Bexhill to Hastings Link Road

Chapter 9: Water Quality and Drainage

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9 Water Quality and Drainage

9.1 Introduction

9.1.1 This chapter is concerned with the effects of the Scheme on surface and groundwater quality and drainage. The impacts during the construction phase, and operationally, due to both normal daily use of the road and accidental spillages on the road have been assessed. Impacts on fisheries have been addressed in Chapter 12: Nature Conservation and Biodiversity.

Chapter Structure

9.1.2 This report includes the following:

- A summary of the existing baseline environment, including methods of assessment, quality of receiving waters, details of existing uses and sensitivities such as nature conservation designations and areas vulnerable to change in hydrological or hydrogeological regime or water quality. This includes any objectives or targets applied to the water bodies;
- An assessment of the potential for localised pollution effects resulting from construction and normal operation of the Scheme, and identification of suitable mitigation measures where appropriate;
- An assessment of the risk of an accidental spillage causing a serious pollution incident and development of the appropriate mitigation measures required;
- An assessment of the potential impact on adjacent watercourses and groundwater from mobilised sediments during construction; and,
- An assessment of the existing drainage regime and flooding problems and the potential effects resulting from the Scheme.

9.2 Method of Assessment

The Study Area

9.2.1 The proposed study area would cover the catchments of both the Egerton Stream and the Combe Haven (See Figures 9.1 and 9.2). The Scheme follows the alignment of the Egerton Stream, running approximately north from Bexhill then north-east across the Combe Haven.

Legislative Requirements

9.2.2 There is a wide range of international and national legislation relevant to the assessment of potential adverse impacts to water quality and drainage from highway developments. In addition, there are many guidance documents concerned with mitigating potential impacts. Table 9.1 lists the key legislation and guidance.

Table 9.1 Relevant Key Legislation and Guidance Documents

Context	Legislation, Policies and Guidance Documents
International	Water Framework Directive 2000/60/EC
	The Groundwater Directive 80/68/EEC
	EC Dangerous Substances Directive 76/464/EEC and daughter directives
	EC Freshwater Fish Directive 76/659/EEC and daughter directives
	Drinking Water Directive 80/778/EEC
National	The Water Act 2003
	The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003
	The Surface Waters (Fishlife) (Classification) Regulations 1997 (as amended 2003)
	The Control of Pollution (Oil Storage) (England) Regulations (2001)
	The Groundwater Regulations 1998
	The Surface Waters [Dangerous Substances (Classification)] Regulations 1998
	Control of Substances Hazardous to Health (COSHH) Regulations (1998)
	The Environment Act 1995 (as amended)
	The Surface Water (River Ecosystem) (Classification) Regulations 1994
	The Water Resources Act 1991 (as amended 2003)
	The Land Drainage Act 1991 (as amended)
	Food and Environment Protection Act 1985
	HA216/06 DMRB Volume 11, Section 3, Part 10: Water Quality and Drainage (amended May 2006)
	WEBTAG Unit 3.3.11 The Water Environment Sub-Objective
	CIRIA Report 648 (2006) *Control of water pollution from linear construction sites*

Context	Legislation, Policies and Guidance Documents
National	CIRIA Report 609 (2004) *Sustainable Drainage Systems – Hydraulic, structural and water quality advice*
	CIRIA Report 532 (2001) *Control of water pollution from construction sites*
	CIRIA Report 522 (2000) *Sustainable urban drainage systems – design manual for England and Wales*
	CIRIA Report 156 (1996) *Infiltration Drainage – manual of good practice*
	CIRIA Report 142 (1994) *Control of Pollution from Highway Drainage Discharges*
	Code of Good Agricultural Practice for the Protection of Water (the "Water Code") (DEFRA 1998 as amended 2002)
	Guidelines for the use of herbicides on weeds in or near watercourses and lakes (DEFRA 1995 PB2289)
	Environment Agency Pollution Prevention Guidelines (PPG), the most relevant being: • PPG1 – General guide to water pollution and prevention; • PPG 2 – Above ground oil storage tanks; • PPG 3 - Use and design of oil separators in surface water drainage systems; • PPG 5 – Works in, near or liable to affect watercourses; • PPG 6 – Working at construction and demolition sites; • PPG 8 – Safe storage and disposal of used oils; • PPG 9 - Prevention of Pollution by Pesticides; • PPG 21 – Pollution incidence response planning; • PPG 22 – Dealing with spillages on highways; and • PPG 23 – Maintenance of structures over water.

9.2.3 The Water Framework Directive (WFD) established a European wide framework for the management of water resources. The Directive stipulates that all classified watercourses should achieve or aim to achieve "*good ecological status*" by 2015. It remains unclear how the WFD would be enforced nationwide with regards to highway schemes in the UK, however this report includes reference to the WFD where appropriate. The EA has indicated that given the extensive use of Sustainable Urban Drainage Systems (SUDs) for the Scheme this should meet the requirements of the Directive, subject to the preparation of a Flood Risk Assessment (FRA) for the Scheme. The FRA has been prepared as a separate document and covers:

- The magnitude of the different potential forms of flooding;
- The Sequential Test looking at alternative route selection avoiding areas of highest flood risk; and,
- The Exception Test detailing the residual flood risk of the chosen route.

9.2.4 In England and Wales, The Water Resources Act 1991 (amended 2003) and the Environment Act 1995 establish the Environment Agency's (EA) powers and duties for the protection of water resources, flood defence, fisheries, recreation, conservation and navigation. The EA is the key statutory consultee responsible for ensuring the Scheme does not adversely affect flood risk, water quality or the local water environment.

9.2.5 The Highways Act 1980 permits the discharge of highway runoff to classified or non-classified surface watercourses, water bodies and/or groundwater. The Scheme would be operated and maintained by the Highway Authority who would be exempt from the need to apply for discharge consent for road runoff under the Water Resources Act 1991 (amended 2003) provided they do not cause pollution. Therefore, strict controls must be in place to ensure highway discharges do not pollute receiving water bodies.

General Approach

9.2.6 The assessment of potential impacts on water quality, drainage and hydrology have been carried out in accordance with the methodology set out in the Design Manual for Roads and Bridges (May 2006) Volume 11, Section 3, Part 10, henceforth referred to as 'DMRB'. The scope of the DMRB assessment covers the potential effects on water quality of receiving waters, as well as fisheries and any other 'feature' that may be sensitive to water pollution, changes in the hydrological regime, or the effects of new structures. Principally, the DMRB assessment provides a method to evaluate the likely impacts on water quality from polluted routine runoff and the risk of spillages leading to a serious pollution incident.

9.2.7 In addition, the assessment has also been informed by the Transport Appraisal Guidance (TAG) set out in TAG Unit 3.3.11: The Water Environment Sub-Objective. TAG incorporates previous guidance in the form of *Guidance on the Methodology for Multi-Modal Studies (GOMMMS)*, *Applying the Multi-Modal Approach to Appraisal to Highway Schemes* and *Major Scheme Appraisal in Local Transport Plans* and includes a method to appraise transport projects. TAG assessment involves a review of activities proposed and the potential impacts identified; an appraisal of the importance of the water environment within the study area; an appraisal of the potential impacts of the proposal on the important attributes; and the formulation of a final assessment score.

9.2.8 The DMRB also requires that potential impacts from construction works are assessed. The Scheme requires the construction of twelve new culverts/underbridges where the route and associated Greenway crosses a number of significant watercourses and minor drainage ditches. As described in this chapter, care will be taken to adequately address the potential for adverse impacts during construction. This would form part of the qualitative assessment of the risk of sediment accumulation and sensitivity of water habitats.

9.2.9 The DMRB highlights the need to take into consideration adverse effects of climate change when assessing proposed highway developments. Changing weather patterns and river flow volumes may affect the ability of a receiving watercourse to cope with contaminated highway drainage. Unfortunately, the DMRB does not provide advice on how these potential effects should be incorporated into the assessment. It is unclear how future changes in climate may affect the hydrology of local rivers. Therefore, when undertaking the DMRB we have consistently used worst case flow data as a precaution.

Sources of Information

9.2.10 Information on water quality, fisheries, flood risk, groundwater, abstractions and discharges was also obtained from the EA, East Sussex County Council (ESCC) and local water companies, and supplemented by an Envirocheck Report. Information of local designated nature conservation sites and their citations was obtained from English Nature (EN).

9.2.11 An initial detailed desk-top study was undertaken to supplement the existing information and assessments. Data on surface water quality was requested from the EA and supplemented where necessary with field sampling.

9.2.12 Where significant gaps in the data were identified, additional sampling was undertaken. However, field monitoring was limited to just one sample from a single site along each watercourse. Although useful background, spot samples are not considered to be representative of actual conditions and have been used carefully and in support of EA data, which has been used in preference during the assessment.

Background Data

9.2.13 Background data was obtained from the following sources:

- Owen Williams, 2006. Drainage Report, Bexhill to Hastings Link Road Preliminary Design Revision No. 0.0. Document Number 262701/007;
- East Sussex County Council, Sept 2005. Bexhill Hastings Link Road Environmental Statement Scoping Document;
- Bullen Consultants Limited Bexhill to Hastings Link Road – Water Quality. Report Reference 103C028/02/A;
- Environment Agency. Groundwater Vulnerability 1:100000 Map Series, Sheet 46, East Sussex;
- British Geological Survey, 1987. Geology of the Country around Hastings and Dungeness;
- British Geological Survey. Solid and Drift 1:10560 scale plans, TQ71SW and TQ71SE;
- Faber Maunsell, April 2006. Decoy Pond, Crowhurst – Water quality Assessment;
- EA Website. *What's in My Backyard* (for information regarding public water supplies);

- Envirocheck report (15981701-1-2) for discharge consents and abstraction licences;
- Hastings Borough Council and Rother Council Environmental Health (for information regarding private water supplies); and,
- Borehole and trial pit logs provided by Owen Williams.

Summary of Consultations

9.2.14 The environment surrounding the Scheme is sensitive to impacts to water quality and hydrology.

9.2.15 The EA and Natural England have been consulted throughout the design process and both require that the Scheme does not adversely affect water quality (both surface and groundwater) or increase flood risk.

9.2.16 Mitigation measures to this effect have been devised in consultation with these two organisations.

Method to Assess Potential Impacts

9.2.17 Highways are depositories of surface water and groundwater pollutants. Pollution sources include vehicle emissions (including atmospheric deposition), vehicle part wear and vehicle leakages, catalytic converters, road surface erosion, and seasonal and regular maintenance practices. The pollutants that are derived from these sources are potentially a significant cause of water pollution.

9.2.18 Possible contaminants include: particulate solids; hydrocarbons (diesel, petroleum, lubricating oil leakages, and grease); heavy metals (especially copper and zinc but also cadmium, iron, lead and chromium in lesser amounts); oxides of nitrogen; sulphates; rubber; asbestos; tyre wear deposits including lead, zinc and hydrocarbons; organic toxic matter and pesticides/herbicides from verge maintenance; and, de-icing agents during cold weather.

9.2.19 The above list includes hydrocarbons which are included in List 1 of the EC Groundwater Directive. Other metals that might be present including copper, zinc and lead are in List 2. Roads are designed to drain freely to avoid standing water and therefore, there is potential for pollutants to find their way quickly into nearby watercourses, unless appropriate mitigation measures are implemented.

9.2.20 Although the impact of highway runoff on receiving water bodies may have no discernible effects, the DMRB takes a precautionary best practice approach. This approach includes four specific quantitative assessments:

- Assessment of Pollution Impacts from Routine Runoff on surface water;
- Assessment of Pollution Impacts from Accidental Spillages;
- Assessment of Pollution Impacts from Routine Runoff on groundwater; and,
- Hydrological Assessment of Design Floods.

9.2.21 The Highways Agency (HA) has recently reviewed the DMRB to reflect the most recent research and understanding. It is considered that it provides the most objective and structured evaluation of the potential impacts of proposed road projects.

9.2.22 Treated and attenuated flows discharged from the proposed drainage system would spread out over the floodplain rather than being piped directly into a watercourse. The underlying geology does not permit effective infiltration and it is not therefore known how much flow would percolate into the ground.

9.2.23 It is also possible that should this infiltration be close to a watercourse the flow would be effectively into the channel and not groundwater. However, for the purpose of the assessment it has been assumed that all flows would reach an adjacent watercourse overland as intended.

