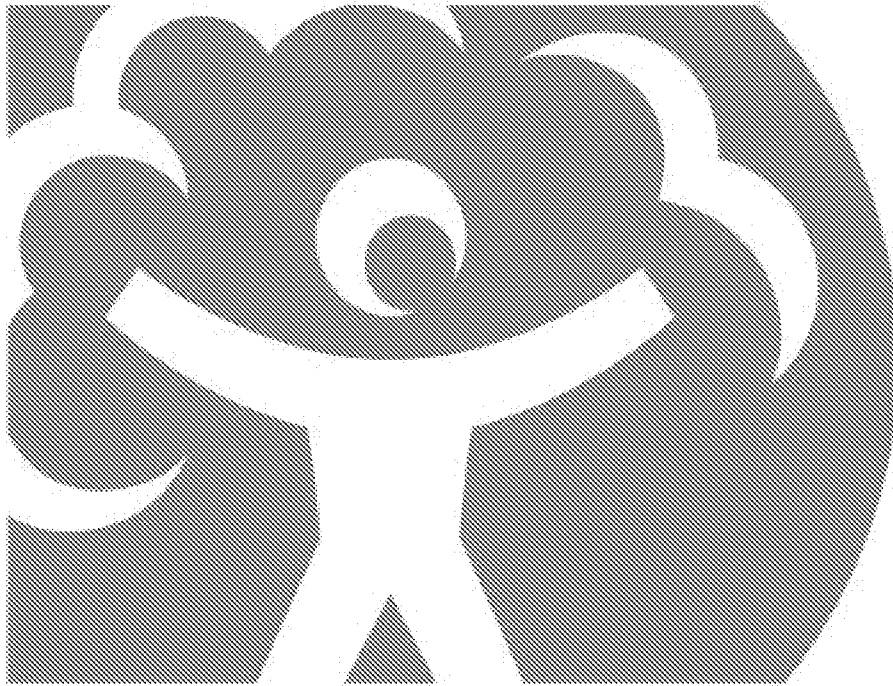




Environmental Review Report

Version 4, September 2017



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

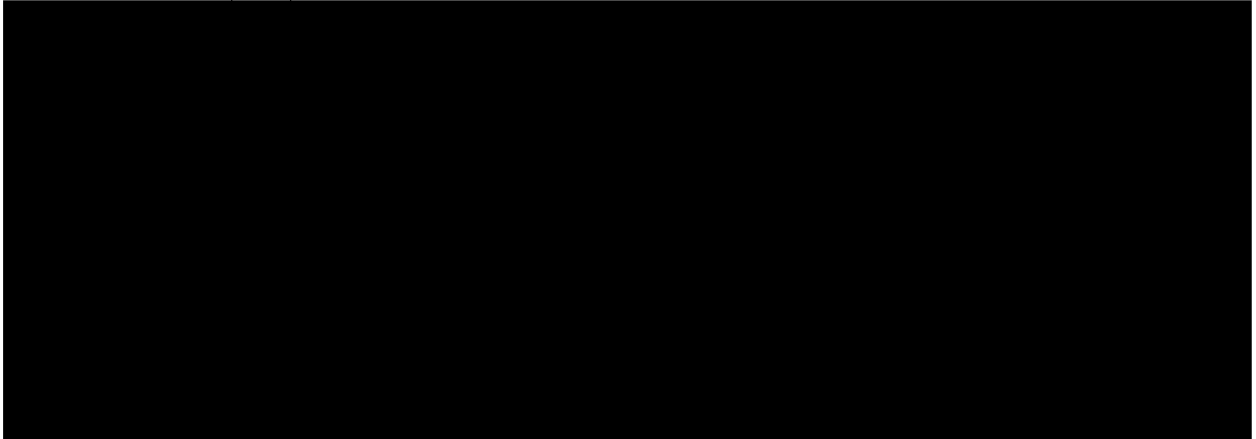
We operate at the place where environmental change has its greatest impact on peoples lives. We reduce the risks to people and properties from flooding; make sure there is enough water for people and wildlife; protect and improve air, land and water quality and apply the environmental standards within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



Quality Assurance

<i>Project name</i>	<i>Littlehampton R4 Tidal Wall Flood Defence</i>
<i>Project 1B1S reference</i>	<i>ENVIMSO001021</i>
<i>Date</i>	<i>08-11-17</i>
<i>Version number</i>	<i>4</i>
<i>Author</i>	<i>GHD Pty Ltd</i>

Approvals

<i>Name</i>	<i>Signature</i>	<i>Title [complete using 497-10 as guidance]</i>	<i>Date</i>	<i>Version</i>
<i>T White</i>	<i>On behalf of EA</i>	<i>EPM</i>	<i>Tbc following amendments</i>	<i>2</i>
<i>Damon Block</i>	<i>On behalf of EA</i>	<i>FBG</i>	<i>28-09-17</i>	<i>2</i>
<i>Paul Falcini</i>	<i>On behalf of EA</i>	<i>Heritage</i>	<i>02-09-17</i>	<i>2</i>

