the chemical or biological quality classifications;
- Minor / no increased flooding in rural areas (this is in lieu of the DMRB increase in flood level <10mm);
- Slight impact on a small area of an abundant aquatic ecological resource;
- Highly localised but not measurable changes in some geomorphological or hydraulic characteristics; and
- Highly localised effect on groundwater movement but no effect on overall groundwater transfer from up gradient to down gradient resources. Widespread or localised, but not measurable, effects on groundwater quality.

Sensitivity of Receptor

The **sensitivity** of a water resources feature is a synthesis of its environmental importance, socio-economic value, recreational value, and also its resilience to cope with change. The sensitivity of a water resources feature was evaluated using the guidance provided in Tables 5.1 "Water Features: Attributes and Indicators of Quality" & 5.3 "Estimating the Importance of Water Environment Attributes" (DMRB). From this guidance the following objective tests have been used in this Chapter to assess sensitivity:

- The environmental importance e.g. if the water resources feature has a designation at an international level (e.g. Special Area of Conservation) or if the water body has A1 water quality and is therefore a valuable pristine habitat, then this would tend to increase the sensitivity value of the receptor;
- The socio-economic value of the water body e.g. if the water body has notable aquatic ecological resources (e.g. an important local or national fishery) or if the groundwater is in a drinking water protected area as defined in the SEPA WFD Protected Areas Register, then this would tend to increase the sensitivity value of the receptor;
- The recreational value of the water body e.g. if an area is a SEPA designated bathing area or if a watercourse is an important local fishery this would tend to increase the sensitivity value of the receptor; and
- The size of the water body and its ability to buffer flow and water quality changes e.g. if a water body has high dilution characteristics compared to a small proposed discharge then its sensitivity value would tend to decrease.

In accordance with the generic methodology, sensitivity has been scaled from Negligible to Low to Medium to High to Very High. In this Chapter a Negligible or Low sensitivity attribute are both considered to be equivalent to the Low Importance stated in Table 5.3 (DMRB). To ensure the transparency of this assessment, a description of how the sensitivity of each water body was derived is included in the "Baseline" Section of this Chapter.

Impact Significance

Overall Significance is a product of both the sensitivity of the receptor and the magnitude of the effect. Significance is scaled from Negligible through Minor, and Moderate, to Substantial. In assessing the product of sensitivity and magnitude the Matrix of Significance presented in Chapter 1 has been adopted. Therefore, only impacts that are moderate or substantial are considered to be Significant. The significance of a potential effect on the water resources features has been evaluated using the guidance provided in Table 5.6 "Definitions of Overall Assessment Scores" (DMRB).

It is noted that primary mitigation (see section below for details) is deemed to have been included when making the initial assessment of impact significance.

It is also valuable to attribute a level of confidence to the predicted impact assessment. Unless otherwise stated the impacts described in this Chapter are given at a high confidence level. Where impacts are given at a low confidence level, a reason shall be stated for this i.e. lack of detailed design data.

Mitigation

Mitigation measures considered appropriate for the avoidance and minimisation of effects on water resource features will be proposed in accordance with the generic guidance provided in Chapter 1.

Primary mitigation has been included in the "Environmental Effects" section of this Chapter, and these measures represent what are considered to be standard mitigation measures that would be applied to the construction and operation of such a scheme. These primary mitigation measures may be standard conditions that would be applied by SEPA or measures that a designer or contractor would be expected to take based on current best practice.

Mitigation measures noted subsequently in the "Mitigation" section, are those that are considered necessary for this Scheme in particular in order to offset the potential environmental effects, but that would not necessarily have been included as a matter of course in the design of such a Scheme.

12.2.4 Assessment Years

The baseline established for this assessment has been assumed to remain constant up to the time when the Scheme is put in place (2009), and this is because the full implementation of the Water Framework Directive will not have been completed (i.e. the publishing of the first round of River Basin Management Plans and setting of specific environmental objectives). For the purposes of this assessment the baseline has also been assumed to remain constant till the point when the Scheme has completed its first 15 year period of operation (2024). The reason for this is that it is difficult at this stage to identify what specific objectives will be set under the River Basin Management Plans. However, it is recognised that there is the potential for the baseline water quality of the water resources features to improve over the next 20 years based on the overall aim of the Water Framework Directive to protect and enhance the water environment.

12.3 Consultations

Table 12.1 provides a summary of the water environment related issues highlighted during the consultation exercise completed for this ES.

Table 12.1: Consultations

Organisation	*Statutory (S) / Non Statutory (NS)*	*Response with regard to the water environment*
Scottish Executive Environment Group – Climate Change & Air Division	S	No specific concerns were raised. It was stated that: Should ensure no significant impact on water environment during or after construction All pollution risks and associated preventative and mitigation measures should be identified SUDS should be adopted where applicable, and long term and temporary disposal of foul water should be considered The Water Environment (Controlled Activities) Regulations 2005 should be adhered to and method statements prepared for all aspects of site work that might impact on water quality
The Scottish Wildlife Trust	S	Raised concern that salty drainage water from the A77 is thought to have previously caused damage to trees along the boundary of the Coodham Estate
South Ayrshire Council – Planning and Transportation	S	Noted that there are a number of watercourses adjacent to the A77 draining into Dow's Burn and the Pow Burn. Sought re-assurance that any works would not increase potential flooding downstream, and that if any additional discharge were to be attenuated to the "greenfield" condition, then this would be sufficient. Noted that SUDS are proposed.
Scottish Environment Protection Agency (SEPA)	S	Require the use of SUDS for both completed road and construction drainage. Noted that the road drainage SUDS may require CAR licensing. Noted that there may be discharge pipes serving septic tanks in the area, which have not been considered.

