Littlehampton Arun East Bank Tidal Walls Flood Defence Scheme

Environmental Statement

Volume Two – Main Text

May 2013

We are the Environment Agency. We protect and improve the environment and make it a better place for people and wildlife.

We operate at the place where environmental change has its greatest impact on people's lives. We reduce the risks to people and properties from flooding; make sure there is enough water for people and wildlife; protect and improve air, land and water quality and apply the environmental standards within which industry can operate.

Acting to reduce climate change and helping people and wildlife adapt to its consequences are at the heart of all that we do.

We cannot do this alone. We work closely with a wide range of partners including government, business, local authorities, other agencies, civil society groups and the communities we serve.

Published by:

Environment Agency
Horizon house, Deanery Road
Bristol BS1 5AH
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk

Further copies of this report are available from our publications catalogue: http://publications.environment-agency.gov.uk or our National Customer Contact Centre: T: 03708 506506

Email: enquiries@environment-agency.gov.uk.

Environmental Statement

Volume Two - Main Text

Project name	Littlehampton Arun East Bank Tidal Walls Flood Defence Scheme
Project 1B1S reference	IMSO001021
Region and Area	South East
Date	29-05-13
Version number	1
Author	E Joanna Walker

Revision history

Revision date	Summary of changes	Author	Version number
May 2013	First issue, Final	E Joanna Walker	1

Approvals

Name	Signature	Title	Date	Version
Fiona Brown	Fiona Brown	Director, Halcrow Group (Ch2mhill)	29-5-13	1
Imran Bukhari	Imran Bukhari	Project Director Europe, Halcrow Group (Ch2mhill)	29-5-13	1

Distribution

Name	Title	Date	Version
Cian Cronin	Senior Planner (Strategic Development), Arun District Council	30-5-13	1
Richard Woodward	Senior Environmental Project Manager, national Environmental Assessment Services, Environmental Agency	30-5-13	1
Peter Borsberry	NCMPS Project Manager, Environment Agency	30-5-13	1

EIA Quality Mark

This Environmental Statement, and the Environmental Impact Assessment (EIA) carried out to identify the significant environmental effects of the proposed development, was undertaken in line with the EIA Quality Mark Commitments.

The EIA Quality Mark is a voluntary scheme, operated by the Institute of Environmental Management and Assessment (IEMA), through which EIA activity is independently reviewed, on an annual basis, to ensure it delivers excellence in the following areas:

EIA Management

EIA Team Capabilities

EIA Regulatory Compliance

EIA Context & Influence

EIA Content

EIA Presentation

Improving EIA practice

To find out more about the EIA Quality Mark please visit:

www.iema.net/qmark

Non-Technical Summary

A Non-Technical Summary has been prepared which aims to provide sufficient information for a member of the public to understand the significant environmental effects of the proposed scheme without having to refer to the main text.

The Non-Technical Summary is available as a stand-alone document at the same location as the Environment Statement. A short summary of the key findings is also presented in final chapter of this Volume of the Environmental Statement.

Contents

Landscape Masterplans

3483 PL 101 Landscape Masterplan Reach 1 (Sheet 1 of 3)

3483 PL 102 Landscape Masterplan Reach 1 (Sheet 2 of 3)

3483 PL 103 Landscape Masterplan Reach 1 (Sheet 3 of 3)

3483 PL 104 Landscape Masterplan Reach 2

3483 PL 105 Visualisations Reaches 1 and 2

3483 PL106 Section Elevations Reaches 1 and 2

3483 PL 107 Landscape Masterplan Reach 3

3483 PL 108 Landscape Masterplan Reach 4

3483 PL 109 Details Reach 4

3483 PL 110 Landscape Masterplan Reach 5 (Sheet 1 of 2)

3483 PL 111 Landscape Masterplan Reach 5 (Sheet 2 of 2)

3483 PL 112 Landscape Masterplan Reach 6 (Sheet 1 of 2)

3483 PL 113 Landscape Masterplan Reach 6 (Sheet 2 of 2)

Engineering Drawings

463457-CIVIL-100-P1	**Reaches 1 and 2 General Arrangement Plan (Sheet 1 of 2)**
463457-CIVIL-101-P1	**Reaches 1 and 2 General Arrangement Plan (Sheet 2 of 2)**
463457-CIVIL-103-P2	**Reaches 1 and 2 General Arrangement Sections**
463457-CIVIL-300-P1	**Reach 3B (private frontage) General Arrangement Plan**
463457-CIVIL-301-P1	**Reach 3B (private frontage) General Arrangement Sections**
463457-CIVIL-302-P1	**Reach3B (private frontage) General Arrangement Elevations**
463457-CIVIL- 400-P2	**Reach 4 General Arrangement Plan**
463457-CIVIL- 401-P2	**Reach 4 General Arrangement Sections**
463457-CIVIL-500-P2	**Reach 5A (Arun View public house) General Arrangement Plan**
463457-CIVIL-501-P2	**Reach 5A (Arun View public house) General Arrangement Sections**
463457-CIVIL-550-P2	**Reach 5B (Arun View public house) General Arrangement Plan**
463457-CIVIL-560-P1	**Reach 5B Details**
463457-CIVIL-600-P3	**Reach 6 General Arrangement Plan (Sheet 1 of 2)**
463457-CIVIL-601-P3	**Reach 6 General Arrangement Plan (Sheet 2 of 2)**

Figures

List of abbreviations

ADC	Arun District Council
BAP	Biodiversity Action Plan
BGS	British Geological Survey
dB	decibel
dB(A)	A-weighted decibel
DBA	Desk-Based Assessment
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EC	European Commission
ECoW	Ecological Clerks of Works
EIA	Environmental Impact Assessment
EQS	Environmental Quality Standards
ES	Environmental Statement
EU	European Union
EUS	Extensive Urban Survey
GQA	General Quality Assessment
ha	hectare
HGV	Heavy Goods Vehicle
IEA	Institute of Environmental Assessment
IEEM	Institute of Ecology and Environmental Management
IEMA	Institute for Environmental Management and Assessment
km	kilometre
LAeq	A-weighted equivalent noise level parameter
LAmax	A-weighted maximum sound pressure level
LNR	Local Nature Reserve
m	metre
m^2	square metre
MAGIC	Multi-Agency Geographical Information for the Countryside
mm	millimetre
N/A	Not Applicable
NJUG	National Joint Utilities Group Guidelines
NNR	National Nature Reserve

No.	number
NPPF	National Planning Policy Framework
PPG	Planning Policy Guidance (Planning)
PPG	Pollution Prevention Guidelines (Water quality)
PPS	Planning Policy Statement
RSS	Regional Spatial Strategy
SAC	Special Area of Conservation
SM	Scheduled Monument
SMP	Shoreline Management Plan
SNCI	Site of Nature Conservation Importance
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
UKBAP	United Kingdom Biodiversity Action Plan
WFD	Water Framework Directive
WCA	Wildlife and Countryside Act
WSCC	West Sussex County Council

Glossary

Aeolian deposits	Wind-blown sediments characteristic of relatively dry periods, e.g. interpluvials or glacials with low precipitation. Aeolian deposits can easily bury sites and create well-preserved archaeological deposits, like many sand-dune-covered sites.
Ancient woodland	Land continuously wooded since 1600 in England and Wales or 1750 in Scotland.
Aquifer	An underground layer of rock with water storage capability/transmissivity.
Baseline	A description of the present state of the environment with the consideration of how the environment would change in the future in the absence of the plan/programme/project as a result of natural events and other human activities.
Baseline studies/ survey	Collection of information about the environment which has potential to be affected by the project
Biodiversity Action Plan (BAP)	An agreed plan for a habitat or species, which forms part of the UK's commitment to biodiversity in response to the Convention on Biological Diversity, Rio de Janeiro 1992
Character area	An area of land with distinctive landscape features resulting from an interaction of wildlife, landforms, geology, land use and human activity as defined by the Countryside Agency.
Conservation Area	An area designated under the Town and Country Planning Act, 1990 to protect its architectural or historic character.
Contaminant	A hazardous substance, usually considered a risk if present in concentrations that can cause harm
Countryside and Rights of Way (CRoW) Act 2000	This Act applies to England and Wales and has five parts: Access to the countryside; Public rights of way and road traffic; Nature conservation and wildlife protection; Areas of outstanding natural beauty; Miscellaneous and Supplementary. This act increases the protection of SSSIs. Environment Agency plans/programmes/projects must gain consent for works in or near SSSIs using a CRoW form.
Cumulative Impacts	The combined impacts of several projects within an area, which individually are not significant, but together amount to a significant impact.
Department for Environment, Food and Rural Affairs (DEFRA)	The government department responsible for flood management policy in England
English Heritage(EH)	Government statutory advisor on the historic environment, funded jointly by the government and by revenue from properties and members.
Environmental Action Plan (EAP)	A standalone document or section within the Environmental Statement that summarises the environmental constraints, and the objectives and targets of the mitigation. Actions are separated into those to be carried out before, during and after

	construction. The document is mainly for use by the Contractor to ensure that the measures set out in the Environmental Statement are actually carried out on the ground. The document is also used to audit the implementation of the measures.
Environmental Impact Assessment (EIA)	"EIA is an assessment process applied to both new development proposals and changes or extensions to existing developments that are likely to have significant impacts on the environment. The EIA process ensures that potential impacts on the environment are considered, including natural resources such as water, air and soil; conservation of species and habitats; and community issues such as visual impacts and impacts on the population. EIA provides a mechanism by which the interaction of environmental impacts resulting from development can be predicted, allowing them to be avoided or reduced through the development of mitigation measures. As such, it is a critical part of the decision-making process." www.iema.net/eiareport
Environmental Statement (ES)	The document produced to describe the environmental impact assessment process where statutory environmental impact assessment is required.
Flood defence	A structure (or system of structures) that reduce the risk of flooding from rivers or the sea
Flood risk management strategy (FRMS)	A long term (50 years or more) plan for coastal or river management to reduce the risk of flooding.
General Permitted Development Order (GPDO)	The Town and Country Planning (General Permitted Development) Order 1995 sets out what may be built without needing planning permission. Part 15 applies specifically to the Environment Agency
Groundwater	Water below the ground surface, within rocks and soils
Habitats Directive	EC Directive (92/43/EEC) on the Conservation of natural habitats and of wild flora and fauna. Implemented (with the Birds Directive (79/409/EEC)) in the UK as the Conservation (Natural habitats and wild flora and fauna) Regulations (1994). This establishes a system of protection of certain flora, fauna and habitats considered to be of International or European conservation importance. Sites are designated as Special areas of conservation (SACs), special protection areas (SPAs) and/or Ramsar sites. Any developments in or close to these designated areas are subject to the Habitat Regulations for approval of Natural England. Together these sites are referred to as the Natura 2000 network.
Land Drainage Regulations	The Environmental Impact Assessment (Land Drainage Improvement Works) Regulations (SI 1999 No. 1783) apply to improvement works to land drainage infrastructure undertaken by land drainage bodies, including the Environment Agency. Such works are permitted development and therefore not subject to the Town and Country Planning EIA requirements.
Landscape Masterplan (LM)	Overlay of existing environment and scheme proposals to highlight environmental constraints and opportunities including designated sites and landscape character.
Local Nature	Nature reserves designated under the National Parks and

Reserve (LNR)	Countryside Act (1949) for locally important wildlife or geological features. They are controlled by local authorities in liaison with Natural England.
Made Ground	Material artificially in place which can comprise of a wide range of materials such as, concrete, tarmac, brick etc, usually to raise the level of the ground.
Main river	A watercourse designated by DEFRA. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities on main rivers. Responsibility for maintenance rests on the riparian owner.
Marine Management Organisation (MMO)	An executive non-departmental public body established under the Marine and Coastal Access Act 2009 with responsibilities including marine licensing and working with Natural England and others to manage a network of marine protected areas (marine conservation zones and European marine sites).
Mitigation measures	Actions that are taken to minimise, prevent or compensate for adverse impacts of the development.
National Nature Reserve (NNR)	Nature reserves designated under the National Parks and Countryside Act (1949) for nationally important wildlife or geological features (these may be the best examples in the country). They are controlled by Natural England.
Natural England	Natural England is an executive non-departmental public body responsible to the Secretary of State for Environment, Food and Rural Affairs. Its purpose is to protect and improve England's natural environment and encourage people to enjoy and get involved in their surroundings. Their aim is to create a better natural environment that covers all of our urban, country and coastal landscapes, along with all of the animals, plants and other organisms that live with us.
Nitrate vulnerable zone (NVZ)	Area where surface or ground waters exceed standards set by the Nitrates Directive (91/676), as implemented in England and Wales by SI2164/2002
Palaeoenvironmental	An environment at a period in the geological past.
Permissive Powers	The Environment Agency has permissive powers under the Water Resources Act 1991. The Environment Agency can use permitted development rights for works in, on or over a water course. Planning permission is required for other works.
Perched Water Table	Groundwater which exists above the regional water table.
Scheduled Monument (SM)	Nationally important historic sites, buildings or monuments identified by English Heritage and designated by the Secretary of State for Culture, Media and Sport. Any work affecting a scheduled monument must gain consent from English Heritage under the Ancient Monuments and Archaeological Areas Act (1979).
Scoping	The process of deciding the scope or level of detail of an EIA/ SEA. During this stage the key environmental issues (likely significant impacts) of a project/strategy are identified so that the rest of the process can focus on these issues. Issues may result from the proposal itself or from sensitivities of the site.
Screening	For environmental impact assessment, the process of deciding which developments require an environmental impact

	assessment to be carried out and whether this will be statutory.
Screening opinion	Statutory opinion from the competent authority as to whether a proposed project requires statutory environmental impact assessment according to the Environmental Impact Assessment Regulations.
Site of Special Scientific Interest (SSSI)	Nationally important site designated for its flora, fauna, geological or physiographical features under the Wildlife and Countryside Act (1981) (as amended) and the Countryside Rights of Way (CRoW) Act (2000).
Shoreline Management Plan (SMP)	A long term (50 years or more) strategy for shoreline management to reduce the risk of flooding.
Standard of protection (SoP)	The level of protection from flooding, for example an SoP of 1 in 100 means that the flood defences in an area provide protection from floods up to a size of flood with a probability of occurring of 1 in 100 in any year
Strategy	See Flood Risk Management Strategy
Tarmac	A generic term for bituminous surface paving and asphalt concrete
Water Framework Directive (WFD)	EC Directive (2000/60/EC) on integrated river basin management. The WFD sets out environmental objectives for water status based on ecological and chemical parameters, common monitoring and assessment strategies, arrangements for river basin administration and planning and a programme of measures in order to meet the objectives.

1 Background

1.1 Introduction

We, the Environment Agency, are proposing works on the tidal walls of the East Bank of the River Arun to manage the risk of tidal flooding to the town of Littlehampton in West Sussex. These works, known as the Littlehampton East Bank Tidal Walls Flood Defence Scheme, hereafter referred to as 'the scheme', will provide protection to a one in three hundred chance of flood in any one year.

In addition, Arun District Council is proposing to carry out public realm enhancement works in the lower reaches of the River Arun. Although not required for flood defence purposes, these works were developed in combination with the flood defence scheme, such that they are included within the definition of the scheme.

The scheme will extend along the East Bank of the River Arun for approximately 2.5 kilometres from the harbour mouth to 500m north of the A259 crossing (National Grid Reference TQ 0283 0131 to 0150 0290). The location of the scheme in the wider and more local context is shown in Figures 1.1 and 1.2.

Figure 1.1 Site location plan

Figure 1.2 Site location plan in local context

We identified the urgent need for these flood defence works in the Rivers Arun to Adur Flood and Coastal Erosion Strategy (Environment Agency, 2009), which followed the Beachy Head to Selsey Bill Shoreline Management Plan (SMP) of 1997 and the 2006 review (SMP2) (see Section 2.1).

Legislative and regulatory requirements

The Environment Agency has permissive powers under Section 165 of the Water Resources Act 1991to carry out works to manage tidal flood risk.

We propose to carry out the majority of the flood defence works as permitted development under our rights set out in The Town and Country Planning (General Permitted Development) Order 1995.

However, we are applying for planning permission under the Town and Country Planning Act (1990) for two areas of proposed realignment (referred to in later parts of this document as Reach 4 Pharos Quay and Reach 6 Realignment. While currently included within the permitted development works, it is possible that planning permission may be required for associated works to the Arun View public house in Reach 5. If this is the case, we will obtain planning permission prior to starting these works.

In addition, planning permission is being sought by Arun District Council under a separate planning application for the enhancement works to the public realm in the lower reaches of the scheme (referred to in later parts of this document as Reaches 1 and 2).

The areas for which planning permission is being sought, as well as those to be undertaken as permitted development, are identified in Figure 1.3.

We have made sure that the scheme is compliant with the EU Habitats Directive and the EU Water Framework Directive and legal requirements as described in following chapters.

Environmental Impact Assessment requirement

By virtue of the nature, scale, size and location of the scheme, there is potential for significant impacts on the environment. As such, it falls within the EU Directive 2011/92/EU (hereafter referred to as the EIA Directive) as requiring an Environmental Impact Assessment (EIA). However, the Marine Management Organisation has confirmed that an EIA is not required under the Marine Works (EIA) Regulations 2007 (as amended) for the purposes of Marine Licensing.

We have undertaken an EIA and prepared an Environmental Statement (ES) for the entire scheme. The objectives of environmental impact assessment are to identify the likely consequences for the natural and built environment and for human beings from the development, and to consider these issues within the planning and design process.

The EIA informed decision-making during design and, in particular, ameliorated potentially significant impacts by incorporating measures to avoid, reduce or remedy any predicted adverse environmental impacts.

Arun District Council confirmed that the public realm works in the lower reaches of the scheme do not have the potential to have significant effects on the environment and, as such, do not need an EIA.

The Environmental Statement

This ES reports the results of the environmental impact assessment in accordance with the requirements of the EIA Directive.

We will submit the ES with the planning application for the realignment sections (Reach 6 realignment and Reach 4 Pharos Quay) of the scheme to the local planning authority (Arun District Council) in accordance with the Town and Country Planning (EIA) Regulations 2011. The ES will also be advertised and made publicly available through our website prior to undertaking the remainder of the scheme under permitted development rights in accordance with EIA (Land Drainage Improvement Works) Regulations (1999).

As no environmental impact assessment is required for the public realm improvements, the ES will not be submitted as part of the planning application made by Arun District Council for these works.

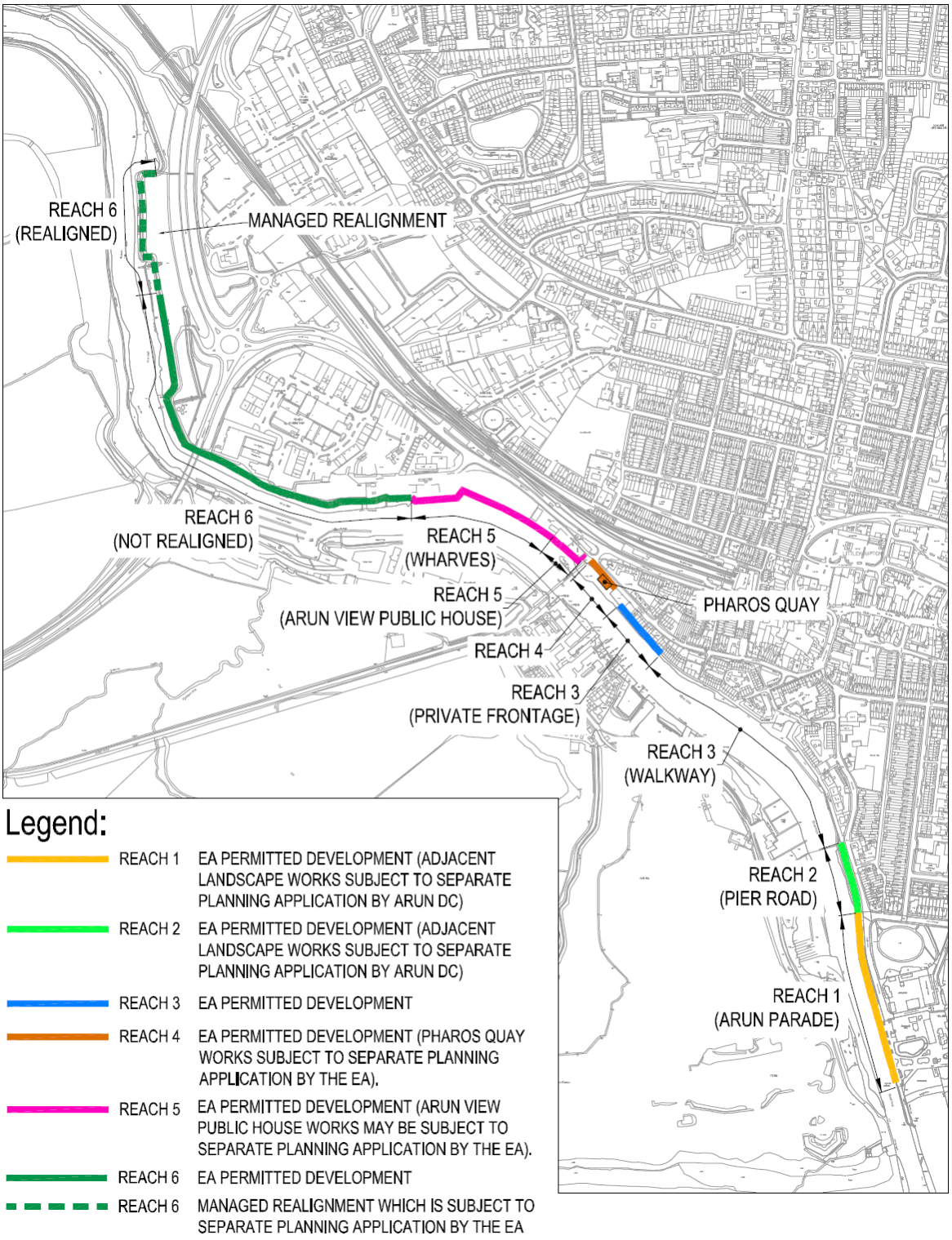


Figure 1.3 Plan of scheme reaches and planning requirements

1.2 The problem

The existing flood defences in the urban area of Littlehampton comprise steel and concrete piled retaining walls as well as sections of masonry and concrete gravity walls. In the more rural area to the north, there is approximately 750m of earth embankment. Many of these defences have a short residual life (less than 10 yrs) and/or a low crest height. As a result, the defences will need significant works or replacement to prevent failure, breach or overtopping that would result in significant flooding and consequential damage, and could pose a risk to life.

Areas at risk of flooding include residential and commercial properties in Littlehampton, highways infrastructure, Littlehampton railway line and station, an industrial area east of the A259 road-bridge and recreational assets including rights of way, public slipways and public green areas. The total number of properties currently at risk from flooding on this frontage of the River Arun from a 1 in 200 year event (0.5%) is 781 residential properties and 336 commercial properties. The number of properties at risk in 100 years is predicted to increase due to rises in the sea level to 1,417 residential properties and 520 commercial properties.

We are proposing works to provide a flood defence to a consistent 1 in 300 year standard for the area covered by the scheme.

1.3 Scoping methods

Scoping is an important preliminary stage of the EIA process, providing the opportunity to focus the assessment on those areas of the environment that are likely to be significantly affected by the scheme and are relevant to the proposals.

For this scheme, we undertook environmental scoping alongside the engineering and cost appraisals of scheme options. This process involved consultation with the public and key stakeholders, including statutory and non-statutory consultees through a series of public exhibitions, individual meetings and workshops, and the preparation of a Scoping Consultation Document. This document was adopted as the Scoping Report following the return of comments from consultees and made available to the public for comment.

A number of issues were scoped out at this stage, including noise and vibration and air quality during operation. The process of scoping and consultation, and the issues scoped in/out of the EIA, are more fully explained in the Chapter 4 – Key Issues and Methodology. A copy of the Scoping Report is available in Appendix A.

1.4 Structure of the report

The ES for the scheme is presented in Three Volumes.

Volume One, presented as a separate document, comprises the Non-technical Summary. The Non-technical Summary provides an outline of the proposals and highlights the key impacts and mitigation measures in non-technical language.

Volume Two, this document, is the Main Report, which is presented in two parts as follow:

- **Part One – The proposed scheme**, comprises four chapters. Chapter 1 provides an introduction to the scheme, and describes the purpose and structure of this document and how comments on its content can be made.

Chapter 2 presents information on how the scheme developed through the preliminary stages and on the alternative options considered. Chapter 3 describes the preferred scheme, with information on both construction and operational aspects. Chapter 4 presents the scope of issues addressed within this document and a summary of the general approach and methods used during the assessment.

- **Part Two – Assessment of the development,** contains 13 chapters. Chapters 5 to 17 present the results of the environmental impact assessment for each environmental issue. For each issue, sub-sections on baseline conditions, relevant legislation and policy, potential impacts, mitigation and residual impacts are provided. Chapter 14 presents the assessment of cumulative impacts, Chapter 15 presents an appraisal of planning policy and guidance, and Chapter 16 presents the key findings of the assessment. A list of references is provided in Chapter 17.

A copy of the Environmental Action Plan which summarizes the mitigation measures that we will implement to avoid adverse impacts is provided at the end of the main report, behind Chapter 17. Figures are either interspersed within the text or provided behind the Environmental Action Plan.

Volume Three, presented as a separate document, provides the Supporting Information for the Main Report. It comprises a series of appendices, as follows:

- Appendix A The Scoping Report
- Appendix B Alternative scheme options appraisal
- Appendix C Summary of consultee responses
- Appendix D Acoustics
- Appendix E Archaeology and heritage (Heritage Statement)
- Appendix F Biodiversity
- Appendix G Ground conditions (Heritage Statement)
- Appendix H Landscape specifications and arboricultural report
- Appendix I Traffic Management and Logistics Plan
- Appendix J Water Framework Directive assessment
- Appendix K Flood Risk Statement

1.5 Review and comments

Copies of this ES together with copies of the plans and supporting information will be made available for inspection by Cian Cronin during normal office hours at the following address:

Planning and Economic Regeneration
Arun District Council
Arun Civic Centre
Maltravers Road
Littlehampton
BN17 5LF

Copies of the ES can be purchased for £150 for a hard copy, or £15 in CD format, on application in writing to Cian Cronin at the above address.

The Non-technical Summary is available free of charge at the same address.

Following publication of the planning application and the ES, there will be a period of at least 21 days, during which the ES will be available for inspection and representations may be made in writing to Cian Cronin at the same address.

Only comments that relate to those parts of the scheme for which planning permission is sought (i.e., for Reach 4 Pharos Quay and Reach 6 Realignment) will be material to determination of the planning application.

For those parts of the scheme that we intend to construct using permitted development rights, we will publish an advert in two local papers and also on the Environment Agency website consultation page. This ES will be a supporting document to this advert, and comments relating to the likely environmental impacts of these works should be made to the address stated on the advertisement, within 28 days of the publication date (expected to be start of June 2013).

During this time, a copy of the ES will be available for inspection by Cian Cronin at the above address and by Peter Borsberry at:

Environment Agency
Guildbourne House
Chatsworth Road
Worthing

We advise that any comments relating specifically to the public realm enhancements should be made in accordance with the instructions associated with the planning application submitted by Arun District Council.

2 Project development

This chapter presents a summary of the strategic background to the scheme, describes the key alternative options that were considered during the design stage and the reasons for the selection of the preferred design.

2.1 Strategic context

The strategic policy for the flood defence of the study area covered by the Littlehampton Arun East Bank Tidal Walls Flood Defence Scheme is set out in the Beachy Head to Selsey Bill Shoreline Management Plan (SMP) of 1997 and the 2006 review (SMP2). These documents recommended a preferred policy option of “hold the line” for the study area.

The Rivers Arun to Adur Flood and Erosion Management Strategy (Environment Agency, 2009) focused in more detail on the shoreline from the east bank of the River Arun to the River Adur in Shoreham. This strategy selected an “Improve” option that would raise the level of the defences to provide a consistent 1 in 300 year standard of defence for the full study area.

2.2 Options

We divided the study area for the current scheme into six reaches according to the nature of the existing defences, current ownership and flood defence responsibilities, and the anticipated scope of the proposals. The location and extent of the reaches are shown in Figure 1.3. The location of key environmental features is shown in Figures 2.1 and 2.2.

We identified a range of alternative options to deliver the flood defence improvements. The way in which we arrived at the proposed scheme is described in Appendix B.

In general, we adopted a sequential approach to option appraisal. A long list of generic options was subject to a high level technical, environmental and economic appraisal on a reach by reach basis. The long list was filtered down to produce a shorter list of viable options, which we then refined and subjected to more detailed appraisal.

The main generic options that we assessed for each reach comprised:

- **Deferring the works until a later date**, which was considered to be the default option where the condition of the existing works was adequate and where a raise is not yet required for a reasonable period of time to meet a 1 in 300 year standard of defence. In the absence of an obvious need for environmental mitigation or enhancement, no alternative options were proposed where this option was considered viable
- **Raising the existing defences**, which was considered the next preferred option in terms of cost and environmental impact where the condition of the existing defences was adequate and where this was considered technically feasible, except where there was a need for environmental mitigation or enhancement
- **Construction of a new rock revetment**, which was not considered viable at any location due to space restrictions within the river and the adverse impact this would have on water flow and consequential flooding elsewhere

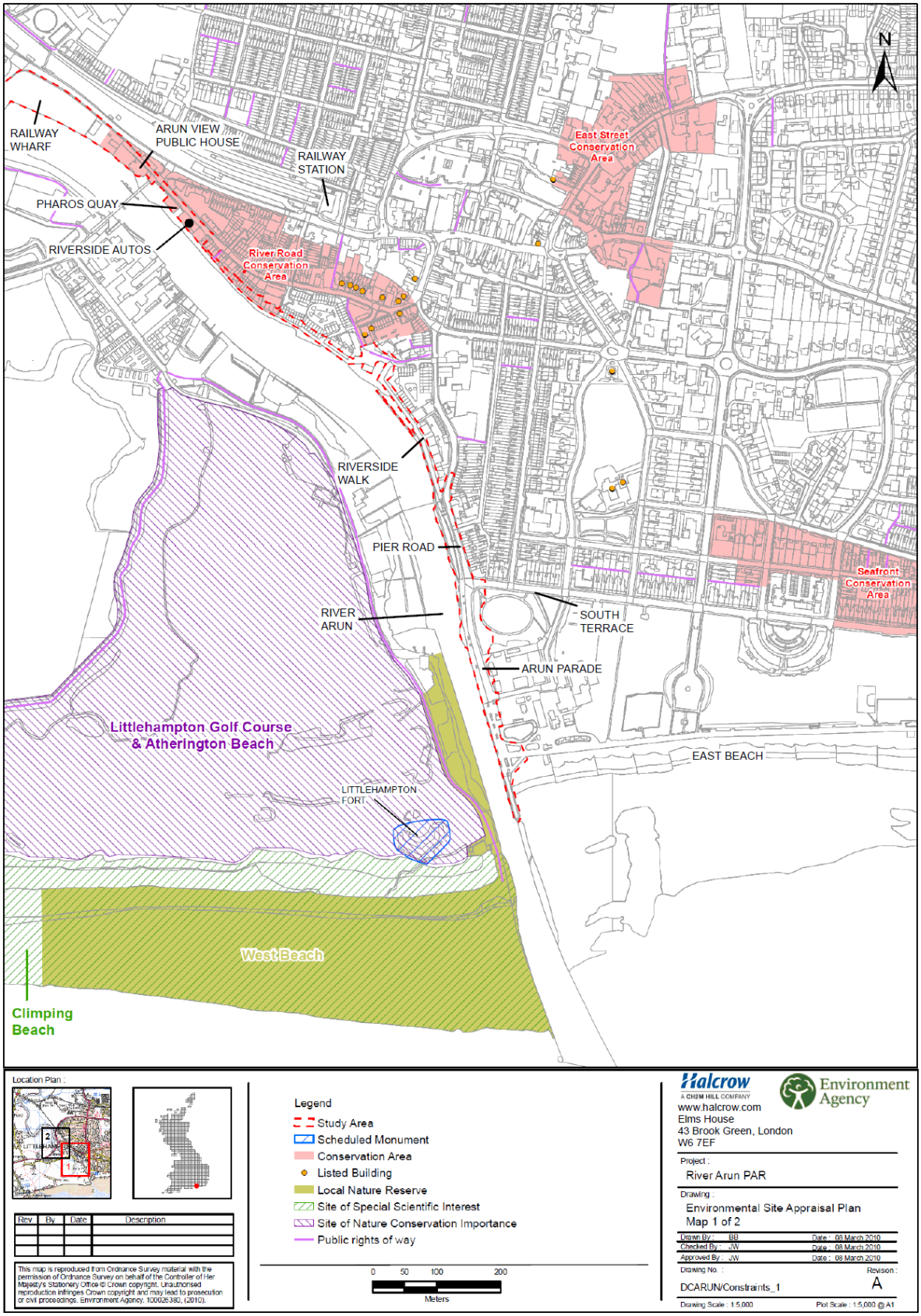


Figure 2.1 Key environmental features (South)

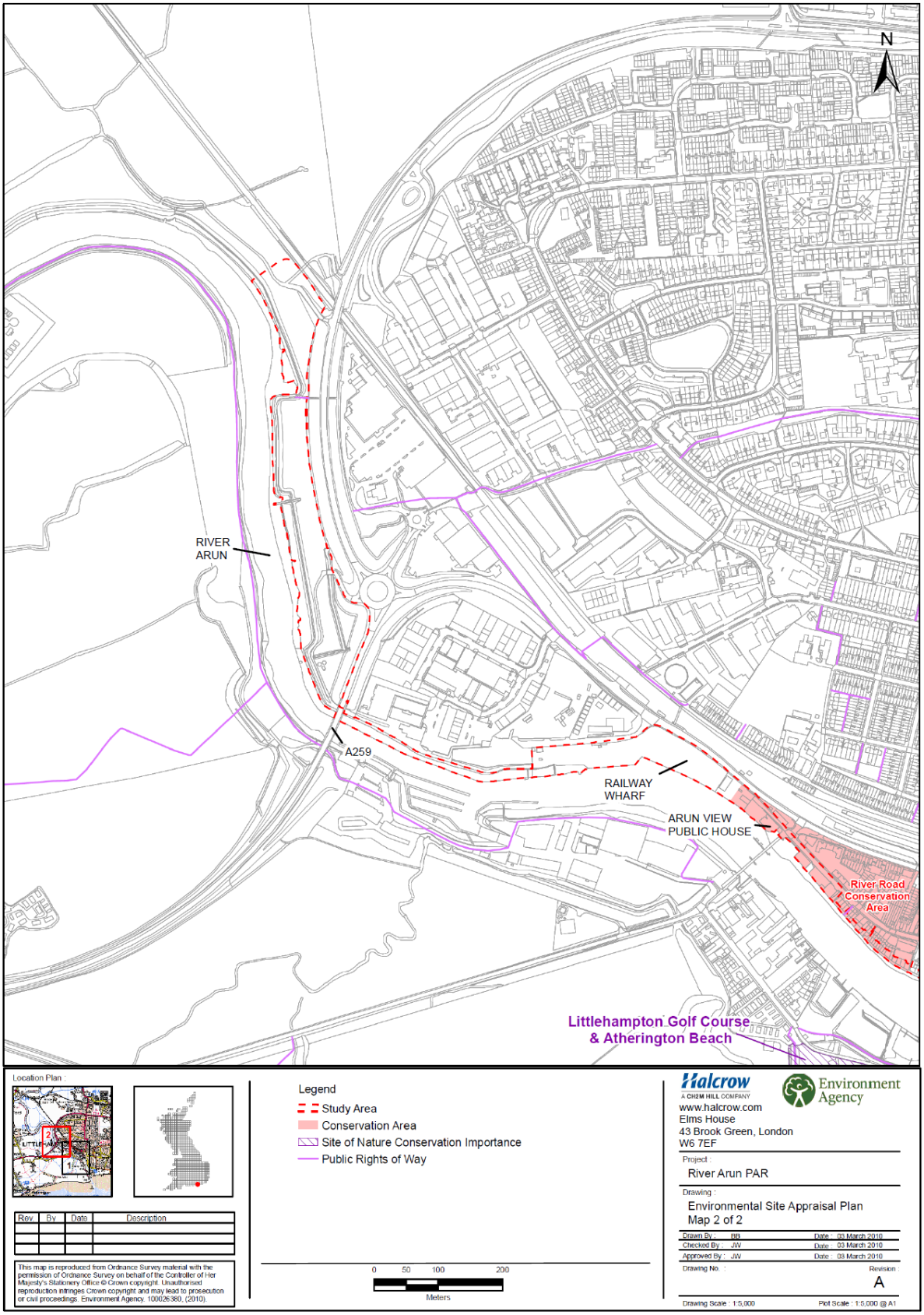


Figure 2.2 Key environmental features (North)

- **Construction of a new embankment** into the river, which was not considered a viable option along any reach due to unacceptable environmental and social impacts. Due to a lack of space on the landward side too, construction of a new embankment on the landward side was considered viable only where adequate space exists (in the northern part of Reaches 5 and 6 only)
- **Construction of a new tidal defence wall**, which was considered viable for all reached in the more rural setting of the northern part of Reach 6. Different materials were considered, but sheet steel piling was considered the preferred material due to ease of construction, cost and lower space

Only options that would provide an acceptable long term technical solution, a clear positive economic case competitive with other options, and those that would meet the environmental objectives of the scheme were considered viable and taken forward for more detailed appraisal.

We assessed the options against environmental objectives which were defined during preparation of the Scoping Report in accordance with Defra guidance. The objectives were to:

- Minimise the impacts on land use and the socio-economy, especially tourism
- Minimise encroachment onto existing mudflats and saltmarsh, and provide compensatory habitat where loss is unavoidable
- Seek opportunities to extend and enhance quality of Biodiversity Action Plan (BAP) habitat and protected species
- Maintain and, where possible, improve access to riverside and water
- Maintain privacy of private households along riverside where possible
- Maintain and, where possible, enhance visual appearance of riverside and promenade. Design all new structures with due regard for the townscape character in accordance with the Littlehampton Waterfront Strategy prepared by Arun District Council
- Maintain or improve the setting of scheduled monuments and listed buildings and avoid, where possible, or minimize the impact on buried archaeology
- Avoid deterioration in water quality resulting from construction and operation of the scheme
- Seek to make use of existing materials (residual life of existing structures) and minimize use of new materials where possible

We presented the options (with a range of illustrations to show how these may look in practice) to the public and key stakeholders in Littlehampton as part of a three-day consultation event in March 2010. Additional targeted stakeholder meetings provided further specific information and opinion feedback. A detailed environmental appraisal of the short listed reach options was undertaken by statutory internal and external consultees at a workshop, also held in March 2010.

After further appraisal and refinement following the feedback from consultation, we selected the most economically viable reach options which meet environmental objectives and reflect the views of the public and statutory consultees.

Consultation and the consideration of alternative design options

We used consultation not only to inform key stakeholders of the proposals, but also to help generate and evaluate alternative design options. It was an integral part of the

process of selecting a preferred option for each reach (see consultation in March 2010 above). We have continued consulting with key stakeholders throughout the detailed design process. Stakeholders include key landowners, riverside inhabitants and businesses, and river users which may be affected during the construction phase, as well as statutory and non-statutory consultees. We have consulted some stakeholders individually and also held stakeholder meetings on a quarterly basis and issued regular newsletters.

Arun District Council has been fully engaged with the detailed design phase and West Sussex County Council have also provided input in key areas. In this way, the design of the proposed scheme has been an iterative process. Comments and concerns raised by stakeholders, including statutory and non-statutory consultees and members of the public, as well as issued raised by the environmental scoping and assessment, have been fed back into the design to inform the design process and avoid unnecessary impacts or conflicts at an early stage. A summary of the issues raised by stakeholders and how they were addressed during the design process is provided in Appendix C.

Some of the key issues and alternative options considered during the design process are summarised in Table 2.1.

Reach	Key issue	Consideration of issue in option selection
Reaches 1 and 2	Space constraints	The lack of space either riverward or landward and cost implications resulted in only one viable option – construction of a new sheet piled wall, immediately riverward of the existing wall.
	Visual amenity	The aesthetic characteristics, views towards the river and amenity value of the promenade for residents, tourists and the local economy were key factors at this location, whilst the need to retain vehicle parking and access to leisure facilities was also recognised. We initially selected a preferred option which would involve raising the whole promenade with improvements to handrails and complementary finishes to existing finishes to mitigate for the loss of views and change to the townscape from raising the defences. However, in consultation with Arun District Council and West Sussex County Council we identified an opportunity to facilitate further public realm enhancements in line with ADC's Waterfront Strategy. ADC developed a concept design on which they undertook public consultation. Subsequently, ADC and WSCC made further funds available in order to provide the much more extensive public realm enhancements which are described in this document. The combination of the two projects allows significant efficiency savings that will produce benefits for the residents, visitors and business community of Littlehampton.
	Ferry berthing point	An option to construct a new ferry berthing point in Reach 2 was considered by the design team, which would have provided further enhancements in terms of connectivity to the west bank and tourism, but the cost and reliance on additional external funding were significant disadvantages and the economic cost could not be justified.

Reach	Key issue	Consideration of issue in option selection
Reach 3	Retention of existing features	In the southern part of Reach 3 we have the option to defer works until Year 20 when the existing sheet piled wall will need to be raised. This was considered the best option as the defences in this section were constructed in 2000. The option will also allow the award-winning landscape features (fish recipe features) to be retained with no adverse environmental impacts.
	Extension of a coastal path	Options to extend the coast walkway along the riverfront at the end of private residential gardens were considered. However, in consultation with residents, we concluded that the loss of privacy from private residences and the high economic cost outweighed the benefits. This has been agreed with Natural England.
Reach 4	Defence alignment	In Reach 4, different alignments options were considered to construct the defences into the river in order to reclaim land to the immediate south of the footbridge for public amenity. However, although the adverse impact on the inter-tidal habitat and possible impact on buried inter-tidal archaeology were considered to preclude options that resulted in significant loss of the inter-tidal area, minor encroachment was considered acceptable in order to mitigate visual impacts.
	Visual amenity	A number of different arrangements were considered in Reach 4. We have chosen an option that lessens the visual impact by providing a raised viewing platform and better public space.
Reach 5	Defence alignment	We considered providing a riverside footpath, but this was rejected due to encroachment into the river and inter-tidal habitat and cost reasons.
	Visual amenity	After consultation with the Arun View public house we selected an option which incorporates glass panels within the defences, in order to maintain the views that this business' customers currently enjoy.
Reach 6	Space constraints and landscape character	Construction of a new sheet piled wall in the northern stretch of Reach 6 was not considered suitable due to the adverse impact on the landscape character. A lack of available space precluded enlarging the embankment next to the industrial area.
	Local amenity	An embankment was considered the most suitable option in northern stretch of Reach 6 due to the rural character and the use of the area for informal amenity.
	Defence alignment	Early in the options appraisal process, we identified an opportunity to realign the embankment landwards, creating habitat which would compensate for the loss of inter-tidal habitat caused downstream by the scheme and for future losses due to coastal squeeze. This option was widely supported by environmental consultees during the workshop. The proposed alignment was selected to provide a maximum habitat creation while maintaining protection to the highways embankment and screening of traffic.

Table 2.1 Key design considerations and options considered

Summary

We selected the preferred option, as described in Chapter 3 – Scheme Description, after a comprehensive appraisal process involving cost and engineering considerations, environmental appraisal and consultation with stakeholders and the public.

The chosen solutions were considered the lowest cost options that provide suitable mitigation, providing ecological outcomes, maintaining the character of the area and avoiding impacts on the tourist economy. Specifically, they were expected to:

- Provide environmental mitigation for habitat lost to encroachment and create additional habitat
- Provide mitigation for visual intrusion of raised defences
- Provide a sympathetic public environment in key tourist areas
- Meet some of the aims of key council strategies
- Gain planning permission or be acceptable permitted development
- Receive support from Natural England
- Meet some of the aspirations of the public/stakeholders to provide improved public realm in line with Arun District Council's Waterfront Strategy
- Achieve WFD compliance

3 Scheme description

This chapter describes the proposed scheme (where the works will be located and how they will look on completion, including details of hard and soft landscape features) and how it will be constructed, focusing on the nature of construction activities, temporary access and provisions for vehicles and pedestrians to be used, and the timing of the works.

3.1 The proposed scheme (preferred option)

The majority of the works will be located either along or immediately riverward of the existing alignment of the flood defences. The exceptions are in Reach 4 Pharos Quay, where the new defence wall will be realigned in part landward and in part riverward of the existing defences and in Reach 6 Realignment, where the embankment will be realigned landward in order to provide saltmarsh and mudflat habitat.

Key features of the design are:

- The design life of the new flood defences is in excess of 75years, with defences typically varying from 4.8mAOD to 5.3mAOD. The exception is in Pharos Quay (Reach 4) and the Wharf (Reach 5) where a phased raising of defences is proposed and the proposed defences are to 4.4mAOD.
- Extensive landscape and public realm works will be undertaken to provide enhancements to the public realm in Reaches 1 and 2 and general improvements throughout the scheme
- For Reaches 1 and 2, the materials, furniture and planting will be inspired by Littlehampton's surrounding natural context. They have been selected to provide a unified, robust, simple and understated public realm which complement the surrounding natural context and will not compete visually with the more brightly coloured buildings along the waterfront
- In Reach 2 the narrow footpath will be widened and a promenade created which forms a continuous link from East Beach to the south and the existing Riverside Walk to the north
- The design of the public realm and landscape reflects the coastal character through the use of materials and colour
- Un-necessary clutter caused by street furniture will be removed from the public realm
- Handrails will be provided in Reach 1 and 2 for health and safety reasons which are visually light weight in design to maintain views to the river. The addition of feature-lighting in the handrails will be considered.
- A planting plan will be implemented in Reaches 1, 2, 4 and 6 to mitigate for those lost trees and vegetation to the scheme. The character of the planting in Reaches 1 and 2 will aim to mimic the natural shoreline coastal planting (naturalistic, not formal). Attractive coastal species, preferably indigenous to the West Sussex coastline or suitability for environment and of low maintenance will be chosen. In Reach 4 the plants will be a combination of herbaceous and shrubs with plants chosen for year round interest to compliment the more residential character. Native trees, shrubs and grassland have been chosen for Reach 6

- Replacement lighting in Reaches 1 and 2 will use high quality light fittings to enhance the public realm.
- Glass panels have been proposed in Reach 5 to mitigate for loss of views
- Access to the river in Reaches 1, 2 and 3 will be maintained and improved where practicable by new ramps, steps or pontoons
- Ecological mitigation and enhancement will be provided through managed realignment in Reach 6

Plans showing the alignment and design details of the proposed works are provided in Landscape Masterplans and on the engineering drawings, which are located at the end of this document.

The Landscape Masterplans comprise:

- Landscape Masterplan Reach 1, Sheet 1 of 3: 3483 PL 101
- Landscape Masterplan Reach 1, Sheet 2 of 3: 3483 PL 102
- Landscape Masterplan Reach 1, Sheet 3 of 3: 3483 PL 103
- Landscape Masterplan Reach 2: 3483 PL 104
- Visualisations Reaches 1 and 2: 3483 PL 105
- Section Elevations Reaches 1 and 2: 3483 PL106
- Landscape Masterplan Reach 3: 3483 PL 107
- Landscape Masterplan Reach 4: 3483 PL 108
- Details Reach 4: 3483 PL 109
- Landscape Masterplan Reach 5, Sheet 1 of 2: 3483 PL 110
- Landscape Masterplan Reach 5, Sheet 2 of 2: 3483 PL 111
- Landscape Masterplan Reach 6, Sheet 1 of 2: 3483 PL 112
- Landscape Masterplan Reach 6, Sheet 2 of 2: 3483 PL 113

The engineering drawings comprise:

- Reaches 1 and 2 General Arrangement Plan (Sheet 1 of 2): 463457-CIVIL-100-P1
- Reaches 1 and 2 General Arrangement Plan (Sheet 2 of 2): 463457-CIVIL-101-P1
- Reaches 1 and 2 General Arrangement Sections: 463457-CIVIL-103-P2
- Reach 3B (private frontage) General Arrangement Plan: 463457-CIVIL-300-P1
- Reach 3B (private frontage) General Arrangement Sections: 463457-CIVIL-301-P1
- Reach3B (private frontage) General Arrangement Elevations: 463457-CIVIL-302-P1
- Reach 4 General Arrangement Plan: 463457-CIVIL-400-P2
- Reach 4 General Arrangement Sections: 463457-CIVIL-401-P2

- Reach 5A (Arun View public house) General Arrangement Plan: 463457-CIVIL-500-P2
- Reach 5A (Arun View public house) General Arrangement Sections: 463457-CIVIL-500-P2
- Reach 5B (Arun View public house) General Arrangement Plan: 463457-CIVIL-550-P2
- Reach 5B Details: 463457-CIVIL-560-P1
- Reach 6 General Arrangement Plan (Sheet 1 of 2): 463457-CIVIL-600-P3
- Reach 6 General Arrangement Plan (Sheet 2 of 2): 46357-CIVIL-600-P3
- Reach 6 General Arrangement Sections (Sheet 1 of 3): 463457-CIVIL-602-P2
- Reach 6 General Arrangement Sections (Sheet 2 of 3): 46345 -CIVIL-603-P2
- Reach 6 General Arrangement Sections (Sheet 3 of 3): 463457-CIVIL-604-P2

The proposed works for each Reach of the scheme are as follows:

Reach 1 (Arun Parade) A new sheet piled vertical flood defence wall installed directly riverward of the existing sheet piled wall and capped with a decorative precast concrete coping. The wall will be approximately 300m long and 1.3m higher than the existing defence. The wall will generally be 0.5m higher than the new river promenade level and will comprise a new transparent railing for health and safety. The level difference between existing and proposed will be transitioned using a combination of pedestrian and seating steps, planting terraces and ramps. These elements will be arranged in a simple repetition along the whole length of Reach 1 and 2. A new footpath adjacent to Arun Parade will be provided at the lower level.

Extensive public realm works landward side will comprise high quality in-situ decorative concrete paving, planting complementing the coastal landscape character, bespoke timber seating, low terraced corten steel (a ready rusted steel used in architectural applications) walls to the planting and a high quality co-ordinated range of replacement street furniture such as litter bins, finger post signs and lighting. Accessibility features including steps and ramps will be located on desire lines and access points to adjacent land uses. Replacement access to the river will be provided.

Reach 2 (Pier Road) A new sheet piled vertical flood defence wall installed directly riverward of the existing sloping concrete revetment and capped with a decorative precast concrete coping. The wall will be approximately 150m long and1.0m higher than the existing defence and landside works will comprise extensive public realm works to match the proposal for Reach 1. The wall will generally be 0.2m higher than the river promenade level and will comprise a new transparent railing for health and safety. The position of the piles will create a wider area between the river and Pier Road, widening the walkway which is a current pinch point and creating space for seating and steps up to the raise promenade. Replacement access to the pontoons will be provided. The fish kiosk will be moved and the promenade widened in this locality to provide more waiting and circulation space.

Reach 3 (walkway) No works are needed for at least 20 years, when the existing flood defence will need to be raised to maintain the 1 in 300 Standard of Protection.

Reach 3 (private frontage) A raised new vertical sheet piled flood defence wall installed riverward of the existing wall and capped with concrete. The wall will be approximately 100m long and 1.0m higher than the existing wall. Replacement access to the pontoons will be provided and private gardens will be reinstated.

Reach 4 (Pharos Quay) In the southern end of this frontage (approximately 40m), in the area subject to planning permission, a retaining wall will be installed to a height of approximately 1.0m above footpath level. This retaining wall will take a landward alignment and will be installed alongside the footpath. Vehicular and pedestrian access to the private quay (Pharos Quay) will be provided.

Works to the northern end of this frontage (adjoining to the footbridge), which are permitted development, comprise a new vertical sheet piled wall with concrete cap to a level approximately 0.9m higher than the existing wall.

This reach will be designed to reflect the Conservation Area status and will included a raised area to allow people to gain a view of the river with an area of low level ground cover planting between the footpath and raised area.

Reach 5 (Arun View public house) The river-facing walls of the Arun View public house will be flood-proofed using concrete and flood glass units. The walls alongside the patios will be raised using flood glass units and access to the pontoons will be reinstated.

Reach 5 (wharves) A 300m length (approximately) of the existing flood defences will be raised by construction of a 0.4m high reinforced concrete wall. To the southern/eastern end of this reach the existing concrete cap will be raised, but for the majority of this reach works will comprise a retaining wall constructed in-situ on an alignment immediately landward of the existing wall.

Reach 6 (non-realigned) The existing flood defence level will be raised by 0.8m through installation of approximately 600m length of steel sheet piled wall driven through the existing embankment, aligned along the riverward side of the existing embankment crest. In the northern 200m length of this reach, the existing embankments will be raised by 1.0m with imported fill (approximately 2,500m^3). The scour protection at the top of the existing embankment will be repaired using open stone asphalt (which will be of a similar construction detail to the existing protection). The embankments will be reseeded as required with a species rich seed mix.

Reach 6 Realignment The objective in this area is to establish a bio-engineered set-back embankment to promote a salt marsh and mudflat with scour protection at the toe of the A259 highway embankment. The salt marsh and mudflat will be created by removing part of the existing flood embankment and re-using approximately 50% of the material to raise existing ground levels behind. The scour protection will be provided by grassing the highway embankment slopes to the 120 yr design life elevation of 5.45m Above Ordnance Datum.

A working platform will be created along the toe of the highway embankment to allow future maintenance of the scour protection and highway embankment. The elevation of this working platform will be approximately 3.85m Above Ordnance Datum (which will be above current ground levels) so that it is accessible during the design life of the scheme (100 years). The platform will be constructed from the remaining 50% of the flood bund material (approximately 2,500m^3). A 50m section of new earth flood embankment will be constructed using 3,000m^3 of imported fill to join the realigned flood defence with the existing defence.

The A259 highways embankment will be protected by the addition of earthworks to form the working platform and the scour protection. Native trees and shrubs will be planted on the road embankment to replace the planting lost. A coastal grass seed mix would be planted on the riverward side of the embankment and a species rich mix on the landward side.

3.2 Construction

Construction of the scheme will comprise the following elements:

- Advance works
- Establishment of site compound
- Main construction activities
- Site clearance and re-instatement

Advance works

A substantial delivery of the sheet piles and king piles required for construction has already taken place (those required for Reaches 1 and 2). These were delivered by vessel and moved on land by crane in March 2013 for storage at Railway Wharf operated by Tarmac in Reach 5. The remaining piles will be delivered to the same location prior to construction in autumn 2013.

Further advance works will be required to divert existing services to avoid disruption to services during the main construction works. All such works will be undertaken in consultation with the relevant suppliers.

Condition surveys will be carried out on existing structures prior to construction, in preparation for monitoring of vibration during piling works. A Traffic Management and Logistics Plan including routes for construction traffic and pedestrian walkways and parking/storage areas will be agreed with the local authority prior to construction.

Advance works will be undertaken to avoid or minimise impacts on ecological receptors. A comprehensive programme of reptile translocation will take place to capture reptiles from within working areas of Reach 6 and move them to a suitable, safe receptor site to the north, from which they can disperse into further suitable habitat.

Ground vegetation in areas of Reach 6 to be cleared will be cut during the translocation programme and will be kept clear until construction in order to maintain conditions that will be unattractive to reptiles and ground-nesting birds.

Any trees that need to be removed will be felled under ecological supervision to check for bats from working areas in autumn 2013. Although not needed in advance of translocation, some of the material from the trees will be used to create minor enhancements in the form of hibernacula at the reptile receptor site.

Treatment of an area of Japanese knotweed, a notifiable invasive species, located in Reach 5 has been started. The plants were spayed in spring 2013. They will be re-sprayed during late summer and will continue to receive treatment in accordance with good practice guidelines. Any material within seven metres of the visible plant that needs to be disturbed during construction will be disposed of in accordance with legal requirements pertaining to controlled waste.

Establishment of the site compound

The main construction compound will be located on hardstanding at Railway Wharf in Reach 5, where the sheet piles are currently being stored. This site has been fenced off, and this will be maintained for health and safety reasons in accordance with legislative requirements, industry good practice and the Contractor's method statements throughout construction until decommissioning of the compound. The site is located in an entry-controlled area, and security will be maintained on a 24 hour basis.

No clearance works were or will be required as the site was already in a suitable condition for use, but staff welfare facilities will be provided.

A satellite compound with staff welfare facilities will be provided on hardstanding for Reach 1 on Arun Parade. Arun Parade will be temporarily closed to traffic for the duration of the works in these reaches. Pedestrian access along the east side of Arun Parade will be maintained (see Chapter 11 – Traffic and Transportation).

A further satellite staff welfare facility will be set up in Reach 6, as required. This is likely to comprise a secure single stand-alone welfare unit.

Main construction activities

Sheet steel piling will be moved by crane and transported from the storage area in Reach 5 by pontoon (i.e. along the river) to the various reaches for installation as piling progresses. All vessel and pontoon movements will be agreed with Littlehampton Harbour Board (the Harbour Board) and would be suspended when commercial shipping is navigating to/from Railway Wharf. Marine and land access to the RNLI station in Reach 3 will be maintained at all times.

Reaches 1 and 2:

The sheet steel pile wall will be installed using a 100-120 tonne crawler crane which will drive the piles in panels using guide frames set up on temporary piles. The piles will be driven using a resonance free vibrating technique and, where needed, a percussion impact hammer will be used to drive the piles to design toe level.

The existing pontoons in Reach 2 will be temporarily re-located by agreement with the Harbour Board to enable piles to be transported by pontoon from Reach 5 and unloaded by the crane. A mobile crane will install the new gangway to the permanent pontoons. A 25 tonne 360^{o} excavator will break out the existing revetment, place backfill material and attend construction of the concrete retaining wall and capping beam.

The crane and excavator will operate from Pier Road, which will be closed to traffic for the duration for the work. A pedestrian access will be maintained next to the businesses on the east side of the road, and provisions will be made to facilitate vehicle deliveries to the businesses during agreed hours to limit disruption to local businesses.

Steel or timber mats will be used to protect basements and the low pressure gas main which runs along Pier Road from heavy equipment movements. If necessary, backfill will be placed behind the new wall as piling progresses to provide passive support to the existing wall and avoid excessive loading on the wall from the crane.

It is envisaged that work will progress linearly from the south end of the Reach 1 heading north. A second piling gang will work concurrently in Reach 2 (again probably heading south to north), in order to minimise the construction period and the disruption to businesses and the public.

Piling will be followed up by installation of the reinforced concrete capping beam. The existing reinforced concrete capping beam will be demolished and the existing promenade paving broken up and removed within the footprint of the proposed new works.

The landscape and public realm works will follow which will comprise the steps and ramps, new surfacing, seating and other street furniture and lighting. The planting would be carried out after the hard landscape works have been completed.

Reach 3:

Due to the closeness of existing buildings to the river wall and consequent lack of access for large equipment, floating plant will be used to install the sheet piles to this reach. To maximise the available working time, a jack up barge and 70 tonne crane will be used. The existing pontoons in front of the wall will be temporarily re-located following discussion with the Harbour Board until the new pile capping is constructed and new risers and ladders are installed.

Sheet piles will be installed in panels and driven using a vibrating technique and potentially a percussion piling to drive the piles to design toe level if necessary. If water jetting is required to drive the piles using the presser, a silt curtain will be used to contain any disturbed chalk in the river.

The piling equipment will be resonance free to minimise vibration to adjacent properties and acoustic shrouds and screening will be provided to try and reduce the impact on receptors.

Due to the lack of working area behind the piles at that stage, placing backfill material will also be undertaken using the jack up barge. Granular material will be delivered by pontoon from Reach 5 in 1 tonne bags, which the crane will lift and empty behind the piles.

Once the backfill material is placed, access for operatives and small equipment will be available from points along the reach to the backfilled area behind the piles. The remaining work (construction of the capping beam, timber access steps, paving, reinstatement of gardens etc) will be undertaken from land using mini excavators, mini dumpers and a static line concrete pump. A pontoon will be used to provide access for operatives to the riverward side of the wall for the capping beam and to install the new pontoon risers and ladders.

Reach 4:

The existing British Telecommunications cable and 11 kilovolt buried cable crossing the river will be located by trial excavation if necessary to ensure piling stops short of the cables.

The sheet piles forming the new flood defence will be installed using a mobile crane and piled from the land. The majority of the installation will use vibro-piling, but some percussion piling may be required to drive the piles to design toe level. This will require a temporary closure of River Road from the junction with Wharf Road to the first residential property to the south. Once piles have been installed, the road will be opened to one-way traffic until the remaining works are completed. The footbridge will remain open during construction.

The concrete retaining wall will be constructed from land. A trench will be excavated for the foundation of the wall using an excavator.

Reach 5:

The Arun View public house may be closed for certain periods during construction. The working periods at the public house will be in agreement with the freeholder and leaseholder. However, it is envisaged that work at the public house will be carried out during the winter of 2013 to 2014, before the start of the tourist season.

Small land based equipment will be used for the construction of the new capping beam and installation of glass panel floodwalls at the public house, and to raise the existing pile cap along Railway Wharf. Work by the public house will be programmed to cause the minimum disruption to the business. Where necessary, access to the riverward side of the wall will be from a small pontoon or workboat.

Reach 6:

Access will be from Reach 5 and using the existing access spur from the roundabout on the A259.

The sheet piles to the downstream section of the reach will be installed using a 25-30 tonne 360º excavator and excavator mounted piling vibrator, working from a temporary access track along the top of the embankment. Piles will be transported from the storage area in Reach 5 using a tractor and trailer. A 25 tonne 360º excavator will attend the sheet piling installation, excavating a narrow and shallow lead trench along the line of the piles. Further excavations may be required to remove buried obstructions. Sheet piles for Reach 6 will need to be delivered by road from the storage location in the main compound in Reach 5. This will require approximately 10 loads.

The excavator will also place the materials for repair to the scour protection. A 25 tonne 360º excavator and dumper will be used for the construction and transport of materials and the possible demolition of the disused sewage treatment works.

Re-aligning the embankment and repairs to the scour protection within the managed realignment is expected to be undertaken from March 2014 onwards during the summer months using 25 tonne 360º excavators, 20 tonne dumper trucks, a dozer and a roller.

The new embankment will be constructed behind the existing one, and the material from existing will be used locally within reach to create suitable levels for saltmarsh establishment.

Scour protection will be provided in the southern part of the reach and along sections of the embankment to be retained using open stone asphalt. Topsoil will be brushed over the surface of the asphalt and seeded to encourage rapid establishment of vegetation and assimilation into the landscape.

Construction plant

The exact specification of plant will be determined by the Contractor and will depend on availability at the time of construction. However, a provisional list of plant has been made for assessment purposes:

- Cranes – two 100-120 tonne cranes plus piling vibrators or percussion hammers working concurrently in Reaches 1 and 2, a 70 tonne crane and percussion piling hammers mounted on jack-up barge for Reach 3 and a mobile crane and percussion piling hammer for Reach 4
- A 25 tonne 360º excavator with mounted piling equipment
- Site dumper trucks – typically one or two 5 tonne dumpers carrying materials within working areas in each reach for the duration of the project
- Jack up barge – (a Seajack or similar) to be present throughout construction of Reach 3 only
- Vessels – two pontoons assembled from ‘Linkflote’ units approximately 25m by10m, plus a river tug to move them from reach to reach
- Other delivery vehicles:
    - Reaches 1 & 2 - total number of vehicle movements to this location amounts to about 1030 over a period from November 2013 to May 2014. This averages about 10 loads per day, though may peak at perhaps 2 or 3 loads per hour. Deliveries may extend beyond May in order to

complete the public realm landscaping works, subject to the final scope of that work.

- Reach 3 - The anticipated number of road deliveries is much smaller to this reach, perhaps 50 in total between January and April 2014, averaging at 3 no per week
- Reaches 4 & 5 - The total number of road deliveries anticipated is 140 to 150 no, averaging at about 7 no per week and peaking at perhaps 2 or 3 loads per day.
- Reach 6 - The total number of deliveries we anticipate here is 1550 in the period March to August 2014. This averages out at about 18 loads per day, but will reach a peak of perhaps 6 no per hour, or one every 10 minutes for a 9 week period in the spring of 2014

- Light goods vehicle for transport of staff to site – typically 10 to 20 private cars per day, all of which will be parked in the main compound in Reach 5 or within the working area in Reach 1

Traffic management, access and car parking

A Traffic Management and Logistics Plan has been prepared to minimise disruption to local residents, visitors and local businesses, and to maintain access and car parking during construction. A draft plan has been prepared and submitted with the planning application (see Chapter 11 – Traffic and Transportation and Appendix I for details). The Contractors will be responsible for agreeing the detail in discussion with West Sussex County Council and for implementing it. Residents and businesses affected by transport disruption will be notified in advance.

The main construction traffic and HGV routes have been identified in the Traffic Management and Logistics Plan. These include the following main roads A27, A259, A284 and B12187. The principal construction routes have been identified to avoid busy shopping areas and narrow residential streets. Surrey Street car park will be unaffected by the construction work. However, all car parking alongside Arun Parade will be closed during works in Reaches 1 and 2 and some seasonal parking will be affected. This has been programmed to avoid the main tourist season as much as possible and alternatives will be advertised.

A number of road closures are planned to facilitate construction activities, these are detailed in Chapter 11. Diversion routes have been identified and these will be clearly signed to minimise disruption.

Construction programme

The programming and timing of construction has been timed both to minimise disruption to the main tourist season, the local community and the local economy, and to avoid conflict with ecological interests. The latter includes the need to minimise noise and vibration from percussion piling in the river, for migratory fish, from April to October, the disturbance of breeding birds between March and August. Disturbance of bats, badgers or reptiles will be avoided or minimised by the prior removal of their feeding, nursery or hibernating habitat and translocation. We intend to start construction of Reaches 1 and 2 in November 2013, which will allow completion of the public realm to largely take place before for the main tourist season, although it may not be possible to complete all works in Arun Parade before July 2014.

The overall construction programme is expected to be as follows:

- Mobilisation, including fencing and preparing the site for construction - October 2013

- Reaches 1 and 2 - approximately 25 weeks, from November 2013 to May 2014. Landscaping and public realm works in Arun Parade may continue beyond this date (until July 2014), subject to the final scope of works agreed. Pier Road will be complete by the end of May 2014
- Reach 3 - approximately 16 weeks, from January 2014 to April 2014
- Reach 4 - approximately 21 weeks, from January 2014 to April 2014
- Reach 5 – approximately 18 weeks from January 2013 to April 2014
- Reach 6 approximately 18 weeks, from March 2014 to August 2014

It is currently proposed that the normal working hours for construction activities will be:

- 8.00am to 6.00pm Mondays to Fridays
- 8.00am to 1.00pm Saturdays
- No working on Sundays or Public Holidays

Deliveries will be further restricted. Deliveries by Heavy Goods Vehicles to the main site compound in Reach 5 will take place only between Monday to Friday 8.00 am to 6.00 pm. Deliveries by Heavy Goods Vehicles to Arun Road and Pier Road in Reaches 1 and 2 will take place only between 9.30 am and 3.00 pm Monday to Friday, and all other deliveries will take place only during normal site working hours, 8.00 am to 6.00 pm Monday to Fridays.

Work and deliveries outside these hours will be permitted only in exceptional circumstances and by arrangement with the Environmental Service Department of Arun District Council and the emergency services.

Commissioning and maintenance

The Environment Agency has statutory permissive powers, but not a duty to construct and maintain works in the interests of flood and coastal risk management. However, we will continue to undertake annual inspections of the tidal flood defences to asset the condition of the flood defences.

Arun District Council will be responsible for the maintenance of the landscaping works in Reaches 1 and 2, which will be subject to a 12 months defects period.

The landscaping in other reaches will be subject to a 5 year maintenance contract.

Monitoring surveys of the reptile receptor site and the realigned saltmarsh will be carried out over a period of 1, 3 and 5 years post works, which will mean surveys being completed in 2015, 2017 and 2019.

Decommissioning

No decommissioning is proposed as part of the scheme. Should the need arise, any decommissioning works will be subject to assessment requirements prevalent at the time.

4 Key issues and methodology

4.1 Key issues

We have defined the scope of the EIA through desk studies, site surveys, workshops and consultations. The desk studies included a review of archaeological and biological records and present and historic land use. The surveys included initial walkover surveys to establish land use and landscape character, a phase 1 habitat survey and specialist surveys designed to determine the presence of protected species, including reptiles and bats, and an archaeological walkover survey. More recent surveys carried out during the detailed assessment are discussed in the relevant chapters of the ES.

As indicated in previous chapters, workshops were held with statutory and non-statutory consultees during the earlier design stages. Details of the scheme and the proposed scope of the assessment was presented to statutory and non-statutory consultees through workshops held during outline design, and through consultation on the Scoping Consultation Document, which presented the results of our preliminary investigations. The final scope adopted for the EIA is that included in the Scoping Report (provided in Appendix A). Natural England provided confirmation that the proposal would likely lead to an environmentally acceptable solution, and that the scheme is unlikely to require an Appropriate Assessment in February 2011. This has been confirmed by the subsequent ecological assessment.

We also undertook a public consultation on the scope of the EIA, which was advertised in local newspapers and on our website, in January / February 2013.

The main issues that that have been scoped into the EIA are:

- Acoustics and vibration, during construction
- Archaeology and heritage
- Biodiversity
- Ground conditions
- Land use and socio-economy
- Traffic and transportation, during construction
- Water resources and flood risk

Other issues that have also been addressed are:

- Air quality during construction
- Material assets and waste

Planning issues and cumulative impacts have also been addressed.

No impacts due to noise or vibration or on air quality are envisaged during operation of the scheme and we have therefore scoped these issues out of further assessment.

We have further refined the scope of the issues to address only those issues identified as potentially significant. A summary is provided in the Table 4.1.

Key issue	Surveys undertaken	Assessment method
Acoustics and vibration: Impacts on residential receptors, visitors and property during construction.	Baseline survey of noise at representative potentially sensitive receptors sites	Noise calculations and assessment based on classifications proposed by Institute of Acoustics / Institute of Environmental Management and Assessment Joint Working Party, 2002
Archaeology: Impacts on the setting of a Conservation Area and on unrecorded remains in the intertidal area.	Cultural heritage appraisal of known heritage and previous archaeological studies Monitoring and interpretation of Ground Investigations	Archaeological desk based appraisal and walkover survey
Biodiversity: Impacts on inter-tidal habitat, reptiles, bats, badgers, water voles and invasive species.	Baseline Phase 1 habitat survey, survey of reptiles, water voles and assessment of bat potential of trees. No survey of aquatic invertebrates, great crested newts or other protected species required.	Surveys and assessment based on Guidelines for Baseline Ecological Assessment, prepared by the Institute of Environmental Assessment (IEA), 1995 Assessment based on Guidelines for Ecological Impact Assessment in the United Kingdom, The Institute of Environmental Management (IEEM), 2006
Landscape, townscape and visual issues: Impacts (positive and negative) on local townscape and landscape character, and loss of views for residents and visitors.	Landscape and visual assessment undertaken. Arboricultural survey undertaken.	Landscape and Visual Impact Assessment based on Guidelines for Landscape and Visual Impact Assessment (Landscape Institute/Institute of Environmental Assessment, 3rd Ed 2013) Tree survey undertaken in accordance with BS 5837
Land use: Impacts on residents, visitors and local businesses. Loss of privacy to householders and changes to access to the water.	Survey of existing land use.	Qualitative assessment
Ground conditions: Potential release of contaminants during construction	Desk-based geo-environmental report using historical land use data and detailed ground investigations undertaken	Risk assessment of contaminated land
Water resources and flood risk: Impact on water quality during construction and long term impacts on water flow in the Arun. Impacts on flood risk in Littlehampton.	None required, but existing models (such as Arun to Pagham Strategy) used to inform flood risk assessment	Water Framework Directive assessment undertaken Flood Risk Statement prepared

Key issue	Surveys undertaken	Assessment method
Traffic and transportation: Impact on local roads and road users during construction.	None required	Based on a Traffic Management and Logistics Plan prepared for the scheme. Quantification and evaluation of traffic generated. Qualitative assessment
Other issues: Air quality (impacts from construction plant and activity) Material assets (use of construction materials and generation of waste)	None required	Qualitative assessment and proposal of measures to avoid impacts Quantification of materials. Evaluation of sources, recycling options and waste receptor sites

Table 4.1 Scope of issues covered

4.2 Generic method of assessment

In assessing the impacts, we have followed the same overall process for all issues:

- Identification and evaluation of the existing environment at the site and its environs
- Consideration of potential causes and magnitude of impacts from the scheme
- Assessment of the level of significance of potential impacts, taking account of the sensitivity of resources and the magnitude of impacts
- Identification of mitigation measures
- Assessment of the level of significance of residual impacts, taking account of any mitigation measures

Existing environment

We assessed each environmental issue in relation to a 'baseline'. The 'baseline' normally reflects the existing situation and how this would change if the development did not go ahead (the future or projected baseline).

We collected information on baseline conditions through site visits, a review of maps, data, records and reports obtained during desk-based assessments or through consultation with statutory or non-statutory consultees and through a variety of site surveys as indicated in the Table 4.1. The study area for each assessment was defined as the area within which impacts would normally be expected. This varies from issue to issue and is therefore described in each chapter.

The description of baseline includes an evaluation of the value or sensitivity of specific environmental resources and receptors potentially affected by the development. Value and/or sensitivity has been generally defined according to the relative importance of the feature, i.e., whether it is of national, regional, local or less than local importance, or by the sensitivity of the receptor (for example, in the assessment of noise or air quality). The specific criteria we used to define value and/or sensitivity are presented for each environmental factor in the relevant assessment chapter.