Contents

Environmental Review Report	i
------------------------------------	----------

Version 4, September 2017	i
----------------------------------	----------

Contents	iv
-----------------	-----------

1	Introduction	1
1.1	Project background	1
1.2	Legislative and regulatory requirement	1
1.3	Environmental impact assessment requirement	1
2	Project background	3
2.1	Project development	3
2.2	Project description	3
2.2.1	Scope of work	3
2.2.2	Proposed construction methodology	3
3	Key issues and methodology	8
3.1	Key issues	8
3.2	Methods of assessment	8
3.2.1	General approach	8
3.2.2	Specific assessment methods	9
4	Potential environmental impacts and mitigation measures	13
4.1	Acoustics	13
4.1.1	Existing environment	13
4.1.2	Likely significant impacts	14
4.1.3	Noise and Vibration effects to residents	15
4.1.4	Noise and Vibration effects to migratory fish species	15
4.1.5	Mitigation	15
4.1.6	Residual impacts	17
4.2	Archaeology and heritage	18
4.2.1	Existing conditions	18
4.2.2	Likely significant impacts	19
4.2.3	Mitigation	19
4.2.4	Residual impacts	19
4.3	Biodiversity	19
4.3.1	Existing conditions	20
4.3.2	Likely significant impacts	21
4.3.3	Mitigation	22
4.3.4	Residual impacts	23
4.4	Ground conditions	23
4.5	Landscape, townscape, and visual issues	23
4.5.1	Existing conditions	24
4.5.2	Likely significant impacts	24

4.5.3	Mitigation	24
4.5.4	Residual impacts	25
4.6	Land use and socio-economy	25
4.7	Traffic and transportation	25
4.8	Water resources and flood risk	28
4.8.1	Existing conditions	29
4.8.2	Likely significant impacts	31
4.8.3	Mitigation	33
4.8.4	Residual impacts	34
4.9	Other issues	36
4.9.1	Air quality	36
4.9.2	Material assets	36
4.9.3	Human health	36
4.9.4	Environmental management issues	37
4.10	Cumulative impacts and inter-relationships	37
4.11	Planning and legislation	38
4.11.1	Planning context	38
4.11.2	Compliance	38
5	Summary	40

1 Introduction

1.1 Project background

The Environment Agency (EA) is pleased to submit this Environmental Report for the construction of a 26.7m vertical sheet pile segment of the Littlehampton East Bank Tidal Walls Reach 4 Flood Defence Project (the Project) in support of the planning application and also the request for variation of the Marine Licence (reference no. MLA2013002127) for the activities required to complete the flood defence system. The Environment Agency (EA) constructed flood protection works on a 2.5km section of the east bank of River Arun, in order to manage the risk of tidal flooding to the town of Littlehampton in West Sussex. The tidal wall was built to a 1 in 300 year flood defence standard, with the exception of a short, 26.7m section that was unable to be completed during the main works. This section, located along the river frontage of 47 River Road and within Reach 4 of the Flood Defence Scheme, remains unprotected, and therefore reduces the effectiveness of the flood defence system built to date. As such, the Project aims to close this gap.

An Environmental Statement was prepared for the substantive Littlehampton Arun East Bank Tidal Walls Flood Defence Scheme in May 2013; relevant information from that document has been incorporated into this Environmental Review in support of the 26.7m gap in Reach 4 of the Flood Defence Scheme.

1.2 Legislative and regulatory requirement

The Environment Agency has permissive powers under Section 165 of the Water Resources Act 1991 to carry out works to manage tidal flood risk, and the Arun Tidal Walls Flood Defence System was carried out in 2013 under a mixture of permitted development under rights set out in The Town and Country Planning (General Permitted Development) Order 1995, with planning permissions under the Town and Country Planning Act (1990) for two areas of realignment (Reach 4 Pharos Quay and Reach 6 Realignment). The Environment Agency has also ensured that the substantive scheme is compliant with the EU Habitats Directive and the EU Water Framework Directive and its legal requirements.

The Environment Agency had undertaken an EIA and prepared an Environmental Statement (ES) for the substantive Scheme, which identified the likely consequences for the natural and built environment and for human beings from the development, for consideration of these issues within the planning and design process.

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

1.3 Environmental impact assessment requirement

We have written to Arun District Council to request for formal approval that an environmental statement will not be required for the segment of the Littlehampton East Bank Tidal Walls Reach 4 Flood Defence (the Project) per the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (the Regulations).

Response from the Council regarding the request that an environmental statement is not required for this section of the works.

During preparation of the ES for the substantive Flood Defence Scheme in May 2013, the Marine Management Organisation (MMO) had confirmed that an EIA was not required under the Marine Works (EIA) Regulations 2007 (as amended) for the purposes of Marine Licensing. The substantive Scheme had received a Marine License (reference no. MLA2013002127) for the works.

Whilst an EIA had not been required to obtain the Marine License from the MMO, this Environmental Report is nevertheless being submitted in support of the variation request to the existing Marine License for the works.

2 Project background

2.1 Project development

The main portion of the Reach 4 tidal wall had been completed as part of the works carried out by the Environment Agency at the East bank of the River Arun for a length of approximately 2.5km from the harbour mouth upstream. The substantive scheme, within which Reach 4 is located, is designed to provide flood defence to a 1 in 300 year standard .

One section of the tidal wall, located along the river frontage of 47 River Road, was not completed as part of the previous works. This unmodified section of the existing defences remains reduces the effectiveness of the flood defence system built to date. As such, the Project aims to close this gap.

The full project development process for the entire Scheme is described in detail in Section 2 of the original ES (EA, 2013), and included a discussion of its strategic context, options appraisal, stakeholder consultations and consideration of alternative design options.

2.2 Project description

2.2.1 Scope of work

The current proposed scope of the Project completes the East bank flood defence. The works will include a raised new vertical sheet piled flood defence wall, approximately 26.7m in length, to be installed riverward of the existing timber retaining structure, with the use of a jackup barge. The wall will meet the alignment and height of the adjacent walls upstream and downstream of this site. Fill will then be placed behind the wall to infill the gap between the existing timber retaining structure and the new sheet pile wall. Concrete capping beams will be put into place and connected to the existing downstream capping beam to form a closed connection cap.