Copies of relevant correspondence are included in Appendix 3. The significant issues raised during these consultations have been assessed within this Chapter.

12.4 Baseline

12.4.1 Overview

There are five water resource features that have been identified within the 250m boundary that has been considered either side of the proposed Scheme. Three of these features are burns, which generally run parallel to the A77. The remaining features comprise of the groundwater under the area and a small surface water body. These features are identified on Figure 12.1.

12.4.2 Pow Burn

This is the principal watercourse within the study area; its catchment is located to the south of the A77 and runs adjacent to the road alignment. It has a catchment area in the order of 14.03km^2, which gives an average daily flow in the region of 24,639m^3/d. The catchment is predominately agricultural land. The watercourse falls from 90mAOD to 0mAOD and enters the sea approximately 2.5km downstream from the proposed Scheme. Adjacent to the A77 the burn channel was observed as varying between 2-4m wide and the watercourse is relatively shallow and slow flowing with a cobble substrate and earthen banks with scattered areas of woodland and scrub vegetation.

In terms of water quality, the river is monitored by SEPA and possesses classifications from C "Poor" to B "Fair" depending on the reach under consideration (2004 results). The reaches and their respective water quality classifications are shown on Figure 12.1. According to the National Water Quality Classification 2004 report by SEPA, the stream biology of the Pow Burn has improved from class "C" to class "B" from 2003. The improvement is linked to enhanced sewage treatment at Hansel Village, but it is still subject to diffuse pollution from farm run-off.

From the Ecology Chapter it is noted that the Pow Burn is a non-statutory site protected through South Ayrshire Council's Wildlife Strategy.

There is also a 1 in 100year flood map published by SEPA (TBC), which shows the predicted extent of the flood plain for this watercourse.

Table 12.2 below outlines the characteristics of the Pow Burn.

Table 12.2: Pow Burn

Receptor	Environmental Importance	Socio-Economic Value	Recreational Value	Size of Water Body	Overall Sensitivity
Pow Burn	Water Quality B - C - No International or National designations - Evidence of old otter activity in the area was identified however no current presence was identified, possibly due to the observed absence of fish from the burn	No specific local fishery identified and no use for abstraction	No specific local fishery identified	Ability to buffer small discharge	**Medium (based on class, but could justify reduction to Low if no otters or other concerns were confirmed)**

12.4.3 Dow Burn

This watercourse is located at the southwest end of the study area, and its catchment is centred around the A77. It has a catchment area in the order of 1.58km^2, which gives an average daily flow in the region of 2515m^3/d. The

catchment is predominately agricultural land. The watercourse falls from 50mAOD to 0mAOD and enters the sea approximately 2km downstream from the proposed Scheme. Adjacent to the A77 the burn channel is approximately 1.5m wide and the watercourse is relatively shallow and fast flowing with a substrate of cobbles, occasional boulders, gravel and silt.

In terms of water quality, the river is not monitored by SEPA and therefore a classification has had to be assigned for the purposes of this assessment. Based on the agricultural nature of the catchment, the proximity to the A77, the fact that burn is understood to receive surface water drainage discharges from the A77, and the water quality of the nearby Pow Burn, this watercourse has been assigned a classification of B "Fair" for the purposes of this assessment.

From the Ecology Chapter it is noted that the Dow Burn does not possess any form of nature conservation designation.

There is also a 1 in 100 year flood map published by SEPA (TBC), which shows the predicted extent of the flood plain for this watercourse.

Table 12.3 below outlines the characteristics of the Pow Burn.

Table 12.3: Pow Burn

Receptor	*Environmental Importance*	*Socio-Economic Value*	*Recreational Value*	*Size of Water Body*	*Overall Sensitivity*
Dow Burn	Water Quality B - No formal designations	No specific local fishery identified and no use for abstraction	No specific local fishery identified	Low ability to buffer flows	**Medium**

12.4.4 Unnamed Burn to North of A77

This watercourse runs parallel with and to the north of the A77 between Symington and Monktonhill, and its catchment is also located to the north of the A77. It has a catchment area in the order of 1.64km^2, which gives an average daily flow in the region of 2696m^3/s. The catchment is predominately agricultural land. The watercourse falls from 80mAOD to 0mAOD and enters the sea approximately 2km downstream from the proposed Scheme. Adjacent to the A77 the burn channel is approximately 1.5m wide and the water depth is relatively shallow (in general <80mm) and slow flowing, with some areas very heavily vegetated to the point of obscuring the channel.

In terms of water quality, the river is not monitored by SEPA and therefore a classification has had to be assigned for the purposes of this assessment. Based on the agricultural nature of the catchment, the proximity to the A77, the fact that burn may receive road surface water drainage discharges, and the water quality of the nearby Pow Burn, this watercourse has been assigned a classification of B "Fair" for the purposes of this assessment.