Water Quality Assessment

9.2.24 The Water Quality Assessment estimates the pollution load in routine road runoff. Dissolved copper and total zinc are used as representative of a list of pollutants in routine runoff. Zinc is indicative of chronic pollution effects and is closely correlated with polyaromatic hydrocarbons (PAHs) and a range of metals. The toxicity of zinc is sensitive to changes in water hardness. Copper is assessed as it is toxic to water organisms in concentrations that might be expected following the discharge of highway runoff.

9.2.25 The DMRB water quality assessment has two parts, a Simple Assessment, and if required, a Detailed Assessment.

9.2.26 The Simple Assessment depends on the relationship between the volume of traffic and the dilution capacity of the receiving watercourse. Results are compared to the River Ecosystem (RE) thresholds illustrated on Figure A.2 in the DMRB (Volume 11, Section 3, Part 10). The RE classification scheme was introduced following The Surface Water (River Ecosystem) (Classification) Regulations 1994. Rivers are classified on a five point scale on the basis of the waters ability to support fish life. Figure A.2 illustrates different thresholds of acceptability for RE classes RE1 to RE4 for the same dilution and traffic flow simulation. If the result of the assessment is low risk, then no further action is required. However, if the result of this assessment is high risk then a more detailed assessment must be undertaken.

9.2.27 The calculation described by the Detailed Assessment is based on ranges in (high growth scenario i.e. worst case) Annual Average Daily Traffic (AADT) flows (modelled for the 2025 design year), the road surface area and the pollution build-up rates. The result is a runoff volume and the dissolved copper and total zinc loading that is in that runoff.

9.2.28 Using Q95 (the flow exceeded 95% of the time i.e. low flow and therefore minimum dilution) flow data and background pollutant concentrations, it is possible to estimate the average residual concentrations of dissolved copper and total zinc in the receiving watercourse. This value can then be compared against the Environmental Quality Standard (EQS) i.e. the receiving watercourse

RE classification criteria for dissolved copper and total zinc to see if there are any significant changes. In addition, if drainage mitigation measures are also proposed, a factor relating to their pollutant removal efficiency can be introduced into the assessment. As a guiding principle, discharge from highways should not:

- Change the class or appearance of the receiving water body;
- Compromise the River Quality Objective (RQO) (RE in this case) where it exists and providing it is realistic; and,
- Compromise the existing fauna and flora.

9.2.29 Low flow (Q95) data was not available for all receiving watercourses and it was therefore necessary to model Q95 from catchment characteristics following the method shown in Appendix 9-A. The DMRB requires the following statement to be made on the validity of estimated Q95 data to be included:

"The reliability of 95 percentile flows must be considered carefully as representative measures of low flow. The values should be used with caution in view of the problems associated with both the measurement of very low discharges and the increasing proportional variability between the natural flow and the artificial influences, such as abstractions, discharges and storage changes as the river flow diminishes."

9.2.30 The following standard assumptions form part of this assessment:

- A five day pollutant build-up on the road surface before a rainfall event (antecedent dry period);
- Highway runoff co-efficient is 0.75;
- Total pollutant wash off during the rainfall event;
- All pollutant runoff drains directly to the intended receiving watercourse via the proposed drainage pathways;
- Average traffic flows between junctions have been used; and,
- Where traffic flows were unavailable they were inferred from other nearby roads that were modelled and that are likely to have similar flows.

Specific assumptions that were made during the assessment are presented as 'notes' on assessment in Appendix 9-D, Table 9-D.2 and Appendix 9E, Table 9E.1.

9.2.31 The change in water quality is expressed as a change in RE class for the receiving watercourse. The RE system is considered appropriate for highway schemes because the pollutants dissolved copper and total zinc are included in the RE classification method. The five RE classes are described in Table 9.2.

Table 9.2 River Ecosystem Classifications

RE Class	Class Description	Water Hardness (Mg/l $CaCO_3$)	Dissolved Copper EQS Limit (mg/l)	Total Zinc EQS Limit (mg/l)
RE1	Water of very good quality suitable for all fish species	<10	0.005	0.03
		>10 - <50	0.022	0.2
		>50 - <100	0.04	0.3
		>100	0.112	0.5
RE2	Water of good quality and suitable for all fish species	<10	0.005	0.03
		>10 - <50	0.022	0.2
		>50 - <100	0.04	0.3
		>100	0.112	0.5
RE3	Water of fairly good quality suitable for high class coarse fish populations	<10	0.005	0.3
		>10 - <50	0.022	0.7
		>50 - <100	0.04	1
		>100	0.112	2
RE4	Water of fairly good quality suitable for coarse fish populations	<10	0.005	0.3
		>10 - <50	0.022	0.7
		>50 - <100	0.04	1
		>100	0.112	2
RE5	Water of poor quality, which is likely to limit coarse fish populations	-	-	-

9.2.32 Another standard used by the EA is known as the General Quality Assessment (GQA) Scheme. This is used for classifying the water quality of rivers and canals in terms of their chemical and biological quality. The river system in England and Wales has been sub-divided into reaches, each consisting of a single water quality monitoring site. Water quality samples are collected routinely and the results over the three previous years used to establish the GQA class for each year. Results of this routine monitoring program are expressed on a six point scale from A (very good) to F (bad).

9.2.33 The toxicity of certain highway derived pollutants increases in 'softer' water, and water hardness data is required for this assessment. The EA no longer routinely monitors main rivers for water hardness due to its long term stability. Nevertheless, the EA provided monthly average water hardness data for the five year period between 1999 and 2004 for Combe Haven, Watermill and Powdermill Streams (see Table 9-C.2 in Appendix 9-C). This information has been summarised in Table 9.3 along with the results of a recent monitoring programme (see Tables 9-C.3 and 9-C.4 in Appendix 9-C). For the purpose of the assessment the average of the EA data is deemed to be the most reliable. Due to the long term spatial stability apparent in water hardness levels it has been assumed that Egerton Stream and Spring Ditch have a similar water hardness to the EA data. This assumption is supported by the monitoring data.

Table 9.3 Water Hardness Data for Receiving Watercourses

Watercourse	**Concentration** **Mg/l $CaC0_3$**	**Source**
Egerton Stream	116	Field Sampling
Combe Haven	140	EA Data
Watermill Stream	140	EA Data
Powdermill Stream	129	EA Data
Drainage ditch near Decoy Pond Stream – Spring Ditch	105	Field Sampling (one-off sample)

9.2.34 In the absence of a comprehensive set of water quality monitoring data and bearing in mind the potential inaccuracies relating to Q95 estimates it was considered appropriate to undertake both the Simple and Detailed Assessment of routine runoff. The calculation in Appendix 9-D presents the assessment of routine runoff on receiving watercourses.

Spillage Risk Assessment

9.2.35 The spillage risk assessment estimates the risk of a pollution incident caused by a spillage from a road traffic accident or from a vehicle carrying a potential pollutants (e.g. oil, liquid food, milk, etc) passing through the drainage system and polluting the surface water body. The method is based on road length, traffic flows (AADT and % Heavy Goods Vehicles (HGV)), road type, and the type of junction. Risk factors apply to junctions and 100m on either side of that junction. In addition, a factor is applied to take account of river quality (RE) and the estimated emergency response time. The detailed methodology is described in Annex I (Method D) of DMRB. The risk of an accident is defined as "*the probability that there will be an accidental spillage of pollutant and that the pollutant will reach and impact the water body to such an extent that either a category 1 or 2 incident (a serious pollution incident) occurs*."

9.2.36 The latest methodology presented in the revised edition of the DMRB (May 2006) included significant changes from the methodology presented in the previous November 2002 DMRB edition. These changes were made following a revision of EA data on spillages that are known to have occurred across a set period of time. As a result, the previous methodology was considered to be too cautious and the revised assessment, although inherently the same, was adapted accordingly to reflect the latest understanding. This assessment has taken a precautionary approach and as such has assessed the Scheme using both the previous and revised spillage risk assessments.

9.2.37 The Scheme is divided into five major hydraulic catchments between the junction with A259 in Bexhill and the B2092 Queensway in Hastings. It is proposed that each catchment would comprise a self-contained drainage area with a dedicated drainage system to attenuate flows and pollutants. More details are provided in Chapter 3B: Construction Strategy.

9.2.38 During the assessment of a traffic accident causing a spillage that leads to a serious pollution incident, the following assumptions were made for each hydraulic catchment:

- The DMRB does not have a spillage risk factor for t-junctions, therefore the factor for cross roads was applied;
- The response time for an emergency is less than 20 minutes; and,
- Where no RE classification was available the RE of the first classified watercourse downstream was assumed.

9.2.39 Spillage risk calculation tables for the five catchments using the revised spillage risk assessment methodology are presented in Table 9-E.1 in Appendix 9-E, and using the previous methodology in Table 9-E.2 in Appendix 9-E.

Groundwater Assessment

9.2.40 The groundwater quality DRMB assessment (Method C in Annex I of Volume 11 Section 3 Part 10) provides a methodology for the assessment of the potential impact on the quality of groundwater due to routine runoff discharges. The method applies weighted scores to a number of risk factors to determine an overall impact risk rating.

Flood Risk Assessment

9.2.41 Planning Policy Guidance (PPG) 25 Development and Flood Risk, July 2001, published by The Stationary Office on behalf of the former Office of the Deputy Prime Minister (ODPM) states that the design event for a river in an urban area, such as the Egerton Stream, is one with a 1% probability of exceedence in any one year (often referred to as the 100 year return period event). The recent issue of Planning Policy Statement 25: Development and Flood Risk (PPS25) in December 2006 strengthens current guidelines contained within PPG25, as well as reinforcing areas that have been previously open to interpretation, including a strengthened role for the EA. Although the Combe Haven is essentially a rural watercourse and could be designed for a lower return period event, the presence of flooding problems at Crowhurst and Bulverhythe indicate that the design event should be the 100 year return period event as well.

9.2.42 PPG25 stipulated that to take account of climate change the impact of an increase in flow of 20% should be considered. This has been confirmed by PPS25 with the proviso that for time periods beyond 2085, the peak rainfall intensity should be increased by 30%. Both watercourses are tide-locked at the downstream end and changes in climate were predicted to increase sea level by an average of 6mm/annum on the south coast of England. PPS25 has clarified the net rate of sea level rise for different time horizons, increasing to 15mm/annum from 2085.

9.2.43 The Flood Risk Assessment, prepared as a separate document, should be read in conjunction with this Environmental Statement.

9.3 Assessment of Impact Significance

9.3.1 The significance of impacts was assessed based on the sensitivity of the receptor (and any associated uses), and the magnitude of the predicted impacts. This assessment has followed the guidance presented in TAG; The Water Environment Sub-objective Unit 3.3.11. Water features and attributes were identified using Table 5.1 in DMRB.

Surface watercourses

9.3.2 The importance of surface features was determined using Table 9.4 and the magnitude of impacts using Table 9.5. Significance was assessed using Table 9.6. The results of this assessment have been presented in full in Appendix 9-F.

Table 9.4 Criteria to Assess the Importance of Surface Water Features

Importance	Criteria	Examples
Very High	Attribute with a high quality and rarity, regional or national scale	EC designated Salmonid/Cyprinid fishery; RE1; International or national nature conservation site
High	Attribute with a high quality and rarity on local scale	RE2; Major Cyprinid fishery; Species protection under international or national legislation
Medium	Attribute with a medium quality and rarity on local scale	RE3 or 4
Low	Attribute with a low quality and rarity on local scale	RE5

Table 9.5 Criteria to Assess the Magnitude of the Predicted Impact

Magnitude	Description
Large Negative	Results in loss of attribute and/or quality and integrity of the attribute.
Moderate Negative	Results in effect on integrity of attribute, or loss of part of attribute.
Slight Negative	Results in some measurable change in attributes quality or vulnerability.
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity.
Slight Positive	Results in some minor beneficial effects on attribute or the possibility of a reduced risk of negative effects occurring.

Table 9.6 Criteria to Assess the Significance of the Predicted Impact

Importance	Magnitude				
	Large Negative	Moderate Negative	Slight Negative	Negligible	Slight Positive
Very High	Major Adverse	Major Adverse	Moderate Adverse	Negligible	Moderate Beneficial
High	Major Adverse	Moderate Adverse	Minor Adverse	Negligible	Minor Beneficial
Medium	Moderate Adverse	Minor Adverse	Negligible	Negligible	Negligible
Low	Minor Adverse	Negligible	Negligible	Negligible	Negligible

Notes:

Negligible means either no effect positive or negative, or positive and negative effects balance

Groundwater

9.3.3 The importance of groundwater features was determined using Table 9.7. Significance was assessed using Table 9.8. The results of this assessment have been presented in full in Appendix 9-F.