The alignment and design details of the proposed works are attached as Drawings 66-00009-K-006 and 66-00009-K-006, and had also previously been provided within the original ES as part of the Landscape Masterplan attachments (Landscape Masterplan Reach 4: 3483 PL 108 and Details Reach 4: 3483 PL 109).

The duration of the Project will be approximately 8 weeks and is planned to be completed between late October 2017 and April 2018, in accordance with seasonal requirements.

2.2.2 Proposed construction methodology

Process

Works are envisaged to occur with the following process, which is described in further detail in following paragraphs:

1. Sheet piles will be driven to required toe level utilising a resonance free or low vibropiling apparatus from a jack up barge;

2. Drainage layer installed within pans of sheet piles;
3. Initial stage of fill provided between the existing reclamation slope and sheet pile walls;
4. Capping Beam constructed utilising framing off the initial fill and sheetpiles, or scaffolding;
5. Fill to ground level (+3.5m OD).

Driving of sheet piles

The sheet piles are proposed to be driven from a floating or jack up barge, utilising a crane attached vibratory hammer and temporary frames. Driving of the sheet piles is anticipated to start at the downstream end, and progressively work upstream utilising the panel driving technique.

A temporary guide frame will be constructed to control the straightness of the wall. The guide will consist of a cantilevered frame supported from the jack up barge.

The panel driving technique shall follow the nominal process identified by ArcelorMittal and described within Figure 2-1, however without the bottom guide due to the configuration of the cantilevered pile guide from the barge.

Prior to or just after driving the piles the following works are required to be undertaken:

- Water pressure relief holes will be included in the design of the piles. A series of drainage holes will be cut into the sheetpile in the area of the drainage column;
- Clutches will be cut at the base and head of each connecting sheet pile to aid in the ease of clutching the sheet piles together. Clutch grease will also be applied to minimise friction during the driving process;
- A corner will need to be developed at the upstream end. A corner section (or connector) will be utilised to allow the change in direction of the piles.

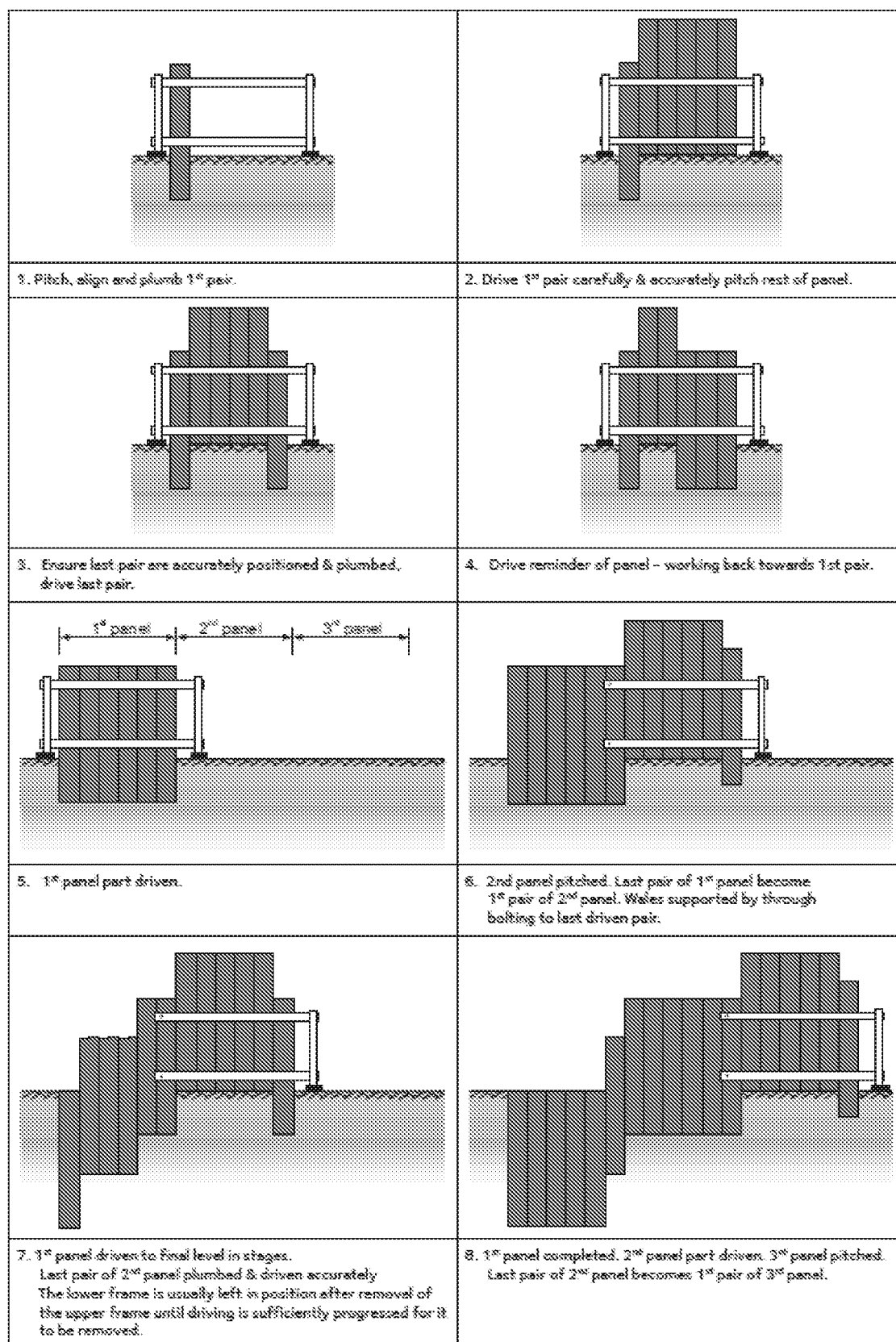


Figure 2-1 - Panel Driving (Source ArcelorMittal)

Drainage layer

The design considers that a drainage system will be provided to prevent the build-up of groundwater behind the piles.