From the Ecological Assessment (Chapter 6 – Ecology and Nature Conservation) it is noted that this watercourse does not possess any form of nature conservation designation.

Table 12.4 below outlines the characteristics of the Pow Burn.

Table 12.4: Unnamed Burn to North of A77

Receptor	Environmental Importance	Socio-Economic Value	Recreational Value	Size of Water Body	Overall Sensitivity
Unnamed burn to the north of the A77	Water Quality B – No formal designations	No fishery or other social / economic use	No fishery or other social / economic use	Low ability to buffer flows	**Medium**

12.4.5 Coodham Lake

Coodham Lake forms a major body of water within the area under consideration and was part of the designed landscape of the former estate. As part of the conversion of the estate into a luxury housing development, the lake has recently been dredged for silt removal in an effort to restore it to its former quality as part of the designed landscape improvements. Large numbers of waterfowl were observed using the lake, including herons feeding indicating the presence of fish. Otters were also observed using the lake, all of which indicate it is a water body with significant ecological value.

In terms of water quality, the lake is not monitored by SEPA and therefore a classification has had to be assigned for the purposes of this assessment. Based on the agricultural nature of the catchment, the proximity to the A77, and the water quality of the nearby Pow Burn, this waterbody has been assigned a classification of B "Fair" for the purposes of this assessment.

Table 12.4 below outlines the characteristics of the Coodham Lake.

Table 12.4: Coodham Lake

Receptor	Environmental Importance	Socio-Economic Value	Recreational Value	Size of Water Body	Overall Sensitivity
Coodham Lake	Water Quality No formal designations Signs of otter activity	No specific local fishery identified and no use for abstractions	No fishery or other social / economic use	Moderate	**Medium**

12.4.6 Groundwater

The following groundwater data has been gathered: -

- From the Groundwater Vulnerability Map of Scotland (BGS 1995) – the geological classification of the area is moderately to weakly permeable with a substantial thickness of superficial drift deposit of boulder clay with a low permeability;
- From the Hydrogeological Map of Scotland (BGS 1988) – the region is underlain mainly by carboniferous westphalian rock with potential areas of impermeable rock generally without groundwater present, except at a very shallow level;
- The SEPA "Bedrock Aquifers" classification records the area as predominantly "Integranular and fracture flow with moderate productivity ". The SEPA "Superficial Aquifers" map records intergranular flow with moderate productivity. The SEPA "Vulnerability of Groundwater in the Uppermost Aquifer" map records the area as "Category 4, predominantly 4b" where categories range from 1 (least vulnerable) to 5 (most vulnerable); and
- The area is not a Drinking Water Protected Area although it is identified as a Groundwater Body, as defined in the SEPA WFD Protected Areas Register. In addition, there are no known significant water supplies relying on groundwater.

SEPA have confirmed that there is no current licensing system in Scotland for groundwater discharges or abstractions and that they do not undertake any groundwater monitoring within the study area.

Table 12.5 below outlines the characteristics of the local groundwater.

Table 12.5: Local Groundwater

Receptor	*Environmental Importance*	*Socio-Economic Value*	*Recreational Value*	*Size of Water Body*	*Overall Sensitivity*
Ground water	Not a groundwater protected zone but is classed as vulnerable. Not identified as being at significant risk from diffuse pollution	No specific groundwater abstractions identified within the study area. Underlying aquifers are generally of low to moderate productivity	Not applicable	Mixed due to different bedrock areas.	**Medium**

12.4.7 Planning

Overarching Legislation

The WFD, enacted in Scotland by the Water Environment & Water Services Act (2003) aims to: protect and enhance the status of aquatic ecosystems; prevent further deterioration to such ecosystems; promote sustainable use of available water resources; and contribute to the mitigation of floods and droughts. A review

of the SEPA website identified the area as being a designated groundwater body, however no areas were identified as "Waters Used for the Abstraction of Drinking Water", "Water Dependant Conservation Areas", "Areas Designated to Protect Economically Significant Aquatic Species and Bathing Water Directive Beaches", and "Nutrient Sensitive Areas".

In terms of groundwater, Scotland currently has no system for reporting the overall condition of groundwater. The Directive requires the reporting and recording of groundwater status, and SEPA have targeted the introduction of such a scheme by 2009. As with surface water bodies, good quality groundwater bodies will be protected and poorer quality groundwater bodies will be targeted for restoration.

SPP7

SPP7 provides the current context for planning controls on flood risk. SPP7 states as general principles that new developments should not: materially increase the risk of flooding elsewhere; add to the area of land which requires protection by flood prevention measures; affect the ability of the functional flood plain to attenuate the effects of flooding by storing flood water; interfere detrimentally with the flow of water in the flood plain; or compromise future options for future shoreline or river management.

Structure and Local Plans

These documents were reviewed in terms of policies affecting water resources features and the following policies are highlighted.

Ayrshire Joint Structure Plan

The joint Ayrshire Councils shall "actively seek to improve the urban and rural environment of Ayrshire, and, …shall not be supportive of development proposals which have significant adverse effects by means of…unacceptable pollution of air, water or land…"

"In allocating land for development, local plans shall seek to ensure that sites…do not have an adverse affect on land, air and water quality."