Likely significant impacts

We have described the nature of likely or potential impacts arising from the development and defined an objective assessment of the level of significance of each impact as far as practicable.

There is no accepted universal definition of what constitutes a significant impact. The definition varies according to the environmental factor under consideration and the context in which the assessment is made. Much depends on the availability of data relating to existing environmental conditions and the value applied to these conditions. However, in general, the level of significance of impacts has been defined using a combination of the sensitivity or value of the receiving environment and the magnitude of impact, each of which having been assessed independently according to defined criteria. The terms used and the number of categories may vary from parameter to parameter, but an example of this system, which can be applied equally to both positive and negative impacts, is provided in Table 4.2.

Magnitude	Sensitivity/Value		
	High	Medium	Low
High	Major	Moderate	Slight
Medium	Moderate	Slight	Negligible
Low	Slight	Negligible	None
Negligible	Negligible	None	None

Table 4.2 Impact significance based on value of receptor and magnitude of impact

Sensitivity or value has generally been defined according to the relative importance of the feature, i.e., whether it is of national, regional, local or less than local (for example, in the assessment of biodiversity, cultural heritage or landscape) or by the sensitivity of the receptor (for example, in the assessment of air quality, noise, visual amenity and water quality). In the definition of magnitude of impact, we have given consideration to any legislative or policy standards or guidelines, and/or the following factors:

- The nature of change, for example, whether the environment or receptor has been enhanced or impaired (generally defined as positive or negative)
- The size of the change, for example, the area of land or number of people affected and the degree of change from existing conditions
- The scale of change resulting from impacts or the degree of change from existing conditions
- Whether the effect is temporary or permanent (generally defined as short, medium or long term)
- Whether there are any cumulative effects
- Direct, indirect and secondary effects have also been taken into account.

The significance of impacts has been defined for each environmental issue in the individual chapters of this ES.

Compliance with legislation or contribution towards achievement of policy or plan guidance or objectives has also been discussed where relevant.

Mitigation

We have adopted an approach to mitigation measures that is consistent with guidance provided in *The Preparation of Environmental Statements for Planning Projects that require Environmental Assessment – a good practice guide (HMSO, 1995)*. This considers mitigation as a hierarchy of measures ranging from prevention of environmental impacts by avoidance down to compensation for effects that cannot be remedied. The mitigation hierarchy is summarised in Table 4.3.

Mitigation approach	Purpose
Prevention	To prevent adverse environmental impacts at source, for example, through choice of site, site layout or design, or specification of construction methods
Reduction	If adverse impacts cannot be prevented, steps taken to reduce them through methods to minimise the cause of impact at source, to abate impacts on site or abate impacts at receptor location
Remedy/Offset/ Compensation	When impacts remain that cannot be prevented or reduced, they are offset by remedial or compensatory action such as provision of environmental improvements, opportunities for access and informal recreation, creation of alternative habitats or recording of archaeological features

Table 4.3 Mitigation hierarchy

The approach to the mitigation of adverse impacts for this scheme has been to avoid them wherever possible. This has been achieved by consideration of ways in which to prevent adverse impacts at source rather than relying on measures to mitigate the impacts. For the proposed scheme, this has entailed consideration of the type of defence structure proposed, the provision of access arrangements for pedestrians, by the proposal of construction equipment or by the specification of methods or timing of construction for inclusion in the contract documents.

Where avoidance is not feasible, we have proposed measures to minimise or reduce potential impacts through abatement measures. This abatement can be undertaken either at source, at site (for example, through the use of screening to minimise noise), or at the receptor (for example, through the use of protection or relocation of sensitive animal species).

Where adverse impacts cannot be prevented or reduced, we have specified ways by which any damage can be offset, or compensated for.

Some of the mitigation measures specified have already been incorporated within the design proposals. Others will be incorporated by means of contract documents. Wherever possible, we have sought the necessary agreements with statutory or other bodies. Where this has not been possible, the necessary agreements will be sought at the appropriate time. Any uncertainties associated with the proposed mitigation measures have been identified in the text.

We have collated all mitigation measures that are material to the outcome of the scheme within an Environmental Action Plan that will be implemented and monitored prior to, throughout and following construction. This will form part of the contract document.

Residual impacts

Residual impacts are impacts that will remain after mitigation has been taken into account. The assessment of residual impacts presents the impacts after mitigation has been taken into account. We have clearly stated where there is any uncertainty as to whether a specific measure can be successfully implemented or the precise details have not been fully defined at present. In these cases we have defined the range of potential impacts with and without mitigation.

Within the assessment of residual impacts, we have determined as far as practicable the level of significance of each effect, as defined under 'Likely significant impacts'.

Cumulative impacts

We have considered cumulative impacts in two ways. Firstly in terms of different types of environmental impacts of the scheme on a specific environmental receptor (such as noise, visual impacts and air quality on local people), and secondly in terms of cumulative impacts affecting environmental receptors resulting from the proposed scheme in combination with impacts from other nearby committed developments or schemes.

In this case, there are two other developments that have been considered. These are the redevelopment of two buildings comprising Riverside Autos and the adjacent former engineering works. Redevelopment of the former engineering works is currently underway and this has therefore been taken into account as future baseline; the proposed scheme has been designed to accommodate this development. We have also held discussions concerning the redevelopment proposals for Riverside Autos. Whilst no planning application has been made to date, the future redevelopment of this site has also been taken into account in the design proposals. An allowance has been made for any uncertainties, should this project not proceed as expected. If the redevelopment does not go ahead as envisaged, changes will be made to the design to ensure an adequate standard of flood defence is achieved consistent with the rest of the scheme. It is envisaged that any impacts associated with the redevelopment of the site, will be addressed in any future planning application for that site.

An option is also being considered by West Sussex County Council to raise the level of Pier Road in Reach 2. If this goes ahead, the work will be advanced under the permitted powers of West Sussex County Council and it is likely to be constructed in conjunction with the proposed public realm works. The proposed scheme has been designed so that it can accommodate any such works to the road, should the option be progressed. Although not yet committed, this work has been considered in the assessment of cumulative impacts.

No other committed developments have been advised. Therefore, the assessment of cumulative impacts has focused on the cumulative impacts of the whole scheme on specific environmental receptors, and the cumulative impacts associated with any future raising of Pier Road in combination with the proposed flood defence scheme.

It should be noted that in some cases, the impacts associated with different issues or developments may ameliorate the impact on a receptor. In other cases, the cumulative effect of different impacts may be considerably more damaging to sensitive receptors than the sum of the separate impacts. This is considered in Chapter 14 – Cumulative Impacts and Inter-relationships.

Long-term management and maintenance

We have outlined the principles for any management and maintenance works required for each environmental issue in the following chapters of this ES. Any maintenance or monitoring requirements that are material to the outcome of the scheme have been summarised in the relevant mitigation section of each chapter.

Changes to the design

We have based the assessment on the proposed scheme as described in this ES. Although no major changes are predicted, the design and environmental mitigation measures as defined in the following chapters of this ES may be refined and further developed as the scheme progresses through construction, for example, if unforeseen ground conditions are found or for other unforeseen reasons. This may result in changes or additions to the design of the scheme as published in this document. In the main, any design changes will seek to develop the design in a manner such that there are no material changes to the environmental impacts as predicted. Indeed, opportunities may be identified that will reduce the impact of the scheme. Any design change that would result in any environmental impact significantly worse than those published in this ES would require an Addendum to be published.

5 Acoustics

This chapter addresses impacts from noise and vibration relating to the construction of the scheme. The assessment addresses potential impacts on humans and fish species. Impacts of noise on birds are addressed in Chapter 7 - Biodiversity. The study area for humans covers the area immediately adjacent to Reach 1 to Reach 6 south of the A259 bridge over the River Arun. The rest of Reach 6 has been specifically excluded as there are no residential properties nearby. Works in the vicinity of the A259 bridge itself are unlikely to present any noise or vibration impacts to the bridge itself given the scale of the structure, although this will be kept under review during the construction activities. The study area for fish includes the waters of the River Arun, where it passes adjacent to the scheme.

During operation of the scheme, there will be a requirement for periodic inspections and maintenance works only, which are not envisaged to give rise to significant levels of noise or vibration. Operational noise has therefore been scoped out of the assessment.

The assessment has been based on calculations of noise and vibration associated with the construction. Detailed noise calculations and the evaluation criteria used to assess the significance of impacts on receptors are presented in Appendix D.

5.1 Existing environment

We undertook an environmental noise survey to establish baseline conditions on the 13th November 2012. The location and measurement methodologies were agreed in advance with Graham Evans from the Environmental Services Department of Arun District Council.

We took noise measurements in accordance with the methodology in British Standard 7445-1: 2003 ‘Description and measurement of environmental noise Part 1 Guide to quantities and procedures’. Microphone readings were taken between 1.2 and 1.5m above the ground and at least 3.5m from any reflecting structure. Weather conditions during the survey (dry with wind speeds of below 3m/s at all times) were acceptable for the measurement of environmental noise. All measurements were undertaken between 7 am and 4 pm on weekdays.

No measurements of existing vibration have been undertaken.

Receptors

The receptors used for the environmental noise baseline survey were as follows:

- The Marina View Chalet developments on the west bank of the Arun
- The Arun View public house car park in line with the riverside facade of the public house
- At the northern end of the riverside walkway to the rear of residential development on River Road
- At the southern end of the riverside walkway opposite 46 Pier Road

These locations are representative of the sensitive receptors in the proposed working areas. The full results of the survey are presented in Appendix D. A summary is shown in Table 5.1.

Location	Average $L_{Aeq, dB}$	Average $L_{A10, dB}$	Average $L_{A90, dB}$	L_{AMax}, dB
Marina View Chalets, Littlehampton Marina	57.8	57.2	52.7	82.0
Arun View Public House car park	58.6	59.1	53.8	82.7
Riverside walkway north end	53.3	54.9	48.4	74.6
Riverside walkway south end, opposite 46 Pier Road	58.7	61.8	46.1	82.2

Table 5.1 Summary of existing noise levels at chosen monitoring locations

Other sensitive receptors include fisheries within the River Arun, notably, species such as sea trout and European eel. These species are migratory and sensitive to noise, although each species displays behavioural responses (ranging from avoidance to mortality) to a specific frequency range, and the sensitivity of each species varies according to the time of year, day and tidal cycle.

A full description of the criteria used to define the sensitivity of receptors to noise is provided in Appendix D.

5.2 Likely significant impacts

Noise

There will be some disturbance from noise that will affect those people living nearby during construction. However, disruption due to construction is generally a localised phenomenon and temporary in nature.

We have calculated construction noise levels to show potential noise levels at the closest residential receptors from the construction works. The calculations have been based on a list of the major plant and equipment likely to be used during construction as provided by the Contractor (see Appendix D), and the distance to the receptors. Full calculation results are provided in Appendix D. A summary is presented in Table 5.2.

Reach	Element of construction	Distance to nearest receptor (m)	Calculated worst case noise levels, dB	Approximate duration of works
Reach 1	Vibro- piling & Percussion Piling	15	90.0	80 Days
	Earthworks/ Backfill	20	68.0	80 Days
	Concreting	20	67.4	70 Days
Reach 2	Vibro – piling & Percussion Piling	10	93.0	70 Days
	Earthworks/ Backfill	10	74.0	60 Days
	Concreting	10	73.5	50 Days
Reach 3	Vibro-piling	5	86.4	30 Days
	Percussion Piling	5	80.5	30 Days
	Earthworks/	5	79.3	5 Days

Reach	Element of construction	Distance to nearest receptor (m)	Calculated worst case noise levels, dB	Approximate duration of works
	Backfill			
	Final Construction	5	75.9	50 Days
Reach 4	Vibro-piling	5	86.4	10 Days
	Percussion Piling	5	80.5	10 Days
	Earthworks/ Backfill	5	79.3	15 Days
	Final Construction	5	75.9	30 Days
Reach 5	Final Construction	30	60.4	40 Days
Reach 6	Piling	120	54.7	60 Days
	Scour Protection	95	43	30 Days

Table 5.2 Summary of calculated noise levels from construction works

We have defined the magnitude of impact in accordance with the classifications established in draft by the Institute of Acoustics / Institute of Environmental Management and Assessment Joint Working Party in 2002. Although in draft, this classification system has been used for this assessment as it is still considered valid and has been accepted for use by the Local Authority.

Both the magnitude and the significance of potential impacts are shown in Table 5.3. An explanation of the criteria used to define magnitude and significance of effect is provided in Appendix D.

Reach	Element of construction	Increase over ambient L_{Aeq}	Sensitivity of receptor	Impact magnitude	Impact significance before mitigation
Reach 1	Vibro Piling & Percussion Piling	30	Low	Major Negative	**Minor averse – moderate averse**
	Earthworks/ Backfill	8	Low		
	Concreting	7	Low		
Reach 2	Vibro Piling & Percussion Piling	32	Low		
	Earthworks/ Backfill	14	Low		
	Concreting	13	Low		
Reach 3	Vibro Piling	31	Low		
	Percussion Piling	26	Low		
	Earthworks/ Backfill	24	Low		
	Final Construction	21	Low		

Reach	Element of construction	Increase over ambient L_{Aeq}	Sensitivity of receptor	Impact magnitude	Impact significance before mitigation
Reach 4	Vibro Piling	31	Low	Major Negative	**Minor averse – moderate averse**
	Percussion Piling	26	Low		
	Earthworks/ Backfill	24	Low		
	Final Construction	21	Low		
Reach 5	Final Construction	0	Low	Negligible	**No significant Impact**
Reach 6	Vibro Piling	-5	Low		
	Rock Revetment	-3	Low		

Table 5.3 Summary of noise impact significance from construction works

In summary, there is potential for the closest residential receptors in Reaches 1 to 5 to be affected by adverse impacts of **minor to moderate adverse significance** due to noise for a period of up to 80 days during construction.

The impact of noise on fish species is species-specific, with each species displaying a different behavioural response to a specific range of noise frequencies and amplitude. Factors that affect the response in any one species will therefore depend on the type of construction equipment used, how it is used, the distance from source to receptor and the transmittance qualities of intervening ground/water. Both sea trout and European eel are sensitive to noise from construction, and piling in particular, and both species are migratory. However, discussions with the fisheries specialists in the Environment Agency confirm that they concur with the research undertaken showing that there is no discernible effect on fisheries from vibro-piling. It has therefore been agreed that there will be no impact on the fish stocks or movement in the river as a result of vibro-piling during any season. This method of piling is proposed along the majority of the reaches.

However, where percussion piling is required in order to drive piles to refusal (i.e., for the last few metres of the piles), there is the potential for significant impacts on certain fish species, namely sea trout and Europeans eels. The behavioural response will depend on the frequency of sound, the type of substrate (ground conditions and transmittance qualities) and the distance between the source and the receptor. Given the restricted width of the river, at minimum, some form of avoidance response would be expected where percussion piling occurs during the migration season.

Vibration

Piling operations are also likely to give rise to vibration. Given that piling operations will take place within up to 5m of residential property in some reaches it is likely that this will cause some degree of impact, although it is proposed that resonant-free vibrators are used wherever possible. These have been successfully used in similar circumstances in close proximity to residential property and other sensitive structures. We have made calculations using the methods contained within BS5228:2009-2 for vibratory piling, to determine the level of impact on buildings and residents, using a 50% probability of the figures noted being exceeded. The results are presented in full in Appendix D and summarised in Table 5.4.

It should be noted that given the method of calculation, and the methods of construction to be employed on the scheme, with vibro-piling being used where possible and percussion piling only being used where vibro-piling will not achieve the desired depth of penetration, vibro-piling apparently generates higher levels of vibrations in the surrounding environment than percussion piling. This is because in order to calculate the impact from vibro-piling, the distance is based on a straight line distance between the line of piles and the receptor, whereas for percussion piling, the distance is based on the slope distance from the toe (or bottom) of the pile to the receptor. As a result Table 5.4 reports the impacts from vibro-piling, which are considered to be the worst case impacts in terms of vibration generation.

Reach	Calculated vibration level PPV (mm/s)	Impact on buildings (BS5228:2009-2)	Impact on residents (BS5228:2009-2)
Reach 1	1.2 mm/s	No Impact	Above a level likely to cause complaint, but can be tolerated if prior warning and explanation has been given, but lower than an intolerable level
Reach 2	1.2 mm/s	No Impact	
Reach 3	7.4 mm/s	No Impact	
Reach 4	7.4 mm/s	No Impact	
Reach 5	No Piling Activities	No Impact	No perceptible impacts
Reach 6	0.1 mm/s	No Impact	Vibration might just be perceptible

Table 5.4 Summary of vibration impact significance from construction works

5.3 Mitigation

During construction we will minimise impacts due to noise and vibration as far as practicable through the adoption of suitable mitigation measures. These will include:

- Restriction of working hours to 8.00am to 6.00pm Mondays to Fridays, 8.00am to 1.00pm Saturdays and no working on Sundays or Public Holidays, in line with the recommendation from Arun District Council
- Programming and phasing the works over a number of stages to restrict impacts within any one area to the minimum time, and to minimise works within Reaches 1 and 2 during the main tourist season
- Submission of a more detailed application under Section 61 of Part III of The Control of Pollution Act 1974 to Arun District Council to detail the construction operations and their impacts in terms of the noise and vibration impacts
- The adoption of Best Practicable Means as defined in the Control of Pollution Act 1974, which is usually the most effective means of controlling noise from construction sites. This generally entails the employment of good site practice to minimise the noise and vibration impacts from the works
- If available, using shielded percussion piling hammers, which will reduce noise levels generated from percussion piling by the order of 10dB
- Using screening around piling equipment and maintaining plant in good operational condition with all engine covers and noise control measures as provided in place

- Keeping local residents and property owners fully informed about the nature and timing of the works, including compound locations and traffic controls, via such means as newsletters or individual contact, where appropriate
- Adoption of Considerate Contractors scheme and having a representative available on site during working hours to answer queries or address any concerns expressed
- Careful selection of equipment, for example any compressors brought to site will be super-silenced or sound reduced models fitted with acoustic enclosures or any pneumatic tools will be fitted with silencers or mufflers wherever practicable
- Careful consideration will be made of the site layout in Reaches 1 and 2 in order that any noise impact at nearby sensitive properties is minimised. Where possible this will include the minimisation of vehicle reversing, the elimination of vehicle waiting outside of residential property, and the orientation of the site layout to ensure that the noisiest activities are either located farthest away from residential property, or are shielded in part from the residential properties by other uses within the site (such as site offices)
- Localised use of hoardings and portable barriers. These will be erected by agreement to shield particularly noisy activities along the areas of Reaches 1 and 2 close to residential property and where stationary generators, concrete pumps and concrete breaking activities are required. Hoardings and portable barriers will not be effective against noise from vibro-piling works at the early stage of insertion of each pile given the potential height of the noise sources. It may be effective against percussion piling on the site where this is being used in the last metre or so in order to drive the sheet piles to refusal, but will be less effective on King Piles where these will have to be percussion hammer driven for a much greater depth.
- All plant and equipment will be properly maintained and operated in accordance with manufacturers' recommendations and in such a manner as to avoid causing excessive noise
- Equipment will be shut down when not in use for a period longer than 5 minutes
- No vehicles will wait or queue on public highways with engines running
- Deliveries will be restricted to daytime hours, during the working hours of the sites and will be routed so as to minimise disturbance to local residents; care will be taken when unloading deliveries and vehicles will be prohibited from waiting on site with their engines running
- Load restraints will be put in place for vehicles on the highways network
- Where elevated levels of vibration are predicted to occur, and vibro- or percussion piling techniques are to be employed, pre construction condition surveys will be undertaken to ascertain the stability of the structure and its potential resistance to vibration. If the property is shown to be susceptible, alternative piling methods should be employed if possible and where ground conditions permit, and, in any case, regular vibration monitoring shall be undertaken at or near the foundations of sensitive buildings to ensure that adequate levels of control are being employed. In addition, we will undertake regular noise monitoring on a four-weekly basis or as required by Arun District Council to ensure compliance with the levels agreed by Arun District Council.

All of the measures listed above will be included in the Environmental Action Plan. The Contractor will be obliged to adhere to these measures. These will help to control the noise levels produced by the construction works on the site, and will reduce noise impacts from the construction works by up to 5dB.

Construction Programme

Construction activities will be programmed to avoid work during the main tourist season in Reaches 1 and 2.

Timings will also aim to avoid adverse impacts on fish. Where vibro-piling methods are proposed, no mitigation will be required. Where percussion piling is unavoidable (due to ground conditions) work will be undertaken during the winter (November to March) during daylight hours. For any work extending into April, river water temperature will be monitored. If the temperature of the water exceeds 10 deg C, further mitigation for percussion piling will be needed. Measures will be discussed and agreed with Environment Agency specialists at the time. In Reach 4, this could include working at low tide, or cushions or baffles around the piles. Similar mitigation will be required for any works starting earlier than November where percussion piling is required.

Further measures that will be considered to mitigate the impacts of noise for both human and marine receptors include slow start techniques which minimise the initial pulse from vibration operations.

Wherever possible, works will be undertaken in a manner that will minimise the effect of vibration on the built environment and local residents. From calculations undertaken it is clear that the effects of vibration on residential properties will be managed to acceptable levels and, whilst the vibration levels will be noticeable to local residents, the levels will be unlikely to cause impacts on residential structures, unless there are pre-existing faults with those structures.

5.4 Residual impacts

The restriction of construction activities to minimise works during sensitive times of the year for tourists and ecological interests, and restriction of the working days and hours for residents and ecological interests, coupled with application of further measures as listed above, will help to avoid adverse impacts or reduce noise levels and nuisance for all sensitive receptors.

Vibro-piling will not result in any adverse impacts on fish during any time of the year. Any remaining risk as result of a need to use percussion piling methods outside the November to March window will be mitigated by the application of further measures such as water temperature monitoring, and further measures to be agreed with Environmental Agency specialists at the time such as the use of cushions or baffles or by adjustment of the working methods under ecological supervision to ensure no significant impact on fish behaviour or well-being. It is envisaged that there will be **no residual impact** on fish.

It is estimated that the mitigation measures will reduce noise levels by up to 5dBA for residential receptors. This will not be sufficient to reduce the significance of impacts affecting the closest residential receptors. The closest residents could be affected by impacts of **minor** to **moderate significance**, particularly where percussion or vibro-piling is used.

Where piling occurs in Reaches 3 and 4, there is the potential for elevated vibration impacts, which could be mitigated completely by press piling techniques if these

techniques are feasible. Where these techniques are not feasible there is likely to be adverse impacts of **minor to moderate adverse significance.**

Noise impacts for the other works will be elevated over existing noise levels but will be temporary in nature, such that each residential receptor may only be exposed to elevated noise levels for periods from a few days to a few weeks at an individual receptor.

Coupled with the short duration of the works, good site practice and advance and continuing communication through the project with residents, nuisance will be reduced to a minimum, albeit that this is likely to be of **minor to moderate adverse significance**.

6 Archaeology and heritage

This chapter addresses issues relating to archaeology and cultural heritage associated with the scheme. The key issues associated with construction comprise:

- Vibration impacts to locally listed buildings and structures in Reaches 1 and 5
- The removal of the historic railings in Reach 4
- The removal of the historic embankments in Reach 6 Realignment
- Potential impacts to unknown paleoenvironmental resources along the line of the scheme

Key issues associated with the operational phase are:

- Impacts to potential paleoenvironmental and archaeological deposits in Reach 6 Realignment
- Impacts to known archaeological features in the foreshore in Reach 6 Realignment
- Added protection to River Road Conservation Area and listed buildings within it

We have based the assessment on an archaeological appraisal, a walkover and foreshore survey, geotechnical results, archaeological reports, historic maps and up-to-date cultural heritage datasets. A comprehensive list of the sources used is presented in Appendix E.

The value of each cultural heritage receptor has been established using the criteria outlined in Table 6.1, while the magnitude of the impact has been defined in Table 6.2.

Value	Criteria
Very High	World Heritage Sites (including buildings and those inscribed for their historic landscape qualities) Assets of acknowledged international importance Assets that can contribute significantly to acknowledged international research objectives
High	Scheduled Monuments (inc. with standing remains) Designated historic landscapes of outstanding interest Undesignated assets of schedulable quality and importance Assets that can contribute significantly to national research objectives Grade I and II* Listed Buildings Other Listed Buildings that can be shown to have exceptional qualities in their fabric or historical associations Conservation Areas containing very important buildings Undesignated structures of clear national importance Undesignated landscapes of outstanding interest, high quality or importance and of demonstrable national value Well-preserved historic landscapes, exhibiting considerable coherence, time-depth or other critical factors

Value	Criteria
Medium	Designated or undesignated assets that contribute to regional research objectives Undesignated historic landscapes that would justify special historic landscape designations, or landscapes of regional value Averagely well-preserved historic landscapes with reasonable coherence, time-depth or other critical factor Grade II Listed Buildings Conservation Areas containing buildings that contribute significantly to its historic character Historic Townscape or built-up areas with important historic integrity in their buildings, settings or built settings
Low	Designated and undesignated assets of local importance Robust undesignated historic landscapes and historic landscapes with importance to local interest groups Historic landscapes whose value is limited by poor preservation and/ or poor survival of contextual associations Assets compromised by poor preservation and/or poor survival of contextual associations Assets of limited value, but with potential to contribute to local research objectives 'Locally Listed' buildings Historic (unlisted) buildings of modest quality in their fabric or historical association Historic Townscape or built-up areas of limited historic integrity in their buildings, or built settings
Negligible	Assets with very little or no surviving archaeological interest Buildings of no archaeological or historical note, or buildings or an intrusive character Landscapes with little or no significant historical interest
Unknown	The importance of the resource has not been ascertained, or buildings with some (hidden) potential for historical significance

Table 6.1 General criteria for classifying the value or sensitivity of environmental resources or receptors

Magnitude	Definition
Major negative	Change to most or all key archaeological materials, such that the resource is totally altered Comprehensive changes to setting
Moderate negative	Changes to many key archaeological materials, such that the resource is clearly modified Considerable changes to setting that affect the character of the asset
Minor negative	Changes to key archaeological materials, such that the asset is slightly altered Slight changes to setting
Negligible	Very minor changes to archaeological materials, or setting
No change	No change
Minor positive	Small beneficial change to extant or buried archaeology or historic structure, for instance from added protection to a light improvement in setting from a superior design compared with the existing
Moderate positive	Better and long-term protection added to archaeological monument or historic structure, and/or an improvement to the receptor's setting
Major positive	Superior and very long-term protection afforded to historic structure or archaeological monument, with a great improvement to the setting of the receptor from an improved design and/ or removal of existing feature which is detrimental to setting

Table 6.2 General criteria for classifying the magnitude and nature of environmental effects

The significance of impacts has been defined using the approach described in Chapter 4 – Key Issues and Methodology, using the matrix shown in Table 6.3.

Magnitude	Sensitivity/Value		
	Very High/High	Medium	Low/Negligible
High or Major	Major	Moderate	Minor
Medium or Moderate	Moderate	Minor	Negligible
Low or Minor	Minor	Negligible	None
Negligible	Negligible	None	None

Table 6.3 Impact significance based on sensitivity or value of receptor and magnitude of impact

The study area includes the area shown on Figures 6.1 to 6.7, which includes assets that lie beyond the immediate boundary of the scheme in order to provide information on the wider historic context.

6.1 Existing environment

Key archaeological receptors in the study area are summarised in Table 6.4. The locations of all features described are shown in Figures 6.1 to 6.9.

Reach	Name	Description
n/a	Littlehampton Fort	Scheduled Monument on the west bank of the Arun
1	Lighthouse	Locally listed building at the south end of Arun Parade
1 (abutting)	East Pier	The northern end of the locally listed pier abuts Reach 1
1 and 2	South Terrace Area of Special Character	A local group designation indicating an area of non-statutorily listed historic buildings
2	Cadet HQ, Pier Road	A locally listed building fronting on to Pier Road
3	The Cairo Club listed building	Grade 2 Listed building adjacent to the 'Look and Sea' Centre in the Old Harbour area
4	Riverside Autos	Locally listed building with historic river wall
4	Railings	Iron railings on pedestrian bridge and on quay wall at Ferry Wharf
5	The Arun View public house	Locally listed building by the footbridge which forms part of the river wall
3 and 4	River Road Conservation Area	Designation encompasses historic core of Littlehampton and development (historic and modern) either side of River Road, abutting the river frontage
5 and 6	Former wharf	Visible on historic maps at the intersection between Reaches 5 and 6. Now filled in and lies under an industrial estate
R6 Realignment	Lime kiln	An old lime kiln noted on historic OS maps. No above ground traces left and positioned at edge of modern road embankment
1-6 (including R6 Realignment)	Potential buried palaeoenvironmental deposits	Likely buried/ submerged resource representing relict courses of the River Arun
1-6 (including R6 Realignment)	Potential buried archaeology	Possible buried resource most likely to represent post-medieval and modern features in Reaches 1-4, but potential earlier features in Reach 6

Table 6.4 Summary of key archaeological receptors

Statutory and non-statutory designated heritage assets

Scheduled Monuments

There are no Scheduled Monuments (SMs), World Heritage Sites, Historic Parks or Gardens or Registered Battlefields along the line of the defences.

The Littlehampton Fort SM lies on the west bank of the River Arun, just over 100m south west of Reach 1 (Figure 6.1). This has a high heritage asset value.

Listed Buildings

There are 11 listed buildings on the east bank of the study area. These represent a cluster of 18th and 19th century buildings around the historic core of Littlehampton, which lies to the east of Reach 3. The nearest building is a former residence, recently known as the Cairo Club, and lies 40m away (Figures 6.1 and 6.2). All the buildings are Grade II listed. These have a medium heritage asset value.

River Road Conservation Area

The scheme overlaps with the River Road Conservation Area in Reaches 3, 4 and 5. The Conservation Area covers the historic core of the town (including the listed buildings mentioned above) and the historic and modern properties either side of River Road. The designation abuts the river (Figure 6.1). The designation has a medium heritage asset value.

Locally Listed Buildings

There are three buildings on the Arun District Council (ADC) local list of 'buildings or structures of special character' within the scheme boundary (Figure 6.1). These are:

- Reach 1: the lighthouse at the southern end of Arun Parade
- Reach 4: Riverside Autos, an historic building with historic river wall, currently subject to redevelopment which will retain the historic wall
- Reach 5: The Arun View, a public house and restaurant, the riverside extension to which abuts the river wall

East Pier is also locally listed and abuts the southern edge of the scheme boundary (Reach 1).

These are local designations and therefore merit a low heritage asset value.

Special Character Areas

Arun District Council has also composed a list of Areas of Special Character (ASCs) (Figures 6.1 and 6.2) within towns, the criteria for designation of which are set out in the supporting appendix (Appendix E). The South Terrace ASC abuts the intersection of Reaches 1 and 2. This is composed of mostly residential terraces of a distinctive build. These are chiefly late 19th and early 20th century three or four storey brick-built structures. This is a designation with a low heritage asset value.

Local Studies

The West Sussex Extensive Urban Survey (EUS) is an historic urban character (HUC) and archaeological character study of the towns in the county (Figure 6.7). A county wide Historic Landscape Characterisation (HLC) has also been undertaken (Figure 6.6), which assesses the historic character of the landscape and its time-depth properties. The HUC and HLC zones are not designations, but rather areas of historic town groupings and classifications, and therefore are not receptors, and do not merit a heritage asset value.

These studies have synthesised a very wide array of historical and archaeological data for the town.

Non-designated heritage assets

Known Archaeology

There are no known archaeological sites along the footprint of the scheme. However, 10 non-designated archaeological sites or heritage features lie in its vicinity:

- Reach 1: the former site of a windmill (MWS 3115) along Arun Parade
- Reach 3: Harbour Saw Mill (MWS 3107) and the old harbour with wharf (MWS 7055) in the Town Quay, Lifeboat Slipway and Residential Parade area
- Reach 4: The site of the former Swing Bridge (MWS 5736) in the area just to the south of the footbridge

- Reach 4: historic cast iron railings around the quay wall at Ferry Wharf and on the eastern lip of the pedestrian bridge. These lie within the River Road Conservation Area
- Reach 6: The extant remains of water treatment facilities, by the embankment near the roundabout within Reach 6 Realignment
- Reach 6: a disused winch within Reach 6 Realignment, presumably once used as a winch for river boats on a slipway
- Reach 6: probably wharf area at the intersection of Reaches 5 and 6. Visible on Ordnance Survey maps from 1876 (Figure 6.9) through to 1932. Later map shows river mouth of feature covered by railway tracks featuring landing stages in the inter-tidal zone. The entire feature was filled in before 1970 and now lies under the industrial estate
- Reach 6R: saltings are shown in the inter-tidal zone on the OS maps
- Reach 6R: An 'old limekiln' is shown at the northern end of the reach adjacent to the flood embankments on the 1876 OS map (Figure 6.9). This feature disappeared by 1970 and has possibly been erased by the ring road (A259)
- Reach 6R: the Climper and Lympster Tithe Maps show the field at the northern end of the reach named as 'old quay' (possibly originally 'Wick Quay')

In accordance with the evaluation criteria used (Appendix E), we have assigned the assets a low heritage value, with the exception of the water treatment works and disused winch, which have been given a negligible value.

Reach 3 is the only area where known archaeological deposits abut the modern river frontage. These were partially excavated in advance of re-development in the 1990's. This revealed the top of the former river wall and other wharfage features such as buildings and dock walls just below the present ground surface, and reaching 1.20m in depth below it. These lay over river alluvium, which is up to 2.50m in depth. Occasional bands of peat have been found in the alluvial sequence (Brown 2002).

The site walkover detected a series of features in Reach 6, including Reach 6 Realignment. These included the redundant winch (as listed above) and a series of stakes and part of a wooden jetty in the foreshore, which possibly formed a landing stage associated with an adjacent slipway. The winch and slipway are shown on the 1973 Ordnance Survey maps of the area.

The stakes run parallel with the river and probably form part of a landing stage. Although none is visible on the OS maps of the area in question, a landing stage is visible on the 1932 map slightly to the north of Reach 6 on the east bank of the river.

The embankments in Reach 6 date originally to the 19th century. They appear on the 1876 OS map (Figure 6.9), although they have undergone late 19th and 20th century enhancement.

These assets, which are shown on Figures 6.3 to 6.5, can be assigned a low heritage value.

Unknown Archaeology and Palaeoenvironmental

The scheme has a high potential for previously unidentified palaeoenvironmental remains to exist at depth below the scheme. The present river channel is a product of 18th and 19th century engineering, and has remained fixed since that period. The area of Arun Parade and part of Pier Road lie within what was either river channel or inter-tidal zones, and therefore comprises post-medieval reclamation. Deeply buried relict channels of the River Arun may therefore lie under the present river channel and the

adjacent terrestrial area. These are liable to contain organic material dating to past eras.

The geotechnical investigations undertaken in 2012 along the scheme did not detect any peat deposits that might indicate a buried palaeochannel, although the investigations were not carried out along the precise alignment of the sheet-piled wall. Some deposits within the alluvium were recorded as having a 'strong organic odour' which indicates decaying organic matter. Whether these are significant from a palaeoenvironmental perspective is unknown. Older geotechnical data in the area of Old Quay Wharf indicates some peaty deposits in the alluvial sequence (Brown 2002).

There is a low potential along the scheme for unknown archaeology. This is supported by the existing EUS survey and by the results of recent geotechnical investigation. The promenade and riverside paths generally occupy areas of reclamation, and modern made ground has been recorded in every reach. Map regression has established that the present line of the river wall has been fixed since the late 18th century, and the promenade next to it has never featured buildings or docks. However, there is a possibility that the original river wall(s) is hidden behind the modern sheet-piled ones.

The archaeological potential is low in Reach 6 Realignment. This is in an area where large-scale construction has taken place as part of the historic river defences. This area was previously salt marsh and has been built up with imported material. The geotechnical data indicates up to 1.60m of made ground beneath the existing floor of the embankments. This is probably contemporary with the 19th century flood embankments which have themselves been subject to enhancement in the modern period. Potential archaeological features could lie within the original salt marsh environment below the post-medieval and modern made ground. These could take the form of fish traps or tracks across the inter-tidal zone. If present, these would be deeply buried below the present ground surface.

The four main EUS zones within the scheme (EUS nos. 4-6 and 9 in Figure 6.7) have all been classified as having a low potential for previously unrecorded archaeology. However, archaeological excavation around the Old Harbour (Bradley and Phillpotts 2006) demonstrates that the buried remains of historic river walls, wharves and river side buildings can exist in the buried environment in the terrestrial part of the scheme, though these are confined to specific areas.

The river channel along all reaches has been subject to extensive works to defend against tidal flooding. The riverside character along the length of the scheme (immediately adjacent to the river walls) has also been subject to change, and is of a very mixed character. Twenty first century residential riverside development now characterises the river frontage in Reach 3, which has replaced an area formerly dominated by quays and wharves (Old Quay Wharf). This contrasts with the late 19th/ early 20th century riverside buildings in Reach 2 and the predominantly industrial and commercial premises in Reach 5.

The historical narrative of the riverside area is presented on information boards along the promenade. The historic development of the river and its adjacent areas are given, along with key historic figures and events. Heritage therefore plays a significant part of the amenity usage of the riverside zone.

Without the scheme in place, the future baseline of the scheme would change over the long-term. In particular, the built heritage, notably that within the River Road Conservation Area, the South Terrace ASC and the individual listed and locally listed buildings, would be subject to flooding. This could lead to temporary and possible permanent damage to the structures.

6.2 Likely significant impacts

A description of operations with potential to affect archaeological and heritage resources is provided in Appendix E, along with the evaluation of value, magnitude of impact and significance of impact. Potential impacts on the resources within the study area are presented in Tables 6.5 to 6.8 (6R indicates Reach 6 Realignment).

Construction Phase

Designated Assets

Reach	Asset	Value	Potential impact	Significance of impact before mitigation
1	Littlehampton Lighthouse LLB	Low	Temporary change to setting. Minor negative impact Impacts from vibration at 4.4 mm/s. Negligible impact	**None**
1	East Pier LLB	Low	Temporary change to setting. Minor negative impact Impacts from vibration (11.8 mm/s) at the north end of the pier, which abuts the sheet-piling in Reach 1. Moderate negative impact	**Minor adverse**
n/a (West bank)	Littlehampton Fort SM	High	Temporary change to setting. Negligible	**None**
1 and 2	South Terrace ASC	Low	Temporary change to setting. Minor negative impact Impacts from vibration at 1.5 mm/s to the western end of the designation. Negligible impact	**None**
2	Cadet HQ LLB, Pier Road	Low	Temporary change to setting. Minor negative impact Impacts from vibration at 5mm/s. Negligible impact	**None**
3	The 'Cairo Club' listed building	Medium	Temporary change to setting. Negligible impact Very low impacts from vibration (1.5 mm/s). Negligible impact	**None**
3 and 4	River Road Conservation Area	Medium	Temporary change to setting. Minor negative impact Impacts from vibration. Minor negative impact	**Negligible**
5	The Arun View public house	Low	Partial demolition of modern extension to public house. Moderate negative impact Temporary impact on setting to public house. Moderate negative impact Impacts from vibration 3mm/s. Negligible impact	**Minor adverse** **Negligible** **None**

Table 6.5 Potential impacts on designated assets

Non-designated Assets

Reach	Asset	Value	Impact	Significance of impact before mitigation
1	Windmill (MWS 3115)	Low	Minimal vibration impacts to buried remains (well below 5mm/s). Negligible	**None**
3	Harbour Saw Mill (MWS 3107)	Low	No impacts	**None**
3	Old harbour (MWS 7055)	Low	No impacts	**None**
4	Former Swing Bridge (MWS 5736)	Low	Vibration impacts to buried remains (approx 3mm/s). Negligible	**None**
4	Railings around Ferry Wharf	Low	Removal. Railings will be replaced with a new concrete cap with new railings. Major negative (based on not being able to reuse existing)	**Minor adverse**
1-6	Potential buried palaeoenviron-mental deposits	Medium (estimate)	Truncation and displacement from steel sheeting. Moderate negative	**Minor adverse**
1-6	Potential buried archaeology	Medium (estimate)	Potential damage of buried archaeological objects. Moderate negative	**Minor adverse**
6	Probable wharf	Low	Likely to be unaffected by work, given encroachment of modern river wall into the inter-tidal zone Negligible	**None**
6R	Saltings	Low	Likely to be directly affected by work Negligible	**None**
6R	The site of an old limekiln	Negligible	Likely to have been erased by ring road Negligible	**None**
6R	Site of former quay	Low	Potentially affected during construction Moderate impact	**Minor adverse**
6 R	Embankments	Low	Removal of embankments. Major negative	**Minor adverse**
6 R	Inter-tidal features (wooden jetty and stakes/ posts)	Low	No impact envisaged during construction (to be left in situ) Negligible impact	**Negligible**
6 R	Winch	Negligible	Removal. Major adverse	**Negligible**

Table 6.6 Potential impacts on non-designated assets

Operational Phase

Designated Assets

Reach	Asset	Value	Potential impact	Significance of impact before mitigation
1	Littlehampton Lighthouse LLB	Low	Improved landscaping around the structure and added flood protection. Moderate positive impact	**Negligible**
1	Littlehampton Pier LLB	Low	Improved landscaping north of the pier. Minor positive impact	**Negligible**
n/a	Littlehampton Fort SM	High	The improved landscaping will have no discernible impact on the setting of the SM, given the state of the monument (overgrown and sitting within low defensive enclosure). No change	**None**
1 and 2	South Terrace ASC	Low	Improved landscaping will enhance the setting of the designation. The added protection from tidal flooding will afford long-term protection to the houses. Moderate positive	**Negligible**
2	Cadet HQ LLB, Pier Road	Low	Added long-term tidal flood protection. Moderate positive	**Negligible**
3	The 'Cairo Club' listed building	Medium	Added long-term tidal flood protection. Moderate positive	**Minor beneficial**
3 and 4	River Road Conservation Area	Medium	Added long-term tidal flood protection. Moderate positive	**Minor beneficial**
5	The Arun View public house	Low	Added long-term tidal flood protection. Moderate positive Change in setting of building on its river side from a new raised river wall. Negligible negative	**Negligible** **None**

Table 6.7 Potential impacts on designated assets during operation

Non-designated Assets

Reach	Asset	Value	Potential impact	Significance of impact before mitigation
1	Windmill (MWS 3115)	Low	No change	**None**
3	Harbour Saw Mill (MWS 3107)	Low	No change	**None**
3	Old harbour (MWS 7055)	Low	No change	**None**
4	Former Swing Bridge (MWS 5736)	Low	No change	**None**
6	Probable wharf	Low	No change	**None**
6R	Saltings	Low	Potential change in accretion and deposition Negligible	**None**
6R	The site of an old limekiln	Negligible	No change	**None**
6R	Site of former quay	Low	No change	**None**
6 R	Embankments	Low	Embankments would have been removed during construction. No change	**None**
6 R	Potential buried palaeo-environmental deposits	Medium (estimate)	Long-term erosion from changes to the inter-tidal zone Moderate negative	**Minor adverse**
6 R	Inter-tidal features	Low	Erosion of inter-tidal features during this phase. Major negative	**Minor adverse**
6 R	Winch	Negligible	No change	**None**

Table 6.8 Potential impacts on non-designated assets during operation

6.3 Mitigation

We will put in place a programme of archaeological mitigation prior to and during construction and operation. This would reduce the possible adverse impacts of these phases on historic and archaeological assets. A summary of the key mitigation measures is provided below. These are collated in the Environmental Action Plan.

Construction phase

Measures aimed at reducing noise and vibration as described in Chapter 5 – Acoustics and Vibration, will be put in place to minimise adverse impacts from vibration on buildings of historic value.

The replacement of the promenade in Reaches 1 and 2 might expose the tops of historic river walls, and therefore we propose to undertake an archaeological watching brief adjacent to the existing river wall, to record any historic structures exposed. The level of monitoring will be tailored to suit the results of the early-stage work.

The promenade and Arun Parade lie on post-medieval fill material and will not be monitored.

The proposed sheet piling in Reach 3 might encounter buried obstructions, which will require excavation to remove them. These obstructions might have an archaeological value. As a precautionary measure, archaeological inspections will be made if the removal of such obstructions occurs. These will be instituted on a 'call-out' basis when need arises.

The historic cast iron railings around Pharos Quay (Ferry Wharf) will be removed during construction. Further work is required to assess the viability (in terms of build-ability, structural integrity and acceptability under current design standards) of re-using them as part of the proposed design. If we cannot re-use them, handrails of a suitable sympathetic design will be agreed with Arun District Council and we will make a photographic record of these to create an archive of the features.

Although the impacts to the old wharf in Reach 6 are unlikely (being under the industrial estate), archaeological 'hotspots' associated with the wharf might exist in the inter-tidal area. There is the possibility of obstructions requiring removal during the sheet-piling programme. These might hold archaeological value. A precautionary 'call-out' archaeological inspection regime will be instituted in this reach.

Ground stripping in Reach 6 Realignment in advance of construction of the new embankment will take place in an area of made ground, as confirmed by the results of geotechnical investigation. However, the zone at the northern end of the reach has been identified as the location of an old quay. Given the scale of the proposed work, it is proposed that an archaeological inspection is made of the stripped areas on a precautionary basis, in case any buried remains are exposed. The focus of the inspection will be on attempting to detect any remains of the old lime kiln and quay.

The wooden features in the Reach 6 Realignment will be accurately located and recorded prior to construction. Photographic recording of the embankments prior to removal will provide sufficient measure to mitigate the effects of their removal. Potential impacts to the palaeoenvironmental deposits within the river cannot be mitigated. However, if any further ground investigation data become available that cover the deposits within the river, these will be submitted to the West Sussex County Council archaeologist. A suite of ground investigation data in the terrestrial zone parallel to the scheme has already been submitted.

Operational phase

It is not currently envisaged that heritage-themed info boards in Reaches 1 and 2 removed during construction will be replaced. Arun District Council will look into providing heritage information in a way that better compliments the design of the public realm enhancements, should funding become available.

6.4 Residual impacts

The measures that we will put in place during construction and operation will mitigate potentially adverse impacts with the exception of potential impacts on palaeoenvironmental deposits in the river. The significance of residual impacts on archaeology and heritage is summarised in Tables 6.8 and 6.9.

Construction phase

Reach	Asset	Potential impact	Mitigation	Residual impact
1-6	Potential buried palaeo-environmental deposits	Minor adverse	Submit any further ground investigation data to the local authority	**Minor adverse**
1-6	Potential buried archaeology	Minor adverse	Targeted archaeological watching brief in Reaches 1, 2 and 6 Realignment	**Negligible**
4	Iron railings around Ferry Wharf	Minor adverse	Photographic recording. Railing will either be re-used (following further viability assessment) or a sympathetic new railing agreed with Arun District Council will be used	**Negligible**
6 R	Embankments	Minor adverse	Photographic recording of embankment prior to removal	**Negligible**

Table 6.8 Summary of residual impacts during construction

Operational phase

Reach	Asset	Potential impact	Mitigation	Residual impact
3	The 'Cairo Club' listed building	Minor beneficial	n/a	**Minor beneficial**
3 and 4	River Road Conservation Area	Minor beneficial	n/a	**Minor beneficial**

Table 6.9 Summary of residual impacts during operation

7 Biodiversity

This chapter presents the assessment of ecological impacts, based on the identified ecology and conservation status of the study area. The assessment is focused on the following key issues:

- Direct or indirect impacts on Climping Beach SSSI or other designated sites
- Potential impact to mudflat habitat
- Potential impact to saltmarsh habitat
- Potential impacts on fish from piling operations
- Potential impacts on reptiles within Reach 6
- Potential impacts on bats and bat roosting habitats through disturbance to trees
- The presence and potential spread of invasive plant species/diseases, particularly Japanese knotweed and Ash dieback.
- Potential impacts on breeding bird activity, water voles, aquatic invertebrates and badgers

In addition to the requirements of the EIA regulations, any works undertaken adjacent to a Site of Special Scientific Interest (SSSI) will require assent from Natural England under Schedule 9 of the Wildlife and Countryside Act 1981 (WCA 1981) (as amended by the Countryside Rights of Way Act 2000).

Specific wildlife species such as bats, badgers, water voles, aquatic invertebrates, reptiles and birds and habitats such as saltmarsh and mudflat receive legal protection in the UK under various acts of legislation, principally the Wildlife and Countryside Act 1981, the Conservation (Natural Habitats, & c.) Regulations 1994 (as amended), and the Countryside and Rights of Way Act 2000.

We have assessed ecological resources following the IEEM guidelines (IEEM, 2006). The following criteria have been used to define ecological value:

Value	Criteria
Very High	International importance
High	National importance
Medium	Regional/County importance
Low	District/Parish importance
Negligible	No listed importance

Table 7.1 Criteria for classifying the value or sensitivity of ecological resources or receptors

We have described the potential impacts of the proposed works (negative or positive) on the structure and function of the ecological receptors, on a quantitative basis where possible, in relation to the following parameters: positive or negative impact, size, extent, duration, reversibility and timing and frequency.

Following an assessment of the potential impacts, we then assessed the significance of these impacts on the ecological resources and receptors. We followed IEEM guidelines which state *'a significant impact in ecological terms (whether negative or positive) is*

defined as an impact on the integrity of a defined site or ecosystem and/or the conservation status of habitats or species within a given geographical area'.

We have defined levels of significance according to the criteria presented in Table 7.2.

Significance (negative or positive)	**Definition**
Significant at an International level (major)	Impact affecting the integrity of an ecological resource or receptor (ecosystem, habitat or population) of very high or international value.
Significant at a National level (major)	Impact affecting the integrity of an ecological resource of high or UK/national value or a part of an international resource which is of UK/national value.
Significant at a County/Regional level (moderate)	Impact affecting the integrity of an ecological resource of medium or county/regional value, or a part of a resource of higher value that is important at a county/regional level.
Significant at a Parish/District level (minor)	Impact affecting the integrity of an ecological resource of low or Parish/District value, or a part of a resource of higher value that is important at a parish/district level.
Negligible	Impact not affecting the integrity of an ecological resource beyond the principal study area.

Table 7.2 Definitions used to define the significance of impacts

We undertook specialist desk studies and surveys to establish baseline conditions. These included an ecological scoping report undertaken during preparation of the Scoping Report and surveys of Phase 1 habitat types, reptiles, bats, water voles and a desk study of aquatic invertebrates. Reports are presented in Appendix F.

7.1 Existing environment

Evidence of protected habitats and species identified during the desk studies and ecological surveys are summarised below. Further details of habitats and species present within the study area can be seen within the ecological scoping report and individual species reports and also on the Phase 1 habitat plan (Figure 7.1). Designations are shown on the key environmental features plans, (Figures 2.1 and 2.2).

Key ecological features identified within the study area are described below.

Designated sites:

- Climping Beach SSSI – comprises of a stretch of coastline with a vegetated shingle beach, behind which is a sand dune system (national value)
- Littlehampton Golf Course and Atherington Beach SNCI - comprises calcareous grassland, ditch system and shingle beach (county value)
- West Beach LNR - located partly within the SSSI, comprising of sand flats, the tide line vegetation and shingle (national value, as features are of national importance within SSSI)

Habitats:

- Brackish water (Rivers) – within the River Arun, which supports freshwater and marine fish species
- Coastal floodplain grassland – relatively unmanaged tall grassland in marginal habitats along the ditch and river embankments, located in the northern part of the scheme
- Intertidal mudflats – narrow strip along both sides of the river which is exposed at low tides
- Saltmarsh – narrow strips along the berms of the river in the northern part of the scheme

The above habitats have been recorded within the scheme and meet the criteria for the UK Biodiversity Action Plan Priority Habitats. Where sufficient areas of these habitats exist in a favourable condition, these habitats may have up to national value. Other habitats such as those listed below are of lower value, although higher value features may be present within them.

- *Drainage ditch* – slow flowing, flanked by common reed, located in the northern part of the scheme considered to be of value up to local level
- *Trees and shrubs* – A number of mature hawthorn *Crategeous monogyna* and a mature yew *Taxus baccata* are present to the north of the scheme within Reach 6 Realignment. Younger trees are also present along the highways road embankment within Reach 6 Realignment including hawthorn, cherry *Prunus avium*, field maple *Acer campestre* and ash *Fraxinus excelsior*. These trees are generally of poor condition and size although some larger/mature trees do exist. Further information on trees can be found within Chapter 8 Landscape and Visual Issues and within the arboricultural report (Appendix H). Some of these trees provide suitable breeding bird habitat e.g. mature hawthorn. It is therefore considered that the trees and shrubs within the study area are of ecological value up to local level

Notable Species:

- Bats – We carried out potential assessment surveys for bat roosting sites within the trees in Reach 6 in September 2012. The majority of trees within Reach 6 provide negligible potential for roosting bats and therefore no further action is required for these trees. However, we recorded that a small number of trees located to the north of the A259 steps at the bottom of the highways embankment provide medium-low potential for roosting bats

  Bat species are protected under EU law and, if present, could be of value up to international level

- Birds – The inter-tidal zone within the River Arun supports a range of bird species. We also observed a number of widespread garden bird species during the habitat survey including two red listed birds (house sparrow *Passer domesticus* and starling *Sturnus vulgaris*). The bird community within the scheme area is of value up to national level. Swans are commonly present on the revetment in Reach 2 and slipway in Reach 3 and are of value up to national level.
- Fish – The tidal River Arun supports a variety of fish species including roach *Rutilus rutilus*, flounder *Platichthys flesus,* sand goby *Pomatoschistus minutes,* mullet spp., bass *Dicentrarchus labrax,* plaice *Pleuronectes platessa* and

solenett *Buglossidium luteum* all of which are generally common and widespread

The European eel *Anguilla anguilla* and the sea lamprey *Petromyzon marinus* have also been recorded within the Arun catchment. Both species are listed on the UKBAP priority species list, with sea lamprey also being protected under Annex II of the EU Habitats directive Appendix III and the European eel as critically endangered on the IUCN red list and a species of principal importance under the NERC Act 2006. The elvers migrate upstream within the River Arun during springtime with silver eels returning back down to sea during the autumn

Sea trout *Salmo trutt* migrate through the estuary to spawn in the headstreams of the River Arun from June through to August and November to March. Sea trout smolts will migrate downstream March to May. They are also on the UK BAP priority list and receive some protection under the Salmon & Freshwater Fish Act 1975

It is considered that the fish community within the project area may be of value up to national level

- Aquatic invertebrates – We carried out a phase 1 habitat survey including a detailed desk study for key aquatic invertebrate species. No records of rare or protected species have been recorded within the immediate vicinity of the works. Due to the poor habitat quality and lack of species diversity in the ditch located within the scheme (Reach 6), it is concluded that the value of the ditches within Reach 6 are of negligible value. No further survey was considered necessary, although appropriate mitigation works will be put in place to protect species currently present

- Reptiles – Surveys we carried out in 2010 recorded the presence of slow worm *Anguis fragilis* and common lizard *Lacerta Zootoca vivipara* in low densities along Reach 6

  Reptiles are of value up to a national level

- Water voles – No obvious signs of water vole activity were recorded during the phase 1 habitat surveys. A further survey was carried out on the 30th April 2013 to determine the presence/absence of water voles within the ditch in Reach 6. No signs of water voles were recorded in the survey and it is therefore considered that water voles are unlikely to be adversely affected by the proposed scheme and are not considered further

7.2 Likely significant impacts

Without mitigation beyond normal best working practices and compliance with the Environment Agency Pollution Prevention Guidelines, there is potential for impacts on the ecology of the study area. The nature of the proposals is such that most adverse impacts are likely to occur during construction and the initial years of the operational phase, although some impacts could be long-term. The main types of impact on ecology that could arise as a result of the scheme are:

- Physical damage to, loss of or change in habitats
- Disturbance to wildlife

A description of potential impacts on each of the key ecological receptors during the construction phase is presented in Table 7.3.

Ecological Receptor	Valuation	Operations with potential for impacts	Reaches affected	Significance of potential effect before mitigation
Designated Sites				
Climping Beach SSSI	National	Temporary noise impacts during piling activities are anticipated. No noticeable impact from increased flooding or impacts to habitats of the SSSI are envisaged as a result of raising the east bank defences (see Chapter 12 – Water Resources).	1, 2, 3	**Minor adverse at national level** (on bird species only)
Littlehampton Golf course and Atherington Beach SNCI	County	No direct or indirect impacts are anticipated as works are located on the east bank of the river.	1, 2, 3	**Negligible**
West Beach LNR (part within the SSSI)	National	No noticeable impact from increased flooding or impacts to habitats of the SSSI are envisaged as a result of raising the east bank defences (see Chapter 12 – Water Resources). No indirect impacts anticipated other than temporary noise impacts during piling activities.	1, 2, 3	**Minor adverse at national level** (on bird species as part of SSSI only)
Habitats				
Brackish water	Up to National	Direct disturbance of water and siltation impacts due to installation of sheet piling works and removal of existing tidal embankments. Secondary impacts from any release of contaminants or sediment from construction.	1-6	**Minor adverse at national level**
Coastal floodplain grassland		Habitat clearance/site preparation. Construction of new tidal embankments	6	
Intertidal mudflats		Direct disturbance to a small area of habitat due to installation of sheet piling works and removal of existing tidal embankments. Secondary impacts from any release of contaminants or sediment from construction.	1-6	
Saltmarsh		Removal of a small area of existing tidal embankments. Potential indirect impacts from any release of contaminants or sediment from construction.	6	
Drainage ditch	Parish	Potential indirect impacts to ditch habitat from any release of contaminants from construction.	6	**Minor adverse at Parish level**
Trees and shrubs	Parish	Tree and scrub removal as a result of site preparation works and the construction/widening of new and existing tidal embankments.	6	**Minor adverse at Parish level**

Species				
Bats	Up to Inter-national	Habitat clearance/site preparation – in particular tree clearance works	6	**Major adverse at international level**
Birds	Up to national	Habitat clearance/site preparation including tree and scrub removal	6	**Major adverse at national level**
Fish	Up to national	Potential vibration impacts as a result of the installation of sheet piling (see also Chapter 5 – Acoustics)	1,2,3,4,5 & 6	**Major adverse at national level**
Invertebrates (aquatic)	Negligible	Indirect impacts to drainage ditch habitat e.g. run-off from construction activities.	6	**Negligible**
Reptiles	Up to national	Loss of habitat due to site preparation and removal of existing tidal embankment.	6	**Major adverse at national level**

Table 7.3 Summary table showing key potential impacts to ecological receptors during construction

During the operational phase of the scheme all disturbed habitats will have been reinstated and new habitats created. No change to hydrogeology or other impacts on designated sites on the west bank of the River Arun are envisaged as a result of the scheme (see Chapter 12 – Water Resources and the Flood Risk Statement presented in Appendix K).

Without mitigation, the scheme will result in a maximum loss of 0.22 ha of existing intertidal mudflat due to encroachment into the river and coastal squeeze. However, there will be a potential creation of 0.27 ha of intertidal mudflat within Reach 6 Realignment resulting in a long term net gain of approximately of 0.05 ha.

Saltmarsh is present within Reach 6 Realignment. No loss of existing saltmarsh is envisaged and approximately 0.7 ha of saltmarsh will be created.

Overall, the scheme will create intertidal habitat that exceeds the areas that will be lost, resulting in a net gain of BAP habitat of approximately 0.75 ha, and this will be achieved by setting back the defences in Reach 6 to allow a more natural estuary margin to develop, and by replacing the existing hard engineered embankment with a bioengineered new set-back embankment.

7.3 Mitigation

Ecological mitigation measures have been discussed and agreed with Natural England, the Royal Society for the Protection of Birds and the Environment Agency, Fisheries and Biodiversity Team. Details of working practices and generic and specific mitigation measures are outlined below and shown on Figures 2a & 2b – Ecological Mitigation plans contained in the reptile methods statement (Appendix F). An ecological clerk of works (ECoW) will be part of the site team to ensure full and correct implementation of the Environmental Action Plan presented at the end of this report and method statements relating to protected species and habitats.

Generic mitigation measures

We will carry out the following mitigation across all reaches of the scheme:

- An ECoW will supervise the clearance work and be present whenever vegetation clearance occurs in sensitive areas in order to check for any notable species
- We will adopt standard site procedures, such as PPG5 – Works and Maintenance, for any works in or near water to ensure that no contaminants/effluent are released into nearby aquatic environments
- Contractors will use existing tracks and access routes and haul roads as far as possible
- The main compound will be on existing industrial hard standing on Railway Wharf in Reach 5 and additional compounds will be located on hard standing in Arun Parade in Reach 1 and, if required, on arable land in Reach 6 to avoid damage to habitats of ecological value. Embankment works will be undertaken from the embankment crest or by accessing from the landward side to minimise impacts to sensitive habitats on the river side wherever possible
- As soon as construction works have been completed, disturbed habitats will be restored to their original condition as quickly as possible in order to minimise loss of key species and colonisation by invasive weed species
- British Standard/National Joint Utilities Group Guidelines (NJUG) will be followed when working in close proximity to trees or shrubs, and appropriate protection zones will be delimited
- All excavations left overnight will be provided with a ramp to enable easy escape of animals

Specific Mitigation measures

Designated sites

Indirect impacts on birds using the SSSI and LNR on the west bank of the River Arun due to noise from piling activities are considered to be low as a result of the distance from the works (a minimum of 30m from West Beach LNR and 100m from Climping Beach SSSI). Piling equipment such as low resonance or resonance-free pile vibrators may be used to reduce noise levels. However percussion piling may be required in order to drive piles to refusal. This type of piling gives rise to higher levels of noise and disturbance to birds, but any percussion piling will be undertaken during daylight hours only, and will only be for a short period of time, thereby avoiding roosting times and keeping any disturbance to a minimum.

Habitats

Adverse impacts on inter-tidal habitats (saltmarsh, inter-tidal mudflats, brackish water and coastal grassland) will be mitigated by means of sensitive working.

We will compensate any long term loss of inter-tidal habitat along the scheme by creating habitat in the Reach 6 Realignment. See table in Section 7.4 for estimated habitat losses and gains resulting from the scheme.

Monitoring surveys of the realigned saltmarsh will be carried out over a period of 1, 3 and 5 years post works, which will mean surveys being completed in 2015, 2017 and 2019.

In order to speed up the re-vegetation of the inter-tidal area/scour protection in Reach 6, a thin layer of soil will be brushed into the surface of the scour protection to enable faster colonisation by vegetation.

Trees and shrubs

We will erect fencing to protect trees and shrubs within the working areas which are to be retained to minimise any damage during construction through collision or soil compaction within the root zone. All trafficking by plant and storage of materials will be restricted to the area outside the canopy of the tree.

We will replace lost trees and shrubs in accordance with the planting plans, which aim to re-create lost areas of vegetation, increase biodiversity and enhance existing habitats which have been retained. See Chapter 9 - Landscape and Visual Issues for further details.

Faunal species

Badgers - We will be carrying out a badger survey in Reach 6 a minimum of three months prior to works commencing in the area. If active badger setts are recorded, appropriate licences and mitigation measures will be put in place prior to construction.

Bats - Where trees requiring removal have been identified as showing potential for roosting bats (see Figure 2b - Ecological Mitigation Plan), all cracks and crevices will be checked with an endoscope by a suitably qualified ecologist in Autumn 2013. If no evidence of bats is recorded, the trees will be felled in January 2014 under an ecological watching brief. If bats are identified as being present, we will obtain a European Protected Species Licence (EPSL) prior to any removal of the trees. We will minimise disturbance to bats using the river corridor as a commuting route or as a foraging habitat by avoiding the use of artificial lighting within the river corridor.

Birds – We will avoid disturbance to breeding birds by ensuring that wherever habitat suitable for breeding bird needs to be cleared, clearance will take place outside the bird breeding season (which is mid February to August inclusive).

No mitigation is required with respect to swans.

Fish - The majority of the piling works will be carried out by vibro-piling. It has been shown that there is no discernible effect on fish from these types of work (Subacoustech Environmental Report No. E321R0102, December 2011) and therefore the Environment Agency Fisheries team has advised that no specific restrictions or mitigation measures will be required for this type of piling work (see also Chapter 5 – Acoustics, section 5.2).

We will programme construction activities to avoid adverse impacts on fish as well as the main tourist season in Reaches 1 and 2. Where press or vibro-piling methods are proposed, no further mitigation will be required to avoid impacts on fish. Where percussion piling is unavoidable (due to ground conditions) work will be undertaken during the winter (November to March), during daylight hours. For any work extending into April, water temperature will be monitored. If the temperature of the water exceeds 10 deg C, further mitigation will be needed. Measures will be discussed and agreed with Environment Agency specialists at the time. Possible options include working only during low tide (Reach 4), use of a slow start technique, or the use of cushions on top or baffles around the piles. Similar mitigation will be required if percussion piling works are required earlier than November.

Invertebrates (Aquatic) - Any works carried out adjacent to the drainage ditch within Reach 6, will be carried out following guidance provided by the Environment Agency (e.g. Pollution Prevention Guideline 5).

Reptiles – We will implement a translocation exercise to move reptiles away from the construction works in Reach 6. As a low population of reptiles has been recorded on site, a minimum of 60 days of trapping during suitable conditions will be carried out from late Spring to late Autumn 2013. We will move captured reptiles to a main receptor site located to the north of the construction works immediately north of the railway line (see Reptile Method Statement, Figures 1a and 1b – Reptile Survey Areas, Appendix F). The main receptor site currently provides suitable reptile habitat with a small population of common lizards and slow worms already present. However, the site has good 'green corridors' linking it to a larger source of reptile habitat and, with further enhancement works (i.e., the addition of hibernacula and basking places), it is considered that sufficient habitat is present to support the relocated reptiles.

Monitoring surveys of the reptile receptor site will be carried out over a period of 1, 3 and 5 years post works, which will mean surveys being completed in 2015, 2017 and 2019.

A detailed reptile method statement can be found in Appendix F outlining the specific mitigation measures to be carried out with respect to reptiles.

Water Voles - As a result of the survey carried out on 30th April 2013, no specific mitigation measures are proposed other than good working practices when working within the vicinity of watercourses (see Chapter 12 – Water Resources).

Invasive Species

Japanese knotweed – We will manage an area of Japanese knotweed located within the working area in accordance with Environment Agency policy to ensure its effective control and destruction and to avoid further spreading. A method statement can be found in Appendix F outlining the mitigation measures to be followed.

Ash dieback – We will manage and remove all ash trees located within the working area in accordance with the latest Environment Agency policy to ensure their effective removal and prevention of spread of this disease to the wider environment.

7.4 Residual impacts

By implementing the mitigation measures identified in the preceding paragraphs we will significantly reduce the impacts on the flora and fauna and designated sites within and in the vicinity of the study area.

Table 7.4 shows the anticipated residual impacts on the sensitive receptors after implementation of the mitigation measures during construction and operation. The significance of all adverse impacts has been greatly reduced, to leave a negligible impact at worst, with net beneficial impacts in the long term on several receptors. In particular, the scheme will, in the long term, create intertidal habitat that exceeds the areas that will be lost, resulting in a net gain of BAP habitat of approximately 0.75 ha. It will also replace the existing hard engineered embankment with a bioengineered new set-back embankment, and allow a more natural estuary margin to develop.

Ecological Receptor	Description of impact	Significance of predicted effect (adverse/ beneficial)	Mitigation measures/ compensation	Significance of residual effect (adverse/ beneficial)
Designated Sites				
Climping Beach SSSI	No direct impacts are anticipated as works are located on the east bank of the river with no indirect impacts other than noise during piling activities	Minor adverse effect on bird species at national level	Majority of piling operations will be carried out using low resonance vibration piling equipment. If percussion piling is required, works will be carried out during daylight hours and for as short a period of time as possible.	**Negligible**
Littlehampton Golf course and Atherington Beach SNCI	No direct impacts are anticipated as works are located on the east bank of the river	Negligible	N/A	**Negligible**
West Beach LNR (part within the SSSI)	No direct impacts are anticipated as works are located on the east bank of the river with no indirect impacts other than noise during piling activities	Minor adverse effect on bird species at national level	Majority of piling operations will be carried out using low resonance vibration piling equipment. If percussion piling is required, works will be carried out during daylight hours and for as short a period of time as possible.	**Negligible**
Habitats				
Brackish water	Installation of sheet piling works. Removal of existing tidal embankments. Also secondary impacts if any release of contaminants or sediment from construction.	Major adverse at national level	Sensitive working practices in accordance with Environment Agency Pollution Prevention Guidelines where close to water.	**Negligible**
Coastal floodplain grassland	Habitat clearance/site preparation. Construction of new tidal embankments		Generic mitigation measures to minimise footprint of construction activities. Protection of topsoil and re-use of seedbank.	**Minor adverse/ negligible**
Intertidal mudflats	Installation of sheet piling works. Removal of existing tidal embankments. Also secondary impacts if any release of contaminants or sediment from construction.		Site management in accordance with Environment Agency Pollution Prevention Guidelines to prevent pollution of intertidal mudflats. There will be a net creation of 0.05ha of inter-tidal mudflats as part of the realignment works in Reach 6 Realignment	**Net beneficial impact** significant at Parish/district level (**minor**)

Saltmarsh	Removal of existing tidal embankments. Also secondary impacts if any release of contaminants or sediment from construction.		Site management in accordance with Environment Agency Pollution Prevention Guidelines to prevent pollution of saltmarsh. There will be a net creation of 0.7ha of saltmarsh habitat as part of the realignment works in Reach 6 Realignment	**Net beneficial impact** significant at Parish/district level (**minor**)
Drainage ditches	Habitat clearance / site preparation. Widening tidal embankments.	Minor adverse at parish level	Sensitive working practices in accordance with Environment Agency Pollution Prevention Guidelines where close to water	**Negligible**
Trees and scrub	Habitat clearance/site preparation, construction of new tidal embankments	Minor adverse at parish level	Generic mitigation measures to minimise footprint of construction. Planting plans and method statements, and British Standard BS5837:2012 trees in relation to design, demolition and construction - recommendations to be followed	**Negligible**
Species				
Bats	Habitat clearance/site preparation – in particular tree clearance works	Major adverse at international level	Endoscope surveys undertaken by experienced bat worker with European Protected Species licence acquired where necessary	**Negligible**
Birds	Habitat clearance/site preparation including tree and scrub removal	Major adverse at national level	Sensitive working practices in accordance with Environment Agency Pollution Prevention Guidelines to minimise disturbance	**Negligible**
Fish	Installation of sheet piling	Major adverse at national level	No specific mitigation required for Vibro/press piling. If percussion piling works are required, specific mitigation is to be followed including; timing of works, slow start piling techniques and monitoring of river water temperature	**Negligible**
Invertebrates (aquatic)	Habitat clearance/site preparation	Negligible	Good working practices in accordance with Environment Agency Pollution Prevention Guidelines undertaken when working near watercourses	**Negligible**
Reptiles	Habitat clearance/ site preparation. Removal of existing tidal embankment.	Major adverse at national level	Translocation programme and enhancement of receptor site Some habitat suitable for reptiles is likely to form on the new embankment in the long term	**Negligible**
Invasive Species	Habitat clearance/site preparation	Major adverse at national level	Japanese knotweed method statement and EA guidelines to be followed EA and national guidance to be followed in relation to removal of all ash trees within the scheme.	**Negligible**

Table 7.4 Residual impacts on individual ecological receptors

8 Ground conditions

This chapter presents the assessment of geo-environmental and geotechnical ground conditions. The key issue relating to ground conditions that we identified during the scoping stage comprised the potential for contamination associated with past and present land use in Littlehampton. The assessment has therefore focused on this issue and any indirect impacts associated with any contamination.

Groundwater is addressed in this chapter in terms of water movement and its potential to carry potential contaminants. Groundwater quality is covered in Chapter 12 – Water Resources.

There are no protected geological sites or soils within the study area, and these issues have therefore been scoped out of the assessment. Any sensitive archaeological or ecological features dependant on ground conditions have been discussed in Chapters 6 and 7 on Archaeology and Heritage and Biodiversity respectively.

Methods

The methods we used to undertake this assessment are in accordance with the general approach presented in Chapter 4. The assessment is based on the information contained in the Revised Geo-environmental Risk Assessment, Littlehampton Arun Tidal Defences – East Bank (Halcrow, March 2013), presented in Appendix G. This report contains the full risk assessment and list of references.

The hazards associated with contamination are usually assessed using risk assessment. The commonly accepted approach to risk assessment is to examine the contaminant (i.e. the source) in relation to the receptor (which might be a human, sensitive environmental feature or building) and determine whether there is a link (pathway) between them (thereby, constituting a pollutant linkage). If any of these elements (contaminant source, pathway or receptor) are absent or removed, the pollutant linkage is broken and site poses no risk from that particular linkage.

We have compared soil and groundwater data against published environmental quality standards. We assessed potential risks to human health from exposure to contaminants in the ground using the CLEA methodology (Environment Agency, 2009). The CLEA model can be used to assess risks from contaminants to humans. We have also calculated Generic Assessment Criteria (GAC) for the scheme. These criteria and the Environmental Quality Standards (EQS) are fully described in the updated Geo-environmental Risk Assessment (Appendix G).

8.1 Existing environment

The location of geological features, the site investigations and potential sources of contamination described below is shown in Figures 8.1 to 8.4.

Geology

British Geological Survey (BGS) Sheet 317/332, Chichester and Bognor (solid and drift) indicates strata including Blown Sand, Tidal River deposits, Raised Beach Deposits and Aeolian Deposits (Brickearth). The underlying bedrock geology is Upper Chalk. Although Made Ground is not shown on the BGS Sheet, development along the riverfront has given rise to quite extensive fill material. No major faults are shown within close proximity to the site.

Both the Made Ground and alluvial deposits encountered within the recent ground investigations vary in depth, thickness and consistency along the reach and comprise both cohesive and non cohesive (granular) soils. A long section of the geology along the length of the scheme is shown in Figures 8.1 to 8.4.