To facilitate this, each of the sheet piles shall have a series of holes drilled into the face of the pan. These holes will approximately align as per the below figure, as the piles are laterally loaded and the toe of the pile is defined during design, the location of these holes are to be drilled in situ.

The sheet pile pans will then be filled with gravel material and sealed with geotextile. The gravel will allow the flow of water, and the geotextile will prevent the loss of fines. A geotextile bag will be prefabricated and filled with gravel. Once the piles are installed, the bags will be lowered into the appropriate pans to form the drainage layer. Fill will then be added behind to support the bags. Volume of gravel will be slightly greater than the pan to allow the material to fill the void.

In some locations, more than one bag may be required per each pan depending on the height and weight of the bags. In this instance, another layer of geotextile shall be provided over the full height of the pile between the geobags and fill material so that fines do not migrate through the point where the bags meet.

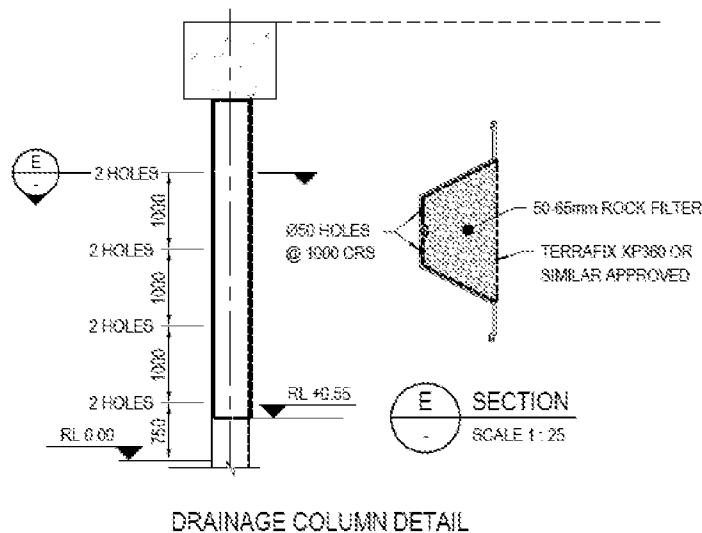


Figure 2-2 - Example Drainage Column Detail

Capping beam

Once the piles have been driven and trimmed to their final level, a reinforced concrete capping beam will need to be constructed along the length of the sheet piles. Casting of the capping beam will occur in two stages:

1. Capping beam (700 mm deep, 1,000 mm wide concrete beam); and
2. Flood protection upstand (1,100 mm high, 500 mm wide concrete beam on top of the capping beam).

It is intended that the formwork for the capping beam will be erected such that it is temporarily supported by the sheetpiles, and the fill behind the wall. The formwork will be constructed out of plywood and supported via a Redeb system, or from a small scaffolding structure constructed over a portion of the fill material.

Reinforcement cages will be prefabricated on ground and lifted into the formwork, with continuity bars located as required. Once placement of the reinforcement bars has

completed, and reinforcement bars have been cleaned of chlorides (if applicable), the concrete will be poured from land utilising a tub lifted by a small crane. The design locates the soffit of the capping beam above MHWS, and therefore the formwork should not be inundated by water, however it may be exposed to wave actions. In the event water seeps through the formwork at high tide prior to the concrete pour, the water shall be drained and the reinforcement bars cleaned with potable water to remove any chlorides.

Fill

The capping beam shall be formed, poured and cured (7 days) prior to undertaking placement of the final fill layer behind. This is to prevent deformation of the sheet piles as the capping beam will provide some lateral restraint once tied into the existing downstream and upstream walls.

The fill shall consist of self compacting gravel material.

3 Key issues and methodology

3.1 Key issues

The scope of the original Environmental Statement (EA 2013) had been defined through a series of desk studies, site surveys, workshops, and consultations. Subsequently, all information from the ES that are relevant to the current Project have been incorporated into this document.

Nevertheless, additional assessments have been made specific to the current scope of work, and these include:

- Ecological PEA
- Bat inspection report or Phase 1 (with no requirement for further study)
- Noise and vibration impacts assessment
- Preparation of a Site Waste Management Plan, and
- Development of an Environmental Action Plan specific to the proposed works.
- The main issues included in the original ES, and have been incorporated into this ER with respect to their relevance to the current Project, include:
 - 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, minor issues have also been taken into consideration, including:
 - Air quality during construction
 - Material assets and waste

Planning issues and the potential for cumulative impacts had also been addressed in the main ES; selected information have been incorporated into this Environmental Review, where relevant.

3.2 Methods of assessment

3.2.1 General approach

For each key issue, potential impacts were assessed in accordance with the following general process:

Developing an understanding of the 'baseline' environment, through a desktop review of the original ES (EA 2013), which reflects the situation prior to the development of the substantive Tidal Flood Defence Scheme. In the context of the current Project, an assessment of conditions without the additional proposed works was also undertaken, to provide context to the fact that there exists a gap in the current flood defence system on the east bank.

An assessment of likely significant impacts was made by making reference to the interaction between the magnitude of the impact, and the sensitivity of the receptor, in accordance with the following matrix:

Magnitude	Sensitivity/value of the receptor		
	High	Medium	Low
High	* Major	* Moderate	* Slight
Medium	* Moderate	* Slight	* Negligible
Low	* Slight	* Negligible	* None
Negligible	* Negligible	* None	* None

Mitigation measures prepared for the current project generally follow those prepared for the wider Scheme, in accordance with The Preparation of Environmental Statements for Planning Projects that require Environmental Assessment—a good practice guide (HMSO 1995), to which the original ES referred (EA 2013). The mitigation measures followed a staged and standard approach to ameliorating impacts, and include prevention as the first preference, followed by reduction, and lastly, by remedy/offset/compensation.