Table 9.7 Matrix to Determine Risk of Impact of Pollution to Groundwater from Routine Runoff

Component Number (see text)	Weighting factor (see text)	Property or Parameter	Low Risk (Score 1)	Medium Risk (Score 2)	High Risk (Score 3)
1	15	Traffic density	<15,000 AADT	15,000 – 50,000 ADT	>50,000 ADT
2	15	Rainfall Volume (annual averages)	<740mm rainfall	740mm-1060mm	>1060mm rainfall
		Rainfall Intensity	Even (<35mm FEH* 1 hour rainfall)	Uneven (35-47mm FEH* 1 hour rainfall)	Concentrated (>47mm FEH* 1 hour rainfall)
3	15	Soakaway geometry	Continuous linear (e.g. ditch, grassed channel)	Single point, or shallow soakaway (e.g. (lagoon) serving low road area)	Single point, deep serving high road area (>5,000m^3)
4	20	Unsaturated zone	Depth to water table >15m and non-aquifer	Depth to water table 5-15m	Depth to water table <5m
5	20	Flow type	Unconsolidated or non-fractured consolidated deposits (i.e. dominantly intergranular flow)	Consolidated deposits (i.e. mixed fracture and intergranular flow)	Heavily concentrated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)
6	7.5	Effective grain size	Fine sand and below	Coarse sand	Very coarse sand and above
7	7.5	Lithology	>15% clay minerals	1-5% clay minerals	<1% clay minerals

Notes:

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Table 9.8 Matrix to Determine the Significance of the Effect on Groundwater Resources

Resource	Risk of Impact		
	Low	**Medium**	**High**
Source Protection Zones			
S P Zone 1	Moderate Adverse	Major Adverse	Major Adverse
S P Zone 2	Minor Adverse	Moderate Adverse	Major Adverse
S P Zone 3	Neutral	Minor Adverse	Moderate Adverse
Aquifers			
Major Aquifer	Moderate Adverse	Major Adverse	Major Adverse
Minor Aquifer	Minor Adverse	Moderate Adverse	Major Adverse
Non Aquifer	Neutral	Minor Adverse	Moderate Adverse

Flooding

9.3.4 The importance of flood risk was assessed using Table 9.9 and the magnitude of the impact using Table 9.10. Table 9.11 shows the resulting significance.

Table 9.9 Criteria to Assess the Importance of Flooding

Importance	Criteria	Examples
Very High	Attribute with a very high value	A significant number of residential properties (2 or more)
High	Attribute with a high value	Single residential property or areas of Grade 1, 2 or 3a agricultural land
Medium	Attribute with a medium value	Areas of agricultural land not Grade 1, 2 or 3a
Low	Attribute with a low value	Non agricultural land

Table 9.10 Criteria to Assess the Magnitude of the Predicted Impact of Flooding

Magnitude	Description
Large Negative	Results in significant increased flood risk
Small Negative	Results in marginal increase in flood risk.
Negligible	Change in flood risk imperceptible
Small Positive	Results in marginal reduction in flood risk
Large Positive	Results in significant decrease in flood risk

Table 9.11 Criteria to Assess the Significance of the Predicted Impact of Flooding

Importance	Magnitude				
	Large Negative	Small Negative	Negligible	Small Positive	Large Positive
Very High	Major Adverse	Major Adverse	Negligible	Major Beneficial	Major Beneficial
High	Major Adverse	Moderate Adverse	Negligible	Moderate Beneficial	Major Beneficial
Medium	Moderate Adverse	Minor Adverse	Negligible	Minor Beneficial	Moderate Beneficial
Low	Minor Adverse	Negligible	Negligible	Negligible	Minor Beneficial

Notes:

Negligible means either no effect positive or negative, or positive and negative effects balance

9.4 Existing Conditions

Site Walkover

9.4.1 A number of specific site visits have been undertaken including a walkover of the whole route in June 2006.

Description of Surface and Groundwater Features

Rivers and Streams – Egerton Stream

9.4.2 The Egerton Stream catchment is 4.2km^2 and is predominantly urban in nature lying almost entirely within the Bexhill area. Drainage of the area is the responsibility of Southern Water and is naturally divided into 9 sub-catchments. Sewer records obtained from Southern Water indicate that Bexhill is served largely by a network of foul and combined sewers (both foul and surface water use the same pipes) with a smaller number of surface water sewers. At high stormwater flows excess water, including untreated sewage is discharged into Egerton Stream via 20 outfalls, 5 from the combined system and 15 from the surface water system. The locations of the outfalls have been taken from the sewer records.

9.4.3 Egerton Stream rises to the north-west of Bexhill in the Sidley area of the town and flows south-east through the gardens of residential properties until it joins the route of the disused and abandoned railway via a culvert between 195 and 197 London Road (see Plate 9-B.1 in Appendix 9-B). A secondary tributary joins from the northern end of the catchment along the old railway cutting. It then flows south, following the old railway alignment. Adjacent to Bexhill High School immediately north of the A259, Little Common Road, the stream flows into a culvert, approximately 450m in length and was constructed by the Southern Water Authority in the early 1980s. Following this culvert the stream flows along a short stretch of open channel before entering another series of culverts conveying the watercourse a further 1km to an outfall on the foreshore, 50m beyond the seawall. The sea is prevented from flowing up Egerton Stream by two flapgates in a chamber adjacent to Egerton Park pond.

9.4.4 Egerton Stream is a 'Main River' under the Land Drainage Act and is under the jurisdiction of the EA from its seaward end to the bridge crossing at Woodsgate Park Road. Upstream of the bridge the watercourse is the responsibility of Rother District Council.

Rivers and Streams – Combe Haven

9.4.5 The Combe Haven lies to the north-east of Bexhill and to the west of Hastings. Its catchment is predominantly rural in nature and covers an area of 51.5km^2. The catchment comprises 10 sub-catchments including its 'Main River' tributaries; the Watermill Stream, Powdermill Stream, Decoy Stream, Spring Ditch, Pebsham Stream and Hollington Stream.

9.4.6 Although the catchment is known as the Combe Haven (see Plate 9-B.2 in Appendix 9-B), its tributaries the Watermill (see Plate 9-B.3 in Appendix 9-B) and Powdermill (see Plate 9-B.4 in Appendix 9-B) Streams are the main contributors of water, with catchment areas of 13.92km^2 and 17.52km^2 respectively, equivalent to approximately 61% of the total. The Powdermill drains the area to the north of the catchment and is the only major tributary with any significant settlement (the village of Crowhurst).

9.4.7 The Combe Haven drains from the west to east being joined by the Watermill and Powdermill Streams from the north. The Combe Haven is generally cut into the natural valley floor with little, if any, embankments. (see Plate 9-B.2 in Appendix 9-B).The Watermill and Powdermill Streams however are both embanked. The Watermill Stream joins from the north-west and runs parallel to the Combe Haven for approximately 700m before its confluence with the Powdermill Stream. They both then flow parallel to the Combe Haven for a distance of a further 100m before their confluence with the Combe Haven at Crowhurst Gauging Weir. The weir, used by the EA to monitor low flows, retains the tributaries about 1m higher than the natural water level in the Combe Haven. The flood bank between the Watermill/Powdermill Stream and the Combe Haven is at a level of approximately 3.1mOD.

9.4.8 An 18" (460mm) diameter concrete pipe links the flood plains north and south of the Watermill approximately 200m upstream of its confluence with the Powdermill, although it is reported that the pipe is partially blocked.

9.4.9 The Combe Haven flows through a series of small flap gates designed to prevent upstream flow. These are generally not functioning and it is likely that water overtops the structures, flowing overland even under relatively low return period events.

9.4.10 Further east the tributaries of Decoy Stream (see Plate 9-B.5 in Appendix 9-B) and Spring Ditch also drain from the north. The outflow from the Decoy Stream exits through a flapgate, preventing water from the Combe Haven flowing upstream under most circumstances. Only in extreme conditions can water overtop the embankment and utilise the Decoy Stream floodplain.

9.4.11 The only tributary from the south/west is Pebsham Stream, with Hollington Stream being the most downstream tributary. The Hollington Stream is principally an urban sub-catchment but is throttled upstream of its confluence with the Combe Haven, restricting its flow to 1.13 cumecs.

9.4.12 Large areas of the valley floor are below the level of high tide. The watercourse discharges to the sea at Bulverhythe via an outfall with a tidal flapgate to prevent tidal flooding of the valley. Flows from the stream are therefore restricted to periods of low tide with excess water, during heavy or prolonged rainfall, being stored in the valley.

9.4.13 The most downstream reach, south of the A259 'coast road', is relatively narrow and flows through residential and commercial areas.

9.4.14 Combe Haven and its 'Main River' tributaries are subject to the direct jurisdiction of the EA. Other tributaries to the streams, such as Gorringe Stream, are Inland Drainage Board watercourses and also come under the jurisdiction of the EA, albeit indirectly.

Ditches and Ponds

9.4.15 There is an extensive ditch system that drains into the Combe Haven and the other streams. Most of the ditches are part of the Combe Haven Site of Scientific Interest (SSSI) and the Filsham Reedbed Nature Reserve.

9.4.16 The Combe Haven SSSI at the point nearest to the Scheme is located approximately 50m to the south of the Scheme, with the Filsham Reedbed Local Nature Reserve, located approximately 1.2km to the south east.

9.4.17 Decoy Pond is a small pond located in the middle of a field close to Decoy Pond Wood at TQ 767 107 (see Plate 9-B.6 in Appendix 9-B). It is not designated as a nature conservation site. Details of the ecology of the ditches and ponds are given in Chapter 12: Nature Conservation and Biodiversity.

Water Quality

9.4.18 Under the WFD Combe Haven, Watermill Stream and Powdermill Stream are all provisionally identified as 'at risk' and classified as heavily modified water bodies (HMWB) (See Table 9.12). There was no information on other watercourses within the study area.

Table 9.12 Classification of Watercourses Within the Study Area Under the Water Framework Directive

Watercourse	At Risk	Provisional HMWB	From point source pollution	From diffuse source pollution	From water abstraction and/or flow regulation	From physical and/or morphological alteration	From alien species
Combe Haven	✓	✓	At risk	Probably at risk	Probably not at risk	At risk	Probably at risk
Watermill Stream	✓	✓	Not at risk	Probably not at risk	Probably at risk	At risk	Probably not at risk
Powdermill Stream	✓	✓	At risk	Probably not at risk	Probably at risk	At risk	Probably not at risk

9.4.19 The study area and its surface water features are illustrated in Figure 9.1 and 9.2. An assessment of existing water quality has been undertaken for Egerton Stream and the Combe Haven catchment. The assessment involved a study of existing water quality data provided by the Sussex Area Office of the EA; and field sampling.

9.4.20 Table 9-C.2 in Appendix 9-C summarises all the water quality data available from the EA monitoring between 1999 and 2004. Table 9-C.3 lists the additional sampling points and Table 9-C.4 the results of the analysis.

9.4.21 Table 9.13 presents a summary of the water quality classifications of each watercourse within the study area. Table 9.14 summarises the key water quality data required for the DMRB assessment.

Table 9.13 Summary Water Quality Classification for all Watercourses

Watercourse	Upstream NGR	Downstream NGR	RE Target	Chemical GQA Grade	Biological GQA Grade
Egerton Stream	No data available				
Combe Haven	X 576270 Y 110300	X 578500 Y 108400	RE4 (marginal because of dissolved oxygen levels)	E (as a result of poor dissolved oxygen)	B (2003)
Watermill Stream	X 571650 Y 113550	X 576270 Y 110300	RE2 (compliant)	B (2002-2004)	B (2003)
Powdermill Stream	X 574070 Y 114620	X 576270 Y 110300	RE3 (compliant)	B (2002-2004)	A (2003)
Spring Ditch	No data available				

Notes:

All data quoted for survey period 2003-2005 unless otherwise stated

Table 9.14 Summary of Water Quality Data Required for DMRB Assessment

Watercourse	EA data			Data from field sampling in June 2004 and January 2006		
	Average Water Hardness (mg/l $CaC0_3$)	95 percentile Dissolved Copper (µg/l)	95 percentile Total Zinc (µg/l)	Water Hardness (mg/l $CaC0_3$)	Dissolved Copper (µg/l)	Total Zinc (µg/l)
Egerton Stream	No data available			116	4.4[1]	55.4
Combe Haven	160	1.34	19.04	59	1.2	36
Watermill Stream	107	2.07	17.73	80	4.7	81
Powdermill Stream	118	1.11	14.68	67	<1	5.7
Spring Ditch	No data available			105	<1	22

Notes:

[1] Mean average of 9 separate sampling points taken across a two day period. Average does not include one outlier. The available data is not sufficiently reliable to be used as indicative of dissolved copper levels in Egerton Stream. Therefore, for the purpose of the assessment it has been assumed that dissolved copper is half the value of the EQS as indicated by the DMRB methodology i.e. 56ug/l.