Hydrogeology

The chalk formations are classified as a Major Aquifer with soils of high leaching potential. The high leaching potential means that the soils have limited ability to attenuate the vertical downward migration of contaminants although there is some limited protection in places afforded by the alluvium. The site does not lie within a Source Protection Zone and there are no documented groundwater abstractions within 500m of the site.

The ground investigations indicate that three groundwater levels may be present within the underlying soils:

- A perched water-table within the Made Ground overlying the cohesive alluvium
- Tidal variation within the underlying granular alluvium and upper chalk
- Natural ground water-table within the upper chalk

Ground conditions and sources of contamination

Ground conditions have been described below by reach. The site investigation locations and potential sources of contamination are shown along with borehole numbers in Figure 8.1 to 8.4.

The following two issues are relevant to most reaches:

- There is the potential for some of the older buildings within the scheme to contain asbestos. Surveys are currently underway, but the results are not yet confirmed.
- Carbon dioxide was found in most boreholes (maximum concentration of 0.9%vol in Reach 4 near ferry wharf). This is thought to be naturally occurring carbon dioxide resulting from the geological ground conditions rather than made ground.

Reach 1

No significant contaminative uses were located in this Reach.

The Made Ground (0.80m and 5.30m thickness) typically comprised a gravel of chalk, flint, tarmac, charcoal, ceramic, glass, brick, clinker and occasional concrete.

The borehole log for CP203 (west of Arun Parade, near the Oyster Pond) recorded “many fragments tarmac between 1.20m and 1.65m” and a “strong creosote odour”.

There were exceedances of soil screening criteria for lead (CP203, 550mg/kg and CP202, near the amusement park, 530mg/kg compared to a GAC of 450 mg/kg) and some polycyclic aromatic hydrocarbons (PAH’s) (CP202 and CP203). CP203 recorded elevated PAHs and total petroleum hydrocarbons (TPH) which relates to the depth where tarmac and a strong creosote odour were noted. The PAHs in CP202 may be due to tarmac found at the surface (PAHs are a component of older tarmac).

Reach 2

The only potentially contaminative use in this reach is a former gas works is located on the east side of Pier Road.

The Made Ground (0.60m and 0.80m thickness) was described as being composed of fine to coarse flint gravel. None of the borehole logs located in Reach 2 recorded notable contamination and the environmental sampling carried out during the site investigations showed no exceedances of assessment criteria.

Reach 3

Potentially contaminative historic uses in this reach include:

- A saw mill located near to the scheme (southern part of reach)
- Wharves, uses including timber, coal and ballast yards (southern part of reach)
- Wharves, warehouses, small boatbuilding yards (northern part of reach)

The Made Ground (0.40m and 2.80m thickness) consisted of a gravel of crystalline rock, chalk, brick, flint and glass. Various investigations have been undertaken in this area, mostly associated with the redevelopment of the wharves for housing. Some remediation was also undertaken. Baltic and Norfolk Wharf site investigations found no hydrocarbon impact but elevated heavy metals in shallower soils. Some contaminants were identified in groundwater. At County Wharf, the top 1.1m of soil at was contaminated with heavy metals, PAHs and petrol range organics. The top 0.5m of soil was dug out and replaced before construction. At Arun Wharf, some hotspots of contamination by heavy metals were identified and removed during redevelopment. Overall, there is potential for metals and PAHs in made ground and, to a lesser extent in groundwater, in this reach.

Reach 4

Potentially contaminative uses associated with this reach included an ironworks to the north of the reach (near junction of River Road and Wharf Road), whilst most of reach itself was historically small wharves.

Made Ground (0.40m and 5.70m thickness) consisted of a gravel of crystalline rock, chalk, brick, flint and glass. None of the borehole logs recorded notable contamination. Environmental sampling carried out during the site investigations showed no exceedances of assessment criteria.

Reach 5

Potentially contaminative associated with this reach included:

- No significant contaminative uses in the southern part of the reach
- Large wharf and coal yard (not currently active), and a large gas holder station (which is still active) to north of the reach (other side of railway)
- Large wharf with conveyors and hoppers shown (asphalt works) in the northern part of the reach (which is still active)

Made Ground in this reach (1.50m and 6.60m thickness) consisted of gravel with occasional clinker and wood fragments. A slight creosote odour was recorded at 0.40-0.70m depth in a borehole drilled at the wharf south of Bridge Road (CP1102), and recorded a slight bituminous odour at 0.30 and 1.50 m depth and a strong hydrogen sulphide within the alluvium (clay) below the made ground (6.60m depth) and a strong bitumen odour at 8.00m depth (borehole CP1201B). Previous investigations have shown an exceedance of the adopted assessment criteria for benzo(a)pyrene in soil in the wharf south of Bridge Road (borehole CP1103 - 11 mg/kg compared to a GAC of 1.0 mg/kg). This contaminant is associated with coal so could be associated with the asphalt works, the gasworks or the coal yards.

Reach 6 to the south of the road bridge

Potentially contaminative uses in the southern part of Reach 6 included, from south to north:

- Large wharf with conveyors and hoppers shown (asphalt works, which is still active) and site of an in-filled ancient creek (in-filled after 1876)
- Historical use as a coal yard
- Precast concrete works from approximately 1970, currently light industrial site

Boreholes WS1302, WS1303 and WS1501 were located along the existing flood embankment. The material is generally described as sand with flint gravel and rare brick fragments. It varies in thickness from 1.20 to 1.90m.

In the Tarmac compound at the western end of Quayside, a slight hydrocarbon odour was recorded at 0.90 to 1.50 m depth (borehole CP/RC-B13). Crushed tarmac was recorded at 0.40 to 0.70m depth (borehole CPB13C). Site investigations have shown an exceedance of the assessment criteria for TPH in groundwater within the Tarmac compound (borehole WS1301A, located in the existing flood embankment), along with an exceedance of the GAC for benzo(a)pyrene in soils (11 mg/kg compared to a GAC of 1.0 mg/kg). Asbestos minerals crocidolite and amosite were detected in soils in the wharf to the south of Quayside Road, in an area of made ground associated with an ancient in-filled creek (borehole CPRCB12A at a depth of 1.0m).

Reach 6 Realignment

Potentially contaminative uses in this part of Reach 6 include, from south to north:

- Sewage works (small) from at least 1974
- In-filled pond (filled between 1932 and 1970)
- Pond 1932-1976, now in-filled. “Old” Limekiln – 1876-1898

All boreholes sampled in this reach were located along the existing flood embankment. The embankment varies in thickness from 1.55 to 2.10m. None of the borehole logs recorded notable contamination. Site investigations have shown an exceedance of the adopted assessment criterion for THP in groundwater in boreholes WS1504 and WS1601 located in the existing flood embankment. A limited amount of bacteriological analysis was also undertaken in areas associated with the former sewage works. The results show levels of bacteriological contamination well below those associated with fresh sewage waste and levels considered to present a risk to construction workers.

Potential receptors

Potential receptors within the study area, sensitive to changes in ground conditions or the release of contaminants include:

- Human beings, notably construction workers, nearby residents and visitors during construction, and residents and visitors during operation
- Building materials
- Ecological receptors, particularly in Reach 6 and in the inter-tidal and estuarine habitats
- Any archaeological features, particularly in the inter-tidal area
- Water, particularly water quality in the inter-tidal and estuarine area

8.2 Likely significant impacts

Construction Phase

Human beings

There is the potential for the older buildings on site to contain asbestos. Surveys are currently underway, but the results are not yet confirmed. Where such buildings need to be demolished in Reaches 1 and 2, should asbestos be found, there is a risk to construction workers, site visitors and nearby residents during the construction period. This is considered a **major adverse effect**.

No works are proposed in Reach 6 where asbestos containing materials may be present. **No effect** is envisaged in this area.

The contaminants found in previous site investigations also pose a potential risk to construction workers, nearby residents and site visitors if uncovered or disturbed during construction. This is considered a **moderate adverse effect** during construction for all reaches except in Reaches 2 and 4 where no contamination was encountered.

There is also a possibility that unforeseeable contamination could be encountered during construction works. Conceptual models showing the level of risk for all the reaches are shown in Drawings 463457-GEOENV-001 to 007. The risk of unforeseen contamination is considered low based on historical land use and ground investigations to date but should not be totally discounted.

Ground Investigation has shown there to be **no effect** on building materials.

Water, archaeological and biodiversity

Water resources, archaeological features and ecological receptors are at risk from any release of contaminants during ground disturbance, or from spillages of hazardous materials or oils from construction plant or vehicles. This is considered a **low adverse effect**.

Operational Phase

Human beings

Following construction, there will be no further ground disturbance and no effect on residents of visitors from contaminants is envisaged.

Building materials

No long term effect on building materials is envisaged.

Water, archaeological and biodiversity

Water resources, archaeological features and ecological receptors are at risk from any change to contamination pathways, which, in this case, is via groundwater flow. This has been assessed on a reach by reach basis as presented in the following paragraphs.

Reach 1: The proposed works in this area will include the construction of a new sheet pile wall in front of the existing flood defence. Sheet pilling has the potential to create preferential pathways through the alluvium for contaminants within the made ground to migrate down into the underlying granular alluvium and laterally towards the river. The alluvium in the area of sheet piling is approximately 5m thick and so any piling is unlikely to create vertical pathways as the alluvium should tend to seal against the piles. The contamination from hydrocarbons seen in borehole BH201 at 0.8m depth is on the landward side of the piling and so any potential for lateral migration of contaminants towards the river is likely to be further reduced once the sheet pile is in

place. This is considered a **negligible beneficial effect** on water, archaeology or biodiversity post construction.

Reach 2: The proposed works in this area will include the construction of a new sheet pile wall in front of the existing flood defence. As there are no significant sources of contamination in Reach 2 the proposed works are considered to have **no effect** on water, archaeology or biodiversity.

Reach 3: The proposed work in this area will include the construction of a new sheet pile wall in front of the existing flood defence. Any potential for lateral migration of contaminants towards the river is likely to be further reduced once the sheet pile is in place. This is considered a **negligible beneficial effect** post construction**.**

Reach 4: The proposed work in this area will include the construction of a new sheet pile wall in front of the existing flood defence and new set back floodwalls. As there are no significant sources of contamination in Reach 4 the proposed works are considered to have **no effect**.

Reach 5: The proposed work in this area will include the flood proofing of the Arun View public house through raising of the existing walls using concrete and flood glass. Part of Reach 5 has also been used to unload and store steel for the works.

Any potential for lateral migration of contaminants towards the river is likely to be further reduced once the sheet pile is in place. This is considered a **negligible beneficial effect** post construction**.**

Reach 6 (south of the road bridge): The proposed works in this area will include raising the existing embankment, using sheet piling and repairs to the scour protection.

Raising the embankment will require covering the existing materials, reducing any potential for exposure of any contaminants post construction. This is considered a **negligible beneficial effect.**

The proposed work in this area will include the construction of a new sheet pile wall through the existing flood defence. Any potential for lateral migration of contaminants towards the river is likely to be further reduced once the sheet pile is in place. This is considered a **negligible beneficial effect** post construction**.**

The piling has the potential to cause downward movement of contamination, albeit considered unlikely. This is considered a **low adverse impact**.

Reach 6 Realignment: In Reach 6 some of the existing flood defences will be partially excavated and re-used to form re-profiled landscape levels. The site investigation data from Reach 6 Realignment does not show significant concentrations of contaminants within the existing flood defences, so the re-use of the material should be acceptable. Further analysis of soils will be required during the works to confirm their suitability (this is standard practice when re-using soils). If all soils are re-used within the site this is considered have **no impact**.

Any soils that are not suitable for reuse on site will require off-site disposal. However, there is not likely to be more than small amounts of unsuitable soils, such that this is considered **low adverse impact** (in terms of lorry movements and landfill disposal.

The existing scour protection (concrete and bitumen) will require disposal to landfill. This is considered a **low adverse impact**.

In summary there are two **low adverse impacts**, associated with disposal of materials to landfill and potential for piling to cause downward movement of contamination. The new sheet piling may reduce contaminant movement towards the river. This is considered a **negligible beneficial impact**.

8.3 Mitigation

Construction phase

We will put in place a number of standard mitigation measures to avoid or minimise the risks to human beings, water, archaeology and biodiversity during construction. These are outlined below:

- We will undertake a 'refurbishment and demolition' type of asbestos survey of all existing buildings and structures that require demolition. This will be followed by the sequence of removal of asbestos-containing materials, if required, by a competent contractor
- All piling works will require a piling risk assessment. Pile design will aim to minimise downward movement of soil contaminants where relevant (i.e. where contamination has been found during the ground investigations)
- There is a possibility that unforeseeable contamination could be encountered during construction works and as such an appropriate method of construction management (a Construction Environment Management Plan) will be put in place to protect construction workers, including the provision of appropriate personal protective equipment
- Where temporary haul routes or similar are required (Reaches 5 and 6), and it is planned to remove these on the completion of the works, care will be taken to minimise mixing of haul route materials with the underlying ground. If excavations are undertaken, arisings will be examined for signs of contamination
- If further contamination is encountered during construction, further assessment will be required. Any excavated suspect materials will be carefully stockpiled separately from other arisings until such time as the nature and composition of the materials has been confirmed
- There is potential for contamination of the site during the construction phase through spillage of fuels or oils associated with construction plant or construction materials. The Contractor will be required to adhere to appropriate legislation and best practice to ensure the watercourse is protected during construction works
- We will avoid generating and disposing of surplus or unsuitable soil materials by means of treatment for necessary and beneficial re-use in earthworks within the site. This process may require consent of an Environmental Permit (Standard Rules Permit), or adoption of the guidance published in CL:AIRE 'The Definition of Waste: Development Industry Code of Practice'
- We will dispose of waste materials unavoidably generated during construction via licensed waste contractors to appropriate disposal sites. Any waste soils generated on site will be reused where possible. Waste generated on site will be stored safely in designated areas and in appropriate containers. Any waste requiring off-site disposal will be disposed of in accordance with a Site Waste Management Plan, which will be prepared and agreed with Arun District Council prior to construction
- Stripped topsoil will be suitably stored and reused for reinstatement landscaping wherever possible. The location of stockpiles will be determined by the contractor in accordance with other environmental requirements specified in the Environmental Action Plan

- Once haulage routes and stockpile areas are no longer required, we will restore the site in accordance with the design proposals and best practice (Defra, 2009)

Further mitigation to protect groundwater and surface water resources during construction is outlined in Chapter 12 – Water Resources.

Operational phase

No mitigation is required during the operational phases.

8.4 Residual impacts

By adhering to standard good practice methods for surveying, removal and disposal of asbestos in accordance with the health and safety plan, we will reduce any risk to construction workers, nearby residents or visitors from any asbestos encountered during the construction period. By applying good site practice and measures included in the Environmental Action Plan we will also manage the risk to construction workers, nearby residents, visitors, water resources, archaeological features and ecological features from other forms of contamination during construction. This includes risks associated with the release of contaminants during ground disturbance, and accidental spillages of hazardous materials, fuels or oils. **No residual impacts are envisaged**.

During operation, no adverse impacts on or resulting from contamination are envisaged. There may be a negligible beneficial impact on water, archaeological and ecological resources in the inter-tidal and estuarine areas as a result of improved protection from seepage of any contaminants into the water channel.

Residual impacts are summarized in Table 8.1.

Reach	Receptor	Potential impact	Significance of impact before mitigation	Mitigation	Significance of the impact after mitigation
1, 2 & 6	Humans	Exposure to asbestos	**Major adverse impact**	Undertake asbestos surveys, removal and management of any asbestos found	**Negligible adverse Impact**
1, 3, 5 & 6	Humans	Exposure to soil contaminant during construction works	**Moderate adverse impact**	Health and Safety planning, preventative measures, Personal Protective Equipment	**Negligible adverse Impact**
1, 3, 5 & 6	River	Migration of contamination from made ground behind defences to River	**Negligible beneficial impact**	None required	N/A
6	Ground-water	Movement of contaminants in surface soils downward into groundwater as a result of piling	**Low adverse impact**	Correct piling design, and piling risk assessment	**No impact**
6 R	Landfill (offsite)	Disposal of unsuitable fill	**Low adverse impact**	No mitigation	**Low adverse impact**

Table 8.1 Residual impacts on and resulting from ground conditions and contamination

9 Landscape, townscape and visual issues

This chapter addresses issues relating to landscape and visual impacts associated with the scheme as identified in the scoping report.

The landscape and visual impact assessment broadly follows the guidance contained within 'The Guidelines for Landscape and Visual Impact Assessment', Third Edition (2013), as published by the Landscape Institute (UK) and the Institute of Environmental Management and Assessment. Its purpose is to help guide the design of the scheme as it develops by identifying potentially significant adverse landscape impacts, designing these out where possible as an iterative assessment and design process or by identifying appropriate mitigation measures. Impacts on landscape are discussed separately from impacts on visual receptors.

Landscape design has been integral to the design process. A number of Landscape Masterplans have been prepared for the scheme. These present the landscape design proposals that have been included as part of the design. Copies (as listed on the Contents page and in Chapter 3 -) are presented at the end of this document. For this reason, there are few landscape mitigation measures listed apart from measures that apply during construction, although we have summarised the key elements that have already been incorporated within design, and there is little difference between likely significant impacts and residual impacts.

The assessment of visual impacts (impacts on visual receptors such as residents, visitors and pedestrians) has been included at the end of the chapter.

9.1 Existing environment

Littlehampton forms part of the extensive south coast development strip. The town has developed to the east of the River Arun, which formed a natural barrier. There is little evidence of an older medieval street pattern, with a 19th century rectilinear pattern being the most dominant. The more modern inner ring road cuts through this in a curve creating wide junctions where the highway dominates. Large scale residential development extends to the east and to the north as far as Wick which lies to the south of the coastal railway. The long sweeping curve of the A259 encloses the town to the north west. Further to the north and east of the river there are areas of farmland.

The River Arun is an important feature of the town with the town centre lying to the east. The mouth of the river is characterised by the entrance to the harbour, East Beach and the dunes to the west. Moving inland, the Harbour Park Amusement Centre to the east is in stark contrast to the open dune ridge to the west of the river. The river widens out with the larger marinas and open landscape of the golf course to the west. Older properties on Pier Road, along with the new flats on the east bank enclose the river with a hard edge and limited views. New residential development extends further north past the life boat station as far as the footbridge.

Here, there are older buildings hard on the edge of the river bank whose origins are clearly related to river activity and trade with boatyards and marinas on the west bank. The footbridge marks a distinct change in character to a larger scale industrial landscape with its open and disjointed form created by the Tarmac plant at Railway Wharf, factories, depots, gas holder station and railway. The A259 creates the edge of the town, crossing the river and railway on high embankment.

Within this overall context there are a number of finer scale character areas which are outlined below according to the criteria presented in Table 9.1.

Sensitivity	Typical descriptors
High	Landscapes where there are no or few features similar to those of the scheme in the existing landscape
Medium	Landscapes where there are some features which are similar to those of the scheme in the existing landscape but are not dominant features
Low	Landscapes where there are similar features to those of the scheme in the existing landscape

Table 9.1 Sensitivity of the landscape to the introduction on the scheme

East Beach and The Green; East Beach extends eastwards from the harbour mouth with long views along the beach and the promenade. The Green is located between the straight lines of the promenade and South Terrace. The openness of The Green is interrupted by parking areas and residential development. The amusement park separates the green from the river and is in part located on remnant dunes in an elevated position and is dominant in the view. The lighthouse is also a locally dominant feature along with the Coast Guard lookout building.

The riverside promenade is visually cluttered with small scale walls and planters, and a wide range of materials and street furniture of varying styles and quality. The existing waterfront railing is of a utilitarian appearance. Further north onto Arun Parade, the character is less cluttered, with the view east dominated by the car parking on Arun Parade. At the junction with South Terrace, the oval boating pond is a distinctive feature partially enclosed by trees but allowing views to the Green to the east.

This character area is of Medium Sensitivity

The Dunes; To the west of the river is an area of dunes, (Climping Beach Site of Special Scientific Interest) which lie between the beach and Littlehampton Golf Course. The open expanse of the golf course with its levelled ground and mown fairways is in stark contrast to the windblown sand, marram grass and scrub of the dunes. The dunes limit views westwards from the promenade but there are open and extensive views across the golf course. Littlehampton Fort Scheduled Monument is low lying and not a dominant feature in the landscape.

This character area is of High Sensitivity

Riverside Marinas; The west bank of the river is characterised by an almost continuous development of marinas and boatyards. These range from well managed boat clubs to landing stages set within the mud flats. There are sections where the jetties are derelict or poorly maintained. The sound of rigging against masts adds to the distinctive waterside character.

This character area is of Medium Sensitivity

Pier Road and South Terrace; The junction of Pier Road and South Terrace is an important location within the town. It is the transition point between The Green and the river, and the residential areas to the north east. It is however dominated by the relatively wide road junction with cars parked on all sides. The Nelson public house and Riverside Fish are locally distinctive buildings. There are a number of obstacles such as signs, CCTV columns, post boxes and litterbins that obstruct pedestrian access from South Terrace to the river. This is further compounded by limited space around the fish kiosk.

Buildings on the southern part of Pier Road are smaller in scale; 2 storey with slate roof and projecting windows at the second floor clad in timber with the majority having a commercial ground floor use. Cars tend to park on one side of the road. Footpaths are relatively narrow, but marked by a stone kerb and channel. Litter bins and streetlights further reduce the footpath width by the river.

A low concrete wall with brick capping marks the top of the river bank with a sloping concrete bank to the piled wall at its toe. There are occasional concrete steps and a floating pontoons lies just off the curved toe wall. The poor condition of the concrete bank further reduces the landscape quality of this section of river.

This character area is of Medium Sensitivity

Littlehampton Harbour Board to River Road; Riverside Walk north of the Harbour Board is characterised by its almost continuous frontage of residential development. The promenade is characterised by the concrete capping to the wall and galvanised and painted balustrade, and the concrete block paving. Lighting and street furniture is painted black with a bespoke seat design and metal artwork panels inserted in to the wall in places. There are also the artwork features with fish recipes which extend along the whole promenade.

The buildings at the back of the promenade are arranged in short terraces, predominately 3 storeys with occasional buildings at 4 and 5 storeys. They are in a variety of styles with a mixture of finishes and rooflines. A consistent feature is the ground floor garden and the balconies. Further to the north the promenade ends where the gardens of properties extend to the top of the banks with the path returning in-land.

This character area is of Medium Sensitivity

The Footbridge and Wharf Road; The area to the north of the residential area on Riverside Walk marks a distinct change in character of the river where it becomes more open and disjointed. Wharf Road and Bridge Road are closer to the river with the road junctions creating open areas, further emphasised by the extensive areas on the approach to the railway station and individual buildings set within areas of car parking. The gasometer and footbridge are distinctive features. The area falls within the River Road Conservation Area with the older locally listed buildings hard against the east bank of the river. These buildings are characterised by their flint and brick walls and tin sheet roofs. The railings on the bank to the south of the footbridge are also of local interest.

South of the bridge on the west bank there is an extensive area of boatyards with slipways and jetties, and a range of boat workshop buildings clad in sheet steel.

This character area is of Medium Sensitivity

Industrial Area; North of the footbridge, as far as Bridge Road (A259), the river landscape is industrial in character. On the east bank an open area of gravel quays separate the river from the industrial buildings behind. The industrial area is enclosed by planting on embankments of Bridge Road (A259 and B2187) and open to the river frontage. The west bank is characterised by a further reach of landing stages for pleasure boats and storage areas for boats and containers. Trees on the road embankments and alongside the ditches create a greener, more rural landscape.

This character area is of Low Sensitivity

Rural Landscape; North of the A259, the landscape is rural in character. The A259 forms a district boundary to the edge of the town with the planting on the road embankment screening both the road and the town from the wider countryside to the north and west. There are open arable and grazing fields with areas of scrub adjacent

to the river and alongside the flood embankment and various ditches. Trains moving along the railway line are a distinctive feature in the landscape.

This character area is of High Sensitivity

9.2 Likely significant impacts on landscape character

We identified a number of potential impacts on landscape character and these are set out below for each of the character areas and reaches. The potential operational impacts described below are prior to the mitigation measures or enhancements being considered. The mitigation measures are then described and these measures are also outlined on the landscape and environmental masterplan drawings that accompany the Environmental Action Plan and shown in more detailed landscape masterplans located at the end of the document. Finally, the residual impacts are described incorporating the mitigation measures and enhancement proposals included as an integral part of the scheme.

Impacts during construction

There is potential for significant adverse impacts on the landscape character during construction. The impacts would be due to the presence of large scale construction machinery in the landscape, particularly the taller plant such as cranes and piling rigs which will be visible from, and will have an influence over a wider area. At Reaches 1 and 2, the promenade would be closed, as would Pier Road for a period of time, and be heavily influenced by the immediately adjacent construction works. Construction impacts on the wider landscape would be less significant at Reach 3 with the majority of the construction plant screened by the adjacent buildings. Works at Reach 4 would also be relatively self contained although more visible from the adjacent road, footbridge and to the north. The works at Reach 6 will be more visible and have an impact on the wider open landscape to the north.

Other adverse impacts would result from the presence of moving plant and vehicles, storage of materials and welfare facilities. There is also the potential for impacts due to temporary lighting.

Operational impacts

East Beach and The Green (Reach 1)

The area is an important landmark and point of reference on the sea front. There is the potential for an adverse impact on the character through the loss of existing landscape features and the introduction of new intrusive engineering features as part of the defences which could be at odds with the character of the landscape. There would be the loss of visual connection to the water from the promenade due to the raised defences and need for railings at the top of the wall. There would be the loss of views from the riverside promenade out to the west over the river and to the landscape beyond due to the raised defence features.

There would be a **moderate adverse impact** on the character area (an impact of moderate magnitude on an area of medium sensitivity).

The Dunes

There would be no significant impact on the setting of Littlehampton Fort Scheduled Ancient Monument or the character of the dunes.

Pier Road and Arun Parade (Reaches 1 and 2)

The area is an important area of public realm and landscape. There would be the loss of direct access to the promenade as is currently possible from most of the length from Pier Road and Arun Parade due to the change in level as a result of the raised defences and promenade.

The introduction of engineering features such as capping beams and balustrades, new walls at the rear of the promenade made from different materials, and street furniture could introduce further visual clutter and affect the quality of Riverside Walk. This would constitute a **large adverse impact** (an impact of major magnitude on an area of medium sensitivity).

River Road (Reach 3)

Whilst there would be a direct impact on the rear gardens of the residential properties, the impacts would be localised and there would be no significant impact on the character of the wider landscape.

There would be a **slight adverse impact** on the character area (an impact of minor magnitude on an area of medium sensitivity).

The Footbridge and Wharf Road (Reach 4)

Potential impacts include the visual separation of the river from the adjacent road and footpath due to the raised defences. The raised wall of the defences would become more of a feature in the landscape introducing an engineered element. There would be the loss of the three trees on the Pharos Quay land, and the loss of boundary railings which have some historic value.

There would be a **moderate adverse impact** on the character area (an impact of moderate magnitude on an area of medium sensitivity).

Industrial Area (Reach 5)

Raising of concrete capping beam with additional concrete would not have any significant impact on the character of the landscape in this area.

There would be a **neutral impact** on the character area (an impact of low magnitude on an area of low sensitivity).

Rural Landscape (Reach 6)

The loss of the existing screen planting on the embankment of the A259 road during construction would open up views of the road and the vehicles on it to the wider landscape.

Trees and vegetation lost are listed below and shown on the landscape masterplans for Reach 6 (included at the end of this document). Refer, also, to the tree survey report (included in Appendix H) for a more detailed description and location plan.

- T6 – a series of individual scrubby Elder
- G9 – part of group of bramble with elder and common hawthorn
- G10 – part of the linear group/outgrown hedge adjacent to the fence at the toe of the road embankment, predominantly field maple with some common hawthorn
- G11 – a thicket of blackthorn
- G12 – embankment planting of common hawthorn, field maple, ash, wild cherry, blackthorn with some larger oak

There is the potential for the introduction of visually intrusive engineering features into the rural landscape such as scour protection, drainage control structures and access points.

There would be a **moderate adverse impact** on the character area (an impact of moderate magnitude on an area of high sensitivity).

9.3 Mitigation

The following landscape and visual mitigation measures are included within the proposals along with the landscape and public realm enhancements for Reach 1 and 2. These measures are also shown on the landscape masterplan drawings which demonstrate that landscape has been an integral part of the development of the scheme.

In addition to the site specific measures for each area outlined below, during the construction period, measures will be taken across the site to mitigate adverse landscape and visual effects. These include actions set out within the Considerate Contractors scheme such as maintaining a tidy site, taking care with the levels and direction of temporary lighting, and providing localised visual screening if required.

East Beach and The Green (Reach 1)

- Raise this area of promenade as a whole to maintain an accessible route with no steps between the sea front promenade and the Riverside Walk
- Raise the level of the area to maintain views to the river which would otherwise be lost due to raised defences blocking the view

In addition to these mitigation measures the area is included within the public realm enhancement scheme which will enhance the quality of the public realm with high quality paving materials, new planting, new seating and replacement lighting.

The Dunes

No mitigation measures required

Pier Road and Arun Parade (Reaches 1 and 2)

- Raise the promenade to maintain the view to the river which would otherwise be blocked by raised defences
- Use visually light weight railings to reduce the screening effect of a more solid railing to maintain views to the river
- Incorporate steps and ramps at desire lines and access points along the length of the promenade to maintain full inclusive access to the raised promenade from Pier Road and Arun Parade
- Position the line of the sheet pile defences to create more usable public realm space between the river and Pier Road

In addition to the mitigation measures outlined above, the area will be significantly enhanced through the implementation of the proposed comprehensive public realm enhancement scheme which will significantly improve the landscape of Pier Road and Arun Parade. The enhancement proposals are shown on the landscape masterplan drawings and described in more detail within the outline specification. The enhancements include high quality paving materials comprising exposed aggregate in-situ decorative concrete in a light buff colour, new planting to mimic the coastal

character set within a bound gravel set within terraces divided by corten steel, new bespoke timber seating and pebble seating, visual lightweight balustrade using tension wires and timber handrail and replacement lighting using timber columns.

River Road (Reach 3)

- Private gardens will be reinstated
- Reinstatement of gardens in consultation with the landowners/residents as part of the works

The Footbridge and Wharf Road (Reach 4)

- The defence wall has been located in a position to create space for a wider footpath with steps up to a raised area to allow views to the river over the defences
- Use appropriate materials and detailing to match the existing details and therefore visually linking the new wall into the adjacent landscape, and also minimising the effect on the setting of historic riverside buildings
- New ground cover planting to offset the loss of existing trees as there is insufficient space for replacement trees
- Reuse the existing railings should it be possible to remove them from the existing wall without damaging them

Industrial area (Reach 5)

No mitigation measures required

Rural Landscape (Reach 6)

- Replacement of planting lost to the access track and embankment toe using native tree and shrub species on the road embankment to reinstate the screening effect mitigating the adverse effect of the road on the wider rural landscape character. Indicative plant species are shown on the Landscape Masterplans located at the end of this document.
- Use of appropriate coastal environment and species rich grass seed mixes on the defence embankment
- Appropriate low key engineering design solutions to minimise the visual intrusion of the engineering features into the rural landscape. This includes the flush timber kerbs rather than raised concrete.
- Placing topsoil based material over the erosion protection to enable re-colonisation of vegetation but recognising that the material may be washed away within the tidal area
- Re-grade existing embankment and other earthworks to allow for natural regeneration of the natural inter-tidal habitat and restoration of the important landscape feature

9.4 Residual impacts on landscape character

There are a number of residual impacts on the character of the landscape, both adverse and beneficial. Overall the scheme would result in moderately beneficial impacts due to the mitigation measures proposed and the proposed public realm enhancements to Reaches 1 and 2 which will take the form of better paving materials, seating, replacement lighting and carefully designed planting which responds to the coastal context in an area important to residents and visitors. The following section describes the residual impacts.

East Beach and The Green (Reach 1)

There will be a **moderately beneficial impact** (medium sensitivity, moderate magnitude) on the character of the area following the implementation of the enhanced public realm scheme with improved paving materials, reduced visual clutter with the removal of unnecessary signs and street furniture, new high quality seating and other street furniture, and new lighting. There will be greater continuity of access between the sea front promenade and the riverside promenade with a continuous paved surface without changes in level, and one which will be wider than the existing pavement alongside Pier Road.

The Dunes

There will be **no residual impact** on the setting of Littlehampton Fort. There will be slighter better views to the west to the sand dunes from the raised promenade.

Pier Road and Arun Parade (Reach 1 and 2)

There will be a **moderately beneficial impact** (medium sensitivity, large magnitude) on the character of the riverside promenade following the implementation of the public realm enhancement scheme. In addition, the narrow footpath which currently exists will be widened, thereby creating a wide promenade from East Beach whilst maintaining the footpath at the lower level adjacent to Pier Road.

The access to the promenade will be **slightly adversely** affected due to the raising of the promenade. Views of the river from the promenade would be maintained both due to the promenade raising and using a visually lightweight balustrade. Views west from Arun Parade would be **moderately adversely** affected due to the raised defences and promenade blocking the view to the river and the landscape beyond.

River Road (Reach 3)

There will be **slight adverse impact** (medium sensitivity, low magnitude) due to the depth of the concrete wall and capping beam which will be slightly more dominant in the view from the river.

The Footbridge and Wharf Road (Reach 4)

There will be a **slight adverse impact** due to the visual separation of the river from the footpath and road, although views would be possible from the raised area. There will be a **slight adverse impact** on the character of the landscape, and therefore on the Conservation Area, due to the size and scale of the defence wall, in particular the capping beam. There is insufficient space for replacement trees but the new ground cover planting will compensate for the loss of the existing three trees to some degree.

Industrial area (Reach 5)

There will be **no residual impact** on the character of the industrial area.

Rural Landscape (Reach 6)

There will be **no residual impacts** on the landscape character once the replacement native tree and shrub planting on the road embankment has established as this will screen the view of the road from the wider landscape. There will be a slight enhancement (a **slight beneficial impact**) through the increase in area of inter-tidal habitat creation and the removal of the flood bank. The scour protection would mellow over time as soil and vegetation establish in places and as it becomes coated in silt material.

9.5 Residual visual impacts

A summary of residual visual impacts after mitigation, describing the main receptors from Reach 1 to Reach 6, is provided in Table 9.2.

Reach	Receptor	Existing view	During construction	During operation
1	Sea front promenade	Open views to the beach and sea with views west towards the river limited by changes in level and intervening structures. High sensitivity	Open views to construction activity in close proximity. High magnitude Major adverse	View to raised promenade with open views west due to removal of old shelter building. Low magnitude **Slight beneficial**
1	The Green/Arun Parade	Views west towards the promenade with parked cars and the river set below hidden from view. High sensitivity	Views to construction in close proximity particularly during the works to the promenade. High magnitude Major adverse	Views to raised promenade with its enhanced steps, ramps and planting. View to the river hidden behind the raised defences/ promenade. Medium magnitude **Moderate adverse**
1	Riverside promenade	Open views west across the river and to the dunes beyond. View east limited by parked cars and the amusement park High sensitivity	Promenade closed during construction. High magnitude Major adverse	Open views as previously, but from a slightly more elevated position due to raising of the promenade. Views of enhanced public realm. Low magnitude **Slight beneficial**
2	Pier Road traders/ residents	Views west across Pier Road to the riverside and the boatyards on the opposite bank. High sensitivity	Open views towards the construction works on the opposite side of the road. High magnitude Major adverse	Views towards the raised defences and promenade with its enhanced paving materials, seating, steps and planting. Partial loss of view to the river. Medium magnitude **Moderate adverse**
2	Pier Road	Views west across the narrow riverside path to the river and the boatyards on the opposite bank. High sensitivity	Open views towards the construction works with the footpath closed. High magnitude Major adverse	Views towards the raised defences and promenade with its enhanced paving materials, seating, steps and planting. Partial loss of view to the river. Views from the widened and raised promenade to the river. Medium magnitude **Moderate adverse**

Reach	Receptor	Existing view	During construction	During operation
1-4	Boat users	Views up and down the river with views east more limited by existing defences. Medium sensitivity	Opens views to the construction activity with piling from within the river. High magnitude Moderate adverse	Slight loss of view to the east of features on the bank due to the raised defences. Low magnitude Negligible
3	Private frontage - River Road residents	Views from rear of property and gardens to the river High sensitivity	Open view to construction activity within the garden. High magnitude Major adverse	View to raised defence wall with partial loss of view to the river. Medium magnitude **Moderate adverse**
4	Britannia Quay	View west towards the river. High sensitivity	Oblique but open views to construction activity on adjacent land. High magnitude Major adverse	No significant change in view. **Negligible**
4	Pharos Quay	Views towards the river across the road and area of open space. High sensitivity	Open view to the construction activity. Loss of existing trees opening up the view. Medium magnitude Major adverse	Loss of existing trees opens up view to west bank. New defences form part of boundary and blocking view of the river. Low magnitude **Slight adverse**
4	River Road	Views from the path and road across the river and south along the road. Low sensitivity	Open view to the construction activity in close proximity. with closure of footpath High magnitude Slight adverse	Partial loss of view to the river due to raised defences partly mitigated by widened path and raised area to allow views for pedestrians. High magnitude **Slight adverse**
4	Footbridge	Open views up and down the river from an elevated position High sensitivity	Open views to construction activity in close proximity Medium magnitude Moderate adverse	View to raised defences Low magnitude **Slight adverse**
5	Arun View PH	View of the river is an important part of the PHs feature with open views of the river from inside and terrace High sensitivity	Loss of view during closure of the section of the restaurant High magnitude Major adverse	View of river retained through glass wall defences **None**

Reach	Receptor	Existing view	During construction	During operation
6	Industrial estate	Some limited views south with views of the river bank between buildings and car parking. Medium sensitivity	Some views towards piling and earthwork activity at the river edge. Medium magnitude Slight adverse	Limited views towards the raised sheet piles defences. Low magnitude **Negligible**
6	Boat users	Open view from the river to the banks High sensitivity	Open view to construction activity on the edge of the river High magnitude Major adverse	Open views to the raised defences Low magnitude **Slight adverse**
6	A259 Bridge Road	Limited views down to the river from the bridge and also partially screened by existing vegetation on the embankment to the north of the bridge. Low sensitivity	Loss of trees on embankment open up views to the river and construction activity by the river. Low magnitude Slight adverse	Once replacement planting has established, view to the river would be screened. **None**
6	Railway line	View south at speed down the river to the A259 bridge. Low sensitivity	Glimpsed views of construction machinery on the river bank. Low magnitude Negligible adverse	No significant change **None.**

Table 9.2 Summary of residual visual impacts

10 Land use and socio-economy

This chapter outlines the potential impacts of the scheme on the local economy and land uses. The assessment includes people living and working in the area, visitors and tourists. This chapter is sometimes called Human Beings or Population.

The assessment comprises a qualified assessment, based on professional judgement. We have considered whether there is likely to be any change to land use or the socio-economy as a result of the scheme. The assessment of significance has been based on whether these changes are likely to cause a noticeable impact on how land is used or the economy of the town.

10.1 Existing environment

Littlehampton is a coastal town in the south of England, flanked to the west by the River Arun which provides a focal point for the town and attracts a number of visitors. The main town centre and commercial area is situated to the east of the river. New riverside residential areas have been built in recent years located between the Harbour Board building and the Arun View public house.

Tourism is a key part of the local economy, with a number of hotels and bed and breakfasts operating in the town. Attractions include the beach, an amusement park, the promenade, harbour and moorings, the Oyster Pond and numerous cafes and restaurants.

The Riverside Industrial Estate is located just south of the A259 road in the east of the town. Other employers in the surrounding area include the Body Shop headquarters to the north of the town and Dando Drilling International Ltd. The majority of other businesses are smaller scale, excluding large shops such as Sainsbury's and Waitrose. Agricultural land is situated to the north of the A259.

The town is connected by both rail and road networks. The A259 and A27 provide road transport along the coast to Bognor Regis and Portsmouth in the west and Worthing to the east. The railway line provides direct transport to London, Gatwick Airport, Brighton and Portsmouth. The railway station is situated to the east of the scheme.

10.2 Likely significant impacts

The scheme once operational will provide increased flood protection to the residential, commercial and recreational assets in the town. At present there are 781 residential and 336 commercial properties at risk of flooding. The recreational assets, particularly those adjacent to the River Arun, in the town will be protected, ensuring that that the economically important tourist numbers are maintained in the future. The transport infrastructure will also be protected against flood events. This represents a **major beneficial** impact for the town.

The construction period will lead to temporary disruption to businesses adjacent to the east bank of the River Arun, including the Arun View public house which may be closed for certain periods to allow safe construction activities, and the row of businesses along Pier Road in Reach 2. Pier Road is expected to be closed to traffic from November 2013 to May 2014. In addition, Arun Parade and the associated car parking provision associated with Arun Parade are expected to be closed from November 2013 to July 2014. However, arrangements will be made for deliveries and pedestrian access will be

maintained (there is no parking provision outside these businesses at present). Although most of these impacts will occur outside the main tourist season, there will be some disruption to businesses from noise and road closures. Whilst different business are likely to be affected to varying degrees, it is envisaged that construction works will result in overall temporary impacts of **moderate adverse** significance to local businesses.

Recreational areas and tourist attractions may also be subject to disruption during construction, particularly in Reaches 1 and 2 along Arun Parade, although pedestrian access will be maintained in Reaches 1 and 2 throughout construction. However, construction work will be taking place adjacent to pedestrian walkways during the construction period which is likely to cause some disruption from noise, albeit outside the main tourist season. Disruption to recreational facilities will result in **moderate adverse** impacts.

Impacts to Public Rights of Way, car parking and transport networks, including the River Arun are detailed in Chapter 11 – Traffic and Transportation.

No change in land use is expected during construction and operation of the scheme. Therefore, **no significant adverse impacts** to land use are expected during construction.

In the long term, once the scheme is operational, it is anticipated that there will be **significant beneficial impact** to local amenities, recreation and local businesses as a result of the extensive public realm enhancements and the reduced risk of flooding, which are expected to boost the local economy.

10.3 Mitigation

We have worked closely with Arun DC to prevent or minimise adverse impacts on the socio-economy of Littlehampton and the surrounding area during construction. In addition we have met with those businesses most directly affected to discuss the scheme and how impacts on their business can be minimised. Mitigation measures include:

- Construction work in the main public areas has been programmed to avoid the peak tourist season, except in Arun Parade, Reach 1, where work mayl extend into July 2014
- Safe pedestrian access will be maintained in all areas, particularly in Reaches 1 and 2, which is an important recreational area for visitors and the local population
- Businesses and commercial premises surrounding the scheme will be informed in advance of the nature and timing of construction activities
- Provisions to enable deliveries to business premises will be made throughout construction and pedestrian access will be maintained. Any alternative access will be signed and it will be made clear that businesses are open as usual. The owners of the Arun View public house have been consulted and we will obtain agreement with them concerning the details of any necessary closures
- The local community and Visitor Centre will also be informed of the nature and timing of the works, and there will be a dedicated site communications officer during works

The public realm enhancements which form part of the scheme will be of benefit to the local economy and population:

- Extensive landscaping works will enhance the public realm in Reaches 1 and 2, an important area for tourists, as well as general improvements throughout the scheme
- We will install new hand rails in Reaches 1 and 2 for health and safety reasons
- A planting plan will be implemented in Reaches 1, 2, 3 and 4
- We will provide replacement lighting in Reaches 1 and 2
- We will maintain and improve access to the river in Reaches 1, 2 and 3

10.4 Residual impacts

The residual impacts on socio-economy are detailed in Table 10.1.

Receptor	Description of impact	Significance of impact	Mitigation measures	Significance of residual impact
Residential, commercial, recreational and infrastructure assets in Littlehampton.	Reduced flood risk to properties and assets once the scheme is completed.	Major beneficial	None	**Major beneficial**
Businesses in the surrounding area	Temporary disruption due to construction activities	Moderate adverse	Construction work has been programmed to avoid the peak tourist season as far as possible. Businesses and commercial premises will be informed of the nature and timing of construction activities. We will provide a dedicated site communications officer. Provision for deliveries and access for pedestrians to business premises will be maintained throughout construction. Any alternative access will be signed and it will be made clear that businesses are open as usual. We are working with businesses with regards to providing compensation where appropriate.	**Slight adverse, although individual businesses may be affected in different ways**
Recreational and tourist attractions	Temporary disruption due to construction activities	Moderate adverse	Construction work has been programmed to avoid the peak tourist season as far as possible. Safe pedestrian access will be maintained in all areas The local community and Visitor Centre will also be informed of the nature and timing of the works.	**Slight adverse**

Receptor	Description of impact	Significance of impact	Mitigation measures	Significance of residual impact
Local businesses and population	Improved public realm and promenade in Reaches 1 and 2, resulting in long term benefits to amenities, recreation, tourism and the local economy	Beneficial	None	**Beneficial**

Table 10.1 Residual impacts on the socio-economy of Littlehampton and the surrounding area.

11 Traffic and transportation

This chapter assesses the potential impact to the traffic and transport networks during construction of the scheme. The assessment addresses impacts on the highways network in terms of traffic flows, on other road users including pedestrians and cyclists and on navigation. The assessment comprises a qualified assessment, based on professional judgement. The main focus is on impacts during the construction as this is when most impacts are likely to occur. This chapter should be read in conjunction with the Traffic Management and Logistics Plan that has been prepared for the scheme as presented in Appendix I.

The study area includes the local road network as far as it joins the wider transport network.

11.1 Existing environment

Key aspects of the existing transportation network and users of the network are described below.

Road and rail network

The A259 is a main coastal road linking towns on the south coast of England. It connects Littlehampton to Bognor Regis in the west and Worthing in the east. The A284 provides a link from the A259 to the A27 (the main east-west trunk road just north of Littlehampton) and other main roads leading north from the coast.

The road network adjacent to the east bank of the River Arun is a mix of local and residential roads. The B2187 (Bridge Road/Terminus Road) provides access from the A259 to the Riverside Industrial Estate and Littlehampton Marina on the west bank. Further south, the B2187 leads onto the High Street and then to residential and recreational areas associated with the River Arun.

Roads immediately adjacent to the scheme include (from south to north) Arun Parade (in Reach 1), which lies adjacent to the promenade and start/terminates at the sea front and which provides parking for visitors. This leads onto Pier Road (in Reach 2), which continues north along the river. This is a single carriageway road with two way traffic and no parking on either side between 1st April and 30th September (except for time-limited parking for disabled users, which is permitted year-round), with South Terrace leading off to the east. Pier Road veers away from the river in Reach 3, before joining onto the B2187, Bridge Road/Terminus Road, which veers back towards the river in Reach 4, then diverges again in Reach 5 to pass behind the Industrial area before joining the A259 which crosses the river by bridge in Reach 6 westwards towards Bognor. The A259 continues northwards adjacent to Reach 6 Realignment (then east) to join the A284.

There is street-side parking along Arun Parade in Reach 1 (estimated to accommodate approximately 54 cars, although three of these are not to current standards, being located close to the junction with Pier Road and South Terrace), and Surrey Street car park is located adjacent to Reach 3. There is also a further car park located on South Terrace.

Littlehampton is connected by a rail line that terminates at a station on Terminus Road and passes along the east side of Terminus Road and Bridge Road, diverging away from the river in Reach 5, before crossing beneath the A259 in Reach 6 Realignment and linking onto the south coast railway line just north of the town.

River network

The River Arun is used for both commercial and recreational activities. Although conditions are not ideal for either commercial vessels or visiting leisure boats due to low water and fast flowing water in the approach to the river, the river is increasingly being used for leisure as commercial activity declines. This is reflected by the presence of Littlehampton Marina and Arun Yacht Club on the west bank and pontoons located along both river banks. Licensed angling boats and diving boats are also available in the river. However, there are no regular regattas held at Littlehampton or at Arundel, upstream.

The peak boating season occurs between April and October.

Access to the river is generally provided from pontoons along the river bank, with steps from the bank itself. Railway Wharf in Reach 5 provides direct access to the river for large commercial boats making deliveries to the site, although this facility is no longer used frequently for that purpose.

Pedestrian access, Public Rights of Way (PRoWs) and cycleways

There are no PRoWs located along the east bank of the River Arun. There are some PRoWs (including footpath numbers 3110, 3109 and 206) along the west bank. Other PRoWs within the vicinity of the scheme (including footpath numbers 42Li and 43Li that are situated close to Surrey Street) are shown on Figures 2.1 and 2.2 of the Key Environmental Features.

Pedestrian access is provided along the east bank of the river along the promenade adjacent to Arun Parade and along footpaths adjacent to roads. Pedestrian access is provided along the promenade extending from East Beach in the south, along Arun Parade, onto a footpath alongside Pier Road, where the footpath is relatively narrow with limited space for passing. From here, the footpath continues onto Riverside Walk, a wider promenade, north, to where the gardens of properties extend to the top of the banks, at which point the footpath turns in-land. These footpaths provide access to the river (via steps and pontoons) and the retail and residential areas associated with the riverside.

There are a number of cycle routes through Littlehampton. Route 2 of the National Cycle Network from Dover to St Austell passes along Terminus Road, across the River Arun via the footbridge, before continuing along Ferry Road towards Bognor. There are also four cycle routes forming part of the East Arun Cycle Network, which pass along the A259 across the River Arun and cover much of Littlehampton, linking to other towns such as Arundel and Bognor. In addition, Pier Road and South Terrace are identified as part of several circular cycle routes passing across the river on the A259 and along the coast.

Receptors

The key receptors identified for this assessment are road users, pedestrians, cyclists and users of the river. This includes the residents of Littlehampton and the surrounding area, businesses, tourists and pleasure and commercial craft.

11.2 Likely significant impacts

Road Network

Access routes for construction vehicles are shown on the Traffic Management and Logistics Plan figures in Appendix I. The main site compound is located at Railway Wharf in Reach 5. A satellite compound will be located in Reach 1 on Arun Parade and

a further satellite facility will be set up in Reach 6 as required. The location of compounds is shown on the figures in Appendix I.

We will need to transport material both on and off site during construction, which will increase traffic levels on the main and local roads into the town, such as the A259 and Bridge Road/Terminus Road.

We have selected the principal construction access routes to avoid busy shopping areas and minimise the use of narrow residential streets, delivery hours have been restricted and construction in the lower reaches has been programmed to avoid the main tourist season. We have estimated the total numbers of vehicle movements. The highest frequency of vehicle movements will be associated with construction of the embankment in Reach 6 where the earthwork needs to be imported and this cannot be done by river. Average and peak vehicle movements are summarised in Table 11.1 and Appendix I.

Reach	Estimated total deliveries	Average vehicle movements	Estimated peak
1 and 2	1,030	10 per day	3 loads per hour
3	50	3 per week	N/A
4 and 5	150	7 per week	3 loads per day
6	1,550	18 per day	6 per hour (9 week period)

Table 11.1 Estimated vehicle movements during construction

The scheme will result in an increase in traffic levels on the main roads in and around the town (the A27, A259, A284 and B2187 Bridge Road) classified as low sensitivity (due to their high vehicle flows and capacity). The predicted increase in road traffic will be relatively small, such that his will have a **negligible impact** on users of these roads.

Increased traffic, including HGV's is expected on the following medium sensitivity residential roads:

- River Road
- Quayside
- Wick Street
- Arundel Road
- Franciscan Way
- East Street
- Fitzalan Road
- South Terrace

The increased traffic levels will result in impacts of **medium magnitude** and **moderate adverse significance**.

Road users

A number of temporary road closures will be required on the local road network to facilitate construction in some reaches. These are detailed in the Traffic Management and Logistics Plan (Appendix I) and summarised below.

Reaches 1 and 2

Arun Parade is expected to be closed from November 2013 until July 2014. Pier Road will be closed from November 2013 until May 2014. Although the closure along Pier Road will be outside the main tourist season, there could be a closure of Arun Parade extending into the tourist season of 2014, and this could result in temporary impacts on road users of **moderate adverse significance**.

Reach 4

River Road, between the junction with Wharf Road and Pharos Quay, is expected to be closed, from February 2014 for eight weeks and traffic will be restricted to a single lane for 12 weeks. Although outside the main tourist season, the road closure and following single lane restriction will result in temporary impacts of **moderate adverse significance**.

Reach 5

River Road, between the junction with Wharf Road and Pharos Quay at the junction adjacent to the pedestrian footbridge, is expected to be closed for four to eight weeks from January 2014. This will result in temporary impacts of **moderate adverse significance**.

Car parking

Parking facilities will be provided on site for all site staff and visitors so that there will be no impact on car parking near the working areas as a result of construction workers or visitors.

The main car park on Surrey Street and the car park on South Terrace will not be affected during construction or operation. Works are expected to be underway in Reaches 1 and 2 from November 2013 until May 2014, and the landscaping and public realm works in Arun Parade may continue into July 2014. During this time, there will be a loss of parking of approximately 51 spaces from along Arun Parade. Alternative parking is available along South Terrace and in nearby car parks. However, the closure of Arun Parade is likely to result in some nuisance and impacts of **negligible significance**.

Following construction, Arun Parade will be reopened to traffic and it has been agreed with Arun District Council and West Sussex County Council that a total of 44 new parking spaces will be provided. This will be a slight reduction from the existing provision of approximately 54 spaces (although three of these are not to current standards, being located close to the junction with Pier Road and South Terrace). Given that adequate parking is available nearby, this will result in an impact of no more than **slight significance**.

Emergency services

Provision will be made to permit access for the emergency services at all times, from either one end of Pier Road or the other. Signage to indicate this route will be agreed in advance with the highways authority and the emergency services. There will be **no adverse impacts** on emergency access.

River navigation

Temporary steelwork for the installation of piles will intrude into the river channel in Reaches 1 and 3 for the duration of the works in these areas (expected November 2013 to February 2014). The steel frames will be about 2m wide and 15m long, moving progressively along the river wall. In Reach 1, the works will be fed by a barge about 25m long by 8m wide. The barge will be moored alongside the wall, but will be relocated when larger vessels enter the port.

Piling in Reach 3 will be installed using a jack-up barge, which will be about 18m by 18m in size. Again, this vessel will be moved out of the way when larger vessels enter or leave the port.

Steel sheet piling will also need to be moved from the storage area in Reach 5 by pontoon along the river to the various reaches where it is required.

Mooring pontoons in Reaches 2 and 3 will need to be relocated for the duration of works in these locations (expected November 2013 to March 2014 and March 2014 to May 2014 respectively). Alternative mooring locations will be provided during this time.

This work will therefore take place outside the main tourist season. It may, however, result in some disruption to commercial and recreational activities on the river, resulting in temporary **moderate adverse impacts.**

In some areas upstream, the works will extend into the tourist season and has the potential to result in disruption to both commercial and recreational activities on the river, resulting in temporary **moderate adverse impacts**.

Marine and land access to the Royal National Lifeboat Institution station in Reach 3 will be maintained at all times. **No impact** expected.

Pedestrian Access and Public Rights of Way (PRoWs)

Access along the public footpaths on the west bank of the River Arun, footpath numbers 3110, 3109 and 206, will not be affected by the construction works.

Construction work is due to take place adjacent to pedestrian walkways and the PRoW located on Surrey Street in Reach 3, 42Li and 43Li, resulting in **negligible adverse impacts**.

Reaches 1 and 2 are located in a recreational and residential area and the pedestrian areas are likely to be busy, particularly in the peak summer seasons. For this reason, we will maintain pedestrian access to Reaches 1 and 2 throughout the construction period. **No impact** on pedestrian access is expected.

11.3 Mitigation

During construction, we will put the following mitigation measures in place to minimise disruption to road users, pedestrians and navigation:

Road network

Details of the Traffic Management and Logistics Plan, including the proposed access routes will be discussed and agreed with Arun District Council prior to construction commencing. The plan outlines how we will:

- Minimise HGV traffic movements. As stated in Chapter 3, a substantial delivery of sheet piles required for the scheme has already been delivered by sea and will be distributed through the site by river
- Plan all deliveries in advance, with intervals of at least 10 minutes between loads, so there would be no ‘stacking up’ of vehicles in local roads
- Restrict Heavy Good vehicle deliveries to the main site compound at Railway Wharf to between 8 am to 6 pm Monday to Friday. Deliveries to Arun Parade and Pier Road will be restricted to 9.30 am to 3 pm Monday to Friday to avoid disturbance to residents and conflict with schools

- Restrict all other deliveries to within the normal site working hours (8 am to 6 pm Monday to Friday, and not on Bank Holidays)
- Avoid deliveries outside these hours without prior written approval from Arun District Council
- Restrict the speed limit for HGV's accessing and leaving the site to 20 mph on all residential streets. Access in to and out of the site will be controlled by vehicle marshals to ensure no disruption is caused to local traffic
- Provide turning facilities and ensure vehicles do not reverse out of sites
- Keep the site roads clean and ensure wheels are clean before leaving site to prevent mud and debris on local roads
- Provide parking facilities on site for staff and visitors
- Ensure HGV deliveries to the main compound in Reach 5 and all other deliveries will be between the houses of 08.00 – 18.00, Monday to Friday. HGV deliveries to Arun Parade and Pier Road will be restricted to avoid disturbance to residents and any schools to 09.30 – 15.00, Monday to Friday
- Erect temporary localised traffic management signage
- Ensure the streets of Littlehampton will not be used as holding areas for waiting vehicles to minimise congestion
- Ensure the site team liaises with West Sussex, Arun District and other highway authorities as necessary
- Ensure all occupiers adjacent to the site are notified in writing detailing the duration and nature of works undertaken. This will take place at least 28 days prior to the commencement of construction

The closure of the parking along Arun Parade has been timed to avoid the peak visitor season as far as possible.

Road users

Appropriate diversion routes will be provided in reaches where road closures are required. We will maintain access to business and commercial areas as much as possible during the temporary road closures.

The single lane traffic in Reach 4 on River Road will be appropriately advertised, signed and managed to minimise driver delays and disturbance.

Car Parking

Alternative car parking in the surrounding area is considered adequate and this will be clearly advertised. No mitigation will be provided to mitigate the small loss of parking along Arun Parade.

River navigation

The works have been programmed to avoid weekend and bank holiday working, and the peak tourist season in Reaches 1 and 2.

The Littlehampton Harbour Board is being consulted on all construction activities that could affect the river network over the course of works in the river channel. All vessel and pontoon movements will be agreed with the Harbour Board and they will be suspended when commercial shipping is navigating to and from Railway Wharf.

We will provide alternative mooring locations where pontoons in Reaches 2 and 3 are affected, for the duration of works (expected November 2013 to March 2014 and March 2014 to May 2014 respectively). These alternative access points will be adequately signed. Once work is complete, access will be reinstated.

Pedestrian Access and Public Rights of Way (PRoWs)

All pedestrian and vehicular access routes will be segregated to avoid disruption.

We will maintain pedestrian access to Reaches 1 and 2 throughout the construction period. Pedestrian access to commercial premises on Pier Road will be maintained. Pedestrian access across the footbridge in Reach 4 will also be maintained during construction.

We will ensure no deliveries are unloaded outside of the site perimeter and onto public footpaths.

The following enhancements have been incorporated into scheme design:

- Street lighting will be replaced in Reaches 1 and 2
- Access to the river in Reaches 1, 2 and 3 will be improved where practicable with new ramps, steps, slipways and pontoons
- Widening of the promenade in areas where there is currently a pinch point

No further mitigation will be required during operation.

11.4 Residual impacts

Residual impacts on the road, river and pedestrian network in and surrounding Littlehampton during construction are summarised in Tables 11.2.

Receptor	Description of impact	Significance of predicted effect	Mitigation measures	Significance of residual effect
Main roads (A27, A259, A284 and B2187)	Increased traffic flows (including HGVs) due to construction vehicles	Negligible adverse	The Traffic Management and Logistics Plan and access routes will be agreed with Arun District Minimise HGV traffic movements. Plan all deliveries in advance	**Negligible**
Residential roads	Increased traffic flows (including HGVs) due to construction vehicles	Moderate adverse	The speed limit for HGV's accessing and leaving the site will be 20 mph on all residential roads. Turning facilities to be provided. Roads to be kept clean. Parking facilities will be provided on site. HGV deliveries to the main compound will be within set hours. Temporary localised traffic management signage will be erected. The streets of Littlehampton will not	**Slight adverse**

Receptor	Description of impact	Significance of predicted effect	Mitigation measures	Significance of residual effect
			be used as holding areas. Traffic marshals to control access and egress to sites. Occupiers adjacent to the site are notified in writing detailing the duration and nature of works undertaken	
Car parking	Closure during construction work, notably in Reaches 1 and 2	Slight adverse	Timing of works to avoid peak season as much as possible. Alternative car parking to be clearly advertised.	**Slight adverse**
Road closures in Reaches 1, 2, 4 and 5	Road closure due to construction access.	Moderate adverse	Appropriate diversion routes and traffic management to be provided and signposted. Access to businesses maintained.	**Slight adverse**
River network	Disruption to river movements and access.	Moderate adverse	Littlehampton Harbour Board to be consulted. All vessel movements to be agreed with Harbour Board. Works have been programmed to avoid peak season as far as possible.	**Slight adverse**
	Disruption to pontoon access	Moderate adverse	Alternative access to be provided.	**Negligible**
PRoW	Construction work adjacent to pedestrian walkways	Negligible adverse	All pedestrian and vehicular access routes will be segregated. Access to Reaches 1 and 2 maintained. Street lighting to be replaced in Reaches 1 and 2. Access in Reaches 1, 2 and 3 to be improved where possible.	**Negligible**

Table 11.2 Residual impacts on road, river and pedestrian network during construction

Following construction, there will be no further restrictions pedestrians, road users, or on navigation. River users will benefit from improvements to access to the river brought about by the replacement steps, ramps and pontoons, and pedestrians will benefit from the significant public realm enhancement works in Reaches 1 and 2. Adequate car parking will be provided.

12 Water resources and flood risk

This chapter addresses the impact assessment undertaken for surface water and groundwater resources.

Key issues related to the construction phase comprise:

- Impacts on surface water or groundwater quality due to release of contaminating materials from construction activities.
- Potential for surface water impacts related to increased suspended solids levels, downstream deposition of fine solids and damage to river and coastal ecosystems.

Key issues relating to the operational phase comprise:

- Compliance with the Water Framework Directive (WFD), which targets the maintenance and improvement of the quality of the UK's rivers, estuaries coastal waters and groundwaters. The full compliance assessment is in Appendix J.

This chapter also summarises the outcome of a Flood Risk Statement, which is reported in full in Appendix K.

We considered the potential for the scheme to mobilise contamination from existing ground sources, resulting in release into surface water or groundwater, in Chapter 8 - Ground Conditions, which should be read in conjunction with the current chapter.

This assessment has been based on a desk study. We used the following sources of information for the assessment:

- British Geological Survey Sheet 317/332, Chichester and Bognor (1996).
- Groundwater Vulnerability 1:100,000 Map, Sheet 45, West Sussex and Surrey;
- Defra, Multi-Agency Geographical Information for the Countryside (MAGIC) website (www.magic.gov.uk);
- Natural England websites www.natureonthemap.org.uk;
- Environment Agency published and unpublished data (www.environment-agency.gov.uk).

The value of water resources has been defined according to Table 12.1.

Sensitivity	Criteria
High	A water body which is not significantly affected by anthropogenic factors and demonstrates high or good biological status or potential as defined under the Water Framework Directive. A water body identified as a Protected Area under the Water Framework Directive (due to abstraction, nature conservation, fishery, shellfishery or bathing interests). A high status groundwater body designated under the Water Framework Directive; a groundwater Source Protection Zone associated with a Principal Aquifer (supporting water supply and/or river baseflow on a strategic scale)
Medium	A water body with measurable degradation as a result of anthropogenic factors and which demonstrates moderate biological status or potential as defined

Sensitivity	Criteria
	under the Water Framework Directive. A water body with an undesignated fishery, shellfishery or bathing water. A groundwater body designated under the Water Framework Directive but not attaining high status; a Principal Aquifer outside a Source Protection Zone
Low	A water body with poor or bad biological status or potential (as defined under the Water Framework Directive) resulting from anthropogenic factors. A water body with limited potential for fish, shellfish or bathing. A groundwater body not designated under the Water Framework Directive; a Secondary Aquifer
Negligible	A water body not included in the above categories.

Table 12.1 Criteria used to define the sensitivity of water features

The WFD compliance assessment (Appendix J) follows national guidance (see "Relevant Guidance" below) in which the compatibility of the scheme with the following WFD environmental objectives is considered:

- Objective 1 - No changes affecting high status sites
- Objective 2 - No changes that will cause failure to meet surface water good ecological status/potential or result in deterioration of surface water ecological status/potential
- Objective 3 - No changes which will permanently prevent or compromise environmental objectives being met in other water bodies
- Objective 4 - No changes that will cause failure to meet good groundwater status or result in deterioration in groundwater status

We have assessed the impact of potential flooding in accordance with the National Planning Policy Framework (March 2012), specifically, component 10: Meeting the challenge of climate change, flooding and coastal change. Although former Planning Policy Statements (PPS) no longer apply following publication in 2012 of the new National Planning Policy Framework, they are considered relevant to the proposed Flood Defence Scheme because:

- The scheme was originally developed and designed when these PPSs were part of national planning policy.
- The new national framework has, at its heart, a presumption in favour of sustainable development and therefore guidance within documents such as PPS25 Development and Flood Risk is useful when designing a sustainable Flood Defence Scheme.

Study Area

The study area for the construction phase impact assessment includes the scheme extent as shown on Figure 1.3 plus the upstream watercourse for a distance of approximately 1km, the immediately downstream water course and the underlying aquifer.

The study area for the WFD assessment addresses the water body within which the scheme is located (i.e. the *Arun* transitional water body), plus the nearest upstream and downstream water bodies and the underlying groundwater body.

The study area for the flood risk assessment is defined as the total area that could be affected by flooding, either from rivers or the sea.

Relevant Guidance

As well as the methodological guidance outlined above, this assessment has been informed by legislation and advice as follows:

- Water Resources Act (1991) as amended by Water Act (2003)
- Environment Act (1995), as amended
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003, implementing Directive 2000/60/EC of the European Parliament establishing a framework for Community action in the field of water policy
- PPS 25: Development and Flood Risk
- Pollution Prevention Guidelines (Environment Agency, various dates)
- Control of Water Pollution from Construction Sites – A Guide to Good Practice (CIRIA/C532)
- Groundwater protection: policy and practice (GP3) Part 4. (Environment Agency, 2008)
- Assessing new modifications for compliance with WFD, operational instruction 488_10,(Environment Agency, 2010)

Assumptions and Limitations

The assessment reported here is based on a desk based study. As indicated in Section 4.1, the Scoping Report confirmed that no water environment surveys needed to be carried out. We have assumed that the limited amount of available information on water resource quality is representative of the general conditions. Sediment dispersal modelling for the channel has not been undertaken.

Considering the nature of the proposed scheme, the data limitations are not considered to introduce any significant uncertainties.

12.1 Existing environment

Surface Water Status and Quality

The scheme is located on the *Arun* transitional water body which extends from the mouth of the River Arun in Littlehampton upstream past the site of the scheme and as far inland as Pulborough, approximately 17.5km in length in total. As well as the main channel within the study area, there are a number of small drainage ditches and outfalls that discharge into the east bank.

The only upstream river water body within the study area is *Ryebank Rife* which joins the River Arun on the west bank opposite Reach 6 of the scheme. The next nearest upstream tributary is *Ford Trib (Lower Arun)* which joins the River Arun approximately 2.8km upstream of the limit of the scheme, outside of the study area. Downstream is the *Sussex* coastal water body at the mouth of the River Arun, directly seawards of the scheme.

Water body baseline conditions are summarised in Table 12.2.

Water body	Hydromorph-ological status	Ecological classification	Supporting conditions	Mitigation measures assessment
Arun	HMWB (urbanisation, flood protection)	Moderate	Dissolved inorganic nitrogen moderate, Dissolved oxygen high, Tidal regime – freshwater flow good	**Moderate**
Sussex	HMWB (coastal protection, fisheries)	Moderate	Arsenic, Copper, Dimethoate, Iron, Zinc all high	**Moderate**
Ryebank Rife	Not HMWB	Moderate	Quantity & dynamics of flow good, Morphology good	n/a

Table 12.2 Water body baseline conditions

Water quality in the upstream River Arun flowing into the study area is affected by run-off from agricultural land, sewage effluent discharges and impoundments on the river. Within the study areas these influences are reduced by dilution and the regular influx of tidal waters.

There are five consented sewage discharges in the study area, one surface water (housing) discharge and one trade discharge. There are no records of recent (<10 years) pollution incidents in the study area although in the 1990s some twelve incidents were recorded related mostly to oils/fuels and sewage.

There is a single licensed surface water abstraction, from Ryebank Rife, for agriculture, which is scoped out of the assessment as the scheme will not materially impact on this water resource.

The “Littlehampton” designated bathing water on Littlehampton sea front (to the east of the river outlet) consistently met the “higher” bathing water standard from 2007 to 2011, but only the “minimum” standard in 2012, with some indications of elevated occurrence of intestinal bacteria.

Based on the criteria in Table 12.1, the estuary can be classified as being of medium sensitivity and the coastal water as high sensitivity (due to its bathing water designation).

Groundwater Status and Quality

The scheme lies over part of the *Littlehampton Anticline East* (GB40701G50340) groundwater body, which extends eastwards from its western margin at the River Arun. This waterbody is currently at poor status overall, as a result of depleted water levels and impacts on associated surface waters. However, this is not relevant to the study area, where the *Arun* transitional water body is not suffering from low groundwater baseflow. The water body’s current chemical status is good.

The superficial geology under the entire study area is classified as a Secondary A aquifer, which indicates the presence of permeable layers able to support local water supplies and potentially contributing baseflow to rivers. Below this, the study area is underlain by a Principal Aquifer in the bedrock, indicating a highly permeable geology which provides a high level of water storage. However, there is no groundwater Source Protection Zone in the study area, the nearest being over 3km east of the river. Five licensed groundwater abstractions are present in the study area, principally for

agriculture but one for process washwater (aggregates). These are scoped out of the assessment as the scheme will not materially impact on this water resource.

The Groundwater Vulnerability map indicates that the majority of the study area comprises high permeability surface geology, whilst the very northern extent, from about midway along the embankment managed realignment site in Reach 6, comprises intermediate permeability surface geology.

Based on the criteria in Table 12.1, the groundwater in the study area can be classified as being of medium sensitivity.

Flood Risk

Along the east bank of the River Arun, the flood risk is relatively high, because of the variable and low standard of protection provided by the existing defences, combined with areas of the town centre being below the current flood defence heights.

The standard of protection afforded by the existing defences gives rise to flood risk from overtopping, ranging from 1 in 1 (100%) to 1 in 300 (0.33%) annual event probability, and it is anticipated that this standard of protection will reduce further with sea level rise. The onset of widespread flooding to property is estimated to be at a 1 in 20 (5%) event. The main mechanism of flooding along this frontage is likely to be through overtopping and/or breach defences. Overwash and overtopping will cause initial flooding, but a sudden failure of the defences could follow, causing a dramatic rise in the flood levels.

The area around Reach 6 (the area north and south of the A259 road bridge) is significantly below surge water levels and Littlehampton town centre is sited in a topographic bowl. In total, a 50 hectare area is at more than a metre below the 1 in 200 (0.5%) flood level, and parts of the town centre are more than 2m below this level.

12.2 Likely significant impacts

Surface Water

All potential impacts on surface water are likely to arise during the construction period. No impacts are envisaged during operation. Potential impacts have been described by reach and are summarised in Table 12.3.

Groundwater

All potential impacts on groundwater, except that affecting Reach 6 Realignment, are likely to arise during the construction period. Potential impacts have been described by reach and are summarised in Table 12.3. (Groundwater risk from the disturbance of potentially contaminated soils is considered in Chapter 8.)

Reach	Receptor	Value	Potential Impact	Significance of Effect Without Mitigation
1-6	Surface water - Arun	Medium	Potential contamination by construction materials, including fuels, oils, hydraulic fluids, hazardous materials and concrete liquor. Temporary, no more than medium magnitude (because of large dilution capacity in the river)	**Slight adverse**

Reach	Receptor	Value	Potential Impact	Significance of Effect Without Mitigation
1-4	Surface water - Arun	Medium	Piling (and enabling excavations or water jetting) and riverbed disturbance re-suspending solids, with localised impact on aquatic life and dissolved oxygen. Temporary, medium magnitude	**Slight adverse**
5-6	Surface water - Arun	Medium	Earthworks adjacent to river releasing suspended solids, with localised impact on aquatic life. Temporary, medium magnitude.	**Slight adverse**
1-6	Surface water – Sussex	High	Sediment plumes or deposition in designated bathing water, affecting aesthetic quality (statutory standards for microbial quality will be unaffected). Temporary, low magnitude.	**Slight adverse**
1-6	Groundwater - Littlehampton Anticline East	Medium	Contamination from accidental release of oils, hydrocarbons and other construction materials, particularly where upper layers of soil or made ground removed. Short term, low magnitude.	**Negligible**
1-4	Groundwater - Littlehampton Anticline East	Medium	Piling will not introduce any new contaminant pathway or changes in groundwater flow regimes.	**No effect**
6	Groundwater - Littlehampton Anticline East	Medium	Managed realignment will form <1ha intertidal zone which could increase saline intrusion where surface geology has moderate to high permeability. 1ha is inconsequential compared to the size of the groundwater body.	**Negligible**

Table 12.3 Potential Impacts on the water environment

Flood Risk

If no works are undertaken to maintain the flood defences along the east bank then rapid deterioration and further failures are expected within the next 10 years and could result in a breach causing wide-spread flooding. With the existing defences maintained but otherwise no change to them, there is a continuing risk of flooding due to wave and tidal overtopping of the defences.