Residual impacts were also taken into consideration, particularly where mitigation measures are unable to fully account for the Project's potential impacts.

Cumulative impacts were considered in the original ES (EA 2013) for the substantive Scheme, in which possible redevelopment of two buildings that constitute Riverside Autos (adjacent to the current Site) was referenced. However, Riverside Autos have decided not to proceed with their redevelopment; as such, an assessment of cumulative impacts from the current scope with respect to other, proximate developments in the area is not anticipated to be required.

Planning implications have also been assessed as part of this environmental review.

3.2.2 Specific assessment methods

Given the time period that has elapsed between the completion of majority of the substantive Scheme in 2013, and the commencement of the additional works within the current Project, some new assessments have been undertaken specific to the current proposed scope of works. As this Environmental Report has also referred to information and data obtained in the original ES (EA 2013), both assessment methodologies used are presented in Table 3-1 below.

Table 3-1 Assessment methodologies for key issues

Key Issue	Assessment methods	
	Original ES (2013)	Current Project (2017)
Acoustics and vibration—impacts on residential receptors, visitors, and property during construction. Percussive shock impacts on migratory fish within the tidal column	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	Desktop review of baseline data and assessment outcomes from the original ES (2013), as well as preparation of new noise and vibration management plan following on site condition assessments. For biodiversity (marine and migratory fish species): implementation of previously consented methodologies and approval of scheme proposals (2017) by FBG specialists
Archaeology and cultural heritage—impacts on the setting of a Conservation Area and on unrecorded archaeological remains	Cultural heritage appraisal of known heritage and previous archaeological studies. Monitoring and interpretation of Ground Investigations. Archaeological desk based appraisal and walkover survey.	Archaeological desk based appraisal, bringing forward relevant methods within an addendum to the former written scheme of archaeological investigation - agreed by the EAs south east heritage specialist.
Biodiversity—impacts on intertidal habitat, reptiles, bats, badgers, water voles, birds, and invasive species	Baseline Phase 1 habitat survey, survey of reptiles, water voles and assessment of bat potential of trees. 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. No survey of aquatic invertebrates, great crested newts or other protected species required.	Desktop review of baseline data and assessment outcomes from the original ES (2013). Preliminary ecological appraisal and Baseline bat roost inspection survey both undertaken in August 2017. Review and approval of methodologies to reduce impact to migratory fish (see acoustics and vibration) Review and agreement of mitigation and enhancements with EA FBG specialists

Key issue	Assessment methods	
	Original ES (2013)	Current Project (2017)
Landscape, townscape, and visual issues—impacts on local townscape and landscape character, and loss of views for residents and visitors	Landscape and visual assessment undertaken. Landscape and Visual Impact Assessment based on Guidelines for Landscape and Visual Impact Assessment (Landscape Institute/Institute of Environmental Assessment, 3rd Ed 2013) Arboricultural survey undertaken in accordance with BS 5837.	Desktop review of baseline data and assessment outcomes from the original ES (2013).
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 of land use impacts.	Desktop review of baseline data and assessment outcomes from the original ES (2013). Customer engagement team site visit with design team, ADC. Discussions and actions agreed with key stakeholders.
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.	Desktop review of baseline data and assessment outcomes from the original ES (2013).
Water resources and flood risk—impact on water quality during construction and long term impacts on water flow in the Arun river; 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.	Desktop review of baseline data and assessment outcomes from the original ES (2013). Water Framework Directive assessment undertaken specific to the proposed works, informed by WFD for substantive scheme. Preparation of Flood Risk Statement (agreed with EA senior user). Agreement of methodologies with HA and Flood Risk Permitting at EA.

Key issue	Assessment methods	
	Original ES (2013)	Current Project (2017)
Traffic and transportation—impact on local roads and road users during construction	No surveys required. Management of potential impacts undertaken via a Traffic Management and Logistics Plan prepared for the scheme. Quantification and evaluation of traffic generated; and qualitative assessment undertaken for impacts.	Desktop review of baseline data and assessment outcomes from the original ES (2013), as well as preparation of a new Traffic and Transportation Plan agreed by ADC. No requirement for TMO.
Other issues: Air quality impacts from construction plant and activities Material assets and use of construction materials and generation of waste	No surveys required. Qualitative assessment and proposal of measures to avoid impacts undertaken. Quantification of materials undertaken, as well as evaluation of sources, recycling options, and waste receptor sites.	Desktop review of baseline data and assessment outcomes from the original ES (2013). SWMP Preparation with minimisation of wastes. Site management in accordance with best practise for reduction of emissions.
Cumulative impacts	Assessment of any significant environmental impacts in combination with other developments in the area.	Not applicable, as no adjoining or proximate developments are occurring, or will occur, near the Site.

4 Potential environmental impacts and mitigation measures

4.1 Acoustics

This subsection addresses potential impacts from construction-related noise and vibration on humans and fish species. The study area is the area immediately adjacent to the proposed works, as well as the waters of River Arun, to the extent that fish may be affected by piling works.

During operation phase, periodic inspections and/or maintenance works are the only activities anticipated to be required, and therefore unlikely to pose any significant noise or vibration impacts. As such, operational noise and vibration have been excluded from further assessment in operational phase.

The impact assessment for construction noise and vibration has been undertaken primarily on the basis of information produced as part of the original ES (EA 2013); however, a noise and vibration management plan has also been produced specific to the current scope of work and mitigation proposed in the WFD and EAP addresses effects to biodiversity.