9.4.22 Egerton Stream and Spring Ditch are not routinely monitored by the EA. The only water quality data available to inform this assessment is that which was provided by field sampling and presented in Table 9.14.

9.4.23 The main rivers feeding the upstream reaches of the Combe Haven are of ‘good’ quality: Watermill Stream has an RE Target of RE2 (meaning water of good quality and suitable for all fish species); which it is compliant. Powdermill Stream has an RE Target of RE 3 (meaning water of fairly good quality suitable for high class coarse fish populations); which it is also compliant. Combe Haven has a RE Target of RE 4 (meaning water of fairly good quality suitable for class coarse fish populations); and, which it is marginally compliant due to saturation levels of dissolved oxygen.

9.4.24 In addition to RE classes, the EA monitors the long term water quality of watercourses in the study area using the GQA method. This is used for classifying the water quality of rivers and canals in terms of their chemical and biological quality. Water quality samples are collected routinely and the results over the three previous years are used to establish the GQA class for each year. Results of this routine monitoring program are expressed on a six point scale from A (very good) to F (bad).

9.4.25 Watermill and Powdermill Streams have chemical and biological GQA grades Grade A/B (very good to good). Downstream of Decoy Pond Stream the chemical water quality in Combe Haven appears to deteriorate (possibly as a result of ditches draining the south-east of the catchment and from the Gorringe Stream System) with a chemical GQA grade of E (poor). Biological GQA for this reach of Combe Haven is Grade B (good).

9.4.26 The additional sampling carried out in June 2004 and January 2006 (for Egerton Stream only) provides a 'snapshot' of the water quality throughout the system, generally in areas not sampled by the EA. Using the collected data and the EAs data should provide a suitable representation of conditions. A full summary of the field sampling program have been presented in Appendix 9-C.

Water Framework Directive

9.4.27 Under Article 5 of the WFD Combe Haven, Watermill Stream and Powdermill Stream have all been identified as 'at risk' and provisionally classified as HMWB. Combe Haven is at risk from point source pollution and physical and/or morphological alteration, and probably at risk from diffuse pollution and alien species. Watermill Stream is classed as at risk from physical and/or morphological alteration, and probably at risk from water abstraction and flow regulation. Finally, Powdermill Stream is at risk from point source pollution and physical and/or morphological alteration, and probably at risk from water abstraction and flow regulation. No information was available for any other water body in the study area.

Low Flow Data

9.4.28 The EA operate a low flow gauging weir at the confluence of the Watermill Stream, Powdermill Stream and the Combe Haven at TQ764102.

9.4.29 The results indicate that the mean flow is of the order of 0.13 cumecs. The 95percentile flow (Q95) is the flow exceeded for 95% of the time and is estimated by the EA to be approximately 0.02 cumecs.

9.4.30 Q95 for all watercourses have been modelled based on catchment characteristics using the methodology contained within CEH-FEH. Actual low flows for Combe Haven provided by the EA were used to evaluate the determination of Q95 to improve accuracy. The results of this exercise have been presented in Appendix 9-A.

Pollution Incidents

9.4.31 Two category 3 (minor incident) pollution incidents occurred on 13th May 1997 at 75 London Road, Bexhill whereby 1 gallon of petrol was accidentally poured down the drain and in 1994 from an industrial property approximately 200m southwest of the Scheme. No other pollution incidences relevant to the investigation were recorded within the study area.

Hydrogeology

9.4.32 EA Groundwater Vulnerability map Sheet 46 shows that the Scheme is underlain by a Minor aquifer along its entire route. Minor aquifers have sufficient groundwater resource to supply local abstractions and support base flow to rivers; but are not usually capable of supporting large abstractions such as public potable water supplies. The Minor aquifer in the vicinity of the Scheme comprises the sandstone bands within the Wadhurst Clay and Ashdown Beds.

9.4.33 Clay bands within the Wadhurst Clay and Ashdown Beds are classified as Non Aquifers, and the borehole logs produced along the Scheme route indicate that the majority of the Scheme is predominantly underlain by such clay bands. Therefore, it is considered that the classification of the area as a Minor Aquifer is conservative.

9.4.34 Further details of the geology are given in Chapter 8: Geology and Soils.

9.4.35 The Groundwater Vulnerability classification of the underlying aquifer is a measure of the protection afforded by overlying soils. According to EA Groundwater Vulnerability Sheet 46, the groundwater vulnerability along the route varies from Low to High.

9.4.36 The EA website *What's in your Backyard* indicates that the route would not cross any Groundwater Protection Zones for public water supplies.

9.4.37 The Environmental Health section of Hastings Borough Council has indicated that there are no private groundwater supplies within the section of the route under their jurisdiction. The contaminated land officer at Rother District Council (RDC) has provided private abstraction information for the section of route under Rother Council's jurisdiction. This indicates that there are no unlicensed abstractions within the vicinity of the Scheme. The list is available in Appendix 9-C.

9.4.38 The Envirocheck report for the Scheme route indicates that there are no licensed surface water or groundwater abstractions within 225m of the route.

9.4.39 Groundwater elevations along the Scheme route have been measured by Owen Williams between March and December 2006. Figure 9.3 shows a layout of the borehole locations considered for this analysis. The full set of readings is given in Volume 1 (Owen Williams, 2006) but a brief summary is provided in Appendix 9-I. The depth to groundwater is predominantly at or very close to the ground surface, especially in low lying ground adjacent to surface watercourses. It is thought that groundwater provides a source of baseflow to the streams and to the man-made drainage channels in low lying areas.

9.4.40 The Scheme has been split into five reaches according to their post construction drainage catchments. The reaches are named A, B, C, D and E from west to east, as shown on Appendix 9-D and 9-E in Volume 3 of this report.

9.4.41 Table 9.15 below, summarises the hydrogeological conditions at the site within each of the five reaches.

Table 9.15 Summary of Hydrogeological Conditions at the Site

Feature	Reach A	Reach B	Reach C	Reach D	Reach E
Geology of Water Bearing unit	Wadhurst Clay or Ashdown Beds	Ashdown Beds	Ashdown Beds	Ashdown Beds with some sandstone bands	Ashdown Beds with some sandstone bands
Aquifer Classification	Minor	Minor	Minor	Minor	Minor
Groundwater Vulnerability	High (Undefined as Urban Area)	Low	Intermediate	Intermediate	Low
Approximate Depth to Groundwater (mbgl)	No info, assume <5m	1 – 8.5	0 - 4	Artesian – 3.5	Ground level – 13.5

9.4.42 As would be expected when the underlying aquifer is a Minor Aquifer; there are few groundwater abstractions in the area, and none within 1.5km of the route. Each reach of the route falls under EA classification R4 for road schemes, which are “*acceptable only if investigation is favourable and with adequate mitigation*”.

9.4.43 There is a small permanent pond and an ephemeral pond in a topographic low point between hills to the south of Little Bog in Reach E. The pond appears to be spring fed, According to the OS 1:25000 scale map, Sheet 124, the ponds are not in hydraulic connection with the adjacent surface water features. However, the EA flood map for the area suggests they may be in continuity during times of flooding.

9.4.44 The permanent pond was sampled on 16th June 2006 and, with the exception of iron, no analytes were found at concentrations elevated above water standards. The water quality standards used were UK drinking water standards and in their absence environmental quality standards.

9.4.45 The concentration of iron was 4.93mg/l compared to the drinking water standard of 0.2mg/l. However, since the Ashdown Beds in the area are known to have a high iron content, it is considered that the elevated iron is naturally occurring. The full set of chemical results is included in Appendix 9-D of this report.

Potential Sources of Groundwater Contamination

9.4.46 The Envirocheck report lists a number of waste management facilities in the vicinity of the route, which are discussed below. Further details are given in Chapter 8: Geology and Soils.

9.4.47 Sidley Waste Transfer Depot (NGR 5751, 1087) is located in the base of the disused railway close to the Egerton Stream in Reach A. The current status of the site is unknown but the depot was licensed to receive up to 10,000 tonnes of household, commercial and industrial waste for an unknown number of years. There was no known restriction on the source of the waste. Since the site was only a transfer station and was never used to dispose of waste, it is considered that the risk of the depot being a source of significant groundwater contamination is low. The Egerton Stream downstream of the depot is discoloured with an orange tinge. This is likely to be the effect of iron.

9.4.48 Serco have an active waste transfer site adjacent to the Egerton Stream in Reach A at NGR TQ 739 082. Since, the site is a transfer station and has not been used to dispose of waste, it is considered that the risk of the depot being a significant source of groundwater contamination is low.

9.4.49 Sita had a waste disposal site close to the Egerton Stream at NGR TQ 7435 0848 alongside Reach A which is currently inactive. Since the site is a transfer station and is not used to dispose of waste, the risk of the depot being a source of groundwater contamination is low.

9.4.50 There was a landfill at Glover’s Farm (NGR TQ 7460 0950) within 65m of the route near the start of Reach B. Details are provided in Chapter 8: Geology and Soils.

9.4.51 A former quarry at Adams Farm was licensed to receive up to 10,000 tonnes a year of ferrous metal scrap, non ferrous metal scrap and lead acid batteries. The date the scrap yard opened is unknown; however, the operating licence was surrendered in 1978. The former facility is located approximately 300m up hydraulic gradient of Decoy Pond (approximately 100m to the south of Reach E of the route).

9.4.52 FM (2006) reported dug trenches on the northern periphery of Decoy Pond Wood with a low pH and orange tinted colour. This water could have been effected by either ferruginous leachate sourced from the facility or could be natural since the Ashdown Beds in the vicinity contain iron rich sphaerosideritic clay.

9.4.53 ESCC had a landfill at Upper Wilting Farm in Reach E for an unknown period around 1979. The type of waste was not thought be restricted. The landfill is shown on Figure 8.2: Potential Sources of Contamination.

9.4.54 There is a licence to discharge treated sewage from a residential property onto land held by Buckholt Kennels towards the end of Reach B, approximately located at National Grid Reference TQ 748 104. The unsaturated zone is estimated to be at least 10m deep in the this area, based on measured groundwater levels and the elevation of the Kennels shown on the OS 1:25000 scale map. Since the discharge is treated and there is a reasonable thickness of unsaturated zone for further attenuation of any residual contamination, the discharge should not cause any significant contamination to the groundwater.

9.4.55 All other discharges in the vicinity of the route are to surface water, and since groundwater is thought to provide baseflow to surface water rather than surface water leaking to groundwater, they are unlikely to affect groundwater quality.

9.4.56 Further details of potential contamination are given in Chapter 8: Geology and Soils.

Flooding

Egerton Stream

9.4.57 Discussions with the EA indicate that there are currently no reported flooding problems associated with the Egerton Stream.

9.4.58 At the downstream end of the catchment there are a number of local drainage problems where surface water is unable to discharge into the culverted stream. This leads to localised flooding of gardens and open spaces but no flooding of residential properties.

Combe Haven

9.4.59 The Combe Haven floodplain is flooded regularly, every couple of years, to a relatively shallow depth, but no definitive levels are available.

9.4.60 The Hollington Stream passes beneath White Bridge before its confluence with Combe Haven. The A259 at White Bridge, together with adjacent roads and properties, flood regularly. To reduce the effect of flows from Hollington Stream, HBC constructed a throttle on the stream limiting flows into the Combe Haven to 1.13 cumecs. The area is still however prone to periodic flooding, due mainly to local drainage problems with surface water runoff unable to drain into the Combe Haven.

9.4.61 Water levels are recorded by the EA continuously at Sheepwash Bridge on the Combe Haven, between the tributaries of the Pebsham Stream and Hollington Stream. The maximum recorded flood level here was 2.83mOD in 1960. During the extensive flooding throughout the South East in 2000/2001 the highest recorded level at Sheepwash Bridge was approximately 2.71mOD in early November 2000.

9.4.62 The results of an investigation by Hydraulics Research, Wallingford (now HR Wallingford), in March 1990, predicted a 100year water level at Sheepwash Bridge between 2.94mOD and 3.00mOD.