12.5 Environmental Effects

As a result of the consultations, site visits and desktop studies, the issues requiring consideration in this assessment were distilled down to those in Table 12.6 below.

Table 12.6: Water Resource Issues

General Issue	*Specific Issues*	*Receptor/s*
Surface Water Quality	Sediment mobilisation and spillage or discharge of other pollutants in watercourses (Construction Phase)	All Watercourses
	Discharge of road run off to watercourses (Operational Phase)	All Watercourses
	Other road and infrastructure maintenance (Operational Phase)	All Watercourses

General Issue	Specific Issues	Receptor/s
Flooding	Flood risk to surrounding land from development (Construction Phase)	Surrounding land & infrastructure
	Flood Risk to surrounding land from development (Operational Phase)	Surrounding land & infrastructure
Geomorphology and Hydrology	Alteration / addition of watercourse crossings (Construction Phase)	All watercourses
	Alteration / addition of watercourse crossings (Operation Phase)	All watercourses
	Alteration to land drainage patterns (Construction and Operation Phase)	All watercourses
	Run off from the Scheme into watercourses (Operation Phase)	All watercourses with outfalls
Ground Water	Potential disturbance of groundwater movement (Construction Phase)	Groundwater
	Potential contamination to shallow groundwater (Construction Phase)	Groundwater
	Potential disturbance of groundwater movement from the new road construction (Operational Phase)	Groundwater
	Potential contamination to shallow groundwater (Operational Phase)	Groundwater

12.5.1 Effects of Construction

Water Quality

The following assessment considers the potential for sediment release and spillage / discharge of pollutants (e.g. oils, fuels, chemicals) to surrounding waters during the construction phase, and the potential impacts that such a release may have on water quality.

Receptor(s)	All Watercourses
Relevant Scheme Information	Given the nature of the project there will be significant earth / rock moving activities during construction. This presents a significant risk of surface water run off eroding bare slopes or material stockpiles, which can lead to increased suspended solids in watercourses. The construction phase also presents the potential for fuels, oils, and other chemicals to be spilled via an accident, improper usage, or poor storage. These could reach the receptors directly via discharge of polluted run off or via seepage into the shallow groundwater. Discharge of construction workforce sewerage and washing effluent into watercourses will not be permitted and this potential impact is therefore not considered further.
Sensitivity of Receptor(s)	**Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	**Slight Adverse** (localised, temporary) – risk of significant discharge of polluting substances into a watercourse should be minimised through the application of the primary mitigation noted below. Some local instances of suspended solid releases into watercourses may be

	experienced given the proximity of the construction work to some of the watercourses. However, with primary mitigation applied the impacts should be minimised and temporary in nature. Therefore no long-term derogation of the water quality classification should be experienced.
Primary Mitigation Included	Consideration should be given to the need for settlement ponds or similar for both the construction and operation phases of the Scheme. The land take required for such facilities should be considered during the finalisation of land acquisition for the project. The Contractor shall implement best practice guidance as detailed in PPG's published by SEPA and CIRIA Report C532, as a minimum. The Contractor shall produce a site management plan covering the areas noted above, and all staff on site should be trained in the relevant best practice techniques. In particular, construction materials should be stored away from watercourses, plant should be stored and maintained away from watercourses, silt fences or similar should be placed around exposed ground and stockpiles, and early re vegetation of the completed elements of the Scheme should be undertaken to reduce further erosion. A general methodology for constructing watercourse crossings should be developed by the Contractor in consultation with SEPA, to ensure that works are completed with the minimum of disturbance to the watercourse. During construction works on new or existing crossings, the flows should be over pumped or temporarily piped through the working area. The working area should then be temporarily sealed at either end so that any contaminated run off can be captured and remains largely isolated from the watercourse. For the larger watercourses where this is not practical, consideration should be given to leaving the natural bed / bank in place and constructing the crossing with no activity in the watercourse.
Overall Significance	**Minor Adverse**

Flooding

This part of the assessment considers whether or not the construction activities at each watercourse or within the Scheme corridor would affect the passage of water down a watercourse or the water levels within the identified floodplains.

Receptor(s)	Rural areas, residential properties, and other infrastructure located within the identified floodplains or upstream of new watercourse crossings
Relevant Scheme Information	During the construction of watercourse crossings there will be some form of land take around each watercourse with a potential for temporary reduction in waterway capacity during the works. Design information is being developed regarding the location and form of new crossings.
Sensitivity of Receptor(s)	Rural land is considered as having a **Low** sensitivity to increased flood risk, but individual residential property is considered as having a **High** sensitivity to increased flood risk.

Magnitude (and Type) of Effect	**Slight Adverse** (localised, temporary) – with the primary mitigation measures included, the Contractor should be able to complete the works without increasing the risk of flooding to rural areas or residential property.
Primary Mitigation Included	During construction works on new or existing crossings, the flows should be over pumped or temporarily piped through the working area. The temporary provisions for passing the flows through the working area should be designed to cater for a defined return period storm for each catchment, and current guidance recommends temporary works planning for a 1 in 10 year return period flow (CIRIA). Current guidance also recommends contingency planning for flows greater than this. No significant material stockpiles should be stored within or immediately beside an existing watercourse or within the identified floodplain of that watercourse, to prevent reduction in waterway capacity or local flood plain. The Contractor should undertake a flood risk assessment where residential property or other infrastructure could be affected, and design temporary measures to ensure flood risk is not increased during the works.
Overall Significance	**Negligible** for rural land and **Minor/Moderate** for residential properties

Geomorphology and Hydrology

This assessment considers the potential effects of the construction works required to provide new watercourse crossings on the structure of the bed and bank of each watercourse and the flow conveyance of each watercourse.