4.1.1 Existing environment

The existing noise along the riverbank comes from a range of sources typical of a town centre location, including road traffic.

An environmental noise baseline survey had been undertaken as part of the original ES (EA 2013) in November 2012. No baseline vibration readings had been taken.

The site of the proposed works at 47 River Road is located in between two of the 2012 noise survey stations—approximately 170m south of the Arun View Public House car park survey station, and approximately 100m north of the Riverside North survey station.

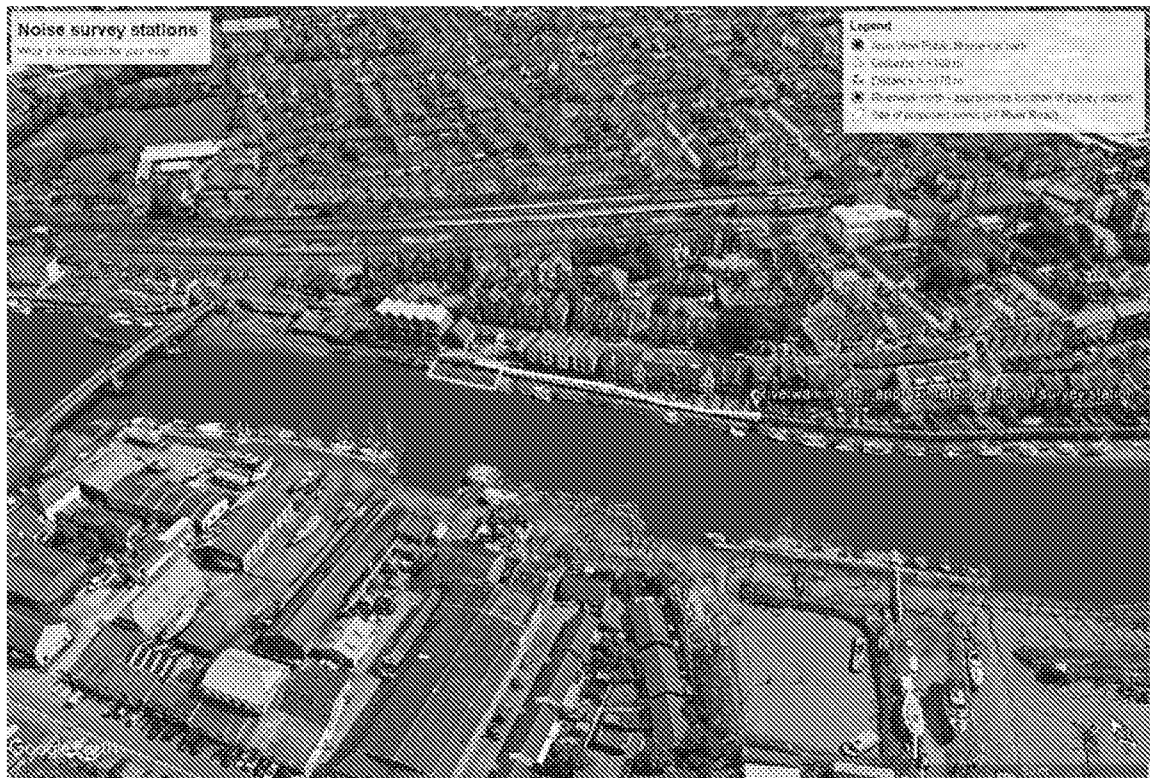


Figure 4-1 Location of Site with respect to 2012 noise survey stations

The above two noise survey stations are therefore considered to be the representative human receptors for the proposed works at 47 River Road, and baseline data (as of 2012) for these stations adopted for this current assessment.

Other receptors considered as sensitive to both noise and vibration from the proposed construction works include fisheries in the River Arun, such as sea trout and European eel, which exhibit varying sensitivity to noise as a function of season, time of day, and tidal cycle. These sensitivities were taken into account in the assessment undertaken within the original ES (EA 2013); for details on criteria used to define receptor sensitivities, please refer to Section 5 of the original ES (EA 2013).

4.1.2 Likely significant impacts

Some localised and temporary disturbance from noise is expected from the proposed construction works, and will affect those people living and/or working proximate to the Site.

The proposed construction methodology is the same as that utilised for the 2013 works, as such, the calculated construction noise values from the original ES have been adopted into this document for the applicable Reach (Reach 4), and these are presented in Table 4-1.

Table 4-1 Potential noise levels at the closes residential receptors*

Element of construction	Distance to nearest receptor (m)	Calculated worst case noise levels, dB	Approximate duration of works
Vibro-piling	5	86.4	15 days
Percussion piling	5	80.5	10 days
Earthworks/backfill	5	79.3	15 days
Final construction	5	75.9	30 days

*Note: Modified from Section 5.2 of the original ES (EA 2013)

Based on the assessment within the original ES (EA 2013), there is potential for noise impact to have a major, negative magnitude, with a minor to moderately adverse impact significance before mitigation. These assessments were made with reference to the classifications established in draft by the Institute of Acoustics / Institute of Environmental Management and Assessment Joint Working Party in 2002. An explanation of the criteria used to define magnitude and significance of effect is provided in Section 5 of the original ES (EA 2013),

4.1.3 Noise and Vibration effects to residents

An assessment of vibration impacts had also been undertaken as part of the original ES (EA 2013), within which vibration levels at the relevant reach (Reach 4) from vibro- and percussion piling has been calculated to be 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.