9.4.63 The village of Crowhurst, on the Powdermill Stream, has existed, according to historical reports, since before the Norman Conquest. A small settlement is recorded on the site in the Doomsday Book. Most of the village is built on the higher ground on either side of the valley floor although in recent times some properties have been built on lower ground. Two causeways cross the valley towards the northern and southern ends of the village.

9.4.64 It is reported that a number of properties have experienced flooding, or near misses, on a number of occasions, over the last 25 years. Of these two Hunter's Moon and Springfields are upstream of the northern causeway, Forewood Lane, in an area known as Pond Bay. while the remainder, probably about 10, are located upstream of the southern causeway.

Groundwater Fed Pond

9.4.65 The permanent groundwater fed pond adjacent to catchment E was sampled on 16th June 2006 and, with the exception of iron, no analytes were found at concentrations elevated above water standards. The water quality standards used were the UK Drinking Water Standards and in their absence environmental quality standards (EQS) developed by the Environment Agency. The concentration of iron was 4.93mg/l compared to the drinking water standard of 0.2mg/l. however, since the Ashdown Beds in the area are known to have a high iron content, it is considered that the elevated iron is naturally occurring

Fisheries

9.4.66 The Watermill Stream, from the Combe Haven confluence to Catsfield is designated under the EC Freshwater Fisheries Directive as a Cyprinid watercourse (Cyprinid watercourses have coarse fish varieties that may include: carp, tench, barbel, rudd, and roach. These fish generally found in slower flowing waters that often flow through lowlands). The migratory fish pattern within the study area include the movement of migratory eels and elvers along the Combe Haven and the movement of a limited number of marine species such as Flat Fish, Flounders and a small quantity of Sea Trout. The EA has received reports of sightings of native Crayfish although this has not been confirmed by the EA Fisheries Officers.

9.4.67 Informal recreational fishing is undertaken in the Combe Haven, which is subject to the EA standard fish rod licensing scheme. The Hastings and Bexhill Angling Association use the lower reaches of the Combe Haven. There are no prohibited fishing areas other than in privately owned land. Other than general recreational use, this area is not formally used by any clubs. More details have been presented in Chapter 12: Nature Conservation and Biodiversity.

Nature Conservation

9.4.68 The Combe Haven Valley contains a number of sites designated for their conservation value (SSSI, Local Nature Reserve, and Sites of Nature Conservation importance (SNCI)). More details have been presented in Chapter 12: Nature Conservation and Biodiversity.

Discharge Points

9.4.69 There are forty eight effluent discharge points present within the study area. These are listed in Table 9-C.5 in Appendix 9-C.

9.4.70 The discharges are from a variety of sources including sewerage network - sewers, sewage disposal works, water treatment works, waste disposal site, transport related sources, educational, recreational and cultural and domestic (single) properties and sources classified as ‘undefined’ or ‘other’.

9.4.71 Volumes of effluent discharged include thirty eight sources of up to $5m^3$, one source between $5m^3$ and $20m^3$ and eight sources between $20m^3$ and $100m^3$.

Local Water Abstractions

9.4.72 The EA website *What’s in your Backyard* indicates that the route does not cross any Groundwater Protection Zones for public water supplies. There are no licensed groundwater abstractions within 200m of the route.

9.4.73 The Environmental Health section of HBC and the Contaminated Land Officer at RDC have confirmed that there are no private (unlicensed) groundwater supplies within the vicinity of the route under their respective jurisdictions.

9.5 Mitigation Strategy

General Approach to Mitigation

9.5.1 Mitigation measures include those that prevent, reduce or offset potential impacts. Detailed plans for construction are given in Chapter 3B: Construction Strategy.

9.5.2 With regards to the operation of the Scheme, the objective of the proposed drainage mitigation measures, detailed in Chapter 3B: Construction Strategy is to convey highway surface water runoff to the receiving watercourse without detrimental effect to water quality and associated ecosystems. A list of generic potential impacts from construction and operation of the Scheme has been presented in Table 9.16.

Table 9.16 Generic Potential Adverse Impacts from Construction and Operation of a Highway Development

List of Potential Impacts from Construction and Operation Without Mitigation
Physical Impacts • Modification to stream flow characteristics (increases or decreases in flow range, velocity etc) with associated effects on stream biota; • Placement of permanent and temporary structures in water bodies may alter channel and flow characteristics, and sediment dynamics; • An increase in the deposition of pollutants from road vehicles onto hard surfaces may increase the concentration of pollutants in nearby receiving watercourses. Drainage from the new road surfaces has the potential to carry a wide range of soluble and insoluble pollutants, which would have a negative impact upon water quality if it is not properly treated; • An increased risk of the potential for traffic accidents to lead to a serious pollution incident (from both infrequent major ‘tanker’ spills and constant minor ‘drip’ spills) may adversely impact water quality and riverine habitats of receiving watercourses; • An increase in surface run-off as a result of an increase in impervious hard surfaces and compaction of surrounding ground would possibly lead to an increased risk of surface flooding; • The potential increase in sediment load (from highway traffic flows or during construction) in water bodies may cause changes to the hydrodynamics, biodiversity and water quality of the affected watercourses; • Physical barriers and/or increased water velocity may restrict fish movements and migration; • Increased water turbidity during construction reducing the potential for angler success; • Changes in sedimentation patterns can have an impact on shellfish growing areas and commercial fisheries; and, • Infilling of watercourses results in increased risk of upstream flooding and lack of water downstream.
Pollution – Fish • Sediments can clog the intra-particle spaces among spawning grounds causing smoothering of eggs and may lead to long term population effect; • Invertebrate mortalities as a result of water pollution and increased sediment deposition may result in there being less food for fish; and, • Fish can avoid areas of poor water quality if they have sufficient time and access, but are more vulnerable to sudden changes in pollution level.

List of Potential Impacts from Construction and Operation Without Mitigation
Pollution – Invertebrates • Should water pollution or sediment deposition increase, less pollution tolerant invertebrates may migrate away leaving a less diverse, pollution tolerant community. Fatalities are also possible, although recovery is usually rapid once the bed of the watercourse has returned to normal and the polluted water has dispersed.
Pollution – Aquatic Plants • Physical removal or smothering the stream bed with sediment; • Plant growth may be encouraged by increases in nutrient levels or discouraged through increase water turbidity or decreased oxygen levels; and, • Loss of bank side cover/habitat.
Pollution – Conservation Interest • Some designated sites including rivers, still waters, and estuaries may be sensitive to pollution from road drainage
Pollution – Aesthetics • Accumulation of solids close to discharge points can affect recreational uses of the receiving water; • If oil content is high, malodours can be produced by microbial degradation and surface water sheens are possible; and, • Impacts most likely in slow flowing watercourses and lakes.

9.5.3 The Scheme has gone through a number of stages during which attempts have been made to ‘design out’ potential environmental problems that may lead to the degradation of the water environment. Solutions aimed at sources of impact result in the prevention of adverse effects. Where potential impacts could not be prevented by design, additional mitigation measures to reduce the risk have been specified.

9.5.4 These measures have been produced in consultation with EA and in accordance with current good practice for highway drainage design outlined in DMRB, references therein, and Construction Industry Research and Information Association (CIRIA) publications (see Table 9.1). Guidance for mitigating the possible adverse impacts to surface watercourses can be found in these publications.

Proposed Drainage Design

9.5.5 The proposed Scheme is for a two-way link road between Bexhill and Hastings. Apart from the tie-in to the existing road network at either end there is only one junction, London Road at Belle Hill. The proposal includes specific measures designed to attenuate flows and pollution from the carriageway.

9.5.6 The Scheme is divided into five major hydraulic catchments between the junction with A259 in Bexhill and the B2092 Queensway in Hastings. It is proposed that each catchment would comprise a self-contained drainage area with a dedicated drainage system to attenuate flows and pollutants.

9.5.7 The drainage design is an example of 'soft' engineering. The Scheme consists of five hydraulic catchments and these have been presented in Table 9.17.

9.5.8 The drainage design consists of the following:

- Kerbs and gullies in the more urban areas and on embankments;
- Shallow grass swales ('grassed ditch') to collect highway runoff elsewhere;
- Carrier pipes to collect seepage from the swales;
- Inlet/Inspection chambers at approximately 80m intervals;
- By-pass interceptors to collect hydrocarbon pollutants and sediments (by-pass petrol/oil interceptors are designed to remove the majority of hydrocarbon pollutants from the first flush runoff);
- Sediment traps and spillage tanks
- Extended detention ponds to form a flow dissipation device to store and discharge the 100 year (+20%) event with reed-beds incorporated within the design;
- A storage tank is also proposed for Egerton Stream to reduce discharge rate but would also provide pollutant attenuation benefits; and
- Combined filter drains in verges would collect surface runoff from cuttings/embankments and would discharge directly into nearby watercourse.

Table 9.17 Hydraulic Catchments

Catchment	Start Chainage	End Chainage	Discharge Location (Chainage)	Outfall to Receiving Watercourse	Drainage Detail
A (urban)	0	1500 (urban)	150 (1.15ha) 685 (1.45ha)	Egerton Stream	Online storage tank (oversized pipes) to Egerton Stream with a by-pass petrol interceptor.
B (rural)	1500	2700	2285 (1.01ha) 2310 (0.71ha)	Combe Haven	Grass swale to carrier drain discharging via petrol interception and two landscaped detention ponds with sediment forebays to Combe Haven floodplain.
C (rural)	2700	3120	3110 (0.60ha)	Watermill Stream	Grass swale to carrier drain discharging via petrol interception and landscaped detention ponds with sediment forebays to Combe Haven floodplain.
D (rural)	3120	4330	3350 (0.75ha) 3710 (0.58ha) 3950 (0.60ha)	Nearby drainage ditch	Widened grass swale discharging via petrol interception and two landscaped detention ponds with sediment forebays to Combe Haven floodplain.
E (mostly rural – urban from 5250)	4330	5500	4480 (1.32ha)	Nearby drainage ditch	Grass swale or kerb and gullies to carrier pipe discharging via petrol interception and landscaped detention ponds with sediment forebays.Concrete channels adjacent to climbing lane.

9.5.9 The principle behind the hydraulic design of this drainage system is that of incremental treatment of pollutants at each stage. In comparison to alternative ‘hard’ engineering solutions (not presented here) the proposed drainage design based on SUDS has added an aesthetic advantage being more in keeping with the rural environment. This drainage system also treats highway runoff at site reducing the distance travelled by contaminated runoff and minimising the chance of a system failure and leak. Despite a low number of road junctions, petrol interceptors and spillage tanks have been included in the design to give confidence that large spills or mobilisation of pollutants during heavy storms can be contained.

9.5.10 The drainage system has been designed in accordance with the latest advice contained in “Sustainable Drainage Systems, hydraulic, structural and water quality advice” (CIRIA C609 2004) and in “Sustainable Urban Drainage Systems: Design Manual for England and Wales” (CIRIA C522 2001) and DMRB, in particular Vegetative Treatment Systems for Highway Runoff (HA 103). SUDS exploit the natural processes of sedimentation, filtration, adsorption and biological degradation to remove pollutants from contaminated runoff. Water retention retains suspended solids, hydrocarbons, and metals that may be present in the runoff. SUDS also provide attenuation of flows of water providing some control over the rate of flow from the highway to receiving watercourses.

9.5.11 Treated and attenuated flows discharged from the proposed drainage system would be dissipated across the floodplain following treatment in the extended detention ponds. There would be no direct link to any nearby watercourses. However, for the purpose of the assessment which takes a precautionary approach, it has been assumed that all flows post attenuation would drain into a nearby watercourse. This assumption allows for residual pollution levels to be predicted and would represent a worst case scenario that is unlikely to occur.

Culverts

9.5.12 The Scheme requires the realignment and culverting of Egerton Stream and traverses four statutory main rivers (Combe Haven, Watermill, Powdermill, and Decoy Pond Stream) and a number of minor unnamed drainage ditches in the Combe Haven Valley. Table 9.18 summarises the proposed major culverts/underbridges and their locations.

Table 9.18 Proposed Culverts and Underbridges

Chainage	Watercourse	Crossing Type	Length (m)	Comment
2300	Combe Haven	Underbridge	12.4	Square
2900	Minor ditch	Diversion	-	-
3100	Watermill Stream	Underbridge	15.2	Skew
3675	Minor ditch	Diversion	-	-
3850	Powdermill Valley	Culvert	14.3	Skew
4000	Powdermill Stream	Underbridge	13.9	Square
4420	Minor ditch	Culvert	150 approx	-
4600	Decoy Pond Stream	Underbridge	20.4	Skew
-	Egerton Stream	Culvert and open channel	-	-

9.5.13 Six new crossings for the Greenway and one new crossing for EA access would also be constructed. The dimensions would be similar to those beneath the main route.

