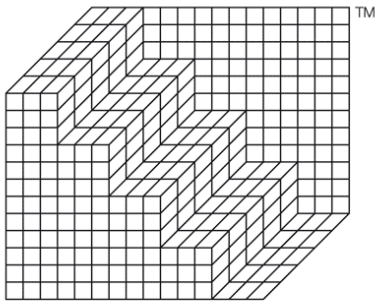

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028324 Avonmouth/Severnside Integrated Development Strategy - Flood Risk

Flood Risk Management Study

Strategy
Job no 028324-2204-01

September 2011Revision 02

Buro Happold

Revision	Description	Issued by	Date	Checked
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author	**Andrew Dannatt**
signature	
date	**02 September 2011**
approved	**Tim Denton**
signature	
date	**02 September 2011**

Contents

1 Executive Summary

This flood risk strategy has been prepared by Buro Happold Ltd on behalf of SWRDA and the Councils of Bristol City and South Gloucestershire for the proposed development of the Avonmouth/Severnside area, Bristol, Avon. The strategy has been developed in accordance with the guidelines set out in Planning Policy Statement 25 Development and Flood Risk (PPS25), as well as other guidelines and procedures.

The principal flood risk to the site is the Severn Estuary, which is tidally influenced at the Avonmouth/Severnside frontage. Climate change impacts are predicted to generate a gradual long term increase in the average sea levels in the adjacent estuary in years to come. There is also a fluvial risk of flooding within the site.

The site is currently defended, or protected, against flooding from extreme tidal events. However, and importantly, the Environment Agency classifies areas into one of three Flood Zones based on risk of flooding from the river or sea, **not** taking into account any flood defences; the Avonmouth/Severnside study area is therefore identified to be almost entirely within Flood Zone 3a.

The following principal sources of data and Information have been used in the preparation of this strategy:

- Strategic Flood Risk Assessment - Level 2 report (SFRA)
- Severn Estuary Shoreline Management Plan
- Severn Estuary Strategy – Consultation January 2011

The SFRA identifies the 10.74m AOD defence as a potential solution to mitigate tidal flood risk in the area. Providing a higher defence level gives added protection against overtopping and reduces the likelihood of breach, but it comes at a high cost (economic and environmental). The Port, within the Deep Sea Container Terminal development within the south west of the study area, is intending to implement proposals to provide a 10.67m AOD defence along part of the estuary frontage and this is scheduled for construction in 2015. In addition to these works, further mitigation measures (e.g. raising land levels for buildings) should be brought forward within the study area to deal with risks from wave overtopping, breach and fluvial flood risk that would not be addressed by the above measures. Implementation of these mitigation measures may require the Environment Agency's Compulsory Purchase Order powers.

The EA consultation on the Severn Estuary Strategy suggests that a strategic solution be developed in stages, either behind the existing railway line or by raising the railway line and converting the existing embankment into a formal flood defence. From an engineering, environmental and economic perspective the repair/improve alternative would be more preferable, although Network Rail may not readily approve such a formal use of their railway embankment. A phased strategic solution behind the existing defence would provide flexibility in the funding stream and would allow some redevelopment of previously developed land within the study area.

Some land raising (that will occur anyway as a result of the 57/58 consent) will be required as the introduction of highways, infrastructure and safe access routes are implemented to better serve the community and the wider area. This work could proceed in advance of a strategic solution coming forward provided it fitted within the strategic framework.

Glossary

Actual Risk	The risk that has been estimated based on qualitative assessment of the performance capability of the existing flood defences
Attenuation	A method to reduce a flood peak to prevent flooding, increasing the duration of the flow
Breach	Failure of flood defences or other infrastructure acting as a flood defence, potentially causing flood related hazards
Brownfield	Land previously developed that has potential to be regenerated
Catchment Flood Management Plan (CFMP)	A CFMP is a large scale strategic planning framework for the integrated management of flood risks to people, natural and developed environment in a sustainable manner
Catchment	A river catchment is the area which the river drains either naturally or with artificial engineering. A surface water catchment is the area which water drains into a river. A groundwater catchment is the area that consists of the groundwater river flow.
Coastal Defence	To provide protection from coastal erosion and/or tidal flooding
Design Flood Level	This is the level of flooding that flood defences or mitigation measures are designed against. This is typically the 1% (1 in 100) flood level.
Discharge	The rate of flow of water measured in terms of volume per unit time
Flood Defence	A natural or man-made infrastructure used to prevent certain areas from inundation from flooding, and / or the provision of flood warning systems
Floodplain	Area of land adjacent to a water course on which water flows or is stored during a flood event, or would otherwise be flooded in the absence of flood defences
Flood Resilience	Improving flood resistance, e.g. reducing the risk of properties against

	flooding events
Flood Risk	The level of risk to personal safety and damage to property resulting from flooding due to the frequency or likelihood of flood events
Flood Risk Assessment (FRA)	An assessment of the flood risks to the proposed development over its expected lifetime and the possible flood risks to the surrounding areas, assessing flood flows, flood storage capacity and runoff
Flood Risk Management (FRM)	Managing/reducing flood risk to people, property and the environment
Flood Warning Systems (FWS)	A system by which to warm the public of the potential of imminent flooding. This is typically linked to a flood forecasting system
Flood Zones	An area susceptible to flooding with a level of risk defined by the Environment Agency according to PPS25 Table D.1:- • **Zone 1 Low Probability** Land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%). • **Zone 2 Medium Probability** Land assessed as having between 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year. • **Zone 3a High Probability** Land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year. • **Zone 3b Functional Floodplain** Land where water has to flow or be stored in times of flood – usually defined as the in 20 floodplain.
Fluvial Flooding	Related or connected to a watercourse (river or stream)
Freeboard	An allowance for uncertainty and/or imprecise engineering allowances

	such as settlement.
Greenfield	Land which has not been previously developed
Groundwater	Water present within underground strata known as aquifers
Groundwater Flooding	Surface flooding resulting from high ground water levels.
Inundation	Flooding of land with water
L1 SFRA	Level 1 Strategic Flood Risk Assessment – assessment carried out on an administrative area
L2 SFRA	Level 2 Strategic Flood Risk Assessment – more detailed assessment on specific area that requires more detailed investigation
LIDAR	Airborne laser scanning of topography
Mitigation	Actions taken to reduce either the probability of flooding or the consequences of flooding or a combination of the two
Previously Developed Land (PDL)	Land which is or was occupied by a permanent structure (excluding agricultural or forestry buildings) and fixed surface infrastructure
Refuge	Area for shelter / protection during flood events
Residual Risk	The risk that remains after risk management and mitigation measures have been implemented
Resilience	Improving the flood resistance, e.g. Buildings
Rhine or rhyne	Network of flat ditches to convey irrigation/surface water – pronounced “reen”
Risk	Risk is the probability that an event will occur and the impact (or consequences) associated with that event
Runoff	Water flow over surfaces to the drainage system. Runoff occurs if the ground is impermeable or if permeable ground is saturated.

Shoreline Management Plan	A large-scale assessment of the risks associated with coastal process
Strategic Flood Risk Assessment (SFRA)	An SFRA is the assessment and 'categorisation' of flood risk on an area-wide basis in accordance with PPS25
Surface Water Flooding	Surface water flooding occurs when the volume of water is unable to filtrate through the ground to enter drainage systems, and therefore runs quickly off land and results in localised flooding. This type of flooding is usually associated with intense rainfall.
Sustainable Drainage Systems (SuDS)	SuDS are used as a strategy to manage surface water in a sustainable manner or least damaging solution through management practices and physical structures.
Sustainable Development	Development which meets the needs of the present without compromising the ability of future generations to meet their own needs
Tidal Flooding	Related or connected to the sea or estuary
Water Table	The top surface of the saturated zone within the aquifer

Abbreviations

AEP	Annual Probability of Exceedance
CFMP	Catchment Flood Management Plan
Defra	Department of Food and Rural Affairs
EA	Environment Agency
EU	European Union
FRA	Flood Risk Assessment
LDF	Local Development Framework
LPA	Local Planning Authority
PDL	Previously Developed Land
RFRA	Regional Flood Risk Assessment
SFRA	Strategic Flood Risk Assessment
SMP	Shoreline Management Plan
SoP	Standard of Protection
SuDS	Sustainable Drainage System

2 Introduction

An overview of the wider project is provided in a separate report by WYG, the Lead Consultant for this commission.

This report provides the advice and information about flood risk within the study area and the options for mitigating that risk. It seeks to identify the potential costs (based on evaluation by others) and risks of those options.

The information from this report is intended to feed into a “green book appraisal”, although it is likely that further detailed investigations will be required before it is possible to complete such an appraisal. This report identifies some of the additional work that will be required to inform a robust appraisal.

3 Project Description

3.1 Site Location

The study area is to the north east of Bristol. It occupies an area of approximately 1600Ha and is bounded to the west by the Severn Estuary and, generally, by the M49 to the east. The area is a mix of industrial, storage and distribution and infrastructure developments with agricultural and other undeveloped land.

The study area is generally flat and low-lying with a slight slope rising gently eastwards from the coast. Ground levels are predominantly low at the north-eastern boundary with an elevation of approximately 4mOD where fluvial watercourses exist, rising to 7m OD to the south-west, where the railway embankment creates an upstanding linear feature. An existing site plan is shown in **Figure 3-1** and in Appendix A.

Figure 3-1 Site Location (Reproduced with the kind permission of the Ordnance Survey)

3.2 Site Description

The site is adjacent to the Severn Estuary and is protected from flooding from the tidal river by existing flood defence walls.

One of the principal landholdings in the study area is that of Astra Zenica (formerly ICI) which historically included a sizeable chemical works. Whilst the built form of these works has generally decreased in overall size with time, their original landholding benefits from 1957/58 planning consents designed, at the time, to allow ICI to expand their business with relevant works-related development on their site. These planning permissions have subsequently allowed the site to be developed without incurring obligations to provide supporting infrastructure, or deal with flood risk through the normal planning processes.

Bristol Port in the south of the site has diversified during the twentieth century and, alongside conventional cargo handling, now houses logistics and warehousing businesses together with fuel supplies and car importation/preparation facilities.

3.3 Site Observation

A site visit was carried out on 7th October 2010 to familiarise the study team with the Avonmouth/Severnside study area. The high degree of heavy industrial development, the low lying topography and the close proximity of the site to the Severn Estuary was particularly noted. Travelling from the south by Bristol Docks, it was evident, and as expected, that dockside operations and port related industry remains in close proximity to the port itself. At the northern end of the site, remote from the port, warehouses and logistics centres prevail with the chemical works site.

It was clear that most of the newer developments had floor levels that had been raised above an anticipated flood level, considerably higher than the existing ground level; refer to Figure 3-1 below. There was evidence of sustainable drainage systems in operation.

Figure 3-2 Typical views of Avonmouth/Severnside

The railway from Avonmouth to Severnside performs as an informal flood defence.

It was considered that the conclusion from the L2 SFRA is valid, namely that the **primary** flood risk to the site, both now and increasingly in the future, is likely to occur due to a breach in the flood defence wall on the estuary, allowing tidal water flows to pass generally over and throughout the Avonmouth and Severnside area. However, we comment later in this report about the risks to the area from fluvial flooding and the additional work that will be required to investigate this matter if additional land is to be brought forward for development within the study area.

3.4 Available Information

The information reviewed and utilised within this assessment included the following principal documents:

- Shoreline Management Plan (Environment Agency)
- Bristol Avon Catchment Flood Management Plan (Environment Agency)
- Avonmouth/Severnside Level 2 Strategic Flood Risk Assessment (Capita)
- Severn Estuary Strategy - Managing flood risk on the Severn Estuary - South Gloucester to Hinkley Point, Somerset (Environment Agency)

A detailed schedule of references is contained in Section 10.

3.5 Flooding History

The documents reviewed do not indicate that Avonmouth/Severnside has been recently inundated from tidal or fluvial flooding. However, many instances of flooding are recorded in the surrounding Avon and Severn Tributaries' catchments.

3.6 Consultations

3.6.1.1 Environment Agency

Consultation has been undertaken with the Environment Agency throughout the development of this report through the Wessex Area Development Control team, Dave Crowson and Nigel Smith.

Key correspondence is in Appendix D of this report.

3.6.1.2 Bristol City and South Gloucestershire Councils

The Councils have been engaged throughout the preparation of this report and representatives attended the site reconnaissance visit and later workshop held on 18th January 2011.

4 Policy Context

4.1 International Context

4.1.1 European Commission Flood Directive (2007/60/EC)[i]

This directive requires all member states to assess whether water courses, including the coast are at risk from flooding. This includes the mapping of flood extents, the risks to humans and assets in these areas, whilst taking adequate and coordinated measures to reduce the flood risk. The directive enforces the right of the public to gain access to above information and to be involved in the planning process.

4.2 European Context

4.2.1 Water Framework Directive

The European Water Framework Directive came into force in December 2000 and became part of UK law in December 2003. It gives the Environment Agency an opportunity to plan and deliver a better water environment, focussing on ecology. The Directive helps to protect and enhance the quality of:

- surface freshwater (including lakes, streams and rivers)
- groundwater
- groundwater dependant ecosystems
- estuaries
- coastal waters out to one mile from low-water.

Previously, a range of inconsistent European legislation covered different aspects of water management. The Directive aims to introduce a simpler approach which will result in greater protection for a vital part of our environment. The Environment Agency is the 'competent authority' for carrying out the Directive.

4.3 National Context

4.3.1 Planning Policy Statement 25

This flood risk assessment (FRA) has been undertaken in accordance with Planning Policy Statement 25 (PPS25) March 2010. This document provides the latest guidance on considering flood risk for new development. The aims of this policy are:

"*to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk"*

PPS25 also requires due consideration of climate change and potential impacts of development in the future.

Sequential Test

Under the guidance in PPS25, a sequential risk-based approach is required to ensure that new development is appropriate taking into account the relative Flood Zones (1, 2 and 3) and the Vulnerability Classifications given in Annex D2 of PPS25 summarised below:

Development Checklist			Flood Risk Zone			
Buro Happold			Zone 1	Zone 2	Zone 3a	Zone 3b
			Low	Medium	High	Functional Floodplain
			<1 in 1000	1 in 1000 <Site> 1 in 100	>1 in 100	>1 in 20
Development Vulnerability Classification	Essential Infrastructure	Mass evacuation routes, strategic utilities, primary substations				
	Highly Vulnerable	Emergency services, basement dwellings etc				
	More Vulnerable	Housing, Hospitals, pubs, clubs, hotels, education etc				
	Less Vulnerable	Retail, restaurants, offices, warehousing, leisure etc				
	Water Compatible	Water treatment, docks, recreation, open space				
			Aim of PPS25 is to direct new development to Low risk areas [Flood Zone 1].	If no Zone 1 options are available development may be allowed in Zones 2 & 3 using risk based Sequential Test [and Exception Test where indicated orange above].		

PPS25 states:

"Local Planning Authorities allocating land in Local Development Documents (LDD) for development should apply the Sequential Test to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed."

"The overall aim of decision-makers should be to steer new development to Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, decision-makers identifying broad locations for development and infrastructure, allocating land in spatial plans or determining applications for development at any particular location should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2, applying the Exception Test if required. ***Only where there are no reasonably available sites in Flood Zones 1 or 2 should decision-makers consider the suitability of sites in Flood Zone 3****, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required."*

"In areas at risk of river or sea flooding, preference should be given to locating new development in Flood Zone 1. If there is no reasonably available site in Flood Zone 1, the flood vulnerability of the proposed development can be taken into account in locating development in Flood Zone 2 and then Flood Zone 3. Within each Flood Zone new development should be directed to sites at the lowest probability of flooding from all sources as indicated by the SFRA."

"The preparation and review of Regional Spatial Strategies (RSSs) and Local Development Documents (LDDs) should be used to review existing and proposed development in order to allocate land in lower flood risk zones

suitable for existing vulnerable uses already in medium and high flood zones, and in doing so, to realise opportunities arising through redevelopment to improve the sustainability of communities."

The majority of the study area is within an area classified by the EA as flood zone 3a (see Figure 4-1).

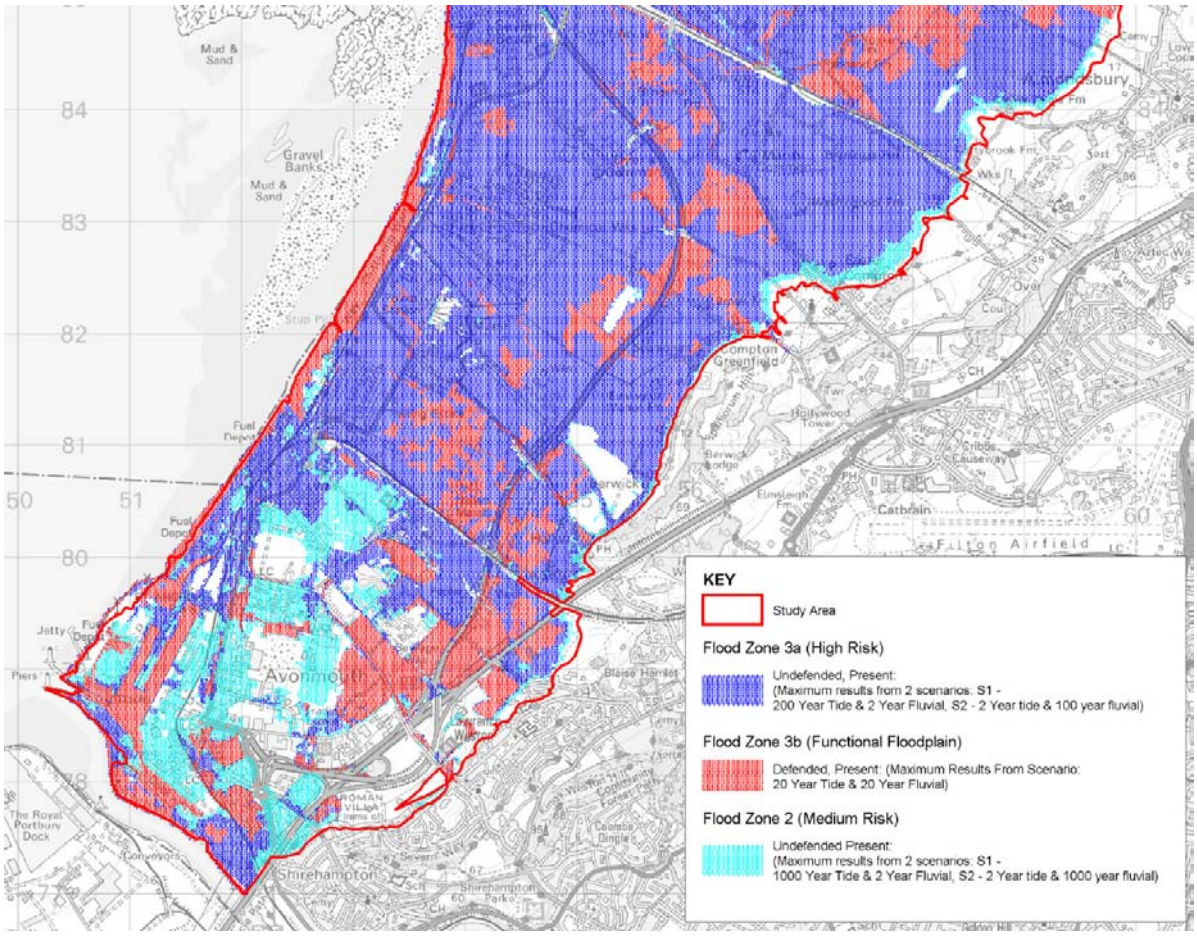

Figure 4-1 Flood Zones (Reproduced from the SFRA Figure 7.1)

The implication of the advice in PPS25 is that proposals for new industrial and warehousing development within the study area should address the "sequential test" i.e. demonstrate that there are no other "reasonably available" sites for the development.

Industrial and warehousing development within the study area would be classed as "Less Vulnerable" and would not, if the "sequential test" were satisfied, normally need to address the "exception test". Refer to the Developer Checklist in Appendix E for further summary of PPS25.

The EA's standing advice suggests that a sequential test may not be required where windfall sites have been designated, or where land allocations have been made by Local Authorities where the sequential approach has

already been demonstrated. Depending on the type of development proposed, sites that have been allocated may still have to satisfy the Exception Test (see below).

Exception Test

The study area lies principally within Flood Zone 3a (high probability) and therefore the Exception Test as defined in Section D9 of PPS25 is required to be satisfied in certain circumstances. PPS25 indicates that "*the **more vulnerable, highly vulnerable** and **essential infrastructure** uses in Table D.2 should only be permitted in this zone if the Exception Test is passed".* The document states that for the exception test to be passed:

a. "it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by an SFRA where one has been prepared";

b. "the development should be on … developable previously-developed land"; and

c. "a FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere".

For the Exception Test to be passed all three parts would have to be satisfied.

Part a) would include, for example, securing local economic development opportunities, improvements to community facilities, improvements to the public realm and services that the proposed development would provide. Part b) indicates that development should only take place on "brownfield" land. In order to pass part c), development within the study area would have to demonstrate that if safe access and egress could not be achieved, then a strategic flood warning and evacuation plan would have to be implemented as recommended in the SFRA. It would also need to demonstrate that flood risk would not be increased elsewhere.

As part of the SFRA work on the Breach Hazard Bandwidth, an extended Flood Zone 3a policy was recommended. In addition to the requirements for development in Flood Zone 3a that are set out in PPS25, the extended policy recommended that the Exception Test should be passed for **all types** of development within the designated Breach Hazard Bandwidth zone (see plan at **Error! Reference source not found.**) and that development within that area should be limited to the "**water compatible**" and "**less vulnerable**" categories only. At all locations at risk of flooding from a breach in the flood defences (including those outside the defined Breach Hazard Bandwidth), FRA for individual developments will need to assess the risk of breach in more detail and also consider mitigation within the design of the building and layout and drainage of the site.

The implication of this recommendation in the SFRA is that proposals for the development of unallocated greenfield land within flood zone 3a within the study area will need to satisfy **both** the sequential and exception tests.

For general industrial and warehousing development (B2/B8), developers (or the local planning authorities in considering the allocation of additional land for development) would need to first address the "sequential test" by demonstrating that there are no other suitable sites available within flood zones 1and 2, and would then need to pass the "exception test" by demonstrating, inter alia, that there were no suitable brown field sites available. All

other suitable brownfield sites within the area of search in flood zones 1 and 2 would have to be considered and if none were suitable then greenfield sites in flood zones 1 and 2 would be considered. Only if none of those sites were suitable would it be appropriate to consider bringing forward greenfield sites for development within the study area.

There may be specific development proposals (for example those requiring proximity to the port or motorway network) where the area of search for suitable sites needs to be restricted to the study area itself to address the sequential test. However, in considering the allocation of additional "green field" sites within the study area for general industrial and warehousing development with less specific location needs, it is likely that the search area will need to cover land beyond the study area. It may be challenging to justify the allocation of such additional land where other suitable sites for such development exist within the Bristol and South Gloucestershire areas that are in flood zones 1 or 2. The allocation of such additional green field sites for general industrial and warehousing development will need to address the sequential test, and in the context of the potential availability of other suitable sites in flood zones 1 and 2 in the area, it may be difficult to pass this test.

If it is possible to demonstrate that there are no other suitable sites for general industrial and warehouse development, if the SFRA recommendations are followed, individual development proposals will then need to address the "exceptions test". However, the development of further "green field" land within the study area would not pass this test and would therefore be considered unacceptable.

A key area of further study in considering the allocation of additional land for development within the study area will therefore be an analysis of other available sites for such development.

4.3.2 Making Space for Water

This relates the Flood and Coastal Erosion Risk Management Strategy in England (Defra 2004) and the Government's responses to the consultation exercise (Defra 2005[ii]).

Over the 20 year life time of the strategy, the Government is implementing a more holistic approach to managing flood and coastal erosion risk in England. The main aims of the strategy are to reduce the threat to people and their property, and to deliver the greatest environmental, social and economic benefit consistent with the Government's sustainable development principles.

4.4 Regional Context

Regional planning policies in relation to flood risk are covered in detail in the separate planning policy report. The key regional policies that affect the study area principally concern the management of Severn Estuary. In this regard the EA have recently completed a consultation on the Severn Estuary Strategy (see references in Section 10).

The EA strategy involved finding effective ways to manage flood risk in the estuary and in particular the stretch from South Gloucetsershire to Hinkley Point, Somerset. Flooding is a natural process, but one that can have a major effect on people, communities, the economy and the environment. Whilst the EA state that they cannot prevent all floods, as part of their flood risk management planning, they can prepare for them and reduce their likelihood,

The strategy indicates that for the 50,000Ha Severn Estuary Study Area there are approximately 250,000 residents and £14 billion of important infrastructure at risk.

The document explains the approach the EA takes for gauging the best approach to reducing the risk of flooding these assets and sets out with the aim of how these policies turn into appropriate action.

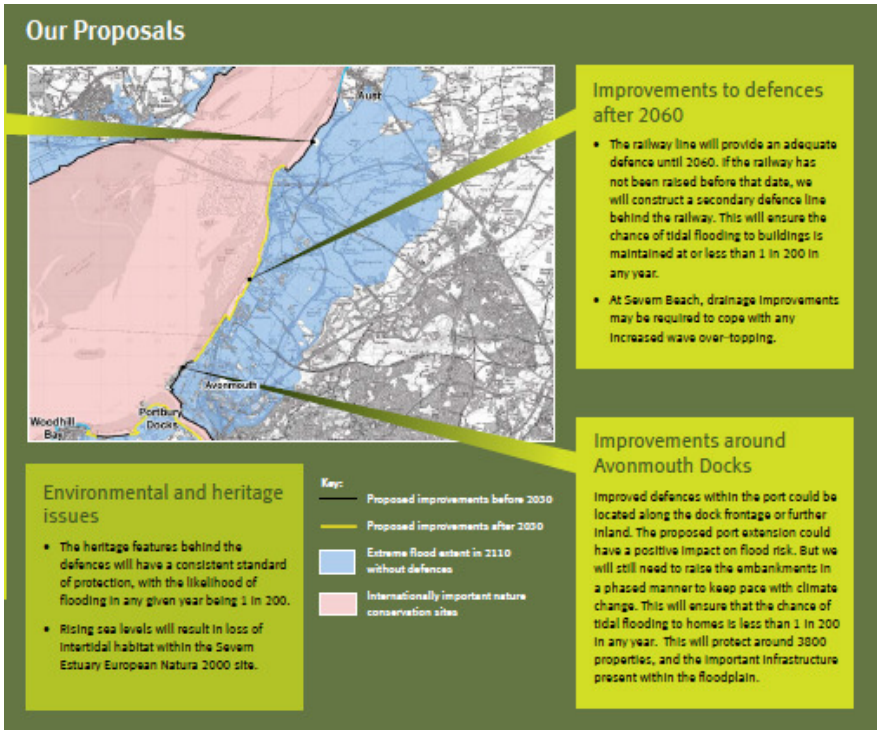

Figure 4-2 Extract from Severn Estuary Strategy 2011 – Aust to Avonmouth

For the study area, the strategy indicates that the railway line will provide an adequate defence until 2060. If the line has not been raised by 2060 a second line of defence will be constructed behind the railway, maintain the 1 in 200 year standard. The port extension will have a positive effect on flood risk but other improvements in the port will be necessary to maintain an adequate defence.

4.5 Local Context

Flood risk should also be set in local context by the Strategic Flood Risk Assessment (SFRA) for the Avonmouth/Severnside area.

4.5.1 Avonmouth/Severnside Level 2 Strategic Flood Risk Assessment, 2010[iii]

This Strategic Flood Risk Assessment (SFRA) is intended to provide flood risk information to strategic planners during the land use allocation process, to assist with development control decisions and also inform the wider community in matters relating to development and flood risk in the Avonmouth / Severnside area.

A Level 1 (initial assessment) SFRA was completed in 2007 which looked into the Avonmouth / Severnside area. In 2011, a (more detailed) Level 2 SFRA for the area was produced by Capita for Bristol City and South Gloucestershire Councils. It describes how the Level 2 SFRA is used to inform the application of Planning Policy Statement 25 – Development and Flood Risk (DCLG, 2010).

The guidance contained within PPS 25 requires a sequential risk based approach to decision making at all levels of the planning process. The SFRA represents the local level, whilst site specific FRA represent the site level (for planning applications).