With the new scheme in place the town will be protected from a 1 in 300 tidal flood event. Any drainage system disturbed during construction along Reaches 1-6 will be re-instated or replaced to the same standard as before the works, but the scheme does not provide any increased protection against surface water or groundwater flooding from surface run-off.

The completed scheme is not anticipated to have an effect on water levels outside of those that would occur naturally under sea level rise. The rationale behind this is described below:

The risk of flooding in the lower reaches of the River Arun is dominated by tidal effects, i.e. the sea flowing into the river on a high spring or surge tide. Fluvial flow from upstream does not present a flood risk here. The existing standards of protection along the west bank are currently lower than those along the east bank; as such the west bank will start and continue to flood before the current or proposed flood defence levels are reached on the east bank. The raising of the defence levels on the east bank will therefore have no noticeable effect on the west bank.

Additionally, the proposed scheme includes for the riverwall on the east bank to be reconstructed by driving a new steel piled wall in front of the existing wall. The effect of this will be to slightly narrow the river channel and thus marginally throttle the tidal flows able to enter the channel from the sea. Thus any effect on the west bank will be to very slightly reduce the tidal flood risk.

Further details are provided in Appendix K.

WFD Compliance

The WFD compliance assessment (Appendix J) has determined that:

- Objective 1 - No changes affecting high status sites: Not applicable as no water bodies potentially affected are at high status.
- Objective 2 - No changes that will cause failure to meet surface water good ecological status or potential, or result in deterioration of surface water ecological status or potential: The new sheet piled floodwall will result in the loss of a strip of subtidal and intertidal mud along the eastern side of the channel, with consequent impacts on invertebrates, periphyton and channel morphological diversity. However, the managed realignment site will result in a minor net increase (0.05ha) in mudflat habitat, as well as creating 0.7ha new saltmarsh habitat, which constitutes a significant increase of this habitat and opportunities for fish species in the lower Arun. Thus, the scheme makes an overall contribution to the morphological mitigation measures identified for the Arun water body by establishing areas of intertidal habitat that exceed the areas that will be lost, by setting back defences in Reach 6 to allow a more natural estuary margin to develop, and by replacing the existing hard engineered embankment with a bioengineered new set-back embankment.

  No other long-term impacts of the scheme are considered likely to significantly affect water body conditions. Thus the objective is met, and no further assessment under the exception tests in Article 4.7 of the WFD is required.
- Objective 3 - No changes which will permanently prevent or compromise the environmental objectives being met in other water bodies: The scheme will result in no changes in upstream river water bodies or the downstream coastal water body. Therefore the requirements of Article 4.8 of the WFD are met in respect of surface water bodies.
- Objective 4 - No changes that will cause failure to meet good groundwater status or result in deterioration in groundwater status: The scheme will result in no changes in the underlying groundwater body. Therefore the requirements of Article 4.8 of the WFD are met in respect of groundwater bodies.
- Protected Area must receive at least the same level of protection as afforded by other existing EU Directives: The scheme can be shown to have no consequences for any water body designated under the Habitats, Birds, Nitrates or Bathing Water Directives.

12.3 Mitigation

Most of the mitigation measures identified below are standard requirements of a civil engineering project and will be addressed in the contractor document. Those which are specific to the Littlehampton scheme have also been identified in the Environmental Action Plan.

Surface Water and Groundwater

- Reaches 1-6: Construction phase risks to surface water and groundwater quality will be effectively avoided through adherence to guidance published by the Environment Agency (PPG01 General guide to the prevention of pollution; PPG05 Works & maintenance in or near water; PPG21 Pollution incident response planning; PPG23 Maintenance of structures over water) and CIRIA (Report 156: Control of water pollution from construction sites – a guide to good practice). In particular the short term risks from hydrocarbon/chemical spills during construction will be minimised by restricting the refuelling of vehicles and machinery to designated areas which do not drain to ground or watercourses, by storing all fuels, oils, hydraulic fluids and chemicals within secondary containment (e.g. drip-trays or bunds).

- Reaches 1-6: The appointed contractors will be required to formulate and follow a pollution response plan with a particular focus on the in-river and over river (pontoon-based) works, aimed at avoiding any accidental pollution incident and minimising consequences should they occur.

- Reaches 1-4: A contractor's Piling Risk Assessment Report is required in accordance with the guidance *Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention (National Groundwater & Contaminated Land Centre Report NC/99/73, 2001).* This will identify specific risks to the environment including sediment re-suspension, and guide the development of method statements to minimise, monitor and manage such impacts.

- Reaches 5-6: Embankment works in Reach 5 will be undertaken as far as possible from the landward side. Earthworks in Reach 6 will involve forming the new landward embankment before removing the existing riverside flood embankment. Site drainage throughout the works in both Reaches will ensure that soil exposed by vegetation stripping and excavation, including soil stockpiles, is protected against erosion and runoff into any adjacent drainage system. All water from the site will be appropriately treated to reduce silt prior to any discharge into the Arun. Any such discharge will be only in accordance with Environment Agency consents that will be agreed in advance. These and other relevant measures will be incorporated in a pollution response plan, including appropriate communications and responses to any silt-related incidents, in particular during the bathing season.

Flood Risk

During construction many of the existing defences will remain in place whilst new defences are constructed, but where existing defences are compromised during the construction work, temporary works will ensure risk to property is managed. During construction, any large stockpiles of materials and equipment will be stored outside of the floodplain wherever possible, to limit the potential for channel blockage. Additionally, whilst working on the floodplain, the Contractor will register with the local Environment Agency Flood Incident Management team for automatic notification of flood warnings to ensure that equipment, materials and personnel can be removed from the area if the risk is severe enough.

12.4 Residual impacts

The adoption of mitigation measures during construction will reduce the potential for, and consequences, of impacts on water quality. Therefore the slight and negligible adverse significant impacts before mitigation will be reduced to **no impact**.

The scheme will not result in deterioration in ecological potential in the Arun water body or in failure of the water body to achieve good potential in the future; it will not result in any changes which will permanently prevent or compromise the environmental objectives being met in other water bodies upstream or downstream, and will have no effect which could result in deterioration in status of any groundwater body. The quality requirements of Protected Areas will not be compromised by the scheme. Managed realignment in Reach 6 will result in a minor net increase (0.05ha) in mudflat habitat, a moderate (0.7ha) increase in saltmarsh habitat, and allow a hard engineered embankment to be replaced by a bioengineered set-back embankment, allowing a more natural estuary margin to develop. Thus, the scheme makes an overall contribution to the morphological mitigation measures identified for the Arun water body.

No adverse impact on drainage or flooding will result during construction. The completed scheme will have a major beneficial effect by providing a better standard of protection for people, properties and infrastructure in Littlehampton. The completed scheme is not anticipated to have any effect on water levels beyond those that would occur under sea level rise, and will not result in any increase in flood risk on the west bank of the Arun.

13 Other Issues

This chapter addresses other environmental issues covered by the EIA Regulations which have either been scoped out or are of minor concern in relation to the scheme, but where some form of standard mitigation will be required to ensure no adverse impact. Issues included in this chapter comprise air quality during construction, material assets (the use of material resources) and human health.

13. 1 Air quality

Arun District Council is responsible for monitoring air quality in Littlehampton. Monitoring results indicate that air quality is likely to meet air quality standards and, as such, there are no Air Quality Management Areas in Littlehampton.

Construction activities and, in particular, the use of construction plant and ground disturbance, have potential to give rise to vehicular emissions and dust during the construction period. Where this is located in close vicinity to residents, visitors or sensitive ecological features, this can result in (most likely, temporary) impacts on human health and local soiling of surfaces. Where contaminated ground is disturbed, the impacts could be more serious.

We will ensure that standard good working practices, such as turning off construction plant and vehicles whilst not in use and the use of wheel washing and dowsers are applied on site as required. All demolition equipment (such as hydraulic breakers and munchers) will be fitted with dust suppression sprayers. Road sweepers will be deployed as necessary to keep highways free from mud and debris. These, and the adoption of the methods described in Chapter 10 relating to avoiding adverse impacts from potential ground contamination will be included in the Environmental Action Plan and the contract documents. These measures should ensure that adverse impacts on air quality and any subsequent indirect impacts on construction workers, residents, visitors and sensitive ecological receptors are avoided as far as practicable, such that no adverse impacts are envisaged.

13.2 Material assets

The proposed scheme will require the use of 4,000 tonnes of sheet steel for the piling works in Reaches 1 to 6. Other materials required for construction of the paving and landscape works include concrete, timber and steel. The existing defences (which are built of sheet steel, concrete and some masonry) will be left in situ, but some paving material, scour protection and building materials will require removal and disposal as waste.

Construction of the embankments and land raising in Reach 6 (including Reach 6 Realignment) will require 16,500m^3 of soil. It is anticipated that the majority of the material from the existing embankments will be suitable for reuse, which will provide 5,000m^3 of material for the land raising and working platform bund at the managed realignment. The remaining 11,500m^3 of soil required for the embankments will be imported.

Only the scour protection from the existing embankment is expected to be removed as waste, with all other site won material being used beneficially within the proposed works.

The Contractor will recycle as much material as possible for reuse on site in order to minimise both the import of new materials and the export of waste for disposal. All material that cannot be reused will be removed from site for disposal in accordance with waste regulations and the Site Waste Management Plan, which will be prepared prior to construction and agreed with Arun District Council.

The impact on traffic and transportation is considered in Chapter 11 – Traffic and Transportation.

13.3 Human health

The improved protection of the residents and businesses of Littlehampton is the key driver for the proposed scheme. This and the enhanced amenity value of the river front are likely to afford a beneficial impact to human health in the local area. Potential adverse impacts resulting from temporary impacts from potential ground contamination and on air quality, noise and local business will be avoided or minimised as far as practicable through mitigation measures described in the relevant chapters of this document and the Environmental Action Plan, such that no further mitigation is considered necessary and no adverse impacts on human health are envisaged.

13.4 Environmental Management Issues

All mitigation measures identified in this Environmental Statement necessary to protect the environment prior to, during construction, or during operation of the scheme, will be incorporated into the contract documents by means of the Environmental Action Plan. The Plan includes the requirement for a number of separate method statements and sub-plans relating to specific areas of mitigation (including an Archaeological Mitigation Strategy and Methods Statement, an Emergency Pollution Response Plan, a Traffic Management and Logistics Plan and a Site Waste Management Plan).

The Environmental Action Plan provides a mechanism to ensure compliance with environmental commitments. In particular, we have defined roles and responsibilities to ensure, firstly, the implementation of the mitigation measures, secondly, the monitoring procedures to check their implementation and thirdly, audit and review mechanisms to ensure that mitigation measures are implemented and adhered to. Specifically, the following has been tabulated:

- The location of the mitigation measure, in particular whether the measure applies to the areas for which planning permission is sought through this Environmental Statement
- The objective of the mitigation
- The actions to be taken to implement the proposed mitigation, including and any special monitoring requirements
- The timing and the party responsible for implementing the mitigation
- Information on any further action and progress made during construction
- A requirement to record compliance with mitigation during construction

The Environmental Action Plan therefore collates mitigation measures identified throughout the Environmental Statement, both for ease of reference and for use by those overseeing the contract documents. It provides a record of commitments made by both the Environment Agency and the contractor that will be incorporated within the

contract documents and to which the contractor will be obliged to adhere throughout the contract period. Together with contract supervision, the Environmental Action Plan will be used to control any details of design over and above those included in this Environmental Statement and the planning application, and the implementation of environmental mitigation and enhancement measures.

The Environmental Action Plan is a live document. However, a copy in its current form is provided at the end of the main text of this document, immediately preceding the figures.

13.5 Uncertainties and limitations

No uncertainties have been identified in terms of the adequacy of the baseline information used for this environmental impact assessment. The level of detail is considered appropriate for the assessment purposes.

Some areas where there is a risk of unknown conditions or features have been identified, namely potential unknown archaeological remains and potential ground contamination, but any risks have been reduced as far as practicable through the studies and ground investigations undertaken during the assessment. Any remaining risks to the project or to the environment are considered low and will be mitigated by appropriate construction methods and a watching brief during construction as required by the Environmental Action Plan.

Further uncertainties relating to ground conditions could affect the suitability of the soil for reuse within the scheme and the piling methods to be used. However, these factors have been taken into account through design and assessment based on professional judgement and worst case assumptions.

Notwithstanding these uncertainties, it is considered that the engineering and environmental design has been based on appropriate levels of information and assessment.

14 Cumulative impacts and inter-relationships

This chapter addresses the assessment of cumulative impacts. The assessment has been undertaken in accordance with the requirements of the EIA Regulations. There is, however, no agreed definition of cumulative impacts. It can apply to the assessment of any significant environmental impacts that are likely to result from the proposed scheme in combination with other projects or activities that have been or will be carried out in the vicinity of the proposed scheme (usually, other committed major developments), or it can apply to the assessment of potential cumulative impacts on specific environmental resources or receptors arising from a number of different sources as a result of the proposed scheme.

As stated in Chapter 4 – Key Issues and Methodology, consideration has been given to the need to address both types of cumulative impacts.

With regards to other developments, there are two that have been considered. These are the redevelopment of two buildings comprising Riverside Autos and the adjacent former engineering works between Reaches 3 and 4. Redevelopment of the former engineering works is currently underway. The proposed scheme has been designed to accommodate this development and this has therefore been taken into account as future baseline.

We have also held discussions concerning the redevelopment proposals for Riverside Autos. Whilst no planning application has been made to date, the future redevelopment of this site has also been taken into account in the design proposals. An allowance has been made for any uncertainties, should this project not proceed as expected. If the redevelopment does not go ahead as envisaged, changes will be made to the design to ensure an adequate standard of flood defence is achieved consistent with the rest of the scheme. It is envisaged that any impacts associated with the redevelopment of the site will be addressed in any future planning application for that site.

Any impacts associated with these developments have not, therefore, been assessed as cumulative impacts in this chapter.

An option is also being considered by West Sussex County Council to raise the level of Pier Road in Reach 2. If this goes ahead, the work will be advanced under the permitted powers of West Sussex County Council and it is likely to be constructed in conjunction with the proposed public realm improvement works. The proposed scheme has been designed so that it can accommodate any such works to the road, should the option be progressed. Although not yet committed, this work has been considered in terms of cumulative impacts.

No other committed developments have been advised. This chapter is therefore focused on the different impacts resulting from the proposed scheme on specific receptors, and the cumulative impacts associated with any future raising of Pier Road.

14.1 Cumulative impacts on environmental receptors

Table 14 .1 presents a summary of where potential impacts on a range of environmental resources or receptors may arise (mostly, during the construction phase).

The table shows that all receptors may be affected to some degree by a range of different environmental impacts. Human beings may, in particular, be affected by changes in air quality, noise, ground conditions (potential release of contaminants during construction), land use, socio-economy, townscape and visual issues, traffic and transportation, waste and flood risk. With appropriate mitigation, the majority of impacts will either be neutral/negligible or beneficial. Any negative impacts are likely to be localised to the site, affecting existing residents, businesses or workers in close proximity to the scheme. However, these receptors are also likely to benefit significantly from the scheme in terms of the improved protection from flooding afforded by the scheme and the enhancements made to the public realm.

Ecological receptors may also be affected by a range of environmental impacts during construction including noise, dust, change to habitats but this will not affect the significance of impacts predicted since these issues have been taken into account in the assessment and, in the long term, there will be a net increase in inter-tidal habitat which is likely to outweigh any temporary adverse impacts, resulting in a net long term gain.

No other significant cumulative impacts affecting specific receptors as a result of the scheme are predicted over and above those already identified in the relevant chapters of this Environmental Statement.

14.2 Cumulative impacts from Pier Road raising

No design proposals are available for the possible future raising of Pier Road. However, as stated above, the proposed scheme has been designed to accommodate any such works and, it is envisaged that these works would be undertaken in conjunction with the proposed public realm improvements.

It is estimated that the road raising works take approximately four to eight weeks, which could be accommodated within the existing construction period (to be complete by the end of May 2013). It is therefore anticipated that the works would require no further closure of Pier Road over and above that already proposed.

However, the construction works would be located in close proximity to the commercial properties along Pier Road. This would be likely to cause additional noise and disruption to businesses. However, the works would comprise normal road working activities, which are not likely to be as noisy the piling works on the riverside. Every effort would be made to minimise disruption and occupiers will be kept fully informed of the works programme.

In the long term, raising the level of Pier Road would create a more level road surface, which would be higher than the existing surface, particularly on the riverward side, thereby reducing the current dip towards the river and the apparent height of the proposed steps and defences. There would be fewer steps required for the transition between the walkway and the road, and this would increase the width of level walkway adjacent to the river. The combined effect of raising Pier Road in the long term would therefore be to further capitalise on the beneficial effects of the public realm enhancement works proposed in combination with the flood defence scheme.

Environmental resource/ receptor	Environmental impact								
	Acoustics	Air quality	Flora & fauna	Ground conditions	Land use & socio-economy	Townscape & visual	Traffic & transport	Waste	Water & flood risk
Human beings	x	x	-	x	x	x	x	x	x
Biodiversity	x	x	x	x	x	-	-	-	x
Water environment	-	-	-	x	x	-	x	x	x
Climate & air environment	-	x	-	x	x	-	x	-	-
Ground conditions	-	-	-	x	x	-	-	x	x
Heritage assets	-	-	-	x	x	-	-	-	x
Townscape & landscape	-	-	x	-	x	x	-	-	-

Table 14.1 Identification of potential cumulative impacts on environmental resources/receptors during construction and operation of the scheme

15 Planning and legislation

The aim of this chapter is to provide an analysis of the proposed scheme in the context of national, regional and local planning policy. It considers whether or not the proposed scheme is compliant or non-compliant with these policies.

15.1 Planning context

Littlehampton is located on the south coast of West Sussex. It is a historic harbour town on the River Arun with some retail and social facilities and manufacturing and warehousing premises. The local economy is dependent on tourism.

Littlehampton has effectively merged with Rustington and East Preston to form a single built-up area with a population in excess of 45,000. Although physically separate, the village of Ferring to the east of East Preston forms part of this network of coastal settlements, which then extends eastwards towards the town of Worthing in Worthing Borough Council.

The main elements of the scheme comprise a range of flood defence improvement works along the River Arun frontage, involving steel sheet piling, concrete capping, embankments and scour protection, and including:

- Promenades in Arun Parade and Pier Road being raised and widened, and access provided to the River where possible
- Managed realignment works in Reach 6 to mitigate the loss of intertidal, mudflat habitat downstream and create new saltmarsh

Any pontoons affected will be replaced or improved. Access for lifeboats and other craft to the slipway outside the RNLI station will not be affected.

Planning permission will be required for part of Reach 4 Pharos Quay and Reach 6 Realignment. For Reaches 1, 2, 3, 5 and those sections of Reaches 4 and 6 aligned along the existing defences, the development falls under the Environment Agency's permitted development rights as set out in Schedule 2, Part 15 of the Town and Country Planning (General Permitted Development) Order 1995 (as amended).

Planning permission will also be required for the public realm enhancements on Reaches 1 and 2, but this will be subject to a separate planning application made by Arun District Council.

If the West Sussex County Council proposal to raise the level of Pier Road in Reach 2 goes ahead, the work will be advanced under their permitted powers.

National Planning Policy

On 27 March 2012 the Government published the National Planning Policy Framework (NPPF). The NPPF revoked or replaced most of the Planning Policy Statements (PPS), Planning Policy Guidance notes (PPG), Minerals Policy Statements (MPS), Mineral Planning Guidance (MPG), Circulars and Letters to Chief Planning Officers that were "in force" before the NPPF was published. Annex 3 of the NPPF lists the PPS, PPG, MPS, MPG, Circulars and Letters to Chief Planning Officers that the NPPF revokes and replaces.

The National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) sets out Government planning policies for England and how these are expected to be applied. It states that the purpose of the planning system is to contribute to the achievement of sustainable development and that a presumption in favour of sustainable development is at the heart of the NPPF. To achieve sustainable development, economic, social and environmental gains should be sought jointly and simultaneously through the planning system.

The NPPF sets out 12 core planning principles that should underpin both plan-making and decision-taking, including that planning should:

- be genuinely plan-led, and plans should be kept up-to-date
- always seek to secure high quality design and a good standard of amenity for all existing and future occupants of land and buildings
- support the transition to a low carbon future in a changing climate, taking full account of **flood risk** and coastal change
- contribute to conserving and enhancing the natural environment
- conserve heritage assets in a manner appropriate to their significance

Section 10 of the NPPF provides more detailed guidance with regard to meeting the challenge of climate change, flooding and coastal change. It states that planning plays a key role in minimising vulnerability and providing resilience to the impacts of climate change and local planning authorities should adopt proactive strategies to mitigate and adapt to climate change, taking full account of flood risk, coastal change and water supply and demand considerations. Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.

Regional and Local Planning Policy

Development Plan Policy

As the Regional Spatial Strategy for the South East (RSS10), published in May 2009, was partially revoked on 25 March 2013 the development plan for the site comprises the Arun District Local Plan, adopted in April 2003.

Regional Spatial Strategy for the South East (RSS)

Prior to its partial revocation on **25 March 2013**, RSS10 provided a framework for spatial planning in the South East and helped the District Councils in the preparation of their Local Development Frameworks and to deliver a coherent framework. As RSS10 was published in May 2009 and was only recently partially revoked, the most relevant parts of RSS10 are referred to below.

- Policy CC1 Sustainable Development states that the principle objective of RSS10 is to achieve sustainable development.
- Policy CC2 Climate Change states that measures to mitigate and adapt to current and forecast impacts of climate change will be implemented through application of local planning policy and other mechanisms.
- Policy NRM5 Conservation and Improvement of Diversity requires that local planning authorities and other bodies shall avoid a net loss of biodiversity and actively pursue opportunities to achieve a net gain across the region.

- Policy NRM8 Coastal Management requires that an integrated approach is taken to the management and planning of development in coastal areas, including the conservation and enhancement of the most valuable habitats and environments (natural and built) within the context of flood risk management and coastal protection measures contained in Coastal Defence Strategies and Management Plans.

- Policy BE6 Management of the Historic Environment states that proposals which protect, conserve and, where appropriate, enhance the historic environment and the contribution that the historic environment makes to local and regional distinctiveness and sense of place will be supported.

- Policy C4 Landscape and Countryside Management requires that all development should respect and enhance local landscape character and appropriate mitigation should be secured where damage to local landscape character cannot be avoided.

The Arun District Local Plan (2003)

The Arun District Local Plan was adopted in April 2003. The Local Plan covers the period to 2011. However, most of the Local Plan policies were 'saved' in 2007 and will be saved until they are replaced by new policies in an adopted development plan document or are no longer compliant with the NPPF.

The key text and policies of the Local Plan that are relevant to the proposed flood defence works are as follows:

- Policy GEN3 Protection of the Countryside states that the countryside will be safeguarded for its own sake. Development will not be permitted unless it meets the criteria set out in the policy or is in accordance with other Local Plan policies.

- Policy GEN7 The Form of New Development states that planning permission will only be granted for schemes displaying a high quality design and layout.

- Policy GEN8 Development and the Production of New Infrastructure requires that development should not be permitted unless the infrastructure or facilities made necessary by the development are available or will be provided at an appropriate time.

- Policy GEN19 Coast Protection and Sea Defence Works encourages the provision of well designed, technically sound proposals for coast protection and sea defence works or improvements to existing works that are in accordance with the recommendations of shoreline management plan and the coastal defence strategies.

- Policy GEN28 Trees and Woodlands seeks to retain trees protected by a tree preservation order, identified as ancient woodland or in a conservation area unless the removal of one or more trees would be in the interests of good arboricultural practice or the benefits of the proposed development outweigh the amenity value of the protected trees.

- Policy AREA8 Littlehampton Harbour Strategy states that within the area defined on the Proposals Map, planning permission will only be granted for development which supports the continuation and development of the harbour as a commercial and recreational port and / or improves both economically and environmentally the links between the town and the harbour.

- Policy AREA15 Sites of Local Importance for Nature Conservation requires that proposals for development in, or likely to have an adverse effect (directly or

indirectly) on a Local Nature Reserve, Site of Nature Conservation Importance (including ancient woodlands or wildlife corridors) or Regionally Important Geological / Geomorphological Site should not be permitted unless it can be demonstrated that reasons for the proposal outweigh the need to safeguard the nature conservation value of the site / feature.

15.2 Compliance

The main elements of the scheme are described in Chapter 3 – The Preferred Option and Section 15.1 above.

Compliance with National Planning Policy

The probability and impacts of flooding in Littlehampton will be reduced through the implementation of this scheme. The construction of well-designed flood defences will provide protection from flood risk and ensure long term sustainability benefits for the local community, in accordance with the principles set out in the NPPF. The well-designed flood defences will also help to meet the principles set out in the NPPF by including measures to maintain and enhance biodiversity and landscape assets, and safeguard and improve vehicular and pedestrian access.

Compliance with Regional and Local Planning Policy

The scheme and the flood risk management benefits it will deliver will help to meet the RSS objectives.

The scheme will also meet Local Plan policy objectives, including the Arun District Council draft Littlehampton Waterfront Strategy, through its good design and appropriate public realm improvements and mitigation, its avoidance of adverse environmental impacts on the town, the countryside and nature conservation and provision of improved amenity.

Mitigation included in scheme design

The main objective of the scheme is to raise and improve the flood defences to provide a standard of protection of 1 in 300 years, therefore reducing the annual probability of the risk of tidal flooding to 0.33%, taking account of sea level rises, throughout the study area. The proposed scheme will allow the Environment Agency to manage tidal flood risk from the River Arun and provide better protection from flooding for Littlehampton.

The proposed scheme incorporates a range of measures to achieve this objective, and also aims to incorporate environmental enhancements and benefits for the local community. The main elements of the scheme comprise a range of flood defence improvement works along the River Arun frontage, involving steel sheet piling, concrete walls, embankments and scour protection, promenades being raised and widened, access provided to the River where possible and managed realignment works in Reach 6 to mitigate the loss of intertidal, mudflat habitat downstream and create new saltmarsh.

The proposed flood defence improvement works have been designed to the latest design standards, and will be built using modern construction techniques. As such the scheme will provide improved durability and more sustained resistance to erosion during potential flood conditions.

The improved flood defences proposed landward of the existing alignment in Reach 4 have been designed to preserve the character and appearance of the local area. Three trees are to be removed in Reach 4. They are small trees and do not make a significant

contribution to the character and appearance of the local area. To mitigate for trees lost, new soft landscaping will be provided in the northern part of Reach 4.

Landward realignment in Reach 6 will compensate for the loss of inter-tidal habitat downstream and for future losses due to coastal squeeze by creating saltmarsh and mudflat habitat (refer to Chapter 8 - Biodiversity for more details). The proposed alignment will provide a net habitat creation, protection to the highways embankment and screening of traffic. Replacement trees will be planted and any necessary tree felling will take place under ecological supervision to check for bats. The timing of the construction programme has been organised both to minimise disruption to the main tourist season, and the local economy, and avoid conflict with ecological interests. The latter includes the timing of piling in the river to avoid adverse impacts on migratory fish.

15.3 Conclusion

The scheme we have designed will provide better protection from flooding for the town of Littlehampton. National and local planning policies and guidance have defined the need for the scheme. It comprises essential infrastructural works required to alleviate flood risk to the town of Littlehampton, which contains business and residential areas, heritage assets, recreational and leisure facilities. The policies have shaped the design of the scheme which will be constructed using sustainably and locally sourced materials where possible. The scheme is a direct response towards planning for protection against climate change.

The flood defence improvement works are well-designed and will deliver significant planning benefits and environmental enhancements for the locality, in accordance with both statutory and emerging planning policy documents. The proposals are sustainable in economic, environmental and social terms and accord with the relevant planning policy criteria for the site, at national, regional and local levels.

The proposed scheme is considered compliant with national, regional and local policies.

16 Summary

This Environmental Statement presents the results of an environmental impact assessment undertaken in accordance with the EIA Regulations for the Littlehampton Arun East Bank Tidal Walls Flood Defence Scheme. We will undertake the majority of the scheme as permitted development. Only the northern part of the scheme, where the proposed defences will be constructed off-line in Reach 6 (the area know as Reach 6 Realignment) and a small length in Reach 4 (know as Reach 4 Pharos Quay) will require planning permission. The Environmental Statement covers the entire area of the scheme, including the public realm works to be undertaken by Arun District Council under a separate planning application.

In this assessment we have identified that the scheme will result in a number of temporary adverse impacts during construction, but these can be adequately controlled through the application of procedures that have been detailed in the Environmental Action Plan, which will be implemented through the employment of an Environmental and a Landscape Clerk of Works and through the contract document. Mitigation measures include:

- Timing of the works to avoid disruption to the main tourist season as much as possible and minimise impact on the local economy and ecological interests
- A programme to translocate reptiles to a suitable, enhanced receptor site
- Further surveys to check for the presence of protected species (bats and badgers)
- Measures to prevent the pollution of the River Arun and harm to construction workers or the public from any release of contaminants
- Measures to prevent nuisance from noise and dust
- Adoption of Considerate Construction scheme
- Diversions for pedestrians to maintain safe walking areas and implementation of a Traffic Management and Logistics Plan
- Measures to recycle, reduce and reuse waste, dispose of any surplus materials in an appropriate manner and implementation of a Site Waste Management Plan
- Implementation of an archaeological watching brief and recording in areas of archaeological potential during construction

We have incorporated further measures within the scheme design to avoid and/or mitigate other potential adverse impacts and to incorporate enhancements. Such measures include:

- The incorporation of significant landscaping works, particularly in the lower reaches of the scheme to bring about a significant enhancement of the public realm of the river front
- Realignment of the flood defence embankment in the upper rural reach of the scheme to create a bio-engineered set-back embankment to compensate for the loss of inter-tidal habitat that will be lost to the scheme and coastal squeeze, and result in a net gain of approximately 0.75 hectares of inter-tidal habitat
- Replacement and improvements to pontoons and slipways to maintain access to the river for residents, visitors and emergency services

- Reinstatement of all working areas and implementation of planting plan to mitigate for any damage caused during construction

Following the implementation of these measures, it is concluded that the proposed scheme will result in significant socio-economic benefits to Littlehampton and the local economy in accordance through the provision of improved flood protection and public realm enhancements.

17 References

Arun District Council, 2012, Local Plan – Consultation Doc, 19th July 2012

Bannister N R, 2010, Sussex Historic Landscape Characterisation

Bradley, T and Phillpotts, C 2006, The development of the Port of Littlehampton, East Sussex and excavations at East Bank, River Road, in Sussex Archaeological Collections 144 (2006) pp155-168

British Geological Survey, 1996, 1: 50 000 Series Solid and Drift Geology Sheet 317/332 Chichester and Bognor

English Heritage, 2011, The Setting of Heritage Assets, HMSO

Halcrow, 2009, Rivers Arun to Adur Flood and Coastal Erosion Strategy

Harris, R B 2009 Littlehampton: Historic Character Assessment Report, Sussex Extensive Urban Survey, April 2009

Environmental Action Plan

Environmental Action Plan

Project name	Littlehampton Arun East Bank Tidal Walls Flood Defence Scheme
Project 1B1S reference	IMSO001021
Region and Area	South East
Date	29-05-13
Version number	1
Author	A. Honeysett

Revision history

Revision date	Summary of changes	Author	Version number
May 2013	First issue, Final	A. Honeysett	1

Approvals

Name	Signature	Title	Date	Version
Fiona Brown	Fiona Brown	Director, Halcrow Group (Ch2mhill)	29-5-13	1
Imran Bukhari	Imran Bukhari	Project Director Europe, Halcrow Group (Ch2mhill)	29-5-13	1

Distribution

Name	Title	Date	Version
Cian Cronin	Senior Planner (Strategic Development), Arun District Council	30-5-13	1
Richard Woodward	Senior Environmental Project Manager, national Environmental Assessment Services, Environmental Agency	30-5-13	1
Peter Borsberry	NCMPS Project Manager, Environment Agency	30-5-13	1

Purpose

This Environmental Action Plan (EAP) summarises the actions required to implement the environmental mitigation contained within the Littlehampton Arun East Bank Tidal Walls Environmental Statement (ES) that has been prepared following Environment Agency Operational Instructions. It sets out specific objectives and targets defining the way we aspire to deliver the ES during the implementation phase of the project (detailed design, construction and post-construction phases). It also details roles and responsibilities of those involved in the proposal, and relates to all **temporary** and **permanent** works.

These actions form part of the contract documentation and must be adhered to.

Roles

It is the contractor's responsibility for ensuring the EAP commitments are delivered.

The National Environmental Assessment Service (NEAS) are responsible for agreeing any changes to the EAP and for signing off, or agreeing to the signing off of, the actions.

The contractor and Project Manager are responsible for advising NEAS on any changes to method statements or the planned construction work as these may result in changes to the EAP or additional consultation with statutory consultees. NEAS will assess the significance of these changes and determine the appropriate course of action.

Site practices shall conform to the EAP. Any additional environmental management actions arising from subsequent consultations must be agreed by the project team. Project designs shall include suitable provision to mitigate negative environmental impacts during temporary works, permanent operation and maintenance.

The personnel involved in administering the EAP are set out below. The named individuals are subject to change and confirmation.

- Environment Agency Project Manager (EAPM): **Peter Borsberry**
- Environment Agency NEAS Senior Environmental Project Manager (SEPM) (NEAS Officer): **Richard Woodward**
- Consultant Design Manager: **Fran Loran**
- Supervisor's Representatives on site (Supervisor): to be confirmed
- Engineering Construction Contract Project Manager (ECC PM): to be confirmed
- Contractor's Project Manager on site: to be confirmed
- Environmental Clerk of Works (ECW): to be confirmed
- Landscape Clerk of Works (LCW): to be confirmed

The contractor is also responsible for implementing good environmental practice on site, in line with their own EMS. The ECW/LCW/Consultant will monitor adherence to the EMS. Typical issues include:

- Any working hour restrictions
- Dust suppression measures
- Traffic management
- Site waste management

- Materials management
- Vehicle maintenance and management
- Pollution prevention and control (including storage, refuelling and incident response)
- Response procedures e.g. services strike, contaminated land
- Hazardous materials handling and storage
- Noise management
- Securing and delineation of working areas including signage

Environmental Audits

The appended template should be used when undertaking any site audits during construction. Such audits can be undertaken by the NEAS Officer or delegated by NEAS to the ECW or other individuals. Technical assistance can be obtained from functional staff as appropriate. Site audits can potentially highlight good practice and can be separate to the review of EAP actions as undertaken in progress meetings. They do not replace the regular checks undertaken by the ECW during the works; no set template has been provided for this.

Environmental Incident Reporting system

All environmental incidents must be reported to the Environment Agency Incident Hotline **0800 80 70 60** as per the Environmental Incident Reporting Poster at the earliest opportunity and then to the ECC Project Manager, Site Supervisor, EAPM and Environment Agency NEAS Officer In addition, near misses must be reported via the hotline where there was/is the potential for a significant impact and where lessons can be learned.

Initial reports for such incidents and near misses must be followed by a written report using the contractor's in-house forms. This must include the following information (project/location, date, contractor, NIRS reference number, details of what happened, cause of incident, lessons learned). This final and comprehensive investigation report is to be provided by the Contractor to the ECC Project Manager, EAPM and Safety, Health and Environment Manager within 14 days.

Summary of scope of works

Works are proposed to be carried out to the east bank of the River Arun to manage the risk of tidal flooding to the town of Littlehampton in West Sussex. The scheme extends along the East bank of the River Arun for approximately 2.5km north from the harbour mouth at Littlehampton (NGR TQ 02827 to 01315). The works will involve a number of improvement works being carried out to the existing flood defences including the construction of new sheet piled walls and raising of existing earth embankments along with the setting back of earth embankments to create saltmarsh/mudflat habitat. A summary of the works in each area is provided below:

Reach 1FD (Flood Defence works) A new sheet piled vertical flood defence wall installed directly riverward of the existing sheet piled wall and capped with a decorative precast concrete coping. The wall will be approximately 300m long and 1.3m higher than the existing defence. The wall will generally be 0.5m higher than the new river promenade level and will comprise a new visually transparent railing for health and safety. The level difference between existing and proposed will be transitioned using a combination of pedestrian and seating steps, planting terraces and ramps. These elements will be arranged in a simple repetition along the whole length of Reach 1 and 2. A new footpath adjacent to Arun Parade will be provided at the lower level.

Reach 1PR (Public Realm works) Extensive public realm works landward side will comprise high quality in-situ decorative concrete paving, planting complementing the coastal landscape character, bespoke timber seating, low terraced corten steel (a ready rusted steel used in architectural applications) walls to the planting and a high quality co-ordinated range of replacement street furniture such as litter bins, finger post signs and lighting. Accessibility features including steps and ramps will be located on desire lines and access points to adjacent land uses. Replacement access to the river will be provided.

Reach 2FD (Flood Defence works) A new sheet piled vertical flood defence wall installed directly riverward of the existing sloping concrete revetment and capped with a decorative precast concrete coping. The wall will be approximately 150m long and 1.0m higher than the existing defence and landside works will comprise extensive public realm works to match the proposal for Reach 1. The wall will generally be 0.2m higher than the river promenade level and will comprise a new visually transparent railing for health and safety. The position of the piles will create a wider area between the river and Pier Road creating space for seating and steps up to the raise promenade.

Reach 2PR (Public Realm works) The extensive public realm enhancement works described for Reach 1 above will be extended into Reach 2. Replacement access to the pontoons will be provided. The fish kiosk will be moved temporarily during construction and the promenade widened in this locality to provide more waiting and circulation space.

Reach 3 (private frontage) A raised new vertical sheet piled flood defence wall installed riverward of the existing wall and capped with concrete. The wall will be approximately 100m long and 1.0m higher than the existing wall. Replacement access to the pontoons will be provided and private gardens will be reinstated.

Reach 4PQ (Pharos Quay) In the southern end of this frontage (approximately 40m) a retaining wall will be installed to a height of approximately 1.0m above footpath level. This retaining wall will take a landward alignment and will be installed alongside the footpath. Vehicular and pedestrian access to the private quay (Pharos Quay) will be provided. Works to the northern end of this frontage (adjoining to the footbridge) comprise a new vertical sheet piled wall with concrete cap to a level approximately 0.9m higher than the existing wall. This reach will be landscaped to reflect the Conservation Area status and will included a raised area to allow people to gain a view of the river with an area of low level ground cover planting between the footpath and raised area.

Reach 5 The river-facing walls of the Arun View pub will be flood-proofed using concrete and flood glass units. The walls alongside the patios will be raised using flood glass units and

access to the pontoons will be reinstated. Along the wharves, a 300m length (approximately) of the existing flood defences will be raised by construction of a 0.4m high reinforced concrete wall. To the southern/eastern end of this part of the reach the existing concrete cap will be raised, but the majority of this reach works will comprise a retaining wall constructed in-situ on an alignment immediately landward of the existing wall.

Reach 6 The existing flood defence level will be raised by 0.8m through installation of approximately 600m length of steel sheet piled wall driven through the existing embankment, aligned along the riverward side of the existing embankment crest. In the northern 200m length of this reach, the existing embankments will be raised by 1.0m with imported fill. The scour protection at the top of the existing embankment will be repaired using open stone asphalt (which will be of a similar construction detail to the existing protection). The embankments would be reseeded as required with a species rich seed mix.

Reach 6R (Realignment)

The objective in this area is to promote a salt marsh and mudflat with scour protection at the toe of the A259 highway embankment. The salt marsh and mudflat will be created by removing part of the existing flood embankment and re-using approximately 50% of the material to raise existing ground levels behind. The scour protection will be provided by grassing the highway embankment slopes to the 120 yr design life elevation of 5.45m Above Ordnance Datum.

A working platform will be created along the toe of the highway embankment to allow future maintenance of the scour protection and highway embankment. The elevation of this working platform will be approximately 3.85m Above Ordnance Datum (which will be above current ground levels) so that it is accessible during the design life of the scheme (100 years). The platform will be constructed from the remaining 50% of the flood bund material. A 50m section of new earth flood embankment will be constructed using imported fill to join the realigned flood defence with the existing defence.

The A259 highways embankment will be protected by the addition of earthworks to form the working platform and the scour protection. Native trees and shrubs will be planted on the road embankment to replace the planting lost. A coastal grass seed mix would be planted on the riverward side of the embankment and a species rich mix on the landward side.

Relevant contact details

Project Sponsor	Dave Robinson – 01903 832663
Project Executive	Katharine Matthews – 01903 832118
Project Manager	Peter Borsberry – 01903 832311
NEAS	Richard Woodward – 01903 832384
Consultant PM	Fran Loran – 01793 816408
Contractor	Windsor Young (Volker Stevin) - 02086 915779
Site Supervisor	TBC
ECW	TBC
LCW	TBC

Environmental Action Plan

Ref. No.	Objective	Action	Reach affected	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
Pre-construction							
General							
A1	**To ensure that the works are undertaken in line with the requirements of the EAP with minimum environmental impact**	*Appoint an Environmental Clerk of Works (ECW) to supervise the duration of the works and a Landscape Clerk of Works (LCW) to supervise works during the public realm works*	*All reaches*	*EAPM*			
A2	**To comply with waste management Licensing Regulations (WMLR)**	*To produce CL:AIRE code of practice declaration or apply for relevant waste management exemption*	*All reaches*	*Contractor*			
A3	**To obtain licence from MMO**	*Licence obtained*	*All reaches*	*EAPM*			
A4	**Location of material/storage areas**	*Confirm final locations sufficiently in advance of works to enable any necessary environmental assessment/mitigation e.g. ecological, archaeological to be completed prior to construction* *Any alternative areas will require appropriate ecological assessment particularly for proximity to trees and archaeological assessment*	*All reaches*	*Contractor*	*ES*		
A5	**To ensure works in sensitive areas are carried out following good working practices and reducing environmental impacts**	*Method statements to be produced to reduce environmental impacts within sensitive areas within the working area including archaeological, WSI, ecological method statements for protected species, piling and fish impacts method statement, traffic management and logistics plan, landscape and habitat management plan, pollution response plan, piling risk assessment/sediment management plan and site waste management plan*	*All Reaches*	*Consultant/Contractor*			

Ref. No.	Objective	Action	Reach affected	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
Human Beings							
A6	**To minimise disturbance to the local community and users of the works area access route.**	*Notify all affected consultees of planned commencement of works and their expected duration:* • *All Statutory consultees* • *Landowners* • *Local residents and Businesses*	*All reaches*	*Contractor*	*ES*		
Flora and Fauna							
A7	**Minimise disturbance to breeding birds**	*Ensure all vegetation e.g. scrub and tall grassland is removed outside the bird breeding season (March – August)* *If vegetation needs to be removed during the active bird breeding season, all areas to be cleared need to be checked by an ecologist immediately prior to removal*	*Reaches 4PQ, 6 & 6R*	*Contractor*	*ES*		
A8	**To protect reptiles and their habitats**	*Reptile translocation programme to be undertaken prior to works commencing within Reach 6, including R6 Realignment* *Reptile Method statement (MS) to be followed*	*Reaches 6 & 6R*	*Consultant (reptile translocation)* *Contractor (habitat clearance under ecological supervision)*	*ES* *Reptile Method Statement*		
A9	**Minimise disturbance to bats and trees**	*Ensure all trees to be removed are checked by a specialist bat worker immediately prior to felling/pruning* *Follow recommended mitigation works within bat technical note e.g. section felling of high risk trees and endoscope inspections by specialist ecologist where required* *If any signs of bats are found, works need to stop and Natural England consulted*	*Reach 6R*	*Contractor/ECW (bat specialist)*	*ES* *Phase 1 Refresher & Bat potential assessment Technical Note*		
A10	**To minimise disturbance to retained trees and vegetation within the works area**	*Tree root protection zones to be marked out and fenced in accordance with British Standards. If avoidance is not possible a protective layer is to be used to prevent soil compaction*	*Reaches 4PQ, 5, 6 & 6R*	*Contractor*	*Landscape and Environmental Masterplans*		

Ref. No.	Objective	Action	Reach affected	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
A11	**To prevent the spread of Ash dieback *Chalara fraxinea***	*Survey all areas of trees and scrub that are to be removed as part of the works for Ash dieback* *If recorded or an ash tree is suspected of having the disease, it must be reported to the relevant government body and all guidelines followed*	*Reaches 6 & 6R*	*Environmental clerk of works (ECW)/Ecologist*	*Forestry commission website Chalara dieback of ash (Chalara fraxinea): http://www.forestry.gov.uk* *Bio-security guidelines http://www.forestry.gov.uk/website/forestry.nsf/byunique/infd-8zjmq4*		
A12	**Prevent the spread of Japanese knotweed**	*Carry out a spraying programme for the containment of Japanese knotweed prior to works commencing*	*Reach 6*	*Contractor*	*Japanese knotweed method statement* *Japanese knotweed code of practice (EA)*		
A13	**To check the works area for the presence of badgers**	*A pre-construction survey to be carried out a minimum of 3 months prior to works commencing.*	*Reach 6 & 6R*	*Consultant*	*ES*		
Air and Noise							
A14	**To obtain consent under Section 61 of the Control of Pollution Act 1974**	*Apply for a consent under Section 61 from Environmental Health department of Arun District Council*	*All reaches*	*Contractor*	*ES*		

Ref. No.	Objective	Action	Reach affected	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
A15	**To minimise noise impacts on landowner, residents and users of the reaches.**	*Site operations to be designed to minimise noise emissions wherever possible. Design measures to include the following mitigation measures:* • *Local residents must be kept fully informed about timing and the nature of any noisy works, including compound locations and any traffic management* • *Works to be programmed and phased in order to restrict impacts in any one area to the minimum time* • *The contractor must comply with the Considerate Contractors Scheme and a representative should be on site to answer any queries* • *Temporary hoarding around the site to be in place, particularly in Reaches 1 and 2 where works are close to residential and business by agreement* • *Works to be undertaken during normal working hours of 08:00 – 18:00 Monday to Friday and 08:00 – 13:00 on Saturday* • *No working on Sundays or bank holidays except in exceptional circumstances and with prior arrangement with Arun District Council*	*Reaches 1FD, 1PR, 2FD, 2PR, 3, 4, 4PQ & 5*	*Contractor*	*ES* *Application & consent under section 61 of Part III of The control of Pollution Act 1974*		
A16	**To minimise vibration impacts on landowner, residents and users of the reaches.**	*Site operations to be designed to minimise vibration emissions above a level of 5mm/s PPV where this is technically feasible and where such a level will not affect adjoining structures.* *Pre – construction condition surveys to be carried out to ascertain stability of the structure and its potential resistance to vibration*	*Reaches 1FD, 2FD, 3, 4 & 4PQ*	*EA (to carry out condition surveys)* *Contractor (to design operations to minimise vibration)*			

Ref. No.	Objective	Action	Reach affected	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
Water							
A17	**To minimise any potential impacts on water quality during construction**	*A piling risk assessment/sediment management plan is to be produced to identify specific risks to the environment including sediment re-suspension*	*All Reaches*	*Contractor*	*NEAS and Area Environment Management Team can advise on plan content*		
		A pollution (including sediment release) management and response plan is to be produced prior to works commencing to include the following mitigation measures; forewarning of local users of the river, minimisation of silt release, monitoring of any silt plume generated during piling or earthworks & appropriate response plan in the event of an 'incident'	*All Reaches*	*Contractor*	*NEAS and Area Environment Management Team can advise on plan content*		
Traffic and Transport							
A18	**To minimise disruption to local traffic**	*Agree details of a traffic management plan with West Sussex County Council Highways Department*	*All Reaches*	*Contractor*			
Geology and Hydrogeology							
A19	**To minimise disturbance of asbestos within buildings to be demolished**	*A refurbishment and demolition asbestos survey of all existing buildings and structures that require demolition to be undertaken including shelter Reach 1, bait hut in Reach 2 revetment and the bitumen in Reach 6 scour blocks.*	*Reaches 1PR, 2PR , & 6*	*Consultant*	*ES,* *Landscape and Environmental Masterplans*		
Landscape and Visual							
A20	**To ensure that the works are undertaken in accordance with a landscape and habitat management plan**	*Prepare a landscape and habitat management plan*	*All Reaches*	*Consultant*	*ES*		

Ref. No.	Objective	Action	Reach affected	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
Archaeology and Cultural Heritage							
A21	**Gain approval for archaeological method statements**	*Prior to works commencing, approval of archaeological methods statement by the county archaeologist and EA archaeologist is required*	*All Reaches*	*Consultant*	*ES*		
A22	**To record historic iron railings around Ferry Wharf**	*Photographic recording to be undertaken to create an archive of the features.* *Archaeological sub contractor to undertake recording to approved methods statement*	*Reach 4*	*Contractor*	*ES*		
A23	**To record historic flood embankments and wooden features**	*Photographic/topographic archaeological recording) to be undertaken as agreed with WSCC/ADC archaeological advisor* *Archaeological sub contractor to undertake recording to approved methods statement*	*Reach 6R*	*Contractor*	*ES*		
During construction							
General							
B1	**To ensure that works are undertaken in line with the requirements of the EAP with minimum environmental impact**	*All construction staff to attend environmental toolbox talks on the mitigation proposed for each reach*	*All Reaches*	*Contractor/ECW*			
B2	**To minimise disturbance to human beings, and flora and fauna in the vicinity of works and access routes**	*Delimit works area and access routes:* • *Clearly mark the boundaries of the works area before the start of works* • *Clearly mark the boundaries of the access routes prior to mobilisation* *Types of fencing to be agreed with the contractor's representative*	*All Reaches*	*Contractor*			

Ref. No.	Objective	Action	Reach affected	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
Human Beings							
B3	**To keep the local community and consultees informed of progress.**	*Site contact to be provided on signs outside working area*	*All Reaches*	*Contractor*			
B4	**To minimise general disturbance to the local community and visitors to the area**	*Keep working area tidy and compact* *Dust suppression to be carried out e.g. during long periods of dry weather* *Only essential construction plant to access works areas, all other non-construction traffic to park within the main compound area in Reach 5.* *Provide appropriate signage* *Programming of works in R1 and R2 to avoid impacts on main tourist season as far as possible*	*All Reaches*	*Contractor*			
B5	**To minimise disturbance to human beings in the vicinity of the works and access routes**	*Maintain working area/access route fencing for duration of the works*	*All reaches*	*Contractor*			
B6	**Minimise ground contamination risk to site workers, visitors and nearby residents**	*Any contaminants found during site investigations to be mitigated for within the health and safety plan, by provision of standard site hygiene measures e.g. no eating, drinking or smoking, washing facilities and PPE provided if required) and the management of soil to prevent dust generation*	*All Reaches*	*Contractor*			
B7	**To minimise disturbance of asbestos within buildings/structures to be demolished**	*If asbestos is recorded within buildings to be demolished a sequence of removal of asbestos-containing materials will be carried out by a competent contractor, if required*	*Reaches 1PR, 2PR& 6*	*Contractor*			
B8	**To minimise impact on residential gardens**	*Reinstate gardens as required, to at least their former condition*	*No*	*Contractor*			

Ref. No.	Objective	Action	Reach affected	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
Flora and Fauna							
B9	**Minimise disturbance to existing habitat**	*Undertake site clearance along the access routes and working area in accordance with the site clearance specification under supervision of suitably qualified ecologist.* *Embankment works to work from the crest and/or a landward direction.* *Securely fence the works area and access route* *Provide appropriate signage* *Use existing haul routes where possible(as specified in the traffic management plan – see also ' Traffic and Transport')*	*All reaches*	*Contractor*	*ES*		
B10	**Minimise disturbance to inter-tidal habitats**	*All works to be carried out using sensitive working practices as outlined within EA guidance notes e.g. PPG5.* *Protective matting to be placed on saltmarsh habitats prior to tracking vehicles across it, if required.*	*Reach 6 & 6R*	*Contractor*			
B11	**Potential presence of protected species during construction**	*If protected species are found cease works in that area and consult an ecologist/ECW* *Any excavations left overnight should be left with a ramp to enable any animal to escape.* *Consult Natural England to agree mitigation and working methods where required*	*All reaches*	*Contractor*			
B12	**To minimise potential disturbance to breeding birds**	*Maintain cut vegetation as short sward until end of construction period*	*Reaches 6 & 6R*	*Contractor*			
B13	**Disturbance to bats**	*If emergency works are to be carried out outside of normal working hours, ensure any lighting that is used is angled away from the river corridor*	*Reaches 6 & 6R*	*Contractor*			

Ref. No.	Objective	Action	Reach affected	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
B14	**To minimise disturbance to reptiles**	*Any further clearance of vegetation/topsoil stripping should be carried out under supervision of a suitably qualified ecologist* *Maintain cut vegetation as short sward until end of construction period* *Suitable vegetation removed as part of the clearance works e.g. small logs, wood chippings(small amounts), grass cuttings(small amounts) is to be used to create hibernacula and carry out enhancement works within the reptile receptor site.*	*Reaches 6 & 6R*	*Contractor*			
B15	**To minimise impacts to existing aquatic invertebrate communities within the drainage ditch**	*Any works carried out adjacent to the drainage ditch to follow guidance provided by the Environment Agency e.g. PPG 5*	*Reach 6*	*Contractor*			
B16	**To minimise the impact of piling on fish/eels and elvers**	*Piling and impact to fish method statement to be followed.* *Where percussion piling is required works are to be carried out between (Nov – March) during daylight hours. If works extend into April, river water temperatures to be monitored. If the temperature exceeds 10C additional mitigation measures will be required including working at low tide (Reach 4) and installing cushions/baffles around the piles prior to works commencing.*	*Reaches 1FD, 2FD, 3, 4 & 5*	*Contractor*	*ES* *EA fisheries team*		
B17	**To protect trees and hedgerows retained within the working area**	*No storage, excavations and/or compaction impacts within tree protection zones* *Tree protection to be carried out in accordance with BS5837:2012 'Trees in relation to design, demolition & construction – recommendations'*	*Reaches 4PQ, 5, 6 & 6R*	*Contractor*	*Landscape and Environmental Masterplans*		
B18	**To prevent the spread of invasive plant species e.g. Japanese knotweed**	*Where required continued treatment of Japanese knotweed to be carried out* *Invasive plant species method statement to be followed*	*Reach 6*	*Contractor*	*Japanese knotweed method statement* *Japanese knotweed code of practice (EA)*		

Ref. No.	Objective	Action	Reach affected	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
Air and Noise							
B19	**To minimise disturbance to the local community**	*Keep to agreed working hours* *Adopt best practicable means to reduce noise impacts as defined in the Control of Pollution Act 1974, including the employment of good site practice to minimise noise and vibration impacts from the works, (see also 'Human Beings').* *All plant and equipment to be properly maintained and operated in accordance with manufacturers recommendations* *Equipment is to be shut down when not in use for a period longer than 5 minutes* *Deliveries will only arrive during daytime hours, preferably during the working hours of the site.* *Regular noise monitoring to be undertaken on a four weekly basis to ensure compliance with levels agreed with ADC* *Vibration monitoring to be undertaken to a schedule agreed between Arun District Council Environmental Health Dept and the contractor and will be undertaken near the foundations of sensitive buildings to ensure that adequate levels of control are being employed.*	*All Reaches*	*Contractor*	*ES*		
Water							
B20	**To minimise potential impacts of sediments on water quality during construction operations**	*Implement agreed sediment management plan, including minimisation of silt release, monitoring of any silt plume & appropriate response plan* *Ensure any temporarily excavated material (to facilitate piling) is stored above high water level*	*All Reaches*	*Contractor*			

Ref. No.	Objective	Action	Reach affected	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
B21	**To minimise any potential impacts of other contaminating materials on water quality during construction**	*Implement rigorous adherence to appropriate methods (Environment Agency Pollution Prevention Guidelines) for working over and adjacent to water, including specific appropriate checks and controls before pontoon work (higher risk) activities commence*	*All Reaches*	*Contractor*	*Pollution Prevention Guidelines No. 5*		
B22	**To minimise any contribution to flood risk during construction**	*Large stockpiles of materials/machinery to be outside the floodplain where possible.* *Register with the EA flood incident management team for notification of flood warnings*	*All Reaches*	*Contractor*			
B23	**To prevent permanent impacts to drainage systems disturbed by the works**	*Any drainage system disturbed must be reinstated and replaced to at least their pre-construction standard*	*All Reaches*	*Contractor*			
Traffic and Transport							
B24	**To minimise impacts on local transport routes**	*Implement the agreed traffic management plan* *Limit movement of construction plant between working areas* *Limit movement to approved access routes as specified in the Traffic Management Plan as agreed with Arun District Council* *Limit movements including deliveries to working hours and avoid peak traffic flows, where possible*	*All Reaches*	*Contractor*			

Ref. No.	Objective	Action	Reach affected	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
B25	**To minimise impacts on river navigation**	*Consultation with Littlehampton Harbour Board to be carried out throughout construction particular on activities that could affect the river network.* *All vessel and pontoon movements to be agreed with Harbour board which will be suspended when commercial shipping is navigating to and from Tarmac's Wharf.* *Alternative access points to be provided and adequately signed when pontoon access is disrupted.*	*Reaches 1FD, 2FD, 3,4 & 5*	*Contractor*			
Geology and Hydrogeology							
B26	**To protect soils and geology**	*Any stripped topsoil is to be suitably stored, separated from other soils and reused for reinstatement landscaping wherever possible* *Avoid unnecessary handling of topsoils, particularly when wet*	*All Reaches*	*Contractor*			
B27	**To reduce the amount of waste soils**	*The generation and disposal of surplus or unsuitable soil materials is to be avoided as far as practicable by adoption of the guidance published in CL:AIRE 'The definition of waste: development industry code of practice'* *Disposal of waste materials unavoidably generated during construction is to be disposed of via licensed waste contractors to appropriate disposal sites in accordance with the Site Waste Management Plan. Any waste soils generated on site that are suitable are to be reused where possible* *Waste generated on site is to be stored safely in designated areas and in appropriate containers in accordance with the Site Waste Management Plan*	*All Reaches*	*Contractor*			

Ref. No.	Objective	Action	Reach affected	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
B28	**To minimise disturbance to soils as a result of temporary haul road construction**	*Where temporary haul routes or similar are required (Reaches 5 and 6) and it is planned to remove these on the completion of the works, care is to be taken to minimise mixing of haul routes materials with the underlying ground* *Once haulage routes and stockpile areas are no longer required, restoration is to be undertaken to restore the site in accordance with the design proposals in accordance with best practice (Defra, 1998)*	*Reaches 6 & 6R*	*Contractor*			
B29	**To reduce the risk of spreading unknown contamination**	*If further contamination is encountered during construction, further assessment will be required. Any excavated suspect materials to be stockpiled separately from other arisings until such time as the nature and composition of the materials has been confirmed* *An appropriate method of construction management (a construction environment management plan) is to be put in place to protect construction workers, including the provision of appropriate personal protective equipment*	*All Reaches*	*Contractor*			
Landscape and Visual							
B30	**Visual appearance of works area and access route**	*Keep working area compact and tidy* *Ensure temporary lighting levels and direction of lighting does not cause visual intrusion at properties* *All materials and machinery to be stored in compound area*	*All Reaches*	*Contractor*			
B31	**To ensure that the works are undertaken in accordance with a landscape and habitat management plan**	*Implement the landscape design proposals and habitat management plan by the LCW* *All planting to be of local provenance, where feasible* *Any planting removed is to be replaced with appropriate species*	*All Reaches*	*Contractor*	*ES*		

Ref. No.	Objective	Action	Reach affected	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
Archaeology and Cultural Heritage							
B32	**To record historic river walls within Reaches 1 and 2**	*Carry out an archaeological watching brief during the replacement of the promenade in Reaches 1 and 2 to record any historic structures exposed (potentially the tops of the historic river walls).*	*Reaches 1PR & 2PR*	*Contractor (to ensure archaeological sub-contractor informed of works)* *Archaeological sub-contractor (to carry out works)*	*ES*		
B33	**To record any archaeology causing obstruction to sheet-piling**	*Archaeological inspections as and when needed (if obstructions are encountered)*	*Reaches 3 and 6*	*Contractor* *Archaeological sub-contractor*	*ES*		
B34	**To record any archaeology exposed during initial topsoil strips**	*Archaeological inspection after completion of initial topsoil strips*	*Reach 6R*	*Contractor* *Archaeological sub-contractor*	*ES*		
B35	**To retrieve information from buried palaeo-environmental remains**	*To pass on any further ground investigation data along the line of the scheme to the West Sussex County Archaeologist*	*All Reaches*	*Contractor*			
B36	**Reuse historic railings or record them if reuse not feasible**	*A photographic record will be made of the historic railings prior to their removal and an assessment made of whether they can be reused. If it is not feasible to reuse them, a suitable alternative will be agreed with Arun District Council*	*Reach 4*	*Contractor*			

Ref. No.	Objective	Action	Reach affected	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
Post construction							
Archaeology and Cultural Heritage							
C1	**Maintain historic information theme along the waterfront area**	*The replacement of any historic information boards along the length of the scheme that need to be moved during construction will be subject to agreement with the Conservation Officer of Arun District Council*	*Reaches 1PR & 2PR*	*Contractor*	*ES*		
Flora and Fauna							
C2	**To reinstate habitats affected by construction**	*All working areas will be reinstated.* *Vegetation on the embankment to be planted and maintained to a satisfactory level in accordance with landscape management plan*	*All Reaches*	*Contractor*	*Landscape management plan*		
C3	**To ensure successful implementation of the reptile translocation**	*Suitably qualified ecologist to monitor reptile receptor sites to ensure they are suitable for reptiles*	*Receptor Site*	*EA/Consultant*	*Reptile Method Statement*		
C4	**To ensure development of mudflat/saltmarsh habitat within realignment area**	*Suitably qualified ecologist to monitor the development of mudflat/saltmarsh plant habitat within the realignment area*	*Reach 6R*	*EA/Consultant*			
Landscape and Visual							
C5	**To preserve and enhance the character and appearance of the area**	*Maintain the implemented landscape planting to ensure establishment and successful mitigation in accordance with maintenance requirements. Planting in Reaches 1 and 2 to be maintained for 1 year prior to handing over to Arun District Council. Planting in Reach 4 and Reach 6 to be maintained for 5 years*	*Reaches 1, 2, 4, 6 & 6R*	*Contractor*	*ES*		

Environmental audit record

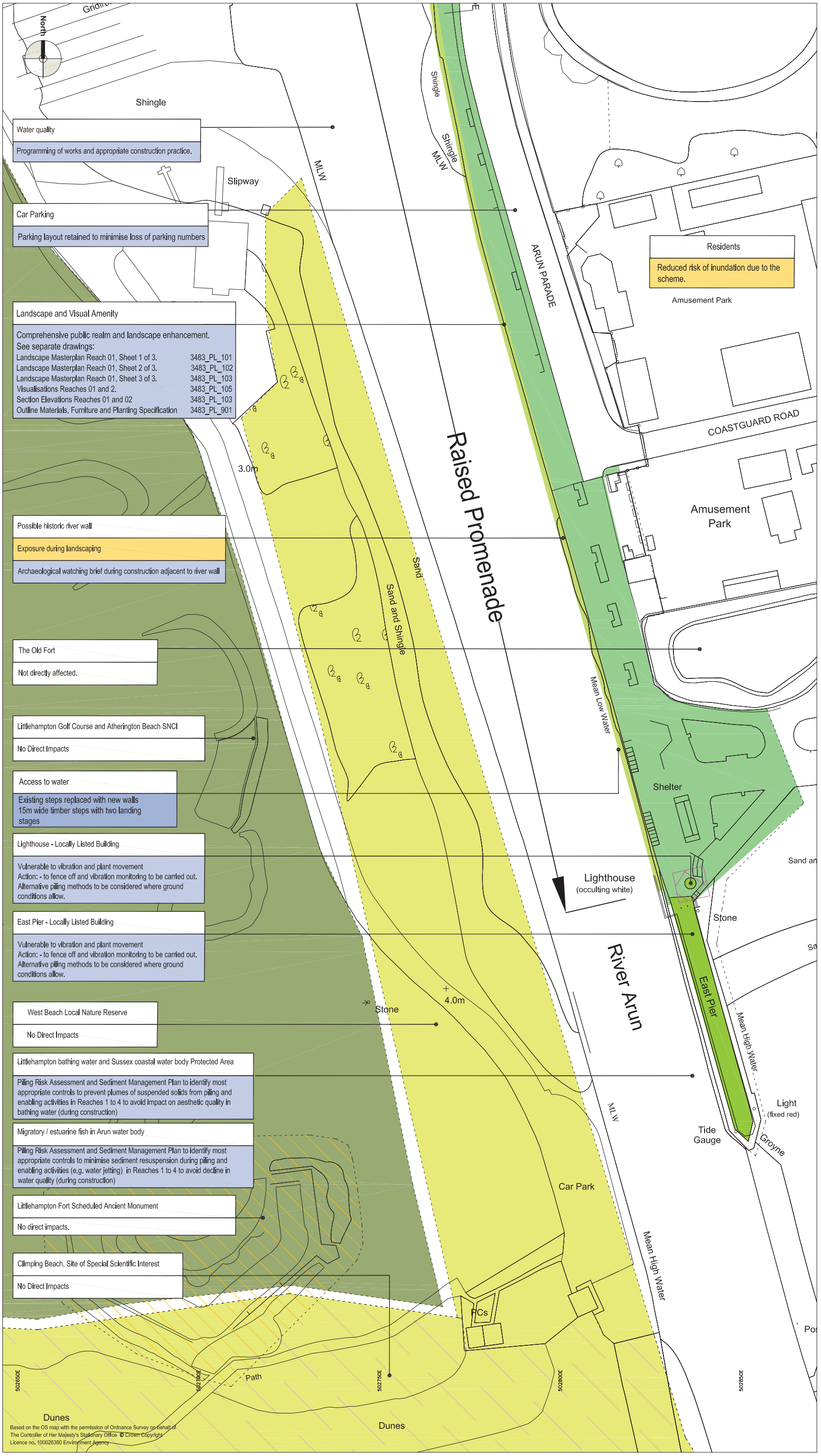
Project		**Project ref.:**	
Project Manager:		**NEAS EPM:**	
Location		**Grid reference**	

Site Visit Audit Details

Visit During/Post Construction:		**Date of Visit:**		**Time of Visit:**	
Audit Officer:		**Photos taken (y/n):**		**Referenced to Pre-Photos(y/n):**	

Does the Site Supervisor have an up to date copy of the EAP? Yes / No

General comments



Key

- Study area
- Proposed sheet pile flood defence
- Proposed improvements to existing flood defence wall
- Existing flood defence wall retained
- Public Realm Enhancement
- Local Nature Reserve
- Scheduled Monument
- Site of Nature Conservation Importance
- Site of Special Scientific Interest
- Impact to Building at Lighthouse
- Locally Listed Buildings

Note legend

- XXX Potential receptor
- XXX Positive environmental effect
- XXX Mitigation measures

Health and Safety

Take appropriate precautions to minimise risk with regards to:
High, steep drops
Large water bodies and channels
Overhead cables
Vehicular traffic

Rev	By	Chkd	Apprvd	Date	Description
B	MMS	AL	-	28/05/13	Amended following comments
A	CMP	AL	-	24/05/13	Amended following comments
0	DTM	ADL	JW	04/08/2010	First Issue

Client
Environment Agency

Halcrow Group Limited
Burderop Park Swindon Wiltshire SN4 0QD
Tel +44 (0)1793 812479 Fax +44 (0)1793 812089
www.halcrow.com
Halcrow

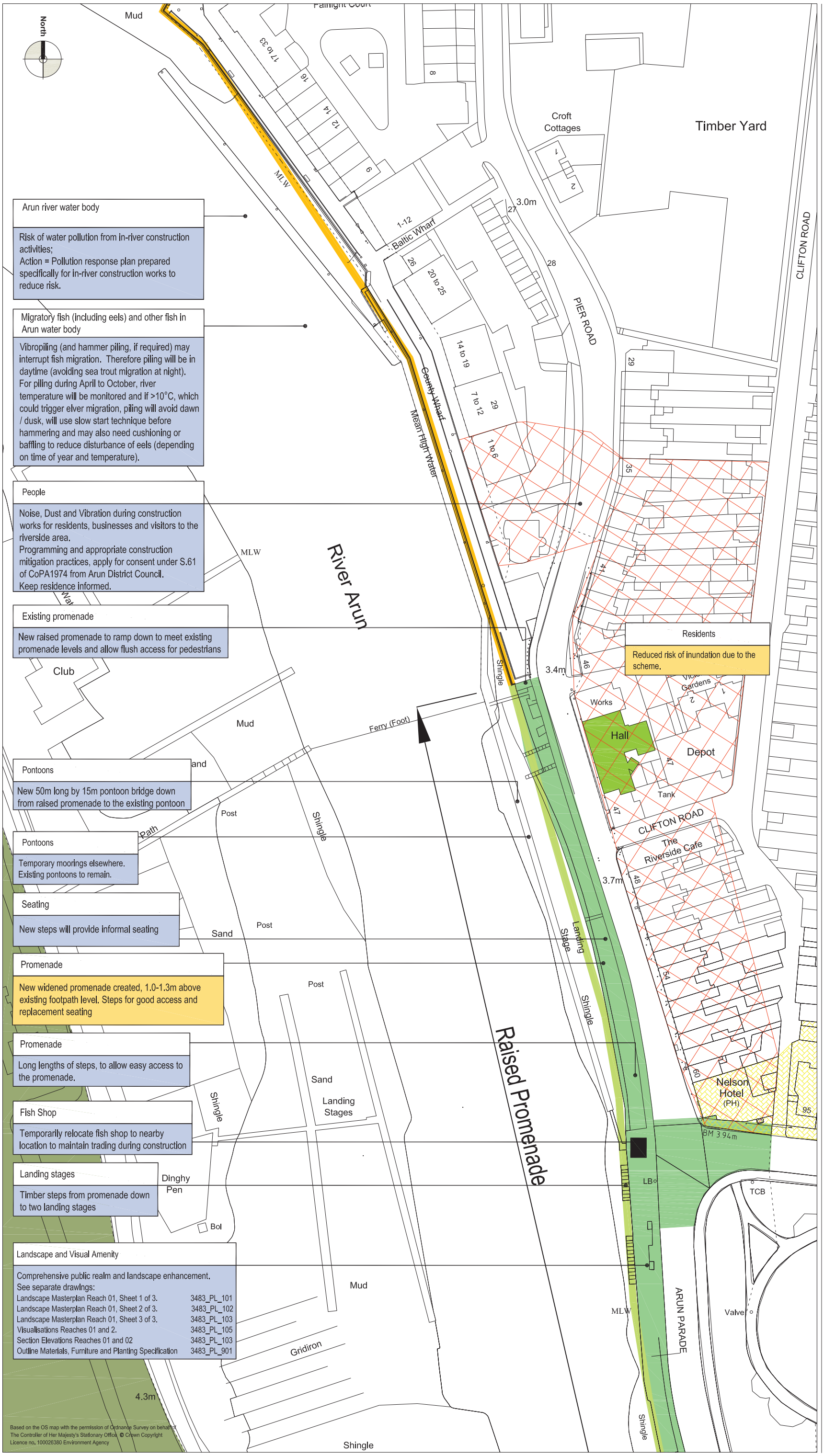
Project
Littlehampton Arun
East Bank Tidal Walls

Drawing
Landscape and Environmental Masterplan
Sheet 1 of 5

Drawn by: CLP	Date: 09/05/2013
Checked by: ADL	Date: 09/05/2013
Approved by: JW	Date: 09/05/2013

Drawing No.	Revision
463457-LEV-001	B

Drawing Scale: 1:750 at A1 1:1500 at A3



Arun river water body

Risk of water pollution from in-river construction activities;
Action = Pollution response plan prepared specifically for in-river construction works to reduce risk.

Migratory fish (including eels) and other fish in Arun water body

Vibropiling (and hammer piling, if required) may interrupt fish migration. Therefore piling will be in daytime (avoiding sea trout migration at night). For piling during April to October, river temperature will be monitored and if >10°C, which could trigger elver migration, piling will avoid dawn / dusk, will use slow start technique before hammering and may also need cushioning or baffling to reduce disturbance of eels (depending on time of year and temperature).

People

Noise, Dust and Vibration during construction works for residents, businesses and visitors to the riverside area.
Programming and appropriate construction mitigation practices, apply for consent under S.61 of CoPA1974 from Arun District Council.
Keep residence informed.

Existing promenade

New raised promenade to ramp down to meet existing promenade levels and allow flush access for pedestrians

Pontoons

New 50m long by 15m pontoon bridge down from raised promenade to the existing pontoon

Pontoons

Temporary moorings elsewhere. Existing pontoons to remain.

Seating

New steps will provide informal seating

Promenade

New widened promenade created, 1.0-1.3m above existing footpath level. Steps for good access and replacement seating

Promenade

Long lengths of steps, to allow easy access to the promenade.