9.5.14 The EA has a presumption against culverts for all main river watercourses. This is to provide continuity for wildlife, adequate light within the watercourse and to reduce head loss under high flows. Clear span structures must provide a minimum of 2m clearance from the top of the banks on both sides of the watercourse.

9.5.15 All structures crossing watercourses have been designed in accordance with HA standards and EA requirements.

9.5.16 The urban Egerton Stream is a more complicated situation requiring a diversion and culverting. It is proposed to extend the Egerton Stream Culvert an additional 200m to allow the eastern tributary to cross the road. Storm flows would be directed into a storage tank from the culvert with a volume of 7250m^3 and located in the old corporation depot to the south of the railway cutting. Elsewhere, the stream would be left open to act as a low flow channel. The additional catchment tributary entering between 195 and 197 London Road would also be culverted (1.2m diameter) and another overflow weir would be provided to convey storm flows to the storage tank.

Groundwater

9.5.17 Details of the potential sources of pollution are described in Chapter 8: Geology and Soils and in 9.4 Existing Conditions of this chapter.

9.5.18 Drainage of run-off to each outfall would undergo some form of pre-treatment before it is released to mitigate the potential contamination risks due to chronic pollution. In all cases the drainage would pass through a by-pass oil interceptor before being discharged. In Reaches B to D the water would also pass through reed beds or a tank which would allow the settlement of suspended solids and further improve the quality of the discharge. In Reaches A, C and E discharge would be to the Egerton Stream, Watermill Stream and Decoy Pond respectively. In Reaches B and D discharge would be to the Combe Haven Floodplain. Since the discharge would be treated prior to release, there is unlikely to be any impact on the groundwater.

9.5.19 In Reaches B, C, D and E run-off from soft verges and the greenway would pass through a filter drain and be routed into streams without further treatment since the run off in these areas has not come into contact with any contamination.

9.5.20 The groundwater fed ponds adjacent to Reach E would not receive any drainage water from the Scheme. In addition, some significant earthworks with balancing ponds would be constructed as part of the Scheme which would mitigate flooding in the area and greatly reduce the risk of the ponds being in contact with surface water features during times of flooding.

9.5.21 A Construction Environmental Management Plan (CEMP) would be produced to limit the impact of acute pollution due to spillages both during the construction and operational phases. This would involve both temporary drainage to divert water away from the groundwater fed pond south of Reach E and a collection system to treat water prior to discharge.

9.5.22 The grass swales, reed beds and balancing ponds would be maintained in good working order to ensure they are working efficiently.

9.5.23 In areas of near surface groundwater elevation, the road would run along an elevated bund. Therefore the road sub base would not be in contact with groundwater.

9.5.24 It is recommended that during the construction phase groundwater quality data is collected along the Scheme particularly in areas which may pose a contamination risk to groundwater. These areas include the urban area within Reach A and parts of the Scheme down hydraulic gradient of landfills, scrap yards and other waste facilities.

Flooding

9.5.25 The current situation along Egerton Stream restricts flow at a number of locations, providing on-line flood storage. The proposed alternative form of storage is at the old corporation depot site adjacent to Bexhill High School and immediately upstream of the culvert. In addition some on-line storage, either within the stream channel itself or in voids beneath the road, is proposed.

9.5.26 A volume of approximately 7,250m^3 is required at the school site between the levels of 8.5mOD and 10.0mOD.

9.5.27 Embankments for the proposed road and associated landscaping in the floodplains of the Watermill and Powdermill streams would reduce the available floodplain storage. The new road would increase the runoff giving the need for a total volume of compensation of the order of 105,478m^3.

9.5.28 The entire runoff from the road, approximately 3,000m^3, would be treated before it is discharged into the local watercourses. Details are provided in Chapter 3B: Construction Strategy. The reed beds and balancing ponds would provide flood compensation in the flood plains and would be larger than the necessary volume for road drainage purposes.

9.5.29 Crossings to all main watercourses would be clear span structures with abutments a minimum of 2m back from the top of the banks. The soffits to the structures would be a minimum of 0.6m above the design water level.

9.5.30 The Powdermill Stream between Crowhurst and its confluence with the Watermill Stream is regarded as having a high environmental value, as discussed in Chapter 12: Nature Conservation and Biodiversity. It is not therefore considered appropriate to relocate the stream onto its original course in the valley bottom. Currently however, in times of high flow, the stream overtops its right bank and floods the fields in its natural flood plain. The excess water then flows along the original course of the stream into the flood plain of the Watermill Stream downstream. With the construction of a clear span structure at the crossing point, water levels upstream of the road would not be increased.

9.5.31 It is proposed that the current course of the Powdermill Stream between Crowhurst and its confluence with the Watermill Stream would be maintained for low and normal flows. As flows increase then the excess water would be diverted, as shown in Figure 9.4 onto the original course of the stream in the valley bottom. This would maintain the ecological benefit of the current watercourse and reduce the frequency of flooding of the fields in the valley bottom.

9.5.32 The flood compensation volume can be provided within the valleys adjacent to the proposed road alignment. It is proposed that the compensation would be provided partially within the Combe Haven Valley and partially within the Powdermill Valley, both immediately upstream of the road. A total of 113,336m^3 is provided (7,858m^3 more than the minimum required).

9.5.33 The possibility of using restrictions on various watercourses to reduce the flood risk to properties is an option. The locations of possible restrictions are described below. None of these are included in the Scheme.

- At the downstream end of the Combe Haven, adjacent to the Combe Haven Holiday Park. A restriction here with a relatively sophisticated control mechanism would increase water levels throughout the Combe Haven Valley and has the potential to reduce the flood risk to Bulverhythe. The increase in water level would have no significant effect on the flood capacity of the Combe Haven flood plain.
- A restriction on the Powdermill upstream of Crowhurst could potentially reduce the flood risk to properties at both the north end and southern end of the village.
- A restriction on the Rackwell Stream north of Crowhurst could potentially reduce the flood risk to properties at the southern end of the village, but not the north.
- An alternative could be to provide the compensatory volume upstream of Crowhurst in the Powdermill valley and local raising of flood banks. This would not only compensate for the loss of flood plain storage due to the road but could also provide some reduction in the flood risk to properties in Crowhurst. This is not considered practicable at this stage and is not included in the Scheme, but options are being investigated separately by ESCC.

Construction Mitigation

9.5.34 The construction phase of the Scheme has the potential to cause adverse impacts to local watercourses from:

- Spillages of chemical pollutants stored on site and/or used on site; and,
- Changes to the hydrodynamics, disturbance of sediment in watercourses, and/or sediment loading of watercourses from construction works.

9.5.35 A Construction Environmental Management Plan (CEMP) would be developed that would contain details of measures and procedures required to manage those elements of the construction works that have potential to cause adverse impacts on the water environment. The contents of the CEMP would be agreed with the EA and other relevant statutory consultees and it would form part of contractual documents. Details of the Outline Construction Strategy are given in Chapter 3B: Construction Strategy.

9.5.36 A temporary site drainage system should be developed that addresses the specific concerns identified in this technical chapter of the Environmental Statement, and implements the appropriate mitigation measures detailed in the CEMP. The site drainage system would include the following generic construction mitigation measures:

- In-channel working would be minimised and avoided where possible;
- Ensure all licences and consents are in place before starting any works. Any works required within 8m of the tops of banks or within the channel of main rivers and critical ordinary watercourses would require land drainage consent from the EA. Works affecting other minor watercourses would still need consent under the Land Drainage Act 1991. Any temporary discharges of construction site drainage would require consent from the EA under the Water Resources Act 1991 (as amended). It would be necessary for the EA to be consulted throughout the preparation of method statements for construction;
- A bund should be constructed around any in-channel works, positioned in such a way as to provide suitable working areas and lined with appropriate materials to prevent the egress of water from the working area. In general, works in watercourses should be undertaken with bunded, dewatered areas, and in such manner as to minimise the disturbance of the existing bed and banks of the watercourse;
- A programme and method for stream diversions including the permanent diversion of the Egerton Stream and the historical channel of Powdermill Stream would be developed in consultation with EA and EN;
- Excavated material should not be allowed to fall into a watercourse or be stored near the top of the bank. The disposal of surface water runoff from excavations which may be contaminated with silt must be carefully controlled with opportunities for ‘settling’;
- Under no circumstances should water be allowed to escape directly from the site and enter a watercourse. Any works adjacent to a watercourse require suitable interception measures of escaped water to prevent unwanted materials entering the watercourse. Water pumped following excavation should be given the opportunity for sediment to ‘settle’ out either in tanks or ponds. These measures should be clearly identified in a temporary site drainage system;

- The storage of fuel/oils on sites must be in accordance with The Control of Pollution (Oil Storage) (England) Regulations (2001). Additional guidance can be found in PPG 2 – *Above Ground Oil Storage Tanks* and PPG 8 - *The Safe Storage and Disposal of Used Oils*. The storage and use of hazardous chemicals must be in accordance with the Control of Substances Hazardous to Health (COSHH) Regulations (1998). Site areas designated for the storage and or use of hazardous substances and chemicals should be remote from watercourses and protected by a bund surrounding the storage area to prevent the escape of any spilled substances into the site drainage system. This system should be temporary and isolated from the main site drainage system. The use of potentially polluting substances must be undertaken with care and managed to ensure that local watercourses are not contaminated;
- During the construction phase, machinery would be refuelled and maintained in bunded areas to contain any accidental fuel or oil spillages. These bunded areas should be located at least 30m from a watercourse. In addition, any vehicles entering the watercourse should be in good condition, be clean, and have drip trays fitted;
- Appropriate techniques and management measures (e.g. well maintained plant and drip trays) to prevent spillages reaching watercourses should be included in the temporary site drainage system. Contingency plans in the event of a major spillage should be prepared in accordance with best practice guidance and in consultation with the EA. Spill response equipment should be kept on site and maintained in good working order;
- The construction site set-up and location of compounds should be designed in such a way as to minimise the potential impacts on local watercourses. Advice can be found in CIRIA Reports C648 (2006) and C532 (2001). Measures should include:
  - Minimise the length of haul roads and their gradient, constructing them from permeable material if possible;
  - Construct gullies/ditches adjacent to haul roads and site works with bunds/dams to reduce drainage water velocity and allow sediments to settle before discharge to the drainage system;
  - The location where compounds are set up would be restored to their pre-construction state following completion of the works;
  - Install effective wheel washes with dedicated drainage and pollution collection sumps and receptors (liase with the EA as to whether jet washes are to be allowed). Areas for washing plant should be located away from watercourses and have appropriate controls for surface runoff; and,
  - Prompt seeding to reduce erosion of newly constructed embankments and cuttings.
- Chapter 3B: Construction Strategy describes the proposed drainage measures for the Scheme. This includes filter drains at the toe of embankments and the top of cuttings; and,
- Mitigation measures concerning possible impacts to fish e.g. timing of works has been presented in Chapter 12: Nature Conservation and Biodiversity.

9.5.37 During the construction phase, the ground surface would be dampened to mitigate the migration of airborne dust particles.

9.5.38 All groundwater collected during construction works would be treated prior to returning it to the watercourses or the flood plain.

9.5.39 Construction access over all main watercourses Combe Haven, Watermill Stream, Powdermill Stream and Decoy Stream would use clear span structures. Minor watercourses would be culverted using pipes with a minimum diameter of 0.6m.

Operational Mitigation

9.5.40 The operation of the Scheme is associated with two main sources of potential adverse impacts on the water quality of receiving watercourses:

- Potential effects arising from pollutants in routine road runoff; and,
- Potential effects arising from pollutants reaching watercourses following accidental spillage.

9.5.41 There are a wide range of potential pollutants from highways including those that are related to the flow of traffic such as: hydrocarbons from incomplete combustion of fuel and from drip leaks from engine oil etc; heavy metals; and, particulate matter. In addition, there are also pollutants from the wear of the roads tarmac surface, the seasonal application of de-icing salts, and from herbicides that are used during routine maintenance of grass verges etc. Anywhere where there is a traffic flow would be associated with a risk that an accident may cause a serious pollution incident. The main concern is that a tanker carrying a hazardous or polluting substance is involved in the accident and its entire contents enters a watercourse untreated. Containment measures with a capacity sufficient to accommodate a tanker size spill have been proposed.