The SFRA is a local strategic framework to provide guidance at the local level. The SFRA provides information on the current flood risks in the area and how these are likely to change in the future. The main objectives of the SFRA are:

- To provide 'the evidence base for the application of the risk based sequential approach, including assessing site allocation within flood zones'
- To 'support planning decisions through the assessment of all sources of flooding'
- To provide strategic support 'as it covers a wide spatial area, considering both present and future risk'
- To 'support sustainability appraisals and local development documents by informing local policy decisions and the requirements to satisfy the Exception Test'
- To identify what further investigations may be required in flood risk assessments for specific development proposals; and
- To 'inform decisions on local emergency planning with respect to flooding'

The guidance and findings have been considered and extensively used in the preparation of this report. Where the document is quoted verbatim, the text is italicised.

Crucially, in respect of the sequential and exception tests, the SFRA in paragraph 8.18 states:

An extended flood zone 3a policy is recommended for the breach hazard bandwidth. In addition to the standard flood zone 3a requirements the extended policy should require an Exception Test for ***all types of development*** *within the breach hazard bandwidth and should also limit development to water compatible and less vulnerable development types only. At all locations at risk of breach (including those outside the defined bandwidth) FRAs will need to assess the risk of breach in more detail and also consider mitigation within the design of the building.*

In this report, we have assumed that this recommendation will be taken forward by the commissioners in preparing policies as part of their Local Development Framework (including their Core Strategies).

The SFRA was published in March 2011 by the joint commissioners, Bristol City Council, South Gloucestershire Council and the Lower Severn Drainage Board.

5 Consideration of Flood Risk

5.1 Avonmouth/Severnside Strategic Flood Risk Assessment (SFRA)

The SFRA identifies a requirement for strategic responses to flood risk in the Avonmouth / Severnside area to enable new **development in accordance with PPS25.** The study identified that, over time and without improvements to the existing tidal defences in particular, the extent and frequency of flooding will become worse. Decisions taken on land use will need to recognise the potential severity of the consequences and the appropriate ways of responding to the risk. Fluvial flood risk is also a determining factor.

The study showed that the tidal flood defences within the study area are to a variety of standards with a range of conditions from poor (and in need of repair) to excellent (i.e. all EA condition grades 1 to 5). The plan (Figure 5-1) and table (Table 5-1) below shows both the location of the tidal wall zones that were adopted for the tidal flood defences assessment as part of the SFRA (February 2011) and the summary of the condition grade assessment.Figure 5-1 Tidal Wall Zones (Reproduced from the SFRA Figure 4.0)

Note: The SFRA study area shown extends beyond (sections A-C) the study area of this report. Further study is required to confirm that the defence of the study area only relies on defences within this studty area.

Section	Type of Structure	Status	Condition
D – E	Raised Foreshore	Private / De Facto	Good
E – F	Raised Railway Embankment	Private / De Facto	Good
F – G	Raised Earth Embankment	Formal EA defence	Good
G – H	Rock Armour and Raised Earth Embankment	Private / De Facto	Good-Fair
H – I	Rock Armour, Pipework and Block Wall	Private / De Facto	Fair
I – J	Rock Armour and Small Ballast Bund	Private / De Facto	Fair
J – K	Lock/ Dock Gates	Private / De Facto	Fair
K – L	Rock Armour, Sea Wall and Earth Embankment	Private / De Facto	Poor
L – M	Rock Armour (Rubble) and Earth Embankment	Private / De Facto	Poor
M – N	Raised Earth Embankment	Private / De Facto	Fair

Section	Type of Structure	Status	Condition
N – O	Brick Wall	Private / De Facto	Fair
O – P	Raised Earth Embankment	Private / De Facto	Fair

Table 5-1 Tidal Flood Defence sections (Table 4.1 SFRA)

Note: Sections A-C lie outside this study area

The tidal defence assessment completed as part of the SFRA highlighted that some defence sections are of unknown or non-standard construction, and therefore may have a high chance of breach or failure. The overall existing standard of protection is unknown as many of the defences are “informal” and are not maintained by the riparian owners.

The SFRA breach modelling results show that failure of the defence in the future case (2110), could lead to severe flooding across virtually the whole study area (with flood depths **in excess of 2 to 3 metres)**. Nearly all of the study area would be affected with its supporting infrastructure inundated. Even where raised site levels have been provided on development sites, safe access and egress may not be possible.

The study area's future standard of protection from the existing tidal flood defences is less than 1 in 200 years. Refer to Figure 5-2.

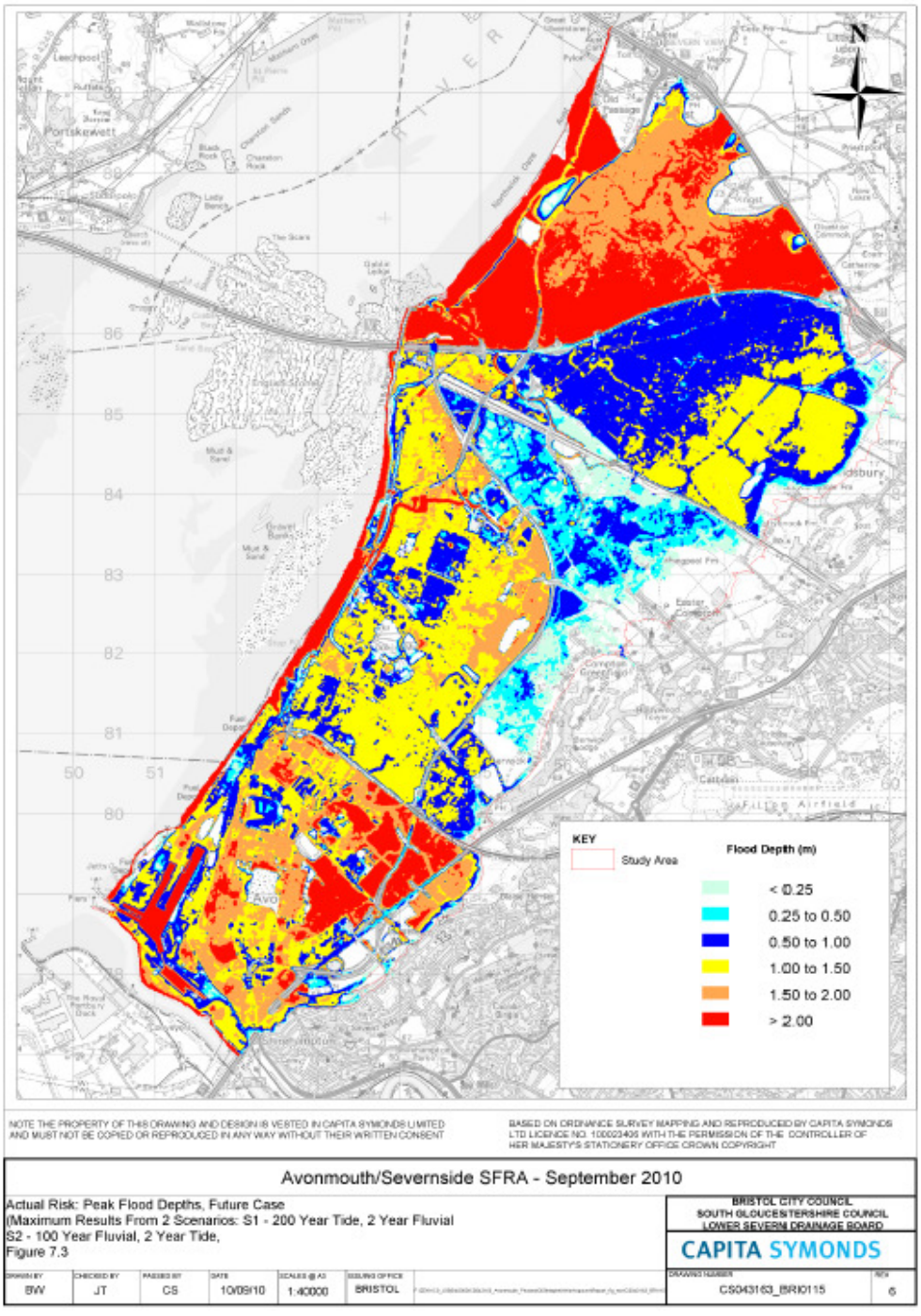

Figure 5-2 Actual Risk Future Case 1 in 200 year Tidal, 1 in 2 year fluvial (SFRA Fig 7.3)

The modelling of the Actual Risk Future Case scenario shows that only higher ground levels around Avonmouth village are outside the EA flood zones 2 and 3.

The consequences of the current situation modelling include:-

- Overtopping of the tidal defences as a result of lengths of low standard of protection
- Overtopping due to sea level rise associated with effects of climate change
- Rapid inundation from a breach of the tidal defences of very high flood levels

The SFRA modelling indicates that:

"*the level of protection provided by the defences is likely to reduce significantly in the future due to the effects of climate change, principally increases in sea level and increased 'storminess' and wave overtopping.* ***If defences are not improved, the frequency and severity of flooding in the future is such that existing and planned development is unlikely to be sustainable.*** *The SFRA findings demonstrate that there is a need to upgrade the defences (both condition and design standard) to sustain proposed development*."

Importantly the SFRA noted that a:

"*HTL (hold the line) policy as recommended by the Shoreline Management Plan (SMP) does not guarantee funding for defence maintenance and / or capital works along these sections of the shoreline but it is expected there will be a commitment to implementation of Shoreline Management Plan policy."*

Due to the potentially high flood hazard posed by a breach in defences in the study area, the SFRA has identified a **breach hazard bandwidth** as an additional flood zone – refer to Figure 5 3. This represents the area in which particularly high velocities and speed of inundation would be expected during a defence breach. This zone extends across a significant strip almost 2kms wide inland from the shoreline, encompassing a significant part of the study area.

Whilst there is a high potential for flooding from tidal sources through overtopping or breach of the defences, there is also the risk of flooding to some parts of the study area from fluvial sources, such as the rhyne river network that flows northwards from the east of the study area between Avonmouth Village and Halstead to Pilning and beyond.

The SFRA makes the following key recommendations:

- The defences protecting Avonmouth / Severnside are of varying design and few construction and condition details are available. BCC / SGC, with the Environment Agency, should consider formalising the responsibilities and maintenance regime for the defences. This should provide improved certainty in the level of protection provided now and in the future.

This could be achieved by establishing a riparian owner group to jointly assess and upgrade their defences to an acceptable standard in accordance with an agreed strategy;
Passing legislation that enforces the riparian owners to assess and upgrade their defences to an acceptable standard in accordance with the agreed strategy.

- Given the scale of flooding anticipated in the future, a strategic approach to flood risk mitigation is recommended over site specific mitigation and a flood risk strategy should be jointly developed.

This is the key outcome from this strategic study

- Improvements to the tidal defences is a key component of the management of flood risk on the Avonmouth / Severnside area;
- Flood incident management and emergency preparedness will be key to reducing risk to life and property in a defence breach situation;
- The effectiveness and feasibility of residual flood risk mitigation options and their impacts on flooding elsewhere needs more detailed investigation, particularly the flood risk associated with wave overtopping taking account of joint probability and the impact of land raising and raised access routes on flooding to existing development and property.

This work would form part of a feasibility study into the preferred strategic option

- An extended flood zone 3a policy is recommended for the breach hazard bandwidth – see Figure 3-1 below. In addition to the standard flood zone 3a requirements, the extended policy should require an Exception Test for all types of development within the breach hazard bandwidth and should also limit development to water compatible and less vulnerable development types only.

Should a strategic option not be brought forward the L2SFRA recommended that a strip of vulnerable land (approx. 2km wide – see Figure 5.3) be designated a “breach hazard bandwidth” to highlight the increased level of risk in this location

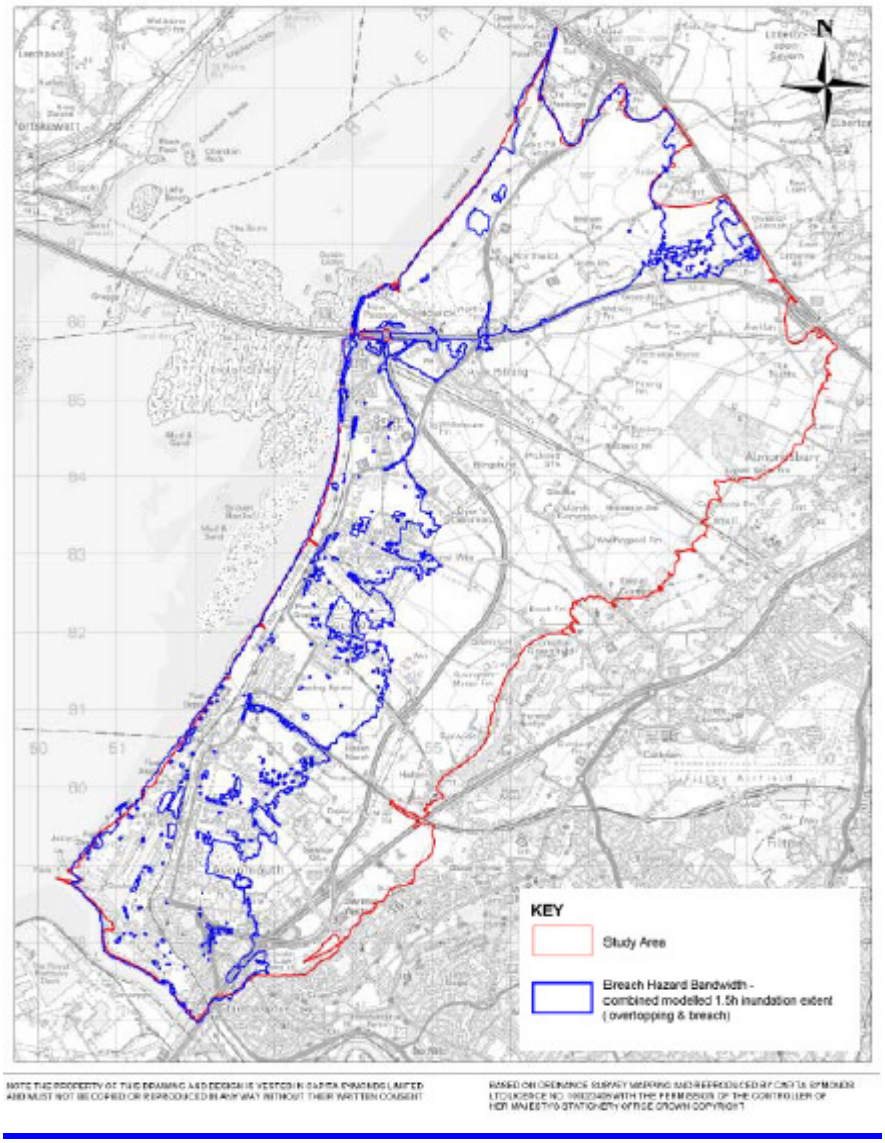

Figure 5-3 Breach Hazard Bandwidth (L2SFRA Figure 7.6)

5.2 Shoreline Management Plan

The Shoreline Management Plan (SMP) sets out the future coastline strategy and was established in 2000 – it looks purely at tidal flooding. A comprehensive review was undertaken in 2009 and was adopted at the end of the 2010. The SMP framework informs the strategy for Avonmouth/Severnside in order to create an integrated implementation strategy for the area.

The Severn Estuary Shoreline Management Plan (SMP2) states that the short term (0-20 years) policy to 2030 adopted in relation to the defences is **Hold the Line** (HTL). This will mean repairing or replacing defences in the same place as they currently exist if a more cost effective option cannot be selected.

The SMP suggests that there are two ways in which HTL may be implemented:

- Maintaining the same standard of protection (SoP) as today – this would keep the existing standard of defence, but with rising level (topographic) ensuring flood defences were repaired but only to the same SoP as today;
- Not increasing the height of defences so that the SoP gradually decreases – the existing topographic level of defence would remain but with the effects of climate change the standard would decrease. It is unclear from the reporting what the SoP offered by 2031 would be.

This policy would mean that the Avonmouth/Severnside area would be protected to a gradually decreasing standard over time due to the effects of climate change.

It is unclear what happens in the event of funding not being available to support this policy. However, the SFRA reported that the Severn Estuary Flood Risk Management Strategy (SEFRMS) aims to consider the HTL policy in more detail, although there is no timeframe for resolving this.

5.3 Catchment Flood Management Plans (CFMP)

The study area covers two CFMP areas which unlike the SMP look purely at fluvial flooding. The adopted CFMP policy for the study area is: '*Areas of low, moderate or high flood risk where we are already managing flood risk effectively but where we may need to take action to keep pace with climate change'*. Whilst CFMPs are primarily aimed at management of fluvial flooding, the drivers behind selection of the policy will also apply to tidal flooding. Identified actions, relevant to the study area, to implement CFMP policies include:

- "Carry out a multi-agency review of flood risk management led by the Environment Agency and involving South Gloucestershire Council and the Internal Drainage Board" (Severn Tidal Tributaries CFMP);
- "Maintain flood warning systems and explore opportunities to improve how effective they are and increase the number in place" (Severn Tidal Tributaries CFMP);
- "Improve the public's awareness of the risk of flooding and what to do when they receive a flood warning" (Bristol Avon CFMP); and
- "Review maintenance operations to make sure they are proportionate to flood risk" (Severn Tidal Tributaries CFMP).

5.4 Climate Change

The effects of climate change are likely to increase the incidence of tidal flooding due to sea level rise. Climate change impacts will mean that there is a long term increase in the average sea levels in the adjacent estuary; predicted to be a 1m increase over the next 100 years (approximately 4mm per year rise for this region – see PPS25 Table B1 for guidance). Assuming that no changes are made to the existing banks or walls that protect the land from flooding the long-term increase in sea levels means that the flooding in the future will be both more frequent and more severe than at present. Further study is required in order to quantify how much more frequent and severe flooding will be, but the SFRA has reported that the likelihood of significant wave over-topping and the risk of breach of the existing defences will rise.

The SFRA comments that "*in the future, the extent of tidal flooding is predicted to include much of the low lying land (within the study area). Compared with the present day, the extent of flooding for more extreme events only increases slightly because of the steep edges of the floodplain. However flood depths are shown to increase significantly;*

5.5 Flood Risk and Developable Land

Previous papers and studies reviewed as part of this study have drawn on a considerable amount of detailed hydrological and mathematical modelling and have established from a technical standpoint what is required to "Hold The Line" and the effects of climate change. The plans outlined in Appendix B show the resulting predicted flood extent.

The plan shown in Appendix C (Plan 07) illustrates the study area and the areas of greenfield land that might be suitable for future development. These areas have been identified following the review of the constraints that affect the area, including flood risk. The SFRA highlights flood risk across the study area from tidal and fluvial events; it is clear that the site is (and will remain) at significant risk of tidal flooding unless sea defences are improved.

At present, the following is occurring:

- In South Gloucestershire, there is the continued build out of the 57/58 permission and some redevelopment of previously developed land. The developers of the land covered by the 57/58 permission are raising land levels to mitigate the risks of flooding from tidal and/or fluvial sources. This is without consideration of the impact of such land raising on adjacent sites, albeit with the incorporation of some SuDS measures to improve surface water runoff performance.
- In the Bristol City area, there are proposals coming forward to develop previously developed land, although there has been some green field development within this area too.
- The Port's proposals to redevelop and extend their site with a new deep sea terminal incorporate a substantial defence at a proposed level of 10.67m AOD that will protect the south western end of the

study area. Should this not come forward any scheme that is proposed for the whole study area should incorporate a defence for the port area to ensure the complete flood cell is incorporated.

The approach being taken on other previously developed sites within the study area (outside the 1957/58 consent area) appears to be that the local planning authorities are, in consultation with the Environment Agency, granting permissions for new development on a site by site basis, raising the finished floor levels of buildings and finished levels of external areas and providing compensatory flood storage in close proximity to or within the sites.

It is evident that the Environment Agency, as set out at the Bristol City Council's Core Strategy examination, is likely to object to new applications for the continued redevelopment of previously developed land within the study area, where such proposals are brought forward on an ad hoc basis in the absence of a strategic flood risk mitigation solution for the wider area, and this has been confirmed in correspondence. The EA has limited powers to intervene in development covered by existing consents (1957/58 particularly)

The SFRA identifies the 10.74m AOD defence as a potential optimum solution to tidal flood risk in the area. Providing a higher defence level would give added protection against overtopping and reduce the likelihood of breach, but it would come at a high financial and environmental cost.

The Bristol Port, as part of the Deep Sea Container Terminal development within the south west of the study area is implementing proposals to provide a 10.67m AOD quay wall (up from the existing 8.5-9m AOD), scheduled for construction in 2015. However, the Port's Terminal works do not include the replacement of the Avonmouth Dock Defences, particularly the lock gates. The Environment Statement for the scheme indicates that "the gates do not form a functional part of the existing defences due to their current design height restrictions", whilst the "tie-in embankment levels adjacent to the lock gates are at an average of 10.2m OD." These defences are owned and maintained by Bristol Port Company.

In addition to these scheme works, further mitigation measures should be brought forward (e.g. raising the lock gates and raising land levels for buildings) to deal with risks from wave overtopping and breach where appropriate. Some of this mitigation may require the Environment Agency's Compulsory Purchase Order powers because it will affect land in private ownership.

5.6 Phasing

Current consultation with the EA has suggested that a strategic solution might be developed in stages, behind the railway line or by raising the railway line and converting the embankment into a formal flood defence. Indeed, this type of option is discussed in the SFRA. A phased strategic solution would provide flexibility in the funding stream and would allow some planned redevelopment of previously developed land within the study area if it could be made to work from a technical and cost basis. This could proceed in advance of a strategic solution coming forward for the entire study area, provided it fitted within the strategy framework.

There are examples of flood defences having been deployed in phases with appropriate materials and methods of ensuring structural integrity of the finished defence. Further work will be required during the next stages to detail whether phased defences can be delivered in a cost effective manner.

6 Intervention Options

6.1 General

There are four principle options that are available as part of a flood defence strategy to help further develop the Avonmouth/Severnside area. These are described below and could incorporate flood defences either on the existing defence, or behind the railway line or by raising the railway line and converting the embankment into a formal flood defence. A combination of these options could also provide a preferred option.

Any scheme should include freeboard allowances that would account for uncertainty in the modelling or engineering factors such as settlement over time.

6.2 Intervention Options

Do Nothing – Exactly that, no expenditure on flood defence works or maintenance activities ignoring whether this is legally possible;

Do Minimum – A continuation of the existing status quo, with flood defence maintenance works and inspections continued to ensure statutory duties maintained.

The SFRA states "*It is recommended that BCC / SGC, with the Environment Agency, consider formalising the responsibilities and maintenance regime for the defences that provide protection to Avonmouth / Severnside. This should provide improved certainty in the level of protection provided now and in the future*."

More investigation is required to define how this could be achieved.

Do Minimum Plus – A continuation of the existing status quo, with land form raising through approved planning applications for developments and the provision of surface water SuDS. The raising of key highway routes for safe dry access/egress would be included in this option.

With Scheme 1 – A higher level of flood defence as defined in the SFRA (10.74mOD) that could allow some development including flood risk improvements to the rhyne network to reduce the risk of fluvial flooding to the area. The scheme would be designed to protect Avonmouth against the risk of overtopping and breach to the year 2110 for the 1 in 200 year still water event allowing 0.5m freeboard.

With Scheme 2 – A higher level of flood defence as defined in the SFRA (12.40mOD) that could allow development including improvements to the rhyne network that will reduce the risk of overtopping and breach to the year 2110. The scheme would be designed to protect Avonmouth against the risk of overtopping and breach to the year 2110 for the 1 in 200 year still water event allowing 1.16m to reduce the effects of overtopping of the defences, also with 0.5m freeboard.

6.3 Mitigation Measures

The SFRA investigated a number of other potential strategic mitigation measures over and above the intervention options, defined in 6.2 above, as part of the Level 2 SFRA. The assessment was carried out dividing the study area in to eight strategic zones defined on areas with similar flooding mechanisms, development characteristics and to fit with the flood defence typology. The mitigations were chosen to increase the standard of protection and accommodate the anticipated effects of climate change.

- Change of land use
- Strategic land raising
- Recommendation of local scale land raising on a plot by plot basis
- New / improved access routes
- Property resilience / resistance measures
- Flood warning / flood event management
- Improvements to the Rhine network (local &strategic)

The assessment indicated that unless properly designed and mitigated, large scale land raising or provision of raised access routes could significantly increase the impact of flooding to existing development, especially in the event of a defence breach – up to a 300mm rise in flood level was reported in the SFRA. It may be necessary to consider alternative solutions, including raised buildings with voids or stilts; elevated roads on viaducts, and limiting the area of land raising to within preset controllable levels. Such structures would need to be designed to withstand the predicted flood depths and velocities.

7 Costs and Benefits

7.1 General

In order to assess the merits of the various options the financial and non-financial costs and benefits for each option should be defined. The key scheme elements have originated from the SFRA, which have been developed using a series of design standard details and cost rates per metre of flood defence repair or renewal and where appropriate complete reconstruction inside or outside the existing line of defences.

The SFRA used the built up rates and applied preliminaries and contingencies with 60% Optimism Bias as Treasury Green Book requirements and subsequently then inflated to February 2011 prices. Tables 7.1.1 and 7.1.2 below show the summary table from the SFRA.

We have not sought to develop different cost estimates, bearing in mind the recent publication of the SFRA and the lack of any detailed proposals for improving the area's flood defences. Further cost analysis will be required following the development of detailed and specific proposals for mitigating flood risk in the area.

The following table splits out those elements that were included in the SFRA but that are outside the remit of this study – in particular the Binn Wall and the flood defences to the north. For comparison the Total for the SFRA 10.74mAOD scheme is £56m. It should be noted that whilst the various lengths of existing flood defence have been separated, in reality the whole study area acts as a single flood cell and any flood risk management scheme would have to be implemented in unison. Refer to Figure 5-1 for a plan of the SFRA scheme sections and corresponding CSL (Capita Symonds Ltd) references.

An option has been shown that includes and excludes the Bristol Port defences and lock gate infrastructure. It is anticipated that these items will be developed by the Port as part of their proposals to develop a new deep sea container terminal.

7.1.1 Tidal Scheme Costs with Bristol Port and Lock Gates

CSLRef	Section	Length (m)	Raising to 10.74	
			Cost (£/m)	Cost (£m)
3	D-E	600	351	0.21
4	E-F	1550	1285	1.99
5	G-H+K-M	2600	2118	5.51
6a	F-G	900	515	0.46
7	H-I	400	2060	0.82

8	N-O	40	351	0.01
	M-N	1000	644	0.64
	O-P	200	515	0.10
Sub Total				**9.76**
Lock gates				5.2
Tie ins				0.6
Sub total				**15.56**
Prelims				3.43
Contingencies				2.29
Profit				2.29
Subtotal 3				**23.56**
Optimism Bias				14.14
Total				**37.71**
Total including inflation				**43.36**

7.1.2 Tidal Scheme Costs without Bristol Port works or lock structure

CSL Ref		Length	Raising to 10.74	
			Cost (£/m)	Cost (£m)
3	D-E	600	351	0.21
4	E-F	1550	1285	1.99
5	G-H+K-M	1716	2118	3.63
6a	F-G	900	515	0.46
7	H-I	400	2060	0.82
8	N-O	40	351	0.01
	M-N	1000	644	0.64

O-P	200	515	0.10
Sub Total			**7.89**
Lock gates			0.00
Tie ins			0.00
Sub total			**7.89**
Prelims			3.43
Contingencies			2.29
Profit			2.29
Subtotal 3			**15.90**
Optimism Bias			9.54
Total			**25.43**
Total including inflation			**29.25**

7.1.3 Fluvial Costs

There is no evidence of proposals to mitigate the risk of fluvial flooding in the area or costs for any such mitigation in the literary review. Further detailed work is required to bring forward rates and build-ups for schemes with various standards of protection for inclusion with the tidal schemes.

Figures included within section 7.2 have been estimated based on engineering judgement, but should be confirmed as part of a further study that will need to identify the impact of fluvial flood risk on the area and proposals for mitigating that risk.

7.2 Cost Summary

The following cost summary can be drawn from the various schemes and options that have been brought forward from the literary review:

Scheme	Scheme standard	Cost		Notes
		Tidal	Fluvial	
Do Nothing	Existing SoP but reduces	£0	£0	No scheme expenditure

	over time			
Do Minimum	Existing SoP maintained	£0.5m	£0.2m	Maintenance and inspection duties only with no allowance for climate change
Do Minimum Plus	Existing SoP maintained	£0.5m	£0.2m	Landfilling costs assumed to be zero provided that waste material is suitable for filling and compaction
With Scheme 1	10.74	£43m	£3m	Tidal and fluvial costs are for improvement works to existing defences or new defences where required to reduce risk of rising sea water levels. This cost includes works to the port lock gates and tie-in structures
With Scheme 2	12.40	£280m	£4m	Tidal and fluvial works to bring flood defences up to 12.40mAOD to minimise effects of overtopping and breach. This cost includes work to the port lock gates and tie-in structures.