Receptor(s)	All Watercourses
Relevant Scheme Information	During the construction of pipe or box culvert watercourse crossings there will be significant disturbance to the physical features of the channel and bank in the locality of each crossing. This will be caused by the excavations required to position each culvert and any associated headwall structures, and from the construction vehicles required for this operation. For the purposes of this assessment it has been assumed that the contractor would implement best practice measures to control the volume of site run off, with a discharge to a watercourse only being made after some form of attenuation (see Mitigation for further details).
Sensitivity of Receptor(s)	**Medium** (see “Baseline” section)
Magnitude (and Type) of Effect	**Slight Adverse** (localised and largely permanent) for the watercourses and drains, as the bed and banks will be significantly disturbed around the new crossing. Extent of works can be controlled to some degree with the primary mitigation measures noted. Effects to the channel and bank outwith the road footprint can be mitigated with reinstatement and would be temporary in nature. Discharges of surface water from site are expected to limited to the

	approximate catchment of each watercourse, and should be controlled in accordance with best practice, as described in primary mitigation. This should mean that inappropriately large point discharges are avoided in comparison to the watercourse.
Primary Mitigation Included	The Contractor shall, where possible, construct culverts and other watercourse crossings as the works progress, to avoid the creation of temporary watercourse crossings that are then replaced at a later date. A full topographic survey and photographic record should be completed along each watercourse covering the area predicted to be disturbed during the works. This information should provide sufficient detail to allow the alignment, levels, and form of each channel and its banks to be reinstated after the works. Reinstatement should include re-vegetation with local plant species to stabilise the structure of the completed banks. The Contractor should set out a working zone around each watercourse in the construction method statements, which should be agreed with SEPA. This should be the minimum area required to safely complete the works, and should not allow for the storage of any plant or materials. This area should be clearly marked out on site and operatives should be briefed on the working area restrictions. Surface water run off from the site should be controlled on a catchment-by-catchment basis, with temporary attenuation provided to control the flow to each watercourse. The Contractor will need to liaise with SEPA regarding the need for temporary discharge licences under the Controlled Activity Regulations.
Overall Significance	**Minor Adverse** for the watercourses and drains

Ground water

This assessment considers the potential effects of the construction works required to create the new road on the **movement** of the groundwater.

Receptor(s)	Ground Water
Relevant Scheme Information	Assumptions based on worst-case scenario.
Sensitivity of Receptor(s)	**Medium** (see “Baseline” section)
Magnitude (and Type) of Effect	**Moderate Adverse to Negligible** (localised, temporary) depending on existing ground water levels and proposed cutting levels.
Primary Mitigation Included	The Contractor should include in the method statements a methodology for controlling groundwater in the overlying drift deposits in sections where groundwater is expected to be encountered. Groundwater collecting on the site should not be allowed to discharge in an uncontrolled fashion into watercourses. The Contractor would need to liase with SEPA regarding any proposed discharge from cuttings.

Overall Significance	**Moderate Adverse to Negligible** as with Magnitude, depending on actual ground water levels and proposed cutting levels

This assessment considers the potential effects of the construction works required to create the new road on the **quality** of the groundwater.

Receptor(s)	Ground Water
Relevant Scheme Information	The construction works will involve earth moving plant and other machinery, and this presents a risk of spillage of fuels, oils, and other chemicals, which can seep into the shallow groundwater and potentially any fractures in the underlying bedrock. The project will also likely require a construction compound, providing welfare facilities for the Contractor, and this may retain a store of fuels, oils, and other chemicals.
Sensitivity of Receptor(s)	**Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	**Slight Adverse** (localised, temporary) – with the primary mitigation measures in place (see below) and continually monitored, the likelihood of significant quantities of contaminants reaching the groundwater should be low. However, there is a residual risk of some localised impacts on groundwater (e.g. small spills, oil / fuel from plant, etc.) due to the scale and nature of the construction works.
Primary Mitigation Included	The Contractor should manage the works in accordance with the best practice guidance provided in the SEPA Pollution Prevention Guidelines and CIRIA Report C532 "Control of Water Pollution from Construction Sites". In particular the Contractor should provide bunds around all fuel, oil, and other chemical stores; centralise and minimise the number of these stores; complete all servicing, fuelling, and storage of vehicles at construction compounds; provide dedicated wash down areas for concrete and other delivery vehicles. The Contractor should implement drainage control measures at the site to prevent areas of standing surface water or groundwater that could become contaminated and leach into the shallow groundwater. Where collection of water at the site is unavoidable (e.g. large cuttings), provision should be made for this water to be passed through some form of treatment (such as settlement and clarification) before discharge. The Contractor would need to liase with SEPA regarding any proposed discharge from cuttings in respect to the new Controlled Activities Regulations (2005).
Overall Significance	**Minor Adverse**

12.5.2 Effects of Operation

Water Quality

Discharge of Road Run Off

The main contaminants that might be carried into the watercourses from road run-off include suspended solids (including grit, mud, metal particles), copper and zinc

(from deterioration of galvanised parts of vehicles), organic materials and hydrocarbons (such as rubber, bitumen, grease, oil and fuel) and salt.