4.1.4 Noise and Vibration effects to migratory fish species

As discussed in more detail in the original ES (Biodiversity –Mitigation s7.3, p59 EA 2013), the EA Technical Advisory team has advised that vibro-piling be selected as the default method to minimise impacts to sea trout and European eel. These species are sensitive to noise and vibration from construction which is mitigated by this technique. Use of soft percussive piling, where unavoidable (due to ground conditions), was assessed and condition placed on its use in respect to the substantive scheme (see below).

No discernible impacts on fish are therefore expected from vibro-piling, which is proposed to be the primary piling method to be utilised in these works

4.1.5 Mitigation

Mitigation of effects on residents and businesses

Temporary increases in noise during construction are unavoidable, but these increases will be short term.

Measures to minimise any nuisance to nearby residents will be considered and the works have been programmed to occur during working hours to minimise impact on residents.

Piling is also likely to give rise to vibration, and where this is close to properties this is expected to cause some impact. To minimise this, resonance-free vibrators will be utilised which have successfully reduced the effects of piling on buildings in similar

circumstances elsewhere. Calculations using British Standard methods to determine the consequences has indicated no effects on the fabric of building but some possible disturbance to residents. As a precautionary measure, buildings will be monitored for vibration so that any effects can be identified if they develop, and subsequent measures taken to avoid damage. Property owners and residents will be kept fully informed on the nature and timing of the works.

Mitigation of effects on biodiversity

It is important to consider the impacts upon the marine environment as well, as the Arun River is an important river for various species. The Environment Agency have agreed that no further mitigation is required in respect of Vibro-piling where this technique is used in this reach of the Arun at this time of year. As a result they are of the view that there is no constraint in terms of the majority of the piling works upon the fish stocks in the River.

Where ground obstruction prevents vibro-piling and unavoidably requires percussive piling (and where this will not affect structures), this will be subject to additional constraints to minimise effects on biodiversity. Such constraints include working with an incremental increase in pile power to full operational power (a soft-start) with not less than 20 minutes incremental increase to gain full power. Where there is a pause in the use of this method, for more than 10 minutes, the soft –start procedure must be repeated.

Mitigation Procedures

Several safeguards exist to minimise the effects of noise and vibration during for both residents and businesses, and biodiversity for the construction, including:

(Version 4 revision: Working hours have been updated to reflect those agreed within the “Prior consent in respect of works on construction sites – Control of Pollution Act 1974 – Section 61”)

1. Restriction of working hours to:

- Construction works during:
 - Monday to Friday 08:00 to 18:00 hours
 - Saturday 08:00 to 13:00 hours
 - Sunday None
- Vibro and percussive piling works, and working over water:
 - Monday to Friday 09:00 to 18:00 hours
 - Saturday 09:00 to 13:00 hours
 - Sundays, bank and public holidays None
- Enabling Activities (start up and shut down)
 - Monday to Friday 07:00 to 18:00 hours
 - Saturday 07:00 to 13:00 hours
 - Sundays, bank and public holidays None

Enabling works are to take place before the start of the main working day or immediately after the end of the main working, including movement of plant to the worksite, unloading and maintenance of plant and equipment.

2. The employment of good site practice to minimise the noise and vibration impacts from the works

3. 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
4. If percussive piling is required, and if available a shielded piling hammer will be utilised to reduce noise levels generated from hammer piling by in the order of 10 dB
5. 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.
6. All pile driving activity shall be carried out by plant equipped with a recognised noise reducing system or by a vibro driving systems. In assessing the impact of any piling operations, the Contractor will comply with the recommendations set out in the relevant current British Standard 5228: Part 4. 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.
7. Equipment will be shut down when not in use for a period longer than 5 minutes.
8. Adoption of Considerate Contractors Scheme and having a representative available on site during working hours to answer queries or address any concerns expressed
9. No vehicles will wait or queue on public highways with engines running.
10. Deliveries will occur during the working hours of the sites except with the express agreement of the Project Manager, and will be routed so as to minimise disturbance to local residents; care will also be taken when unloading deliveries and vehicles will be prohibited from waiting on site with their engines running.
11. Where elevated levels of vibration are predicted to occur, 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 where ground conditions permit, and in any case, vibration monitoring shall be undertaken during the pile driving phase by a qualified structural engineer at or near the foundations of sensitive buildings to ensure that adequate levels of control are being employed.
12. Mitigations identified above will help to control the noise levels produced by the construction works on the site, but at best will reduce noise impacts from the construction works by 5dB. With respect to the potential for unavoidable impact piling, the Environment Agency had advised in 2013 that such work will be acceptable in daylight hours during the winter, (Nov – March) since the vast majority of Sea Trout move at night, subject to the use of the soft-start technique, shielded hammers where available, and vibration monitoring during driving. This was advised further to EA specialists' assessment that that Sea Trout will have migrated further up the catchment by November.

4.1.6 Residual impacts

Some residual noise and vibration impacts on human receptors may remain. Therefore, the project will keep local residents and property owners fully informed about the nature

The works are of short duration and will operate using best practice with advance and continuing communication through the project engaging residents. As such, nuisance will be reduced to a minimum.

During construction, there is potential for impact to occur on unknown archaeology. No issues are anticipated to arise out of the operational phase.

No Scheduled Monuments (SM), World Heritage Sites, Historic Parks or Gardens, or Registered Battlefields exist in close proximity to the proposed works, as identified in the original ES (EA 2013). No other locally designated heritage assets are impacted by the scheme



Figure 4-2 Location of Site with respect to 2012 noise survey stations

4.2.2 Likely significant impacts

The original ES (EA 2013) identified some significant impacts to potentially occur on a number of archaeologically significant locations across the substantive Flood Defence Scheme. However none of these are in or adjacent to the proposed works site. As such, the current project is not anticipated to have any significant impacts on built heritage or archaeological sites in the area.