Source – L2SFRA Capita (Section 4.6.3.37)

7.3 Phasing

The phased implementation of a strategic solution for flood risk mitigation of the Avonmouth/Severnside area should to be considered carefully, as whilst this may be more attractive and give access to potential funding, it may not be possible to deliver the scheme in discrete lengths of works, as the defences may become outflanked by flood water. However, if the scheme was implemented based on the phased raising of design height with intervention at certain times in the design life of the scheme, then a phased approach may provide value.

It should be noted that the total strategic solution would be required to be implemented before the scheme provided the required standard of protection.

The possible phasing of the flood defence works should be subject to further study and the relative merits of this approach should be fully understood. Included within the scope of this study should be the relative cost/value analysis of improving the existing flood defences by refurbishment/extension of the existing defences set against building new flood management measures.

8 Risks and Mitigation

The key risks to any strategic solution from a flood risk perspective can be summarised under the general headings as follows:

8.1 Funding stream not guaranteed

Funding for a flood defence scheme to increase the standard of protection provided to Avonmouth/Severnside may be possible in part through Defra Grant in-aid funding. Schemes will be subject to appraisal and assessed based on a robust cost-benefit analysis using the HM Treasury Green Book (2003) methodology.

However, from a National perspective there are many pressures on these funds, particularly now that the grants have been reduced. The scoring system to assess the priority on a National basis, is weighted towards protecting the most residents, or businesses for the least capital cost.. Whilst the SMP documentation highlights the fact that benefits for a scheme in the area are significant resulting from offsetting damage to residential and business property, the environment and infrastructure, the likelihood of gaining Defra funding is remote for a scheme with such high capital value. For Defra funding to be granted, it will be necessary to establish a highly cost beneficial case around the protection of the businesses and homes within the Avonmouth / Severnside area. This should be the subject of a separate study and in particular the damage and hence economic benefit that such a scheme would provide.

There are other means of attracting funds such as contributions from significant new development or by developer contributions.

Also, levies imposed by the Environment Agency on Local Authorities, and by the Local Authorities themselves could be used to raise the necessary funds for capital works. The local levies are raised by a committee from local authorities at the request of a regional flood defence committee and used to fund flood risk reduction and resilience projects that would not otherwise be eligible for national funding.

The Community Infrastructure Levy was introduced in April 2010. The main report by WYG deals with the possibility of funding from Section 106 agreements/CIL for the development of land within the study area.

Funding of strategic flood defence improvements is therefore the principal factor for the progression of a strategy.

8.2 Fluvial Risk

In order for flood risk to be adequately managed including the effects of climate change, not only the tidal risk but also the fluvial risk from the Rhyne network should be managed. A scheme of works, to be approved by the Lower Severn Drainage Board, should be prepared and brought forward to ensure that future development in the key 57/58 consent area does not jeopardise the availability of channel capacity or compensatory storage elsewhere within the study area.

The nature, extent and cost of any scheme would need to be investigated, including how the project could be funded.

8.3 EA Objection to New Development

The EA have indicated that they are likely to object to new development in the Avonmouth/Severnside area until a strategic plan is implemented with detailed design and a funding stream in place.

The EA is currently considering development proposals within the study area on a scheme by scheme basis and the broad approach of developers to date has generally been to incorporate measures to mitigate tidal flood risk on site to address the EA's concerns. Such measures often comprise elevating the finished floor levels of new buildings. However, the EA is concerned that such an approach will, on a cumulative basis, potentially increase the risk of flooding elsewhere within the study area. The EA therefore wishes to see a comprehensive solution brought forward to mitigate the risk of flooding to new and existing development in the study area.

In the context of the SFRA, the EA is likely to object to new "greenfield" development within the study area that is not covered by the extant 57/58 or other planning permissions, unless such development addresses the tests in PPS25. On "brownfield" sites, the EA is also likely to object to development proposals in the future unless a comprehensive package of measures is brought forward to address flood risk in the study area.

8.4 Land ownership

Land ownership and the availability of the various land parcels that are required for a flood risk strategy that will enable continuing economic development in the study area.

9 Recommended Way Forward

9.1 General Recommendations

The existing risk of flooding of the Avonmouth/Severnside study area is significant. The principal flood risk is from tidal flooding due to defences that are in variable but generally poor condition. The risk from fluvial flooding is also apparent across significant parts of the study area.

It is anticipated that if the existing flood defences are not improved, with the frequency and severity of flooding in the future due to the effects of climate change, existing and planned development is unlikely to be sustainable on the Avonmouth/Severnside study area. The area is severely at risk from flooding, primarily from tidal breach and overtopping, but also from fluvial flooding from the rhyne system. The recently published SFRA findings demonstrate that there is a need to upgrade the defences that are generally in poor condition and have a low but also variable standard of protection, to sustain any proposed development. This is in alignment with the Severn Estuary Shoreline Management Plan Review that states that the short term (0-20 years) policy adopted in relation to the defences is Hold the Line (HTL).

From a planning perspective PPS25 is clear in that new development of the Less Vulnerable type (Offices, warehouses etc.) in Flood Zone 3a need not be accompanied by a Sequential Test and there are some limited pockets of this flood zone in the study area . PPS25 states that Flood Zone 3b requires a Sequential Test, which should be addressed for any greenfield or brownfield allocations i.e. show there are no other suitable sites in Flood Zones 1 or 2 before allocation of land in Flood Zone 3. However, the recently published SFRA has recommended that in addition to applying the Sequential Test, properties within the study area's breach hazard bandwidth (see plan in Figure 5-3) should be subject to an Exception Test. Where greenfield land in the study area hasn't already been allocated in a Local Development Document, it will become difficult to bring it forward for (re)development due, in particular, to the application of the Exception Test, which requires amongst other criteria, for the development to be on previously developed developable land..

The EA is, in the context of the SFRA, likely to resist development (on greenfield and brownfield sites) within the study area unless a strategic flood risk solution is seen to be forthcoming. That's because with climate change, flood risk is increasing and an ad-hoc site-by-site approach only increases flood risk to others. However, if a strategic flood risk solution were identified, the redevelopment of brownfield land could be progressed within the study area, in accordance with planning policies, provided the "Exception Test" was satisfied.

With regard to the development of greenfield land within the study area, even with a strategic tidal defence solution in place, a sequential approach will be required as the area will still be in flood zone 3a. The sequential test will be likely to show preference to brownfield and greenfield sites out of the study area in flood zones 1 and 2, unless the development is specific to port related uses. Some development sites that have been put forward

for development are outside the breach hazard bandwidth and may therefore proceed without an Exception Test.

The EA would like to see a strategic solution implemented, either with phased improvements on the existing defence alignment, behind the railway line or by raising the railway line and converting the embankment into a formal flood defence. A phased strategic solution would provide flexibility in the funding stream and would allow some planned redevelopment of previously developed land within the study area.

Bristol's recently adopted Core Strategy proposes only the redevelopment of existing brownfield land and indicates that additional Greenfield land will not be allocated for development in the study area during the plan period.

With regard to the 57/58 consented land parcel it is inevitable that further land raising in this area is likely and that it needs to be integrated and "planned" into any future development scenarios and flood risk mitigation strategies.

9.2 Recommended Further Study

There is a great deal of synergy for this region between the strategic flood risk assessment and the shoreline management plan as the drivers are consistent. However, the risk of fluvial flooding should not be overlooked and further study on fluvial mitigation measures is required in order to define solutions to sustainably reduce flood risk.Critically, it should be confirmed that this study area acts on its own and is not out-flanked by other flood cells to the north.

Further work is also envisaged by the Environment Agency which has indicated during this study that the following areas should be investigated in order to add detail to emerging strategies: joint wave/tide assessment, ground conditions assessment, land ownership and defence crest height requirements.

In order to attempt to attract Defra funding a damage assessment study will have to be undertaken in accordance with the Flood Hazard Research Centre Multi-Coloured Manual to establish the benefits of fully costed schemes.

10 References

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10. European Commission Flood Directive (2007/60/EC)
11. Water Framework Directive (2000/60/EC)
12. HM Treasury. The Green Book (2003)

Appendix A – Existing Site Plan

Appendix B – 1 in 200 year Existing Flood Extent

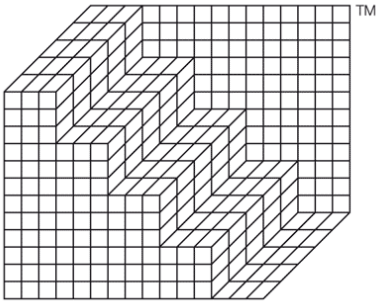
Appendix C – 1 in 200 year Climate Change 2105 Flood Extent

Appendix D – Developable Land showing Breach Hazard

Appendix E – Key Correspondence

Andrew Dannatt
Buro Happold Limited
71 Newman Street
London
W1T 1PD
UK

Telephone: +44(0) 207927 9700
Facsimile: +44(0) 870787 4145
Email: andrew.dannatt@burohappold.com



Buro Happold

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00	Initial version	PI	09/03/2011	AD
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author	**Pablo Izquierdo**
signature	
date	**24/06/2011**
approved	**Anthony Davies**
signature	**By email.**
date	**24/06/2011**

Contents

1 Executive Summary

This study discusses the energy related opportunities that could unlock the potential of the Avonmouth/ Severnside study area as part of the WYG-led team that is developing an integrated development strategy for the area on behalf of SWDRA, Bristol City Council and South Gloucestershire Council.

Following a description of the low carbon energy framework at international and national level and a description of the relevant regional policies, an assessment of the low carbon energy opportunities in the area has been carried out based on previously published reports and information on the study area. The assessment concludes that, with the exception of wind, solar technologies (photovoltaic and solar hot water) and energy from both wet and solid waste, no other renewable or low carbon technologies could make a significant energy contribution to the study area. In particular, energy recovery facilities using municipal solid waste or non-local biomass offer the largest low carbon energy opportunity for the study area. This study discusses how this energy could act as a catalyst to unlock the area's potential if it was made available locally, particularly in the case of heat that would have to be distributed through a distribution network as opposed to electricity that could be transported through the national grid and used elsewhere.

A detailed review of the drivers and barriers for installing a district heating in the area highlights that there are very important national targets and regional strategies that, because of the economic and environmental benefits associated to it, support its implementation. Conversely, the economic and technical risks associated with the funding, design, build and operation of a district heating network, are the most important barriers. At the same time, the presence of large heat sources in the area, e.g. energy recovery plants, presents an opportunity for the network. However, the current and forecasted building use mix, that results in a very low heat demand density, and the introduction of more stringent building regulations, that requiring new buildings to have lower CO_2 emissions thus lower energy demands, mean that the energy demand may even be lower in the future.

Therefore the only area where the installation of the network will be currently justified is in the land not yet developed within the 57/58 permission area. Nonetheless, and because of the opportunity that a district heating network has to unlock the whole study area potential and bring economic and environmental benefits to it, a possible layout for the district heating has been proposed and supported by a feasibility statement for the best case scenario. A list of the existing and proposed heat generation plants and large heat consumers, i.e. anchor loads, has also been produced together with the network phasing. It has been proposed to start the network in the South of the study area, where there is a concentration of large heat generators and users, and then expand it to the North; where the Viridor energy from waste plant has just been granted planning permission and the 57/58 planning consent area, that presents the best opportunity to install a district heating network because of its high heating demand density, are. The feasibility assessment includes a capital cost estimation of £30m that could be recovered, in a best case scenario, in a period of 19 years with a discount rate of 6%.

Finally, this energy study concludes with some recommendations for the Bristol City Council and South Gloucestershire Council that include:

- To commission a market study to assess the interest of companies with high potential heating or cooling loads in getting established or relocating to the study area to establish and support the feasibility of the district heating network.
- To commission a market study to assess the interest of companies with high heating or cooling loads to relocate to the study area to increase the feasibility of the network.
- To carry out a detailed feasibility assessment of the district heating to validate and test the sensitivity of the assumptions and the results as well as to refine the layout and phasing proposals presented in this energy study.
- Assuming the feasibility of the network is proven, to engage an energy services company to share the funding, designing and building the network as well as to operate, maintain and manage the network.
- To make use of the policies incorporated in the Bristol and South Gloucester core strategies to:
    - Support the best low carbon energy opportunity for the area represented by the district heating network;
    - Explore the potential mechanisms for developers to contribute to the developments of an area by using planning obligations or a Community Infrastructure Levy that could be used to help fund the district heating network;
    - Apply the heat strategy described in the policies; and
    - Discuss in every planning application in the study area the possibility to connect to the proposed district heating network or to justify otherwise.

2 Introduction

Buro Happold has been commissioned to study the energy related opportunities that could unlock the potential of the Avonmouth/Severnside area as part of the WYG-led team that is developing an integrated development strategy for the area on behalf of SWDRA, Bristol City Council and South Gloucestershire Council.

The strategic importance of the area has been acknowledged by both Bristol City and South Gloucestershire Councils. This has been expressed in a draft joint vision statement that sets out the key characteristics of the area to 2050:

“An internationally significant industrial location, home to world-class companies operating in key sectors which are at the heart of the UK’s economic future, including advanced engineering, green and environmental technologies, tidal power and transport and logistics.

Business will be drawn by investment opportunities and a reputation for innovation, competitiveness and superb infrastructure including a deep-water container terminal providing direct access to road and rail networks from the closest port to the UK population with 45 million people living within 300 kilometres.

Through a positive approach to development planning and public investment in infrastructure that will unlock the area’s full potential, Avonmouth and Severnside will provide up to 7,500 new jobs helping to drive forward Bristol and the West of England as the UK’s most competitive city region, generating a wide range of jobs and significant local economic benefits.”

This future role of the area is challenged by:

- A lack of infrastructure to distribute locally generated energy, e.g. energy from waste plants, back into the local area;
- Close proximity but limited connectivity to the national motorway network;
- The 1957/58 planning consent for a large part of the study area that allows a potentially unconstrained development, resulting in limited public sector leverage to realise infrastructure improvements through the development control;
- An increasing risk of large scale catastrophic flooding; and
- Proximity to nature conservation areas of European significance.

The local Councils and other agencies recognise the need for an integrated approach to identify how best to tackle these issues in order to protect existing investment, manage and protect the natural wetland resource and realise the opportunities that arise from a long term planned approach to future development and infrastructure provision to 2050.

This energy study describes the site, reviews the applicable energy policies at international, national, regional and local level and discusses the energy opportunities that could unlock the potential of the area so that they can be integrated with the wider development strategy being prepared by the WYG-led team.

2.1 Site description

The site is located to the North East of Bristol and is bounded to the West by the Severn Estuary, the M49 to the North and East and the river Avon to the South as shown in Figure 2—1.

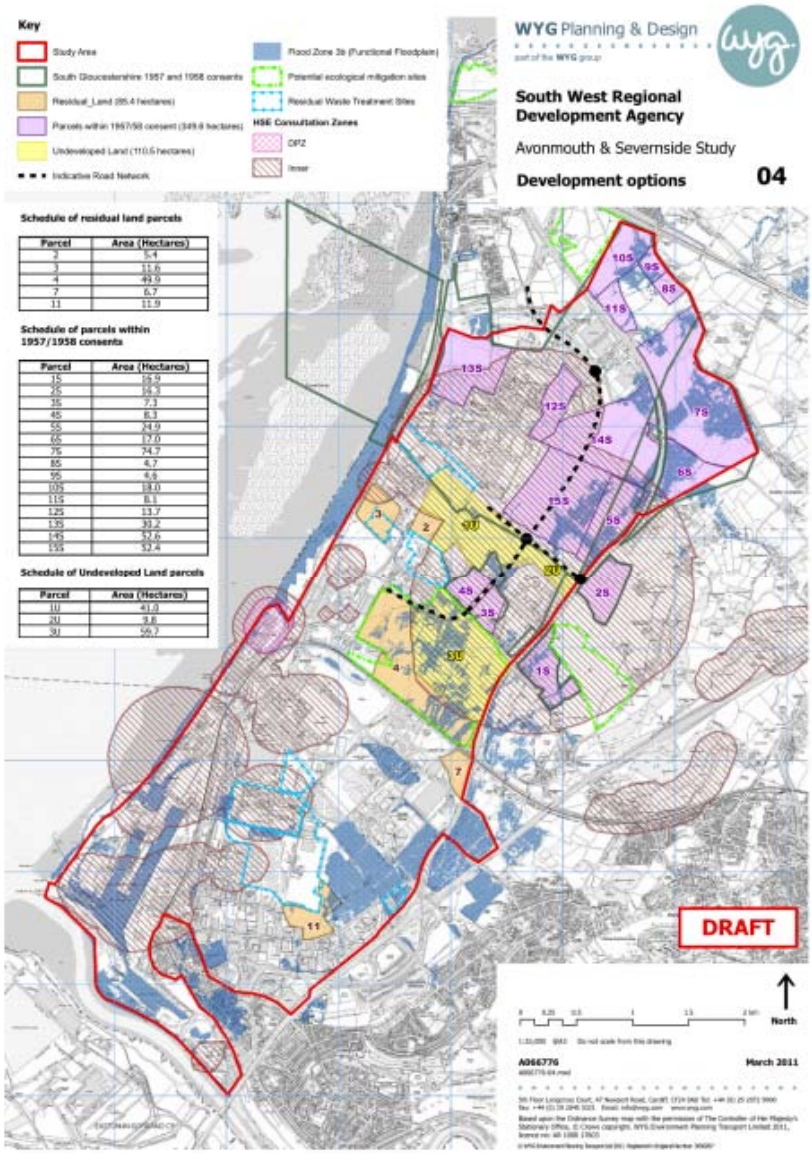


Figure 2—1 Site location.

3 Low carbon energy framework

This section reviews the applicable international and national legislation and policies that define a low carbon energy framework where a potential district heating network for the study area would fit.

This section also presents an extract of the regional core strategies that outline some of the drivers and opportunities at a regional scale which will be explored in detail for the study area in the next section.

3.1 International level

3.1.1 EU Renewable Energy Directive.

This European Union (EU) directive requires the UK to generate 15% of its energy from renewable sources by 2020 and according to Department for Energy and Climate Change (DECC), this could mean that more than 30% of the UK's electricity and 12% of our heat should be generated from renewable energy sources. Some of the developments in the study area already generate renewable electricity and a district heating network will enable the distribution and use of renewable heat.

3.2 National level

3.2.1 The Climate Change PPS and PPS 22: Renewable Energy

The Climate Change PPS is a supplement to PPS1 and was published in December 2007 to highlight climate change considerations in the planning system.

The Climate Change PPS sets out how the Government expects planning to help deliver its ambition on zero carbon development and shape sustainable communities to be resilient to climate change. The PPS also requires local planning authorities to prepare and managed the delivery of decentralised renewable and low carbon energy strategies aligned with the Government's Climate Change Programme and energy policies.

PPS 22 requires local authorities to enable renewable energy developments throughout England in locations where the technology is viable and environmental, economic, and social impacts can be addressed satisfactorily. Therefore, creating a district heating network in the study area, subject to the detailed analysis of its environmental, economic and social impacts, will be clearly aligned with the PPS 22.

3.2.2 The UK Renewable Energy Strategy 2009

This strategy sets out how the UK will generate renewable electricity, heat and transport fuels to meet the EU Renewable Energy Directive target. Some of the existing and planned developments in the study area are already exploiting the renewable energy opportunities and generating renewable energy and contributing towards the national targets.

3.2.3 Building Regulations

The building regulations require all residential houses to be "zero carbon" by 2016 and non-residential developments to achieve this target by 2019. To achieve these challenging targets, improvements in materials, building design and construction techniques will be required, but also the use of renewable or low carbon energy technologies. Complying with these regulations requires the new building stock of the study area to use less energy and of a lower carbon intensity which could be delivered through a district heating network.

3.3 Regional Context

The following regional core strategies have been reviewed to provide a background on the regional low carbon energy initiatives that will influence any development within the Avonmouth / Severnside study area:

- South Gloucestershire Core Strategy with proposed changes. Published in December 2010.
- Bristol Core Strategy with proposed changes. Published in December 2010.

3.3.1 Bristol Development Framework Core Strategy Policy BCS4: Avonmouth and Bristol Port.

This policy identifies the Avonmouth area as a priority area for industrial and warehousing development and renewal and highlights that the Bristol Citywide Sustainable Energy Study has identified significant potential for renewable and low carbon energy installations, e.g. wind, biomass and waste to energy, in the area. It also states that Avonmouth's economic strengths and low carbon energy opportunities will be supported whilst protecting its environmental assets and acknowledging its development constraints. This support will be provided in collaboration with neighbouring unitary authorities and other relevant stakeholders.

3.3.2 Bristol Development Framework Core Strategy Policy BCS11: Infrastructure and Developer Contributions

This policy identifies two potential mechanisms for developers to contribute to the developments of an area, the use of planning obligations or a Community Infrastructure Levy, to fund the development and provision of infrastructure, services and facilities needed that will support the growth in the city, maintain and improve quality of life and respond to the needs of the local economy. If this policy was applied in the study area, developers could contribute to fund the district heating network.

3.3.3 Bristol Development Framework Core Strategy Policy BCS13: Climate change

This policy sets out a requirement for developments in Bristol to take into account the impact of climate change. Proposed developments should demonstrate through "sustainability statements" how they will contribute to both mitigating climate change and meet targets to reduce carbon dioxide emissions as well as showing how they will adapt to climate change. The district heating network could be used in the sustainability statements for all developments in the Bristol part of the study area as a mitigation climate change feature.

3.3.4 Bristol Development Framework Core Strategy Policy BCS14: Sustainable energy

This policy sets out a requirement for developments to minimise their energy requirements and incorporate renewable or low carbon energy supplies to reduce their carbon dioxide emissions. It also requires developments to provide sufficient renewable energy generation to reduce carbon dioxide emissions from residual energy use in the buildings by at least 20% and that the use of CHP and district heating will be encouraged.

The policy encourages the use of combined heat and power (CHP), combined cooling, heat and power (CCHP) and district heating, and sets up a heat hierarchy that favours the installation of CHP/CCHP distribution networks. These principles will apply particularly to developments within “Heat Priority Areas” that are identified in the Bristol Citywide Sustainable Energy Study. Although Avonmouth is not within one of these areas, the study identifies it as a potential location for the development of low carbon and renewable technologies.

3.3.5 South Gloucester Core Strategy Policy CS3. Renewable and low carbon energy generation.

Similarly to Bristol Development Framework Core Strategy Policy BCS4, this policy states that proposals for the generation of energy from renewable or low carbon sources will be supported in South Gloucester, provided that the installation would not cause significant demonstrable harm to residential amenity, individually or cumulatively.

3.3.6 South Gloucester Core Strategy Policy CS4. Renewable or low carbon district heat networks.

According to this policy, any applications to develop a thermal generating station or proposals that have a capacity to generate significant waste heat as part of an industrial or commercial process must include heat recovery and re-use technology as well as heat distribution infrastructure, or demonstrate that this is not feasible. It also requires that all major development proposals must explore the possibilities of heat distribution on-site, connect to an existing or proposed district heating network or demonstrate that these requirements are unfeasible. This policy in combination with the previous CS3 policy provide some legislative support for a district heating network in the study area.

3.3.7 South Gloucester Core Strategy Policy CS35 – Severnside.

This policy requires all developments in the area to work co-operatively to unlock economic potential of this strategically important location for employment use. It also requires delivering, reconciling and mitigating the development with the site constraints, including flood risk, coastal protection, biodiversity, archaeology and transportation.

In addition, the following regional reports have also been considered in the following sections of this energy study:

- Bristol Energy Master-plan. Produced by Regen SW and Centre for Sustainable Energy in December 2010.

- Potential for Renewable and Low Carbon Energy Supply in South Gloucestershire. Published by AECOM in June 2010.
- The South West Heat Map. Produced by the Centre for Sustainable Energy and Geofutures Ltd in July 2010.

In conclusion, a district heating network in the area could contribute towards some of the national and international low energy carbon targets and help the developments in the area meet their building regulations requirements in the future. Finally, regional policies and reports support the idea of low carbon energy generation and district heating networks as long as they are feasible within the environmental, economic and social site constraints.

4 Low carbon energy opportunities in the study area

The “Bristol Energy Master-plan” and the “Potential for Renewable and Low Carbon Energy Supply in South Gloucestershire” reports analyse the availability of renewable and low carbon energy generation resources in the respective Council areas.

The reports conclude that with the exception of wind, solar technologies (photovoltaic and solar hot water) and energy from both wet and solid waste, no other renewable or low carbon technologies could make a significant energy contribution to the study site. In particular, the Bristol Sustainable Energy Study identifies a theoretical maximum CO_2 emission reduction of 22% of Bristol’s total CO_2 emissions in 2006/7 if all available resources were fully exploited. However, it highlights that 17.8% of this reduction would be achieved by energy from waste combined heat and power (CHP) plants whilst local sustainable electricity and heat resources excluding waste would only account for 3.8% and 0.9% respectively. Additionally, if non-local biomass resources were used in a biomass CHP plant, further CO_2 emission reductions of 26% could be achieved. Therefore, energy recovery facilities using municipal sold waste or non-local biomass offer the largest low carbon energy opportunity for the study area.

Nonetheless, generating renewable or low carbon energy in biomass or energy from waste plants, will not bring by itself many benefits to the study area unless that energy is used locally. Electricity generated in these facilities could be used elsewhere because it can be transported through the national electricity grid and therefore has environmental benefits at a national level. However, transporting heat long distances is more complicated than transporting electricity because it requires the construction of significant and costly new infrastructure that will be subject to larger distribution losses so it has to be distributed locally.

Nonetheless, generating renewable or low carbon energy in biomass or energy from waste plants, will not bring by itself many benefits to the study area unless used locally. Electricity generated in these facilities, could be used elsewhere because it can be transported through the national electricity grid and therefore has environmental benefits at a national level. However, transporting heat long distances is more complicated than electricity so it has to be distributed locally through a distribution network.

In conclusion, a local heat distribution network powered mostly with biomass and energy from waste CHP plants offers the best renewable energy opportunity for the Avonmouth/Severnside area because it will maximise the environmental benefits of the low carbon/renewable energy generated in the area.

Table 4—1 below presents a summary of the Bristol Energy Master-plan (The Bristol Study) and the Low Carbon Energy Supply in South Gloucestershire (The South Gloucester Study) assessment of the potential for each different low energy carbon technology in each region. The third column presents a quick technical and economical assessment of each technology potential in the study area using specific information from references in the reports to the Avonmouth/Severnside study area.

Technology	Assessment summary in Bristol Study	Assessment summary in South Gloucester Study	Assessment for Avonmouth/Severnside area
Hydropower	No potential found.	Technology not considered in the report.	No potential has been found for this technology in river Avon.
Biogas	There is an anaerobic digestion plant in the Wessex Water waste water treatment plant that generates energy from biogas.	Technology not considered in the report.	The existing anaerobic digestion plant in the Wessex Water waste water treatment plant is located within the study area (see Figure 5—3) and no further potential has been identified.
Wind	The Avonmouth area represents the vast majority of Bristol's potential for wind power, however, the installation of large scale wind turbines is highly constrained by the presence of environmental protected areas and, until it closes, Filton Airfield. Sites identified as suitable for large scale wind are already exploited or the council has already received planning applications to install wind turbines on them. Small scale wind has more installation potential although much lower renewable energy generation.	The study identifies some large scale wind potential locations in the region, although it highlights the largest potential is in the nearby Avonmouth area that is part of Bristol City Council's area. Very limited potential renewable electricity generation from building-integrated small scale wind technologies.	Large scale wind turbines are already installed or proposed in the sites with the largest wind potential in the study area so once the proposed turbines are built this resource will be fully exploited in the area. Small scale wind turbines could be installed in existing and new developments within the area. However, the amount of renewable electricity generated will be limited and their economic feasibility compromised because of low wind speeds. Therefore, small scale wind turbines are not further considered in this study although they could be considered for individual developments within the study area.

Technology	Assessment summary in Bristol Study	Assessment summary in South Gloucester Study	Assessment for Avonmouth/Severnside area
Solar technologies	There is potential for installing photovoltaic (PV) and solar hot water (SHW) panels in roofs of existing and new developments. The overall contribution of these technologies to reduce CO_2 emissions from the site will be limited These technologies could benefit from the Feed In Tariffs (FIT) and the Renewable Heat Incentive (RHI).	Same analysis as for Bristol.	Both PV and SHW panels could be installed in the roofs of existing and new developments within the study area. B2/B8 uses have typically large un-shaded roof areas that are very suitable for installing these panels. The high costs of PV panels make them only suitable to be installed in individual buildings whilst SHW panels are not suitable for B2/B8 building uses because of the low SHW demand in them. The high costs of a large PV installation across multiple developments in the study area and the technical complexity of integrating SHW panels into a district heating network mean that solar technologies should only be considered for individual developments within the study area rather than at a site-wide scale.