9.5.42 Chapter 3B: Construction Strategy summarises the proposed stages of incremental drainage measures for each catchment to attenuate and treat highway runoff. This includes kerbs and gullies (in the urban areas) or grassed swales (for rural sections), followed by carrier drains, sediment traps, by-pass petrol interceptors, and bunded earth embanked dissipation basins with reed-beds and sediment traps. A storage tank is also proposed for Egerton Stream to reduce discharge rate but would also have some pollutant attenuation benefits. The DMRB provides guidance on the pollutant removal efficiency of mitigation measures and these have been incorporated into the assessment. The DMRB also provides a reduction factor for the assessment of spillage risk where mitigation measures have been incorporated into the design. The following is a brief summary of the key proposed measures describing how they treat contaminated runoff and reduce the risk of spillage impacts:

- Grassed Swales – Grassed swales are open vegetated channels with a low gradient that can convey highway runoff from the point of discharge and also provide storage and infiltration capabilities. They are particular effective in removing solids and associated pollutants through sedimentation, biofiltration and chemical adsorption (Revitt 2004). The performance of grass swales depends on flow rates, vegetation type and density. Swales require regular maintenance to ensure effectiveness.

- By-pass petrol/oil interceptors – Remove insoluble pollutants including hydrocarbons and sediments from runoff. The proposed bypass petrol interceptors are effective against the "first flush" runoff.
- Bunded earth embanked dissipation basins with reed-beds – This approach brings together many positive aspects of other measures. These facilities would include measures to trap sediment from influx, reed-beds, retention ponds, and devices to controlled discharge rates (and potentially hold back a large spillage). Pollutants are often transported in association with particulate matter and the removal of sediment results in improvements to water quality. It is presumed that the reed-beds would contain the effective Typha latifolia and/or Phragmites australis, although other species may be used. Reed-beds treat runoff by a combination of several processes including biofiltration, sedimentation, adsorption, biological uptake, and physiochemical interactions.
- Storage tanks for Egerton Stream – These are artificial structures that store surface water storm runoff prior to releasing it at the appropriate rate. Water quality improvements are achieved through sedimentation and biodegradation. The effectiveness of this system is limited against dissolved pollutants. Storage tanks require regular maintenance to remove silt.

9.5.43 During operation it would be necessary for the drainage mitigation measures to be routinely maintained to ensure their effectiveness in attenuating contaminated routine runoff and to provide containment in the event of a significant spillage. Signage of pollution control measure devices should be clear so that they can be located quickly and used correctly in the event of a pollution emergency. The local authority and emergency services would be involved in the production of contingency plans for in the event of an emergency.

9.5.44 Flood compensation would be provided for all permanent works below the design, 100 year return period event plus 20%, level.

9.6 Construction Impacts

9.6.1 The Scheme would cross four main rivers (Combe Haven, Watermill Stream, Powdermill Stream, and Decoy Pond Stream) and four minor drainage ditches in the Combe Haven Valley. The Scheme would also involve the restoration of the historic channel of Powdermill Stream for flood flows and the separation of normal and flood flows in Egerton Stream. The alignment passes close to Decoy Pond with the potential to cause adverse impacts.

9.6.2 For the purpose of the assessment of impact significance the importance of watercourses, including Decoy Pond is considered to be high.

9.6.3 During construction the runoff carrying sediment from bare ground on the site and the risk of accidental spillages of potentially polluting chemicals are the main sources of potential adverse impacts. Temporary works in watercourses could also disrupt flow and mobilise sediments. During the detailed design specific proposals for temporary and permanent crossing would be developed in consultation with the EA. The works would be carried out under the conditions of a Land Drainage Consent. Provided appropriate measures are in place to ensure flows are not impeded and water qualities not deteriorated the effect of crossings should be slight adverse for a temporary period.

9.6.4 Section 9.5 of this chapter describes the potential adverse impacts to the local water environment that may result as a consequence of the construction works. The following assessment has been based on the assumption that any Contractor, appointed to undertake the planned construction, would adhere to the strict mitigation measures identified in this Chapter where they are relevant to do so. It is also understood that these measures would form part of the CEMP.

9.6.5 The EA has specified that all new bridges would need to be clear span offset from the top of the banks by at least 2m both sides. The surrounding landscape of the Combe Haven Valley (and downstream SSSI) is very sensitive to changes in water quality and hydrology and the EA has stipulated no degradation of water quality would be acceptable. Therefore, it is essential that the mitigation measures that have been identified in Section 9.5 are correctly implemented where appropriate.

9.6.6 The EA has statutory powers to ensure the construction works do not adversely impact upon receiving watercourses. Any construction works within 8m of the banks or within the channel of main rivers would require Land Drainage Consent by the EA. Appendix 9-F presents the full assessment of the significance of impacts due to construction. Providing the CEMP is comprehensive and adhered to, it is unlikely that construction activities would cause residual impacts. Please note that Chapter 12: Nature Conservation and Biodiversity provides an assessment of impacts to fish.

Spillage Risk

9.6.7 There is the potential during construction works for the water quality of local receiving waters and drains to be contaminated by accidental spillages of a range of potentially polluting substances. Substances that may be found at any one time on the construction site include: oil, diesel, lubricating oil, grease, hydraulic fluid, cement, thinners, paints, lime, preservatives, sealant, battery acids, other acids, weed killers, and fertiliser.

9.6.8 Mineral oils and petroleum products comprise a complex mixture of hydrocarbons, which are damaging to the water environment and hazardous to aquatic life. During a spill, hydrocarbon compounds may form a film across the surface of water bodies preventing oxidation of the water column and exerting a biochemical oxygen demand (BOD). A relatively small spillage or accidental leaks of any of these substances, if not adequately controlled, can produce significant acute adverse impacts to receiving watercourses. However, provided appropriate measures as detailed in Section 9.5 of this chapter are implemented on site, the risk of a significant spillage should be adequately mitigated. The handling of cement, concrete and other construction materials would be managed so as not to cause pollution. Appropriate procedures would be included in the CEMP. Provided these measures are implemented on site the effects would be negligible.

Suspended Sediments

9.6.9 There is the potential for construction works to mobilise large volumes of sediment which, unless appropriate measures are implemented, could discharge directly into nearby watercourses causing adverse impacts (See Appendix 9-F) Construction activities that may mobilise sediment include: site drainage, excavation waters, wash off from materials, truck and machinery washing, runoff from bare ground and soil stockpiles, dirty water in disused pumps and the build up of dust and mud on site access roads.

9.6.10 If not adequately controlled, the increased sediment loading of streams within the Combe Haven Valley and Egerton Stream could have significant adverse impacts upon its water quality. Suspended sediment can act as a medium to transport other pollutant compounds e.g. metals and hydrophobic organic pollutants (e.g. hydrocarbons) and may degrade water quality. In addition, pollutants contained with the sediments or absorbed on the surface may remain in the channel and be released over extended time periods therefore affecting background concentrations in the long term.

9.6.11 The discharge of sediments into watercourses may also adversely impact the flora and fauna of receiving watercourses. Typical impacts include: smothering substrate, decreasing light penetration retarding photosynthesis, decreasing oxygenation potential, affecting feeding and reproduction, and clogging the gills of fish.

9.6.12 However, provided appropriate mitigation measures described in Section 9.5 of this chapter are carefully implemented during construction, there is unlikely to be any residual impact from suspended sediment. These measures include obtaining consents from the EA for works in and adjacent to a watercourse, and for discharges from the construction site. In addition, any temporary discharge of construction site drainage would also require a Discharge Consent from the EA. All discharges including site run-off and pumped water from excavation should be directed through the temporary site drainage system for treatment prior to discharge via consented outfall. Provided the mitigation measures described in Section 9.5 are implemented on site the impact would be minor adverse for a temporary period.

9.6.13 The EA would advise on the timing of construction works affecting the channel and more information can be found in Chapter 12: Nature Conservation and Biodiversity.

Decoy Pond

9.6.14 Decoy Pond and a small adjacent ephemeral pond are located close to the Scheme alignment. It would be necessary to remove and alter the shape of Decoy Pond to accommodate the link road carriageway. For compensation, the Scheme would provide a number of oversized retention ponds to add ecological and landscape value replacing what has been lost as well as the construction of wildlife ponds that would also add to the local pond/wet land habitat.

9.6.15 The modifications to the layout of Decoy Pond would result in temporary adverse impacts during construction works (e.g. increase in suspended sediment concentration). There is also the potential for chemical spillages to occur which could affect wildlife and habitat. These adverse impacts are likely to be short term.

9.6.16 The extension of the pond would be designed to ensure minimal disturbance to the existing pond area. Appropriate mitigation measures such as use of silt curtains would be put in place to control disturbance of sediment and minimise any reduction in water quality. The main intrinsic value of Decoy Pond is in the habitat it provides for aquatic organisms. This is detailed in Chapter 12: Nature Conservation and Biodiversity. In terms of water quality, any works to Decoy Pond or adjacent to it should adopt the same measures outlined for construction of the Scheme. With these measures, the impacts are of low significance.

Groundwater

9.6.17 There is potential for the following impacts to groundwater during the construction phase:

- The groundwater level is very shallow in some parts of the Scheme, especially in the Combe Haven floodplain near to Reaches B to E. Therefore spilled fuels and lubrication oils readily could percolate to groundwater with minimal opportunity for attenuation. The CEMP would include measures to reduce the risk by containing spillages;
- Excavations may need to be dewatered during construction in areas of shallow groundwater level. Any groundwater encountered should be collected and treated prior to disposal. Since shallow groundwater is feeding the local surface water courses; and as road drainage would be returned either directly to surface water courses or to floodplains, it is considered that any dewatering would cause no appreciable change to the net volume of recharge to surface water or groundwater;
- Spillage of fuels and lubrication oils from machinery and vehicles entering the groundwater fed small pond south of the road in Reach E via surface water runoff. The CEMP would include drainage measures to reduce the risk; and,
- Dust and particles entering the groundwater fed small pond south of the road in Reach E via air borne deposition or contained as suspended solids in surface water runoff. The CEMP would include measures to reduce the risk.

9.7 Operational Impacts

9.7.1 Routine highway runoff often includes a variety of contaminants that can lead to chronic water pollution in receiving water bodies. Chronic pollution is the result of ongoing discharges of low levels of pollutants, which may accumulate in the receiving watercourse over time. Chronic pollution tends to produce non-lethal effects, but causes the continuous degradation of the quality of the receiving environment. Effects to water organisms include reduced feeding and growth rates, reduced reproduction, and even death. Acute pollution occurs as a result of a severe, usually transient impact e.g. from an accidental spillage of a pollutant.

9.7.2 One of the controlling factors of the concentration of pollutants in highway runoff is the volume of traffic flow. The DMRB states that water pollution is restricted primarily to roads with 30,000 AADT or more, although flows of 15,000 AADT may be significant for particularly sensitive receiving water bodies. The estimated two-way AADT flows for the Scheme in the design year (2025) would be less than 30,000 vehicles per day, and the proportion of HGVs is low..

9.7.3 A Simple Assessment was undertaken for each road catchment and receiving watercourse. The results are presented in Appendix 9-D. The Simple Assessment identified that a more detailed assessment was required for catchments A and B only. However, due to the proximity of the SSSI and the dependence on assumptions in performing this assessment, it was appropriate to undertake a Detailed Assessment of routine runoff for all of the hydraulic catchments to improve reliability of results.

Impacts from Routine Runoff

9.7.4 The impact assessment from routine highway runoff has followed the methodology described in Section 9.2 of this chapter and has been based on the method outlined in the DMRB. The detailed findings are presented in Appendix 9-D. A summary of the results of the Detailed Assessment are presented in Table 9.19.