Fish Shop

Temporarily relocate fish shop to nearby location to maintain trading during construction

Landing stages

Timber steps from promenade down to two landing stages

Landscape and Visual Amenity

Comprehensive public realm and landscape enhancement.
See separate drawings:

Landscape Masterplan Reach 01, Sheet 1 of 3.	3483_PL_101
Landscape Masterplan Reach 01, Sheet 2 of 3.	3483_PL_102
Landscape Masterplan Reach 01, Sheet 3 of 3.	3483_PL_103
Visualisations Reaches 01 and 2.	3483_PL_105
Section Elevations Reaches 01 and 02	3483_PL_103
Outline Materials, Furniture and Planting Specification	3483_PL_901

Key

- Study area
- Proposed sheet pile flood defence
- Existing flood defence wall retained
- Site of Nature Conservation Importance
- Impact on People From Noise, Dust & Vibration
- Locally Listed Buildings
- Public Realm Enhancement
- Area of Special Character

Note legend

- XXX Potential receptor
- XXX Positive environmental effect
- XXX Mitigation measures

Health and Safety

Take appropriate precautions to minimise risk with regards to:
High, steep drops
Large water bodies and channels
Overhead cables
Vehicular traffic

Rev	By	Chkd	Apprvd	Date	Description
B	MMS	AL	-	28/05/13	Amended following comments
A	CMP	AL	-	24/05/13	Amended following comments
0	CLP	ADL	JW		First issue

Client: Environment Agency

Halcrow Group Limited
Burderop Park Swindon Wiltshire SN4 0QD
Tel +44 (0)1793 812479 Fax +44 (0)1793 812089
www.halcrow.com
Halcrow

Project

Littlehampton Arun
East Bank Tidal Walls

Drawing

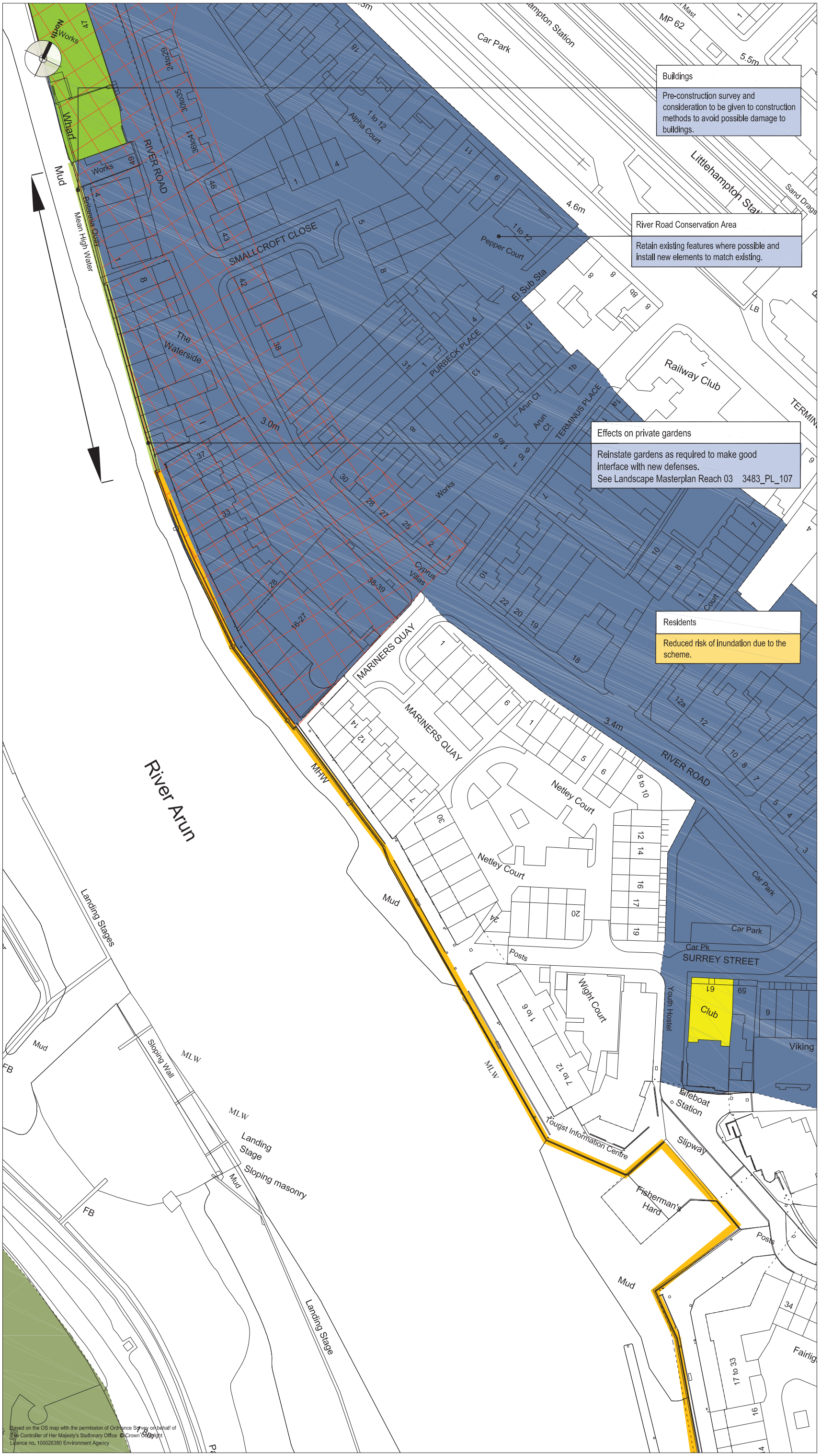
Landscape and Environmental Masterplan Sheet 2 of 5

Drawn by: CLP	Date: 09/05/2013
Checked by: ADL	Date: 09/05/2013
Approved by: JW	Date: 09/05/2013

Drawing No. 463457-LEV-002

Revision B

Drawing Scale: 1:500 at A1 1:1000 at A3



Refer to drawing 463457-LEV-002 with regard comments concerning Migratory and other fish in Arun water body

Health and Safety

Take appropriate precautions to minimise risk with regards to:
High, steep drops
Large water bodies and channels
Overhead cables
Vehicular traffic

Rev	By	Chkd	Apprvd	Date	Description
A	MMS	AL	-	28/05/13	Amended following comments
0	DTM	ADL	JW	04/09/2010	First Issue

Client
Environment Agency

Halcrow Group Limited
Burderop Park Swindon Wiltshire SN4 0QD
Tel +44 (0)1793 812479 Fax +44 (0)1793 812089
www.halcrow.com
Halcrow

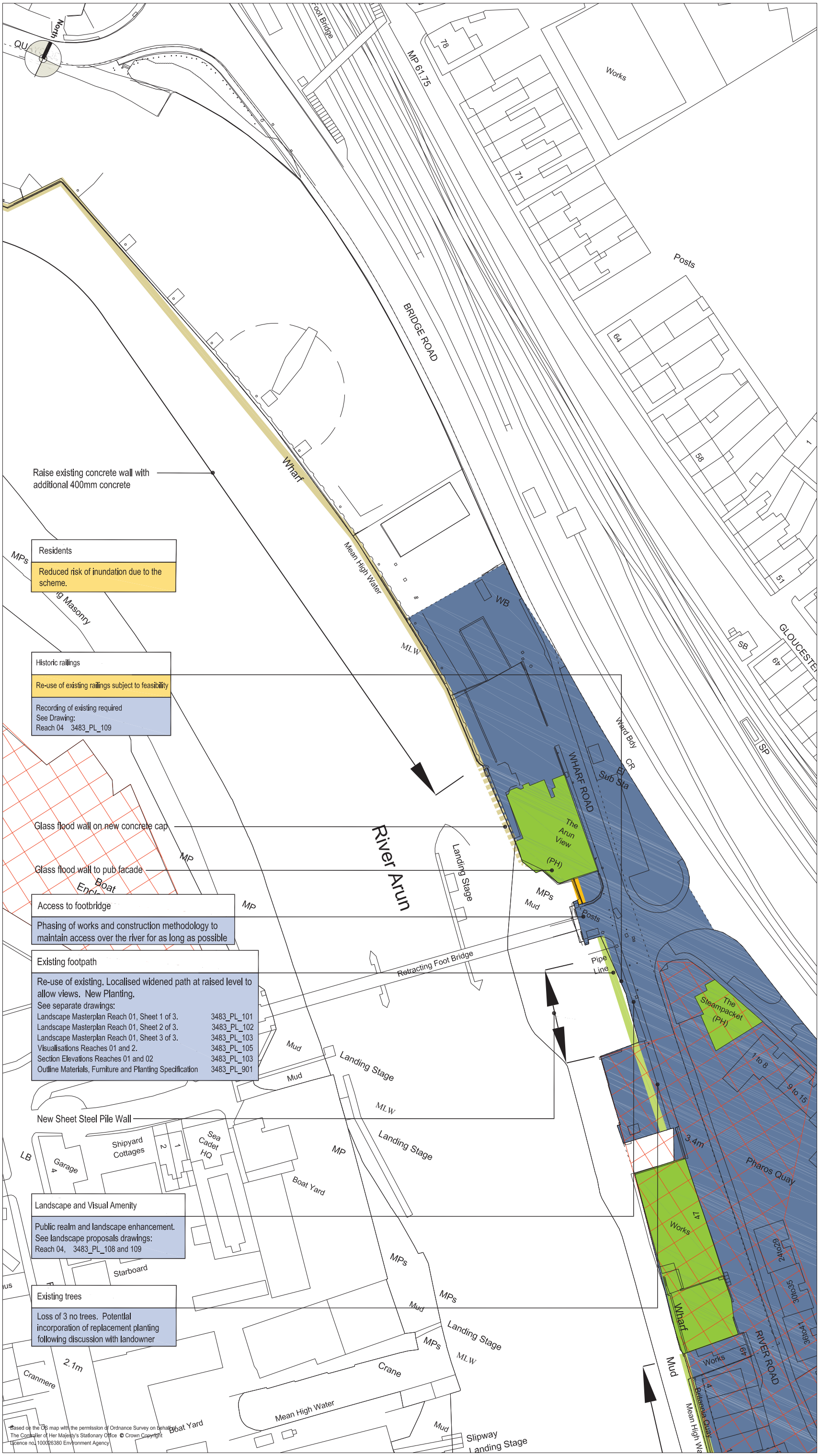
Project
Littelhampton Arun
Eastbank Tidal Walls

Drawing
Landscape and Environmental Masterplan
Sheet 3 of 5

Drawn by: CLP	Date: 09/05/2013
Checked by: ADL	Date: 09/05/2013
Approved by: JW	Date: 09/05/2013

Drawing No.	Revision
463457-LEV-003	A

Drawing Scale: 1:500 at A1 1:1000 at A3



Key

- Study area
- Proposed sheet pile flood defence
- Proposed improvements to existing flood defence wall
- Existing flood defence wall retained
- Conservation Area
- Impact on People From Noise, Dust & Vibration
- Locally Listed Buildings

Note legend

- XXX — Potential receptor
- XXX — Positive environmental effect
- XXX — Mitigation measures

Health and Safety

Take appropriate precautions to minimise risk with regards to:
High, steep drops
Large water bodies and channels
Overhead cables
Vehicular traffic

Rev	By	Chkd	Apprvd	Date	Description
A	MMS	AL	-	28/05/13	Amended following comments
0	DTM	ADL	JW	04/05/2010	First Issue

Client

Environment Agency

Halcrow Group Limited
Burderop Park Swindon Wiltshire SN4 0QD
Tel +44 (0)1793 812479 Fax +44 (0)1793 812089
www.halcrow.com
Halcrow

Project

Littlehampton Arun
East Bank Tidal Walls

Drawing

Landscape and Environmental Masterplan Sheet 4 of 5

Drawn by: CLP	Date: 09/05/2013
Checked by: ADL	Date: 09/05/2013
Approved by: JW	Date: 09/05/2013

Drawing No.	Revision
463457-LEV-004	A

Drawing Scale: 1:500 at A1 1:1000 at A3

North

Badgers

Disturbance to badger setts

A pre-construction survey to be carried out a minimum of 3 months prior to construction to check for the presence of badgers and active setts

Breeding birds

Disturbance to breeding birds during the construction period

Scrub/tall grass vegetation within working area to be removed outside of the bird breeding season (March - August)

Residents

Reduced risk of inundation due to the scheme.

Reptile receptor sites

Reptile receptor site to be enhanced with log piles, creating additional hibernacula and basking places.

Reptile translocation programme to be undertaken (Spring - Summeer 2013) prior to works commencing.

Reptiles

Translocation to a new site to the east and north of the railway.

Salt marsh to be retained

Arun water body

Creation of 0.22ha of new inter-tidal mud-flat as over-mitigation for mud flat-loss.

Wooden features in inter-tidal area

Change in inter-tidal zone

Located and photographed prior to construction

Bats

Tree felling to occur a minimum of 3 months prior to construction, ideally during Sept/Oct. Trees to be checked by a qualifed bat specialist immediately prior to felling/pruning

Earth groyne

Planting on road embankment

Replacement native tree and scrub planting at top of embankment.
See separate drawings:

Landscape Masterplan Reach 01, Sheet 1 of 3.	3483_PL_101
Landscape Masterplan Reach 01, Sheet 2 of 3.	3483_PL_102
Landscape Masterplan Reach 01, Sheet 3 of 3.	3483_PL_103
Visualisations Reaches 01 and 2.	3483_PL_105
Section Elevations Reaches 01 and 02	3483_PL_103
Outline Materials, Furniture and Planting Specification	3483_PL_901

Refer to Drawing 3483_SK_106 Rev A for details

Trees to be retained

Root protection zones of trees to be retained to be fenced off and protected in accordance with BS 5837

Arun water body

Creation of approximately 0.7ha saltmarsh by setting back defences in Reach 6 allowing for more natural estuary margin to develop and directly contributing to WFD morphological mitigation measures resulting in net gain of approximately 0.07ha of this habitat overall.

Access track

Existing track widened to 4m for improved access

Existing scrub

Replacement with species rich grass

Japanese Knot-weed

Spraying programme prior to works commencing in the area. Method Statements and Japanese Knotweed code of practice procedures to be followed.

Arun water body

Replacement scour protection to be laid with locally sourced riverbank sediment / soil to encourage colonisation.

Reptiles

Translocation to new site to the east and north of the railway.

Raise existing concrete wall with additional 400m concrete

People

Appropriate construction mitigation practices. Inform occupiers and landowners of construction

River Arun

Ryebank Rife

1.8m

Key

- Study area
- Proposed sheet pile flood defence
- Proposed improvements to existing flood defence wall
- Existing flood defence wall retained
- Impact on People From Noise, Dust & Vibration
- EXISTING TREES TO BE RETAINED CANOPIES AND ROOTZONES TO BE PROTECTED DURING CONSTRUCT REFER TO RPS DWG'S JSL2151_703 & JSL2151_702
- EXISTING TREES TO BE REMOVED, REFER TO RPS DWG'S JSL2151_703 & JSL2151_702
- EXISTING VEGETATION TO BE RETAINED REFER TO RPS DWG'S JSL2151_703 & JSL2151_702
- EXISTING VEGETATION TO BE REMOVED REFER TO RPS DWG'S JSL2151_703 & JSL2151_702

Note legend

- XXX — Potential receptor
- XXX — Positive environmental effect
- XXX — Mitigation measures

Health and Safety

Take appropriate precautions to minimise risk with regards to:
High, steep drops
Large water bodies and channels
Overhead cables
Vehicular traffic

Rev	By	Chkd	Apprvd	Date	Description
B	MMS	AL	-	28/05/13	Amended following comments
A	CMP	AL	-	24/05/13	Amended following comments
0	DTM	ADL	JW	04/08/2010	Was drawing number DCARUNLP-2

Client

Environment Agency

Halcrow Group Limited
Burderop Park Swindon Wiltshire SN4 0QD
Tel +44 (0)1793 812479 Fax +44 (0)1793 812089
www.halcrow.com

Halcrow

Project

Littlehampton Arun
East Bank Tidal Walls

Drawing

Landscape and Environmental Masterplan Sheet 5 of 5

Drawn by: CLP	Date: 09/05/2013
Checked by: ADL	Date: 09/05/2013
Approved by: JW	Date: 09/05/2013

Drawing No. 463457-LEV-005

Revision B

Drawing Scale: 1:2000 at A1 1:4000 at A3

Figures

WALLS
600mm

OPOSED FOR
THIS AREA

TRADE TO LENGTH
OF WATER'S EDGE

LARGE TIMBER CLAD
SEATING BUILT INTO
STEPS

LARGE TIMBER BENCHES
WITH BACK RESTS
OVERLOOKING THE RIVER

STEP ACCESS BETWEEN
EXISTING STREET LEVEL
AND PROMENADE

CONTROLLED ACCESS GATE TO
STEPS

STEP ACCESS TO THE RIVER

LARGE BESPOKE DUAL
FACING TIMBER BENCH
WITH BACKRESTS

WHEELCHAIR ACCESSIBLE
GRADED ROUTE BETWEEN
PROMENADE AND EAST PIER

WALL HEIGHT STEPS DOWN
TO TRANSITION TO EXISTING

LIGHTHOUSE RETAINED IN
ITS CURRENT POSITION

REFER TO DWG 3483_PL_102

WHEELCHAIR ACCESSIBLE
GRADED ROUTE BETWEEN
EAST BEACH PROMENADE
AND ARUN PARADE

THERE ARE CURRENTLY NO NEW
WORKS PROPOSED FOR THIS AREA
OF PROMENADE THAT LINKS WITH
THE SEAFRONT PROMENADE

TOW 5.3

TOW 4.7

TOW 4.1
(Existing)

TOW 5.15
(Existing)

TOW
5.19
(Existing)

TOW 5.16
(Existing)

EXISTING DOG BIN RETAINED AND
RELOCATED

EXISTING BEACH WALL AND RAILING
RETAINED

PEBBLE SEATS

NEW STEP ACCESS BETWEEN EAST
PIER AND PROMENADE

BEACH WALL AND RAILING REMOVED
FROM BOTTOM OF NEW STEP ACCESS

EXISTING STEP ACCESS RETAINED

Amusement
Park

Sand and Shingle

Slipway

OVERALL DESIGN INTENT

The public realm design for Reaches 1 and 2 proposes a simple, well-coordinated clutter free waterfront with improved pedestrian access and circulation. A new sheet piled vertical flood defence wall will be installed directly riverward of the existing piled wall and capped with a decorative precast coping. In Reach 1 the wall will be generally 1.3m higher than the existing defence and 0.5m higher than the new river promenade level. In Reach 2 the wall will generally be 1.0m higher than the existing defence and 0.2m higher than the new river promenade level. Replacement waterfront balustrade will be provided on top of the precast coping for health and safety reasons. This aims to be visually light weight in design to maintain views to the river.

The level difference between existing and proposed will be transitioned using a combination of pedestrian and seating steps, planting terraces and ramps. The arrangement of these elements will be arranged in a simple repetition along the whole length of Reach 1 and 2. A new footpath adjacent to Arun Parade in Reach 1 will be provided at the lower level. Extensive public realm works landward side will comprise high quality in-situ decorative concrete paving, planting complementing the coastal landscape character, bespoke timber seating, low terraced corten steel walls to the planting and a high quality co-ordinated range of replacement street furniture such as litter bins, finger post signs and lighting. Accessibility features including steps and ramps will be located on desire lines and access points to adjacent land uses. Access to the river will be maintained and improved where practicable by new ramps, steps or pontoons. In Reach 1 the fish kiosk will be moved westwards and the promenade widened in this locality to provide more waiting and circulation space.

For Reaches 1 and 2 the materials, furniture and planting for the public realm will be inspired by Littlehampton's surrounding natural context. They will be selected to provide a unified, robust, simple and understated public realm which complement the surrounding natural context and will not compete visually with the more brightly coloured buildings along the waterfront. The character of the planting will aim to mimic the natural shoreline coastal planting (naturalistic, not formal). Attractive coastal species, preferably indigenous to the West Sussex coastline or suitability for environment and of low maintenance will be chosen. Replacement lighting in Reaches 1 and 2 using high quality light fittings to enhance the public realm and the incorporation of feature lighting within the waterfront balustrading or handrails to steps is currently being considered.

KEY

- Planning Application Boundary
- Visualisations (see drawing 3483_PL_002)
- Cross Sections (see drawing 3483_PL_003)
- Exposed Aggregate Promenade and Footpaths
- Balustrade to Length of Waterfront
- DDA Compliant Graded Route
- Large Bespoke Benches
- Large Benches with Backrests
- Pebble Seats
- Litter Bins
- Fingerpost Sign
- 10m Street Lights with Timber Columns (Double and Single Lantern)
- DDA Compliant Steps with Handrails
- Timber Cladding to Large Concrete Seating Steps
- Terraced Planting Through Layer of Self Binding Gravel

N

0 10m

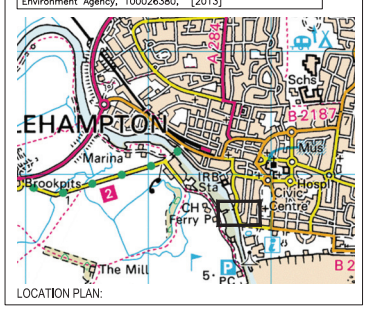
PRELIMINARY

NOTES:
1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.

TO BE READ IN CONJUNCTION WITH LANDSCAPE MASTERPLAN REACH 01 SHEETS 02 & 03.

REFER TO ENGINEER'S DRAWINGS 463457-CIVIL-100-P1, 463457-CIVIL-101-P1 AND 463457-CIVIL-103-P1

LOCATION PLAN:



Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire. SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089

www.halcrow.com

A CH2M HILL COMPANY

Halcrow

LDA Design
Kings Wharf, The Quay, Exeter, EX2 4AN
T: 01392 260 430
F: 01392 260 431

LDĀDESIGN

Project

LITTLEHAMPTON ARUN, EAST BANK
LANDSCAPE AND PUBLIC REALM

Drawing

LANDSCAPE MASTERPLAN
REACH 01
SHEET 1 OF 3

Drawn by	KB (LDA)	Date:	May 2013
Checked by	SJT (LDA)	Date:	May 2013
Authorised by	SJT (LDA)	Date:	May 2013

Drawing No. 3483_PL_101 Revision

Drawing Scale: 1:200 @ A1

CAD Filename: 3483_Reach 1 and 2 Plot Scale:

REFER TO DWG 3483_PL_103

LARGE TIMBER BENCHES WITH BACK RESTS OVERLOOKING THE RIVER

EXISTING ON-STREET PARKING RETAINED

NEW RAISED TABLE AND KERB TO CREATE SIGHTLINES FOR PEDESTRIANS

STEP ACCESS BETWEEN EXISTING STREET LEVEL AND PROMENADE (TO PICK UP DESIRE LINE FROM AMUSEMENT PARK)

CYCLE STANDS

WHEELCHAIR ACCESSIBLE GRADED ROUTE BETWEEN EXISTING STREET LEVEL AND PROMENADE

BALUSTRADE TO LENGTH OF RAMP WALLS WHERE DROP EXCEEDS 600mm

NO WORKS ARE CURRENTLY PROPOSED FOR THIS AREA

BALUSTRADE TO LENGTH OF WATER'S EDGE

LARGE TIMBER CLAD SEATING BUILT INTO STEPS

LARGE TIMBER BENCHES WITH BACK RESTS OVERLOOKING THE RIVER

STEP ACCESS BETWEEN

WHEELCHAIR ACCESSIBLE GRADED ROUTE BETWEEN EAST BEACH PROMENADE AND ARUN PARADE

Amusement Park

Amusement Park

COASTGUARD

Sand

Sand and Shingle

3.6

4.8

4.9

4.0

3

4.4

A

A'

4.2

4.8

4.4

4.5

4.9

4.6

REFER TO DWG 3483_PL_101

OVERALL DESIGN INTENT

The public realm design for Reaches 1 and 2 proposes a simple, well-coordinated clutter free waterfront with improved pedestrian access and circulation. A new sheet piled vertical flood defence wall will be installed directly riverward of the existing piled wall and capped with a decorative precast coping. In Reach 1 the wall will be generally 1.3m higher than the existing defence and 0.5m higher than the new river promenade level. In Reach 2 the wall will generally be 1.0m higher than the existing defence and 0.2m higher than the new river promenade level. Replacement waterfront balustrade will be provided on top of the precast coping for health and safety reasons. This aims to be visually light weight in design to maintain views to the river.

The level difference between existing and proposed will be transitioned using a combination of pedestrian and seating steps, planting terraces and ramps. The arrangement of these elements will be arranged in a simple repetition along the whole length of Reach 1 and 2. A new footpath adjacent to Arun Parade in Reach 1 will be provided at the lower level. Extensive public realm works landward side will comprise high quality in-situ decorative concrete paving, planting complementing the coastal landscape character, bespoke timber seating, low terraced corten steel walls to the planting and a high quality co-ordinated range of replacement street furniture such as litter bins, finger post signs and lighting. Accessibility features including steps and ramps will be located on desire lines and access points to adjacent land uses. Access to the river will be maintained and improved where practicable by new ramps, steps or pontoons. In Reach 1 the fish kiosk will be moved westwards and the promenade widened in this locality to provide more waiting and circulation space.

For Reaches 1 and 2 the materials, furniture and planting for the public realm will be inspired by Littlehampton's surrounding natural context. They will be selected to provide a unified, robust, simple and understated public realm which complement the surrounding natural context and will not compete visually with the more brightly coloured buildings along the waterfront. The character of the planting will aim to mimic the natural shoreline coastal planting (naturalistic, not formal). Attractive coastal species, preferably indigenous to the West Sussex coastline or suitability for environment and of low maintenance will be chosen. Replacement lighting in Reaches 1 and 2 using high quality light fittings to enhance the public realm and the incorporation of feature lighting within the waterfront balustrading or handrails to steps is currently being considered.

KEY

- Planning Application Boundary
- Visualisations (see drawing 3483_PL_002)
- Cross Sections (see drawing 3483_PL_003)
- Exposed Aggregate Promenade and Footpaths
- Raised Table Pedestrian Crossing
- Balustrade to Length of Waterfront
- DDA Compliant Graded Route with Balustrade
- Large Bespoke Benches
- Large Benches with Backrests
- Litter Bins
- Cycle Stands
- Fingerpost Sign
- 10m Street Lights with Timber Columns (Double and Single Lantern)
- DDA Compliant Steps with Handrails
- Timber Cladding to Large Concrete Seating Steps
- Terraced Planting Through Layer of Self Binding Gravel

N

0 10m

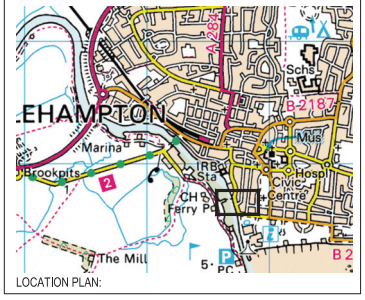
PRELIMINARY

NOTES:
1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.

TO BE READ IN CONJUNCTION WITH LANDSCAPE MASTERPLAN REACH 01 SHEETS 01 & 03.

REFER TO ENGINEER'S DRAWINGS 463457-CIVIL-100-P1, 463457-CIVIL-101-P1 AND 463457-CIVIL-103-P1

LOCATION PLAN:



Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire. SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089

www.halcrow.com

A CH2M HILL COMPANY Halcrow

LDA Design
Kings Wharf, The Quay, Exeter, EX2 4AN
T: 01392 260 430
F: 01392 260 431

LDĀDESIGN

Project

LITTLEHAMPTON ARUN, EAST BANK LANDSCAPE AND PUBLIC REALM

Drawing

LANDSCAPE MASTERPLAN REACH 01 SHEET 2 OF 3

Drawn by	KB (LDA)	Date:	May 2013
Checked by	SJT (LDA)	Date:	May 2013
Authorised by	SJT (LDA)	Date:	May 2013

Drawing No. 3483_PL_102 Revision

Drawing Scale: 1:200 @ A1

CAD Filename: 3483_Reach 1 and 2 Plot Scale:

STREET LEVEL AND PROMENADE

CONTROLLED ACCESS GATE TO PONTOON

EXISTING CCTV COLUMN

REACH 2

REACH 1

REFER TO DWG 3483_PL_104

JUNCTION BETWEEN PIER ROAD AND SOUTH TERRACE NARROWED PROVIDING MORE SPACE FOR THE WATERFRONT PROMENADE AND IMPROVED PEDESTRIAN CONNECTIONS

FISH KIOSK

CONTROLLED ACCESS GATE TO STEPS

STEP CHANGE IN WALL HEIGHT

STEP ACCESS TO THE RIVER

THE HEIGHT OF THE WATERFRONT PROMENADE ALONG ARUN PARADE IS REDUCED FROM THE FLOOD PROTECTION HEIGHT BY 0.2 METRES TO BRING THE PROMENADE HEIGHT CLOSER TO THE EXISTING STREET HEIGHT, THIS REQUIRES A 0.5 METRE UPSTAND ON THE NEW FLOOD DEFENCE WALL

PLANTING TERRACES BETWEEN THE EXISTING STREET LEVEL AND THE PROMENADE

LARGE TIMBER CLAD SEATING BUILT INTO STEPS

CAR PARKING SPACES

PLANTING TERRACES BETWEEN THE EXISTING STREET LEVEL AND THE PROMENADE

NEW KERB TO ARUN PARADE ONLY

Slipway

MLW

ARUN PARADE

TCB

(PH)

95

5.0

3.5

4.8

TOW 5.0

TOW 5.3

3.4

4.9

2

4.8

4.9

3.5

B

B'

3.4

3.5

4.8

4.9

3.7

REFER TO DWG 3483_PL_102

OVERALL DESIGN INTENT

The public realm design for Reaches 1 and 2 proposes a simple, well-coordinated clutter free waterfront with improved pedestrian access and circulation. A new sheet piled vertical flood defence wall will be installed directly riverward of the existing piled wall and capped with a decorative precast coping. In Reach 1 the wall will be generally 1.3m higher than the existing defence and 0.5m higher than the new river promenade level. In Reach 2 the wall will generally be 1.0m higher than the existing defence and 0.2m higher than the new river promenade level. Replacement waterfront balustrade will be provided on top of the precast coping for health and safety reasons. This aims to be visually light weight in design to maintain views to the river.

The level difference between existing and proposed will be transitioned using a combination of pedestrian and seating steps, planting terraces and ramps. The arrangement of these elements will be arranged in a simple repetition along the whole length of Reach 1 and 2. A new footpath adjacent to Arun Parade in Reach 1 will be provided at the lower level. Extensive public realm works landward side will comprise high quality in-situ decorative concrete paving, planting complementing the coastal landscape character, bespoke timber seating, low terraced corten steel walls to the planting and a high quality co-ordinated range of replacement street furniture such as litter bins, finger post signs and lighting. Accessibility features including steps and ramps will be located on desire lines and access points to adjacent land uses. Access to the river will be maintained and improved where practicable by new ramps, steps or pontoons. In Reach 1 the fish kiosk will be moved westwards and the promenade widened in this locality to provide more waiting and circulation space.

For Reaches 1 and 2 the materials, furniture and planting for the public realm will be inspired by Littlehampton's surrounding natural context. They will be selected to provide a unified, robust, simple and understated public realm which complement the surrounding natural context and will not compete visually with the more brightly coloured buildings along the waterfront. The character of the planting will aim to mimic the natural shoreline coastal planting (naturalistic, not formal). Attractive coastal species, preferably indigenous to the West Sussex coastline or suitability for environment and of low maintenance will be chosen. Replacement lighting in Reaches 1 and 2 using high quality light fittings to enhance the public realm and the incorporation of feature lighting within the waterfront balustrading or handrails to steps is currently being considered.

KEY

- Planning Application Boundary
- Visualisations (see drawing 3483_PL_002)
- Cross Sections (see drawing 3483_PL_003)
- Exposed Aggregate Promenade and Footpaths
- Re-surface Existing Carriageway
- Raised Table Pedestrian Crossing
- Balustrade to Length of Waterfront
- Large Bespoke Benches
- Large Benches with Backrests
- Litter Bins
- Cycle Stands
- Fingerpost Sign
- 10m Street Lights with Timber Columns (Double and Single Lantern)
- DDA Compliant Steps with Handrails
- Timber Cladding to Large Concrete Seating Steps
- Terraced Planting Through Layer of Self Binding Gravel

N

0 10m

PRELIMINARY

NOTES:
1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.

TO BE READ IN CONJUNCTION WITH LANDSCAPE MASTERPLAN REACH 01 SHEETS 01 & 02.

REFER TO ENGINEER'S DRAWINGS 463457-CIVIL-100-P1, 463457-CIVIL-101-P1 AND 463457-CIVIL-103-P1

LOCATION PLAN:

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire. SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089

www.halcrow.com

A CH2M HILL COMPANY

Halcrow

LDA Design
Kings Wharf, The Quay, Exeter, EX2 4AN
T: 01392 260 430
F: 01392 260 431

LDĀDESIGN

Project

LITTLEHAMPTON ARUN, EAST BANK LANDSCAPE AND PUBLIC REALM

Drawing

LANDSCAPE MASTERPLAN
REACH 01
SHEET 3 OF 3

Drawn by	KB (LDA)	Date:	May 2013
Checked by	SJT (LDA)	Date:	May 2013
Authorised by	SJT (LDA)	Date:	May 2013

Drawing No. 3483_PL_103 Revision

Drawing Scale: 1:200 @ A1

CAD Filename: 3483_Reach 1 and 2 Plot Scale:

WHEELCHAIR ACCESSIBLE GRADED ROUTE BETWEEN EXISTING AND PROPOSED PROMENADES

BALUSTRADE TO LENGTH OF WATER'S EDGE

PROPOSED FLOOD DEFENCE WALL

NEW FEATHERED STEPS TO PROMENADE

EXISTING STEPPED KERB RETAINED

NEW 3-7 METRE WIDE CONTINUOUS WATERFRONT PROMENADE LINKING TOWN AND BEACH

CONTROLLED ACCESS GATE TO PONTOON

PLANTING TERRACES BETWEEN THE EXISTING STREET LEVEL AND THE PROMENADE

EXISTING LITTER BINS REMOVED FROM FOOTPATH TO ALLOW A 2 METRE WIDE UNOBSTRUCTED FOOTPATH AT EXISTING STREET LEVEL. REPLACED WITH NEW.

NON CONTINUOUS TOP SEATING STEP TO PROVIDE BALANCE BETWEEN SEATING PROVISION AND VISIBILITY OF THE RIVER

LARGE TIMBER CLAD SEATING BUILT INTO STEPS

STEP ACCESS BETWEEN EXISTING STREET LEVEL AND PROMENADE

THE HEIGHT OF THE WATERFRONT PROMENADE ALONG PIER ROAD IS REDUCED FROM THE FLOOD PROTECTION HEIGHT BY 0.2 METRES TO BRING THE PROMENADE HEIGHT CLOSER TO THE EXISTING STREET HEIGHT, THIS REQUIRES A 0.2 METRE UPSTAND ON THE NEW FLOOD DEFENSE WALL

EXISTING CROSSING POINT ON PIER ROAD RETAINED

WHEELCHAIR ACCESSIBLE GRADED ROUTE BETWEEN EXISTING STREET LEVEL AND PROMENADE

CONTROLLED ACCESS GATE TO PONTOON

EXISTING CCTV COLUMN

TOW 5.0
3.6
4.8
3.6
4.9
3.7
TOW 5.0
3.8
4.8
4.9
3.6
4.8
4.9
5.0

Victoria Gardens
CLIFTON ROAD
PIER ROAD
Nelson Hotel (PH)
E
E'
D
D'
C
C'

REFER TO DWG 3483_PL_103

REACH 2
REACH 1

OVERALL DESIGN INTENT

The public realm design for Reaches 1 and 2 proposes a simple, well-coordinated clutter free waterfront with improved pedestrian access and circulation. A new sheet piled vertical flood defence wall will be installed directly riverward of the existing piled wall and capped with a decorative precast coping. In Reach 1 the wall will be generally 1.3m higher than the existing defence and 0.5m higher than the new river promenade level. In Reach 2 the wall will generally be 1.0m higher than the existing defence and 0.2m higher than the new river promenade level. Replacement waterfront balustrade will be provided on top of the precast coping for health and safety reasons. This aims to be visually light weight in design to maintain views to the river.

The level difference between existing and proposed will be transitioned using a combination of pedestrian and seating steps, planting terraces and ramps. The arrangement of these elements will be arranged in a simple repetition along the whole length of Reach 1 and 2. A new footpath adjacent to Arun Parade in Reach 1 will be provided at the lower level. Extensive public realm works landward side will comprise high quality in-situ decorative concrete paving, planting complementing the coastal landscape character, bespoke timber seating, low terraced corten steel walls to the planting and a high quality co-ordinated range of replacement street furniture such as litter bins, finger post signs and lighting. Accessibility features including steps and ramps will be located on desire lines and access points to adjacent land uses. Access to the river will be maintained and improved where practicable by new ramps, steps or pontoons. In Reach 1 the fish kiosk will be moved westwards and the promenade widened in this locality to provide more waiting and circulation space.

For Reaches 1 and 2 the materials, furniture and planting for the public realm will be inspired by Littlehampton's surrounding natural context. They will be selected to provide a unified, robust, simple and understated public realm which complement the surrounding natural context and will not compete visually with the more brightly coloured buildings along the waterfront. The character of the planting will aim to mimic the natural shoreline coastal planting (naturalistic, not formal). Attractive coastal species, preferably indigenous to the West Sussex coastline or suitability for environment and of low maintenance will be chosen. Replacement lighting in Reaches 1 and 2 using high quality light fittings to enhance the public realm and the incorporation of feature lighting within the waterfront balustrading or handrails to steps is currently being considered.

KEY

- Planning Application Boundary
- Visualisations (see drawing 3483_PL_002)
- Cross Sections (see drawing 3483_PL_003)
- Exposed Aggregate Promenade and Footpaths
- Re-surface Existing Carriageway
- Balustrade to Length of Waterfront
- DDA Compliant Graded Route with Balustrade
- Large Bespoke Benches
- Litter Bins
- Fingerpost Sign
- 10m Street Lights with Timber Columns (Double and Single Lantern)
- DDA Compliant Steps with Handrails
- Timber Cladding to Large Concrete Seating Steps
- Terraced Planting Through Layer of Self Binding Gravel

N

0 10m

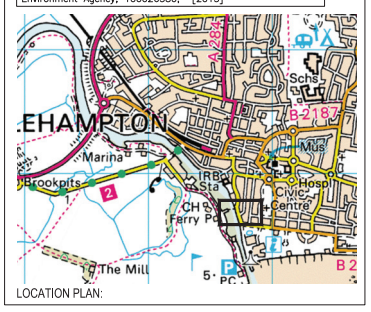
PRELIMINARY

NOTES:
1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.

TO BE READ IN CONJUNCTION WITH LANDSCAPE MASTERPLAN REACH 01 SHEETS 01, 02 & 03.

REFER TO ENGINEER'S DRAWINGS 463457-CIVIL-100-P1, 463457-CIVIL-101-P1 AND 463457-CIVIL-103-P1

LOCATION PLAN:



Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire. SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089

www.halcrow.com

A CH2M HILL COMPANY

Halcrow

LDA Design
Kings Wharf, The Quay, Exeter, EX2 4AN
T: 01392 260 430
F: 01392 260 431

LDĀDESIGN

Project

LITTLEHAMPTON ARUN, EAST BANK LANDSCAPE AND PUBLIC REALM

Drawing

LANDSCAPE MASTERPLAN REACH 02

Drawn by	KB (LDA)	Date:	May 2013
Checked by	SJT (LDA)	Date:	May 2013
Authorised by	SJT (LDA)	Date:	May 2013

Drawing No. 3483_PL_104 Revision

Drawing Scale: 1:200 @ A1

CAD Filename: 3483_Reach 1 and 2 Plot Scale:

X:\JOBS\3483 Littlehampton Implementation\Sgraphics\Plans_Images\Planning Review Sheets

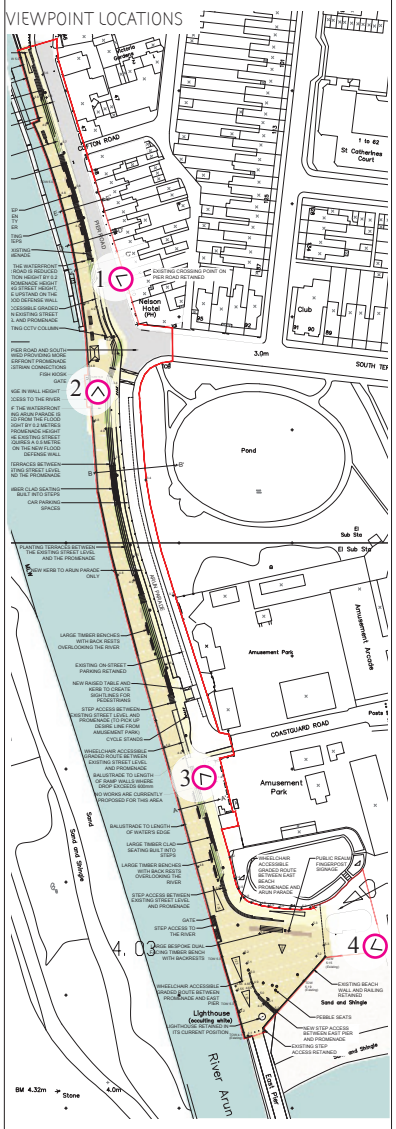
VISUALISATION 1

VISUALISATION 2

VISUALISATION 3

VISUALISATION 4

VIEWPOINT LOCATIONS



Revision	By	Checked	Approved	Date	Description

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Griffin House, 135 High Street, Crawley, West Sussex, RH10 1DQ
Tel 01293 434500 Fax 01293 434599
www.halcrow.com

Halcrow

LDA Design
Kings Wharf, The Quay, Exeter, EX2 4AN
T: 01392 260 430
F: 01392 260 431

LDĀDESIGN

Project

LITTLEHAMPTON ARUN, EAST BANK
LANDSCAPE AND PUBLIC REALM

Drawing

VISUALISATIONS
REACHES 1 AND 2

Drawn by	KB (LDA)	Date:	May 2013
Checked by	SJT (LDA)	Date:	May 2013
Authorised by	SJT (LDA)	Date:	May 2013

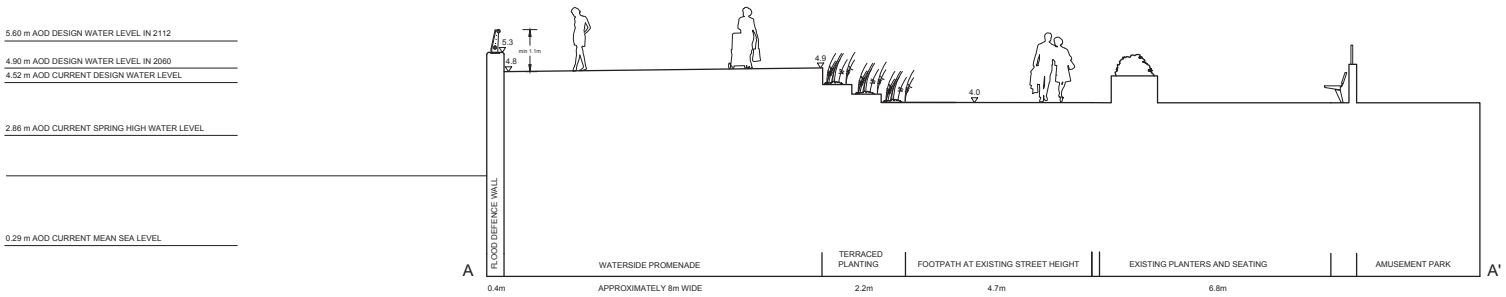
Drawing No. 3483_PL_105

Revision

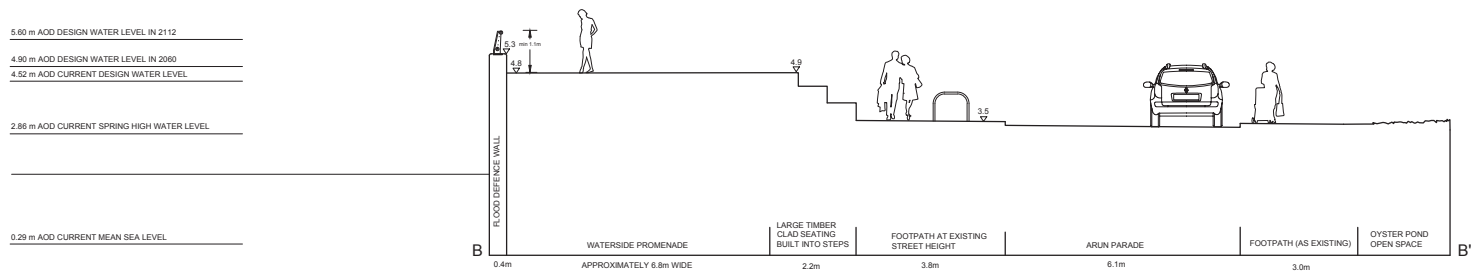
Drawing Scale: N/A

CAD Filename: Xis&SectionsSheets

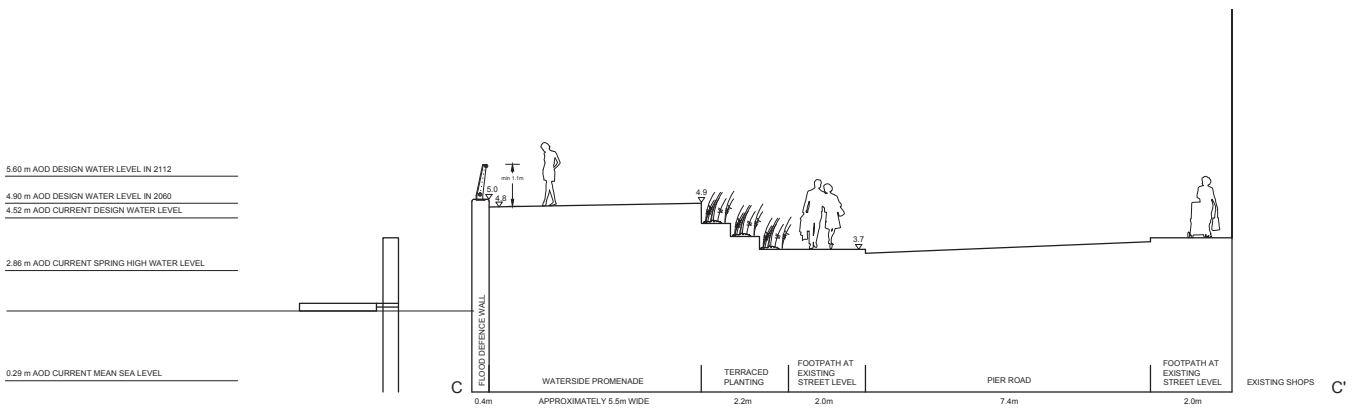
Plot Scale:



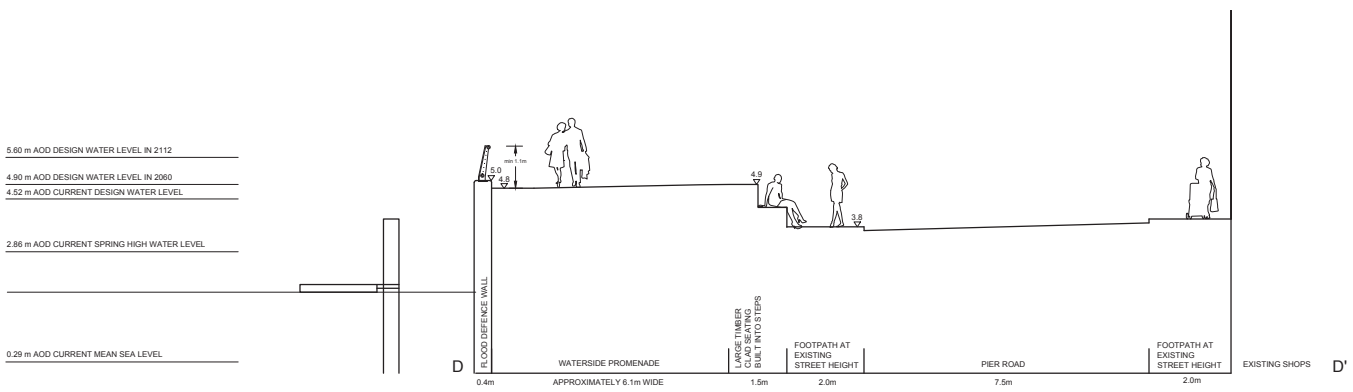
CROSS SECTION A -A'



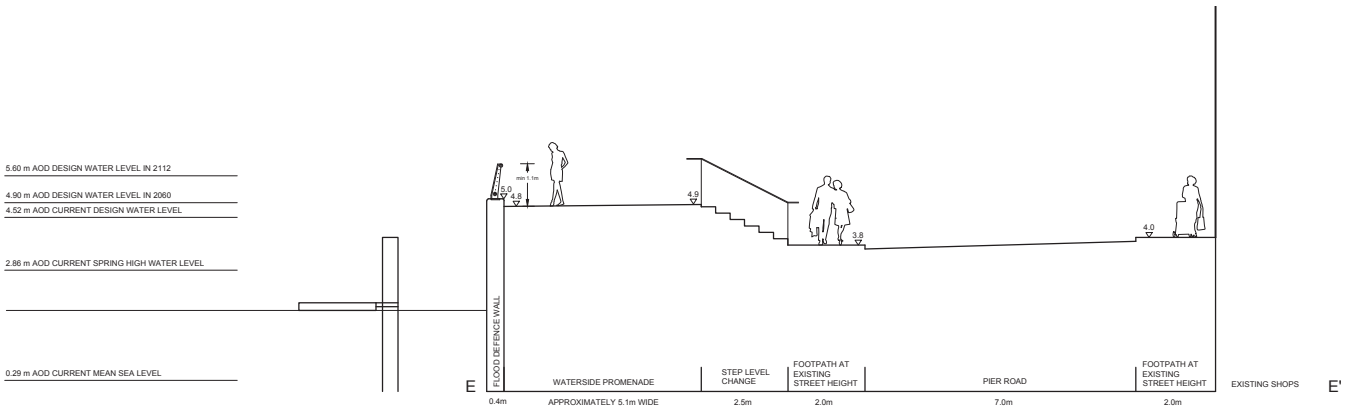
CROSS SECTION B- B'



CROSS SECTION C- C'



CROSS SECTION D- D'



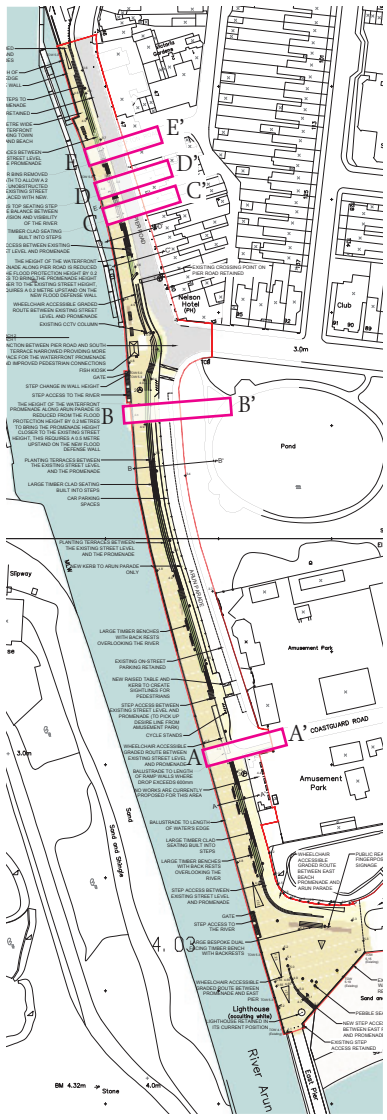
CROSS SECTION E -E'

PRELIMINARY

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.

CROSS SECTION LOCATIONS



Revision	By	Checked	Approved	Date	Description

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Griffin House, 135 High Street, Crawley, West Sussex, RH10 1DQ
Tel 01293 434500 Fax 01293 434599
www.halcrow.com

Halcrow

LDA Design
Kings Wharf, The Quay, Exeter, EX2 4AN
T: 01392 260 430
F: 01392 260 431

LDĀDESIGN

Project

LITTLEHAMPTON ARUN, EAST BANK LANDSCAPE AND PUBLIC REALM

Drawing

SECTION ELEVATIONS REACHES 1 AND 2

Drawn by	KB (LDA)	Date:	May 2013
Checked by	SJT (LDA)	Date:	May 2013
Authorised by	SJT (LDA)	Date:	May 2013

Drawing No. 3483_PL_106

Revision

Drawing Scale: 1:10 @A1

CAD Filename: 3483_Sections

Plot Scale:

REFER TO DWG 3483_PL_108

EXISTING FLOOD DEFENCE WALL.
(NO WORKS REQUIRED)

CLEAR WIDTH OF1250mm BETWEEN THE FRONT FACE OF THE EXISTING WORKSHOP AND THE PILE CAP TO ALLOW ROOM FOR PRIVATE ACCESS TO THE REINSTATED PONTOONS (FOR PONTOON AND ACCESS RISER DETAILS SEE DRAWING 463457-CIVIL-301-P1

THE INSIDE FACE OF BRITANNIA QUAY WALL TO BE EITHER BRICK CLAD OR WITH GLASS FLOOD WALL PANELS. THESE ARE INDICATIVE ONLY AND ARE SUBJECT TO DISCUSSION AND FINANCIAL CONTRIBUTIONS. OTHERWISE DETAIL TO BE AS THE WATERSIDE DEVELOPMENT

LADDERS (12 No.) AND GALVANISED STEEL HANDRAIL

GARDENS TO BE REINSTATED BY AGREEMENT WITH RESIDENTS/ OWNERS.

THE WATERSIDE - STEEL SHEET PILES WITH REINFORCED CONCRETE CAP TO +4.8m (WALL LENGTH APPROX. 90m) FINISH OF CONCRETE TO BE AGREED TO COMPLIMENT ADJACENT WALLS

REACH 03 - NO WORK REQUIRED

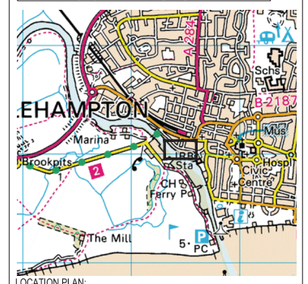
Works
Wharf
WORKSHOP
Works
RIVER ROAD
Mud
Britannia Quay
Mean High Water
ACCESS PATH
+ 4.8m TOW
+ 3.8m EGL
+ 3.6m EGL
+ 4.8m TOW
PROPERTIES AT BRITANNIA QUAY
PROPERTIES AT THE WATERSIDE
The Waterside
SMALLCROFT CLOSE
RIVER ARUN
Slipway
Landing Stage
Slipway
Landing Stage
Mud
Mud
3.0m
BM 3.54
PRELIMINARY
N

OVERALL DESIGN INTENT

The proposals for Reach 3 comprise a new section of steel sheet piled wall with a new reinforced concrete capping beam with an up stand wall. The existing ground levels are typically 3.6/3.8m AOD and the flood protection level is 4.8m. The wall lies in the vicinity of two residential blocks to River Road - Britannia Quay and The Waterside, as well as a workshop to the north. The proposals lie within the Conservation area, therefore will need to be sensitive to this context.

To the rear of the residential gardens the impact of the new river defence is to be mitigated locally through the use of appropriate brick cladding to the inside face of the concrete wall or glass floodwall panels within the wall in the vicinity of Britannia Quay to maintain garden and ground floor views to the river. The brick will be chosen to complement the adjacent red brick residential properties. The glass flood wall panels are indicative only and are subject to financial contributions; otherwise the detail will be the same as for the Waterside residential area. The gardens will be reinstated by consultation and agreement with residents and/or owners. No works are planned until year 20 in the southern part where the existing defences are adequate, when the existing concrete cap will be raised

NOTES:
1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.



LOCATION PLAN:

NEW FLOOD WALL- STEEL SHEET PILES WITH REINFORCED CONCRETE CAP

NEW FLOOD WALL- BRICK CLAD OR GLASS WALL PANELS

GARDENS TO BE REINSTATED BY AGREEMENT WITH OWNERS/ RESIDENTS.

FOR MORE INFORMATION AND ENGINEERING DETAILS REFER TO 463457-CIVIL-300, 301 AND 302

GLASS FLOODWALL PANELS FOR BRITANNIA QUAY ARE INDICATIVE ONLY AND ARE SUBJECT TO FINANCIAL CONTRIBUTIONS, OTHERWISE DETAIL TO BE AS THE WATERSIDE DEVELOPMENT.

Revision	By	Checked	Approved	Date	Description

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire. SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY
Halcrow

Project

LITTLEHAMPTON ARUN, EAST BANK LANDSCAPE AND PUBLIC REALM

Drawing

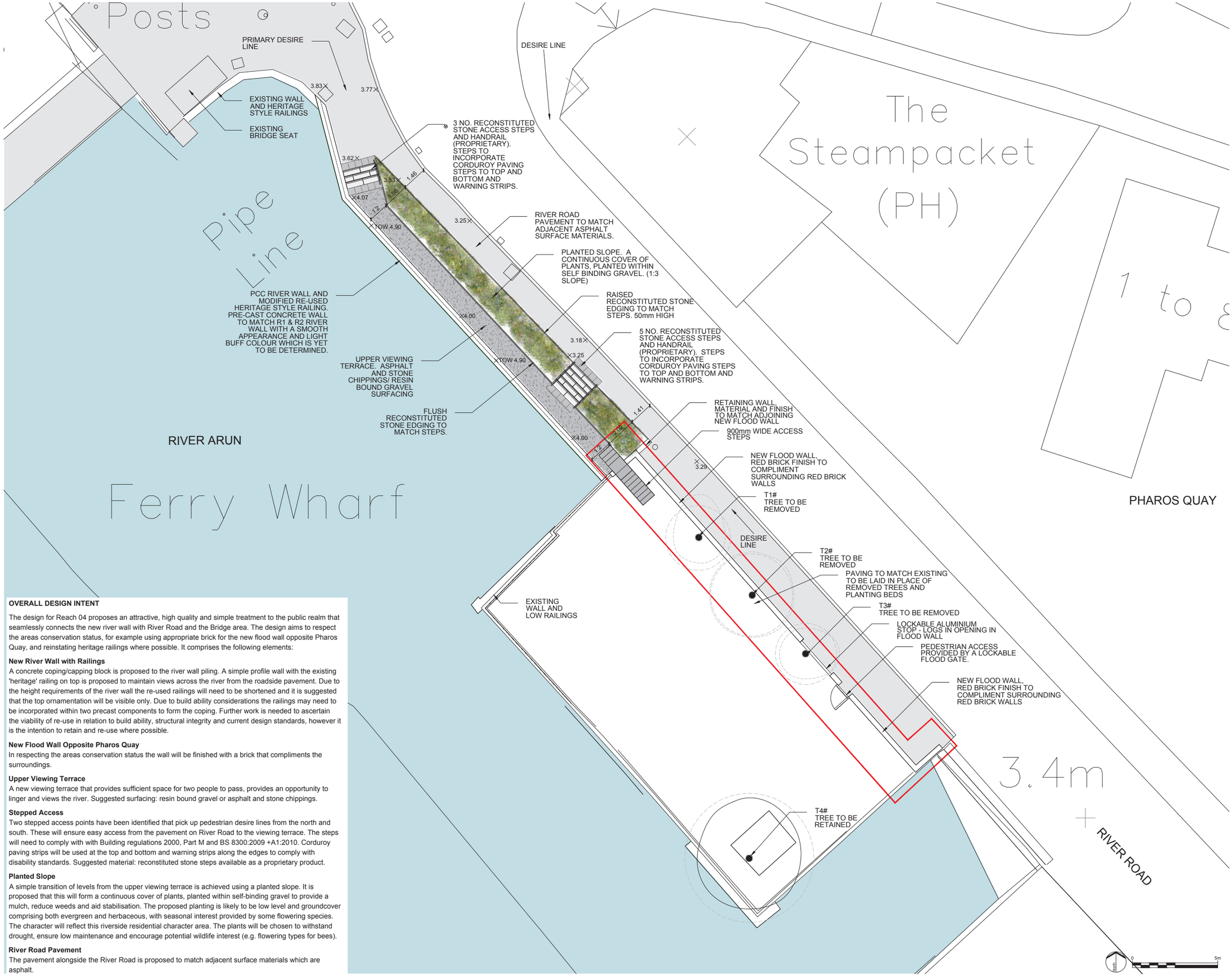
LANDSCAPE MASTERPLAN REACH 03

Drawn by	KB (LDA)	Date:	May 2013
Checked by	SJT (LDA)	Date:	May 2013
Authorised by	SJT (LDA)	Date:	May 2013

Drawing No. 3483_PL_107 | Revision

Drawing Scale: 1:200 @ A1

CAD Filename: 3483_Reach 3 and 5 Plan | Plot Scale:



OVERALL DESIGN INTENT

The design for Reach 04 proposes an attractive, high quality and simple treatment to the public realm that seamlessly connects the new river wall with River Road and the Bridge area. The design aims to respect the areas conservation status, for example using appropriate brick for the new flood wall opposite Pharos Quay, and reinstating heritage railings where possible. It comprises the following elements:

New River Wall with Railings

A concrete coping/capping block is proposed to the river wall piling. A simple profile wall with the existing 'heritage' railing on top is proposed to maintain views across the river from the roadside pavement. Due to the height requirements of the river wall the re-used railings will need to be shortened and it is suggested that the top ornamentation will be visible only. Due to build ability considerations the railings may need to be incorporated within two precast components to form the coping. Further work is needed to ascertain the viability of re-use in relation to build ability, structural integrity and current design standards, however it is the intention to retain and re-use where possible.

New Flood Wall Opposite Pharos Quay

In respecting the areas conservation status the wall will be finished with a brick that compliments the surroundings.

Upper Viewing Terrace

A new viewing terrace that provides sufficient space for two people to pass, provides an opportunity to linger and views the river. Suggested surfacing: resin bound gravel or asphalt and stone chippings.

Stepped Access

Two stepped access points have been identified that pick up pedestrian desire lines from the north and south. These will ensure easy access from the pavement on River Road to the viewing terrace. The steps will need to comply with with Building regulations 2000, Part M and BS 8300:2009 +A1:2010. Corduroy paving strips will be used at the top and bottom and warning strips along the edges to comply with disability standards. Suggested material: reconstituted stone steps available as a proprietary product.

Planted Slope

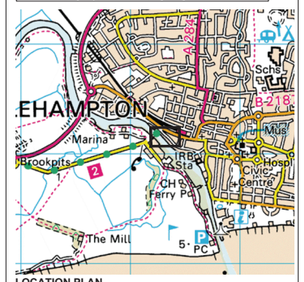
A simple transition of levels from the upper viewing terrace is achieved using a planted slope. It is proposed that this will form a continuous cover of plants, planted within self-binding gravel to provide a mulch, reduce weeds and aid stabilisation. The proposed planting is likely to be low level and groundcover comprising both evergreen and herbaceous, with seasonal interest provided by some flowering species. The character will reflect this riverside residential character area. The plants will be chosen to withstand drought, ensure low maintenance and encourage potential wildlife interest (e.g. flowering types for bees).

River Road Pavement

The pavement alongside the River Road is proposed to match adjacent surface materials which are asphalt.

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.



LOCATION PLAN

- PLANNING APPLICATION BOUNDARY
- TREES TO BE REMOVED. FOR FURTHER INFORMATION REFER TO RSP DRAWINGS JSL2151_701 & JSL2151_750
- PCC RIVER WALL AND MODIFIED RE-USED HERITAGE STYLE RAILINGS.
- NEW FLOOD WALL OPPOSITE PHAROS QUAY
- UPPER VIEWING TERRACE. ASPHALT AND STONE CHIPPINGS/ RESIN BOUND GRAVEL SURFACING
- CORDUROY PAVING STEPS
- RECONSTITUTED STONE ACCESS STEPS WITH WARNING STRIPS
- PROPRIETARY HANDRAILS
- PLANTED SLOPE
- RIVER ROAD PAVEMNT

NOTE: T1, T2 AND T3 TO BE REMOVED. REPLACEMENT PLANTING WILL BE PROVIDED AT THE REQUEST OF THE RESIDENTS

TO BE READ IN CONJUNCTION WITH 3483_PL_110 DETAILS REACH 04

REFER TO ENGINEERING DRAWINGS 463457-CIVIL-400-P2 AND 463457-CIVIL-401-P2 FOR DETAILS.

Revision	By	Checked	Aproved	Date	Description

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burdercop Park, Swindon, Wiltshire. SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089

www.halcrow.com

A CH2M HILL COMPANY

Halcrow

LDA Design
Kings Wharf, The Quay, Exeter, EX2 4AN
T: 01392 260 430
F: 01392 260 431

LDĀDESIGN

Project

EAST BANK, RIVER ARUN
LITTLEHAMPTON

Drawing

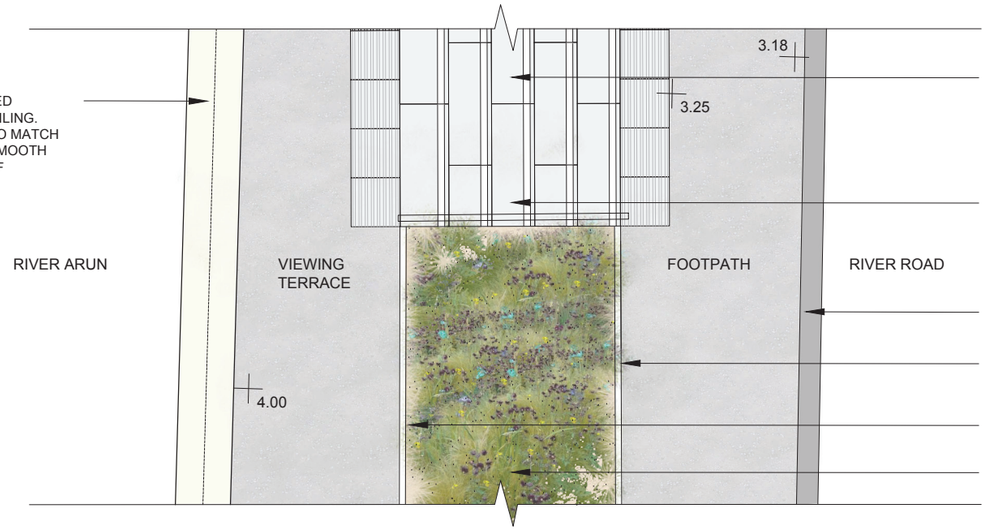
LANDSCAPE MASTERPLAN
REACH 04

Drawn by	KB (LDA)	Date:	May 2013
Checked by	SJT (LDA)	Date:	May 2013
Authorised by	SJT (LDA)	Date:	May 2013

Drawing No. 3483_PL_108 | Revision

Drawing Scale: 1:100 @A1

CAD Filename: 3483_Reach 4 Plan | Plot Scale:



PCC RIVER WALL AND MODIFIED RE-USED HERITAGE STYLE RAILING. PRE-CAST CONCRETE WALL TO MATCH R1 & R2 RIVER WALL WITH A SMOOTH APPEARANCE AND LIGHT BUFF COLOUR WHICH IS YET TO BE DETERMINED.

RECONSTITUTED STONE STEPS
350 X 150 X 1000MM, TOP STEP TO BE 400 X 150 X 1000MM, SQUARE PROFILE
SILVER GREY, LIGHTLY TEXTURED FINISH
WHITE VISIBILITY STRIP
SUPPLIER: MARSHALL'S OR OTHER EQUIVALENT AGREED

CONCRETE TACTILE CORDUROY PAVING
400 X 400 X 50MM. SQUARE EDGE PROFILE.
NATURAL, TEXTURED FINISH.
SUPPLIER: MARSHALL'S OR OTHER EQUIVALENT AGREED

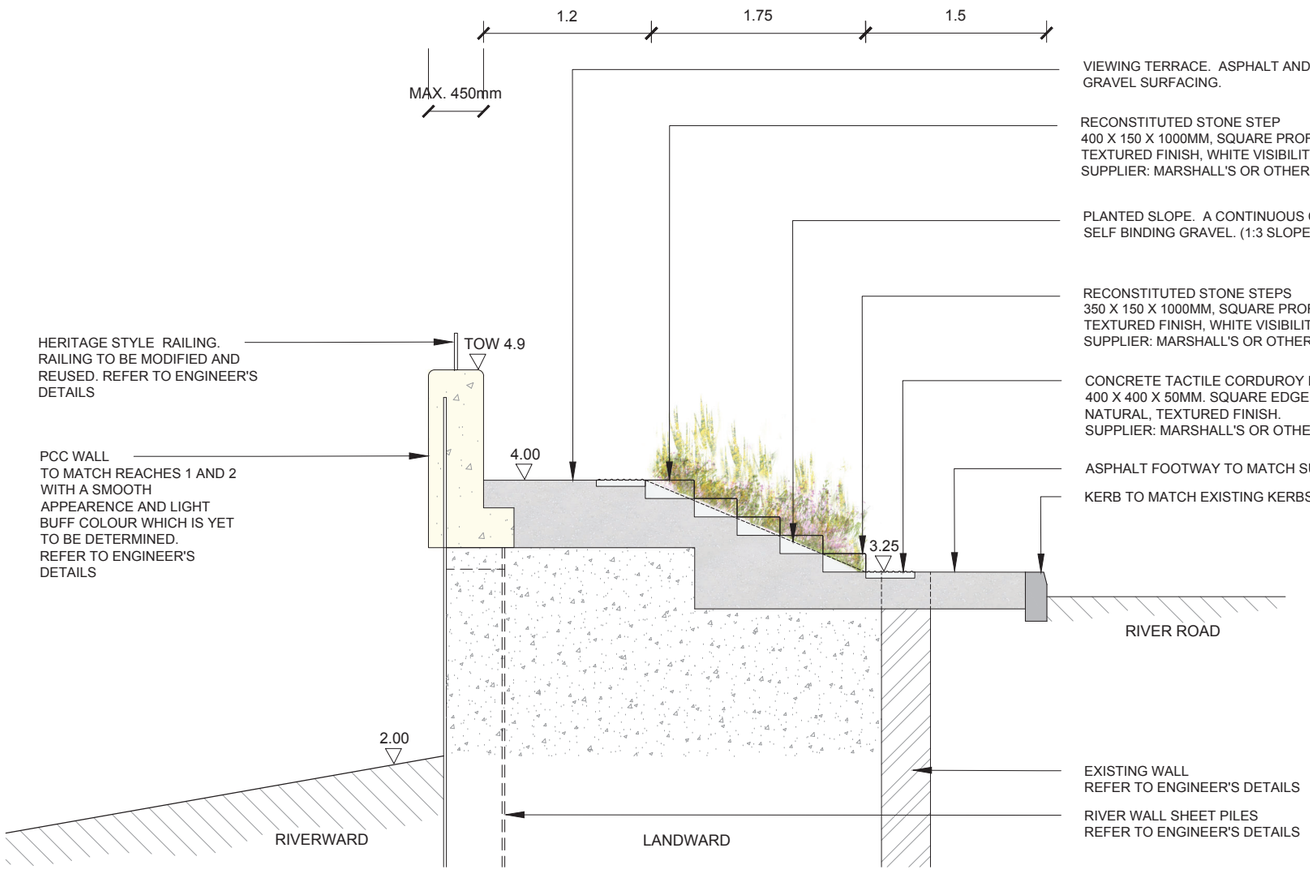
KERB TO MATCH EXISTING KERBS ALONG RIVER ROAD

RAISED RECONSTITUTED STONE EDGING TO MATCH STEPS. 50mm HIGH ALONG LANDWARD SIDE OF PLANTED SLOPE

FLUSH RECONSTITUTED STONE EDGING TO MATCH STEPS ALONG RIVERWARD SIDE OF PLANTED SLOPE

PLANTED SLOPE (1:3)
PROPOSED PLANTING TO BE LOW LEVEL AND GROUNDCOVER COMPRISING BOTH EVERGREEN AND HERBACEOUS, WITH SEASONAL INTEREST PROVIDED BY SOME FLOWERING SPECIES.

PLAN
(1:25 @ A1)



VIEWING TERRACE. ASPHALT AND STONE CHIPPINGS/ RESIN BOUND GRAVEL SURFACING.

RECONSTITUTED STONE STEP
400 X 150 X 1000MM, SQUARE PROFILE, SILVER GREY, LIGHTLY TEXTURED FINISH, WHITE VISIBILITY STRIP
SUPPLIER: MARSHALL'S OR OTHER EQUIVALENT AGREED

PLANTED SLOPE. A CONTINUOUS COVER OF PLANTS, PLANTED WITHIN SELF BINDING GRAVEL. (1:3 SLOPE)

RECONSTITUTED STONE STEPS
350 X 150 X 1000MM, SQUARE PROFILE, SILVER GREY, LIGHTLY TEXTURED FINISH, WHITE VISIBILITY STRIP
SUPPLIER: MARSHALL'S OR OTHER EQUIVALENT AGREED

CONCRETE TACTILE CORDUROY PAVING
400 X 400 X 50MM. SQUARE EDGE PROFILE.
NATURAL, TEXTURED FINISH.
SUPPLIER: MARSHALL'S OR OTHER EQUIVALENT AGREED

ASPHALT FOOTWAY TO MATCH SURROUNDING SURFACING

KERB TO MATCH EXISTING KERBS ALONG RIVER ROAD

HERITAGE STYLE RAILING. RAILING TO BE MODIFIED AND REUSED. REFER TO ENGINEER'S DETAILS

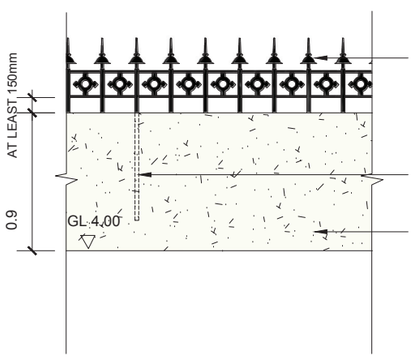
PCC WALL
TO MATCH REACHES 1 AND 2 WITH A SMOOTH APPEARENCE AND LIGHT BUFF COLOUR WHICH IS YET TO BE DETERMINED. REFER TO ENGINEER'S DETAILS

EXISTING WALL
REFER TO ENGINEER'S DETAILS

RIVER WALL SHEET PILES
REFER TO ENGINEER'S DETAILS

TYPICAL SECTION
(1:25 @ A1)

NOTE: FURTHER WORK IS NEEDED TO ASCERTAIN THE VIABILITY OF RE-USE IN RELATION TO BUILD ABILITY, STRUCTURAL INTEGRITY AND CURRENT DESIGN STANDARDS, HOWEVER IT IS THE INTENTION TO RETAIN AND RE-USE WHERE POSSIBLE.