Technology	Assessment summary in Bristol Study	Assessment summary in South Gloucester Study	Assessment for Avonmouth/Severnside area
Heat pumps	The study concludes that unless the RHI offers significant incentives for heat pumps, it is unlikely that they will be widely installed.	Heat pumps are considered to be suitable as building integrated technologies rather than for large installations. It is not forecasted that heat pumps will have a large uptake.	The use of heat pumps in the study area is deemed as possible, although limited to new developments within the study area with substantial space heating/hot water demands.
Biomass	There is a limited biomass supply when considering Bristol City only. Considering larger catchment areas and including waste, woodland and arboriculture activities the amount of available resource improves.	The study has the same conclusions as the Bristol study.	Limited local biomass resources and supply. Mostly coming from waste wood that would have to be processed in facilities compliant with the waste incineration directive limit. There is a proposed biomass chipper facility in Avonmouth docks which may help establish a biomass supply chain to the area. If non-local biomass resource was used, biomass CHP plants could generate renewable power and particularly heat that could be distributed within the study area through a district heating network.

Technology	Assessment summary in Bristol Study	Assessment summary in South Gloucester Study	Assessment for Avonmouth/Severnside area
Energy crops	Very limited space available for energy crops plantation in Bristol City although miscanthus could be grown in nearby agricultural land. Potential conflict with other uses.	The study has the same conclusions as the Bristol study.	Energy crops could be planted on Bristol City Council Tenant Farms and burnt in biomass boilers. This technology can generate some renewable heat but its contribution will be very limited due to the availability of the resource.
Solid waste	Energy could be recovered from large quantities of residual, i.e. non-recyclable, solid waste as described in the Joint Waste Core Strategy. There is only a small pyrolysis plant treating residual waste in Avonmouth.	The study has the same conclusions as the Bristol study.	There are approved and proposed large scale energy from waste plants (see section 6.2) capable of treating residual solid waste in the study area. These plants typically generate power but could also potentially generate heat, which would be partially renewable, and could be distributed locally via a district heating network.
Wet waste	Large quantities of food and sewage sludge are generated in Bristol City which could be treated in anaerobic digesters. There is an anaerobic digestion plant treating wet waste in the Wessex Water waste water treatment plant.	Technology not considered separately from solid waste in the report.	The existing Wessex Water waste water treatment plant is within the study area and has a sewage sludge anaerobic digestion CHP plant and therefore this resource is fully exploited.

Table 4—1 Renewable energy technologies potential in Bristol City and Avonmouth/Severnside study area

5 Unlocking the potential

The previous section has identified that a district heating network powered mostly with biomass and energy from waste CHP plants offers the best renewable energy opportunity for the Avonmouth/Severnside area because it will maximise the environmental benefits of the low carbon/renewable energy generated in the area and could act as a catalyst to unlock the area potential. Following from it, this section describes the drivers and barriers for the implementation of such a network as well as describing the existing situation in terms of heat sources and heat demand of the current and "business as usual" building use mix.

5.1 Drivers

Several important drivers supporting a district heating network in the area have already been identified in previous sections, e.g. international, national and regional legislative drivers identified in section 3, and the fact that a district heating network represents the best renewable energy opportunity for the Avonmouth / Severnside area as summarised from the "Bristol Energy Master-plan" and the "Potential for Renewable and Low Carbon Energy Supply in South Gloucestershire" reports in section 4.

Another two very important drivers for district heating networks are the economic and environmental benefits - reduced operational costs and CO_2 emissions. These benefits could be further increased in the study area if some of the heat were generated from renewable biomass and waste sources in local plants (see section 6.2). In addition, district heating networks also bring the following benefits to generators, users and the local area as a whole:

- Developing local economies;
- Fuel flexibility;
- Improving security of energy supply;
- Reduction of plant space requirements and capital cost; and
- Ease of maintenance.

The possibility of connecting to a district heating network capable of distributing the large amounts of heat locally generated heat from biomass or waste treatment CHP plants could act as a catalyst to shift away from the "business as usual" development mix of B2/B8 uses in the study area. However, a separate detailed market analysis will be required to assess the number and type of companies that could be attracted to the area specifically because of the presence of a district heating network. Some of these companies may include environmental technology, advanced waste processing, cleaner production, resource efficiency and associated advanced engineering technologies companies as well as companies with large heat demands covered by the

Carbon Reduction Commitment (CRC) Energy Efficiency Scheme. Section 8.2 discusses the type of companies that could be attracted to the area in more detail.

Finally, the possibility of a district heating network in the area becoming the seed for a city-wide district heating network that could extend over time towards the Heat Priority Areas identified within the Bristol Citywide Sustainable Energy Study (see Figure 5—1) is an attractive opportunity. However, the long distances between the study area and the heat priority areas and the need to lay connecting pipes across the city centre represent significant technical and economic barriers that would have to be assessed in detail in further studies.

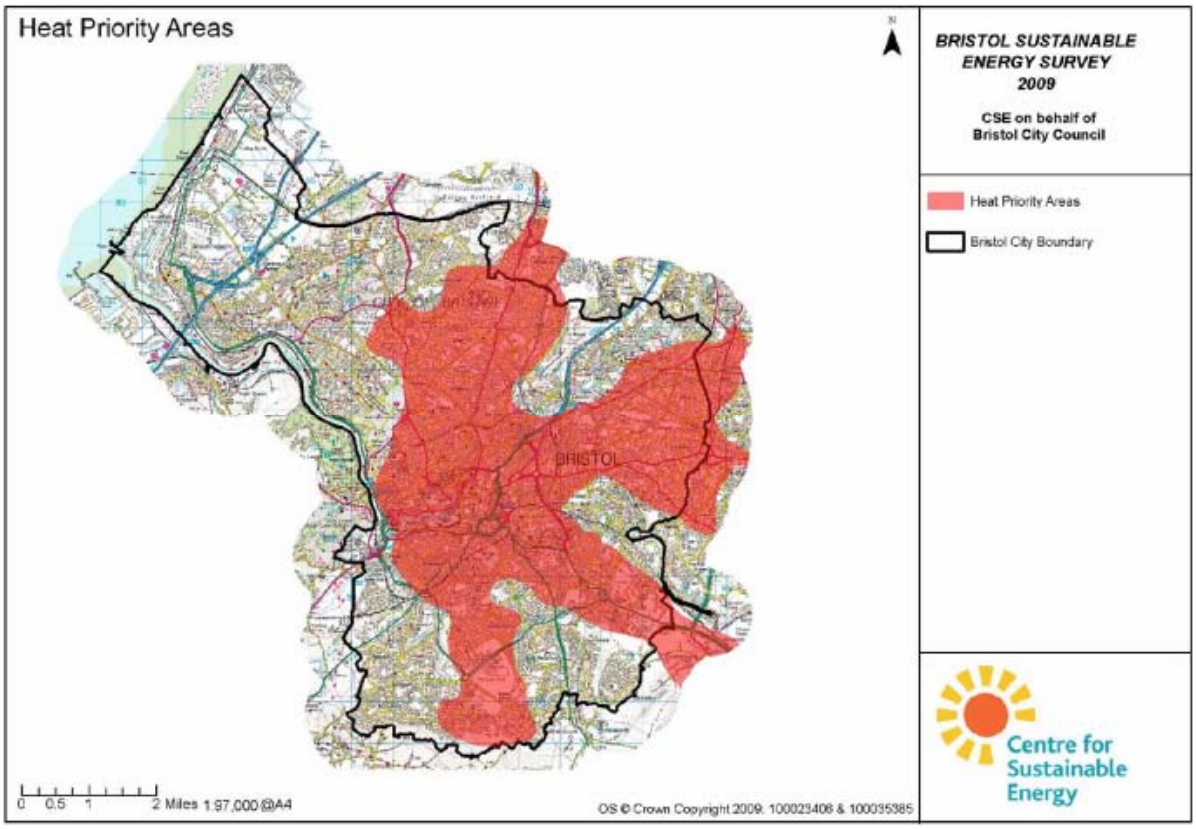


Figure 5—1 Heat priority areas in Bristol (Source: Bristol Citywide Sustainable Energy Study)

5.2 Barriers

The economic and technical risks associated with the funding, design, build and operation of a district heating network, as well as the management issues associated with its ownership and the stakeholder management are the most important barriers to the deployment of a district heating network in the study area.

Firstly, the capital cost of district heating networks is a very important barrier for its deployment. For a district heating system to be viable the cost of establishing the network has to be recovered from the income of selling

energy to the customers, whilst being economically attractive for customers to sign up. The latter statement has an intrinsic risk because customers have the freedom to change energy suppliers. This might prevent recovering the capital investment and negate the environmental benefits associated with the operation of the network. Therefore, maximising customer participation and retention, is paramount for the economic feasibility of the network.

Another potential barrier for the network is the very low heat demand existing in the area because of the existing B2/B8 building stock (see Figure 5—2 and Figure 5—3). Although the presence of the district heating network could act as a catalyst for changes to the building stock, the extent of any such changes is difficult to predict over time and further studies will be required to assess if the heat sales to the current and possible future buildings in the area would be enough to recover the capital investment on infrastructure.

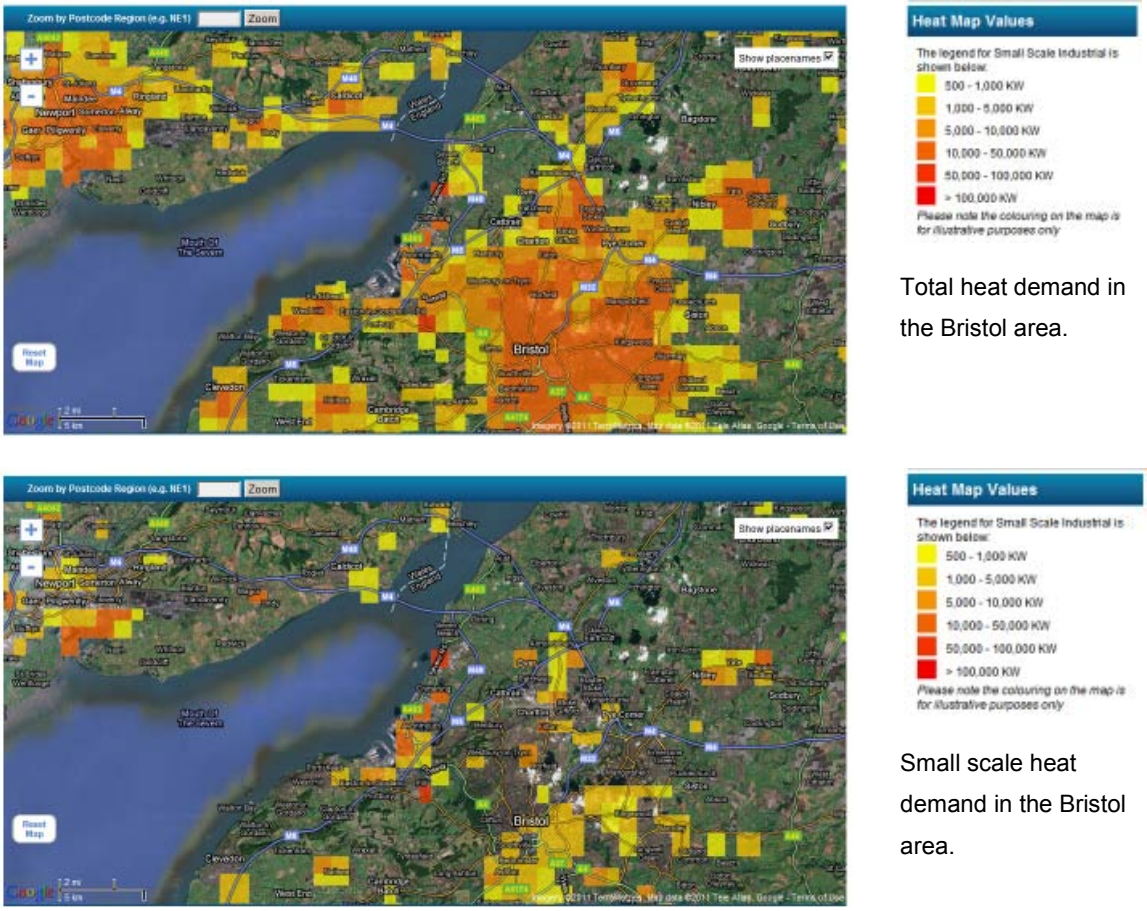
Technically, the physical construction of the district energy infrastructure in the Avonmouth/Severnside area will be complex in terms of distance and layout. The network will have to cross other infrastructure elements (see Figure 6—1), such as railway lines and motorways that cross and surround the area and which will present some technical challenges and increase the cost.

Finally, management issues related to the network ownership as well as the stakeholder, both public and private, and customer management are another important barrier for district heating. Some of these issues can be addressed by involving an Energy Services Company (ESCO) that can help with the financial, technical and management aspects of the network.

5.3 Existing situation

Some of the developments in the area already incorporate some efficient energy generation measures, for example the Wessex Water waste water treatment plant CHP, whereas others either have or have applied for permission to install renewable generation technologies, e.g. the wind turbines proposed by the Bristol Port Company, Wessex Water and the Bristol City Council.

Existing developments in the area, mostly comprising B2 and B8 uses, have low heat demand. This can be seen in Figure 5—2 extracted from DECC's heat database. These maps, although without very high resolution, show that heat demand in the Avonmouth / Severnside area is almost entirely due to small scale industry.



Total heat demand in the Bristol area.

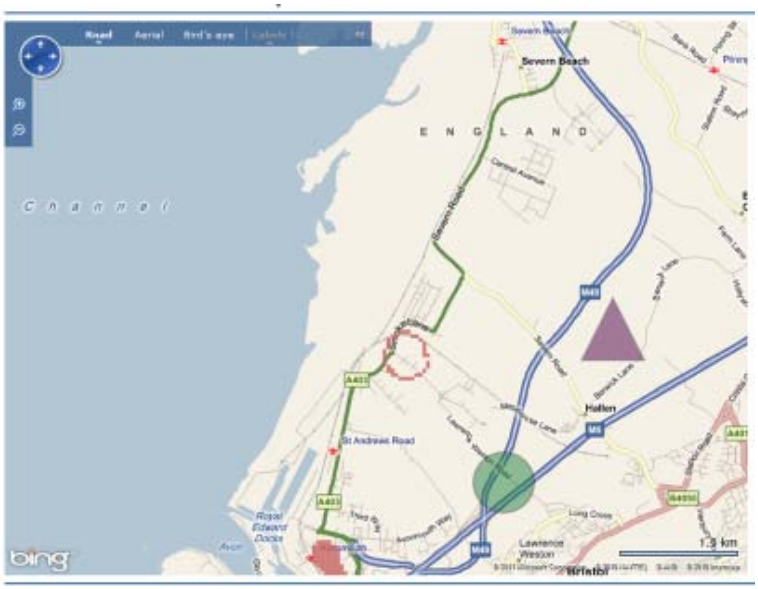
Small scale heat demand in the Bristol area.

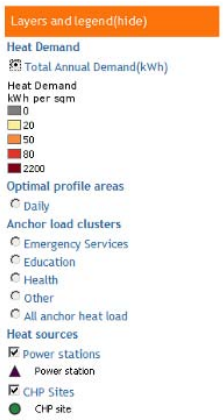
Figure 5—2 Heat Demand in the Bristol area from DECC UK Heatmap.

More detailed versions of these heat maps have been prepared by The Centre for Sustainable Energy and Geofutures Ltd. Figure 5—3 shows more detailed views of the total heat demand in the study area as well as the areas where the heat demands are less variable, e.g. anchor loads (see section 7.4), that have the highest potential for district heating. These maps show that the constant heat demand in the Avonmouth/Severnside area, which is best suited to a district heating network, is concentrated in the residential zone outside the South boundary of the study area whilst within the study area, constant heat demand is quite low because the existing B2 and B8 buildings uses have low heating requirements.

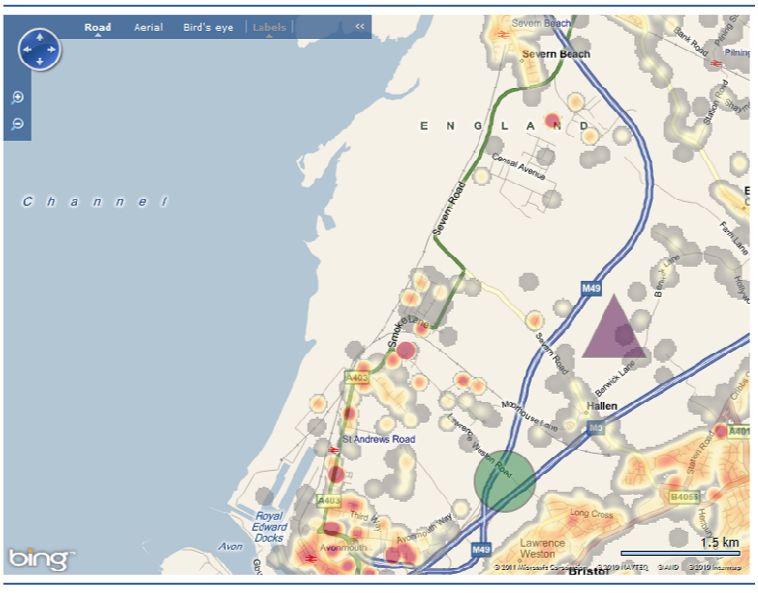
In addition, two existing heat sources are shown in Figure 5—3 by a green circle and a purple triangle, the Seabank power station and the Wessex Water waste water treatment plant CHP plant. Due to a limited representation capacity of the maps, these plants are slightly misplaced in them as they are both to the North of the M49 hence within the Avonmouth/Severnside study area.

Further study will be required to identify if the Seabank power station design allows exporting heat or if it would require major modifications to be considered as a heat source for a potential district heating network. Similarly, additional research will be needed to find out if the CHP plant installed in Wessex Water waste water treatment plant is sized only for exporting heat within the sewage works site or if it has spare capacity and could be connected to a local district heating network.





Constant heat demand areas in Avonmouth/Severnside



Total heat demand in Avonmouth/Severnside area.

Figure 5—3 Detailed heat demand in the Avonmouth area from South West Heatmap.

5.4 Future development

The previous section showed how the existing situation in the study area is not ideal for installing a local district heating network. This section explores how this situation might change as a result of changes in the heat sources and the development mix.

5.4.1 Heat sources

Some of the proposed energy generation developments in the area, e.g. Helius energy or Cyclamax facilities (see section 6.2 for further details), intend to use low carbon energy sources, e.g. biomass or waste, and could be fitted with high efficient energy generation technologies, e.g. CHP. They could be connected to a district heating network that would allow the surplus heat to be used locally.

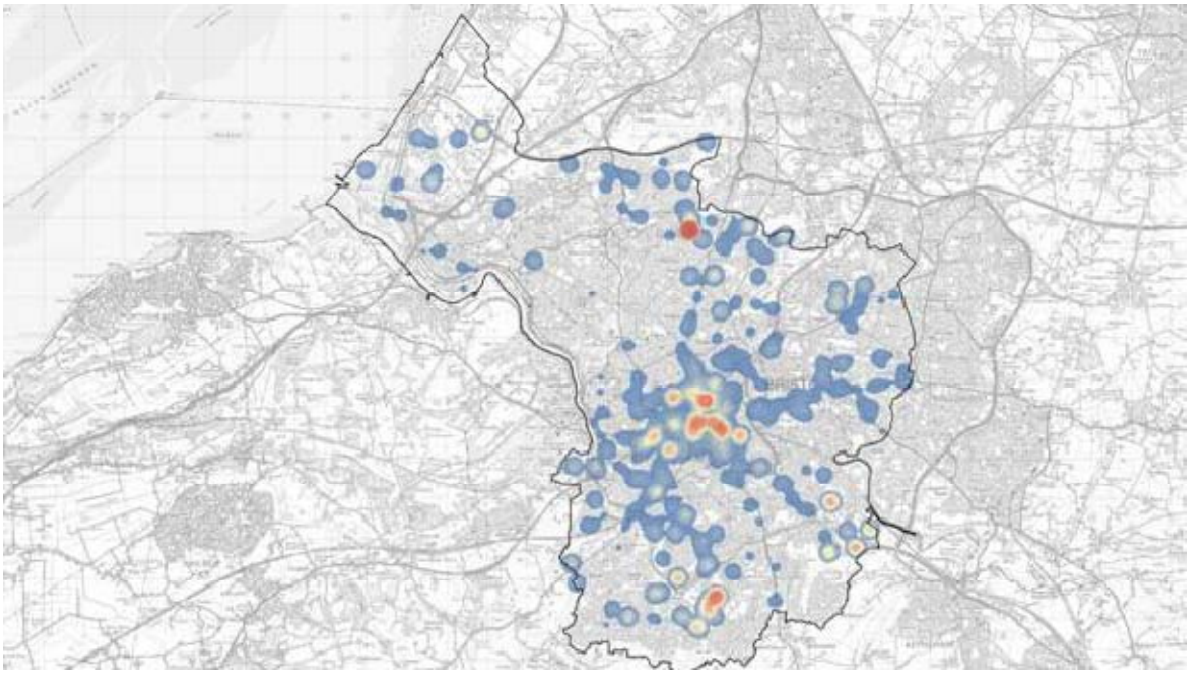
5.4.2 Business as usual development mix

Table 5—1 presents a summary of the past developed areas as well as those proposed to be developed (see Appendix for reference). It shows how in a "business as usual" scenario most future developments in the study area will be similar to the existing mix of B2/B8 uses. If this is the case, although the total heat demand in the area will increase, the energy demand density, a key parameter to assess the feasibility of a district heating network (see section □) will remain low. Furthermore, as a result of the introduction of more stringent building regulations in the future that require new buildings, including those replacing the existing ageing building stock, to have lower CO_2 emissions and therefore lower energy demands, it is likely that the energy demand density may even be lower in the future.

Building type	Past development over last 10 years on greenfield and previously developed land	Future development on undeveloped land within the area of the 57/58 Permission	Future development on greenfield land under private ownership	Future development on greenfield land under council ownership
Total plot area (m^2)	1,598,000	2,447,000	356,000	499,000
Total gross area (m^2)	599,250	727,982	75,990	127,245
Industrial (B2)	20%	0%	60%	70%
Warehouse (B8)	80%	95%	30%	20%
Sui Generis	0%	5%	10%	10%

Table 5—1 Past and future development area and development mix

Figure 5—4 presents the modelled future heat demand in Bristol according to the Bristol Energy Masterplan and South West heat map that shows that only a few locations in the study area will have a significant, although low, heat demand.



Colour key: High heat demand Low heat demand

Figure 5—4 Modelled future heat demand in Bristol (Source: Bristol Energy Masterplan and South West heat map.)

5.5 Conclusions

Previous sections have shown that there are some very powerful drivers, but also some significant barriers, for the implementation of a district heating network in the study area and that it represents the best renewable energy opportunity for the Avonmouth / Severnside area. Therefore, this network presents an opportunity to unlock the area potential and the following sections describe how this network may look like and present an initial feasibility study for it. However, such a network will only be feasible if the future mix of development in the area were to include users with a high heat demand. At present, there are few such users within the study area.

6 District heating network

This section briefly describes a district heating network as well as the heat sources available in the area and a possible network layout.

6.1 Description

District heating networks supply heat to a number of buildings or dwellings from one or multiple centralised energy production facility/facilities by means of a grid and a pipe network carrying hot water or steam.

The network consists typically of two pipes, one flow and one return, the former with a higher temperature of 90 °C or even 120 °C whilst the return will have a temperature of between 40 °C or 70 °C. These pipes are typically made of steel or a rigid plastic and factory assembled with pre-insulation. They are connected to heat exchangers typically located within each building and that separate the district heating pipe circuit and the internal building circuits. The heating systems within each building do not need to be different from traditional systems, e.g. radiators, and the only difference will be in the energy meter that will meter heat as opposed to gas or electricity.

Developing district heating systems requires substantial initial investment in infrastructure, including pipe networks to connect existing and future buildings and the construction, or connection, of a central energy centre or series of them. However, this infrastructure provides an opportunity for the use of large scale CHP and renewable energy technologies that can achieve substantial carbon savings when compared to use of conventional gas supply. District systems can also achieve other benefits including, long term fuel flexibility, lower energy prices and a reliable income stream.

6.2 Heat sources

Some of the existing and proposed energy and waste plants in the study area are potential heat sources for a district heating network. Their location are shown in Figure 6—1 and Table 6—1 summarises the potential amount of heat that these plants could generate.

Plant name	Situation	Thermal output (MW_{th})	Comments
Helius energy	Pending approval	200	Estimated a heat to power ratio of 2:1 (same as used in Bristol Energy Masterplan) to the intended electricity generation of 100 MW_e.

Plant name	Situation	Thermal output (MW_{th})	Comments
Cyclamax	Approved	25	Estimated a ratio of 2:1 (same as used in Bristol Energy Masterplan) to the planned electricity generation of 12.5 MW_e[1].
New Earth Solutions	Approved	7.5	A capacity of 7.5 MW_e is quoted in the company page[2]. A heat to power ratio of 1:1 is used instead of 2:1 as it is expected that some of the heat generated will be used in the nearby MBT plant.
Sita	Denied	74	Estimated a heat to power ratio of 2:1 (same as used in Bristol Energy Masterplan) to the intended electricity generation of 37 MW_e.
Viridor	Approved	60	Estimated a heat to power ratio of 2:1 (same as used in Bristol Energy Masterplan) to the intended electricity generation of 30 MW_e.
Ethos Group	Approved but progress unclear	15.2	Assuming the plant will have two MT8 units each with a capacity of 32,000 tpa (similar to the consented capacity of 70,000 tpa) with a total electric output of 7.6 MW_e[3] and a heat to power ratio of 2:1 (same as used in Bristol Energy Masterplan).

Table 6—1 Potential thermal output of proposed energy recovery facilities in study area

6.3 Proposed network layout

Figure 6—1 shows the proposed network layout which could be built initially around the Cyclamax and New Earth Solutions energy recovery facilities (identified as heat sources 1 and 2 respectively) and that have

[1] http://www.avonmouthresourcepark.co.uk/images/pdfs/AvonmouthNTS.pdf

[2] http://www.newearthsolutions.co.uk/our-facilities-and-projects/

[3] http://www.defra.gov.uk/environment/waste/residual/newtech/demo/documents/ethos-renewables-100603.pdf

planning permission but are not yet built. The figure also shows an existing chilled distribution centre and the in-vessel composting plan proposed by SITA and that are identified as anchor loads 1, 2.