Table 9.19 Summary of Potential Operational Impacts from Routine Runoff

Catchment	Receiving Watercourse	RE	Cu EQS (mg/l)	Predicted dispersion concentration for dissolved copper without mitigation (mg/l)	Predicted dispersion concentration for dissolved copper with mitigation (mg/l)	Zn EQS (mg/l)	Predicted dispersion concentration for total zinc without mitigation (mg/l)	Predicted dispersion concentration for total zinc with mitigation (mg/l)
A	Egerton Stream	3/4	0.112	0.068	0.05	2	0.56	0.408
B	Combe Haven	4	0.112	0.044	0.029	2	0.226	0.088
C	Watermill Stream	2	0.112	0.007	0.005	0.5	0.042	0.026
D	Powdermill Stream (existing or old – TBC)	4	0.112	0.012	0.008	2	0.07	0.034
E	Drainage ditch near Decoy Pond Stream	2/3	0.112	0.062	0.053	0.5	0.149	0.065

9.7.5 Dissolved copper and total zinc are two of the parameters used for the determination of watercourse RE targets (described earlier) and therefore the classification is particularly relevant to highway schemes. For each RE class there is an Environmental Quality Standard (EQS) for dissolved copper and total zinc. It is typical for the impacts of routine runoff from highways to be evaluated against whether the treated discharge changes the EQS level. The EQS for dissolve copper and total zinc are dependent on water hardness and the threshold for total zinc also increases with the lower target grades (the EQS for dissolved copper is the same for all RE classes). Therefore, for the watercourses that would receive highway discharges the EQS for copper is 0.112mg/l and for total zinc it is either 0.5mg/l or 2mg/l.

9.7.6 The assessment of routine runoff assumes all end pipe treated highway runoff drains into a receiving watercourse. The actual drainage arrangements are for the end pipe discharge to be distributed across the flood plain of adjacent watercourses. Therefore, the assessment may be considered as a 'worse case' situation.

9.7.7 The effectiveness of the proposed treatment measures was determined from information in the now replaced November 2002 version of the DMRB. There is some doubt as to how accurate these values may be and they have not been reproduced in the latest May 2006 version. However, Volume 4, Section 2, Part 1 *Vegetated Drainage Systems for Highway Runoff* (HA103/06) suggests that the effectiveness of vegetated systems to treat routine runoff may actually be more effective than the efficiencies used in the assessment. Therefore, the assessment can be considered to be relatively conservative and it is likely that residual concentrations in receiving watercourses would be lower than those reported.

9.7.8 The assessment predicts that for each receiving watercourse the predicted residual concentration of dissolved copper and total zinc would be below the relevant EQS with or without mitigation. Therefore, it is considered that the water quality of receiving watercourses is unlikely to be adversely affected by routine runoff from the proposed Scheme. Hence, the significance of impact from contaminated highway runoff is considered to be neutral with or without mitigation. However, as described in this chapter substantial mitigation to minimise pollution potential would be incorporated in the Scheme.

Impacts from Spillage Risk

9.7.9 Spillages may occur as a result of a road traffic accident or a vehicle fire and can cause acute short term potential impacts to receiving watercourses. The environment surrounding the Scheme is sensitive to changes in water quality. Therefore, the acceptable return period for a spillage that results in a serious pollution incident is 1 in 100 years. In order to mitigate the adverse effects to receiving watercourses of a potentially large spillage, the design includes containment measures to control any spill e.g. swales, spillage tanks, by-pass interceptors, and extended detention ponds.

9.7.10 An assessment of the risk of spillage has been conducted for each hydraulic catchment and the results are presented in Appendix 9-E. The assessment with mitigation includes a risk reduction factor (as per DMRB guidance) for each appropriate containment facility. Table 9.20 presents a summary of the results.

Table 9.20 Summary of Spillage Risk

Methodology	November 2002 DMRB Edition		May 2006 DMRB Edition	
Catchment	**Spillage Risk without mitigation**	**Spillage risk with mitigation**	**Spillage Risk without mitigation**	**Spillage risk with mitigation**
A	11	1312	11,335	1,311,903
B	25	2927	25,291	2,927,220
C	48	5576	48,174	5,575,657
D	25	2903	25,082	2,903,028
E	18	2077	17,944	2,076,804

9.7.11 The latest methodology presented in the revised edition of the DMRB (May 2006) included significant changes from the methodology presented in the November 2002 DMRB edition. These changes were made following a revision of EA data on spillages that are known to have occurred across a set period of time. As a result, the previous methodology was considered to be too cautious and the revised assessment, although inherently the same, was adapted accordingly to reflect the latest understanding. Table 9.20 presents the findings of the assessment into the risk of a spillage leading to a serious pollution incident using both the old (November 2002) and new (May 2006) DMRB versions. This assessment has followed a precautionary principle and even if the more cautious DMRB assessment results are used, the considerable mitigation that has been included in the design of the Scheme ensures that the spillage risk for any road catchment is within acceptable standards with the proposed mitigation.

9.7.12 The inclusion of appropriate mitigation measures in the drainage design therefore means that the risk of spillage leading to a serious pollution incident has been adequately mitigated and return periods for each catchment are acceptable for sensitive water environments. Regular maintenance of the drainage measures would be required to ensure that performance remains as estimated. It is considered that the significance of impacts from the risk of spillage is neutral with or without mitigation.

Regular and Seasonal Maintenance Activities

Impacts from De-icer Salts

9.7.13 Rock salt (and sometimes other de-icing agents) is frequently applied to road surfaces during the winter months to ensure the safety of road users during cold conditions. In addition to Sodium Chloride, de-icing salts may also contain quantities of clay, cyanide, sediment, and a number of metals (DMRB 1998). Furthermore, de-icant salts are corrosive and contribute to the release of metals from vehicles. Therefore, the application of salts between November and March is one source of potential contamination from highway runoff with winter discharges intermittently containing high concentrations of chloride, among other pollutants.

9.7.14 The use of de-icing chemicals is intermittent and seasonal. This complicates any assessment of its effects, and it has only been possible to consider the potential impacts qualitatively. It is unlikely that the receiving watercourses will have a history of the pollutants typically found in de-icing salts. However, while sudden increases in chloride concentration can adversely affect fish and freshwater invertebrates, any winter runoff would normally be very rapidly diluted and dispersed by rainfall (DMRB 1998).

9.7.15 Recent research has shown that de-icant in normally anticipated concentrations are not a major threat to fish populations, especially salmonids that have a high tolerance to variations in chloride level. There remains the possibility that following the application of de-icant salts the ‘first flush’ may contain elevated levels of chloride (and other pollutants in the salts). Due to the relatively small surface area of the proposed Scheme, the high dilution capacity and treatment of flows provided by the proposed drainage measures, it is unlikely that the use of de-icant would result in any residual long term impacts. Therefore, the significance of impact from de-icant use is considered to be minor adverse without mitigation, and neutral with mitigation.

Herbicides

9.7.16 Herbicides may also be used by the ESCC to control and manage highway verges and vegetated areas within the highway boundary. Herbicides have the potential to cause adverse impacts to water bodies and their use must be strictly controlled. The bacterial decomposition of large quantities of organic matter killed by herbicides exerts a high BOD, which is detrimental to the aquatic ecosystem and may result in fatalities of aquatic organisms and plants. In addition, high levels of nutrients released during the decaying process may cause the excessive growth of algae and encourage eutrophication. In sufficient concentrations herbicides may also be toxic to fish and aquatic invertebrates.

9.7.17 The impact of herbicides may be minimised through careful selection and targeted application, only using chemicals that comply in all respects with the statutory requirements of COSHH and the Control of Pesticides Regulations 1986. Herbicides used in this way are not a potential source of pollution to local watercourses. Also, it is not envisaged that significant volumes of herbicide would be applied during maintenance of the Scheme. Therefore, the risks of adverse impacts from herbicide application are thought to be neutral with or without mitigation.

9.7.18 Other maintenance activities include routine cleaning out of drainage entrapment features e.g. gully pots and interceptors, and the flushing of these features may potentially be as damaging as an accidental spillage. The proposed mitigation measures would be capable of containing and treating the runoff from these activities.

Groundwater

9.7.19 The road would have little impact on groundwater resources since:

- The area of the road is very small compared to the size of the groundwater catchments and therefore any loss of direct infiltration into the ground would be small. In addition, shallow groundwater currently feeds the local surface water courses; and as road drainage would be returned either directly to surface water courses or to floodplains there would be no appreciable change to the net volume of recharge to surface water or groundwater; and,
- The underlying aquifer is a Minor Aquifer and there are few groundwater abstractions in the area, and none within 1.5km of the route.

9.7.20 The road would have little impact on groundwater quality since:

- Run off from the road would be pre-treated before being returned to the flood plain or water courses; and,
- The DRMB *Assessment of Pollution Impacts from Routine Runoff on Groundwaters* indicates that for each of the five reaches the 'Risk of Impact' is Moderate. However, the DRMB risk assessment does not incorporate the fact that reed beds and oil interceptors would be used at the site. Therefore the actual risk would be less than Moderate. The spreadsheets used to calculate the DRMB scores are included in Appendix 9-G. A summary is given in Table 9.21.

Table 9.21 Summary of Groundwater Risk

Catchment	Risk Score	Risk Classification	Resource Sensitivity	Groundwater Sensitivity
A	215	Medium	Minor Aquifer	Moderate
B	215	Medium	Minor Aquifer	Moderate
C	22.5	Medium	Minor Aquifer	Moderate
D	215	Medium	Minor Aquifer	Moderate
E	222.5	Medium	Minor Aquifer	Moderate

9.7.21 The WebTAG analysis indicates that the impact of the Scheme is Neutral with respect to groundwater. The table used to reach this classification is given in Appendix 9-H.

Other Considerations

9.7.22 The proposed drainage design encompasses the 'soft' option that offered aesthetic benefits more in keeping with the surrounding landscape. Where possible, discharges have been proposed to minor drainage ditches to avoid direct discharge into local classified watercourses, all of which have fairly good to very good water quality, except Egerton Stream that flows through an urban catchment.

9.7.23 The proposed drainage system includes dissipation ponds that have been purposely oversized to provide an ecological and landscape enhancement. The provision of vegetation in the form of reed-beds also adds to the effectiveness of these ponds.

9.7.24 The Scheme would result in the intermittent reintroduction of flow down parts of the historical channel of Powdermill Stream. Therefore, provided that the mitigation measures outlined in Section 9.5 of this chapter are implemented on site the impacts should be minor adverse and temporary.

9.8 Conclusions

9.8.1 The assessment of potential impacts on water quality (both surface and groundwater), drainage and hydrology have been carried out in accordance with the methodology set out in the DMRB (May 2006).

9.8.2 Due to the presence of a SSSI downstream all receiving waters have been considered to be sensitive and a precautionary principle has been used throughout when considering the effects of potential pollutants.

9.8.3 The principle behind the hydraulic design of this drainage system is that of incremental treatment of pollutants at each stage using Sustainable Urban Drainage Systems (SuDS).

9.8.4 The Scheme is underlain by a Minor aquifer along its entire route. Groundwater levels are close to the surface, particularly across the Combe Haven Valley.

9.8.5 The DRMB *Assessment of Pollution Impacts from Routine Runoff on Groundwaters* indicates that the overall risk rating is Moderate, excluding any mitigation works. Comprehensive mitigation measures during both the construction and operational phases are proposed.

9.8.6 The Scheme would therefore have only a minor adverse impact on groundwater quantity or quality during the construction phase. The WebTAG analysis indicates that the impact of the Scheme would be Neutral with respect to groundwater during operation.

9.8.7 A Detailed Assessment of the potential impact of routine highway runoff has followed the methodology in the DMRB. The assessment predicts that for each receiving watercourse the predicted residual concentration of dissolved copper and total zinc would be below the relevant EQS with or without mitigation, and are therefore unlikely to be adversely affected by routine runoff from the Scheme.

9.8.8 Using the more cautious DMRB assessment results, the predicted return period of a pollution incident with the mitigation measures in place is greater than 1000 years.

9.8.9 The impact on surface water quality would be only minor adverse during the construction phase and neutral during operation.

9.8.10 Egerton Stream currently restricts flow at a number of locations, providing on-line flood storage. The Scheme would provide storage in a tank, approximately 7,250m^3 capacity between the levels of 8.5mOD and 10.0mOD, at the old corporation depot site adjacent to Bexhill High School. Water levels throughout the system would be similar to existing.

9.8.11 The road and associated landscaping would cross the floodplains of the Watermill and Powdermill Streams and hence reduce the available floodplain storage. The new road would also increase the total runoff needing storage within the floodplain. The Scheme would provide compensatory storage in excess of that occupied by the road and associated landscaping.

9.8.12 Where the Scheme crosses main watercourses clear span structures would be used with abutments a minimum of 2m back from the top of the banks. Flood levels up to 100 year return period would not be increased following construction of the Scheme.

9.8.13 With the mitigation measures proposed the impact on flooding would be Neutral.

9.8.14 Raising water levels within the Combe Haven Valley by the construction of a weir or more sophisticated control structure towards the downstream end of the Combe Haven and/or a series of stoplog controls elsewhere throughout the catchment would have benefits for the general ecology. These are discussed in Chapter 12: Nature Conservation and Biodiversity.