EXISTING RAILINGS MODIFIED (SHORTENED) AND FIXED WITHIN/ TO WALL. RAILINGS TO HAVE AT LEAST A 15mm VERTICAL STRUT. (EXTENTS AND FIXING TBC)

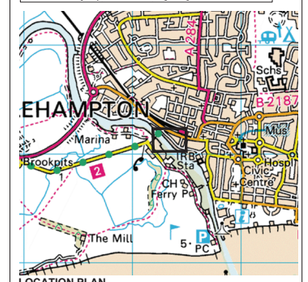
APPROXIMATE SIZE OF ORIGINAL RAILINGS TO BE SHORTENED.

PCC RIVER WALL
REFER TO ENGINEER'S DETAILS

MODIFIED AND RE-USED HERITAGE STYLE RAILINGS ELEVATION
(1:20 @ A1)

0 5m

NOTES:
1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.



LOCATION PLAN

TO BE READ IN CONJUNCTION WITH LANDSCAPE MASTERPLAN REACH 04
REFER TO ENGINEERING DRAWINGS 463457-CIVIL-400-P2 AND 463457-CIVIL-401-P2 FOR ADDITIONAL DETAILS.

Revision	By	Checked	Approved	Date	Description

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY
Halcrow

LDA Design
Kings Wharf, The Quay, Exeter, EX2 4AN
T: 01392 260 430
F: 01392 260 431
LDĀDESIGN

Project

LITTLEHAMPTON ARUN, EAST BANK LANDSCAPE AND PUBLIC REALM

Drawing

DETAILS
REACH 04

Drawn by	KB (LDA)	Date:	May 2013
Checked by	SJT (LDA)	Date:	May 2013
Authorised by	SJT (LDA)	Date:	May 2013

Drawing No. 3483_PL_109 Revision

Drawing Scale: As Shown

CAD Filename: 3483_Reach 4 Plan Plot Scale:

'D (400mm HIGH)
'EL +4.40m OD

REFER TO DWG 3483_PL_111

NEW CONCRETE RETURN WALL c2300. SEE DRAWING 463457/ CIVIL/ 500 FOR DETAILS. FINISH TBC

EXISTING PATIO REINSTATED AS REQUIRED

ARUN VIEW PUBLIC HOUSE PATIO

ARUN VIEW PUBLIC HOUSE CAR PARK

+ 4.8m FLOOD PROTECTION LEVEL

c17500 GLASS FLOODWALL

NEW TIMBER STEPS AND LANDING TO EXISTING PONTOON

EXISTING PATIO + 3.90

EXISTING 4.13+ LANDING

NEW FLOODWALL + 4.81

c7800 CONCRETE FLOODWALL FINISH TBC

+ 4.8m FLOOD PROTECTION LEVEL

c18000 GLASS FLOODWALL

RIVER ARUN

El Sub Sta

WHARF ROAD

The Arun View Inn (PH)

ARUN VIEW PUBLIC HOUSE

ROOF AREA OF EXTENSION MAY BE RE-BUILT FOLLOWING FLOOD DEFENSE WORKS

+ 3.8m PROPOSED PUB FLOOR LEVEL

EXISTING PATIO AREA

EXISTING BRICK WALL AND GLASS BALUSTRADE

FACADE OF PUB TO BE DEMOLISHED AND REPLACED WITH ENGINEERING BRICKS/ GLASS FLOODWALL. COMPLETED WORKS WILL BE VISUALLY SIMILAR TO EXISTING. TO BE AGREED WITH PUB OWNERS

REFER TO DWG 3483_PL_108

Landing Stage

River Arun

Mud

MPs

Posts

Pipe Line

N

PRELIMINARY

OVERALL DESIGN INTENT

Proposals for Reach 5 sit within an existing Conservation Area and the Arun View Public house is a locally listed building, Therefore, the design approach is to incorporate the river flood defence as sensitively as possible and maintain views to the river. Therefore, long sections of glass floodway panels are proposed to balance the needs of the flood defence, mitigate visual intrusion of walling and maintain views to the river from customers using the pub and from the river towards this locally distinctive building. Use of the glass panels also compliments the existing glass balustrade to the eastern patio area. The height of the waterfront floodway panels will need to be 1.1m for health and safety. The glass will be specified with a self-cleaning film that requires minimal maintenance. The pub owners/landlords have been consulted with on the proposals

For flood protection/wall levels and adjacent pedestrian levels refer to 463457/Civil/501. The concrete finish for the concrete return wall is still to be determined. However, the design intention is to compliment adjacent concrete walling and the adjacent public house. In the vicinity of the patio area a set back wall was not considered by the Engineer's for technical reasons (it is not feasible without flood gates).

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.

LOCATION PLAN:

ALIGNMENT OF EXISTING CONCRETE WALL TO NORTH

NEW FLOOD WALL ALIGNMENT

FOR MORE INFORMATION AND ENGINEERING DETAILS REFER TO 463457-CIVIL-500-P2 AND 463457-CIVIL-501-P2

TO BE READ IN CONJUNCTION WITH 3483_PL_111 LANDSCAPE MASTERPLAN REACH 05 SHEET 02.

Revision	By	Checked	Approved	Date	Description

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY

LDA Design
Kings Wharf, The Quay, Exeter, EX2 4AN
T: 01392 260 430
F: 01392 260 431

Project

LITTLEHAMPTON ARUN, EAST BANK LANDSCAPE AND PUBLIC REALM

Drawing

LANDSCAPE MASTERPLAN REACH 05A SHEET 1 OF 2

Drawn by	KB (LDA)	Date:	May 2013
Checked by	SJT (LDA)	Date:	May 2013
Authorised by	SJT (LDA)	Date:	May 2013

Drawing No. 3483_PL_110 | Revision

Drawing Scale: 1:150 @ A1

CAD Filename: 3483_Reach 3 and 5 Plan | Plot Scale:

REFER TO DWG 3483_PL_112

GRAVEL MOUNDS TO INDUSTRIAL WORKS

NEW REINFORCED CONCRETE UPSTAND

EXISTING REINFORCED CONCRETE BLOCK

Bollards

Mud

+ 4.4m TOW

Bollards

Wharf

Wharf

EXISTING REINFORCED CONCRETE CAPPING BEAM

RAILWAY WHARF
PROVIDE PRECAST UPSTAND (400mm HIGH) TO FLOOD PROTECTION LEVEL +4.40m OD

EXISTING BOLLARD TO BE RETAINED

UMA WHARF
PROVIDE PRECAST UPSTAND (400mm HIGH) TO FLOOD PROTECTION LEVEL +4.40m OD

REFER TO DRAWING BELOW

RAILWAY WHARF
PROVIDE PRECAST UPSTAND (400mm HIGH)
TO FLOOD PROTECTION LEVEL +4.40m OD

REFER TO DRAWING ABOVE

EXISTING BOLLARD TO BE RETAINED

RAISE EXISTING CONCRETE WALL WITH ADDITIONAL 400mm CONCRETE ENSURING LINKAGE TO PUB WALL. CONCRETE FINISH TO BE AGREED. FINISH TO COMPLIMENT ADJACENT WALLS.

Travelling

Moorin

Posts

Wharf

RAILWAY WHARF
PROVIDE PRECAST UPSTAND (400mm HIGH)
TO FLOOD PROTECTION LEVEL +4.40m OD

NEW REINFORCED CONCRETE CAPPING BEAM
DOWELLED INTO EXISTING CAPPING BEAM

EXISTING REINFORCED CONCRETE BLOCK

+ 4.4m TOW

Mean High Water

LHB YARD

PROVIDE PRECAST UPSTAND (400mm HIGH)
TO FLOOD PROTECTION LEVEL +4.40m OD

WB

REFER TO DWG 3483_PL_110

OVERALL DESIGN INTENT

The design approach for Reach 5 (B) in the area of the existing wharfs is a low impact intervention that provides a cost effective solution to maintain the standard of defence in the context of the existing open area of gravel to the industrial works. To utilise the remaining residual life of the existing structures without impacting on port operations, a phased approach has been taken with the wharfs. Most of the length of the proposed 400mm high concrete up stand wall is independent of the quay edge to minimise impact on the wharf furniture (bollards, fenders, ladders etc.) and its operation. Concrete mix design and finish still to be determined, to compliment adjacent materials and walling.

N

PRELIMINARY

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.

LOCATION PLAN:

NEW REINFORCED CONCRETE UPSTAND (400mm HIGH) TO FLOOD PROTECTION LEVEL +4.40m OD

FOR MORE INFORMATION AND ENGINEERING DETAILS REFER TO 463457-CIVIL-550 AND 463457-CIVIL-560-P1

TO BE READ IN CONJUNCTION WITH 3483_PL_110 LANDSCAPE MASTERPLAN REACH 05 SHEET 01.

Revision	By	Checked	Approved	Date	Description

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY
Halcrow

LDA Design
Kings Wharf, The Quay, Exeter, EX2 4AN
T: 01392 260 430
F: 01392 260 431
LDĀDESIGN

Project

LITTLEHAMPTON ARUN, EAST BANK LANDSCAPE AND PUBLIC REALM

Drawing

LANDSCAPE MASTERPLAN
REACH 05B
SHEET 2 OF 2

Drawn by	KB (LDA)	Date:	May 2013
Checked by	SJT (LDA)	Date:	May 2013
Authorised by	SJT (LDA)	Date:	May 2013

Drawing No. 3483_PL_111 | Revision

Drawing Scale: 1:200 @ A1

CAD Filename: 3483_Reach 3 and 5 Plan | Plot Scale:

OVERALL DESIGN INTENT

The design for Reach 6 focuses on re-establishing bio-diveristy and ecological richness into the area. Working with the flood defence scheme, the proposals look to mitigate against the impact of the adjacent A259, introduce new areas for wildlife along the River Arun, and retain where possible existing habitats and vegetation. The main elements of the scheme are:

New Native Trees and Native Understorey Planting

Located along the embankment of the A259, Native trees will be planted at regular intervals to screen views of the A259. Understorey planting will also be planted along the entirety of the embankment to aid in mitigating against noise and screening. Native species/ species local to the area are to be planted, this will ensure the current character of the area is retained.

Grass Seed Mixes to Embankment

The grass seed mixes specified within the scheme have been chosen to be native to the UK and of local provenance where possible. The two mixes have been chosen to grow in the different conditions within the scheme i.e. the harsher and wetter conditions of the riverward embankment side and the more sheltered landward side. The wildflower mix to be used on the landward side of the embankment has been chosen to encourage butterflies and bees into the scheme whilst providing seasonal interest and colour.

Grass Seed Mixes to Groynes

To enhance the appearance and protection of the existing flood embankments, additional scour protection is to be added to the surface. On top of the new Open Stone Asphalt a 100mm layer of topsoil is to be added with an even coverage of Coastal Grass Seed Mix. Once the grass is fully established the groynes will appear as green banks along the rivers edge.

Additional Topsoil along Southern Sheet Pile Wall

The topsoil along the proposed sheet pile wall in the southern area of the scheme is to be raised to within 200mm of the top of the wall. By doing this the views of the sheet piling will be vastly reduced along this stretch of the River Arun. Topsoil will also be brushed into the new OSA surfacing along this stretch. This will allow vegetation to establish within the OSA a merge into the grasses above. A coastal grass seed mix is to also be added to aid in the regeneration of this area.

WILDFLOWER GRASS SEED MIX

SPECIES	%
Hard Fescue	25
Sheeps Fescue	20
Chewings Fescue	15
Slender Creeping Red Fescue	15
Brown top Bent	5
Ox-eye Daisy	2
White Melliot	1
Yarrow	1
Kidney Vetch	1
Cornflower	1
Common Knapweed	1
Greater Knapweed	1
Lady's Oat Grass	1
Tufted Vetch	1
Common Vetch	0.75
Garlic Mustard	0.75
Foxglove	0.5
Teasel	0.5
Field Scabious	0.5
Musk Mallow	0.5
Cowslip	0.5
Red Clover	0.5
Cow Parsley	0.5
Meadow Cranesbill	0.25
Marjoram	0.25
Small Scabious	0.25
Dandelion	0.25

To be sown at 5g/m2

COASTAL GRASS SEED MIX

SPECIES	%
Perennial Rye Grass	20
Slender Red Fescue	40
Hard Fescue	15
Smooth Stalked Meadow Grass	12
Sea Couch Grass	8
Creeping Bent	3
Brown Top Bent	2

To be sown at 8g/m2

INTER-TIDAL HABITATS

ADVERSE IMPACTS ON INTER-TIDAL HABITATS (SALTMARSH, INTER-TIDAL MUDFLATS, BRACKISH WATER AND COASTAL GRASSLAND) WILL BE MITIGATED BY MEANS OF SENSITIVE WORKING.

ANY LONG TERM LOSS OF INTER-TIDAL HABITAT ALONG THE SCHEME WILL BE COMPENSATED BY CREATING HABITAT IN THE REACH 6 REALIGNMENT. SEE TABLE IN SECTION 7.4 OF ENVIRONMENTAL STATEMENT FOR ESTIMATED HABITAT LOSSES AND GAINS RESULTING FROM THE SCHEME.

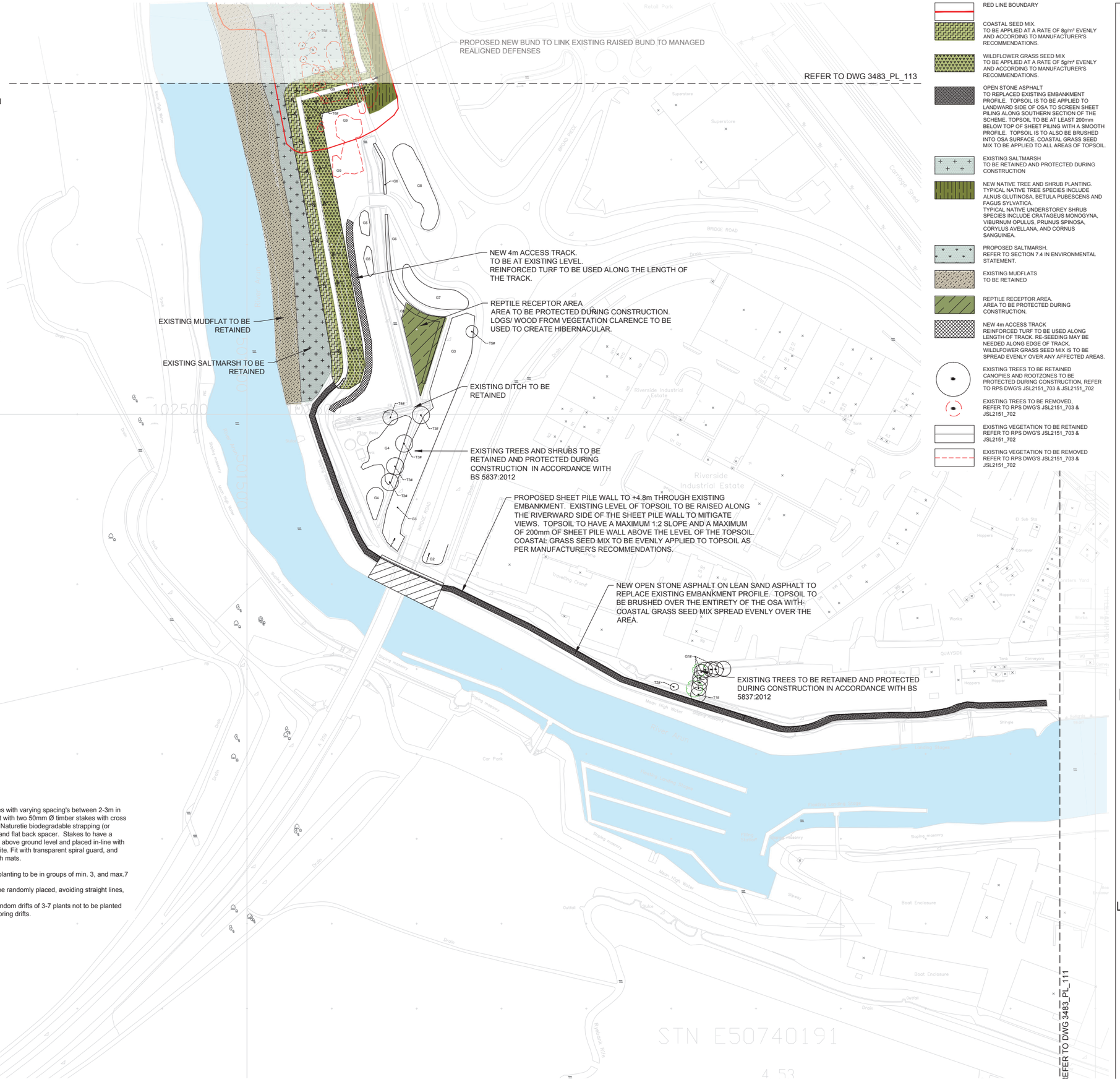
MONITORING SURVEYS OF THE REALIGNED SALTMARSH WILL BE CARRIED OUT OVER A PERIOD OF 1, 3 AND 5 YEARS POST WORKS, WHICH WILL MEAN SURVEYS BEING COMPLETED IN 2015, 2017 AND 2019.

ROAD EMBANKMENT PLANTING MIX

CANOPY SPECIES	NAME	SIZE	%
Alnus *glutinosa*	Alder	14-16cm	10
Betula *pubescens*	Downy Birch	10-12cm	15
Fagus *sylvatica*	Beech	14-16cm	10
Populus *tremula*	Aspen	14-16cm	5
Carpinus *betulus*	Hornbeam	10-12cm	5
Salix fragilis	Crack Wilow	10-12cm	5
UNDERSTOREY SPECIES			
Crataegus *monogyna*	Hawthorn	60-80cm	10
Viburnum *opulus*	Guelder Rose	60-80cm	5
Prunus *spinosa*	Blackthorn	60-90cm	5
Corylus *avellana*	Hazel	60-90cm	10
Cornus *sanguinea*	Dogwood	60-90cm	5
Sambucus *nigra*	Elder	3L	3
Ilex *aquifolium*	Holly	3L	5
Salix *cinerea*	Grey Willow	60-80cm	7

Plant canopy species with varying spacing's between 2-3m in groups of 3 or 5. Fit with two 50mm Ø timber stakes with cross strut and Greenleaf Naturetie biodegradable strapping (or equivalent agreed) and flat back spacer. Stakes to have a minimum of 500mm above ground level and placed in-line with prevailing wind on site. Fit with transparent spiral guard, and biodegradable mulch mats.

Understorey shrub planting to be in groups of min. 3, and max.7 with the densities
shown. Species to be randomly placed, avoiding straight lines, within 1m of edge
of planting area. Random drifts of 3-7 plants not to be planted parallel with neighboring drifts.



RED LINE BOUNDARY

COASTAL SEED MIX.
TO BE APPLIED AT A RATE OF 8g/m² EVENLY AND ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.

WILDFLOWER GRASS SEED MIX
TO BE APPLIED AT A RATE OF 5g/m² EVENLY AND ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.

OPEN STONE ASPHALT
TO REPLACED EXISTING EMBANKMENT PROFILE. TOPSOIL IS TO BE APPLIED TO LANDWARD SIDE OF OSA TO SCREEN SHEET PILING ALONG SOUTHERN SECTION OF THE SCHEME. TOPSOIL TO BE AT LEAST 200mm BELOW TOP OF SHEET PILING WITH A SMOOTH PROFILE. TOPSOIL IS TO ALSO BE BRUSHED INTO OSA SURFACE. COASTAL GRASS SEED MIX TO BE APPLIED TO ALL AREAS OF TOPSOIL.

EXISTING SALTMARSH
TO BE RETAINED AND PROTECTED DURING CONSTRUCTION

NEW NATIVE TREE AND SHRUB PLANTING.
TYPICAL NATIVE TREE SPECIES INCLUDE ALNUS GLUTINOSA, BETULA PUBESCENS AND FAGUS SYLVATICA.
TYPICAL NATIVE UNDERSTOREY SHRUB SPECIES INCLUDE CRATAGEUS MONOGYNA, VIBURNUM OPULUS, PRUNUS SPINOSA, CORYLUS AVELLANA, AND CORNUS SANGUINEA.

PROPOSED SALTMARSH.
REFER TO SECTION 7.4 IN ENVIRONMENTAL STATEMENT.

EXISTING MUDFLATS
TO BE RETAINED

REPTILE RECEPTOR AREA.
AREA TO BE PROTECTED DURING CONSTRUCTION.

NEW 4m ACCESS TRACK
REINFORCED TURF TO BE USED ALONG LENGTH OF TRACK. RE-SEEDING MAY BE NEEDED ALONG EDGE OF TRACK.
WILDFLOWER GRASS SEED MIX IS TO BE SPREAD EVENLY OVER ANY AFFECTED AREAS.

EXISTING TREES TO BE RETAINED
CANOPIES AND ROOTZONES TO BE PROTECTED DURING CONSTRUCTION, REFER TO RPS DWG'S JSL2151_703 & JSL2151_702

EXISTING TREES TO BE REMOVED,
REFER TO RPS DWG'S JSL2151_703 & JSL2151_702

EXISTING VEGETATION TO BE RETAINED
REFER TO RPS DWG'S JSL2151_703 & JSL2151_702

EXISTING VEGETATION TO BE REMOVED
REFER TO RPS DWG'S JSL2151_703 & JSL2151_702

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.

LOCATION PLAN:

TO BE READ IN CONJUNCTION WITH DWG 3483_PL_113 LANDSCAPE MASTERPLAN REACH 6 SHEET 02

REFER TO ENGINEER'S DETAILS 463457-CIVIL-600-P3, 463457-CIVIL-601-P3, 463457-CIVIL-602-P2, 463457-CIVIL-603-P2 AND 463457-CIVIL-604-P2

Revision	By	Checked	Approved	Date	Description

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire. SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY

LDA Design
Kings Wharf, The Quay, Exeter, EX2 4AN
T: 01392 260 430
F: 01392 260 431

Project

LITTLEHAMPTON ARUN, EAST BANK LANDSCAPE AND PUBLIC REALM

Drawing

LANDSCAPE MASTERPLAN
REACH 6
SHEET 1 OF 2

Drawn by	KB (LDA)	Date:	May 2013
Checked by	SJT (LDA)	Date:	May 2013
Authorised by	SJT (LDA)	Date:	May 2013

Drawing No. 3483_PL_112 Revision

Drawing Scale: 1:1000 @ A1

CAD Filename: 3483_Reach 6 Plan Plot Scale:

0 50m

OVERALL DESIGN INTENT

The design for Reach 6 focuses on re-establishing bio-diveristy and ecological richness into the area. Working with the flood defense scheme, the proposals look to mitigate against the impact of the adjacent A259, introduce new areas for wildlife along the River Arun, and retain where possible existing habitats and vegetation. The main elements of the scheme are:

New Native Trees and Native Understorey Planting

Located along the embankment of the A259, Native trees will be planted at regular intervals to screen views of the A259. Understorey planting will also the planted along the entirety of the embankment to aid in mitigating against noise and screening. Native species/ species local to the area are to be planted, this will ensure the current character of the area is retained.

Grass Seed Mixes to Embankment

The grass seed mixes specified within the scheme have been chosen to be native to the UK and of local provenance where possible. The two mixes have been chosen to grow in the different conditions within the scheme i.e. the harsher and wetter conditions of the riverward embankment side and the more sheltered landward side. The wildflower mix to be used on the landward side of the embankment has been chosen to encourage butterflies and bees into the scheme whilst providing seasonal interest and colour.

Grass Seed Mixes to Groynes

To enhance the appearance and protection of the existing flood embankments, additional scour protection is to be added to the surface. On top of the new Open Stone Asphalt a brushed layer of topsoil is to be added with an even coverage of Coastal Grass Seed Mix. Once the grass is fully established the groynes will appear as green banks along the rivers edge.

Additional Topsoil along Southern Sheet Pile Wall

The topsoil along the proposed sheet pile wall in the southern area of the scheme is to be raised to within 200mm of the top of the wall. By doing this the views of the sheet piling will be vastly reduced along this stretch of the River Arun. Topsoil will also be brushed into the new OSA surfacing along this stretch. This will allow vegetation to establish within the OSA a merge into the grasses above. A coastal grass seed mix is to also be added to aid in the regeneration of this area.

WILDFLOWER GRASS SEED MIX

SPECIES	%
Hard Fescue	25
Sheeps Fescue	20
Chewings Fescue	15
Slender Creeping Red Fescue	15
Brown top Bent	5
Ox-eye Daisy	2
White Melliot	1
Yarrow	1
Kidney Vetch	1
Cornflower	1
Common Knapweed	1
Greater Knapweed	1
Lady's Oat Grass	1
Tufted Vetch	1
Common Vetch	0.75
Garlic Mustard	0.75
Foxglove	0.5
Teasel	0.5
Field Scabious	0.5
Musk Mallow	0.5
Cowslip	0.5
Red Clover	0.5
Cow Parsley	0.5
Meadow Cranesbill	0.25
Marjoram	0.25
Small Scabious	0.25
Dandelion	0.25

To be sown at 5g/m2

COASTAL GRASS SEED MIX

SPECIES	%
Perennial Rye Grass	20
Slender Red Fescue	40
Hard Fescue	15
Smooth Stalked Meadow Grass	12
Sea Couch Grass	8
Creeping Bent	3
Brown Top Bent	2

To be sown at 8g/m2

INTER-TIDAL HABITATS

ADVERSE IMPACTS ON INTER-TIDAL HABITATS (SALTMARSH, INTER-TIDAL MUDFLATS, BRACKISH WATER AND COASTAL GRASSLAND) WILL BE MITIGATED BY MEANS OF SENSITIVE WORKING.

ANY LONG TERM LOSS OF INTER-TIDAL HABITAT ALONG THE SCHEME WILL BE COMPENSATED BY CREATING HABITAT IN THE REACH 6 REALIGNMENT. SEE TABLE IN SECTION 7.4 OF ENVIRONMENTAL STATEMENT FOR ESTIMATED HABITAT LOSSES AND GAINS RESULTING FROM THE SCHEME.

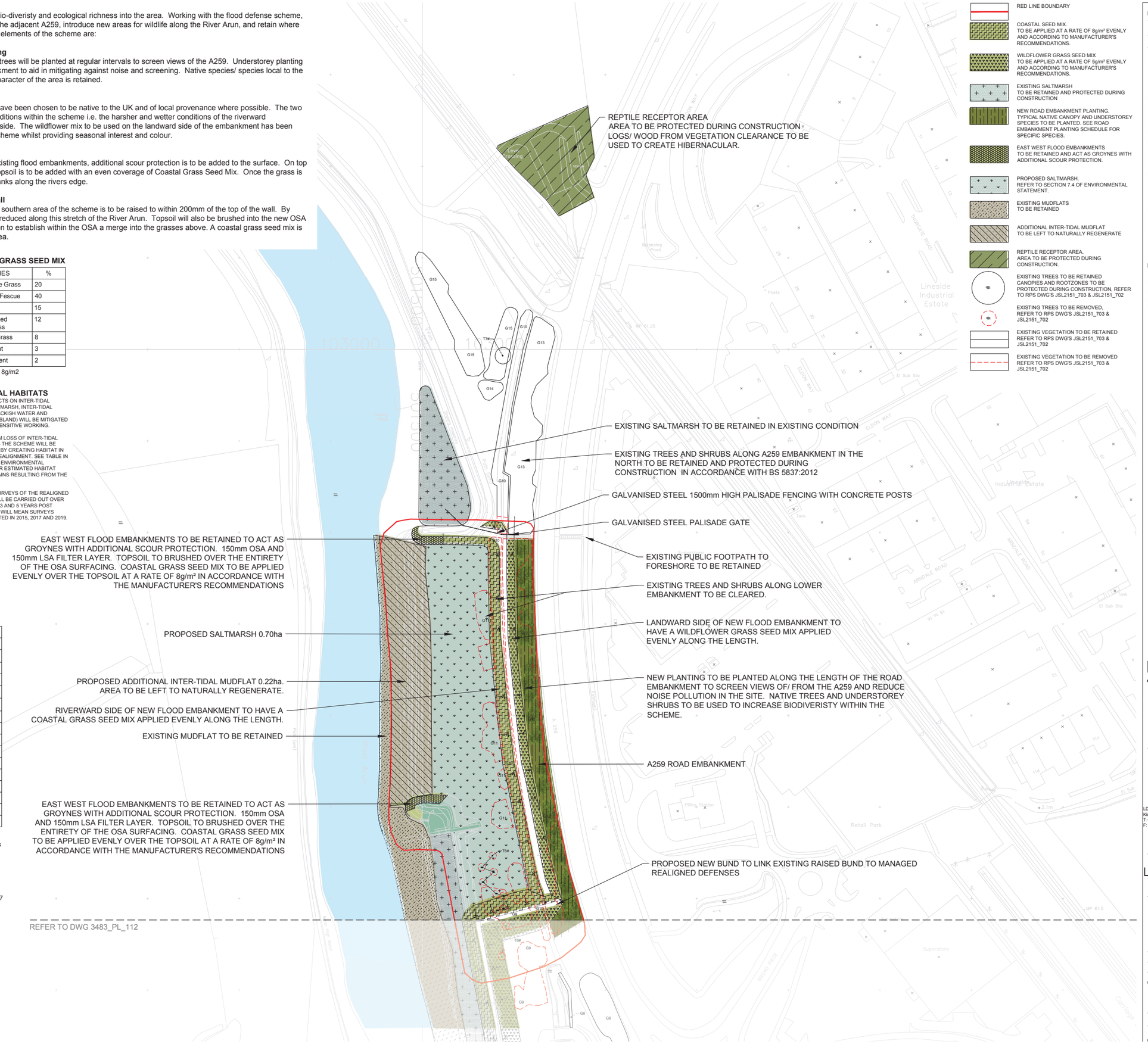
MONITORING SURVEYS OF THE REALIGNED SALTMARSH WILL BE CARRIED OUT OVER A PERIOD OF 1, 3 AND 5 YEARS POST WORKS, WHICH WILL MEAN SURVEYS BEING COMPLETED IN 2015, 2017 AND 2019.

ROAD EMBANKMENT PLANTING MIX

CANOPY SPECIES	NAME	SIZE	%
Alnus *glutinosa*	Alder	14-16cm	10
Betula *pubescens*	Downy Birch	10-12cm	15
Fagus *sylvatica*	Beech	14-16cm	10
Populus *tremula*	Aspen	14-16cm	5
Carpinus *betulus*	Hornbeam	10-12cm	5
Salix fragilis	Crack Wilow	10-12cm	5
UNDERSTOREY SPECIES			
Crataegeus *monogyna*	Hawthorn	60-80cm	10
Viburnum *opulus*	Guelder Rose	60-80cm	5
Prunus *spinosa*	Blackthorn	60-90cm	5
Corylus *avellana*	Hazel	60-90cm	10
Cornus *sanguinea*	Dogwood	60-90cm	5
Sambucus *nigra*	Elder	3L	3
Ilex *aquifolium*	Holly	3L	5
Salix *cinerea*	Grey Willow	60-80cm	7

Plant canopy species with varying spacing's between 2-3m in groups of 3 or 5. Fit with two 50mm Ø timber stakes with cross strut and Greenleaf Naturetie biodegradable strapping (or equivalent agreed) and flat back spacer. Stakes to have a minimum of 500mm above ground level and placed in-line with prevailing wind on site. Fit with transparent spiral guard, and biodegradable mulch mats.

Understorey shrub planting to be in groups of min. 3, and max.7 with the densities
shown. Species to be randomly placed, avoiding straight lines, within 1m of edge
of planting area. Random drifts of 3-7 plants not to be planted parallel with neighboring drifts.



RED LINE BOUNDARY

COASTAL SEED MIX.
TO BE APPLIED AT A RATE OF 8g/m² EVENLY AND ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.

WILDFLOWER GRASS SEED MIX
TO BE APPLIED AT A RATE OF 5g/m² EVENLY AND ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.

EXISTING SALTMARSH
TO BE RETAINED AND PROTECTED DURING CONSTRUCTION

NEW ROAD EMBANKMENT PLANTING.
TYPICAL NATIVE CANOPY AND UNDERSTOREY SPECIES TO BE PLANTED. SEE ROAD EMBANKMENT PLANTING SCHEDULE FOR SPECIFIC SPECIES.

EAST WEST FLOOD EMBANKMENTS
TO BE RETAINED AND ACT AS GROYNES WITH ADDITIONAL SCOUR PROTECTION.

PROPOSED SALTMARSH.
REFER TO SECTION 7.4 OF ENVIRONMENTAL STATEMENT.

EXISTING MUDFLATS
TO BE RETAINED

ADDITIONAL INTER-TIDAL MUDFLAT
TO BE LEFT TO NATURALLY REGENERATE

REPTILE RECEPTOR AREA.
AREA TO BE PROTECTED DURING CONSTRUCTION.

EXISTING TREES TO BE RETAINED
CANOPIES AND ROOTZONES TO BE PROTECTED DURING CONSTRUCTION, REFER TO RPS DWG'S JSL2151_703 & JSL2151_702

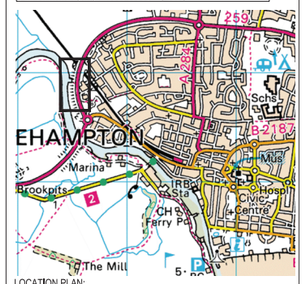
EXISTING TREES TO BE REMOVED,
REFER TO RPS DWG'S JSL2151_703 & JSL2151_702

EXISTING VEGETATION TO BE RETAINED
REFER TO RPS DWG'S JSL2151_703 & JSL2151_702

EXISTING VEGETATION TO BE REMOVED
REFER TO RPS DWG'S JSL2151_703 & JSL2151_702

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.



LOCATION PLAN:

TO BE READ IN CONJUNCTION WITH DWG 3483_PL_112 LANDSCAPE MASTERPLAN REACH 6 SHEET 01

REFER TO ENGINEER'S DETAILS 463457-CIVIL-600-P3, 463457-CIVIL-601-P3, 463457-CIVIL-602-P2, 463457-CIVIL-603-P2 AND 463457-CIVIL-604-P2

Revision	By	Checked	Approved	Date	Description

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burdenp Park, Swindon, Wiltshire. SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089

www.halcrow.com

A CH2M HILL COMPANY

LDA Design
Kings Wharf, The Quay, Exeter, EX2 4AN
T: 01392 260 430
F: 01392 260 431

LDĀDESIGN

Project

LITTLEHAMPTON ARUN, EAST BANK LANDSCAPE AND PUBLIC REALM

Drawing

LANDSCAPE MASTERPLAN REACH 6 SHEET 2 OF 2

Drawn by	KB (LDA)	Date:	May 2013
Checked by	SJT (LDA)	Date:	May 2013
Authorised by	SJT (LDA)	Date:	May 2013

Drawing No. 3483_PL_113 | Revision

Drawing Scale: 1:1000 @ A1

CAD Filename: 3483_Reach 6 Plan | Plot Scale:

0 50m

REACH 1 CONTINUED ON DRG. 463457/CIVIL/101

Shingle
Sand
Slipway
MLW
Boat House
3.0m
Buried water mains crossing harbour (Southern water 500 Dia. foul rising main and 700 Dia. treated effluent)
Sand and Shingle
Steel sheet piles with reinforce concrete cap
Mean Low Water
RC recess for 1.5 wide galvanised open grid access steps with two landing stages (Refer to details on drawing 463457/GEN/103
REACH 1 – Steel sheet piling Remain as existing
Golf Links
Stone
4.0m
River Arun
ARUN PARADE
Amusement Park
Turning area
COASTGUARD ROAD
Posts
Windmill Theatre
PC
PC
CG Lookout
THE PROMENADE
5.2m
Shelter
Slipway
Sand and Shingle
Lighthouse
(occulting white)
Stone
Sand and Shingle
Groyne
East Pier
Mean High
N
WORK IN PROGRESS
0 10 20 30 40 50
SCALE 1:500 (A1)
SCALE 1:1000 (A3)
METRES

SAFETY HEALTH AND ENVIRONMENT INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks:

Materials

Construction

Hazard to public due to the proximity of promenade and public amenity area along the frontage.

Damage to existing services during excavation and piling.

Elevation difference (fall) between the existing promenade and river bed and due to fast flow/currents at mouth.

Propagation of waves in the estuary.

Finding deep void or obstructions between old and new defences.

Movement of cargo vessels in the estuary (approx one vessel per month).

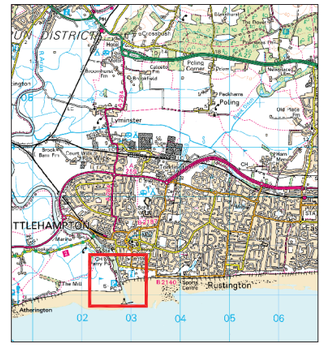
Destabilising existing wall when breaking out the wall to install the anchor ties.

Environmental pollution of watercourse and impact on migrating fish from piling works.

Maintenance

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.



REACH LOCATION PLAN

KEY

Revision	By	Checked	Approved	Date	Description
P1	MCC	RSH		18/04/13	PRELIMINARY ISSUE

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY
Halcrow

Project

LITTLEHAMPTON ARUN
EAST BANK TIDAL WALLS

Drawing

REACH 1 AND 2
GENERAL ARRANGEMENT
(SHEET 1 OF 2)

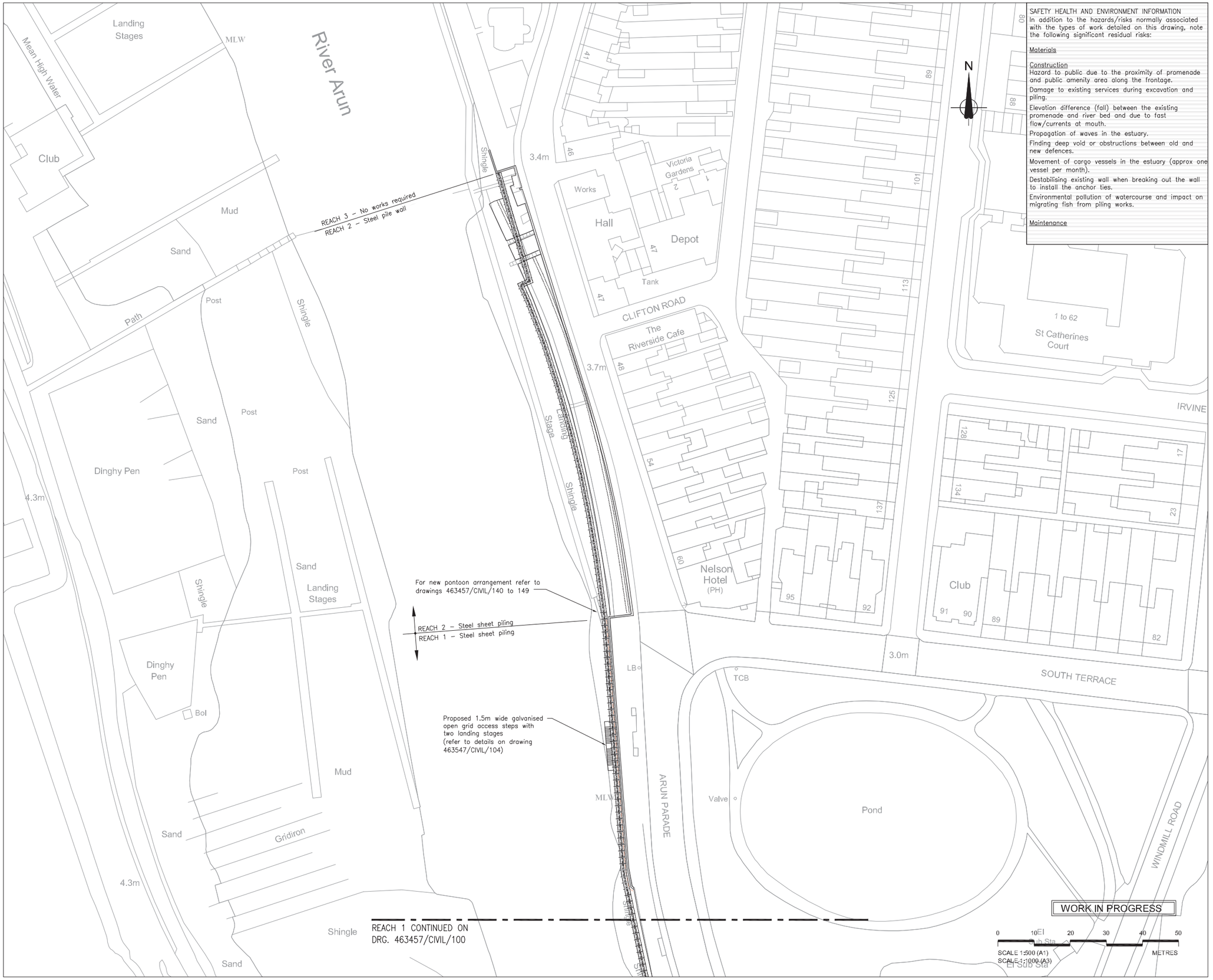
Drawn by	MCC	Date:	11.04.13
Checked by	T.O.	Date:	
Authorised by		Date:	

Drawing No. 463457/CIVIL/100 Revision P1

Drawing Scale: 1:500

CAD Filename: 463457-CIVIL-100.dwg Plot Scale: 1:1

Drawing name: S:\PROJECTS\Coastal\Littlehampton DD\CAD\463457-CIVIL-100.dwg
USER: CrawtherMC 18:09 – Apr 18, 2013
xrefs: 05 Littlehampton [\\h-fs#\DD 05Littlehampton.dwg]
XREF A1 Border [\\h-fs#\XREF A1 Border.dwg]
Xref-New-works – R1 [S:\PROJECTS\Coastal\Littlehampton DD\CAD\L-Ref\Xref-New-works – R1.dwg]
Xref-Revises To: \\HALFILES\Projects\Coastal\Littlehampton DD\CAD\L-Ref\Xref-Revises.dwg]



SAFETY HEALTH AND ENVIRONMENT INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks:

Materials

Construction

Hazard to public due to the proximity of promenade and public amenity area along the frontage.

Damage to existing services during excavation and piling.

Elevation difference (fall) between the existing promenade and river bed and due to fast flow/currents at mouth.

Propagation of waves in the estuary.

Finding deep void or obstructions between old and new defences.

Movement of cargo vessels in the estuary (approx one vessel per month).

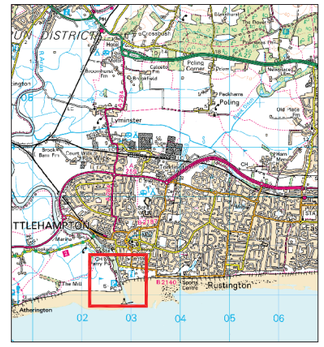
Destabilising existing wall when breaking out the wall to install the anchor ties.

Environmental pollution of watercourse and impact on migrating fish from piling works.

Maintenance

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.



REACH LOCATION PLAN

KEY

Revision	By	Checked	Approved	Date	Description
P1	MCC	RSH		18/04/13	PRELIMINARY ISSUE

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY
Halcrow

Project

LITTLEHAMPTON ARUN EAST BANK TIDAL WALLS

Drawing

REACH 1 AND 2 GENERAL ARRANGEMENT (SHEET 2 OF 2)

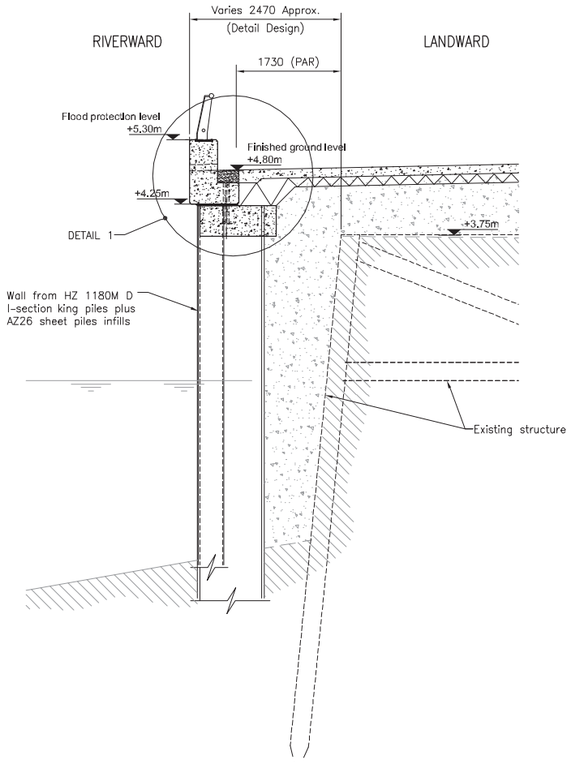
Drawn by	MCC	Date:	11.04.13
Checked by	T.O.	Date:	
Authorised by		Date:	

Drawing No. 463457/CIVIL/101 Revision P1

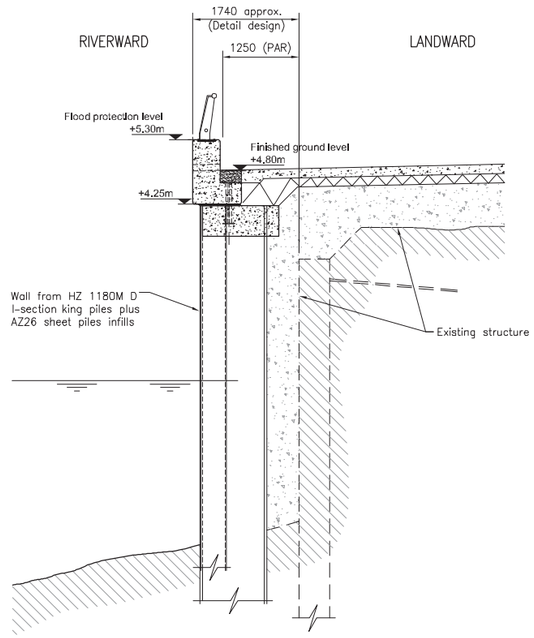
Drawing Scale: 1:500

CAD Filename: 463457-CIVIL-101.dwg Plot Scale: 1:1

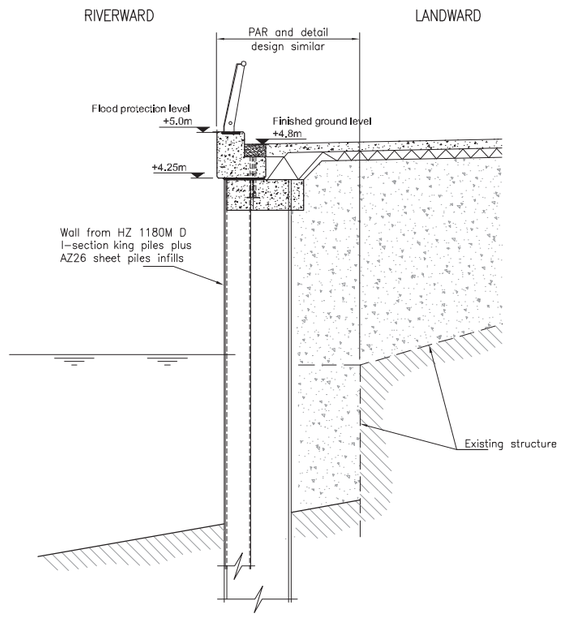
Drawing name: S:\PROJECTS\Coastal\Littlehampton DD\CAD\463457-CIVIL-101.dwg
USER: CrowtherMC 18:08 – Apr 18, 2013
prefs: 05 Littlehampton [\\h-file\DD$ Littlehampton.dwg]
XREF A1 Border [\\h-file\XREF A1 Border.dwg]
Xref-New-works – R1 [S:\PROJECTS\Coastal\Littlehampton DD\CAD\L-Ref\Xref-New-works – R1.dwg]
Xref-Revises T0:\PROJECTS\Coastal\Littlehampton DD\CAD\L-Ref\Xref-Revises.dwg]



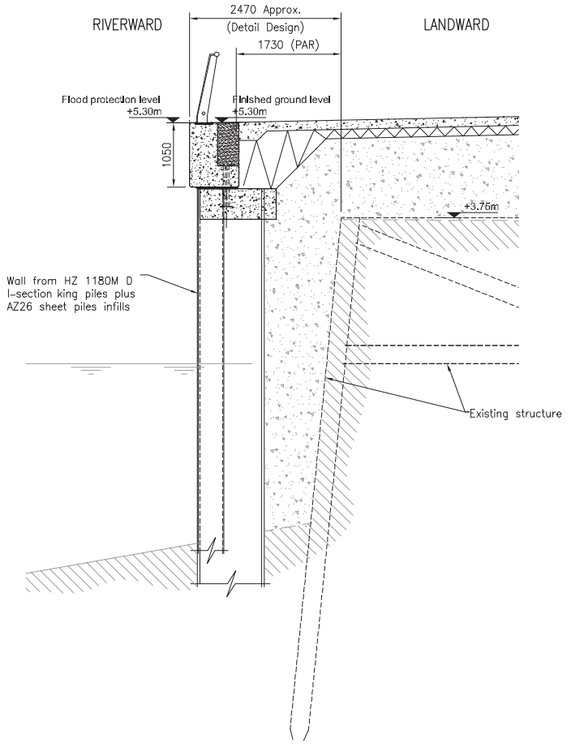
TYPICAL SECTION REACH 1A - TYPICAL
SCALE 1:50



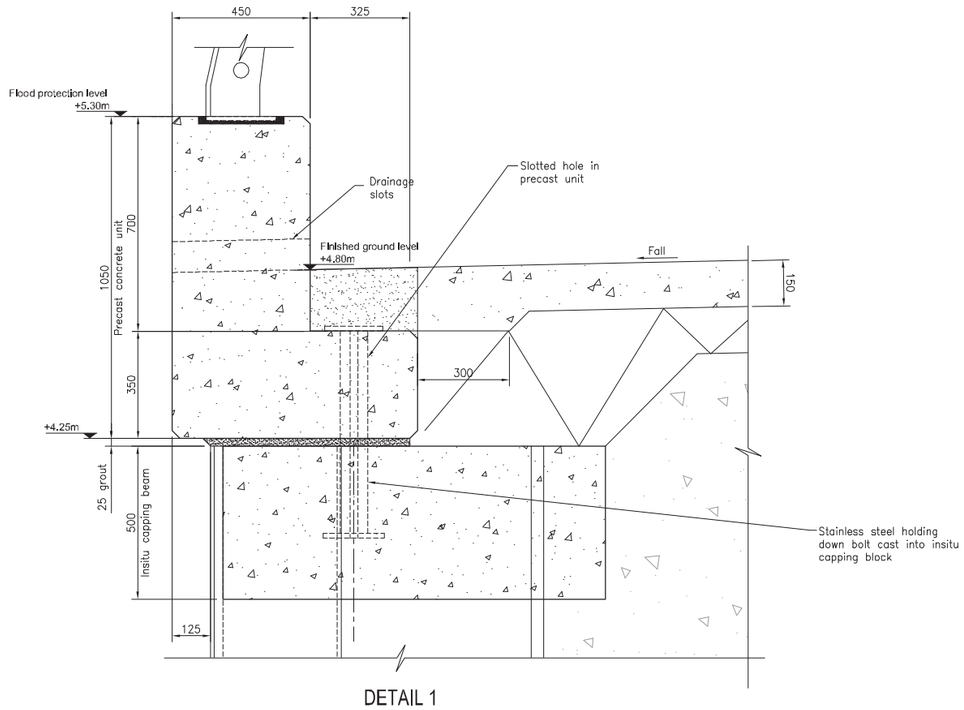
TYPICAL SECTION REACH 1B
SCALE 1:50



TYPICAL SECTION REACH 2
SCALE 1:50



TYPICAL SECTION REACH 1A - SOUTHERN END
SCALE 1:50



DETAIL 1
SCALE 1:10

WORK IN PROGRESS

0 100 200 300 400 500 1000
SCALE 1:10 (A1)
SCALE 1:20 (A3)
MILLIMETRES

0 1000 2000 3000 4000 5000
SCALE 1:50 (A1)
SCALE 1:100 (A3)
MILLIMETRES

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in millimetres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.

Revision	By	Checked	Approved	Date	Description
P2	MCC	TO		14.05.13	ADVANCED ISSUE TO LDA
P1	MCC	TO		18/04/13	PRELIMINARY ISSUE

Client
ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY

Project
LITTLEHAMPTON ARUN
EAST BANK TIDAL WALLS

Drawing
REACH 1 AND 2
TYPICAL SECTIONS

Drawn by	MCC	Date:	09.01.13
Checked by		Date:	
Authorised by		Date:	
Drawing No.	463457/CIVIL/103	Revision	P2
Drawing Scale:	As Shown at A1		
CAD Filename:	463457-CIVIL-103	Plot Scale:	1:1

Drawing name: S:\PROJECTS\Coastal\Littlehampton DD\CAD\463457-CIVIL-103.dwg
USER: CrowtherMC 15-05 - May 28, 2013
xrefs: GREY A1 Border [S:\PROJECTS\Coastal\Littlehampton DD\CAD\X-Ref\GREY A1 Border.dwg]

Pharos Quay

3.4m

REACH 4 – Steel sheet piling
REACH 3 – No work required

47

Works

Wharf

Mud

REACH 3 – No work required
REACH 3 – Steel sheet piling

2410.29

3010.35

3610.41

1 to 12
Alpha Court

11

6

4

1

46

43

5

8

SMALLCROFT CLOSE

42

31

38

37

33

RIVER RC

49

Works

4

Britannia Quay
Mean High Water

B
463457/CIVIL/301

1

8

Ladders (12 no.)
and galvanised steel handrail

A
463457/CIVIL/301

Clear width of 1250 between the front face of the existing workshop and the pile cap to allow room for private access to the reinstated pontoons (access and pontoon riser details as drawing 301)

The Waterside

Steel sheet piles with reinforced concrete cap to +4.8m
(Wall length Approx. 90m)

REACH 3 – Steel sheet piling
REACH 3 – No work required

ding Stage

MLW

Mud

Slipway
Landing Stage

Slipway

Mud

Landing Stage

Mud

Mud MHW

Slipway
Landing Stage

Crane

N

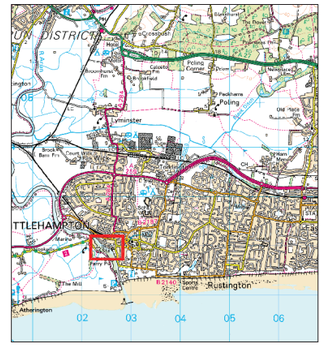
WORK IN PROGRESS

0 10 20 30 40 50
METRES

SCALE 1:500 (A1)
SCALE 1:1000 (A3)

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.



REACH LOCATION PLAN

KEY

Proposed sheet pile flood defence

Existing flood defence wall – no works required (raise cap in 2030)

+5.3m Level above Ordnance Datum Newlyn

SAFETY HEALTH AND ENVIRONMENT INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks:

Materials

Construction
Hazard to the public due to the proximity of residential properties

Elevation difference (fall) between the existing promenade and river bed

Finding deep void or obstructions between old and new defences.

Movement of cargo vessels in the estuary (approx one vessel per month).

Requirement to work from jack up barge directly over watercourse.

Within River Road Conservation Area.

Environmental pollution of watercourse from piling works.

Maintenance

Revision	By	Checked	Approved	Date	Description
P1	MCC	RSH		18/04/13	PRELIMINARY ISSUE

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY
Halcrow

Project

LITTLEHAMPTON ARUN
EAST BANK TIDAL WALLS

Drawing

REACH 3B
GENERAL ARRANGEMENT
PLAN

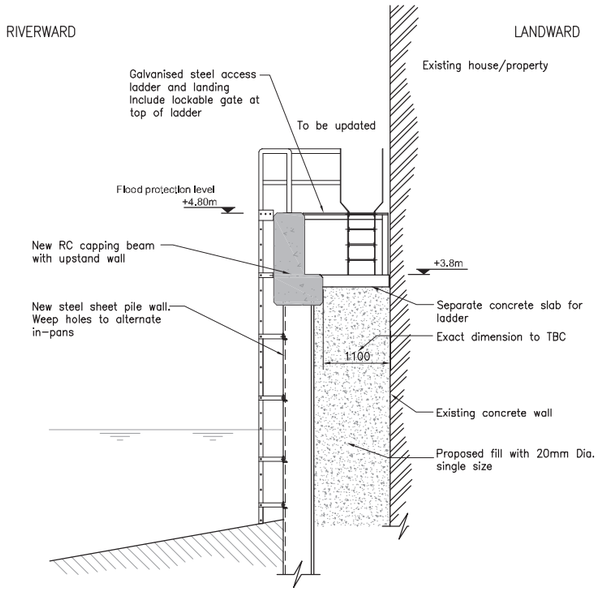
Drawn by	JAB	Date:	02.04.13
Checked by	RSH	Date:	-
Authorised by	FL	Date:	-

Drawing No. 463457/CIVIL/300 Revision P1

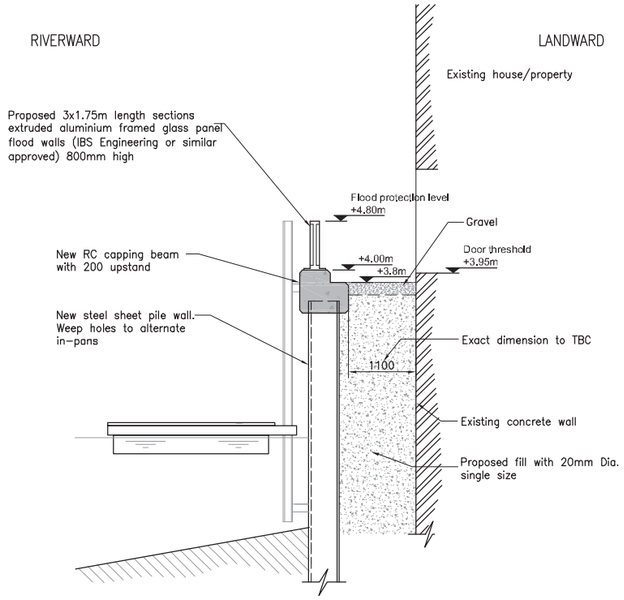
Drawing Scale: 1:500

CAD Filename: 463457-CIVIL-300.dwg Plot Scale: 1:1

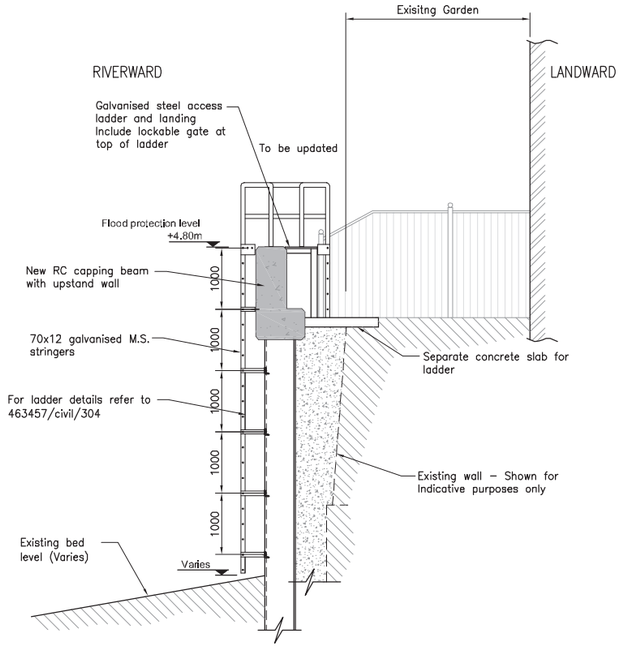
Drawing name: S:\PROJECTS\Coastal\Littlehampton DD\CAD\463457-CIVIL-300.dwg
USER: CrowtherMC 18:13 - Apr 18, 2013
xrefs: OS Littlehampton [S:\X-Ref\OS Littlehampton.dwg]
WSP A1 Border [S:\X-Ref\WSP A1 Border.dwg]
X-ref-Services [S:\PROJECTS\Coastal\Littlehampton DD\CAD\X-Ref\Xref-Services.dwg]
Xref-New-works - RS TO S:\PROJECTS\Coastal\Littlehampton DD\CAD\X-Ref\Xref-New-works - RS.dwg]



SECTION A-A



SECTION B-B



SECTION C-C

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in millimetres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.

KEY

+3.70m Level above Ordnance Datum Newlyn

NOTE: DETAILS OF EXISTING STRUCTURES TAKEN FROM ARCHIVED DRAWINGS INDICATIVE ONLY (T.B.C. BY THE CONTRACTOR ON SITE)

WORK IN PROGRESS

0 1000 2000 3000 4000 5000

SCALE 1:50 (A1)
SCALE 1:100 (A3)
MILLIMETRES

Revision	By	Checked	Approved	Date	Description
P1	MCC	RSH		18/04/13	PRELIMINARY ISSUE

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089

www.halcrow.com

A CH2M HILL COMPANY

Project

LITTLEHAMPTON ARUN EAST BANK TIDAL WALLS

Drawing

REACH 3B
GENERAL ARRANGEMENT
SECTIONS

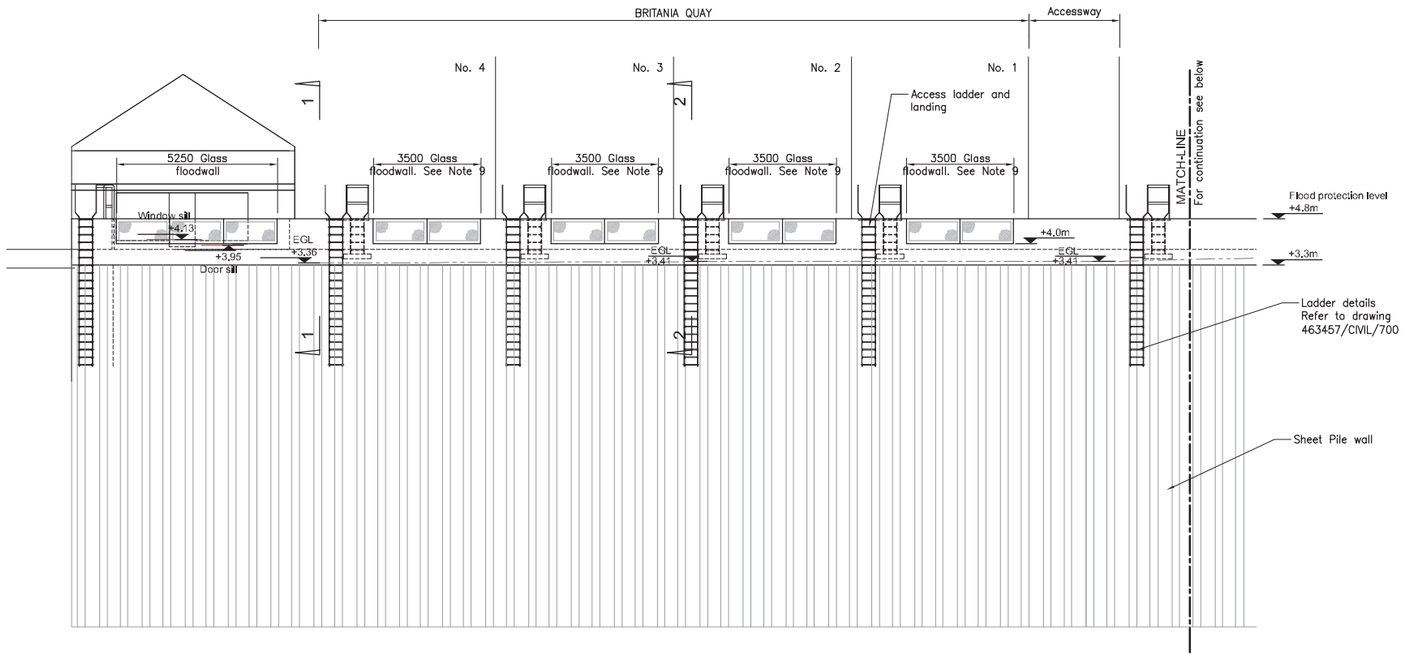
Drawn by	MCC	Date:	02.04.13
Checked by	RSH	Date:	-
Authorised by	FL	Date:	-

Drawing No. 463457/CIVIL/301 | Revision P1

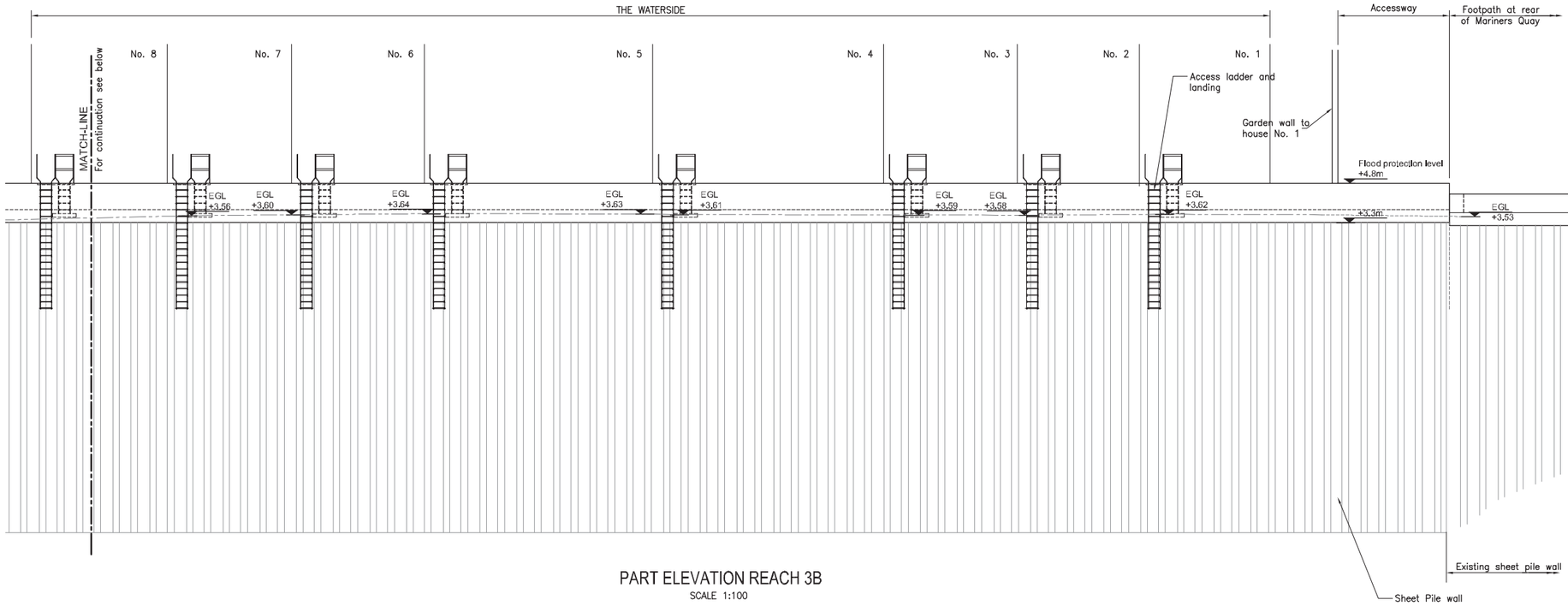
Drawing Scale: 1:50 at A1

CAD Filename: 463457-CIVIL-301 | Plot Scale: 1:1

Drawing name: S:\PROJECTS\Coastal\Littlehampton DD\CAD\463457-CIVIL-301.dwg
USER: CrowtherMC 16:17 - Apr 18, 2013
xrefs: 'IREF A1 Border' [S:\PROJECTS\Coastal\Littlehampton DD\CAD\X-Ref\IREF A1 Border.dwg]



PART ELEVATION REACH 3B
SCALE 1:100



PART ELEVATION REACH 3B
SCALE 1:100

WORK IN PROGRESS

0 5 10
SCALE 1:100 (A1)
SCALE 1:200 (A3)
METRES

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in millimetres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.
4. Private gardens to be reinstated to the same conditions as existing unless advised otherwise.
5. Details of the existing walls unknown.
6. Condition survey of the properties will be undertaken by the Client before and after construction.
7. Contractor to minimise piling offset from the existing wall where site conditions and construction plant allow.
8. Silent piling from Jack-up barge required with continuous vibration monitoring.
9. Glass floodwall panels for Britannia Quay are indicative only and are subject to financial contributions, otherwise detail to be as The Waterside development.

KEY

+3.70m Level above Ordnance Datum Newlyn

NOTE: DETAILS OF EXISTING STRUCTURES TAKEN FROM ARCHIVED DRAWINGS INDICATIVE ONLY (T.B.C. BY THE CONTRACTOR ON SITE)

SAFETY HEALTH AND ENVIRONMENT INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks:

Materials

Construction
Hazard to the public due to the proximity of residential properties
Elevation difference (fall) between the existing promenade and river bed
Finding deep void or obstructions between old and new defences.
Movement of cargo vessels in the estuary (approx one vessel per month).
Requirement to work from jack up barge directly over watercourse.
Within River Road Conservation Area.
Environmental pollution of watercourse from piling works.

Maintenance

Revision	By	Checked	Approved	Date	Description
P1	MCC	TO		18/04/13	PRELIMINARY ISSUE

Client
ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY
Halcrow

Project
LITTLEHAMPTON ARUN EAST BANK TIDAL WALLS

Drawing
REACH 3B LITTLEHAMPTON ELEVATION

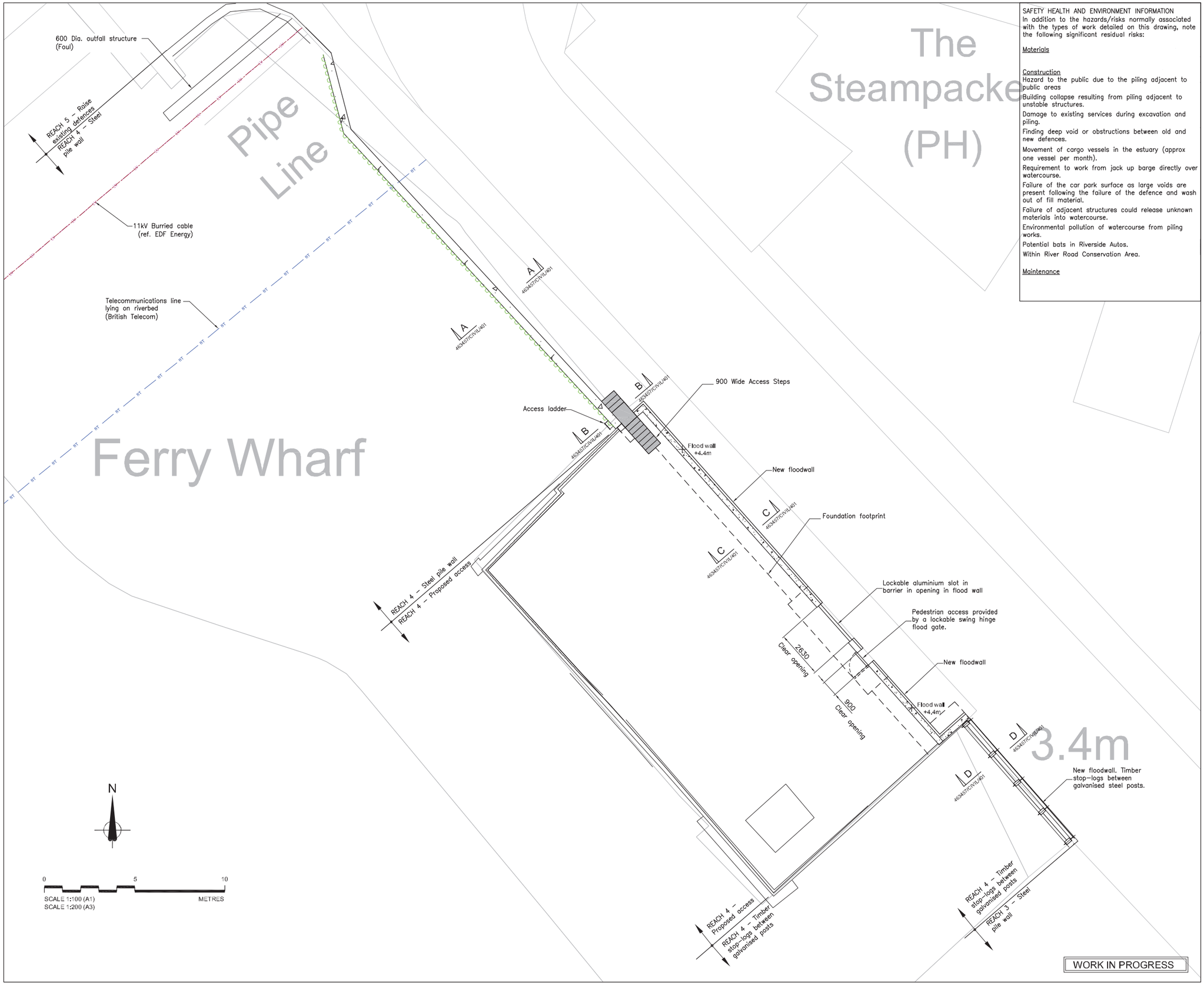
Drawn by	MCC	Date:	27.03.13
Checked by	RSH	Date:	27.03.13
Authorised by		Date:	

Drawing No. 463457/CIVIL/302 | Revision P1

Drawing Scale: 1:100 at A1

CAD Filename: 463457-CIVIL-302 | Plot Scale: 1:1

Drawing name: S:\PROJECTS\Coastal\Littlehampton DD\CAD\463457-CIVIL-302.dwg
USER: CrawtherMC 18:21 - Apr 16, 2013
xrefs: 'A1 Border [S:\PROJECTS\Coastal\Littlehampton DD\CAD\V-Ref\A1 Border.dwg]
'1800000121 Topographic Survey [S:\PROJECTS\Coastal\Littlehampton DD\CAD\Topo\1800000121 Topographic Survey.dwg]
'Xref-R3B wall construction [S:\PROJECTS\Coastal\Littlehampton DD\CAD\V-Ref\Xref-R3B wall construction.dwg]
'additional 3b survey [S:\PROJECTS\Coastal\Littlehampton DD\CAD\Topo\Additional Topo Month 2013\33813 Shoc Arun Foot Bank Improvements, Littlehampton, Reach3b and 4 Additional Surveydwg]



SAFETY HEALTH AND ENVIRONMENT INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks:

Materials

Construction

Hazard to the public due to the piling adjacent to public areas

Building collapse resulting from piling adjacent to unstable structures.