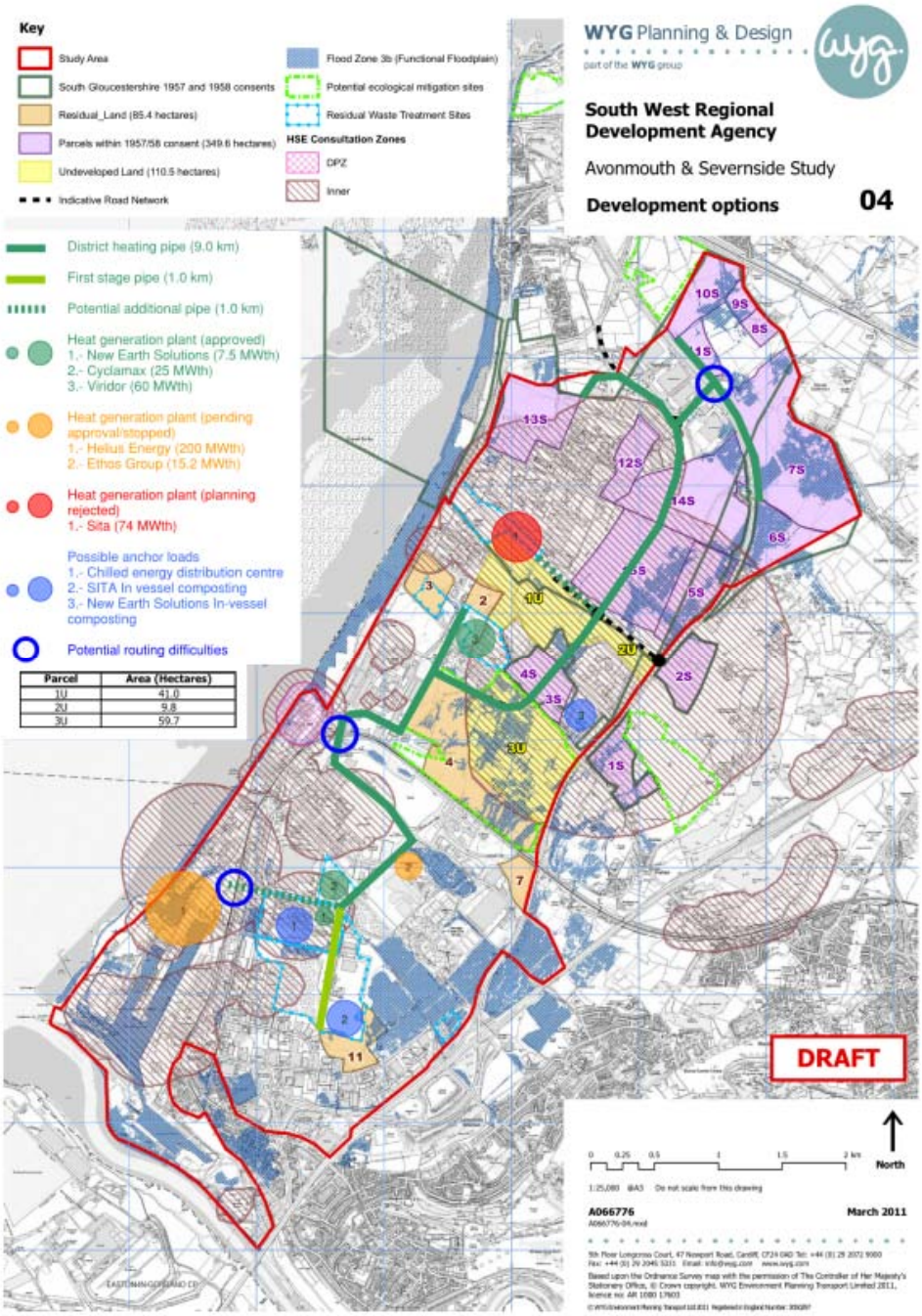


Figure 6—1 Proposed district heating network routing and location of heat sources and anchor loads

6.4 Phasing

The location of some heat sources in close proximity to some potential anchor loads in the South part of the study area which is bounded by the railway line and the M49 and M5 suggests that the district heating network could be initially installed in that area and later expanded to the North of the site crossing the railway line parallel to the bridge over Smoke Lane.

The North part of the network should follow any new spine/distributor road to minimise costs, but also considering the location of potential heat sources and demand. The extension to the North beyond the M49 will require the network to cross major infrastructure again and it is proposed that this could be done following the Holloway Road bridge. The proposed route connects most of the proposed development sites to the network to maximise revenue options.

The length of the first stage of the district heating network is about 1.0 km with the remaining pipe length measuring 9.0 km. This excludes individual connections to each development./user. Approximately 4.0 km of the 10.0 km of pipes of the network could be laid out at the same time as the new spine road achieving some capital savings (see section 7.5). Figure 6—1 also shows other connections to potential heat sources which would require a pipe distance of 1.0 km.

As mentioned in section 5.1, the presence of very important heat sources, either existing or planned, within the study area combined with the proposed district heating network represent an opportunity for an embryonic Bristol wide district heating network that could extend South towards the Heat Priority Areas identified in the Bristol Citywide Sustainable Energy Study (see Figure 5—1). Such a district heating network will enable the distribution of decentralised heat generation and contribute significantly to the renewable energy targets for Bristol and South Gloucestershire County Councils although not without significant technical and economic challenges.

7 Feasibility

This section explores the following aspects that influence the economic feasibility of the proposed district heating network, and therefore its ability to provide environmental benefits:

- Existing and future heat demand density;
- Heat demand profile;
- Anchor heat loads; and
- Heat sources (already described before in section 6.2)

7.1 Assumptions

The following assumptions are used throughout this feasibility assessment:

- An Energy Services Company (ESCO) will be set up to design, build, operate, maintain and managed the district heating network, liaise with the heat generators and bill the end users.
- The ESCO will buy heat from the generators at wholesale prices and will sell it at retail prices to individual developments within the study area with all the profit obtained used to repay the capital cost of the network.
- Only the current approved heat sources have been considered i.e. Cyclamax, New Earth and Viridor.
- The heat output from these facilities has been estimated with a 2:1 heat to power ratio (see section 6.2) that has already been used in the Bristol Energy Masterplan.
- The calculations have been made assuming full occupancy and developments completed on undeveloped sites broadly in accordance with the Figure 6—1 above .
- Only 50% of existing B2/B8 developments have space heating (this approximately matches the information shown in the available heat maps).
- 100% of all new B2/B8 developments will have space heating in future developments due to heat availability.
- Demand from Sui Generis developments has not been considered.
- No process load has been considered.
- The cost of installing the district heating pipes has been based on estimates from past Buro Happold projects.

- Energy prices and incentives will remain fixed over time due to the large uncertainty on these.
- No operational or maintenance costs have been assumed (pending a detailed study for the district heating network).

As a result of these assumptions, the current outline feasibility assessment presents a best case scenario for the feasibility of the district heating network and the findings presented here will have to be refined and validated with additional information and sensitivity analyses.

7.2 Existing and future heat demand density

Heat demand density is typically used as a starting point for assessing the viability of district heating networks. The lower the heat demand density, the higher the infrastructure capital cost compared to potential revenues. In addition, pipe heat losses make up a greater proportion of the total heat supply, which affects both the financial viability and environmental benefits.

There are two main ways of representing heat demand density:

- Area heat demand density, which is expressed in kWh/m^2/year as an energy demand over land area. Note it is not built area, but the total land area of development.
- Line heat demand, which is expressed as an energy demand per unit length of pipe (kWh/m/year)

The report 'The Potential and Costs of District Heating Networks' published by Poyry and Faber Maunsell in 2009 for DECC investigated the viability of district heating to serve the existing UK building stock and identified a minimum area heat density of 26 kWh/m^2/year as the threshold for district heating viability. Another source, the International Energy Agency report 'District Heating Distribution in Areas of Low Heat Demand Density' published by IEA in 2008, estimates that district heating systems can be viable at heat densities as low as 10 kWh/m^2/year or line heat demands of 300 kWh/m/year if advanced design measures are employed and recognises line heat demand as a more accurate measurement of viability as it takes account of the heat network layout. However, because only an indicative layout of the network is available and no detailed location and heat demand information is available, the area heat demand density will be used in this assessment.

Table 7—1 summarises the information on average CO_2 emission rates, energy demand and the calculation assumptions used to estimate current and future space heating demands from the current and proposed developments in the study area. Hot water demand for B2/B8 uses is likely to be negligible. Table 7—2 shows the estimated heating demand density using the areas shown in the Appendix.

Building type	CO_2 emissions from heating and hot water[4]	Thermal energy demand[5]	Comments / Assumptions
Unit	kg CO_2/m^2/year	kWh/m^2/year	
Industrial (B2)	1 + 0	4.9	May have a high heat process demand. All space is conditioned in current and future developments
Warehouse (B8)	17 + 0	83.3	Estimated that only 50% of existing warehouses have space heating to roughly match information shown in heat maps. Assumed that 100% of warehouses will have space heating in future developments due to heat availability.
Offices (B1)	20 + 3	112.7	Will not have any process heat demand. Possible future building use.
Sui Generis	Not available	Not available	May have a high heat process demand.

Table 7—1 Heating CO_2 emissions, energy demand and assumptions

Type of development	Past development over last 10 years on greenfield and previously developed land	Future development on land with 57/58 permission	Future development on other greenfield land
Estimated heat demand density (kWh/m^2/year)	12.8	33.7	5.5

Table 7—2 Estimated heating demand density

[4] Table 6 in the consultation document on "Definition of zero carbon homes and non-domestic buildings" published in December 2008 by HMRC

[5] Carbon factor of 0.204 kgCO_2/kWh of natural gas, assumed to be the traditional heating method, as published in August 2010 by DEFRA in table 1 of the guidance to report GHG emissions.

As a result of the assumption that all future warehouses will have space heating due to the availability of heat, developments, the development proposed in the residual land of the area with 57/58 permission present the best opportunity for the development of district heating. However, installing a district heating network to supply heat to the proposed developments in the remaining residual land within the study area but outside the 57/58 permission area is not viable as they have a heat energy demand density below the threshold identified by Poyry and Faber Maunsell of 26 kWh/m^2/year. Finally, the existing developments within the study area have an estimated heat demand density below the Poyry and Faber Maunsell threshold but still above the lower threshold of 10 kWh/m^2/year identified by IEA for which district heating networks could be feasible if advanced design measures were employed.

However, this assessment only takes into account space heating demands but no process demands or requirements for specific developments, e.g. composting process, chilled storage, work environments with closely controlled temperature requirements, nor the potential impact that other building uses that may be attracted to the area may have. If these were considered, heat demand density in the area may increase and could make the development of a district heat network viable on land outside the area of the 57/58 permission.

In summary, installing a district heating network to serve new developments in the area covered by the 57/58 planning permission will be economically feasible and it can help with the feasibility of installing a network supplying existing developments within the study area, which otherwise will be borderline. Nonetheless, because the above assessment has not considered the possibility of serving specific process loads or developments demands, a detailed market research will be necessary to refine these results. Moreover, further research will also be necessary to assess how exactly the building use mix might change as a result of the presence of the district heating network that and how this in turn might increase the feasibility of the network creating a positive feedback loop that will unlock the area potential.

7.3 Heat demand profile

The heat demand profile is a very important design factor for a district heating network. If the network is sized to supply the peak load and there is a large difference between it and the baseline load, the network will be more expensive to build and operate and its capacity will be under-utilised most of the time. Moreover, networks that supply constant heat demands require less investment for the same environmental benefits.

B2/B8 uses have daily variable heat demands as shown in Figure 7—1. In addition, they also have seasonal heat demands, e.g. higher in winter and lower in summer.

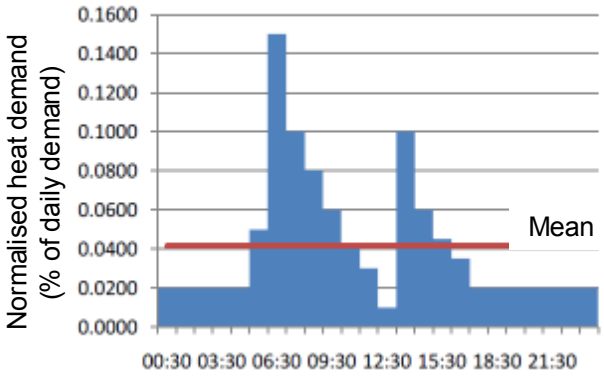


Figure 7—1 Daily heat demands for warehouses and industrial uses (Source: South West heat map)

This variability is not ideal for the operation of district heating network although it could be accommodated if there was enough of a baseline provided by "anchor loads" that would help to smooth the relative effect of the peaks. The detailed effect of this demand variation should be further study in a detailed feasibility assessment.

7.4 Anchor loads

Large heat users with relatively constant heat demands could act as "anchor loads" that may increase the feasibility of district heating networks. These anchor loads bring the following benefits to the heating network:

- Economic. Anchor loads are a source of secure income thus improving the economic feasibility of the network and attracting potential energy services companies.
- Technical. Anchor loads are typically constant thus providing the base load for the district heating and smoothing heat demand profiles;
- Environmental. Anchor loads can act as catalysts for the creation of a district heating network that could deliver low carbon heat to other nearby developments that would otherwise had used fossil fuels for heating.

Not only large heat loads, but also large cooling loads could also be considered anchor loads because absorption cooling chillers can use heat to provide cooling.

Within the study area, there are some existing anchor loads. These include an in-vessel composting facility and a chilled storage centre (see Figure 6—1). Other potential anchor loads include a proposed biomass to biodiesel plant and a biomass chipping facility, both in the Avonmouth docks. Other anchor loads such as those discussed in 8.2 could be attracted if a district heating network was set up in the area.

7.5 Capital costs

District heating network infrastructure is expensive, particularly if laid in an already developed area. Based on estimations and past project experience, on average savings of around 17% of the capital costs will be achieved

because it will not be necessary to dig trenches and reinstate the surface to its previous condition if the installation is coordinated with other infrastructure work. Therefore, to maximise the return of investment and environmental benefits, it has to be done initially in areas with current or expected high and constant heat demands. Once the initial investment is made, the marginal cost of expanding the network to supply other loads will be less than installing it for the first time.

These capital costs estimations are based on a network capable of distributing the heat produced in the heat plants already approved and the layout described in Figure 6—1 and will need refinement in future detailed studies.

In a first approximation, it has been estimated that a district heating pipe with a diameter of 600 mm would be enough to carry around 100 MW of heat. This is equivalent to the heat output from the heat plants that have planning permission and could even accommodate heat from the Ethos facility should it become on-line.

In addition to the main district heating network, additional connections will be required to each individual development. Given the initial stages of the design, an additional 100% of 25 mm piping has been deemed necessary for this connection. Nonetheless, this assessment is based on past experience for residential projects which may not be fully applicable for the B2/B8 use mix.

These assumptions together with the distances shown in Figure 6—1 have been summarised in Table 7—3. The total cost for the network has been estimated at £30m.

Pipe diameter	New development pipe costs (£m/km)	Existing development pipe costs (£m/km)	Distance in new development (km)	Distance in existing development (km)	Total cost (£)
25 mm	0.3	0.4	4.0	6.0	3.6
450 mm	2.4	2.9	4.0	6.0	26.4

Table 7—3 Estimated unitary district heating capital costs

7.6 Revenues

Using the same assumptions as for the heat demand density estimations, Table 7—4 shows the estimated heat that will be demanded by the developments in the different parts of the study area. In total, 107.6 GWh of heat will be demanded annually in the study area once fully built.

Type of development	Past development over the last 10 years on greenfield and previously developed land	Future development on undeveloped land within the 57/58 Permission	Future development on other greenfield land
Total gross area (m^2)	599,250	727,982	203,235
Estimated heat demand (GWh/year)	20.5	82.4	4.7

Table 7—4 Estimated heat demand in the study area

The total estimated thermal capacity of the approved plants, i.e. Cyclamax, New Earth and Viridor, is 92.5 MW_{th} as shown in Table 6—1, which if assumed to operate for 8,000 hours a year would generate 740 GWh of heat a year, more than enough to supply all the proposed developments within the study area.

According to Figure 7—2 that shows the price of gas from the quarterly tables published by DECC and last updated 31 March 2011, a price of between 1.8 and 2.8 pence per kWh (p/kWh) can be expected for heat depending on the client heat demand. Nonetheless, the figure also shows that these figures are highly variable with time. As described in section 7.1, it has been assumed that these prices will be constant and that heat will be bought in bulk from producers at 1.8 p/kWh, and sold to retail prices to customers at 2.8 p/kWh, a maximum yearly revenue of just over £1m will be achieved.

Type of development	Past development over the last 10 years on greenfield and previously developed land	Future development on undeveloped land within the 57/58 Permission	Future development on other green field land
Costs (£m)	0.369	1.483	0.085
Revenue (£m)	0.574	2.307	0.132
Profit (£m)	0.205	0.824	0.047

Table 7—5 Estimated heat costs, revenues and profits

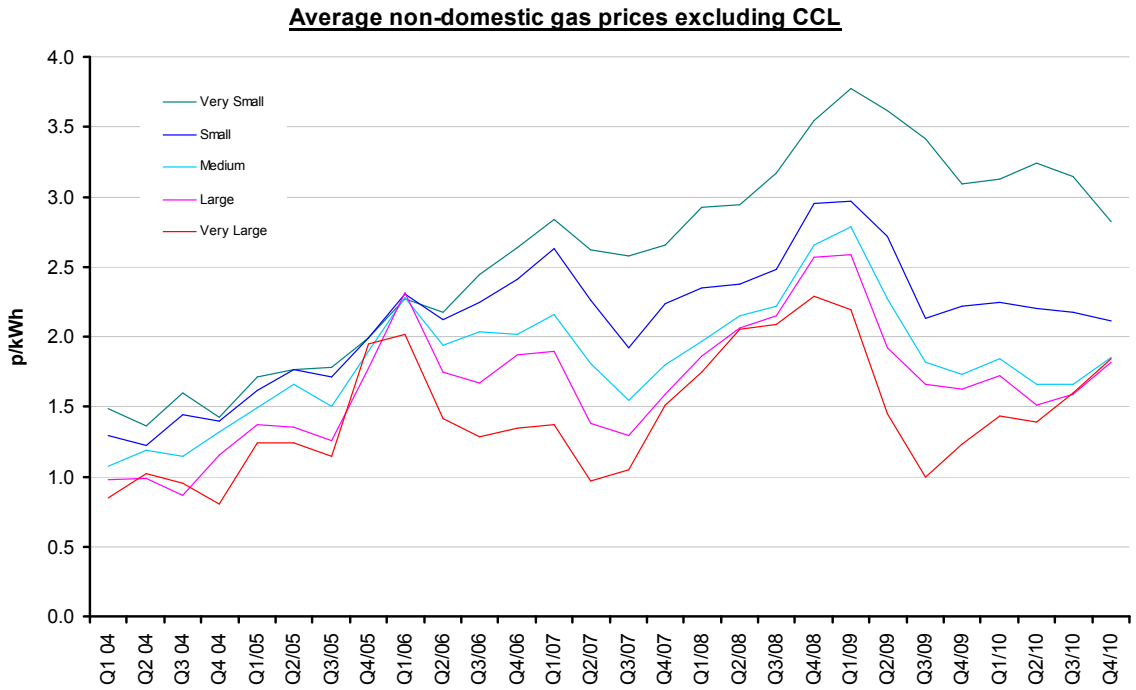


Figure 7—2 Average non-domestic gas prices excluding CCL (Source: DECC)

7.7 Low Carbon Energy Incentives

Some financial incentives are available for low carbon energy technologies and a district heating scheme using waste heat or a renewable fuel could benefit from some of them. These incentives provide a great support for the UK low carbon energy industry, making renewable energy far more cost-effective for all developments.

- Renewable Heat Incentive (RHI). Recently, through the UK Renewable Energy Strategy published by DECC in 2009, the UK Government has announced a RHI that will provide generators with additional income from the production of renewable heat. DECC intends to implement the RHI by June 2011. Renewable heat distributed through a district heating network will qualify for this incentive thus increasing the economic feasibility of the scheme. The current proposal is for large scale biomass facilities, as those existing or proposed in the study area, will receive a tariff of 2.6 p/kWh although only the renewable fraction of the heat will qualify for it. The current proposal sets out that unless a higher percentage of biomass content is proven, a default of 50% will be used.
- Climate Change Levy (CCL). Exemption A CHP scheme, either new or upgraded, can be exempt from the CCL, if it proves to be “Good Quality CHP” as defined by the CHP Association. Existing and proposed power plants in the study area could be either built as CHP facilities or retrofitted to allow them to export

heat thus qualifying for this incentive and improving their economic feasibility. From 1 April 2012, the CCL will be 0.177 p/kWh.

- Renewable Obligation Certificates (ROC) and Feed In Tariff (FIT). Renewable Obligation Certificates are awarded to large scale renewable energy generators proportionally to the amount of renewable energy and the technology they use. These certificates can then be sold to electricity distribution companies for a premium. For small scale installations, the Feed In Tariff system applies and small scale generators can benefit from a fixed price on the electricity they generate. Large renewable electricity generators already exist in the area, e.g. wing turbines, whilst smaller installations could potentially be installed in individual developments if deemed appropriate. This incentive will not be applicable to a district heating network.

In summary, assuming that all the CCL and only 50% of the RHI could be claimed by the currently approved facilities that will use waste as feedstock, the total incentive per kWh generated will total 1.47p/kWh.

7.8 Economic summary

Table 7—6 summarises the economic model assumptions as well as the capital costs, operational costs, revenues and incentives of the proposed district heating network.

	Value
Capital costs (£m)	30.0
Annual Energy Costs (£m)	1.9
Annual Energy sales Revenue (£m)	3.0
Annual Energy Profit (£m)	1.1
Annual incentive (£m)	1.6

Table 7—6 Costs, revenues and incentives for the district heating

Figure 7—3 shows the NPV evolution over a period of 30 years, and the payback periods, of the district heating network for different discount factors with the numerical representation shown in Table 7—7. The discount rates used are a 3.5% social discount factor described in the Green Book, a more common 6% discount factor that would be typical for a commercial enterprise, and even more aggressive discount factor of 10%. In this last case, the investment is never recovered even in a period of 50 years.

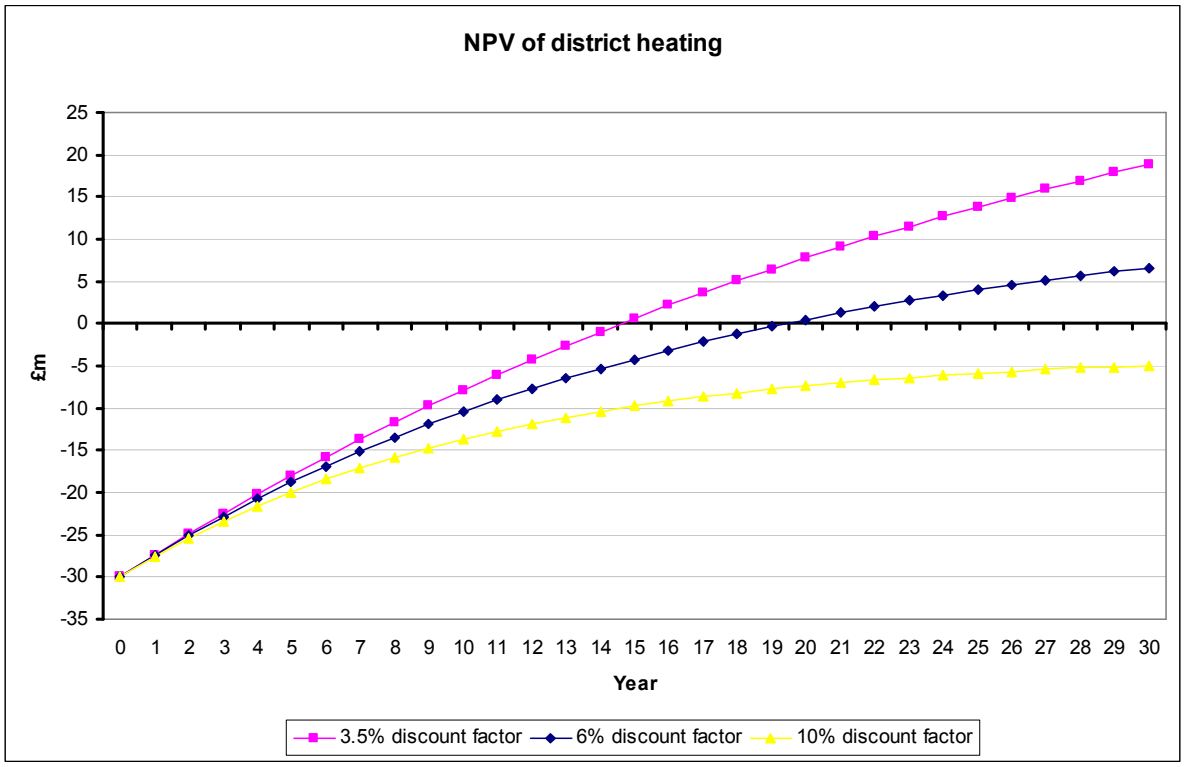


Figure 7—3 NPV of district heating

Discount factor	3.5%	6.0%	10.0%
Payback period (years)	14	19	N/A
NPV in 30 years (£m)	18.8	6.5	-4.9

Table 7—7 Economic summary of feasibility study.

8 Recommendations

As a conclusion to this energy study, this section presents a set of recommendations grouped into categories for SWDRA, Bristol City Council and South Gloucestershire Council to implement.

8.1 Techno-economic recommendations

It is understood that Low Carbon South West has commissioned work to assess the technical and commercial feasibility of an Avonmouth/Severnside district heat grid which will provide detailed information to SWDRA, Bristol City Council and South Gloucestershire Council on a possible district heating network in the study area.

If the detailed feasibility study recommends building a district heating in the study area, or a part of it, it is suggested to engage an energy services company (ESCO) to share the funding, designing and building the network as well as to operate, maintain and manage its heat generators and consumers in return for some of the economic benefits that will be achieved during its operation. In addition, a phased build out of the district heating network is proposed to minimise upfront capital expenditure and risks. Pending the detailed study results, it is suggested to start the network in the South of the study area and then expand it to the North. The South of the site concentrates some of the heat generators, e.g. New Earth Solutions and Cyclamax plants, as well as some potential anchor loads, e.g. chilled distribution centre and in-vessel composting plant, whilst the Viridor plant just granted planning permission and the 57/58 planning consent area that presents the best opportunity to install a district heating network because of its high heating demand density are in the North. The revenues obtained from the operation of the first phases of the network can help to partially fund its expansion. In the long-term, the feasibility of connecting the district heating network in the study area to a network serving the Heat Priority Areas identified to the South of Bristol should also be studied.

Finally, it is also recommended to align the network layout with existing infrastructure, e.g. road, railway, etc. and to synchronise the construction of the network with the proposed spine road or other new infrastructure when possible, to minimise costs.

8.2 Development use mix recommendations

The assessment presented in section 7.2 shows that, pending further detailed study, the proposed business as usual development mix would only justify the installation of the network in the residual land with 57/58 permission and that higher heating demand density values will be necessary to justify the installation of the network in other parts of the study area. This means that, from a heat demand point of view, the current and proposed development mix of B2/B8 uses is not optimum and building uses with higher space heating, hot water or process heat demands would be more appropriate.

Therefore, it is suggested to commission a market study to assess the interest of companies with high heating or cooling loads to relocate to the study area to increase the feasibility of the network. The study should explore

the how willing companies will be to relocate as a result of the presence of the district heating network, as well as some of the other proposed improvements to the area such as transport links. The possibility of attracting business with high cooling demands should also be considered because absorption cooling equipment can use heat to generate cooling.

The presence of business with high heating or cooling loads in the area should not be seen as unlikely because some of the existing or already approved developments in the area, include:

- Chilled storage centre;
- In vessel composting facility near the Seabank power station;
- Biomass to biodiesel plant in the Avonmouth docks; and
- Biomass chipping facility in the Avonmouth docks.

Therefore, and given the background of the study area, it should be possible that some of the businesses in the key sectors identified by the client, e.g. advanced waste processing, cleaner production, resource efficiency companies and associated advanced engineering technologies, would be willing to relocate to the study area in the form of:

- Work environments with closely controlled temperature requirements; or
- Spaces with high heating/cooling loads; or
- Industrial plants with high heating/cooling loads.