DMRB Volume 11, Section 3, Part 10, HA 216/06 provides a number of assessment methods to gauge the potential impact of run-off from roads on the water environment. This Advice Note also provides guidance on suitable mitigation measures that can be applied when the above assessments indicate a risk of pollution to the water environment.

With regard to the potential contamination from discharge of routine road run off into a watercourse, the Advice Note requires that a "Simple Assessment" be made initially to determine whether the watercourse is at high or low risk of pollution. This assessment involves examining the relationship between the predicted volume of run off from the road, the assessed low flow within the watercourse, and the daily flow of vehicles (full details of the methodology are within HA 216/06). If this "Simple Assessment" puts a watercourse in the "low risk" category then no further assessment is required, and the guidance states that the simple assessment method "…produces conservative estimates, so that if it indicates low risk, there is a high level of confidence that there will be minimal impact". Should the "Simple Assessment" indicate that the watercourse is at "high risk", then the "Detailed Assessment" method needs to be used. This method compares the pre and post Scheme levels of Copper and Zinc within the watercourse against the relevant Environmental Quality Standard.

Initial worst-case scenario calculations have been undertaken, based on overall estimated areas draining to each watercourse. In order to provide a precautionary estimation, the assumption has been made that all discharge to a given watercourse enters only at one location. In reality there are likely to be several outfalls along the watercourse, sufficiently distant as to be considered independently, therefore the contributory drainage area to each would be greatly reduced and the actual risks considerably lower than those calculated using the combined area.

Assessment by "Simple Assessment" showed the Pow Burn and Dow's Burn to be at a low risk even using this overly cautious method. The unnamed watercourse was however assessed as being at a high risk, indicating that detailed assessment should be carried out. Due to the absence of water quality data for this watercourse, a detailed assessment was unable to be carried out at this time. Once the final road drainage configuration is known, the assessment of all three watercourses should be revisited in order to confirm the risk categories.

With regard to the potential contamination of a watercourse from an accidental spillage on the proposed road, the Advice Note requires an "Assessment of Pollution Impacts from Accidental Spillages" to be undertaken. This involves consideration of the probability of a spillage accident with an associated risk of a serious pollution risk occurring. It is stated in the Advice Note that watercourses should be protected such that the risk of a serious pollution incident has an annual probability less than 1%. This assessment method was followed for all watercourses where an outfall has been identified by the designers, and in all cases the annual probability was calculated for both the existing case and proposed improvements, the results of which can be seen in Table 12.7 below.

Table 12.7: Risk of Pollution

Watercourse	*Risk Probability Existing Case*	*Risk Probability Proposed Improvements*
Dow's Burn	0.03%	0.03%
Pow Burn	0.05%	0.04%
Unnamed Watercourse	0.05%	0.04%

In all cases the probability is significantly less that 1%, therefore no additional protection measures are required. It should be noted that the proposed road improvements have either a negligible or positive impact on the risk of an accidental spillage incident occurring; they do not increase the volume of traffic using the road, and improve safety by removing crossroads and closing central reservation gaps.

De-icing salts will commonly be used on road between the months of November and March. It is noted that the concurrent flows in watercourses are relatively high during these months, and therefore the salts would be subject to reasonable dilution and dispersion on entering a watercourse. From PPG 10 it is noted that the *"…use of salt on highways is unlikely to lead to levels in the water environment that could affect aquatic life or drinking water supplies"*. There is no specific assessment within the Advice Note for the potential impacts of de-icing salts on watercourses.

Based on the above assessment the following summary of the effects on water quality has been derived.

Receptor(s)	All Watercourses
Relevant Scheme Information	Details are being developed for the new surface water drainage proposals and for existing road drainage infrastructure.
Sensitivity of Receptor(s)	**Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	**Pow Burn - Negligible (permanent)** see Table 5.4 of HA 216/06 (i.e. low risk from Method A and risk of pollution from accidental spillage <0.5%). Detailed zinc and copper calculations not completed as no data available **Dow's Burn – Negligible (permanent)** see Table 5.4 of HA 216/06 (i.e. low risk from Method A and risk of pollution from accidental spillage <0.5%). Detailed zinc and copper calculations not completed as no data available **Unnamed Watercourse – Slight Adverse (permanent)** see Table 5.4 of HA 216/06 (i.e. high risk from Method A but risk of pollution from accidental spillage <0.5%). Detailed zinc and copper calculations not completed as no data available.
Primary Mitigation	The new sections of road are to incorporate SUDS principles, by providing some treatment and attenuation to the road run off. The

Included	proposed road alignment and profile has been designed to improve safety and hence reduce the risk of serious accidents and attendant spillages.
Overall Significance	**Dow's Burn – Negligible** **Pow Burn – Negligible** **Unnamed Watercourse – MinorAdverse**

Other road and infrastructure maintenance

This assessment considers whether the maintenance of the road, gullies, culverts, and soft landscaping is likely to have any effect on the water quality of the surrounding watercourses. There is no specific guidance with DMRB HA 216/06 on assessing the potential impacts from this source of pollution.