Damage to existing services during excavation and piling.

Finding deep void or obstructions between old and new defences.

Movement of cargo vessels in the estuary (approx one vessel per month).

Requirement to work from jack up barge directly over watercourse.

Failure of the car park surface as large voids are present following the failure of the defence and wash out of fill material.

Failure of adjacent structures could release unknown materials into watercourse.

Environmental pollution of watercourse from piling works.

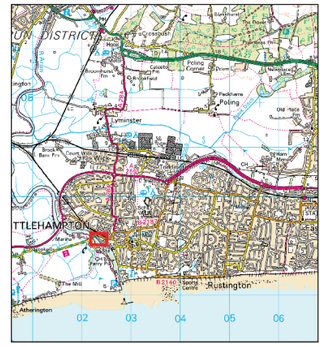
Potential bats in Riverside Autos.

Within River Road Conservation Area.

Maintenance

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.



REACH LOCATION PLAN

KEY

- Proposed sheet pile flood defence
- +4.4m — Level above Ordnance Datum Newlyn
- LV — Low voltage electricity cable
- BT — Telecommunications cable

Revision	By	Checked	Approved	Date	Description
P2	MCC	RSH		17.03.13	MINOR AMENDMENTS
P1	MCC	TO		18/04/13	PRELIMINARY ISSUE

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY
Halcrow

Project

LITTLEHAMPTON ARUN EAST BANK TIDAL WALLS

Drawing

REACH 4 GENERAL ARRANGEMENT PLAN

Drawn by	JAB	Date:	02.04.13
Checked by	RSH	Date:	-
Authorised by	FL	Date:	-

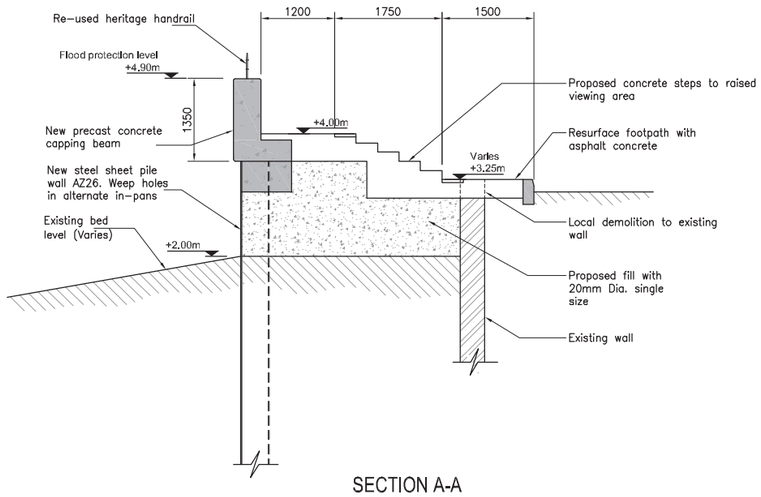
Drawing No. 463457/CIVIL/400 — Revision P2

Drawing Scale: 1:100

CAD Filename: 463457-CIVIL-400.dwg — Plot Scale: 1:1

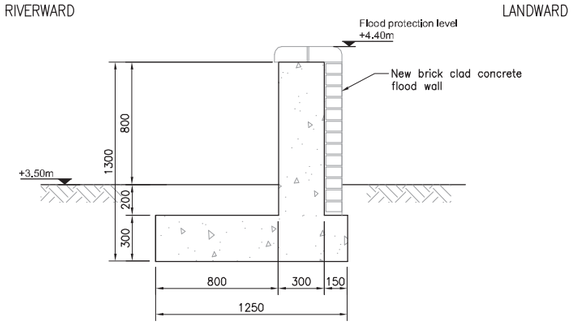
Drawing name: \\swin-fs-05\Maritime\PROJECTS\Coastal\Littlehampton DD\CAD\463457-CIVIL-400.dwg
USER: crowthermc 14:48 - May 17, 2013
xrefs: DD Littlehampton [S:\PROJECTS\Coastal\Littlehampton DD\CAD\U-Ref\DD Littlehampton.dwg]
XREF A1 Border [S:\PROJECTS\Coastal\Littlehampton DD\CAD\U-Ref\XREF A1 Border.dwg]
Xref-Services [S:\PROJECTS\Coastal\Littlehampton DD\CAD\U-Ref\Xref-Services.dwg]

RIVERWARD LANDWARD



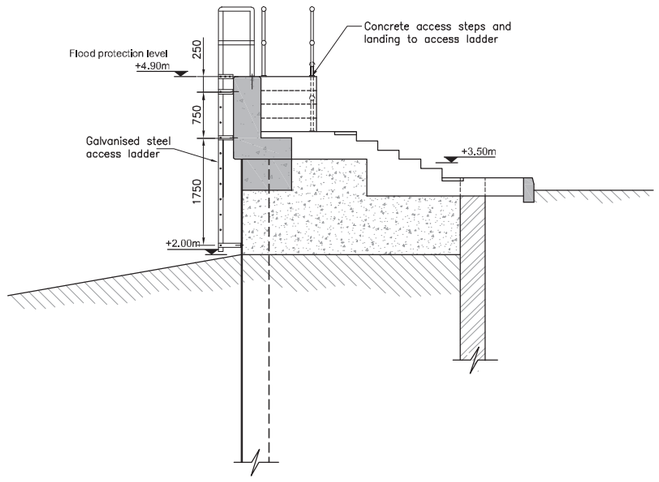
SECTION A-A
SCALE 1:50

RIVERWARD LANDWARD



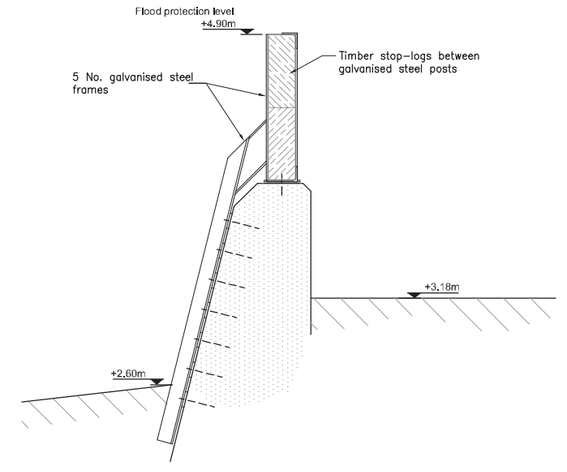
SECTION C-C
SCALE 1:20

RIVERWARD LANDWARD



SECTION B-B
ACCESS STEP/LADDER DETAIL
SCALE 1:50

RIVERWARD LANDWARD



SECTION D-D
SCALE 1:20

WORK IN PROGRESS

0 0.5 1 2
SCALE 1:20 (A1)
SCALE 1:40 (A3)
METRES

0 1000 2000 3000 4000 5000
SCALE 1:50 (A1)
SCALE 1:100 (A3)
MILLIMETRES

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in millimetres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.

KEY

+3.70m Level above Ordnance Datum Newlyn

NOTE: DETAILS OF EXISTING STRUCTURES TAKEN FROM ARCHIVED DRAWINGS INDICATIVE ONLY (T.B.C. BY THE CONTRACTOR ON SITE)

Revision	By	Checked	Approved	Date	Description
P2	MCC	TO		17.05.13	SECTIONS UPDATED
P1	MCC	TO		18/04/13	PRELIMINARY ISSUE

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY

Project

LITTLEHAMPTON ARUN
EAST BANK TIDAL WALLS

Drawing

REACH 4
GENERAL ARRANGEMENT
SECTIONS

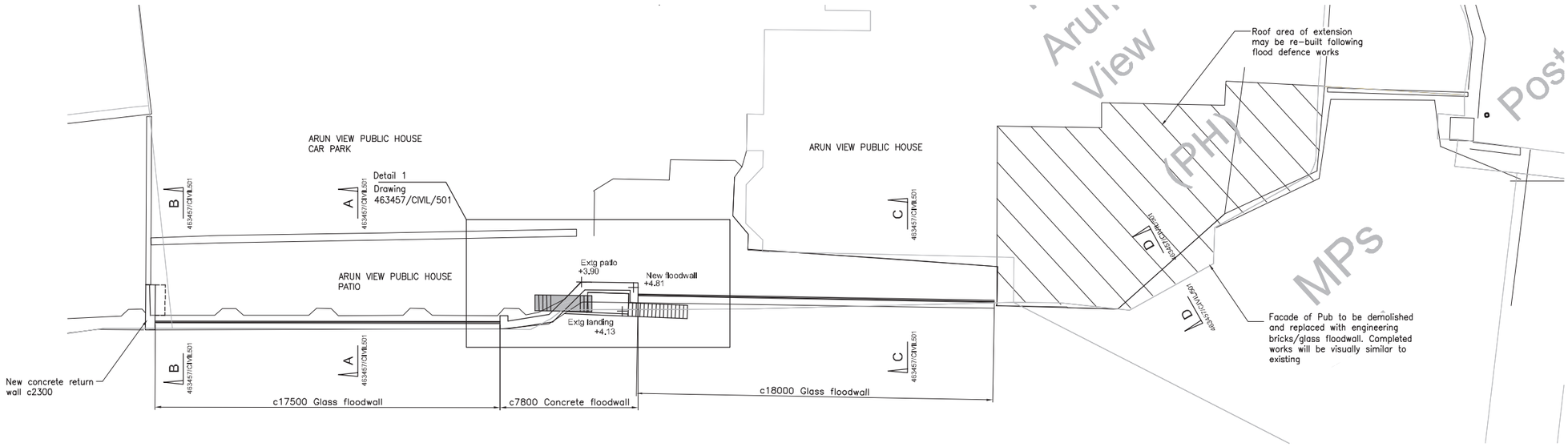
Drawn by	JAB	Date:	04.02.13
Checked by	RSH	Date:	-
Authorised by	FL	Date:	-

Drawing No. 463457/CIVIL/401 | Revision P2

Drawing Scale: As Shown

CAD Filename: 463457-CIVIL-401.dwg | Plot Scale: 1:1

Drawing name: \\swin-fs-05\Maritime\PROJECTS\Coastal\Littlehampton DD\CAD\463457-CIVIL-401.dwg
USER: crowthermc 14:07 — May 17, 2013
xrefs: IREF A1 Border [S:\PROJECTS\Coastal\Littlehampton DD\CAD\X-Ref\IREF A1 Border.dwg]



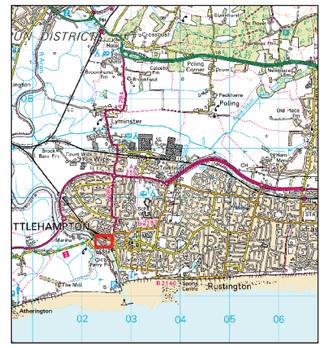
PLAN ON ARUN VIEW PUBLIC HOUSE PATIO
SCALE 1:125

WORK IN PROGRESS

0 1 2 3 4 5 6 7 8 9 10
SCALE 1:125 (A1)
SCALE 1:250 (A3)
METRES

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.



REACH LOCATION PLAN

Revision	By	Checked	Approved	Date	Description
P2	MCC	RSH		15.05.13	ANNOTATION AMENDED
P1	MCC	TO		18/04/13	PRELIMINARY ISSUE

Client
ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY
Halcrow

Project
LITTLEHAMPTON ARUN
EAST BANK TIDAL WALLS

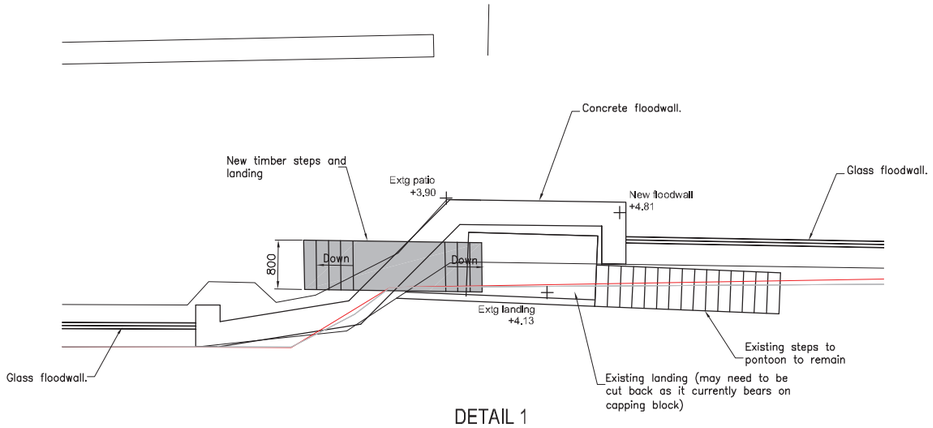
Drawing
REACH 5
AGENERAL ARRANGEMENT
PLAN

Drawn by	JAB	Date:	08.04.13
Checked by	RSH	Date:	-
Authorised by		Date:	

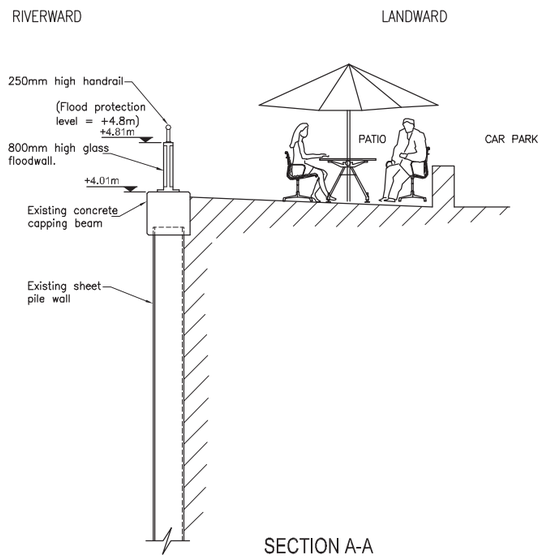
Drawing No. 463457/CIVIL/500
Revision P2

Drawing Scale: As Shown at A1
CAD Filename: 463457-CIVIL-500
Plot Scale: 1:1

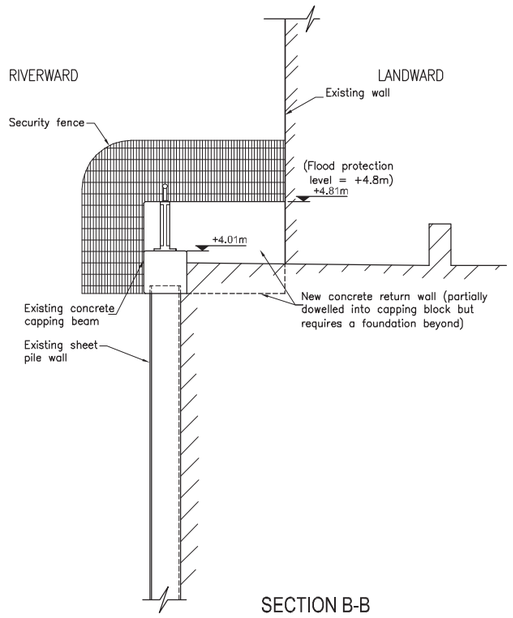
Drawing name: \\swin-fs-05\Maritime\PROJECTS\Coastal\Littlehampton DD\CAD\463457-CIVIL-500.dwg
USER: CrowtherMC 16:19 - May 15, 2013



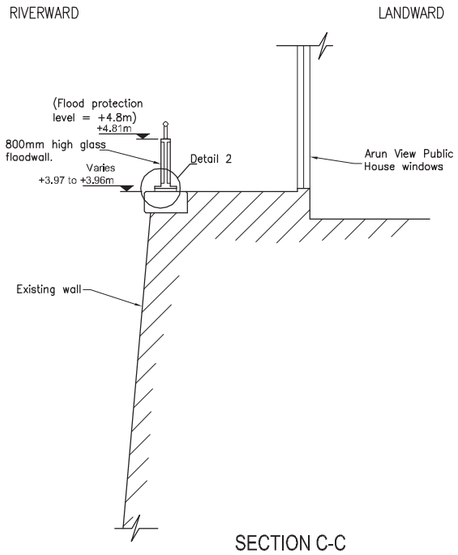
DETAIL 1
ACCESS TO PONTOON OPTION B
SCALE 1:50



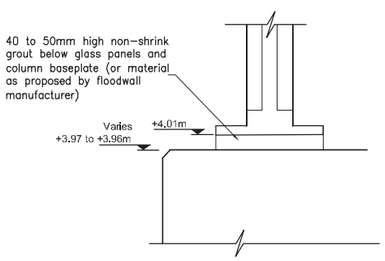
SECTION A-A
SCALE 1:50



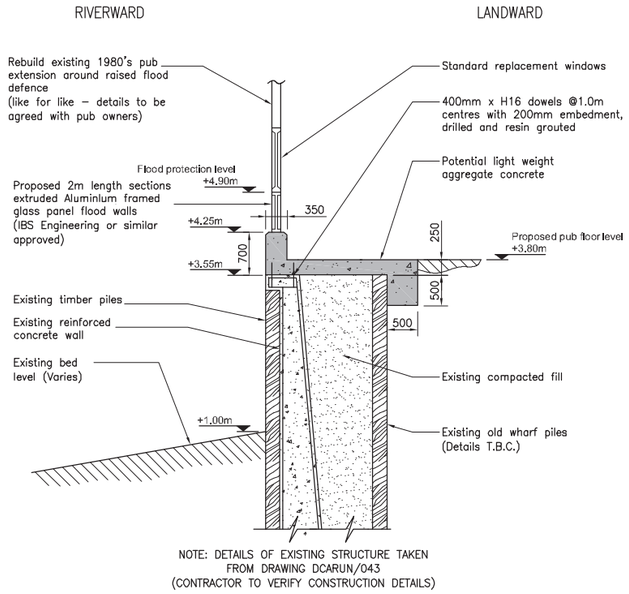
SECTION B-B
SCALE 1:50



SECTION C-C
SCALE 1:50



DETAIL 2
SCALE 1:10

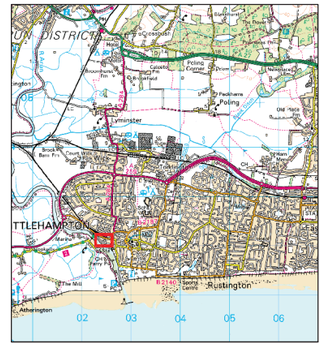


NOTE: DETAILS OF EXISTING STRUCTURE TAKEN FROM DRAWING DCARUN/043 (CONTRACTOR TO VERIFY CONSTRUCTION DETAILS)

SECTION D-D
SCALE 1:50

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.



REACH LOCATION PLAN

Revision	By	Checked	Approved	Date	Description
P2	MCC	RSH		15.05.13	SECTION E–E REMOVED
P1	MCC	TO		18/04/13	PRELIMINARY ISSUE

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY
Halcrow

Project

LITTLEHAMPTON ARUN EAST BANK TIDAL WALLS

Drawing

REACH 5A
GENERAL ARRANGEMENT
SECTIONS

Drawn by	JAB	Date:	08.04.13
Checked by	RSH	Date:	-
Authorised by		Date:	

Drawing No. 463457/CIVIL/501 — Revision P2

Drawing Scale: As Shown at A1

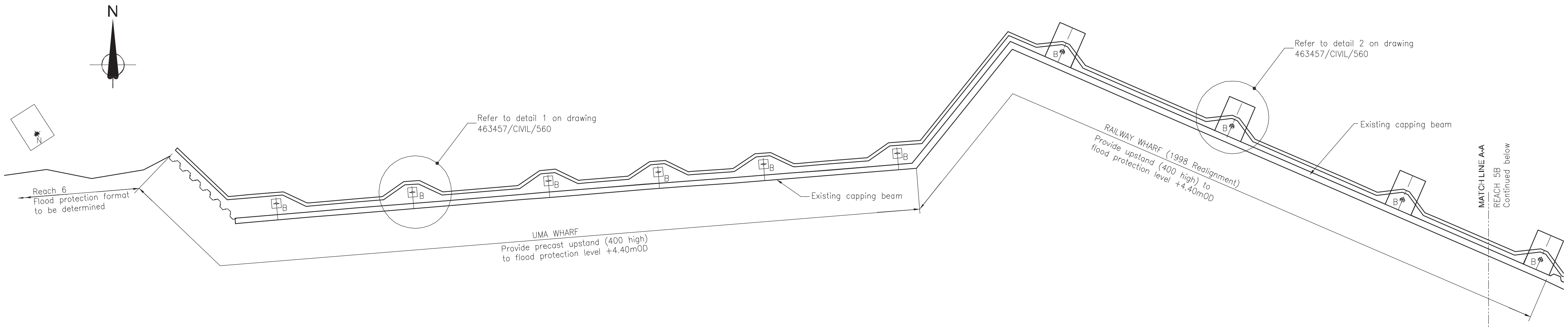
CAD Filename: 463457-CIVIL-501 — Plot Scale: 1:1

WORK IN PROGRESS

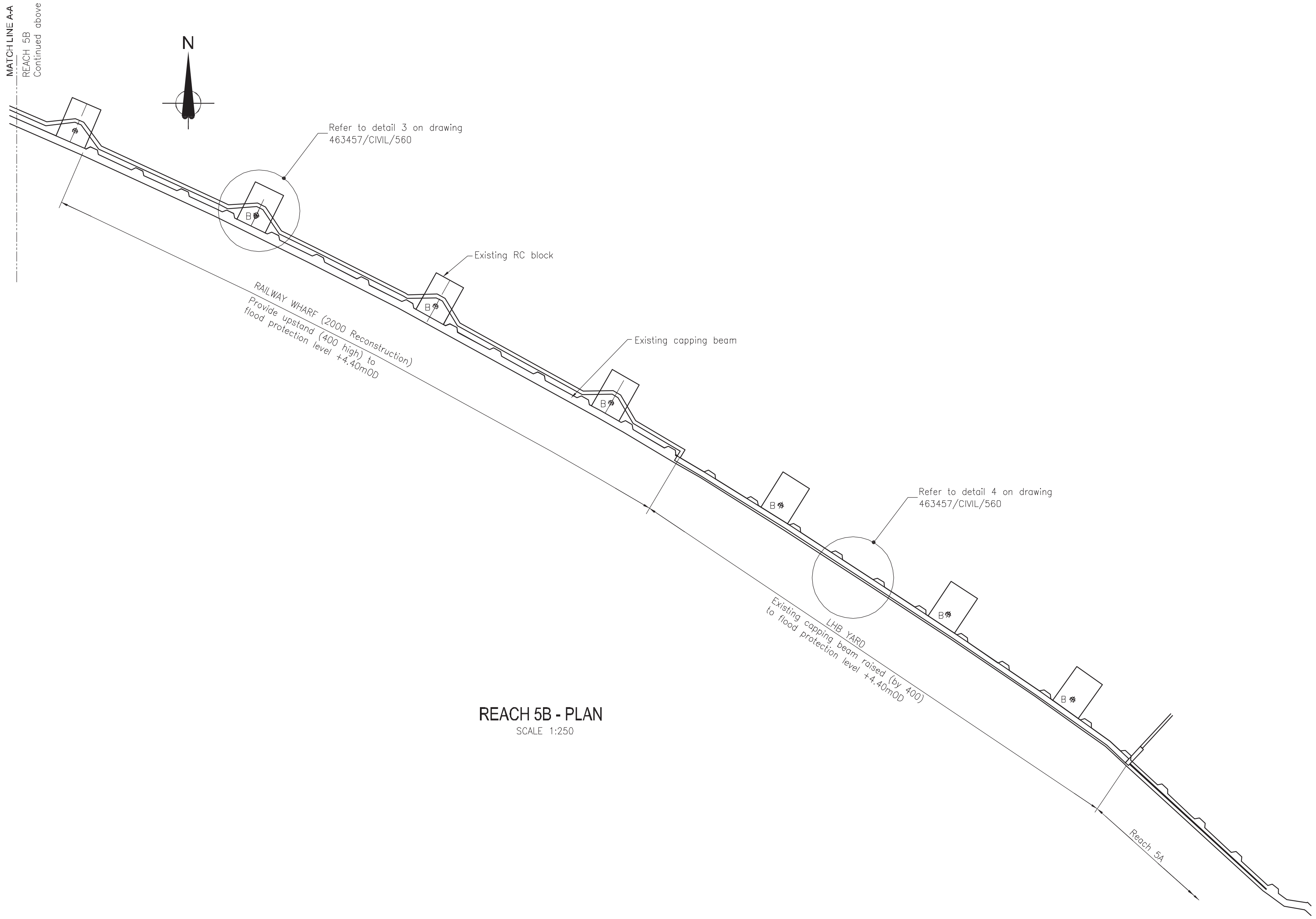
0 100 200 300 400 500 1000
SCALE 1:10 (A1)
SCALE 1:20 (A3)
MILLIMETRES

0 1000 2000 3000 4000 5000
SCALE 1:50 (A1)
SCALE 1:100 (A3)
MILLIMETRES

Drawing name: \\swin-fs-05\Maritime\PROJECTS\Coastal\Littlehampton DD\CAD\463457-CIVIL-501.dwg
USER: GrowtherMC 16:21 – May 16, 2013



REACH 5B - PLAN
SCALE 1:250



REACH 5B - PLAN
SCALE 1:250

WORK IN PROGRESS

0 5 10 15 20
SCALE 1:250 (A1)
SCALE 1:500 (A3)
METRES

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.
4. Existing davit within LHB Yard to be removed and reinstated on top of new upstand.
5. Existing ladder within LHB Yard to be amended to suit new level.

LEGEND

B Existing bollard to be retained
N Existing bollard to be replaced with new 20t twin-horn bollard on new foundation

Revision	By	Checked	Approved	Date	Description
P2	MCC	TO		24/04/13	SPLAY ANGLE REVISED
P1	MCC	TO		18/04/13	PRELIMINARY ISSUE

Client
ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY
Halcrow

Project
LITTLEHAMPTON ARUN
EAST BANK TIDAL WALLS

Drawing
REACH 5B
GENERAL ARRANGEMENT

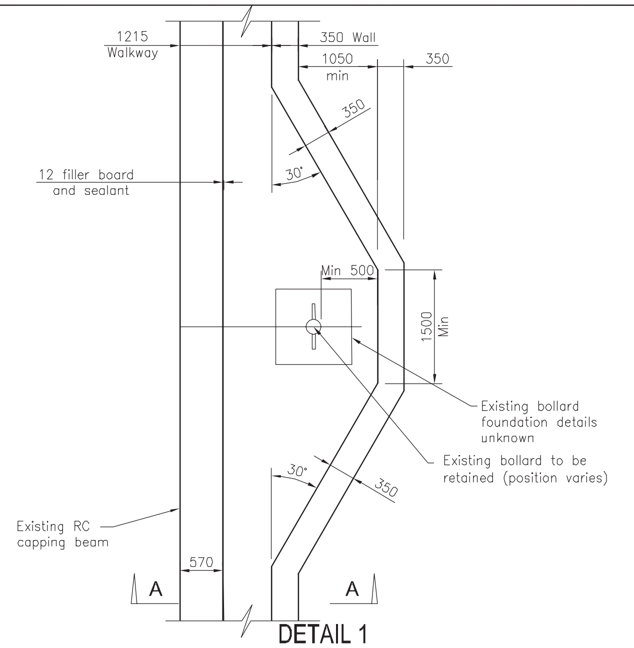
Drawn by	JAB	Date:	08.04.13
Checked by	RSH	Date:	-
Authorised by	-	Date:	-

Drawing No. 463457/CIVIL/550 Revision P2

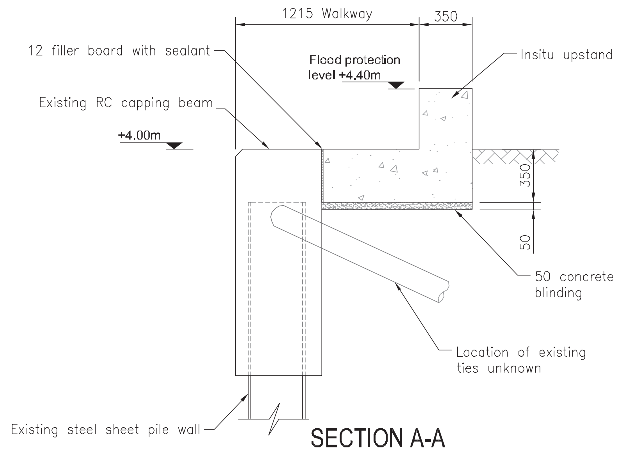
Drawing Scale: 1:250

CAD Filename: 463457-CIVIL-550 Plot Scale: 1:1

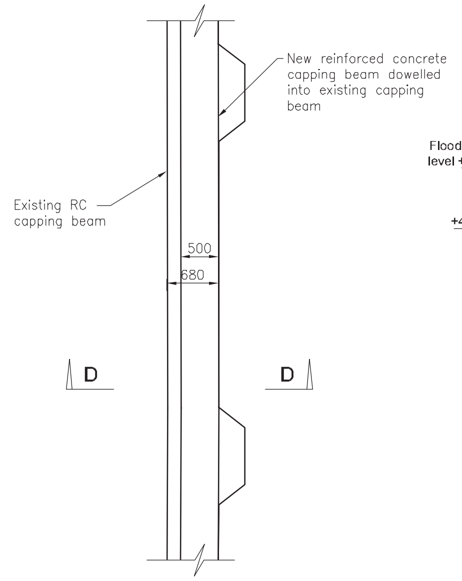
Drawing name: S:\PROJECTS\Coastal\Littlehampton DD\CAD\463457-CIVIL-550.dwg
USER: CrowtherMC



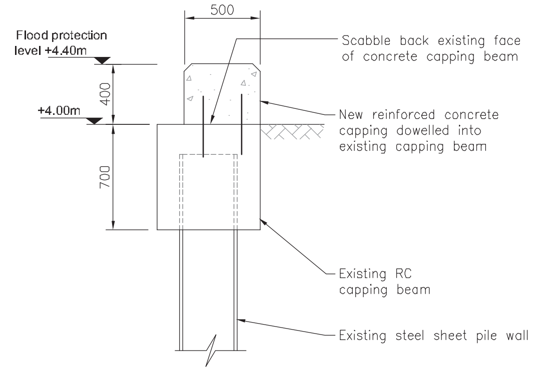
DETAIL 1
PART PLAN - UMA WHARF
SCALE 1:50



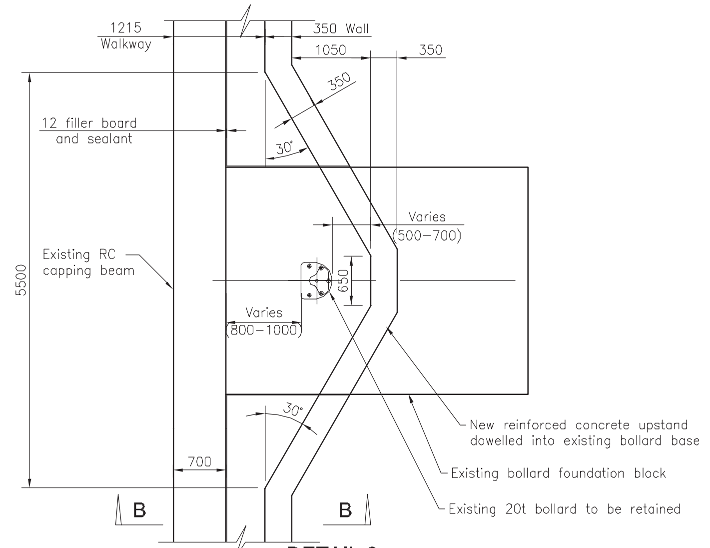
SECTION A-A
SCALE 1:25



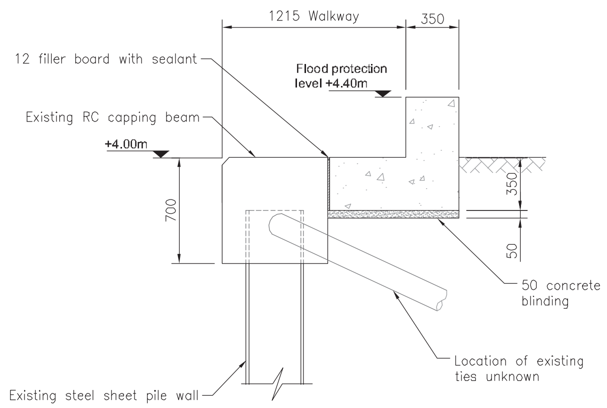
DETAIL 4
PART PLAN - LHB AREA
SCALE 1:50



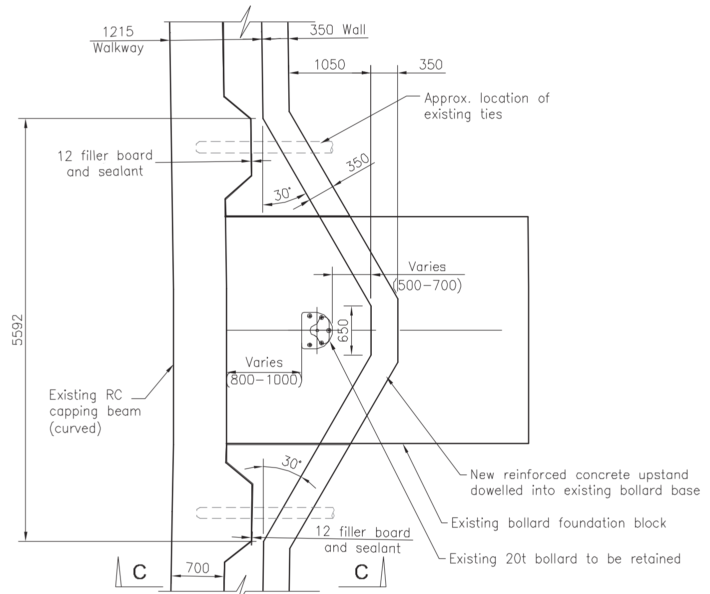
SECTION D-D
SCALE 1:25



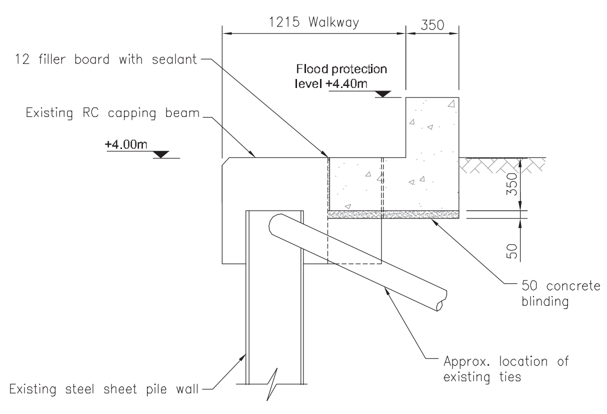
DETAIL 2
PART PLAN - RAILWAY WHARF
(1998 REALIGNMENT)
SCALE 1:50



SECTION B-B
SCALE 1:25



DETAIL 3
PART PLAN - RAILWAY WHARF
(2000 RECONSTRUCTION)
SCALE 1:50



SECTION C-C
SCALE 1:25

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in millimetres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.

NOTE: DETAILS OF EXISTING STRUCTURES TAKEN FROM ARCHIVED DRAWINGS INDICATIVE ONLY (T.B.C. BY THE CONTRACTOR ON SITE)

WORK IN PROGRESS

0 0.5 1 1.5 2
SCALE 1:25 (A1) METRES
SCALE 1:50 (A3)

0 1000 2000 3000 4000 5000
SCALE 1:50 (A1) MILLIMETRES
SCALE 1:100 (A3)

Revision	By	Checked	Approved	Date	Description
P1	MCC	TO		24/04/13	PRELIMINARY ISSUE

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY
Halcrow

Project
LITTLEHAMPTON ARUN
EAST BANK TIDAL WALLS

Drawing
REACH 5B
DETAILS

Drawn by	JAB	Date:	08.04.13
Checked by	TO	Date:	-
Authorised by	-	Date:	-

Drawing No. 463457/CIVIL/560 Revision P1

Drawing Scale: As shown

CAD Filename: 463457-CIVIL-560 Plot Scale: 1:1

Drawing name: S:\PROJECTS\Coastal\Littlehampton DD\CAD\463457-CIVIL-560.dwg
USER: CrowtherMC

REACH 6 CONTINUED ON DRG. 463457/CIVIL/601

Access to new track via existing private tarmac road

Existing roundabout spur to be retained (Principal construction access)

Proposed raised bund with 3m crest width to +5.2m

4m Access track at existing ground level (Armour Turf)

Existing Saltmarsh to be retained

Reptile receptor area

Existing ditch to be retained

Disused water treatment works

A259 Road embankment

Raised existing sheet pile wall under bridge using reinforced concrete to +4.8m

Proposed steel sheet pile wall to +4.8m through existing embankment

Section E-E

Section D-D

Section C-C

Section B-B

Section A-A

463457/CIVIL/603

463457/CIVIL/602

463457/CIVIL/002

+2.3m

+3.3m

+5.3m

River Arun

Riverside Industrial Estate

Carriage Shed

Works

Arunside Industrial Estate

BRIDGE ROAD

QUAYSIDE

Landing Stages

Floating Landing Stages

Floating Landing Stage

Car Park

Marina View

Boat Enclosure

Travelling Crane

Forsters Yard

Hoppers

Conveyor

Filling Station

Sloping masonry

Stepped masonry

Mean High Water

MLW

Drain

Culvert

Outfall

A259

REACH 6

REACH 5

N

WORK IN PROGRESS

0 10 20 30 40 50 60 70 80 90 100

SCALE 1:1000 (A1)
SCALE 1:2000 (A3)

METRES

SAFETY HEALTH AND ENVIRONMENT INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks:

Materials

Construction

Movement of materials during managed realignment construction works in areas subject to tidal and river flows.

Hazards to the public from unauthorised overnight access into satellite compound.

Falling objects when moving and placing gabions.

Sharp protrusions on rock gabions.

Restricted height under A259 bridge.

Requirement for work within the watercourse/on muddy foreshore

Disturbance to existing saltmarsh through contact with plant/materials and from seeding of adjacent embankments.

Disturbance to breeding or overwintering birds.

Potential for bats in trees on embankment

Health hazards associated with working with potential contaminated materials from disused sewage works.

Spread of the Japanese Knotweed identified on site.

Disturbance to potential water voles in ditch.

Disturbance to protected reptile populations on the embankment.

Maintenance

Sharp protrusions on rock gabions.

Work within the watercourse/on muddy foreshore.

Presence of reptiles

NOTES:

1. Do not scale from this drawing.
2. All levels are in metres above Ordnance Datum Newlyn.

REACH LOCATION PLAN

KEY

- Proposed sheet pile flood defence
- Existing saltmarsh
- Proposed saltmarsh
- Reptile receptor sites
- Track
- +5.3m — Level above Ordnance Datum Newlyn

Revision	By	Checked	Approved	Date	Description
P3	MCC	TMH			BUND UPDATED
P2	MCC	TMH		25/04/13	REPTILE RECEPTOR AREA AMENDED
P1	MCC	TMH		18/04/13	PRELIMINARY ISSUE

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY

Halcrow

Project

LITTLEHAMPTON ARUN EAST BANK TIDAL WALLS

Drawing

REACH 6
GENERAL ARRANGEMENT PLAN
(SHEET 1 OF 2)

Drawn by	MCC	Date:	05.04.13
Checked by	TMH	Date:	
Authorised by		Date:	

Drawing No. 463457/CIVIL/600 — Revision P3

Drawing Scale: 1:1000 at A1

CAD Filename: 463457-CIVIL-600.dwg — Plot Scale: 1:1

Drawing name: \\swin-fs-05\Maritime\PROJECTS\Coastal\Littlehampton DD\CAD\463457-CIVIL-600.dwg
USER: CrowtherMC 10:32 - May 10, 2013

Reptile receptor area

310m total length of reusable reptile fencing required to cover all reptile receptor areas in Reach 6

Existing road/ramp

Existing saltmarsh to be retained

Galvanised steel 1800 high palisade fencing with concreted posts

Galvanised steel palisade gate

Retain existing public footpath to foreshore

East west flood embankments to be retained to act as groynes with additional scour protection. 150mm OSA and 150mm LSA filter layer

REACH 6 (Northern boundary line to the scheme)

Proposed saltmarsh 0.70 ha

Proposed additional intertidal mudflat 0.22 ha

A259 Road

Section G-G

G
463457/CIVIL/604

Clear trees and shrubs from lower embankment over section G-G footprint

A259 road embankment

East west flood embankments to be retained to act as groynes with additional scour protection. 150mm OSA and 150mm LSA filter layer

463457/CIVIL/603

Setting-Out line

Section F-F

Section E-E

Proposed new bund to link existing raised bund to managed realigned defences

REACH 6 CONTINUED ON DRG. 463457/CIVIL/600

N

WORK IN PROGRESS

0 10 20 30 40 50 60 70 80 90 100

SCALE 1:1000 (A1)
SCALE 1:2000 (A3)

METRES

SAFETY HEALTH AND ENVIRONMENT INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks:

Materials

Construction

Movement of materials during managed realignment construction works in areas subject to tidal and river flows.

Hazards to the public from unauthorised overnight access into satellite compound.

Falling objects when moving and placing gabions.

Sharp protrusions on rock gabions.

Restricted height under A259 bridge.

Requirement for work within the watercourse/on muddy foreshore

Disturbance to existing saltmarsh through contact with plant/materials and from seeding of adjacent embankments.

Disturbance to breeding or overwintering birds.

Potential for bats in trees on embankment

Health hazards associated with working with potential contaminated materials from disused sewage works.

Spread of the Japanese Knotweed identified on site.

Disturbance to potential water voles in ditch.

Disturbance to protected reptile populations on the embankment.

Maintenance

Sharp protrusions on rock gabions.

Work within the watercourse/on muddy foreshore.

Presence of reptiles

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in metres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.

REACH LOCATION PLAN

KEY

- Existing saltmarsh
- Proposed saltmarsh
- Reptile receptor sites
- Proposed intertidal mudflat
- +5.3m — Level above Ordnance Datum Newlyn

Revision	By	Checked	Approved	Date	Description
P3	MCC	TMH			BUND UPDATED
P2	MCC	TMH		25/04/13	REPTILE RECEPTOR AREA AMENDED
P1	MCC	TMH		18/04/13	PRELIMINARY ISSUE

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089

www.halcrow.com

A CH2M HILL COMPANY

Halcrow

Project

LITTLEHAMPTON ARUN EAST BANK TIDAL WALLS

Drawing

REACH 6
GENERAL ARANGEMENT PLAN
(SHEET 2 OF 2)

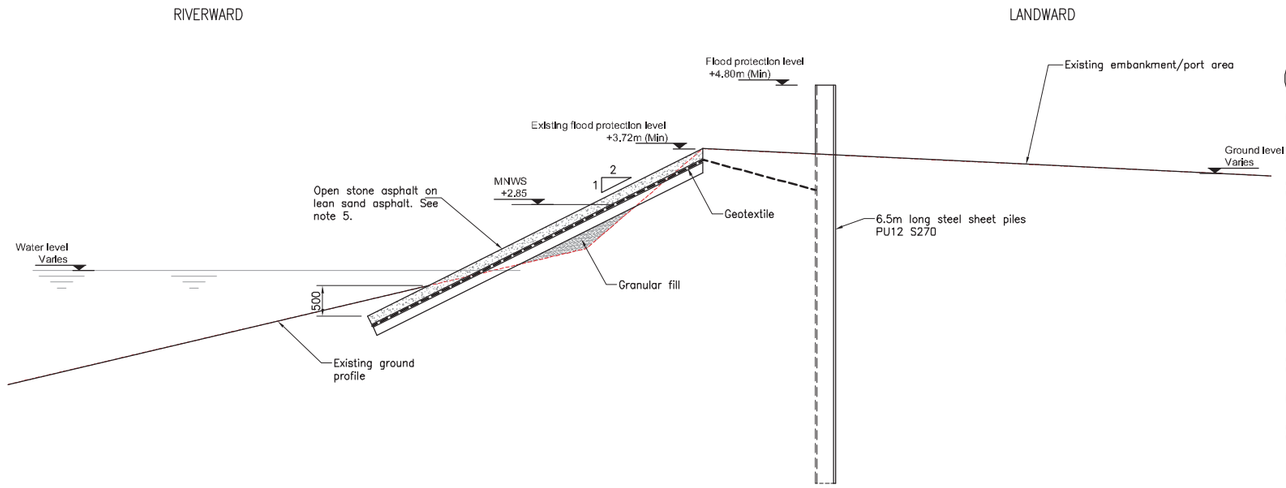
Drawn by	MCC	Date:	05.04.13
Checked by	TMH	Date:	
Authorised by		Date:	

Drawing No. 463457/CIVIL/601 — Revision P3

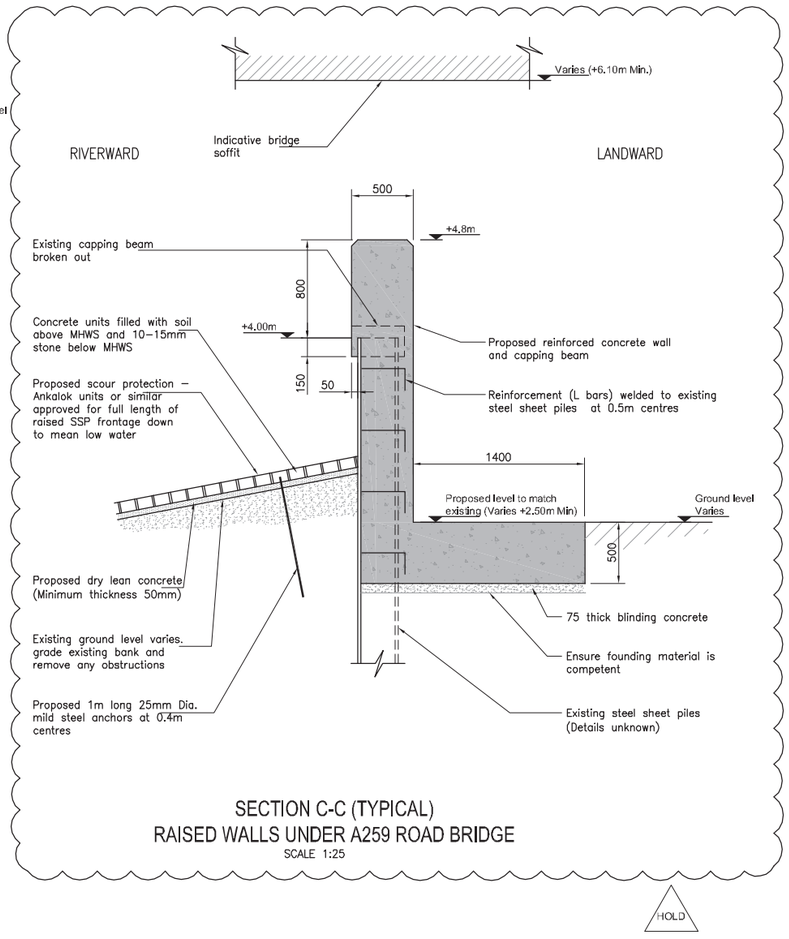
Drawing Scale: 1:1000 at A1

CAD Filename: 463457-CIVIL-601.dwg — Plot Scale: 1:1

Drawing name: \\swin-fs-05\Maritime\PROJECTS\Coastal\Littlehampton DD\CAD\463457-CIVIL-601.dwg
USER: CrowtherMC 09:10 - May 15, 2013
xrefs: OS Littlehampton (\\J:\Ref\OS Littlehampton.dwg)
WSP A1 Border (\\swin-fs-05\Maritime\PROJECTS\Coastal\Littlehampton DD\CAD\WSP A1 Border.dwg)
Xref-Bw-Base (\\J:\REGEN\Drawings\Littlehampton DD\CAD\X-Ref\Xref-Services.dwg)
Xref-Mow-works - RB Hatch (\\J:\Ref\Xref-Mow-works - RB Hatch.dwg)

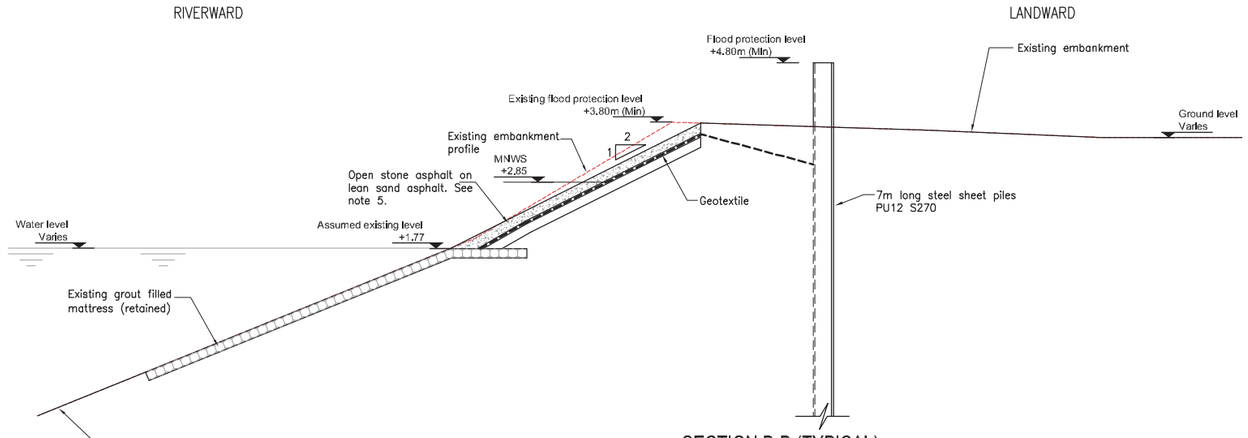


SECTION A-A (TYPICAL)
STEEL SHEET PILE WALL AND SCOUR PROTECTION
SCALE 1:50

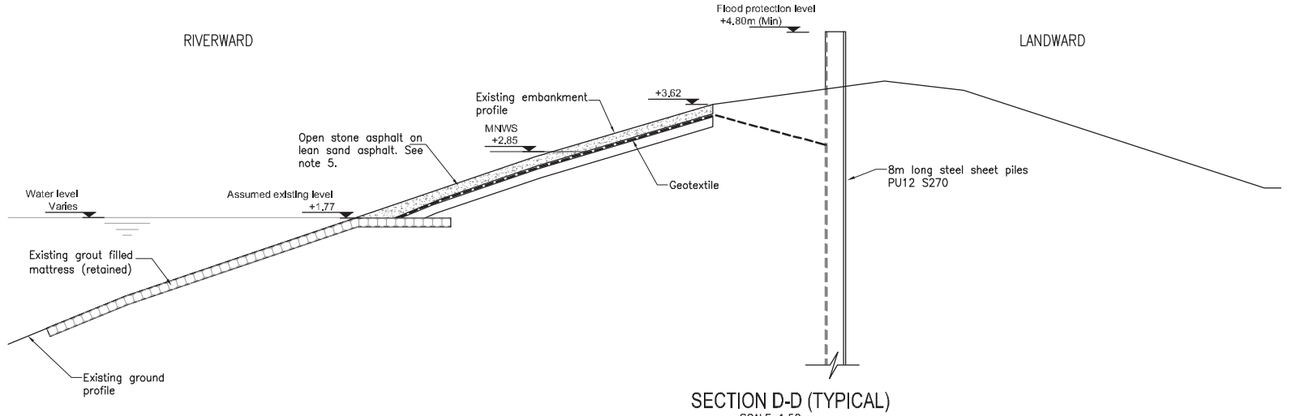


SECTION C-C (TYPICAL)
RAISED WALLS UNDER A259 ROAD BRIDGE
SCALE 1:25

HOLD



SECTION B-B (TYPICAL)
STEEL SHEET PILE WALL AND SCOUR PROTECTION
SCALE 1:50



SECTION D-D (TYPICAL)
SCALE 1:50

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in millimetres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.
4. Both sides of steel piles to be pre–coated with proprietary paint system which provides 20 year design life before first maintenance.
5. Open stone asphalt surface to be brushed with topsoil to promote vegetation growth.

KEY

+3.70m — Level above Ordnance Datum Newlyn

NOTE: DETAILS OF EXISTING STRUCTURES TAKEN FROM ARCHIVED DRAWINGS INDICATIVE ONLY (T.B.C. BY THE CONTRACTOR ON SITE)

SAFETY HEALTH AND ENVIRONMENT INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks:

Materials

Construction
Movement of materials during managed realignment construction works in areas subject to tidal and river flows.
Hazards to the public from unauthorised overnight access into satellite compound.
Falling objects when moving and placing gabions.
Sharp protrusions on rock gabions.
Restricted height under A259 bridge.
Requirement for work within the watercourse/on muddy foreshore
Disturbance to existing saltmarsh through contact with plant/materials and from seeding of adjacent embankments.
Disturbance to breeding or overwintering birds.
Potential for bats in trees on embankment
Health hazards associated with working with potential contaminated materials from disused sewage works.
Spread of the Japanese Knotweed identified on site.
Disturbance to potential water voles in ditch.
Disturbance to protected reptile populations on the embankment.

Maintenance
Sharp protrusions on rock gabions.
Work within the watercourse/on muddy foreshore.
Presence of reptiles

Revision	By	Checked	Approved	Date	Description
P2	MCC	TMH		25/04/13	NOTE 5 ADDED
P1	MCC	TMH		18/04/13	PRELIMINARY ISSUE

WORK IN PROGRESS

0 0.5 1 1.5 2
SCALE 1:25 (A1)
SCALE 1:50 (A3)
METRES

0 1000 2000 3000 4000 5000
SCALE 1:50 (A1)
SCALE 1:100 (A3)
MILLIMETRES

Client
ENVIRONMENT AGENCY

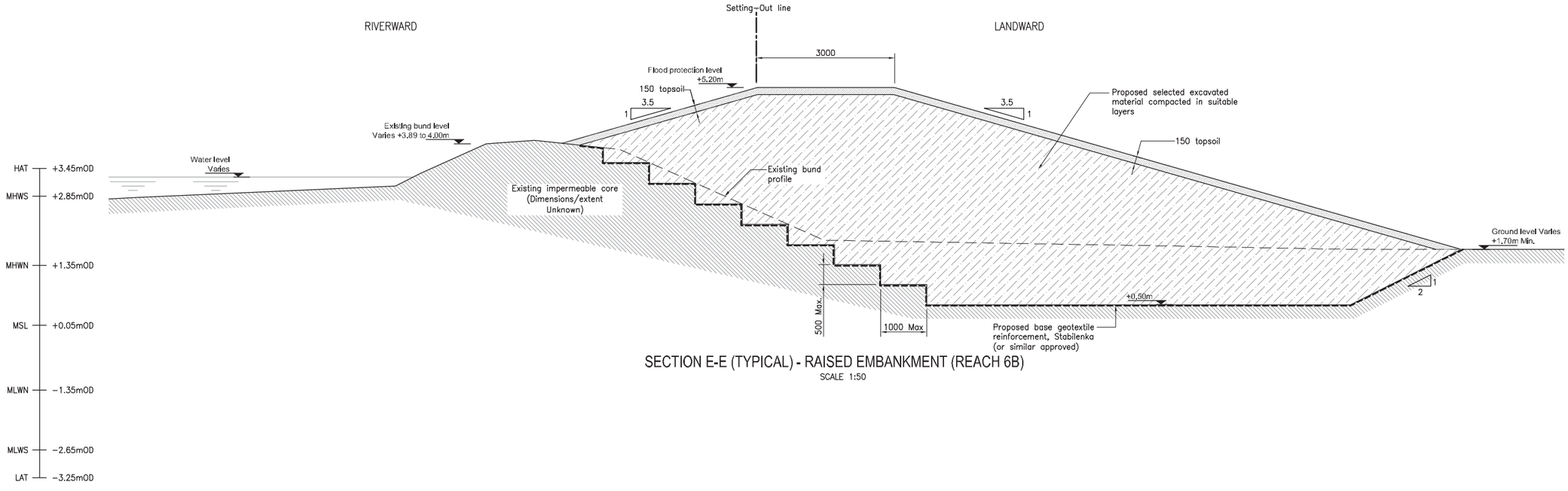
Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY
Halcrow

Project
LITTLEHAMPTON ARUN
EAST BANK TIDAL WALLS

Drawing
REACH 6
GENERAL ARRANGEMENT SECTIONS
(SHEET 1 OF 3)

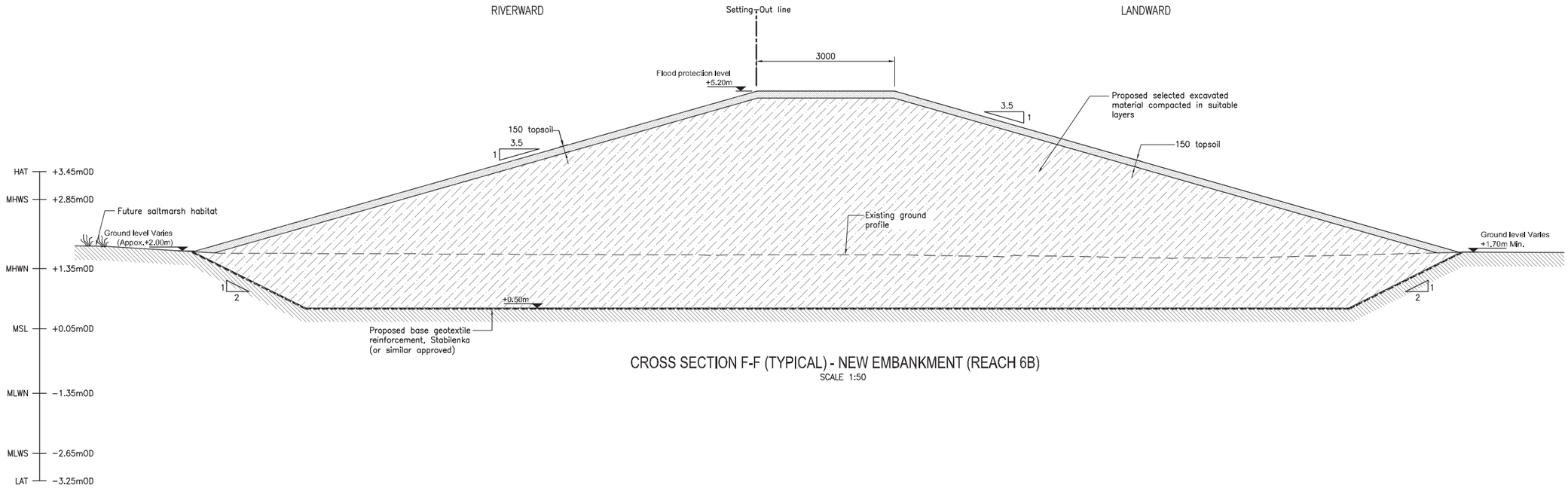
Drawn by	MCC	Date:	08.04.13
Checked by	TMH	Date:	
Authorised by		Date:	
Drawing No.	463457/CIVIL/602	Revision	P2
Drawing Scale:	As Shown at A1		
CAD Filename:	463457-CIVIL-602.dwg	Plot Scale:	1:1

Drawing name: S:\PROJECTS\Coastal\Littlehampton DD\CAD\463457–CIVIL–602.dwg
USER: CrowtherMC 10:34 – Apr 25, 2013
xrefs: UREF A1 Border [S:\PROJECTS\Coastal\Littlehampton DD\CAD\X–Ref\UREF A1 Border.dwg]



SECTION E-E (TYPICAL) - RAISED EMBANKMENT (REACH 6B)

SCALE 1:50



CROSS SECTION F-F (TYPICAL) - NEW EMBANKMENT (REACH 6B)

SCALE 1:50

WORK IN PROGRESS

0 1000 2000 3000 4000 5000

SCALE 1:50 (A1)
SCALE 1:100 (A3)

MILLIMETRES

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in millimetres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.

KEY

+3.70m Level above Ordnance Datum Newlyn

NOTE: DETAILS OF EXISTING STRUCTURES TAKEN FROM ARCHIVED DRAWINGS INDICATIVE ONLY (T.B.C. BY THE CONTRACTOR ON SITE)

SAFETY HEALTH AND ENVIRONMENT INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks:

Materials

Construction

Movement of materials during managed realignment construction works in areas subject to tidal and river flows.

Hazards to the public from unauthorised overnight access into satellite compound.

Falling objects when moving and placing gabions.

Sharp protrusions on rock gabions.

Restricted height under A259 bridge.

Requirement for work within the watercourse/on muddy foreshore

Disturbance to existing saltmarsh through contact with plant/materials and from seeding of adjacent embankments.

Disturbance to breeding or overwintering birds.

Potential for bats in trees on embankment

Health hazards associated with working with potential contaminated materials from disused sewage works.

Spread of the Japanese Knotweed identified on site.

Disturbance to potential water voles in ditch.

Disturbance to protected reptile populations on the embankment.

Maintenance

Sharp protrusions on rock gabions.

Work within the watercourse/on muddy foreshore.

Presence of reptiles

Revision	By	Checked	Approved	Date	Description
P2	MCC	TMH			SECTIONS UPDATED
P1	MCC	TMH		18/04/13	PRELIMINARY ISSUE

Client

ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY
Halcrow

Project

LITTLEHAMPTON ARUN
EAST BANK TIDAL WALLS

Drawing

REACH 6
GENERAL ARRANGEMENT SECTIONS
(SHEET 2 OF 3)

Drawn by	MCC	Date:	08.04.13
Checked by	TMH	Date:	
Authorised by		Date:	

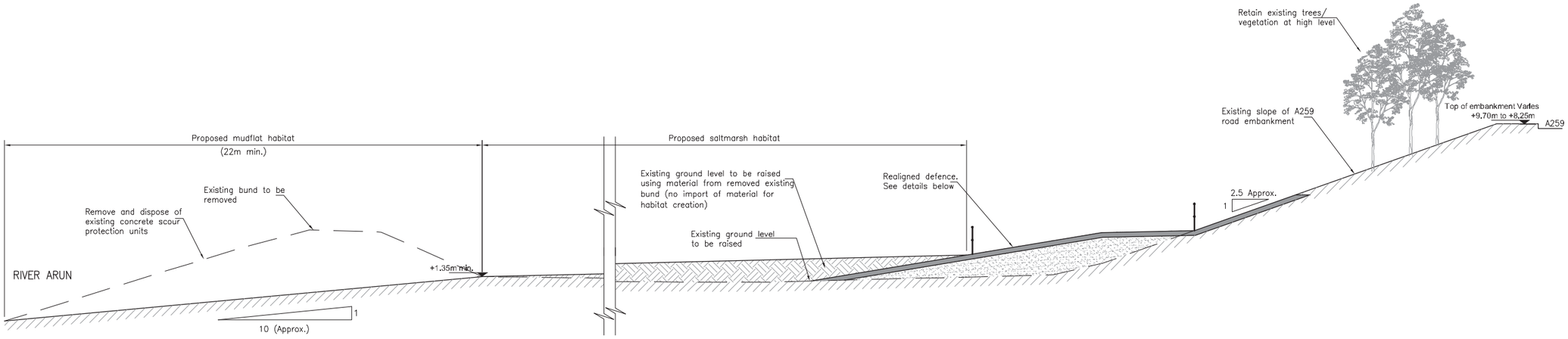
Drawing No. 463457/CIVIL/603

Revision P2

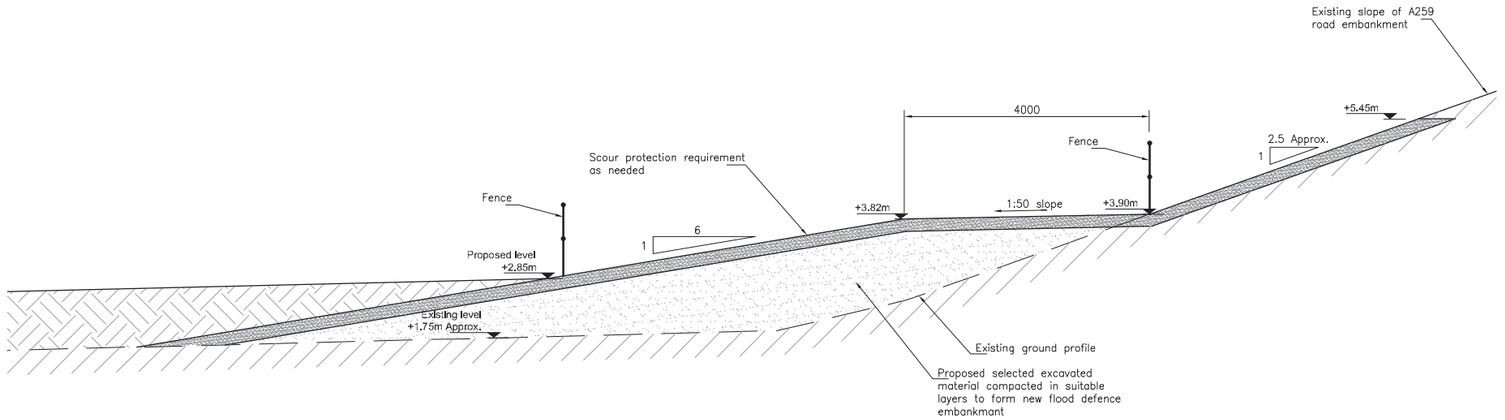
Drawing Scale: 1:50 at A1

CAD Filename: 463457-CIVIL-603.dwg Plot Scale: 1:1

Drawing name: \\swin-fs-05\Maritime\PROJECTS\Coastal\Littlehampton DD\CAD\463457-CIVIL-603.dwg
USER: CrowtherMC 12:39 - May 10, 2013
xrefs: HSG A1 Border [S:\PROJECTS\Coastal\Littlehampton DD\CAD\X-Ref\HSG A1 Border.dwg]



SECTION G-G (TYPICAL)
FLOOD DEFENCE AT EXISTING A259 ROAD EMBANKMENT
SCALE 1:100



REALIGNED DEFENCE DETAILS
SCALE 1:50

WORK IN PROGRESS

0 1000 2000 3000 4000 5000
SCALE 1:50 (A1)
SCALE 1:100 (A3)
MILLIMETRES

0 5 10
SCALE 1:100 (A1)
SCALE 1:200 (A3)
METRES

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in millimetres unless noted otherwise.
3. All levels are in metres above Ordnance Datum Newlyn.
4. Low level trees on road embankment to be removed by an Arboriculturist.

KEY

+3.70m — Level above Ordnance Datum Newlyn

NOTE: DETAILS OF EXISTING STRUCTURES TAKEN FROM ARCHIVED DRAWINGS INDICATIVE ONLY (T.B.C. BY THE CONTRACTOR ON SITE)

SAFETY HEALTH AND ENVIRONMENT INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks:

Materials

Construction
Movement of materials during managed realignment construction works in areas subject to tidal and river flows.
Hazards to the public from unauthorised overnight access into satellite compound.
Falling objects when moving and placing gabions.
Sharp protrusions on rock gabions.
Restricted height under A259 bridge.
Requirement for work within the watercourse/on muddy foreshore
Disturbance to existing saltmarsh through contact with plant/materials and from seeding of adjacent embankments.
Disturbance to breeding or overwintering birds.
Potential for bats in trees on embankment
Health hazards associated with working with potential contaminated materials from disused sewage works.
Spread of the Japanese Knotweed identified on site.
Disturbance to potential water voles in ditch.
Disturbance to protected reptile populations on the embankment.