8.3 Strategic interventions

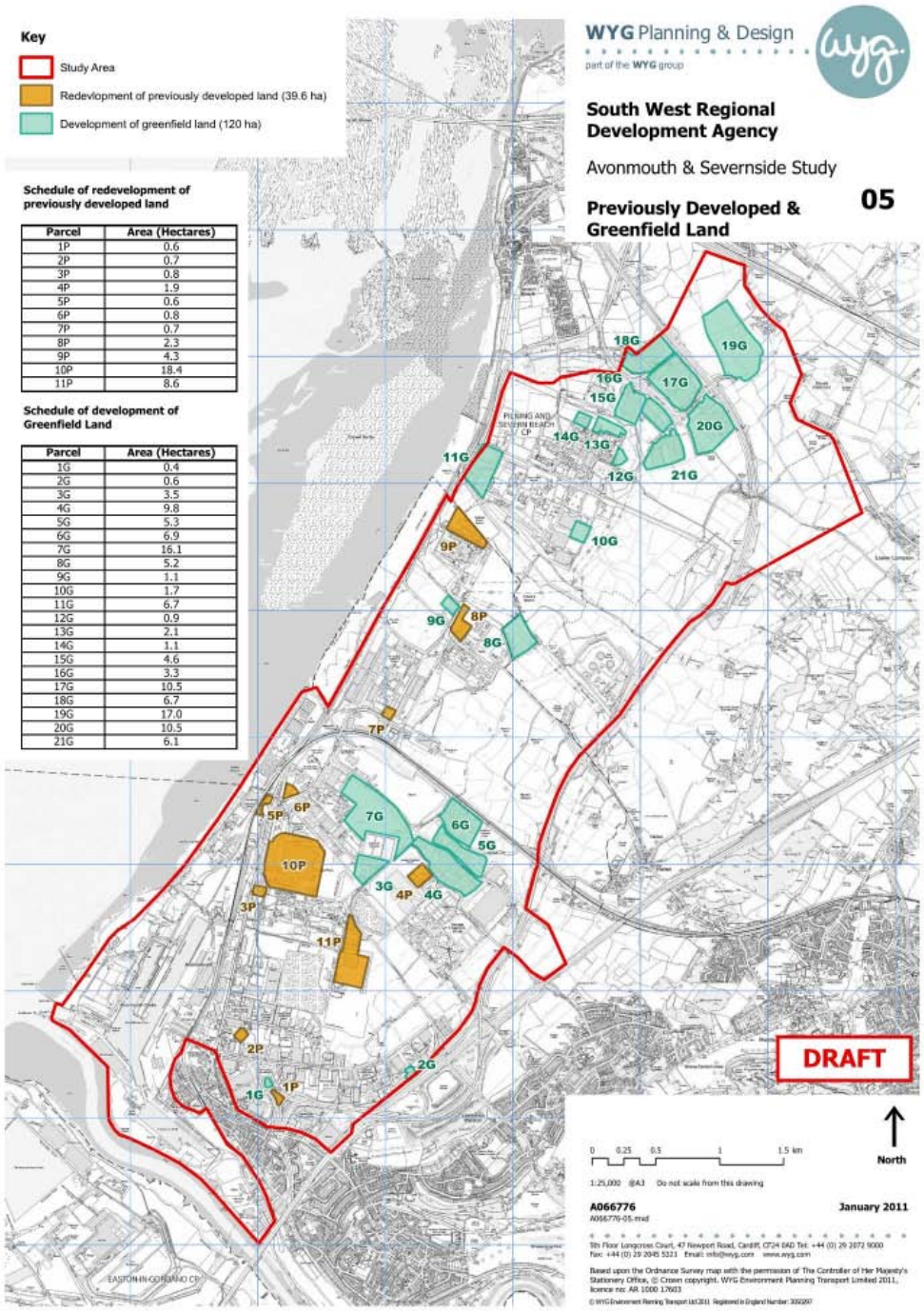
In order to shift from the “business as usual” scenario to the optimum development use mix, some strategic interventions by Bristol City Council and South Gloucestershire Council will be required. In energy terms these include:

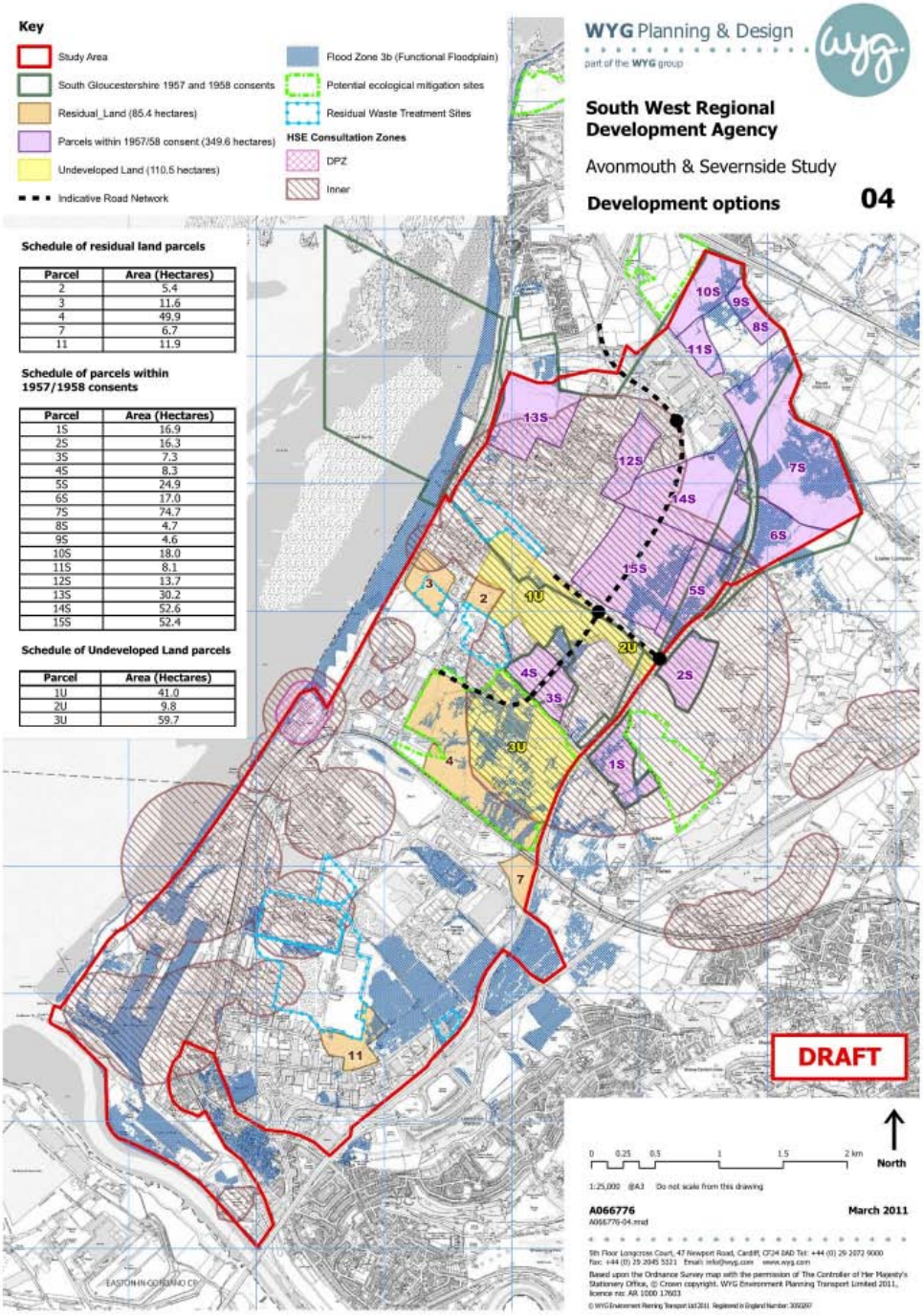
- Collaborate in the implementation of the Bristol Development Framework Core Strategy Policy BCS4: Avonmouth and Bristol Port, the South Gloucester Core Strategy Policy CS35: Severnside and the South Gloucester Core Strategy Policy CS3: Renewable and low carbon energy generation, that support low carbon energy opportunities such as that presented by the district heating network in the study area.
- Study the feasibility of implementing the measures described in the Bristol Development Framework Core Strategy Policy BCS11: Infrastructure and Developer Contributions regarding the potential mechanisms for developers to contribute to the developments of an area by using planning obligations or a Community Infrastructure Levy that could be used to fund the district heating network.
- Apply the heat strategy described in the Bristol Development Framework Core Strategy Policy BCS14: Sustainable energy in the study area and the principles established in the South Gloucester Core Strategy

Policy CS4: Renewable or low carbon district heat networks to discuss in every planning application in the study area the possibility to connect to the proposed district heating network or to justify otherwise. A similar requirement is mentioned in the Core Strategies of other local authorities with existing heating networks such as Sheffield and Southampton.

9 Appendix

The following maps show the previously developed and greenfield land within the boundaries of the study area as well as the development options considered.





Pablo Izquierdo
Buro Happold Limited
Camden Mill
Lower Bristol Road
Bath
BA2 3DQ
UK

Telephone: +44 (0)1225 320600
Facsimile: +44 (0)870 787 4148
Email: pablo.izquierdo@burohappold.com

Key

- Study Area
- Commitments
- Undetermined
- South Gloucestershire 1957 and 1958 consents
- Residual Waste Treatment Sites

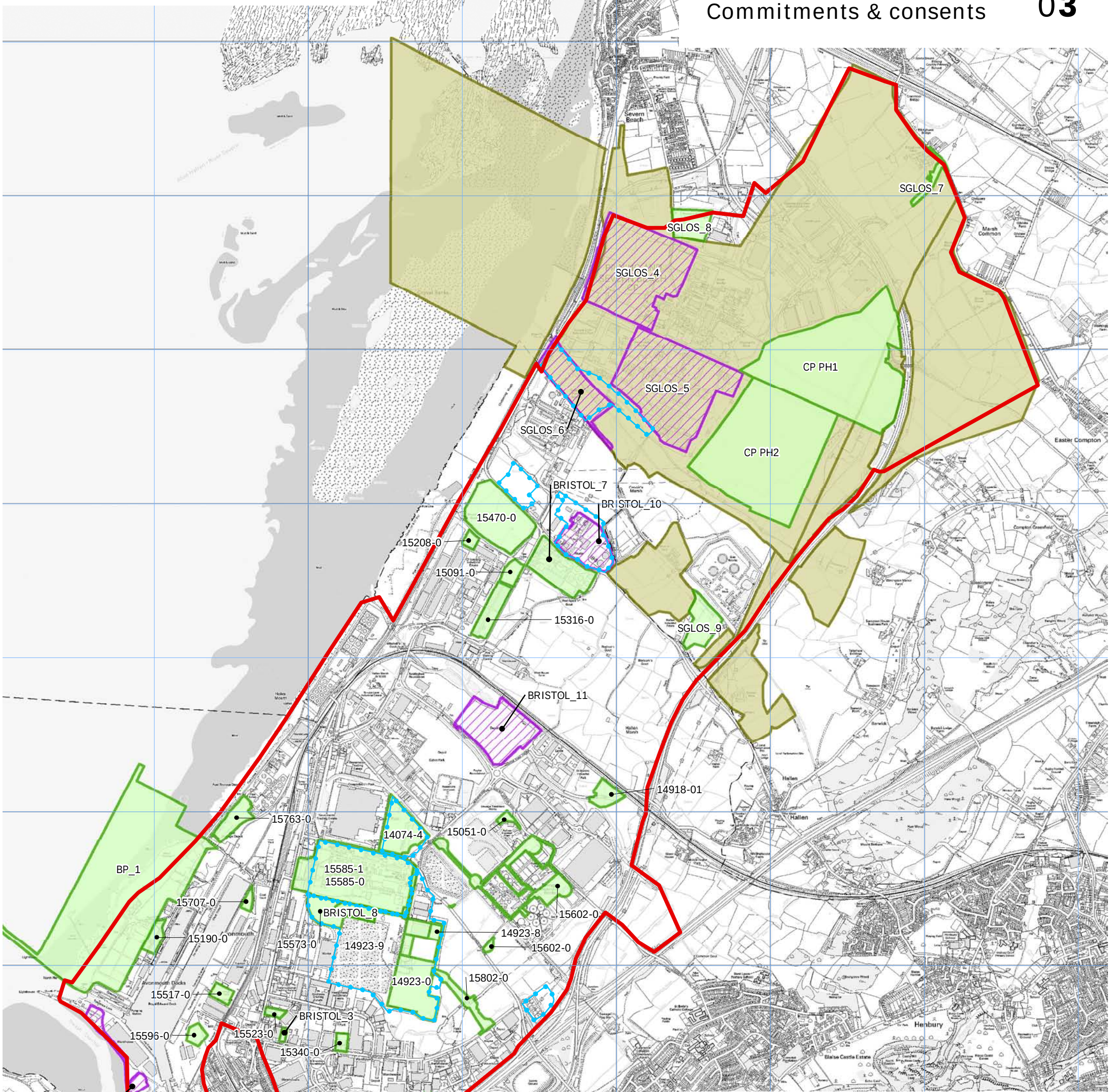
WYG Planning & Design

part of the WYG group

Bristol City and South Gloucestershire Councils

Avonmouth and Severnside Study

Commitments & consents 03



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North

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A066776 March 2011

A066776-03.mxd

5th Floor Longcross Court, 47 Newport Road, Cardiff, CF24 0AD Tel: +44 (0) 29 2072 9000
Fax: +44 (0) 29 2045 5321 Email: info@wyg.com www.wyg.com

A066776 AVONMOUTH/ SEVERNSIDE STUDY
MAP 2 - DEVELOPMENT COMMITMENTS SCHEDULE (AT DECEMBER 2010)

Map/ LPA/ Site Ref	App Ref	App type	Site Area (ha)	Description	Address	Decision Date	Development Mix (sq m) (additional floorspace)			
							B1	B2	B8	Sui Generis
South Gloucestershire Council										
	1957	OUT	404.6	Development of an area of 1,000 acres for the construction and operation of a) factories for the prodution of chemical and allied products etc b) offices, warehouses, stores, reservoirs, sports pavilions and playing fields etc.	Area between Severn Beach and Chittening Trading Estate, in parishes of Rediwck and Northwick and Almondsbury in Thornbury Rural District	27/11/1957				
	SG.4244/A	OUT	9.1	Development of an area of 22.55 acres for the construction and operation of a) factories for the prodution of chemical and allied products etc b) offices, warehouses, stores, reservoirs, sports pavilions and playing fields etc.	Between Crooks Marsh and Elmington Manor Farm, Hellen	13/07/1958				
CP PH1	Central Park - Phase 1 (WAP2)			Unit 1	Central Park, Western Approach, Severnside BS35 4GG		576		11,399	
				Unit 2			901		17,940	
				Unit 3			1,589		31,745	
				Unit 4			1,756		35,117	
				Unit 5			2,323		46,489	
CP PH2	Central Park - Phase 2 (WAP2)			Unit 6			1,802		36,000	
				Unit 7			1,951		39,000	
				Unit 8			5,800		116,000	
	P94/0400/8	OUT	87.9	Development of 87.9ha of land for the layout and construction of a distribution park	Land at Severnside					
SGLOS7	PT07/3051/RM	RM	12.4	Construction of vehicular access (Amendment to previous permission PT00/0261/RM approved on appeal).	Land south of Ellinghurst Farm Marsh Common Pilning BRISTOL South Gloucestershire BS35 4JX	16/04/2008				
Undetermined Applications										
SGLOS4	PT10/2630/0	OUT	31.96	Development of 31.96ha of B2, B8 and ancillary B1 uses, with highway infrastructure, car parking and associated works. Outline including access with all other matters reserved.	Astra Zeneca, Severnside ('site SS2'), Hellen, BS10 7ZE	PENDING DECISION				
SGLOS5	PT09/5982/FMW	COU	6.7	COU for construction of an Energy Recovery Centre for thermal treatment of non hazardous waste and ancillary development inc. new road and roundabout on A403 and new railhead	Land at Severnside Works (Central Park), Severn Road, Hallen	Refused 28/07/10 APPEAL DECISION PENDING				
SGLOS6	Application Anticipated late 2010		37	Formerly Terra Nitrogen site, now cleared and will be subject of development proposals in 2010. Scottish Power proposing CCGT power station	Grow How site					
Bristol City Council										
14918-01	98/02621/P	OUT	2.3	Industrial development within use classes B2 and B8	Land at Moorend, Parkgate and Poplar, Lawrence Weston Road, Lawrence Weston - Plot P7B and P8	26/03/1999		8,500		
15051-0	05/02171/F	FULL	0.58	Erection of building to house waste preparation and advanced thermal processing plant (previously approved under 01/02319/F)	Avonmouth Refuse Transfer Station, Kings Weston Lane	07/09/2005				3,560
14923-0	07/00187/P	OUT	11	Outline app (resubmission of 05/02288/P - retention of exisitng B1,B2 floorspace and provison of further B2/B8 floorspace) and provision of new vehciular access	Britannia Zinc Ltd, Kings Weston Lane	29/03/2007			27,449	
15190-0	07/01367/F	FULL	1.22	Erection of biodiesel processing plant	Land at Avonmouth Dock Royal Edward Dock, Bristol BS11 9BE	02/10/2007				4,389
14923-9	07/03022	RM	0.9	RM applicaton further to outline pp 07/00187/P for the erection of 27,449sqm of B8 floorspace - Phase 2 comprises 5,454sqm	Britannia Zinc Ltd, Kings Weston Lane	08/10/2007			5,454	
15208-0	07/01843/F	FULL	0.84	Erection of new workshop and finishing facility with new sales office and replacement staff mess fecilities	Ravenstock MSG Ltd Greensplott Road Bristol BS11 0YQ	17/12/2007		654		
15214-0	07/02235/F	FULL	0.06	Demolition of shed to rear of bus depot ad conversion of remainder to 3no. Dwellings and commercial use (Classes A1, A2, B1 or D2). Erection of building comprising 20no. flats	Former Avonmouth Bus Depot	05/03/2008 (by Appeal)				
14923-8	08/00753/M	RM	0.8	RM app for erection of 3,421sqm of B8 development, car/ lorry parking and associated works	Britannia Zinc Ltd, Kings Weston Lane	19/05/2008	416		3,005	
15517-0	08/01047/CP	COL	1.3	Certificate of Lawfulness for erection of a steel clad portal framed building	Sims Metal Royal Edward Dock Bristol	21/05/2008				945
15340-0	08/01184/F	COU	0.92	COU of part of warehouse (Class B8), to include general industrial use (Use Class B2), with external plant and machienery and covered aggregate bays	Rono House, Avonmouth Way, Avonmouth, Bristol	06/06/2008		2,000		
15523-0	08/04096/F	FULL	0.64	Redvelopment of plot covering southern section of third way corner - construction of new commercial unit containing B1,B2 and B8 uses and associated works	Part of Third Way Corner, St Andres Road, Avonmouth	20/11/2008		1,279		
15470-0	08/03724/FB	FULL	12.8	Erection of 2 wind turbines associated works and temporary storage compound and access to A403. Improvements to A403	Former Shell Tanker Site, Severn Road, Avonmouth	04/02/2009				
15316-0	08/04633/F	FULL	3.72	Subdivision of existing industrial unit and construction of 3no. Industrial buildings (flexible B1c, B2 and B8 Use Classes)	Land at Chittening Industrial Estate, Bristol BS11 0YB	23/02/2009		14,524		
15602-0	08/04925/F	FULL	9.6	Erection of 4no. Wind turbines with a maximum height base to tip of 126.25m and maximum rotor diameter of 92.5m together with ancillary development	Bristol Sewage Treatment Works, Kings Weston Lane	15/05/2009				
14074-4	09/00608/F	FULL	6.5	COU from industrial building to development and operation of resource park to enable the recycling and sorting of waste materials and generation of renewable/low carbon energy	Plot M2 Kings Weston Lane, Avonmouth	28/05/2009				26,472
15627-0	09/01439/F	FULL	0.15	COU of Unit 5 (light industrial) and Unit 6 (warehouse) to B2 use (general industrial)	Unit 5 and 6 Point 4 Industrial Estate, Second Way, Bristol BS11 8DF	24/07/2009		1,320		
15091-0	08/01749/F	COU	1.6	COU from vacant industrial land to recycling facility including reprofiling site leevls and erection of site portacabins (partly in retrospect), cycle shed and office	Land at Chittening Road, Bristol BS11 0YU	22/10/2009				50
15802-0	09/00979/F	FULL	2.75	Construction of an access road together with associated landscaping and engineering works	Land to North of Junction, Avonmouth Way & Fifth Way, Avonmouth, Bristol	23/10/2009				
15573-0	09/03003/F	FULL	5.5	Development of a Mechanical Biological Treatment Facility and associated plant and infrastructure works	New Earth Solutions, Former Britannia Zinc Site, Kings Weston Lane, BS11 8HT	16/11/2009				28,186
15707-0	09/03812/CP	COL	0.68	Cert of Proposed Lawfulness relating to installation of a purpose built unit to be used for the sorting and crushing of glass	Avonmouth Docks, St Andrews Road, Avonmouth, BS11 9DQ	23/11/2009		418		
15585-0	09/03511/P	OUT	24.5	Hybrid application comprising outline planning for development of 19.73ha for B2 & B8 uses. Detailed planning for proposed 11,420sqm B2/B8 use in a single building. Part of site covered by full pp 09/04076/F for chilled distrubution unit	Former Rhodia Works, St Andrews Road, Avonmouth BS11 9YF	21/12/2009		36,264		
15585-1	09/04076/F	FULL	17.4	Redevelopment of site to provide a chilled distribution unit Use Class B8	Former Rhodia Works, St Andrews Road, Avonmouth BS11 9YF	21/12/2009			43,736	
15763-0	09/04802/CP	COL	3.22	COL for construction of facility for processing liquified petroleum gas, plus ancillary parking	Former BP Gas Storage Site, Avonmouth Docks St Andrews Road, Avonmouth Bristol BS11 9DQ	14/01/2010				
15596-0	09/05196/CP	COL	_	COL to install, operate, and maintain a facility for the chipping of logs and waste wood imported into Avonmouth and for onward distribution to biomass power stations	Avonmouth Docks, St Andrews Road, Avonmouth, BS11 9DQ	20/01/2010				
BRISTOL3	10/02696/F	COU	0.31	COU from transport/fuel depot (Sui Generis) to storage (B8)	Pace Fuelcare Ltd, Avonmouth Way West BS11 9EX	10/08/2010			3,100	
BRISTOL8	10/02837/F	FULL	5.5	Development of a Low Carbon Energy Facility in connection with the adjoining Mechancial Biological Treatment Facility (pp ref: 09/03003/F)	New Earth Solutions Former Britannina Zinc Site, BS11 8HT Kings Weston Lane,	13/10/2010				
Undetermined Applications										
BRISTOL7	09/03235/F	FULL		Redevelopment of part of existing industrial site for a Bio-fuel, renewable energy plant together with ancillary access roads, parking facilities and landscaping (W4B)	Sevalco (South), Severn Road, Avonmouth	Refused 24/02/10 - APPEAL DECISION PENDING				
BRISTOL9	10/02547/F	FULL	6.6	Erection of 3 wind turbines assoicated bases and cables and control buildings	Land at Avonmouth Docks St Andrews Road, Avonmouth BS11 9DQ	PENDING DECISION				
BRISTOL10	09/04470/F	FULL	8.3	The construction and operation of a Resource Recovery Centre, including a Material Recycling Facility (MRF), an Energy-from-Waste and Bottom Ash facility, associated Office Visitor Centre, with new access road and weighbridge facilities, associated landscaping and surface water attenuation features.	Sevalco (North), Severn Road, Avonmouth	Refused 02/06/2010 - APPEAL DECISION PENDING (Inquiry)				
BRISTOL11	10/05469	FULL	13.3	Erection of new building, 40,041sqm (within Class B8) for use as storage and distribution depot, new access off Poplar Way Wes, lorry, car and cycle parking and landscaping.	Land North of Poplar Way, Avonmouth, Bristol	PENDING DECISION (22/03/2011)			40,041	

A066776 AVONMOUTH/ SEVERNSIDE STUDY
MAP 1 - COMPLETED DEVELOPMENT (AT 2010)

Map/ LPA/ Site Ref	App Ref	Completed
14130-1	00/02583/X	2000/1
15463-0	0800002/F	2008/9
15209-0	07/01884/F	2007/8
14109-1	00/00418/M	2000/1
15037-0	04/03783/F	2007/8
15557-0	unknown	unknown
15266-0	08/00077/DM	2008/9
14959	03/01060/F	2003/4
14966-0	05/00445/F	2005/6
14964	02/04377/F	2004/5
15105-0	06/01596/F	2006/7
14022-1	02/03417/P	2004/5
14920-0	98/03007/F	1999/0
14128-1	01/01515/M	2002/3
14946	03/01300/F	2003/4
14919	98/02093/F	1999/00
14080-6	97/02149/F	1997/98
15242	07/05058/F	2008/9
14923-6	07/03022/M	2008/9
14147-0	07/00593/F	2007/8
14923-7	07/05174/F	2008/9
14923-3	06/02260/F	2007/8
14923-5	07/00305/F	2007/8
14068-0	94/00293/F	1996/7
14074-1	06/00077/F	2006/7
14068-2	99/02182/F	1999/0
14074-3	07/01408/M	2008/9
14968-0	05/04771/F	2005/6
14918-15i	06/01275/M	2006/7
14918-15ii	06/01275/M	2008/9
14918-17	06/05296/F	2007/8
15272-0	08/1578/F	2008/9
14074-2	06/03801/F	2007/8
14131-0	01/00230/F	2001/2
14918-10	03/02267/M	2003/4
14918-05	99/01828/F	1999/0
14075-5	97/01232/M	1997/8
14075-7	97/02033/M	1999/0
14918-19	unknown	unknown
14918-04	99/02194/M	1999/0
14075-4	97/01233/F	1997/8
14918-14	06/03439/M	2007/8
14918-16	06/05295/M	2007/8
15212-0	07/02081/F	2007/8
15224-0	07/03360/F	2007/8
14136-0	01/00315/F	2001/2
14918-6	01/03445/M	2001/2
14918-9	05/00278/M	2005/6
14918-13	03/03465/M	2004/5
14918-11	02/04670/M	2003/4
14918-12	02/03008/M	2003/4
14965-0	05/03062/F	2006/7
14177/0	02/03982/F	2002/3
15547-0	08/00078/DM	2008/9
14111-0	99/01388/F	1999/0
14939	03/00810/F	2003/4

P4(4001/8

DATED 7th June 1995

IMPERIAL CHEMICAL INDUSTRIES Plc

- and -

NORTHAVON DISTRICT COUNCIL

- and -

AVON COUNTY COUNCIL

SEVERNSIDE

DEED OF AGREEMENT UNDER SECTION 106 OF THE TOWN AND COUNTRY PLANNING ACT 1990 RELATING TO DISTRIBUTION PARK PROPOSALS

Berwin Leighton
Planning & Environment Department
Adelaide House
London Bridge
London EC4R 9HA

I N D E X

FIRST SCHEDULE - Agreed principles for the Overall Masterplan

1 Principal Structural Landscaping Framework

2 Rhine Drainage System

3 Highway Infrastructure

4 Ecological Corridors

SECOND SCHEDULE - Matters to be addressed by and agreed principles for the Ecological and Estate Management Plan ("the EEM Plan")

THIRD SCHEDULE - Part I : Roads to be used by construction traffic

Part II: Roads to be avoided by construction traffic

PLANS

THIS DEED of AGREEMENT is made the 7th day of June 1995

BETWEEN

(1) IMPERIAL CHEMICAL INDUSTRIES PLC whose registered office is at Millbank London SW1 and

(2) NORTHAVON DISTRICT COUNCIL of The Council Offices, Castle Street, Thornbury, Bristol, BS12 1HS

(3) AVON COUNTY COUNCIL of Avon House The Haymarket Bristol BS99 7DE

RECITALS

A **Definitions**

A.1 Words and phrases used in this Agreement are defined in clause 2.1

B **Interests in the Site**

The Owner is the owner in fee simple of the Site

C **Statutory Authority**

C.1 The Council is the local planning authority for the purposes of Section 1 Town and Country Planning Act 1990 for the area in which the Site is situated

C.2 The County Council is the highway authority for the purposes of the Highways Act 1980 for highways other than trunk and special roads in the area in which the Site is situated

D **Planning**

D.1 On 24 May 1994 the Owner submitted the Access Application and the Development Application to the Council for determination

D.2 The Council resolved to grant the Access Permission on 26 April 1995 and the Development Permission On 7 December 1994 on the understanding (inter alia) that the Owner first voluntarily enters into an appropriate legal agreement to provide for:

"(1) Revocation of elements of the claimed 1950s planning permission on the application site, and to the West of the proposed development area.

(2) Submission and approval of a Master Plan for all of the land in the applicant's ownership including details of the following:-

- Landscape framework
- Drainage
- Highways
- Ecology

(3) Contributions to community forest and public access.

(4) Contributions to appropriate highway infrastructure.

(5) Use of waste heat from Seabank Power Station, where feasible.

(6) Provision of a set-aside area for ecological purposes (approximately 38 hectares) to service the whole of the ICI land holding.

(7) An ecological and estate management plan.

(8) Contribution/provision of publicly accessible art.

(9) Restriction on construction hours of working and traffic routes.

(10) Production of manual of practice for site management.