Receptor(s)	All Watercourses
Relevant Scheme Information	During the operation of the Scheme the principal maintenance activities are likely to be road pavement maintenance (anticipated to be minimal during first 10years), cleaning debris from culverts (possibly annual), inspection and repair of bridges (including crash barriers, etc) and maintenance of roadside verges (e.g. clearing debris, removing invasive species, etc).
Sensitivity of Receptor(s)	**Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	**Negligible Adverse** (localised, temporary) – cleaning of debris from culverts is likely to cause only minor disturbance to the bank and bed locally at the entrance and exit of each culvert and the vehicles / plant are assumed to work from the road with the appropriate traffic control measures in place. Repair of other infrastructure may involve repainting of parapets or use of other chemicals, and this presents a risk of materials entering watercourses. However, with the primary mitigation noted below, the risk of a major spillage should be reduced to a very low level.
Primary Mitigation Included	Works to culverts and bridges should be completed under an approved method statement and should include best practice measures (including the SEPA Pollution Prevention Guidelines) to reduce the risk of significant physical disturbance of, or major spillages to, watercourses.
Overall Significance	**Neutral / Minor Adverse**

Flooding

This part of the assessment considers whether or not the construction activities at each watercourse or within the Scheme corridor would affect the passage of water down a watercourse or the water levels within the identified floodplains

Receptor(s)	Rural areas, residential properties, and other infrastructure located within the identified floodplains or upstream of new watercourse crossings
Relevant Scheme Information	Details are being developed for the new surface water drainage proposals and for details of any new water crossings or changes to existing crossings.

Sensitivity of Receptor(s)	Rural land is considered as having a **Low** sensitivity to increased flood risk, but individual residential property is considered as having a **High** sensitivity to increased flood risk.
Magnitude (and Type) of Effect	**Negligible Adverse** (localised, temporary) – with the primary mitigation measures included the Contractor should be able to complete the works without increasing the risk of flooding to property.
Primary Mitigation Included	New culverts should be sized to accept a defined return period storm, which in turn should be set by the Scheme designers in accordance with current best practice and advice from SEPA. The storm flows should be calculated for each watercourse using FEH or similar accepted methods. The culverts should be no smaller than the existing watercourse crossings they will be replacing or acting in conjunction with. No material stockpiles should be stored within or immediately beside an existing watercourse, to prevent reduction in waterway capacity or local flood plain.
Overall Significance	**Minor Adverse**

Geomorphology and Hydrology

Alteration / addition of watercourse crossings

This assessment considers the potential effects of extending existing crossings or adding new crossings on the structure of the bed and bank and the flow conveyance of each watercourse.

Receptor(s)	All Watercourses
Relevant Scheme Information	The presence of new culverts on watercourses will alter the physical features of the bed and bank over the width of the road, and for a short distance upstream and downstream. Effectively the natural features of each watercourse will be lost over this distance. Assuming the culvert is correctly sized (see primary mitigation) for each watercourse, the overall flow capacity of the watercourse should not be decreased, however the flow characteristics may be altered over the length of the crossing.
Sensitivity of Receptor(s)	**Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	With respect to watercourse crossings the effect is predicted as **Negligible Adverse** (localised, permanent) – with the primary mitigation measures included the crossings should be able to be designed so as not to worsen any existing flooding problems. Where an opportunity exists to replace existing culverts that are inadequate or in poor condition, a **Negligible Beneficial** (localised, permanent) effect may be experienced.
Primary Mitigation Included	The design of each new culvert shall be such as to avoid changing the alignment and concentration of flows upstream and downstream of each crossing point. Bank protection works should be kept to a minimum. Analysis of the potential for scour at all culvert sites, and good design of scour protection works. The advice within CIRIA Report C551 Manual on Scour at Bridges and other Hydraulic Structures should be taken into

	account in the design. Design of all new river crossings and culvert works for the Scheme in accordance with the Scottish Executive's "River Crossings and Migratory Fish: Design Guidance (April 2002)". Finalisation of exact culvert locations and orientations to be undertaken on site by the Designer's representative and the Contractor, in order to minimise the length of watercourse realignment required. The culverts should be sized to accept a defined return period storm (see primary mitigation in the flooding assessment above).
Overall Significance	**Negligible** (provided that the primary mitigation measures are followed during design and construction)

Run off from the Scheme into watercourses

This assessment considers the potential effects of road drainage outfalls on the geomorphology and hydrology of the watercourses they discharge into.