Maintenance
Sharp protrusions on rock gabions.
Work within the watercourse/on muddy foreshore.
Presence of reptiles

Revision	By	Checked	Approved	Date	Description
P2	MCC	TMH			DEFENCES AMENDED
P1	MCC	TMH		18/04/13	PRELIMINARY ISSUE

Client
ENVIRONMENT AGENCY

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel. +44 (0) 1793 812479 & Fax +44 (0) 1793 812089
www.halcrow.com
A CH2M HILL COMPANY
Halcrow

Project
LITTLEHAMPTON ARUN
EAST BANK TIDAL WALLS

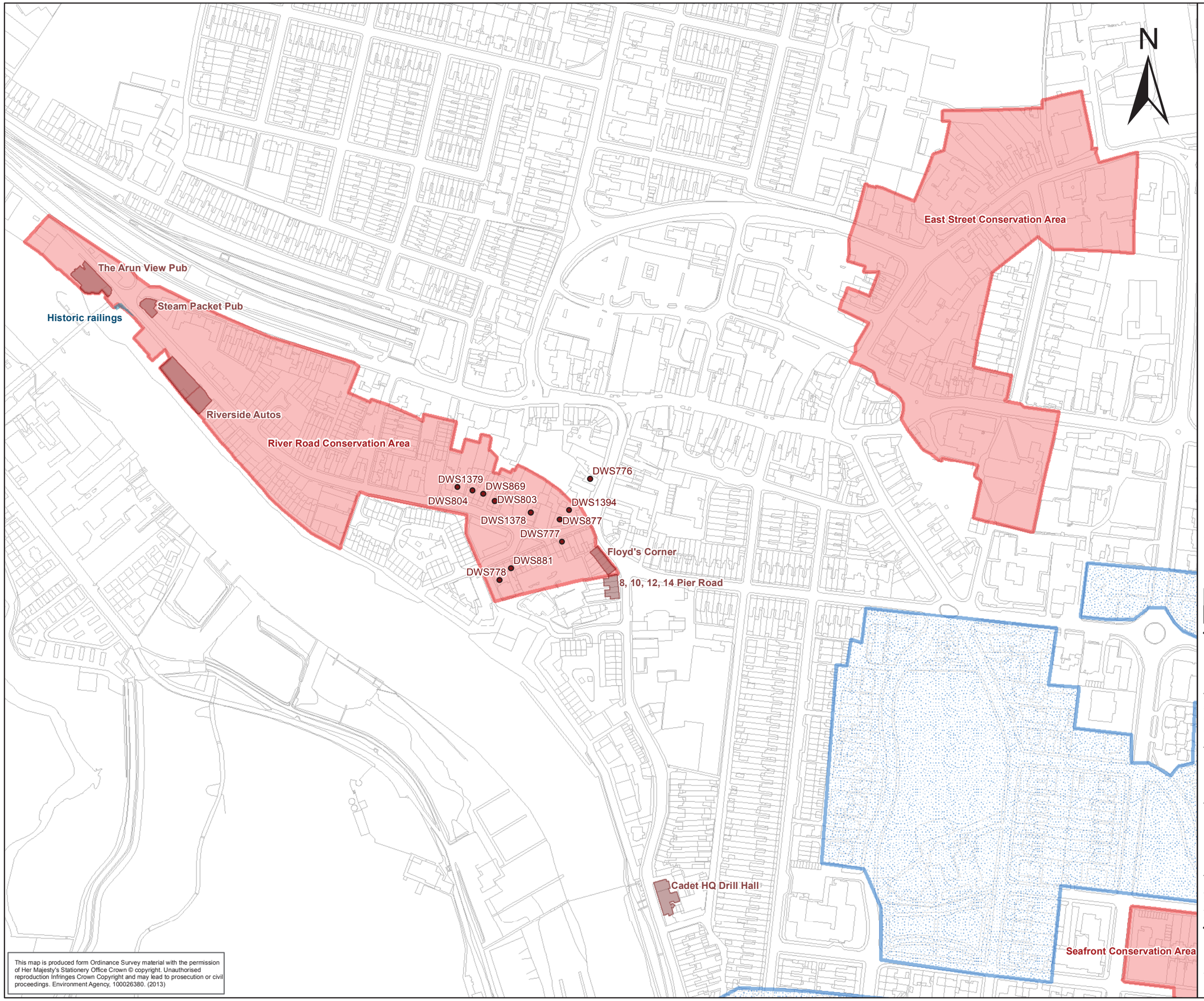
Drawing
REACH 6
GENERAL ARRANGEMENT SECTIONS
(SHEET 3 OF 3)

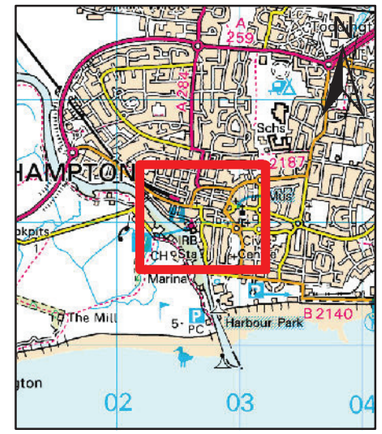
Drawn by	MCC	Date:	08.04.13
Checked by	TMH	Date:	
Authorised by		Date:	

Drawing No. 463457/CIVIL/604
Revision P2

Drawing Scale: As Shown at A1
CAD Filename: 463457-CIVIL-604.dwg
Plot Scale: 1:1

Drawing name: S:\PROJECTS\Coastal\Littlehampton DD\CAD\463457-CIVIL-604.dwg
USER: CrowtherMC 09:17 – May 15, 2013
xrefs: GREY A1 Border [S:\PROJECTS\Coastal\Littlehampton DD\CAD\X-Ref\GREY A1 Border.dwg]





Key:

- Listed Buildings
- Locally Listed Buildings
- Local Heritage
- Conservation Areas
- Areas of Special Character

0 25 50 100 Metres

Original sheet size A3

Rev	By	Chkd	Apprvd	Date	Description

Client

Environment Agency

HALCROW GROUP LTD
A CH2M HILL COMPANY
Elms House
43 Brook Green, Hammersmith
London, W6 7EF
TEL: +44 (0) 20 3479 8000
FAX: +44 (0) 20 3479 8001
halcrowyolles.com

Halcrow
A CH2M HILL COMPANY

Project

Littlehampton Arun East Bank Tidal Walls

Drawing

Designated Cultural Heritage Assets

Drawn by:	Nick Stockwell	Date: 03/04/2013
Checked by:	Tim Curtis	Date: 03/04/2013
Approved by:	James Goad	Date: 03/04/2013

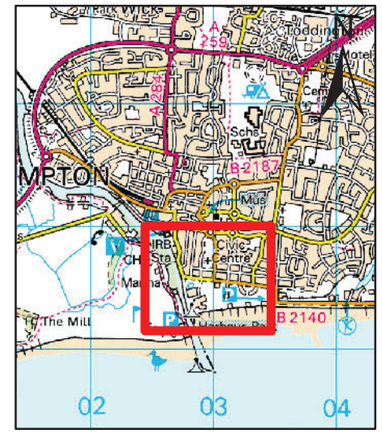
Drawing No.	Revision
Figure 6.1: NORTH	0

Drawing Scale:
1:3,000 @ A3

Drawing path: \\swin-fs-03\Geospatial\Projects\PN_463457MX\Dx\Fig1_Listed_North.mxd

River Road Conservation Area
Floyd's Corner
DWS881
DWS778
8, 10, 12, 14 Pier Road
Cadet HQ Drill Hall
South Terrace
South Terrace A.S.C.
Seafront Conservation Area
Lighthouse
Pier
LITTLEHAMPTON FORT

N



Key:

- Listed Buildings
- Conservation Areas
- Locally Listed Buildings
- Areas of Special Character
- Scheduled Monument

0 25 50 100
Metres

Original sheet size A3

Rev	By	Chkd	Apprvd	Date	Description

Client

Environment Agency

HALCROW GROUP LTD
A CH2M HILL COMPANY
Elms House
43 Brook Green, Hammersmith
London, W6 7EF
TEL: +44 (0) 20 3479 8000
FAX: +44 (0) 20 3479 8001
halcrowyolles.com

Halcrow
A CH2M HILL COMPANY

Project

Littlehampton Arun East Bank Tidal Walls

Drawing

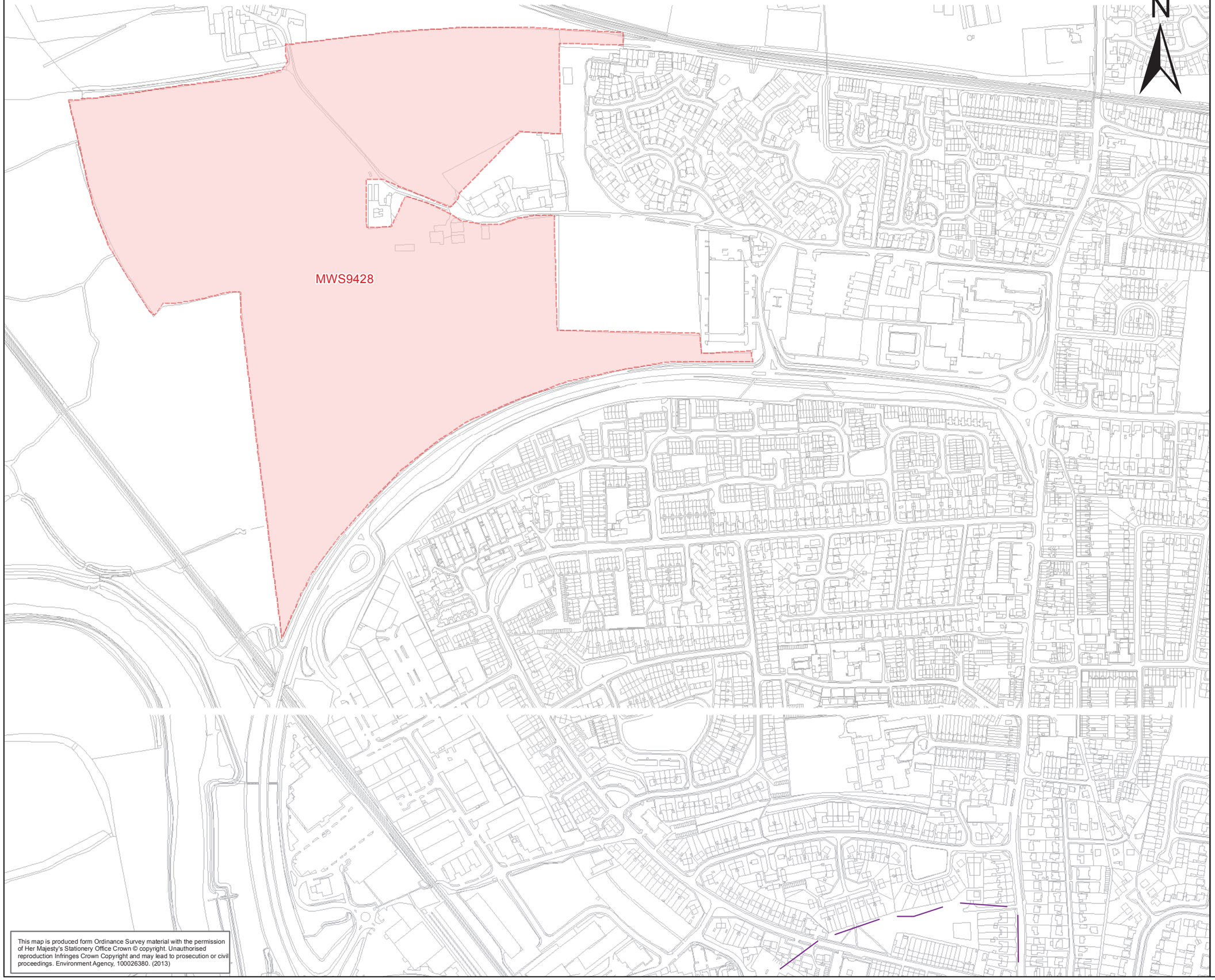
Designated Cultural Heritage Assets

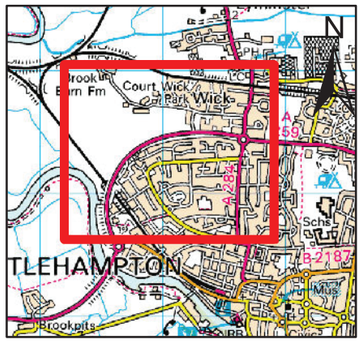
Drawn by:	Nick Stockwell	Date: 03/04/2013
Checked by:	Tim Curtis	Date: 03/04/2013
Approved by:	James Goad	Date: 03/04/2013

Drawing No.	Revision
Figure 6.2: SOUTH	0

Drawing Scale:
1:3,000 @ A3

Drawing file path: \\swin-fs-05\Geospatial\Projects\IPN_46345?MXDs\Fig2_Listed_South.mxd





Key:

- HER Data point
- HER Data line
- HER Data polygon
- Scheduled Monument

0 25 50 100 150 200
Metres

Original sheet size A3

Rev	By	Chkd	Apprvd	Date	Description

Client

Environment Agency

HALCROW GROUP LTD
A CH2M HILL COMPANY
Elms House
43 Brook Green, Hammersmith
London, W6 7EF
TEL: +44 (0) 20 3479 8000
FAX: +44 (0) 20 3479 8001
halcrowyolles.com

Halcrow
A CH2M HILL COMPANY

Project

Littlehampton Arun East Bank Tidal Walls

Drawing

Non-Designated Cultural Heritage Assets

Drawn by:	Nick Stockwell	Date: 03/04/2013
Checked by:	Tim Curtis	Date: 03/04/2013
Approved by:	James Goad	Date: 03/04/2013

Drawing No.

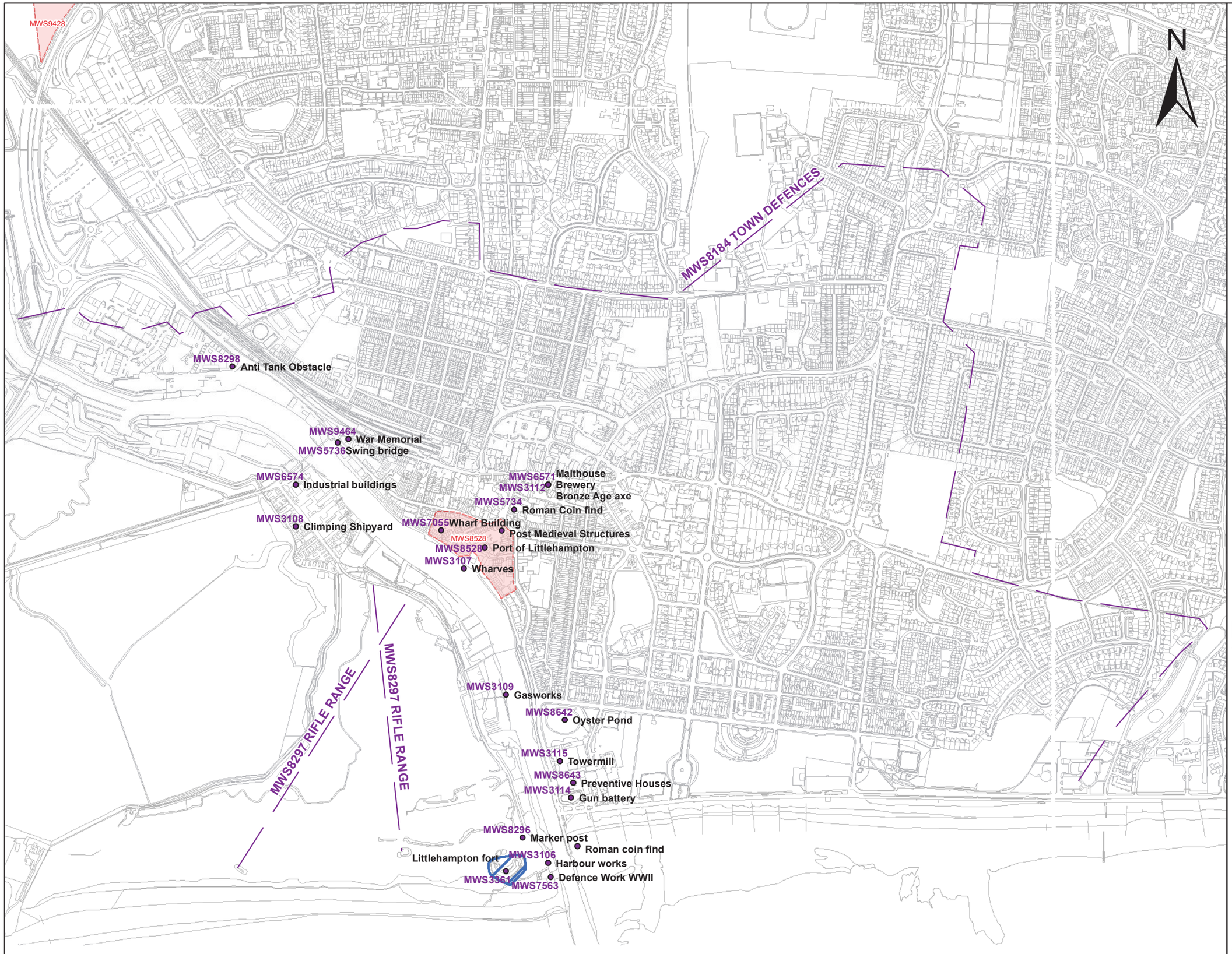
Figure 6.3: NORTH

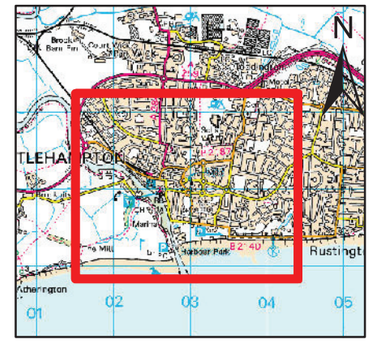
Revision

0

Drawing Scale:
1:5000 @ A3

Drawing file path: \\swin-fs-05\Geospatial\Projects\PN_46345?MXDs\Fig3_ Non-designated_ South.mxd





Key:

- HER Data point
- HER Data line
- HER Data polygon
- Scheduled Monument

0 50 100 200 300 400 Metres

Original sheet size A3

Rev	By	Chkd	Apprvd	Date	Description

Client

Environment Agency

HALCROW GROUP LTD
A CH2M HILL COMPANY
Elms House
43 Brook Green, Hammersmith
London, W6 7EF
TEL: +44 (0) 20 3479 8000
FAX: +44 (0) 20 3479 8001
halcrowyolles.com

Halcrow
A CH2M HILL COMPANY

Project

Littlehampton Arun East Bank Tidal Walls

Drawing

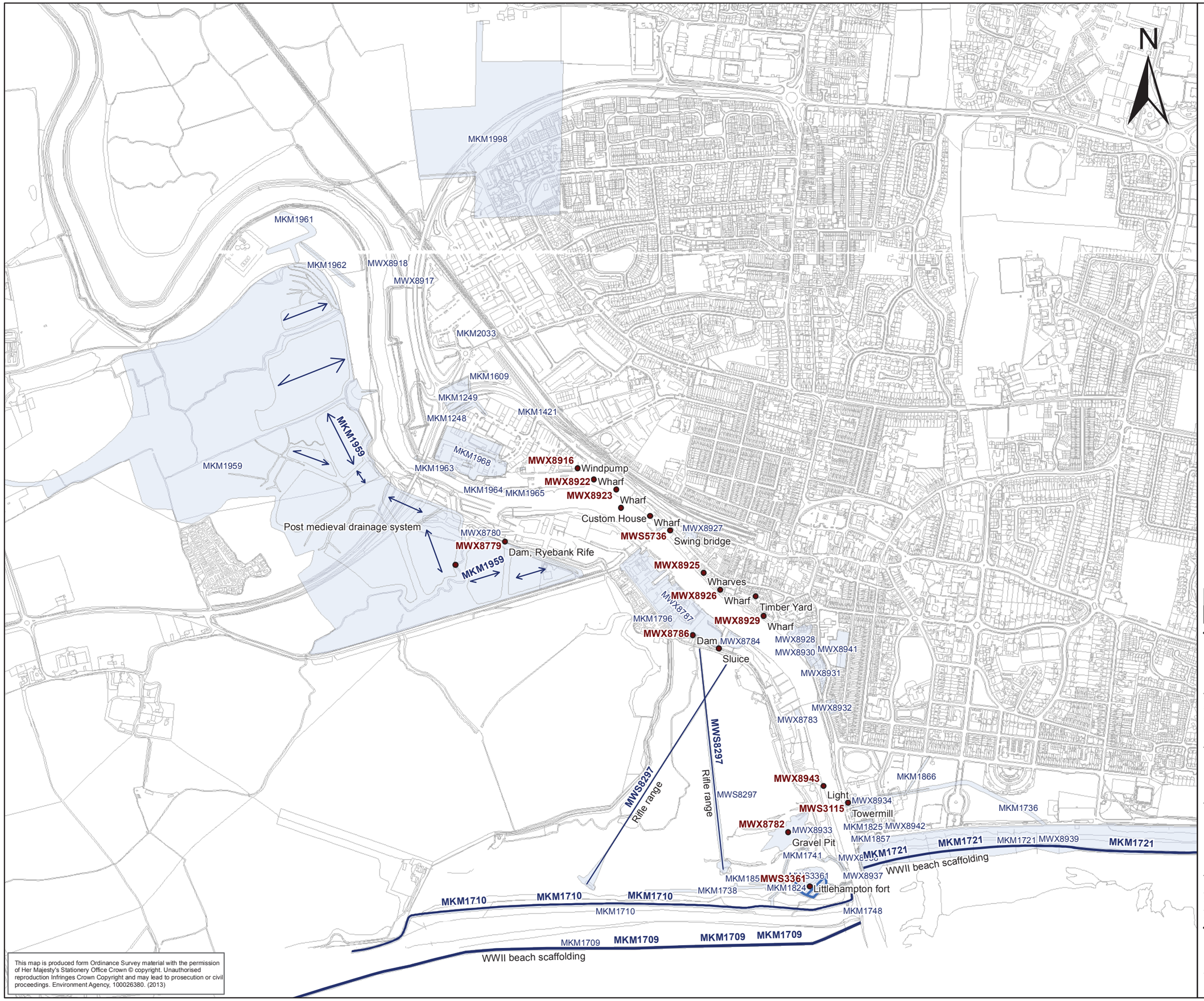
Non-Designated Cultural Heritage Assets

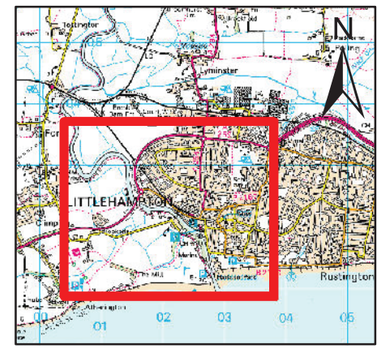
Drawn by:	Nick Stockwell	Date: 03/04/2013
Checked by:	Tim Curtis	Date: 03/04/2013
Approved by:	James Goad	Date: 03/04/2013

Drawing No.	Revision
Figure 6.4: SOUTH	0

Drawing Scale:
1:8500 @ A3

Drawing file path: \\swin-fs-05\Geospatial\Projects\PN_46345?MXDs\Fig3_Non-designated_South.mxd





Key:

- RCZAS line
- Scheduled Monument
- RCZAS point
- RCZAS polygon

0 100 200 400 Metres

Original sheet size A3

Rev	By	Chkd	Apprvd	Date	Description

Client

Environment Agency

HALCROW GROUP LTD
A CH2M HILL COMPANY
Elms House
43 Brook Green, Hammersmith
London, W6 7EF
TEL: +44 (0) 20 3479 8000
FAX: +44 (0) 20 3479 8001
halcrowyolles.com

Halcrow
A CH2M HILL COMPANY

Project

Littlehampton Arun East Bank Tidal Walls

Drawing

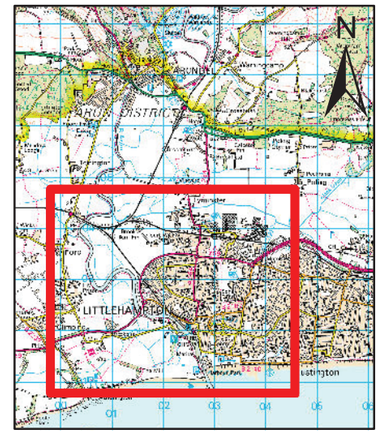
Rapid Coastal Zone Assessment Data

Drawn by:	Nick Stockwell	Date: 03/04/2013
Checked by:	Tim Curtis	Date: 03/04/2013
Approved by:	James Goad	Date: 03/04/2013

Drawing No.	Revision
Figure 6.5	0

Drawing Scale:
1:10000@ A3

\\swin-fs05\Geospatial\Projects\PN_463457\MXDs\Fig5_RCZA.mxd



HLCType

- Dunes
- Expansion - other
- Expansion - suburbs
- Formal parkland
- Fort
- Golf courses
- Historic Core
- Informal Fieldscapes
- Informal parkland
- Marinas
- Other Industry
- Ponds
- Processing
- Shingle & dunes
- Sports fields
- Stations & Sidings

0 125 250 500 Metres

Original sheet size A3

Rev	By	Chkd	Apprvd	Date	Description

Client

Environment Agency

HALCROW GROUP LTD
A CH2M HILL COMPANY
Elms House
43 Brook Green, Hammersmith
London, W6 7EF
TEL: +44 (0) 20 3479 8000
FAX: +44 (0) 20 3479 8001
halcrowyorkes.com

Halcrow
A CH2M HILL COMPANY

Project

Littlehampton Arun East Bank Tidal Walls

Drawing

Historic Landscape Character Data

Drawn by:	Nick Stockwell	Date: 03/04/2013
Checked by:	Tim Curtis	Date: 03/04/2013
Approved by:	James Goad	Date: 03/04/2013

Drawing No.

Figure 6.6

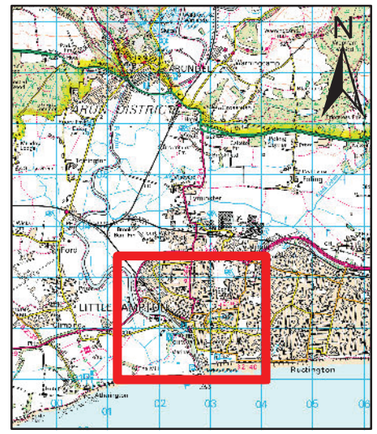
Revision

0

Drawing Scale:

1:14,000 @ A3

Drawing file path: \\swin-fs-05\GeospatialProjects\PN_48345\MXDs\Fig6_HLC.mxd



Historic Character Areas from the Extensive Urban Survey of West Sussex

- Study Area
- River Road - Low archaeological potential
- Station - Low archaeological potential
- Seafront - Low archaeological potential
- New Road - Low archaeological potential

0 75 150 300
Metres

Original sheet size A3

Rev	By	Chkd	Apprvd	Date	Description

Client

Environment Agency

HALCROW GROUP LTD
A CH2M HILL COMPANY
Elms House
43 Brook Green, Hammersmith
London, W6 7EF
TEL: +44 (0) 20 3479 8000
FAX: +44 (0) 20 3479 8001
halcrowyorkes.com

Halcrow
A CH2M HILL COMPANY

Project

Littlehampton Arun East Bank Tidal Walls

Drawing

Archaeological Sensitivity Plan

Drawn by:	Nick Stockwell	Date: 03/04/2013
Checked by:	Tim Curtis	Date: 03/04/2013
Approved by:	James Goad	Date: 03/04/2013

Drawing No.

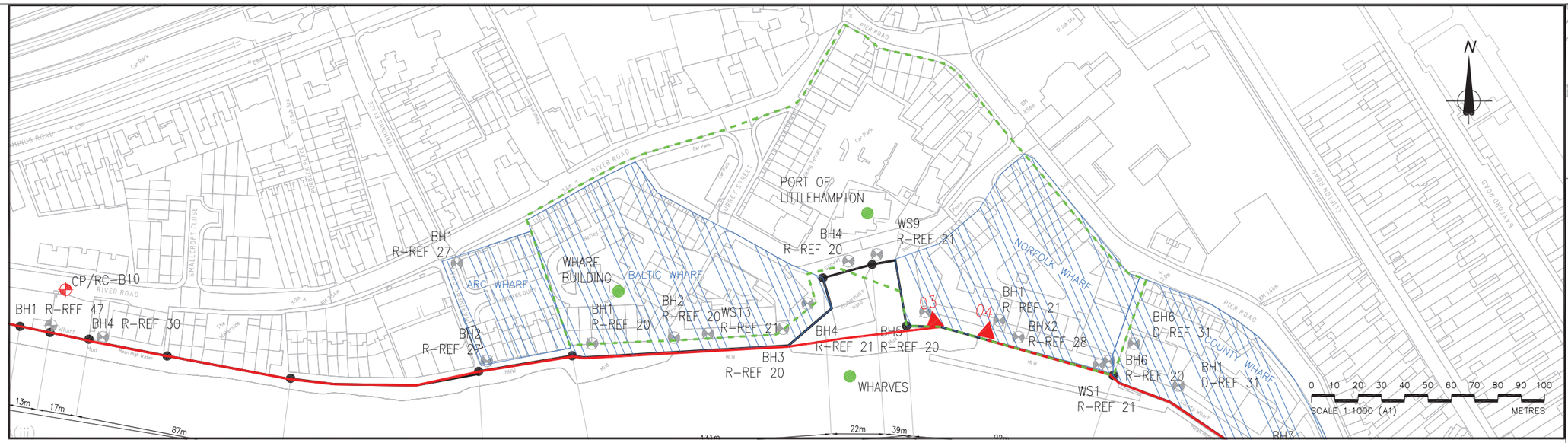
Figure 6.7

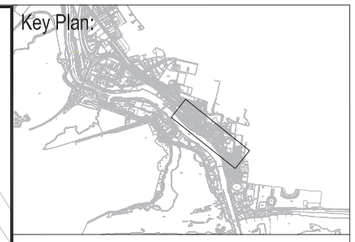
Revision

0

Drawing Scale:
1:8,500 @ A3

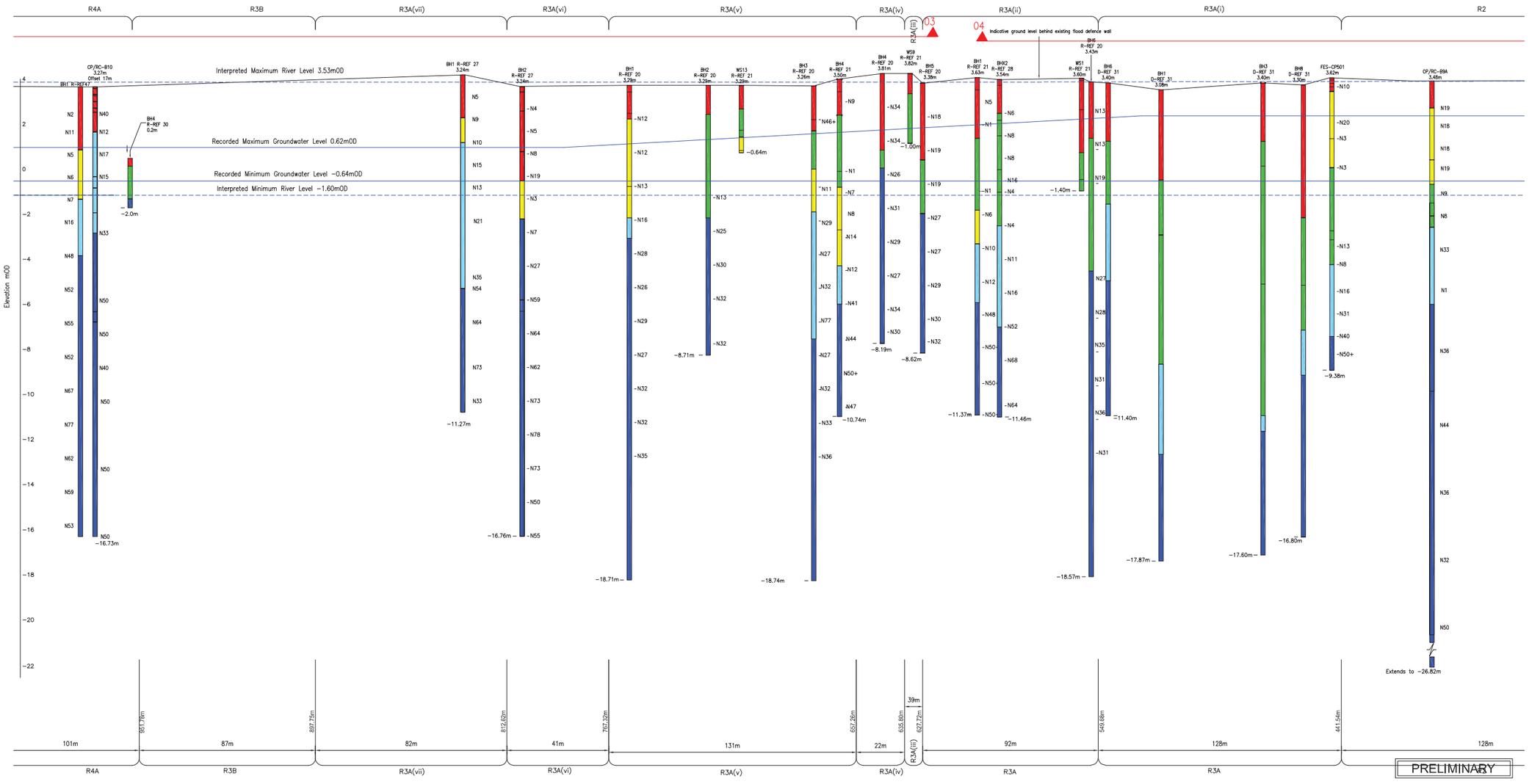
\\swin-fs-05\Geospatial\Projects\PN_483457\MXDs\Fig7_Archaeology.mxd





Notes:

1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS ARE IN METRES.
3. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM NEWLYN.
4. EXPLORATORY HOLES WITH THE PREFIX "FES10" WERE CARRIED OUT DURING THE 2010 GROUND INVESTIGATION BY FUGRO ENGINEERING SERVICES LTD.
5. EXPLORATORY HOLES WITH THE PREFIX "BGS" ARE ARCHIVED BOREHOLES OBTAINED FROM THE BRITISH GEOLOGICAL SURVEY.
6. EXPLORATORY HOLES WITH THE PREFIX "BH" ARE ARCHIVED BOREHOLES OBTAINED FROM HISTORIC GROUND INVESTIGATIONS. REFERENCE NUMBERS ASSOCIATED WITH EXPLORATORY HOLES REFER TO ARCHIVED GROUND INVESTIGATION REPORTS OR DRAWINGS REFERENCED IN THE PHASE 2 GEOTECHNICAL INTERPRETATIVE REPORT TEXT.
7. ALL OTHER EXPLORATORY HOLES WERE CARRIED OUT DURING THE 2012 GROUND INVESTIGATION BY FUGRO ENGINEERING SERVICES
8. GROUNDWATER AND RIVER LEVEL DATA ARE INTERPRETED BASED ON DATA OBTAINED FROM CERA DIVERS
9. RIVER ARUN WATER LEVEL DATA IS INTERPRETED FROM THE DIVER LOCATED AT THE RETRACTING FOOTBRIDGE IN REACH 3B



Rev	By	Chkd	Apprvd	Date	Description
-	-	-	-	-	-

Client

Environment Agency

Halcrow Group Limited
Red Hill House, 227 London Road, Worcester, WR5 2JG
Tel: 01905 361361 Fax: 01905 361362
www.halcrow.com

Halcrow

Project

Littlehampton Arun
East Bank Tidal Walls

Drawing

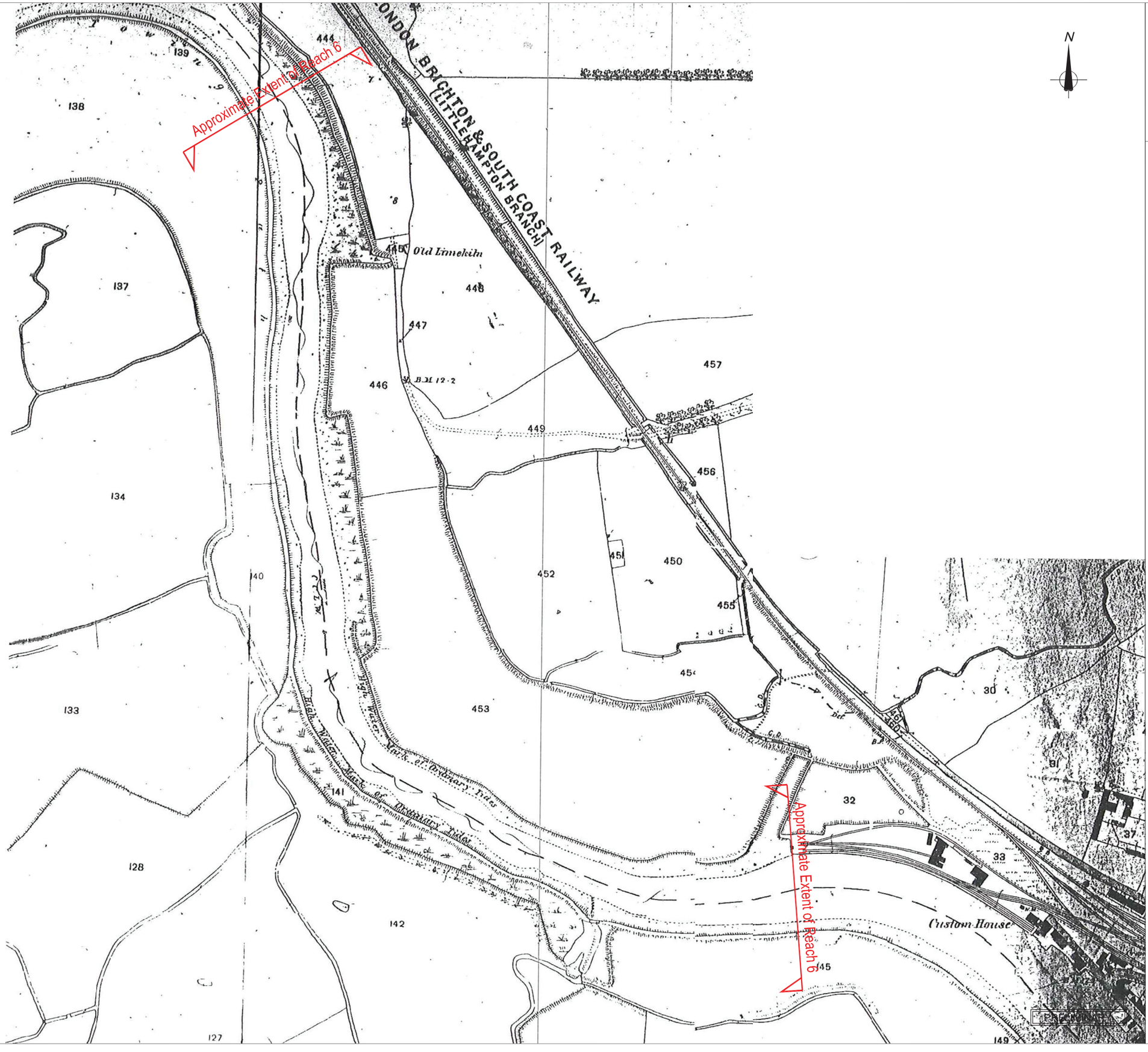
Ground Investigation Results and Known Archaeology

Drawn by: DP	Date: 11/03/13
Checked by: JG	Date: 11/03/13
Approved by: JG	Date: 11/03/13
Drawing No. Figure 6.8	Revision

Drawing Scale: 1:1000 at A1

Drawing file path & name : \\worcs-fs-01\Consulting\DCARUN - Arun Tidal Walls\98.0 Drawings\98.1 Working Drawings\ES Figs 2013\ Figure 6.8.dwg
Xreference file path : \\worcs-fs-01\Consulting\DCARUN - Arun Tidal Walls\98.0 Drawings\98.1 Working Drawings\ES Figs 2013\
User and Plot Date : msanders 5 : 24/2013 - 11:4 am

Xref .\02 XRefs\A1 V Frame.dwg



N

Key Plan:

Notes:

1. DO NOT SCALE FROM THIS DRAWING.

Rev	By	Chkd	Apprvd	Date	Description
-	-	-	-	-	-

Client

Environment Agency

Halcrow Group Limited
Red Hill House, 227 London Road, Worcester, WR5 2JG
Tel: 01905 361361 Fax: 01905 361362
www.halcrow.com

Halcrow

Project

Littlehampton Arun
East Bank Tidal Walls

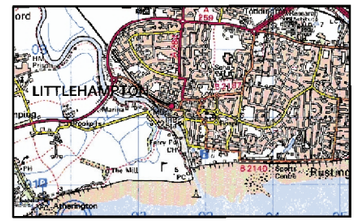
Drawing

Ordnance Survey West Sussex
LX111/13, 1:2500, 1876
Reach 6 and Reach 6 Realignment

Drawn by: MMS	Date: 21/05/13
Checked by: JG	Date: 21/05/13
Approved by: JG	Date: 21/05/13
Drawing No. Figure 6.9	Revision
Drawing Scale: NTS	

Drawing file path & name : \\wcnas-fs1\Lamc2\Com\Consulting\DCARN\ - Arun Tidal Walls\06 Drawings\ES Fig 2013\ Figure 6.5.dwg
Xreference file path : \\wcnas-fs1\Lamc2\Com\Consulting\DCARN\ - Arun Tidal Walls\06 Drawings\ES Fig 2013\
User and Plot Date: - matthews5 - 28/5/2014 - 11:5 am

Location Plan :



Legend

- Scattered scrub
- Dense scrub
- Buildings and hard-standing
- Flowing water - brackish
- Intertidal cobbles/shingle
- Salt marsh
- Arable
- Amenity grassland
- Coastal grassland
- Dune grassland
- Open dune
- Inter-tidal mud/sand
- 1 Target Notes

0 125 250 500

Meters

Rev.	By	Date	Description

Halcrow
A CH2M HILL COMPANY
www.halcrow.com
Elms House
43 Brook Green
London
W6 7EF

Client: Environment Agency

Project : RIVER ARUN PAR

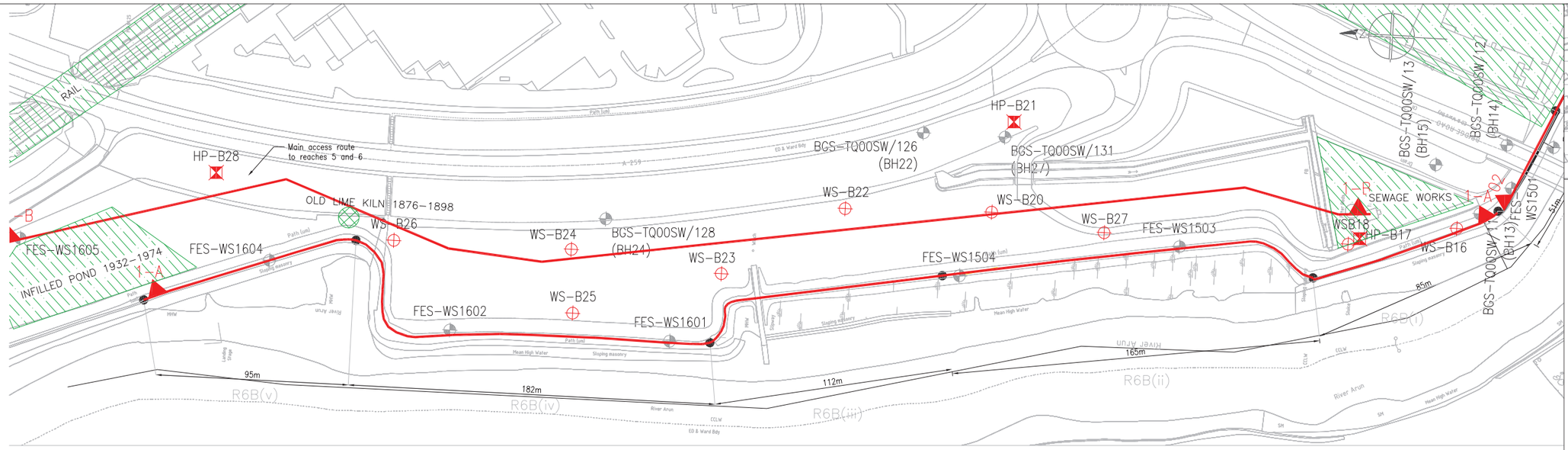
Drawing: Figure 7.1 – Phase 1 Habitat Plan

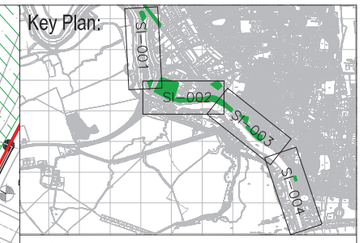
Drawn By : FM	Date : 23 Oct 2012
Checked By : AH	Date : 23 Oct 2012
Approved By : JW	Date : 23 Oct 2012

Drawing No. : DCARUN040/Figure 7.1

Revision : B

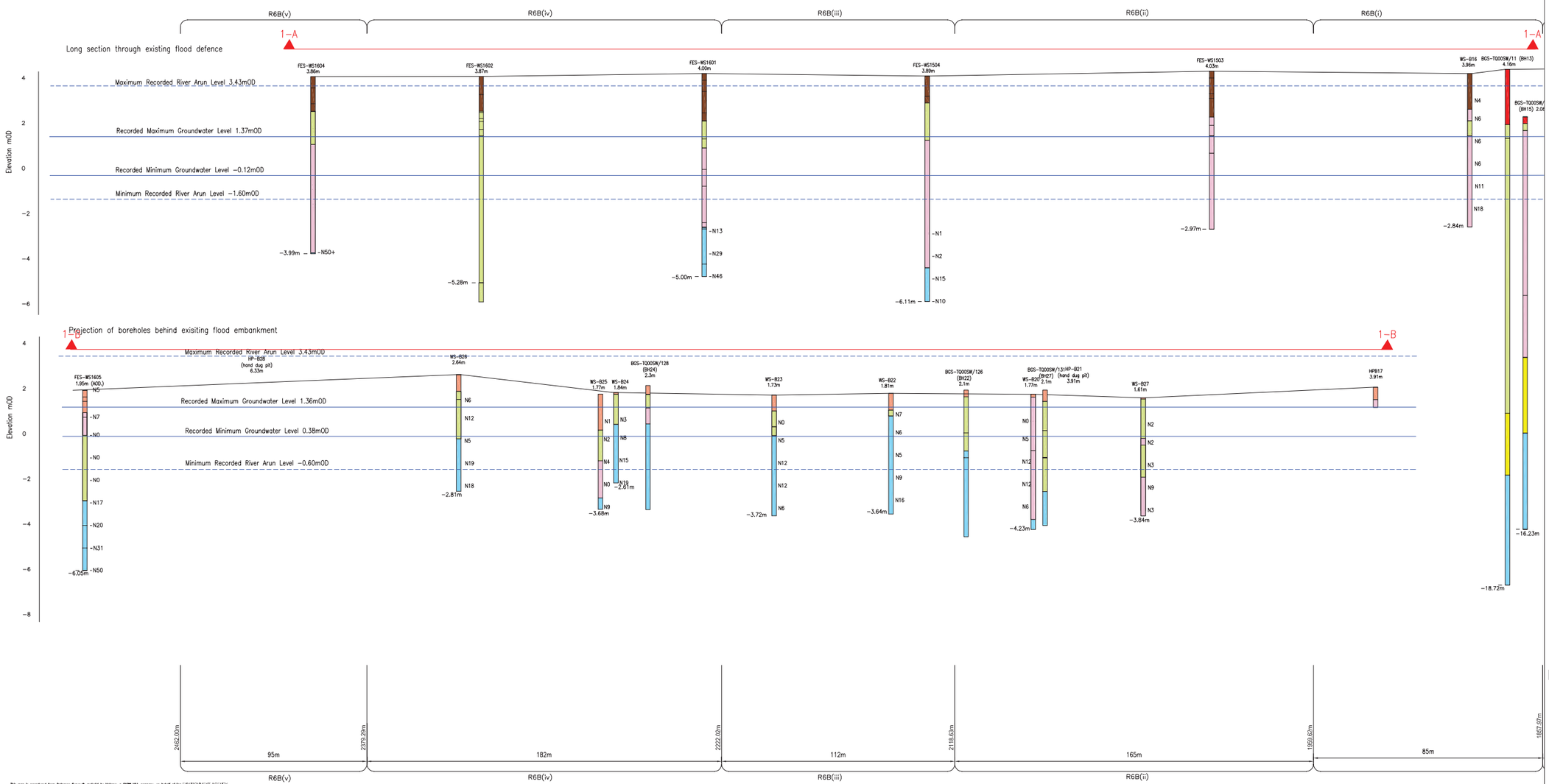
Drawing Scale : 1:10,000 Plot Scale : 1:10,000 @ A3





Notes:

1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS ARE IN METRES.
3. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM NEWLYN.
4. EXPLORATORY HOLES WITH THE PREFIX "FES10" WERE CARRIED OUT DURING THE 2010 GROUND INVESTIGATION BY FUGRO ENGINEERING SERVICES LTD.
5. EXPLORATORY HOLES WITH THE PREFIX "BGS" ARE ARCHIVED BOREHOLES OBTAINED FROM THE BRITISH GEOLOGICAL SURVEY.
6. EXPLORATORY HOLES WITH THE PREFIX "BH" ARE ARCHIVED BOREHOLES OBTAINED FROM HISTORIC GROUND INVESTIGATIONS. REFERENCE NUMBERS ASSOCIATED WITH EXPLORATORY HOLES REFER TO ARCHIVED GROUND INVESTIGATION REPORTS OR DRAWINGS REFERENCED IN THE PHASE 2 GEOTECHNICAL INTERPRETATIVE REPORT TEXT.
7. ALL OTHER EXPLORATORY HOLES WERE CARRIED OUT DURING THE 2012 GROUND INVESTIGATION BY FUGRO ENGINEERING SERVICES
8. GROUNDWATER AND RIVER LEVEL DATA ARE INTERPRETED BASED ON DATA OBTAINED FROM CERA DIVERS
9. RIVER ARUN WATER LEVEL DATA IS INTERPRETED FROM THE DIVER LOCATED AT THE RETRACTING FOOTBRIDGE IN REACH 3B



Key

TP/HP-B15	= Hand-Dug Pit/ Trial Pit (2012 Investigation)
CPT-B1	= Cone Penetration Test (2012 Investigation)
CP/RC-B10	= Cable Percussion with Rotary Coring Follow-on (2012 Investigation)
WS-B23	= Window Sample (2012 Investigation)
BGS-TQ00SW/128 (BH24)	= BGS Exploratory Hole (See Note 8)
FES-WS1504	= FES 2010 Exploratory Hole (See Note 7)
BH1 R-REF 27	= Archived Report Exploratory Hole (See Note 9)
R1(i)	= Reach
39m	Total = Reach Length
2452.00m	= River Centre Chainage.
	= Groundwater Level.
	= River Arun Water Level
	= Former Creek (Unknown Depth)
04 04	= Section Line.
	= Made Ground Granular
	= Made Ground Cohesive
	= Flood Bund/ Embankment Fill
	= Granular Alluvium
	= Cohesive Alluvium
	= Alluvial Sands (cohesive)
	= Alluvial Sands (Granular)
	= Structureless Chalk
	= Structured Chalk
N7	= SPT 'N' Value

Rev	By	Chkd	Apprvd	Date	Description

Client

Environment Agency

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel +44 (0)1793 812479 Fax +44 (0)1793 812089
www.halcrow.com

A **CH2M HILL** COMPANY

Project

LITTLEHAMPTON
ARUN TIDAL DEFENCES
- EAST BANK

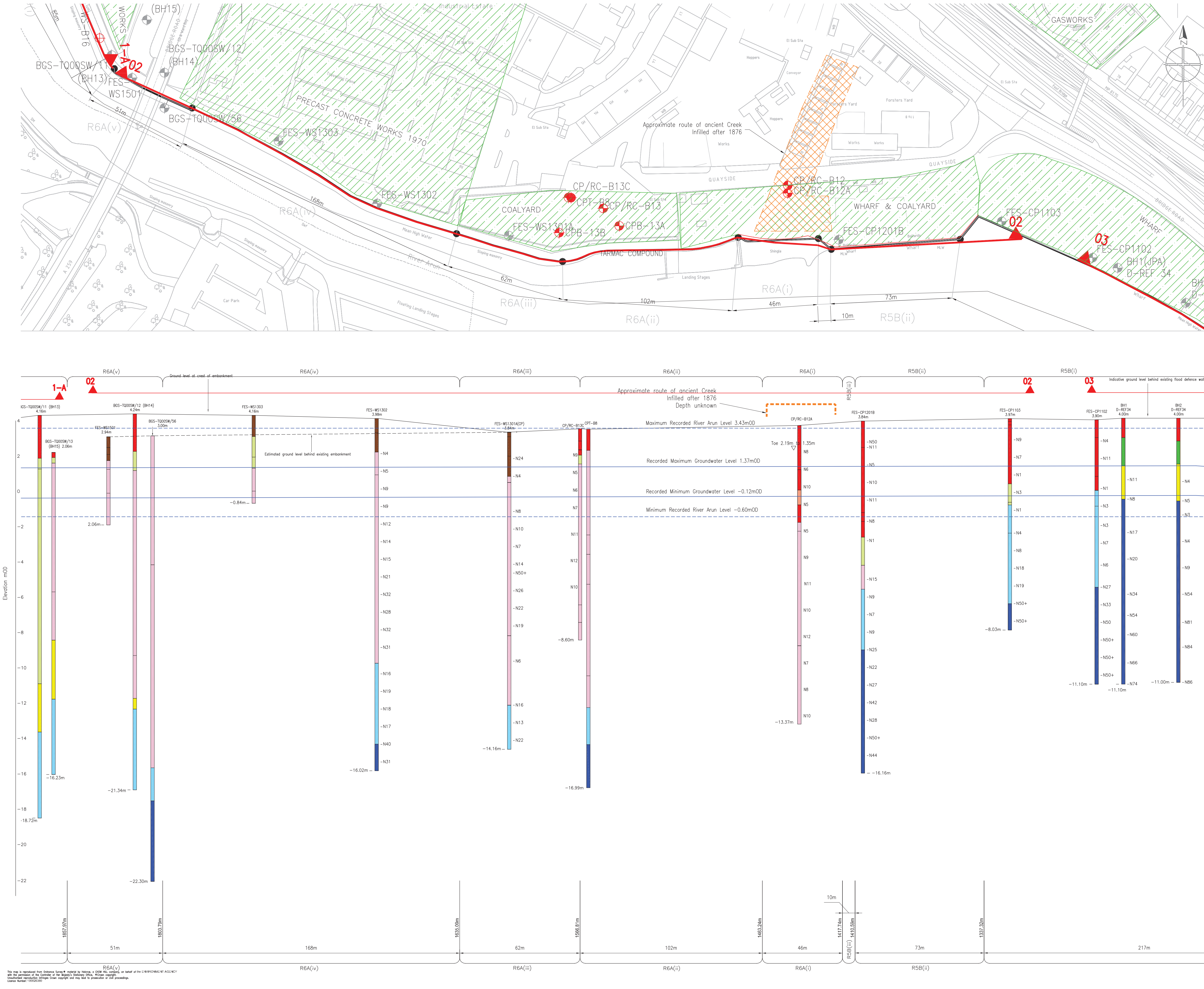
Drawing

FIGURE 8.1
GEO-ENVIRONMENTAL INTERPRETATIVE LONG SECTIONS SHEET 1 OF 4

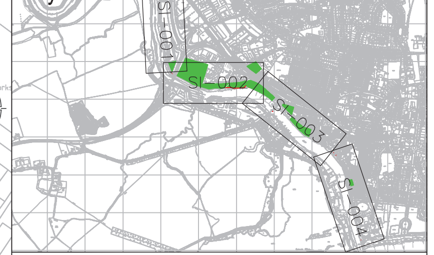
Drawn by: CK	Date: 28/05/13
Checked by:	Date:
Approved by: -	Date: -
Drawing No. 463457-SI-001/FIGURE8.1	Revision

Drawing Scale: 1:1000 at A1

Drawing file path & name :-
Xreference file path
User defined Data



Key Plan:



Notes:

1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS ARE IN METRES.
3. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM NEWLYN.
4. EXPLORATORY HOLES WITH THE PREFIX "FES10" WERE CARRIED OUT DURING THE 2010 GROUND INVESTIGATION BY FUGRO ENGINEERING SERVICES LTD.
5. EXPLORATORY HOLES WITH THE PREFIX "BGS" ARE ARCHIVED BOREHOLES OBTAINED FROM THE BRITISH GEOLOGICAL SURVEY.
6. EXPLORATORY HOLES WITH THE PREFIX "BH" ARE ARCHIVED BOREHOLES OBTAINED FROM HISTORIC GROUND INVESTIGATIONS. REFERENCE NUMBERS ASSOCIATED WITH EXPLORATORY HOLES REFER TO ARCHIVED GROUND INVESTIGATION REPORTS OR DRAWINGS REFERENCED IN THE PHASE 2 GEOTECHNICAL INTERPRETATIVE REPORT TEXT.
7. ALL OTHER EXPLORATORY HOLES WERE CARRIED OUT DURING THE 2012 GROUND INVESTIGATION BY FUGRO ENGINEERING SERVICES
8. GROUNDWATER AND RIVER LEVEL DATA ARE INTERPRETED BASED ON DATA OBTAINED FROM CERA DIVERS
9. RIVER ARUN WATER LEVEL DATA IS INTERPRETED FROM THE DIVER LOCATED AT THE RETRACTING FOOTBRIDGE IN REACH 3B

Key

- TP/HP–B15 = Hand–Dug Pit/ Trial Pit (2012 Investigation)
- CPT–B1 = Cone Penetration Test (2012 Investigation)
- CP/RC–B10 = Cable Percussion with Rotary Coring Follow–on (2012 Investigation)
- WS–B23 = Window Sample (2012 Investigation)
- BGS–TQ00SW/128 (BH24) = BGS Exploratory Hole (See Note 8)
- FES–WS1504 = FES 2010 Exploratory Hole (See Note 7)
- BH1 R–REF 27 = Archived Report Exploratory Hole (See Note 9)
- = Reach
- = Total Reach Length
- = River Centre Chainage.
- = Groundwater Level.
- = River Arun Water Level
- = Former Creek (Unknown Depth)
- = Section Line.
- = Made Ground Granular
- = Made Ground Cohesive
- = Flood Bund/ Embankment Fill
- = Granular Alluvium
- = Cohesive Alluvium
- = Alluvial Sands (cohesive)
- = Alluvial Sands (Granular)
- = Structureless Chalk
- = Structured Chalk
- N17 = SPT 'N' Value

Rev	By	Chkd	Apprvd	Date	Description

Client

Environment Agency

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel +44 (0)1793 812479 Fax +44 (0)1793 812089
www.halcrow.com

A CH2M HILL COMPANY

Halcrow

Project

LITTLEHAMPTON
ARUN TIDAL DEFENCES
- EAST BANK

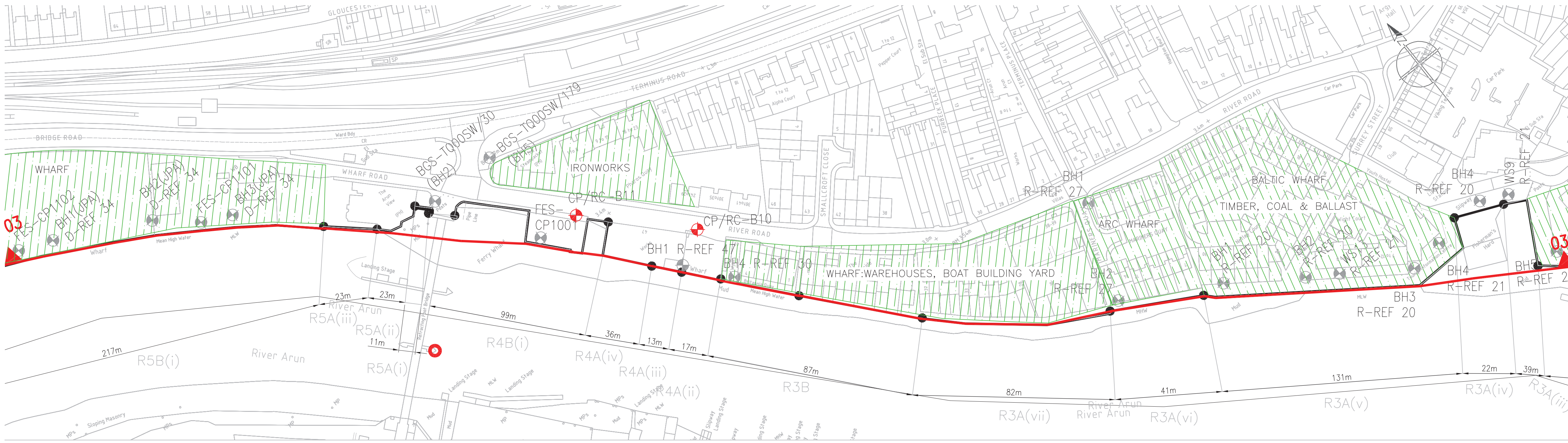
Drawing

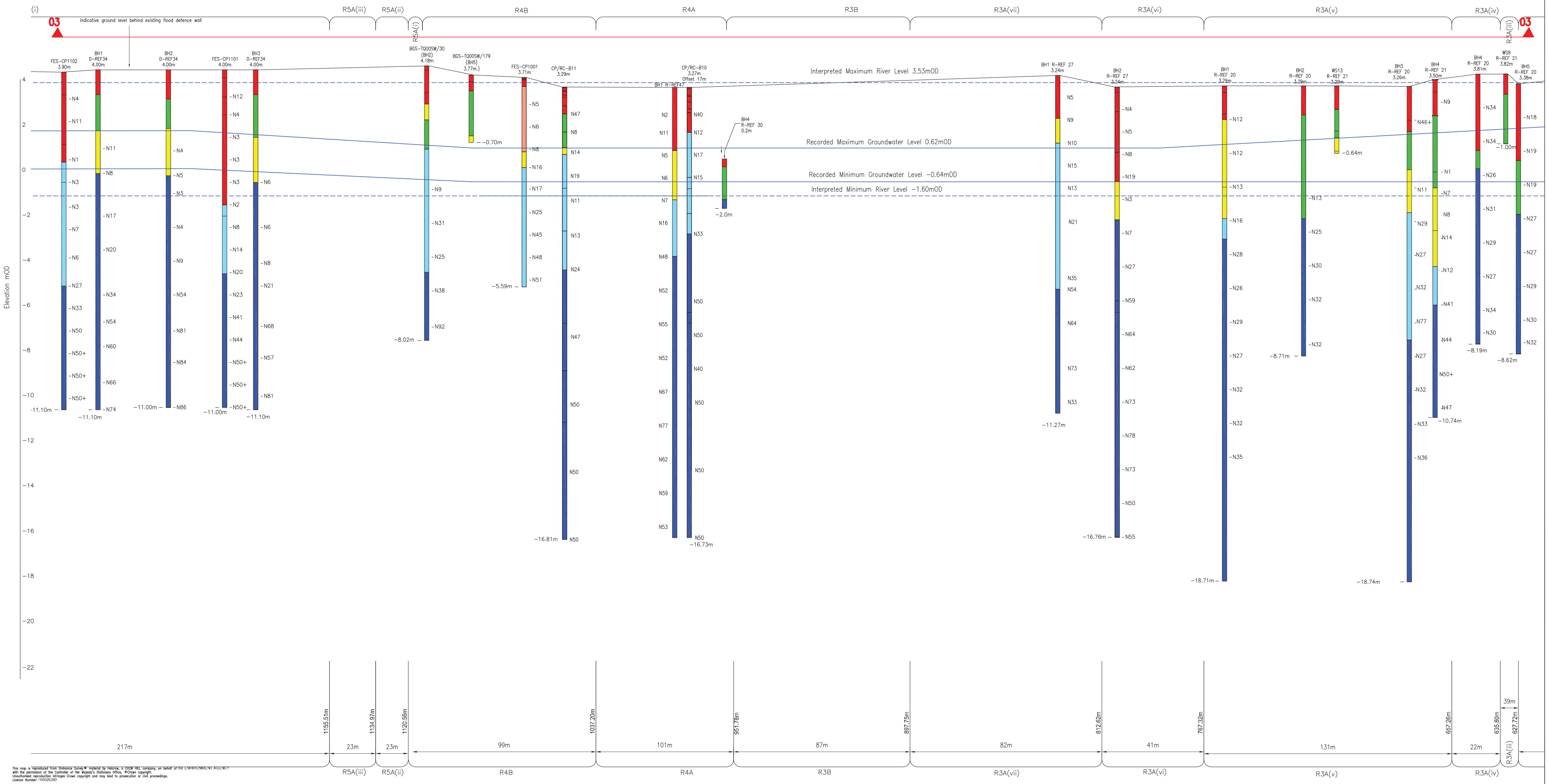
FIGURE 8.2
GEO-ENVIRONMENTAL INTERPRETIVE LONG SECTIONS
SHEET 2 OF 4

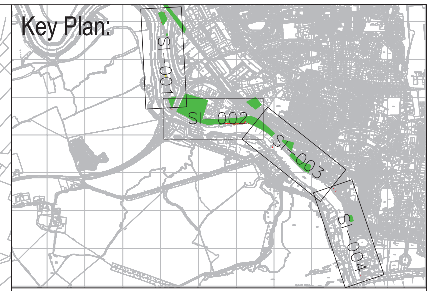
Drawn by: CK Date: 31/01/13
Checked by: 28/05/13 Date:
Approved by: - Date: -

Drawing No. 463457-SI-002/FIGURE8.2 Revision

Drawing Scale: 1:1000 at A1







Notes:

1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS ARE IN METRES.
3. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM NEWLYN.
4. EXPLORATORY HOLES WITH THE PREFIX "FES10" WERE CARRIED OUT DURING THE 2010 GROUND INVESTIGATION BY FUGRO ENGINEERING SERVICES LTD.
5. EXPLORATORY HOLES WITH THE PREFIX "BGS" ARE ARCHIVED BOREHOLES OBTAINED FROM THE BRITISH GEOLOGICAL SURVEY.
6. EXPLORATORY HOLES WITH THE PREFIX "BH" ARE ARCHIVED BOREHOLES OBTAINED FROM HISTORIC GROUND INVESTIGATIONS. REFERENCE NUMBERS ASSOCIATED WITH EXPLORATORY HOLES REFER TO ARCHIVED GROUND INVESTIGATION REPORTS OR DRAWINGS REFERENCED IN THE PHASE 2 GEOTECHNICAL INTERPRETATIVE REPORT TEXT.
7. ALL OTHER EXPLORATORY HOLES WERE CARRIED OUT DURING THE 2012 GROUND INVESTIGATION BY FUGRO ENGINEERING SERVICES
8. GROUNDWATER AND RIVER LEVEL DATA ARE INTERPRETED BASED ON DATA OBTAINED FROM CERA DIVERS
9. RIVER ARUN WATER LEVEL DATA IS INTERPRETED FROM THE DIVER LOCATED AT THE RETRACTING FOOTBRIDGE IN REACH 3B

Key

- TP/HP-B15 = Hand-Dug Pit/ Trial Pit (2012 Investigation)
- CPT-B1 = Cone Penetration Test (2012 Investigation)
- CP/RC-B10 = Cable Percussion with Rotary Coring Follow-on (2012 Investigation)
- WS-B23 = Window Sample (2012 Investigation)
- BGS-TQ00SW/128 (BH24) = BGS Exploratory Hole (See Note 8)
- FES-WS1504 = FES 2010 Exploratory Hole (See Note 7)
- BH1 R-REF 27 = Archived Report Exploratory Hole (See Note 9)
- R1(i) = Reach
- 39m = Total Reach Length
- = River Centre Chainage.
- = Groundwater Level.
- = River Arun Water Level
- = Former Creek (Unknown Depth)
- 04 04 = Section Line.
- = Location of River Diver
- = Made Ground Granular
- = Made Ground Cohesive
- = Flood Bund/ Embankment Fill
- = Granular Alluvium
- = Cohesive Alluvium
- = Alluvial Sands (cohesive)
- = Alluvial Sands (Granular)
- = Structureless Chalk
- = Structured Chalk
- N17 = SPT 'N' Value

Rev	By	Chkd	Apprvd	Date	Description

Client

Environment Agency

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel +44 (0)1793 812479 Fax +44 (0)1793 812089
www.halcrow.com

A CH2M HILL COMPANY

Halcrow

Project

LITTLEHAMPTON
ARUN TIDAL DEFENCES
- EAST BANK

Drawing

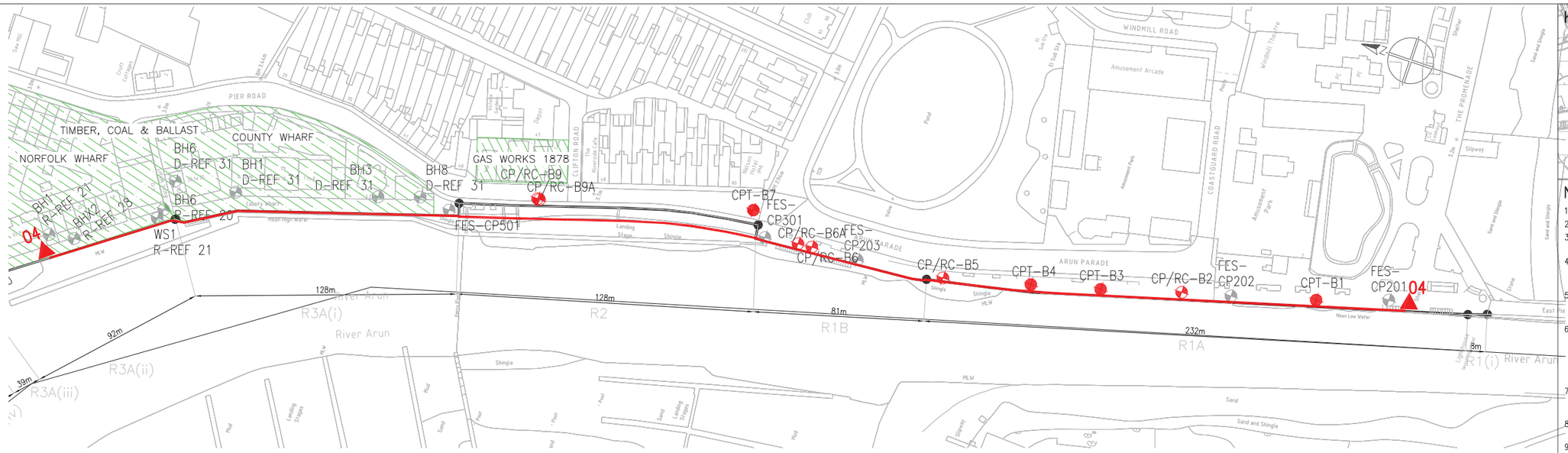
FIGURE 8.3 GEO-ENVIRONMENTAL INTERPRETIVE LONG SECTIONS SHEET 3 OF 4

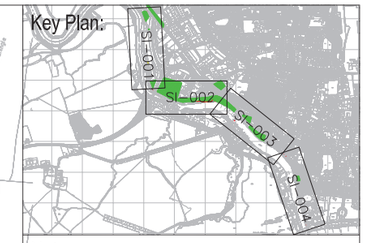
Drawn by: CK	Date: 28/05/13
Checked by: LR	Date: 04/02/12
Approved by: GG	Date: 04/02/12

Drawing No. 463457-SI-003/FIGURE8.3

Revision

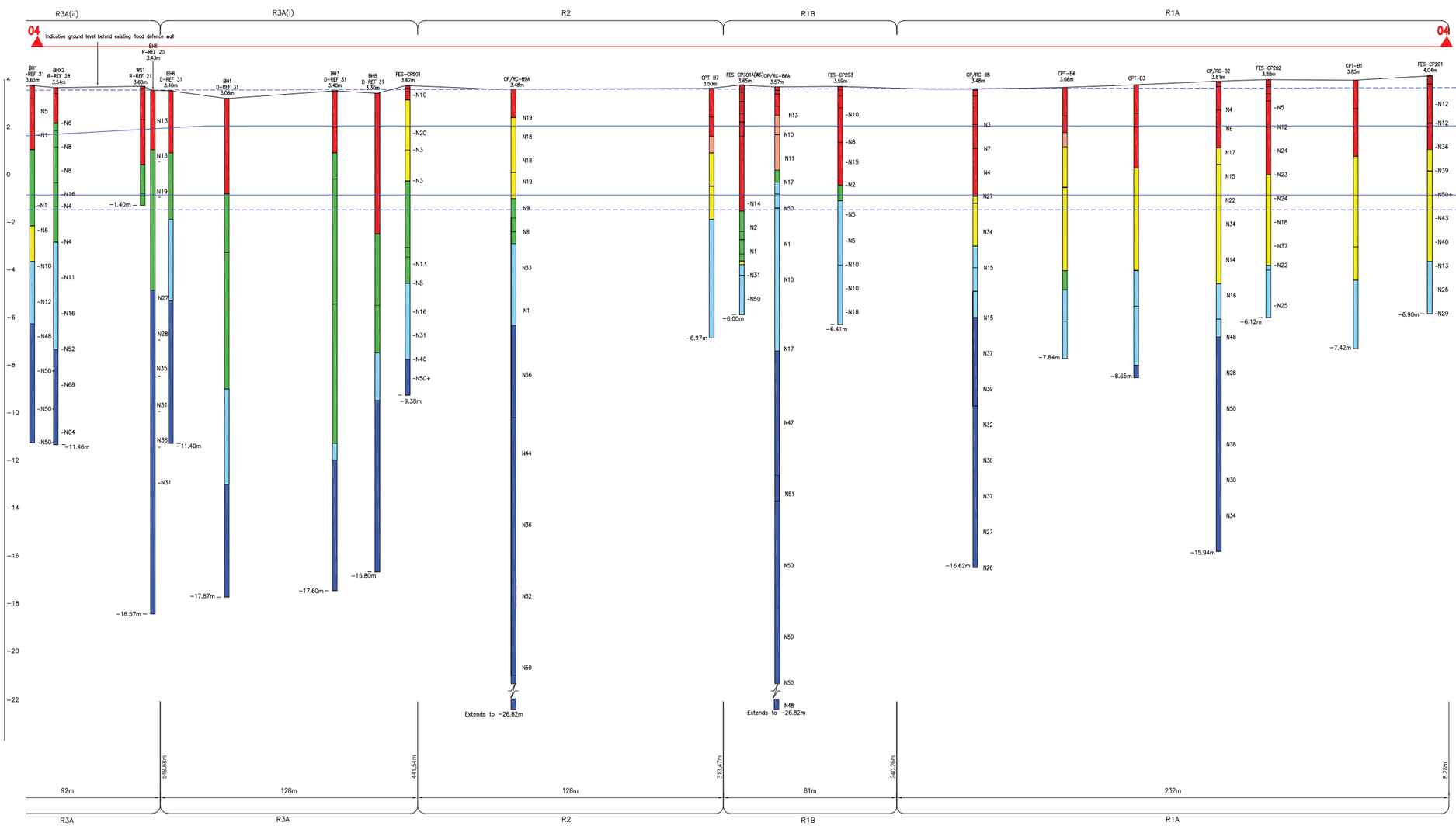
Drawing Scale: 1:1000 at A1





Notes:

1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS ARE IN METRES.
3. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM NEWLYN..
4. EXPLORATORY HOLES WITH THE PREFIX "FES10" WERE CARRIED OUT DURING THE 2010 GROUND INVESTIGATION BY FUGRO ENGINEERING SERVICES LTD.
5. EXPLORATORY HOLES WITH THE PREFIX "BGS" ARE ARCHIVED BOREHOLES OBTAINED FROM THE BRITISH GEOLOGICAL SURVEY.
6. EXPLORATORY HOLES WITH THE PREFIX "BH" ARE ARCHIVED BOREHOLES OBTAINED FROM HISTORIC GROUND INVESTIGATIONS. REFERENCE NUMBERS ASSOCIATED WITH EXPLORATORY HOLES REFER TO ARCHIVED GROUND INVESTIGATION REPORTS OR DRAWINGS REFERENCED IN THE PHASE 2 GEOTECHNICAL INTERPRETATIVE REPORT TEXT.
7. ALL OTHER EXPLORATORY HOLES WERE CARRIED OUT DURING THE 2012 GROUND INVESTIGATION BY FUGRO ENGINEERING SERVICES
8. GROUNDWATER AND RIVER LEVEL DATA ARE INTERPRETED BASED ON DATA OBTAINED FROM CERA DIVERS
9. RIVER ARUN WATER LEVEL DATA IS INTERPRETED FROM THE DIVER LOCATED AT THE RETRACTING FOOTBRIDGE IN REACH 3B



Key

- TP/HP-B15 = Hand-Dug Pit/ Trial Pit (2012 Investigation)
- CPT-B1 = Cone Penetration Test (2012 Investigation)
- CP/RC-B10 = Cable Percussion with Rotary Coring Follow-on (2012 Investigation)
- WS-B23 = Window Sample (2012 Investigation)
- BGS-TQ00SW/128 (BH24) = BGS Exploratory Hole (See Note 8)
- FES-WS1504 = FES 2010 Exploratory Hole (See Note 7)
- BH1 R-REF 27 = Archived Report Exploratory Hole (See Note 9)
- R1(i) = Reach
- 39m = Total Reach Length
- = River Centre Chainage.
- = Groundwater Level.
- = River Arun Water Level
- = Former Creek (Unknown Depth)
- 04 04 = Section Line.
- = Made Ground Granular
- = Made Ground Cohesive
- = Flood Bund/ Embankment Fill
- = Granular Alluvium
- = Cohesive Alluvium
- = Alluvial Sands (cohesive)
- = Alluvial Sands (Granular)
- = Structureless Chalk
- = Structured Chalk
- N17 = SPT 'N' Value

Rev	By	Chkd	Apprvd	Date	Description

Client

Environment Agency

Halcrow Group Limited
Burderop Park, Swindon, Wiltshire, SN4 0QD
Tel +44 (0)1793 812479 Fax +44 (0)1793 812089
www.halcrow.com

A **CH2M HILL** COMPANY

Project

LITTLEHAMPTON
ARUN TIDAL DEFENCES
- EAST BANK

Drawing

FIGURE 8.4
GEO-ENVIRONMENTAL INTERPRETIVE LONG SECTIONS SHEET 4 OF 4

Drawn by: CK	Date: 28/05/13
Checked by: LR	Date: 02/04/12
Approved by: GG	Date: 02/04/12

Drawing No.	Revision
463457-SI-004/FIGURE8.4	

Drawing Scale: 1:1000 at A1

Drawing file path & name : Xreference file path :

Would you like to find out more about us, or about your environment?

Then call us on

03708 506 506 (Mon-Fri 8-6)

Calls to 03 numbers cost the same as calls to standard geographic numbers (i.e. numbers beginning with 01 or 02).

email

enquiries@environment-agency.gov.uk

or visit our website

www.environment-agency.gov.uk

incident hotline 0800 80 70 60 (24hrs)
floodline 0845 988 1188

Environment first: Are you viewing this on screen? Please consider the environment and only print if absolutely necessary. If you are reading a paper copy, please don't forget to reuse and recycle if possible.

LIT 8339