(11) Monitoring and maintenance of mitigation measures"

D.3 This Agreement provides for the matters referred to in Recital D2

E **Planning Obligations**

E.1 Subject to the provisions of Clause 3 (as to conditionality) this Agreement is intended:-

E.1.1 to create Planning Obligations for the purposes of Section 106 of the Town and Country Planning Act 1990 which are to be binding upon the whole or relevant part or parts of the Site

E.1.2 to be enforceable by the Council as local planning authority and

E.1.3 (subject to the provisions of Clause 15.12) to be enforceable by the County Council in its capacity as local highway authority

OPERATIVE PROVISIONS

1 **PLANNING OBLIGATIONS**

Subject to the provisions of Clause 3 (as to conditionality) this Agreement is intended:

1.1 to create Planning Obligations for the purposes of Section 106 of the Town and Country Planning Act 1990 which are to be binding upon the whole or relevant part or parts of the Site and

1.2 to be enforceable by the Council as local planning authority

1.3 (as to the provisions of the Clauses referred to in Clause 15.12) by the County Council as highway authority

2 **INTERPRETATION**

2.1 In this Agreement the following expressions (arranged in alphabetical order) shall unless the context otherwise requires have the following meanings

"the Access Application"
the application for full planning permission for the A403 Access submitted by the Owner on 24 May 1994 and given reference no P94/400/9

"the A403 Access"
an access road from the A403 and associated landscaping on land at Severnside

"the Access Planning Permission"
the planning permission pursuant to the Access Application

"the Account"
the Account referred to in Clause 11.3

"Agreement"
Deed of Agreement

"Approval"
approval by the Council or (following call-in or appeal) by the Secretary of State for the Environment or a duly authorised person on his behalf following submission by (or on behalf and with the consent of) the Owner under the terms of a condition or conditions attached to the Development Permission

"Approved"
submitted by the Owner and approved by the Council or (following call-in or appeal) by the Secretary of State for the Environment or a duly authorised person on his behalf under the terms of a condition or conditions attached to the Development Permission

"the Avonmouth/Severnside Development Strategy Area"
such area as is shown by a dot-dash line on Plan 1 of the Interim Draft Avonmouth/Severnside Strategy August 1994 a copy of which is attached to this Agreement

"Commercial Development"
development for a use falling within Class B8 of the Town and Country Planning (Use Classes) Order 1987 or equivalent use under a later replacement of that order

"Community Forest Areas"
such areas within the Site as may be identified in principle in the Overall Masterplan for the natural regeneration of woodland and/or wetland habitat types

"the Council"
the Northavon District Council and any successor authority to its function as local planning authority for the area in which the Site is situated

"the County Council"
Avon County Council and any successor authority to its function as highway authority for roads (other than trunk or special roads) for the area in which the Site is situated

"the Development"
the development of the Site by the layout and construction of a Distribution Park (Class B8 of the Town and Country Planning (Use Classes) Order 1987) on land at Severnside

"the Development Application"
the application for outline planning permission for the Development submitted by the Owner on 24 May 1994 and given reference no P94/400/8

"the Development Permission"
planning permission pursuant to the Development Application

"the Development Masterplan"
such masterplan as may from time to time be Approved

"the Dispute Resolution Procedure"
the procedure for resolving disputes under the terms of this Agreement as set out in Clause 15.9

"the East/West Link"
a road (including where appropriate verges footway(s) and cycleway(s)) (of such width and such standard as shall be Approved) to connect the Spine Road to the easternmost boundary of the Site and the western-most boundary of the M49 at the point marked "X" (the approximate location of the Edsleigh Farm Overbridge) on the Site Plan

"the Ecological and Estate Management Plan"
such plan as may from time to time be approved under the terms of Clause 5.2.2

"the Ecological Refuge Area"
such area as shall be identified under the terms of Clause 5.1.1

"the Expert"
such expert as shall for the purposes of the relevant dispute be agreed or (in default of agreement) nominated under the terms of Clause 15.9.1

"Gross External Area"
"Gross External Area" as defined in Paragraph 1 of the "Code of Measuring Practice" Fourth Edition published on behalf of the Royal Institute of Chartered Surveyors and the Incorporated Society of Valuers by Surveyors Holdings Limited

"Identified"
identified upon Approval of Reserved Matters pursuant to the Development Permission

"Interest"
interest at a rate not less than the rate from time to time at which sterling deposits are offered to the National Westminster Bank plc for seven days by Prime Banks in the London Interbanks Market for amounts equivalent to the balance outstanding to the credit of the relevant account

"Kings Weston Lane"
the road so named as indicated on the Merebank Plan

"the Kings Weston Lane Junction"
the junction indicated by a yellow circle on the Merebank Plan

"the Kings Weston Link Road"
the proposed road indicated by a blue line on the Merebank Plan

"LRT"
light rail transit system

"the LRT Reserve"
such land as shall pursuant to Clause 7 be reserved for an LRT

"the M49"
the M49 motorway when constructed (the approximate location of which is indicated on the Plan)

"the M49 Junction"
a junction in a form and location to be agreed between the M49 Link and the M49 which may be a split or a northern all movements junction as generally indicated on the Plan

"the M49 Link"
the proposed link(s) between the Spine Road and the M49 in approximately the position(s) marked by a solid red line on the Plan

"the Merebank Permission"
the planning permission dated 21 September 1994 and bearing Bristol City Council Reference No 2014P/93N authorising the reclamation and development for industrial use to include B8 and open storage B2 rail freight depot and truck stop car auction and ancillary uses on the land edged red on the Merebank Plan

"the Merebank Plan"
the attached plan marked "Merebank Plan"

"Occupation"
beneficial occupation for the purpose for which the relevant building constructed was designed excluding occupation for the purpose of construction fitting out security maintenance marketing or repair

"Occupied"
occupied for the use for which the relevant building constructed was designed excluding occupation for the purpose of construction fitting out security maintenance marketing or repair

"the Overall Masterplan"
such masterplan as may from time to time be approved under the terms of Clause 4.4

"the Overall Masterplan Area"
the area referred to in Clause 4.1

"the Owner"
Imperial Chemical Industries Plc aforesaid

"the Owner's Land to the South"
that land belonging to the Owner which is edged blue (for illustrative purposes only) on the Site Plan

"the 1957 Planning Permission"
the planning permission dated 27th November 1957 relating to (inter alia) the Site authorising

(i) the development of an area of 1,000 acres

(a) for the construction and operation of factories for the production of chemical and allied products (including non-ferrous metals) and

(b) for the development mentioned in sub-paragraphs (ii) and (iii) hereof

(ii) the development within an area of 545 acres consisting of

(a) the construction and operation of offices warehouses stores reservoirs pumphouses canteens clubs hostels training establishments amenity and welfare buildings sports pavilion and sports playing fields and

(b) the development mentioned in sub-paragraph (iii) hereof

(iii) the development within an area of 1,100 acres consisting of the construction and operation of any buildings structures erections or engineering works expedient for an ancillary to the construction and operation of the factories mentioned in paragraph (i) above other than building structures or erections in which actual processes of manufacturer are carried on

(iv) the change of use of Hock Farm and Severn Farm to office and/or residential hostel and club purposes

(v) permission to construct accesses to existing public highways

"the Plan"
the plan attached to this Agreement and marked "the Plan"

"Public Art"
shall include but not be limited to the provision of hard and soft landscaping planting water features stained glass iron railings and gates ceramic tiling murals paving design street furniture signage banners and flags and interior works including textiles paintings photographs furniture and pots

"Relevant Parts"
part of the Overall Masterplan referred to in Clauses 4.2.1 4.2.2 4.2.3 or 4.2.4

"Reserved Matters"
details of siting reserved under the terms of the Development Permission for subsequent Approval

"Seabank Power Station"
the gas fired power station proposed for the area indicated on the Plan as "Seabank Power Station"

"the Second Carriageway Reserve"
such land as shall pursuant to Clause 6.5 be reserved for the second carriageway of the Spine Road

"the Site"
the area shown (for the purposes of illustration only) edged red on the Site Plan

"the Site Plan"
the plan attached to this Agreement marked "Site Plan"

"the Spine Road"
such road (including where appropriate verges footway(s) and cycleway(s)) as may be Identified for the purpose (inter alia) of performing the function of the principal distributor road for the Development and development on the Owners' Land to the South and potentially of a County primary route (including access to the M49 Link) and distributor road leading to land beyond the Owner's Land to the South

"Successor(s) in Title"
successor(s) in title and person(s) deriving title through or under the Owner to any part or parts of the Site

2.2 References to any Recital Clause Schedule Paragraph (or any part of any of them) shall (unless the context otherwise requires) be references to a recital clause schedule or paragraph (or any part of any of them) of this Agreement

2.3 References to the masculine gender shall include the feminine gender and vice versa

2.4 Unless the context otherwise requires references to the singular shall include the plural and vice versa

2.5 Headings are for ease of reference only and are not intended to be construed as part of this Agreement

2.6 A reference to the Owner shall (as appropriate) include or constitute reference to Successors in Title

3 **CONDITIONALITY**

3.1 All obligations of the Owner under the terms of this Agreement are conditional upon

3.1.1 the grant by the Council of both the Development Permission and the Access Permission and

3.1.2 commencement of the Development pursuant to the Development Permission as construed in accordance with Clause 15.1

3.2 Any obligation of the Owner expressed to be subject to or conditional upon a particular event shall not take effect unless and until the relevant event has occurred

4 **OVERALL MASTERPLAN**

4.1 **Area**

The Overall Masterplan shall relate to the Site and to other areas owned by the Owner within the area shown edged by a broken red line (for illustrative purposes only) on the Plan

4.2 **Scope**

The Overall Masterplan shall address (in outline and not in detail) the following principles for the Overall Masterplan Area

4.2.1 (with the objective of establishing a structure for the emerging landscape) the principal structural landscaping framework

4.2.2 (with the objective of maintaining the integrity of the rhine drainage system as well as ensuring an efficient economical drainage system in connection with the Development and development of other areas within the Overall Masterplan Area) the principal elements of surface water drainage infrastructure to be provided and/or maintained as the area is developed

4.2.3 the principal elements of highways infrastructure including footpaths and bridleways the approximate location of principal access roads and the Spine Road and (in relation to the Spine Road) principles concerning design and number and locations of junctions having regard to the proposed function of the Spine Road as a road serving the function of a County primary route

4.2.4 (with the objective of establishing a network of wildlife corridors and sites of semi-natural habitat to link to the Ecological Refuge Area) the approximate location of corridors to be maintained by virtue of their ecological value

4.3 Matters deemed to be approved for the purposes of the Overall Masterplan

For the purposes of the Overall Masterplan the following principles shall be deemed to have been approved under the terms of Clause 4.4

4.3.1 the principles set out in the First Schedule

4.3.2 matters Approved as part of the Development Masterplan and any Approved variations of/or substitutions for the Development Masterplan

4.3.3 (at the Owner's election) any matter relating to the Overall Masterplan decided by the Expert under the Dispute Resolution Procedure

4.4 Mechanics for approval

4.4.1 Proposals for the Overall Masterplan shall be submitted to the Council by the Owner for aɪ roval no later than proposals for the Development Masterplan are submitted to the Council for Approval under the terms of the Development Planning Permission

4.4.2 Before giving any approval under Clause 4.4.1 the Council shall consult the County Council (in its capacity as highway authority for the area) as to those elements of the Overall Masterplan referred to in Clause 4.2.3 and shall prior to making a decision take into account such reasonable representations as the County Council may make

4.4.3 If the proposals for the Overall Masterplan or a Relevant Part of it have not been approved by the Council within eight weeks of submission (including such level of detail as the Council may reasonably require) the Owner may invoke the Dispute Resolution Procedure in relation to the Overall Masterplan Relevant Part or level of detail required by the Council

4.5 Variation of Overall Masterplan

4.5.1 the Owner may from time to time request that the Overall Masterplan be substituted or varied in whole or in part and the provisions of this Clause 4 shall apply (mutatis mutandis) to any such proposals for variation or substitution and to any revisions to the Overall Masterplan or any substitute for it as may be approved as part of that process

4.5.2 the Overall Masterplan including any variation of (or substitution for) it shall be deemed from time to time to be varied so far as may be necessary to give effect to any Approval granted under the terms of the Development Permission and any other planning permission granted pursuant to an application submitted by the Owner and relating to the Site.

5 ECOLOGY

5.1 Ecological Refuge Area

5.1.1 An area of approximately 38 Hectares (from within the area of search shown edged green on the Site Plan and which shall include the two core areas shown hatched green on the Site Plan) shall be identified under the terms of the Overall Masterplan and the Ecological and Estate Management Plan as a nature sanctuary with the objective of providing a fixed area of land capable of sustaining the general biodiversity of the Overall Masterplan Area free from disturbance

5.1.2 The Ecological Refuge Area shall in so far as practicable be protected from intrusion and disturbance with the aim of satisfying the objectives referred to in Clause 5.1.1 save to the extent specified in such Ecological and Estate Management Plan as may from time to time be approved under the terms of this Agreement

5.1.3 The Ecological Refuge Area may at the Owner's discretion be transferred (subject to the provisions of Clause 5.1.2) to an appropriate nature conservation body in full and final discharge of all and any obligations that the Owner may have in relation to such area under the terms of this Agreement.

5.2 Ecological and Estate Management Plan

5.2.1 Principles already approved

Principles that have been approved by the Council for the purposes of the Ecological and Estate Management Plan are set out in the Second Schedule

5.2.2 **Mechanics for approval**

5.2.2.1 No later than the submission of proposals for the Development Masterplan under the terms of the Development P anning Permission for Approval the Owner shall submit to the Council proposals for the Ecological and Estate Management Plan which are consistent with the proposals set out in the Second Schedule

5.2.2.2 The provisions of Clauses 4.3 to 4.5 (inclusive) in relation to the Overall Masterplan shall (mutatis mutandis) apply to approvals variation and substitution of the Ecological and Estate Management Plan

5.2.3 **Areas to be subject to the Ecological and Estate Management Plan**

The areas which are to be subject to the requirements of the Ecological and Estate Management Plan shall be Identified and shall be limited to

5.2.3.1 the principal structural landscape features and ecological corridors as shown indicatively on the Plan

5.2.3.2 existing agricultural areas within the Overall Masterplan Area

5.2.3.3 new habitats and advanced landscape planting proposed as part of the Development

5.2.4 **Duties following approval of the Ecological and Estate Management Plan**

Following approval of the Ecological and Estate Management Plan the Owner shall manage the areas to which it relates and monitor its efficacy generally in accordance with the terms of the Ecological and Estate Management Plan

5.3 **Community Forest**

The Owner shall lay out and plant the Community Forest Areas in accordance with such timescale and such principles as may from time to time be Approved as part of the landscape framework for the Development

6 **SPINE ROAD AND EAST/WEST LINK**

6.1 **Location**

6.1.1 The location of the Spine Road and the East/West Link shall be Identified and shall generally accord with the location for the Spine Road established under the terms of the Overall Masterplan

6.1.2 For the avoidance of doubt as part of the Approval process for the purposes of Clause 6.1.1 the Council shall consult the County Council in its capacity as highway authority and shall prior to making a decision take into account such reasonable representations as the County Council may make

6.2 **Highways Agreement**

6.2.1 The Spine Road and the East/West Link shall be constructed under the terms of appropriate agreements with the highway authority for the area in which the Site is situated

6.2.2 The terms of the agreements shall be such reasonable terms as the Owner and the County Council as highway authority agree

6.2.3 If the Owner and the County Council are unable to agree terms for any agreement either may refer all or any terms of the proposed agreement to the Expert under the terms of the Dispute Resolution Procedure and the County Council and the Owner shall be bound by the Expert's decision

6.3 Adoption

6.3.1 The Spine Road shall be built to such specification as is necessary for the function which the road is to serve and shall be offered for adoption by the Owner not later than the date at which each end of the Spine Road (whether dual or single carriageway) connects directly to a public highway open to all vehicles and directly serves areas outside the Site

6.3.2 The East/West Link shall be offered for adoption by the Owner upon its substantial completion and being opened to through traffic from both the Spine Road and areas to the East of the M49

6.3.3 Subject to the terms of the relevant adoption agreement having been observed and performed the County Council shall upon the Owner offering the whole or any section of the Spine Road or the East/West Link for adoption do such acts or things as are necessary for the whole or relevant section to be adopted as a public highway maintainable at public expense

6.4 Phasing of Construction of First Carriageway of the Spine Road

The first carriageway of the Spine Road shall be constructed in phases corresponding to the progress of the Development southward from the A403 to the intent that:-

6.4.1 the Owner shall not be required to construct any carriageway of the Spine Road beyond the northernmost boundary of the area or phase of the Development which it is to serve unless the access to such phase or area is to the south of the northernmost boundary of that phase or area in which case the first carriageway of the Spine Road shall be constructed up to such accessway

6.4.2 no building forming part of any phase or area of the Development shall be Occupied before that part of the first carriageway of the Spine Road which serves the road off which the access to that building is taken has been constructed

6.5 **Second Carriageway of the Spine Road**

6.5.1 The Owner shall reserve for the purposes of future construction of a second carriageway of the Spine Road until 1st January 2016 (or it earlier becoming apparent that the second carriageway of the Spine Road will not be required) a strip of land (the width of which shall not exceed the minimum reasonably necessary to provide the second carriageway of the Spine Road) in a location to be Identified alongside the first carriageway of the Spine Road southward of its junction with the East/West Link

6.5.2 During such time as land is reserved pursuant to Clause 6.5.1 it shall not be used in such a way as would preclude later performance of the obligations contained in Clause 6.5.3

6.5.3 The Owner shall construct (within 24 months of the satisfaction (if the same shall occur prior to 1 january 2016) whichever is the later of the conditions in Clauses 6.5.3.1 and 6.5.3.2 to be satisfied) the second carriageway of the Spine Road within the Second Carriageway Reserve subject to:-

6.5.3.1 traffic volumes having grown on the Spine Road (as a result of (a) buildings constituting Commercial Development within the Overall Masterplan Area having been Occupied and (b) the M49 Junction having been completed and opened for use) to such an extent as to require the provision of such carriageway on highway capacity or highway safety grounds and

6.5.3.2 the Owner having procured any necessary Approvals and other necessary statutory consents on terms which are not unreasonable

(it being agreed between the parties that for the purposes of Clauses 6.5.3.1 and 6.5.3.2 in the event of their disagreeing whether the second carriageway is required on highway safety or highway capacity grounds or any terms are unreasonable the subject of their disagreement may be referred to the Expert under the Dispute Resolution Procedure by any of them and each shall be bound by the Expert's decision)

6.5.4 The detailed location of the whole or any part of the Second Carriageway Reserve may from time to time until the second carriageway of the Spine Road has been built be varied at the Owner's election subject to

6.5.4.1 such variations being consistent with such Development Masterplan and any relevant Approvals of reserved matters under the terms of the Development Planning Permission or any subsequent planning permission as may in any case at the relevant time have been Approved and

6.5.4.2 the location which is to be varied not being alongside to a section of the first carriageway of the Spine Road which has already been constructed

6.5.5 The Owner may (subject to the location and the specification first having been approved by the highway authority) from time to time lay services and service conduits and infrastructure under the Second Carriageway Reserve

6.5.6 The Owner shall not be required to create a greater interest in the Second Carriageway Reserve than is essential for the construction operation or use of the Spine Road and shall retain all other rights in over and under the land the subject of the land upon which the Spine Road has been constructed

6.6 **East/West Link**

6.6.1 The Owner shall construct the East/West Link prior to the date of Occupation of the last phase of the Development to be Occupied or earlier Occupation of 2 million square feet (185,800 square metres) Gross External Area of Commercial Development forming part of the Development

6.6.2 No part of the last phase of the Development to be Occupied or Commercial Development the Gross External Area of which (when added to the Gross External Area of Commercial Development already Occupied as part of the Development) exceeds 2 million square feet (185,800 square metres) shall be Occupied until the East/West Link has been opened to traffic

6.7 **Construction by the County Council**

6.7.1 At any time (prior to 1 January 2016) after the M49 Junction or the East/West Link has been completed and opened to the public and in the case of the East/West Link been opened to through traffic from both sides of the M49 the County Council may serve notice in writing upon the Owner stating that it wishes to construct or to fund the construction to the Southern boundary of the Site of such parts of the first carriageway of the Spine Road and/or the second carriageway of the Spine Road as have not as at that date been constructed by the Owner

6.7.2 If notice is served on the Owner pursuant to Clause 6.7.1 (prior to 1 January 2016) the Owner shall (subject to the County Council first undertaking to maintain such parts of the Spine Road at public expense) upon substantial completion of those parts of the Spine Road completed following such notice dedicate the land within the Site upon which such parts of the Spine Road have been constructed as public highway

6.7.3 Within 56 days of receipt of notice from the County Council pursuant to Clause 6.7.1 the Owner may elect either

6.7.3.1 to undertake the detailed design and to construct the relevant parts of the Spine Road and to charge the cost of so doing to the County Council commensurately with the rate at which the Owner is obliged to pay its own design consultants and contractors or

6.7.3.2 to permit the County Council to design and construct the relevant parts of the Spine Road at no cost to the Owner

6.7.4 If the Owner fails to make any election under Clause 6.7.3 it shall be deemed to have elected pursuant to Clause 6.7.3.2

6.7.5 If the Owner elects pursuant to Clause 6.7.3.1 the County Council shall be obliged to give a deed of indemnity to the Owner (in such form as the Owner may reasonably require) to cover all costs incurred by the Owner in designing or constructing the relevant parts of the Spine Road but such parts shall be designed and constructed to the County Council's reasonable approval in the manner contemplated by Clause 6.2

6.7.6 If the Owner elects pursuant to Clause 6.7.3.2

6.7.6.1 the relevant parts of the Spine Road shall not be constructed otherwise than in the location Approved or to a layout other than that Approved

6.7.6.2 the Owner shall grant to the County Council a licence to enter on to such parts of the Site as may be reasonably necessary to facilitate the construction of the relevant part of the Spine Road and which are approved by the Owner

6.7.6.3 the licence referred to in Clause 6.7.5.2 shall contain such terms as the Owner may reasonably specify for the purpose of protecting the amenity and marketability of those parts of the Development in the vicinity of the areas of the Site upon which works will be undertaken

6.7.6.4 the County Council shall construct as part of the construction of the relevant part of the Spine Road such conduits and service media (including manholes culverts and draw-pits) in such locations and to such specification as the Owner may reasonably require

6.7.6.5 the County Council shall consult the Owner with reference to the detailed design of the relevant part of the Spine Road

6.7.6.6 the County Council shall not construct the relevant part of the Spine Road other than in accordance with a programme first approved by the Owner (approval not to be unreasonably withheld or delayed)

6.7.6.7 the County Council shall indemnify the Owner against all liability losses costs claims demands directly or indirectly sustained by the Owner arising as a result of the construction of the relevant part of the Spine Road save insofar as and to the extent that the same may result from the default or negligence of the Owner

7 LIGHT RAIL TRANSIT RESERVE

7.1 The LRT Reserve shall comprise land not exceeding 9.5 metres in width alongside either the Second Carriageway Reserve or the first carriageway of the Spine Road in a position to be Identified

7.2 The Owner shall until 1st January 2016 (or such earlier date upon which any proposals for the construction of an LRT in such area are abandoned) reserve the LRT Reserve for the purpose of a future

LRT serving the Development Site and linking to such other centres of population as may be approved by the Owner (approval not to be unreasonably withheld or delayed)

7.3 The provisions of Clause 6.5.2, 6.5.4 to 6.5.6 (inclusive) and 6.7 shall mutatis mutandis apply to the LRT Reserve save that:-

7.3.1 references to the Spine Road and the Second Carriageway Reserve shall be replaced by references to the LRT and the LRT Reserve and

7.3.2 in clause 6.7:-

7.3.2.1 all references to the first carriageway of the Spine Road shall be deleted

7.3.2.2 the Owner shall not be obliged to permit commencement of construction of the LRT unless the County Council warrants that sufficient funding has been procured for its completion and operation

7.3.2.3 references to the County Council (save in respect of Clause 7.3.2.2, 7.3.2.4 and 7.3.2.5) shall be replaced by references to the County Council or such body (of sound financial status) as it shall elect for the purposes of constructing the LRT on its behalf

7.3.2.4 the Owner shall not in Clause 6.7.2 be obliged to dedicate land as public highway but merely to create in favour of the County Council at a consideration of One Pound (£1) such interest in the Site as is necessary to comply with Clause 6.5.6 and

7.3.2.5 there shall be deemed to be included a new Clause 6.7.6 under which if the LRT ever falls into disuse the County Council shall be obliged at no cost to the Owner (a) to the Owner's reasonable satisfaction to remove all structures apparatus track and machinery constructed as part of the LRT and to reinstate the LRT Reserve to no worse state and condition than applied prior to

commencement of construction of the LRT and (b) (unless the County Council is unable having used its best endeavours to create legal relations with the LRT operator to enable it so to do) to revest in the Owner any land interest created in respect of the LRT and/or the LRT Reserve pursuant to Clause 6.7.2

8 **CONTRIBUTION TOWARDS KINGS WESTON LANE IMPROVEMENTS**

8.1 The obligation under Clause 8.2 shall apply subject to

8.1.1 all Commercial Development authorised under the terms of the Merebank Permission having been Occupied prior to 1st January 2001 and

8.1.2 Neither the M49 Junction nor the Kings Weston Link Road having been constructed at the date that the last of such Commercial Development is Occupied and

8.1.3 all Commercial Development forming part of the Development having been Occupied

8.2 the Owner shall pay to the County Council the sum of £20,000 toward any sums incurred after the date of this Agreement by the County Council toward the construction of road improvements designed

8.2.1 to bring about a material increase in the capacity of the Kings Weston Lane Junction or

8.2.2 a material increase in the capacity or safety of any other roads which will benefit the Development the details of which are first agreed between the Owner and the County Council

8.3 the County Council shall not apply any monies received pursuant to Clause 8.2 otherwise than toward the road improvements referred to in Clause 8.2.1 and 8.2.2.

8.4 all monies paid to the County Council shall be held in an Interest bearing account with a bank first approved by the Owner

8.5 all interest earned or monies held in the said account shall be accumulated with capital held on the account

8.6 the County Council shall not withdraw monies from the account other than for the purpose referred to in Clause 8.3

8.7 on the fifth anniversary of payment to the County Council all monies held by the County Council and not expended for a purpose specified in Clause 8.2 shall be returned to the Owner together with all accrued interest

9 **TRANSPORTATION STUDY**

9.1 The Owner shall within twenty-eight days of the date that development is commenced (within the meaning of Clause 15.1) pursuant to the Development Permission contribute to the County Council Eight Thousand Five Hundred Pounds (£8,500) or such lesser sum as shall represent 25% of the cost of a study to examine proposals for public transport links between the Development Avonmouth and Bristol City Centre

9.2 The sum referred to in Clause 9.1 shall not be payable until the transportation study has been commissioned by the County Council and the County Council has agreed that:

9.2.1 in return for a reasonable contribution in excess of the 25% referred to in Clause 9.1 (sufficient to meet the full cost of any additional work) the County Council shall require the consultant producing the study to address such additional proposals and/or issues as the Owner may reasonably specify and

9.2.2 a full copy of the consultant's report shall be provided to the Owner within seven days of receipt by the County Council

10 **OVERALL IMPROVEMENTS TO HIGHWAYS INFRASTRUCTURE**

10.1 The Owner the Council and the County Council will (along with other landowners in the area who would benefit) in good faith participate in discussions with the objectives of reaching agreement concerning:

10.1.1 the provision of additional highway infrastructure (including access to and egress from the M49) to serve the Avonmouth/ Severnside Development Strategy Area

10.1.2 the design location timescale of such infrastructure and what is to trigger its provision and

10.1.3 an equitable means by which the cost (including land costs) of construction of such infrastructure can be divided between those who will benefit from it.

10.2 The Owner the Council and the County Council will each act in good faith, both in terms of the initial discussions and in the negotiation of any associated documentation, without prejudice to the Owner's duty to shareholders and the Council's responsibilities as planning authority and the County Council's responsibilities as highway authority.