Receptor(s)	All Watercourses
Relevant Scheme Information	The proposed Scheme will increase the impermeable area draining into the watercourses, as the additional link roads and junctions will be greater than the present situation. The new proposals should incorporate some form of SUDS to comply with SEPA requirements with discharges to surrounding watercourses.
Sensitivity of Receptor(s)	**Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	On the basis that the primary mitigation measures noted below are adopted the effects are assessed as **Slight Adverse** (localised, temporal) – as the surface water run off should be able to be controlled to an acceptable percentage of the concurrent flow in each watercourse.
Primary Mitigation Included	The integration of SUDS for the drainage of all new sections of road, and the avoidance of new outfalls to surrounding watercourses where possible. Where outfalls are deemed to be necessary, an assessment of the flows within each watercourse and limiting the discharge rate from road drainage to an appropriate rate for each watercourse. One method would be to adopt a common Greenfield run off rate of 5 - 7l/s/ha (CIRIA C609), but this would need to be assessed against the capacity of each watercourse. The design of the surface water drainage infrastructure should be developed so as to retain run off within its natural drainage catchment and thereby minimise hydrological changes to each watercourse. Design of outfalls in accordance with current best practice to prevent scour and erosion of adjacent channel and bank of watercourse.
Overall Significance	**Minor Adverse (temporal)**

Alteration to land drainage patterns (overland flow)

This assessment considers the potential effects of the presence of the new road on the natural surface drainage patterns of the surrounding land. It is noted that given the similarities in effects between construction and operational phases, namely potential severance of overland flow between upslope and down slope, both phases have been considered in this assessment.

Receptor(s)	Watercourses
Relevant Scheme Information	During construction (excavation for new road pavement, creation of new cuttings and embankments) and in operation (presence of new road pavement, cuttings, and embankments) the proposed Scheme will cause some degree of severance of the existing pattern of overland flows to certain watercourses.
Sensitivity of Receptor(s)	The ultimate receptors will be the watercourses, and therefore sensitivity is **Medium** (see "Baseline" section).
Magnitude (and Type) of Effect	**Negligible Adverse** (localised, permanent) The introduction of new junction configurations including link roads and bridges will serve to create a discontinuity to existing overland flows in these areas. Overland flows are expected to be a relatively small component of the flows in these watercourses / drains given the relatively flat nature of the area immediately surrounding the Scheme.
Primary Mitigation Included	Surface flows collected in uphill drainage ditches and discharged to nearest watercourse or drainage feature as existing, thereby retaining the water within its natural drainage catchment and minimising hydrological changes to each watercourse. The drainage discharge points at each watercourse should be designed in accordance with best design practice to prevent erosion of the channel and banks. Green bank reinforcement should be included locally around each culvert to prevent the additional flow input from causing erosion.
Overall Significance	**Neutral – Minor Adverse**

Ground water

This assessment considers the potential effects on groundwater **movement** from the presence of the Scheme.

Receptor(s)	Ground Water
Relevant Scheme Information	Assumptions based on worst-case scenario.
Sensitivity of Receptor(s)	**Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	**Negligible Adverse** (highly localised, permanent) – groundwater movement within the solid geology will not be affected, as the depth of road construction will not physically impinge into this stratum. Groundwater movement within the drift deposits may be slightly disrupted over short lengths of cut however there is not expected to be a significant

	disruption to overall groundwater movement.
Primary Mitigation Included	None included at this stage.
Overall Significance	**Neutral – Minor Adverse**

This assessment considers the potential effects on groundwater **quality** from the operation of road run.

Receptor(s)	Ground Water
Relevant Scheme Information	The main operational element of the Scheme that has the potential to affect the groundwater quality will be the surface water run off from the road, which will carry with it hydrocarbons and metals (principally Copper and Zinc) from vehicles and salts from road de-icing. The other potential source for pollution is from vegetation maintenance alongside the road, where herbicides are frequently used to control weeds along linear infrastructure features.
Sensitivity of Receptor(s)	**Medium** (see "Baseline" section)
Magnitude (and Type) of Effect	**Slight Adverse** (widespread, permanent) – following Method C within HA216/06 puts the groundwater below the proposed Scheme site at medium risk of impact. However, a number of the parameters in this assessment had to be assumed given the lack of available ground investigation data. The calculated risk of pollution from accidental spillages is <0.5%, which places the groundwater at a negligible risk of impact.
Primary Mitigation Included	None included at this stage
Overall Significance	**Minor Adverse** (moderate confidence level pending further information)

12.5.3 Significance of Environment Effect

The significance of the environmental effects has been summarised in each of the above tables.

12.6 Mitigation

Primary mitigation, as defined in the assessment methodology (Section 12.2.3), has been included in each of the above assessments, and no specific requirement for secondary mitigation measures has been identified at this stage.

12.7 Residual Impacts

Residual impacts (including primary mitigation measures) have been determined in the tables in Section 12.5. It is noted that no significant residual impacts have been predicted at this stage.

12.8 Summary

This chapter addresses the potential effects on water resources as a result of the proposed Scheme. In the context of these proposals the significant water resources are the surface watercourses, surface water bodies and the groundwater. The assessment of effects was divided into four main areas, and these were: Surface Water Quality; Flooding; Geomorphology and Hydrology; and Groundwater. The predicted residual impacts ranged from **Neutral** to **Moderate Adverse**, however classification of an impact as moderate adverse has been as a worst-case scenario due to absence of detailed design information or estimated data. Therefore it is not thought to be likely that any significant residual impacts on water resources features would be predicted if assessment was carried out based on confirmed information and that the predicted residual impacts would then range from **Neutral** to **Slight Adverse**.

However, the following further assessment work is recommended prior to the start of construction:

Recalculation of pollution impacts from routine runoff using Method A once road drainage configuration is confirmed;

Revisitation of pollution impacts from routine runoff on groundwaters using Method B with confirmed data regarding the pathway elements of the assessment; and

Reassessment of pollution impacts from accidental spillages using Method D once road drainage configuration is confirmed.