10.3 The Owner the Council and the County Council each agree that

10.3.1 it will be an objective of the discussions referred to in Clause 10.1 that when the funding formula is agreed between the parties and other landowners in the area it shall apply to all land within the Avonmouth/Severnside Development Strategy Area

10.3.2 when the funding formula is agreed it shall apply (inter alia) to the Site

10.3.3 the formula when agreed shall have regard to traffic generated by land uses within the Avonmouth/Severnside Development Strategy Area

10.3.4 the formula when agreed shall credit against any contribution which the Site may be agreed to bear the cost (including land costs) to the Owner of the Spine Road and the East/West Link provided as part of or contemporaneously with the Development

10.3.5 they shall each endeavour in good faith to draw into the discussions referred to in Clause 10.1 each significant landowner within the Avonmouth/Severnside Development Strategy Area

10.4 The Owner the Council and the County Council will each enter into such documentation with other landowners as may be necessary or appropriate to give effect to such arrangements as may be agreed as a result of the discussions referred to in Clause 10.1

11 PUBLICLY ACCESSIBLE ART

11.1 The Owner shall contribute up to One Hundred Thousand Pounds (£100,000) toward Public Art which unless otherwise agreed shall be located on the Site and shall be provided according to the principles set out in this Clause 11

11.2 Upon each building forming part of the Development being Occupied the Owner shall pay Five Hundred Pounds (£500) per complete 1000 square metres (Gross External Area) of that building into the Account until (without prejudice to the maximum amount referred to in Clause 11.1 only being payable if the Development in its entirety is Occupied) the amount referred to in Clause 11.1 has been paid in total

11.3 The Owner shall within 28 days of commencement of construction of the first building comprising not less than 5,000 square metres (Gross External Area) open an Interest bearing account with

Lloyds Bank Plc or such other bank as the Owner and the Council may agree in the joint names of the Owner and the Council on terms that sums may only be withdrawn from the account by joint request

11.4 All monies contributed by the Owner under Clause 11.2 shall be paid into the Account

11.5 All interest earned on deposits shall accrue to the Account and shall be subject to the same terms as principal sums held on the account

11.6 Monies held in the Account may not (subject to the provisions of Clause 11.10) be applied otherwise than towards Public Art which is agreed by the Owner and the Council acting reasonably or the reasonable expenses of administering competitions for the purposes of selecting particular items of Public Art

11.7 The Owner and the Council and/or their respective representatives shall meet regularly after the Development has commenced to endeavour in good faith to identify projects to which funds held on the account may be applied

11.8 In the event of a dispute between the Owner and the Council as to whether a particular project or proposal constitutes Public Art within the meaning of this Agreement or whether it is an appropriate subject for expenditure pursuant to this Agreement either the Council or the Owner may (without prejudice to the Owner's right to veto the construction location or creation of any element of Public Art on the Site) after 14 days have elapsed invoke the Dispute Resolution Procedure

11.9 The Expert's decision shall be binding on the parties and the Council shall sign any necessary notice of withdrawal within 10 days of request from the Owner

11.10 All monies outstanding to the Account and not paid toward Public Art or administration of competitions as anticipated by Clause 11.6 prior to the fifth anniversary of Occupation of the last building forming part of the Development to be Occupied under the terms of the Development Permission shall be repaid (along with all accrued interest) to the Owner and the Account shall be closed

12 THE 1957 PLANNING PERMISSION

12.1 Land Areas

The Owner will not develop the area shown edged red on the Site Plan under the terms of the 1957 Planning Permission

12.2 Estuarine Area

The Owner will not implement any part or parts of the 1957 Planning Permission which are as yet unimplemented within the Estuary "Buffer Zone" (being one of the areas indicated by green tinting on the Plan) or the area to the West and North West of the A403 insofar as such implementation would cause significant harm to the Severn Estuary SPA and could not be mitigated to an extent to which implementation would not be contrary to the EC Habitats Directive (92/43/EEC)

13 WASTE HEAT FROM SEABANK POWER STATION

13.1 If Seabank Power Station (or any other new power station within 1.2 kilometres of any boundary of the Site) is constructed within 10 years of the date of this Agreement the Owner will examine the practicability of using its waste heat and exhaust gases to provide heat for the Development

13.2 The examination referred to in Clause 13.1 will have regard (inter alia) to

13.2.1 infrastructure and long term maintenance and operational costs

13.2.2 practicability of supply

13.2.3 unit cost for energy and

13.2.4 feasibility of achieving a realistic commercial return on capital employed

13.3 If the examination referred to in Clause 13.1 indicates the supply of waste heat in principle to be practicable and commercially viable the Owner will explore with existing and potential future occupiers of the Development ways in which all or part of their heating requirements can be met by such supply

14 CONSTRUCTION HOURS AND TRAFFIC ROUTING

14.1 During the construction of the Development construction traffic shall be encouraged to use those roads listed in part 1 of the Third Schedule and discouraged from using those roads listed in part 2 of the Third Schedule when driving to and from the Site

14.2 The Owner shall require of contractors employed by the Owner that they adhere in so far as practicable to the arrangements referred to in Clause 14.1

14.3 Unless otherwise agreed between the Council and the Owner the Owner shall prohibit construction works generating noise materially above background levels (Leq) (as measured at the facade of the nearest house (outside the Site) to the relevant construction activity or material levels of traffic on roads in the vicinity of the Site between the hours of 7.00 pm and 7.00 am Mondays to Fridays and between the hours of 8.00 pm and 7.00 am on weekends and public holidays

15 MISCELLANEOUS AND GENERAL PROVISIONS

15.1 Commencement of Development

15.1.1 Irrespective of the provisions of Section 56(4) Town and Country Planning Act 1990 none of the following operations shall constitute a material operation for the purposes of commencement of development pursuant to the Development Permission

15.1.1.1 any works pursuant to the Access Permission;

15.1.1.2 laying of services and service media

15.1.1.3 construction of boundary fencing or hoardings

15.1.1.4 construction of temporary accesses and/or highway works

15.1.1.5 construction of foundations

15.1.1.6 archaeological investigations

15.1.1.7 landscaping works

15.1.1.8 noise attenuation works

15.2 No Fetter of Discretion

15.2.1 Except insofar as legally or equitably permitted this Agreement shall not prejudice fetter or affect the exercise of any statutory power duty or discretion of the Council or the County Council

15.3 **Lapse Revocation or Modification of the Development Permission**

15.3.1 This Agreement shall lapse and all entries relating to it on the Register of Local Land Charges and the Register of Title of the Site or (in the event of the type of development anticipated by Clause 15.3.1.4 occurring) the relevant part of the Site shall be deleted if the Development Permission

15.3.1.1 shall lapse without having been implemented

15.3.1.2 shall be revoked or

15.3.1.3 shall be modified other than at the request or with the consent of the Owner or

15.3.1.4 if the Owner shall before commencing the Development pursuant to the Development Permission on the relevant part of the Site implement any subsequent planning permission for the permanent development of that part of the Site which is inconsistent with the Development Permission

15.4 **Notices**

15.4.1 That any notice or other written communication to be served or given by one party upon or to any other under the terms of this agreement shall be deemed to have been validly served or given if transmitted by facsimile delivered by hand or sent by registered or recorded delivery post to the party upon whom it is to be served or to whom it is to be given as specified in Clause 15.4.2 or as otherwise notified for the purpose by notice in writing

15.4.2 The address for any notice or other written communication is (unless otherwise notified in writing by the relevant party)

15.4.2.1 for the Council as specified above marked for the attention of the Chief Executive Officer or Head of Paid Services

15.4.2.2 for the County Council as specified above marked for the attention of the Chief Executive Officer or Head of Paid Services

15.4.2.3 for the Owner as specified above marked for the attention of the Company Secretary

15.4.3 any notice or other written communication to be given by the Council shall be deemed valid and effectual if it is signed on behalf of the Council by an officer or duly authorised signatory of it

15.5 **Land Ownerships**

15.5.1 Nothing in this Agreement shall require the performance of any obligation whatsoever in upon over or under land outside the ownership of the person to perform the obligation

15.6 **Parting with Interests in the Site and Successors in Title**

15.6.1 (Save in respect of Clause 10) the Owner shall upon parting

15.6.1.1 with the fee simple in any part of the Site be released from all obligations and duties under the terms of this Agreement insofar as they relate to or are binding on that part of the Site

15.6.1.2 with the entirety of its interest in the Site as a whole be released from all liabilities whatsoever under the terms of this Agreement

15.6.2 The releases provided for in Clause 15.6.1 shall not apply to any prior or existing breach as at the date of disposal

15.6.3 Any Successor in Title to any part of the Owner's interest which is no greater than that of the Owner or occupier of an individual building or any part of an individual building within the Development shall not be bound by or incur any liability in

respect of any of the obligations of the Owner under this Agreement except insofar as and to the extent that the relevant obligation is a restriction on Occupation of the building in which such interest exists

15.6.4 No Successor in Title to the Owner shall be liable under the terms of any obligation under this Agreement which is not directly referable to land of which he is a successor

15.7 **Discharge by Performance**

Upon the performance discharge or other fulfilment of the obligations (or any of them) of the Owner under the terms of this Agreement such covenant obligation or obligations shall absolutely cease and determine save in respect of any antecedent breach

15.8 **Consents and Approvals**

Where the approval agreement or consent of the Council the County Council or any officer of either is required for any purpose under or in connection with the terms of this Agreement unless specified to the contrary such approval agreement or consent shall not be unreasonably withheld or delayed (and the party from whom the relevant approval agreement or consent which has been unreasonably withheld shall not be liable for a consequential breach of its obligations)

15.9 **Dispute Resolution**

15.9.1 The expert shall be a person with acknowledged expertise in the subject matter of the dispute and in the event that the parties cannot agree his identity within two weeks of the right to refer the matter to the expert arising either may require that he be nominated by the President for the time being of the Royal Institution of Chartered Surveyors

15.9.2 the parties shall use best endeavours to appoint the Expert (whether agreed between the parties or nominated by the President for the time being of the Royal Institution of Chartered Surveyors) within one calendar month of the date of the right to refer the matter to the Expert having arisen

15.9.3 it shall be a specific term of the appointment of the Expert that he is to reach his decision within one calendar month of the date of his appointment and that he is to set a timetable for each of the steps specified in Clauses 15.9.5 to 15.9.7 (inclusive) to be complied with

15.9.4 the costs of the Expert shall be in the award of the expert and his decision shall be final and binding on the parties save in the case of manifest error

15.9.5 the Expert shall require each party to deliver to him and each other written submissions on their respective opinions as to the matter in dispute

15.9.6 each party shall have the opportunity to deliver to the Expert and to each other written counter submissions

15.9.7 after the delivery of counter submissions or (if none) after submission of written submissions no party shall be entitled to make any further submissions and the Expert shall forthwith deliberate and deliver to each party his decision in accordance in writing within a reasonable time of closing submissions or counter submissions

15.9.8 the Expert shall be restricted in settling the dispute to choosing between one or other of the proposals put to him by the Owner or the Council or elements compatible with one another from the submissions of either party

15.10 **Registration as a local land charge**

This Agreement shall be registered as a local land charge

15.11 **Legal Costs**

The Owner shall within 14 days of completion of this Agreement

15.11.1 pay to the Council the Council's reasonable and proper legal fees incurred in connection with the negotiation and drafting of this Agreement in the sum of

15.11.2 pay to the County Council the County Council's reasonable and proper legal fees incurred in connection with the negotiation and drafting of this Agreement in the sum of One Thousand Five Hundred Pounds [£1,500]

15.12 **Provisions of this Agreement enforceable by the County Council**

The County Council shall have the benefit of and be entitled to enforce Clauses 4.4.2 6.1.2 6.2 6.3 6.4 6.5 6.6 6.7 7 8 9 10 and 15.11.2

15.13 **Notification of dispositions**

The Owner shall from time to time

15.13.1 within 28 days of each relevant disposal notify the Council and the County Council of any disposal by the Owner of any freehold interest or leasehold interest for a term of more than twenty one years in the Site

15.13.2 within 28 days of a written request from the Council County and/or the Council notify the County Council and/or the Council (as appropriate) of such details as the Owner has available to it of the identity of the person or persons occupying any relevant part of the Site

DELIVERED AS A DEED BY ALL PARTIES ON THE DATE OF THIS DOCUMENT

PILNING

SEVERN BEACH

SEMI-IMPROVED GRASSLAND

ESTUARY "BUFFER ZONE"

GREEN-LANE LINKING GYPSIE'S PLATT & ZENECA

POSSIBLE LINK TO EASTER COMPTON BYPASS

ALTERNATIVE NORTHERN ALL MOVEMENTS M49 JUNCTION

ZENECA

MIDDLE COMPTON RHINE

ICI WORKS SEVERNSIDE

VIMPENNY'S LANE

M49

SPLIT M49 JUNCTION (Northern Half) ACC OPTION

EASTER COMPTON

SEABANK POWER STATION

BRITISH GAS

SPLIT M49 JUNCTION (Southern Half) ACC OPTION

KEY:

- OVERALL MASTERPLAN AREA
- LRT (Approximate Route)
- M49
- M49 LINK ROAD
- EAST-WEST LINK (APPROX LOCATION)
- SPINE ROAD (APPROX LOCATION)
- POSSIBLE EXTENSION OF SPINE ROAD
- RHINES FOR STRATEGIC DRAINAGE
- ECOLOGICAL CORRIDORS

ICI

ASSISTANT SECRETARY

DIRECTOR

THE PLAN

0 500 1000

Metres

North

WESTERN APPROACHES BRISTOL

APRIL 1995

10371/ S106/01D

KINGS WESTON
LANE JUNCTION

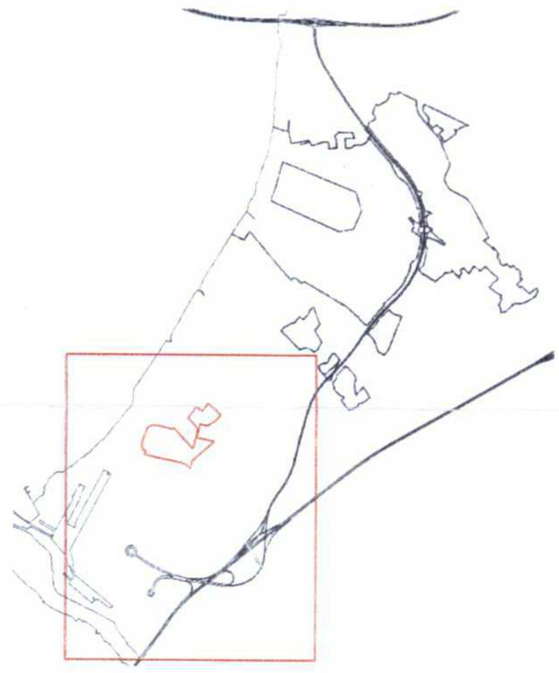
AREA
SUBJECT TO
MEREBANK
PERMISSION

M49

KINGS WESTON LANE

KINGS WESTON
LINK ROAD

MEREBANK
LOCATION



THE MEREBANK PLAN

2500m

North

WESTERN APPROACHES BRISTOL

APRIL 1995
10371/ S106/03B

Severn Beach

A403

EDSLEIGH FARM
OVERBRIDGE

"X"

Avlon Works Zeneca

ICI Severnside Works

Easter Compton

eabank
Power
tation

M49

KEY:

THE SITE

AREA SUBJECT TO ACCESS PERMISSION

OWNER'S LAND TO THE SOUTH

AREA SUBJECT TO 1957 PLANNING PERMISSION

AREA OF SEARCH FOR ECOLOGICAL REFUGE AREA (CORE AREA OF 28 HECTARES SHOWN HATCHED)

CONNECTING POINT OF EAST-WEST LINK "X"

ICI

ASSISTANT SECRETARY

DIRECTOR

THE SITE PLAN

0 500 1000 Metres

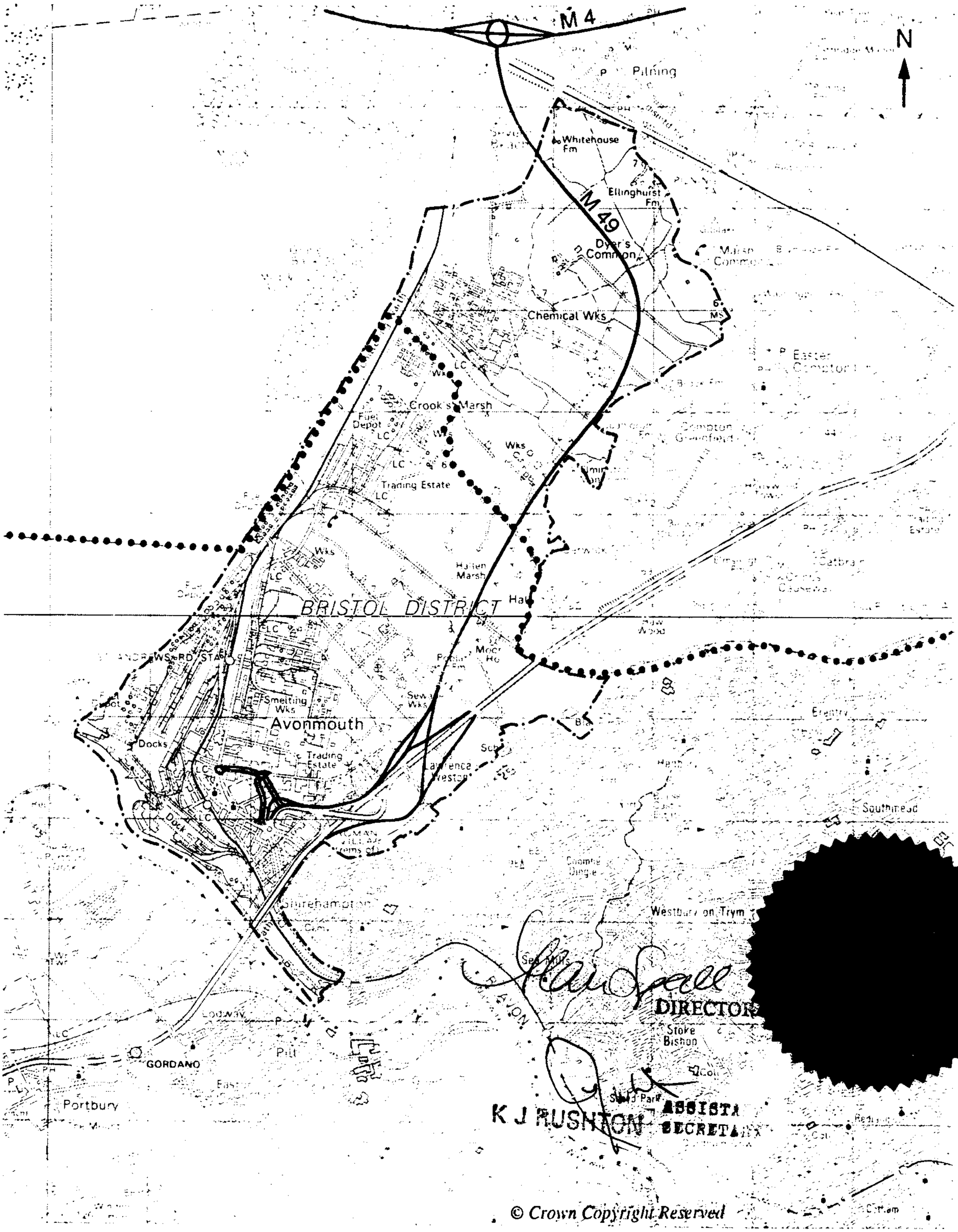
North

WESTERN APPROACHES BRISTOL

APRIL 1995

10371/ S106/02D

Strategy Area



Strategy Area

•••••• Administrative Boundary

Scale in Kilometres :- 0 1 2

FIRST SCHEDULE

Agreed principles for the Overall Masterplan

1 Principal Structural Landscaping Framework

1.1 The principal structural landscaping framework shall include those areas and corridors illustrated on the Plan as to be retained and managed for their ecological value but otherwise shall define only those areas intended to be outside individual development plots on completion of the development and either alongside principal roads or within areas to be designated solely for landscape purposes.

1.2 Details of landscaping of a non-structural landscaping nature within development areas will not be required for or form part of the Overall Masterplan.

2 Rhine Drainage System

2.1 The rhines the general integrity of which are to be maintained (albeit that they may be significantly rerouted and their banks may if necessary be modified) are as indicated by blue lines on the Plan.

2.2 With the exception of the rhines referred to in Paragraph 2.1 all other rhines may be realigned culverted and/or infilled to accommodate development, provided the overall integrity of the rhine drainage system is maintained.

2.3 The landscape treatment of the rhines referred to in Paragraph 2.1 shall be as outlined in paragraph 6.8.13 and Figure 6.4 of the Environmental Statement which accompanied the Development Application.

2.4 There shall be safeguarded for maintenance access purposes an area which shall not be required to extend more than 8 metres on one side of the centre line of the channel of the relevant rhine.

3 Highway Infrastructure

3.1 All development areas will be served (directly or indirectly) from a distributor road ("the Spine Road") running west of the M49 south from the A403 Access to Severn Road, adjoining the southern boundary of the ICI landholding.

3.2 Other than for public transport vehicles and any connection to an Easter Compton By-Pass there will be no connection between the development areas east of the M49 and the B4055 Easter Compton to Pilning Road. It is anticipated that these areas will be served from a distributor road west of the M49 (the East/West Link) and by way of a further distributor road crossing the M49, inter alia, via the Edsleigh Farm overbridge.

4 Ecological Corridors

4.1 The ecological corridors to be maintained shall be those shown on the Plan, namely Vimpenny's Lane the Estuary "Buffer Zone" the Semi Improved Grass Land south of the A403 the un-named green lane linking Gypsies Platt with the boundary of the Zeneca Avlon Works and (as may be rerouted and modified) Middle Compton Rhine Upper Compton Rhine and Impool Rhine

4.2 The area to be safeguarded from development within these corridors shall not be required to extend to more than 20 metres either side of the centreline of the feature defined.

4.3 The distributor roads to service development east and west of the M49 may cross these corridors subject to appropriate measures (to be agreed between the Owner and the Council or determined via the

Dispute Resolution Procedure) being taken to mitigate any material adverse impact upon the function of the corridors as part of a network of wildlife corridors.

SECOND SCHEDULE

Matters to be addressed by and agreed principles for the Ecological and Estate Management Plan ("the EEM Plan")

1 The Plan shall address five main areas:-

1.1 Retention and (through the long-term operation of the EEM Plan) enhancement of principal landscape features and ecological corridors within the Overall Masterplan Area;

1.2 Retention and (through the long-term operation of the EEM Plan) enhancement of the wild life value (pending development) of existing agricultural areas within the Overall Masterplan Area;

1.3 Monitoring of ecological mitigation measures associated with the Development; and

1.4 Landscape and ecological principles for creation of new habitats and advanced landscape planting as part of the Development.

1.5 Principles procedures and controls in relation to inspection laying maintenance repair and renewal of services and service media serving or to serve the Development insofar as they pass or are to pass under over or through the areas to which the EEM Plan relates

2 The part of the EEM Plan referred to at paragraph 1.1 above will address (inter alia) the buffer zone for the Severn Estuary SSSI and wader feeding areas greenways and major rhines to be retained following development and the proposed Ecological Refuge Area.

3 The part of the EEM Plan referred to at paragraph 1.2 above will address (inter alia) measures which tenant farmers will be encouraged to adopt to increase biodiversity such as sympathetic

hedge and rhine maintenance, appropriate field management regimes and the creation of field headlands; and proposals for encouraging adoption of the relevant measures.

4 The part of the EEM Plan referred to in paragraph 1.3 above shall address the proposals for mitigation listed in the tables referred to in paragraph 6.10 of the Environmental Statement which accompanied the Development Application on pages 82 to 91.

5 The EEM Plan shall in respect of each of the matters referred to in paragraph 1 above include guidance notes or outline specifications addressing (as appropriate):-

5.1 Techniques and methods to be adopted in managing maintaining planting or mitigating;

5.2 Timetabling of activities;

5.3 Procedures for monitoring the efficacy of measures taken;

5.4 Report and Review procedures;

5.5 Circumstances in which modification of activities procedures or timetabling may be considered; and

5.6 Those responsible for overseeing implementation.

THIRD SCHEDULE

Part I

Roads to be used by construction traffic

M49

A403

Part II

Roads to be avoided by construction traffic

B4055

Severn Road

Lawrence Weston Road

EXECUTED under the)
COMMON SEAL of)
IMPERIAL CHEMICAL)
INDUSTRIES PLC)
in the presence of:)

Director

Secretary

K J [illegible]HTON] ASSISTANT SECRETARY

tjp/i213/1/g2

Key

- Study Area
- South Gloucestershire 1957 and 1958 consents
- Additional Development Land (63 hectares)
- Undeveloped Land Parcels within the 1957/58 Permissions (348.9 hectares)
- Indicative Road Network - Planned
- Indicative Road Network - Future
- New Access from Marsh Common Road (ref. PT08/2196/RM)
- Flood Zone 3b (Functional Floodplain)
- Potential ecological mitigation sites
- Residual Waste Treatment Sites
- WAP1 Estuary Buffer Zone
- WAP1 Ecological Refuge Area: Search Area
- WAP1 Ecological Refuge Area: Core Area

HSE Consultation Zones

- DPZ
- Inner

WYG Planning & Design

part of the WYG group

Bristol City and South Gloucestershire Councils

Avonmouth and Severnside Study

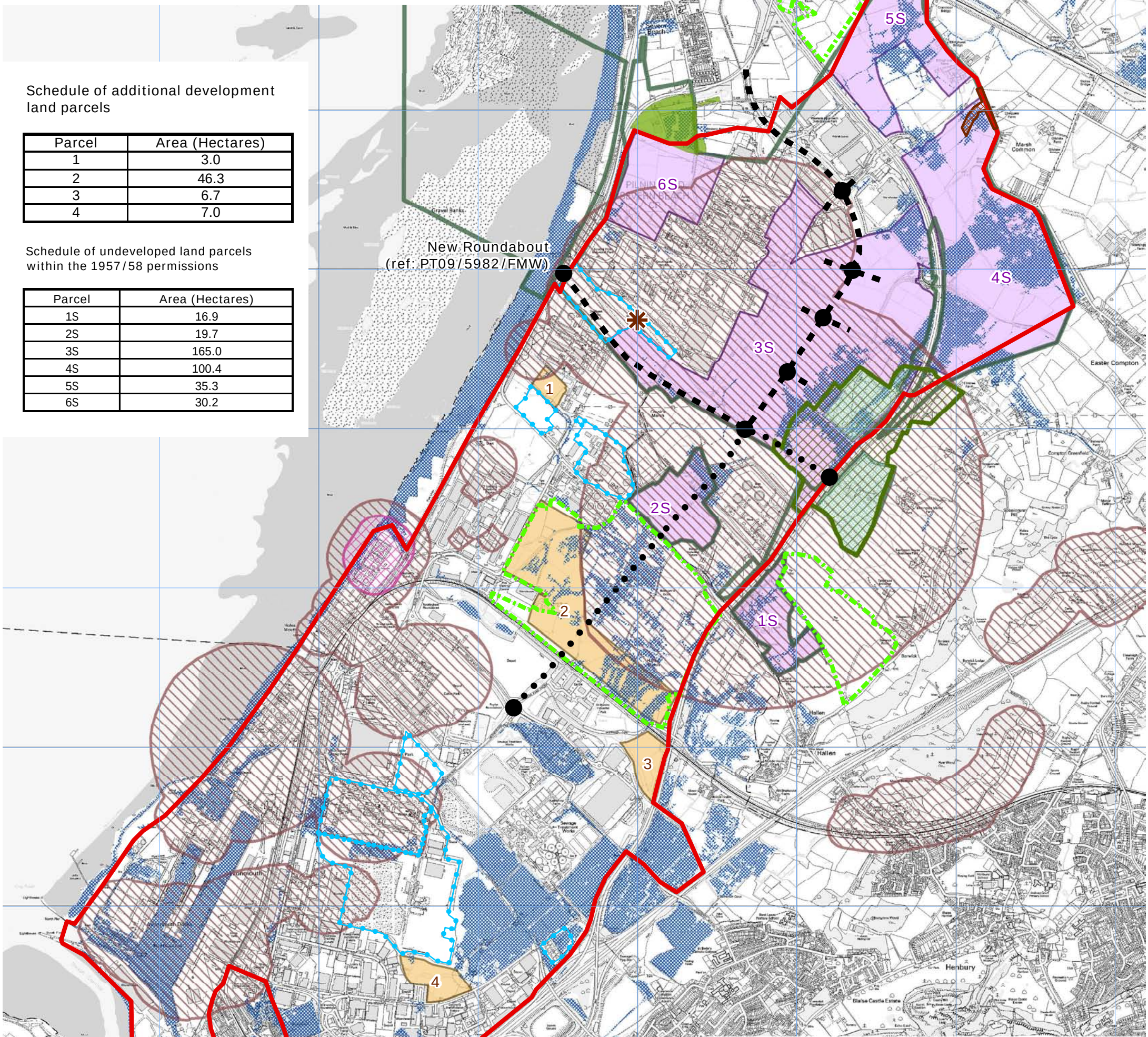
Development Options 15

Schedule of additional development land parcels

Parcel	Area (Hectares)
1	3.0
2	46.3
3	6.7
4	7.0

Schedule of undeveloped land parcels within the 1957/58 permissions

Parcel	Area (Hectares)
1S	16.9
2S	19.7
3S	165.0
4S	100.4
5S	35.3
6S	30.2



0 0.25 0.5 1 1.5 km

North

1:25,000 @A3 Do not scale from this drawing

A066776 Januray 2012

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5th Floor Longcross Court, 47 Newport Road, Cardiff, CF24 0AD Tel: +44 (0) 29 2072 9000
Fax: +44 (0) 29 2045 5321 Email: info@wyg.com www.wyg.com