Taking into account that the majority of the substantive Flood Defence Scheme has already been constructed and the small scale of these works, the setting impacts on the Conservation Area and the locally listed Riverside Autos are considered to be negligible.

In addition, there is potential for previously unidentified archaeology including paleo-environmental remains at depth to be present at the Site of the proposed works. Impacts at depth from the sheet piling will be negligible and no specific elevated risk of impacts to sensitive paleo-environmental deposits were identified in the 2013 ES.

4.2.3 Mitigation

Apart from unknown archaeology all other impacts have been identified as nil or negligible so mitigation is only proposed for unknown archaeology.

Because of the potential for previously unidentified unknown archaeology to be impacted by the proposed works, a Written Scheme of Investigation has been prepared and submitted for the project, and details a method statement for archaeological mitigation.

The WSI had been prepared in accordance with the Environment Agency Brief for Archaeological Works and Monitoring, prepared in 2013 by the National Environment Assessment Service for the entire 2.5 km Littlehampton Arun East Bank Tidal Walls. It details the archaeological methodology for undertaking archaeological work in order to ensure that any archaeological remains are investigated and recorded appropriately during construction.

4.2.4 Residual impacts

No residual impacts are anticipated to occur at the site after implementation of mitigating measures as presented.

4.3 Biodiversity

This subsection addresses issues associated with potential ecological impacts of the project on surrounding habitats. Assessment was undertaken through a desktop review of the original ES (EA 2013) and its results. A preliminary ecology appraisal and a baseline bat inspection were undertaken at the existing building on Site on 14th August 2017. Furthermore, a Water Framework Directive Assessment has been undertaken for the current proposed works, and is relevant for management of biological elements within the Arun River.

The original ES (EA 2013) assessed ecological resources following the IEEM guidelines (IEEM 2006), and used the following criteria for defining ecological value:

- Very high—international importance

- High—national importance
- Medium—regional/county importance
- Low—district/parish importance
- Negligible—no listed importance

The significance of the impacts were subsequently defined according to IEEM guidelines.

The preliminary ecological appraisal incorporated a Phase I Habitat Survey (undertaken in accordance with JNCC 2010) .

The bat building inspection undertaken in August 2017 was produced in accordance with Chapter 11 of Collins (2016) and report writing guidelines produced by the Chartered Institute for Ecology and Environmental Management (CIEEM 2015).

THE WFD Assessment was undertaken with respect to the Water Framework Directive (Directive 2000/60/EC) as implemented by in England and Wales by the Water Environment (WFD) Regulations SI 3242/2003. Preparation of the assessment was informed by EA guidelines.

4.3.1 Existing conditions

Based on the original ES (EA 2013), there are no designated sites proximate to the Site of the proposed works within Reach 4. Brackish water and intertidal mudflat habitats do exist within the Site, which support freshwater and marine fish and invertebrate species.

The preliminary ecological appraisal (August 2017) identified several habitats on Site and within the standard buffer of 50m, including bare ground, coastal grassland, hard standing, intertidal mudflats, and brackish running water (Refer to plans within the preliminary ecological survey report). Of these, coastal grassland is not impacted. The area of intertidal mudflats within the tidal range of the River Arun qualifies as the Habitat of Principle Importance 'Intertidal Mudflats', characterised by high biological productivity and abundance of organisms, but low diversity with few rare species. The ES states "The mudflat biota reflects the prevailing physical conditions. The surface of the sediment is often apparently devoid of vegetation, although mats of benthic microalgae are common. These produce mucilage that binds the sediment. Under nutrient-rich conditions, there may be mats of the macroalgae *Enteromorpha spp* or *Ulva spp*. Occasional stones or shells may also provide suitable attachment for stands of fucoid macroalgae such as *Fucus spp*. The proposed development removes approximately 40 m² of intertidal mudflats, however this has been previously compensated by the substantive scheme, that calculated losses for the 2.5 km length and provided net gain of habitat.

The possibility that protected species could be present on Site, and thereby pose a constraint to the proposed development was also evaluated within the 2017 ecological appraisal. The evaluation was based on the assessment of habitat suitability and other relevant factors, such as:

- National distribution of each species/group
- Previous records of species occurrence obtained through the desk study
- Connectivity to suitable habitats in the surrounding landscape
- Field signs (e.g., tracks, droppings, direct sightings) suggesting presence of species within or near to the site
- Probability of the proposed development having an adverse impact on the species/group if present.

The original ES (EA 2013) also listed bats as potentially roosting in the general vicinity of the Site. As bat species are protected under EU law, their presence could become reflective of international value. Subsequently, a bat roost inspection survey was undertaken at the sole building that exists immediately adjacent to the Site (as voids behind existing timbers are regularly filled by tidal water); any bats roosting within the building could potentially be affected by construction works indirectly as a result of disturbance from increased noise and vibrations. The inspection showed no signs of bat roosting in the immediate vicinity of the construction Site, nor within the inspected building. The building is currently subject to a level of disturbance (noise and vibration) not dissimilar to that expected by the proposed localised sheet piling.

According to the original ES (EA 2013), the intertidal zone within the River Arun supports a range of bird species that could have national value. The brackish water within River Arun also supports a variety of fish and eel species. Baseline surveys for aquatic invertebrates, reptiles, and water voles undertaken within the preliminary ecological assessment in August 2017 did not identify any rare or protected species (other than fish and eel) within the Site. Birds present and roosting at the SSSI at approx. 2km south of site are considered outside the radius of disturbance, and are additionally separated from impacts as piling is constrained to daylight hours.

4.3.2 Likely significant impacts

Mudflats

The 2013 ES for the substantive Flood Defence Scheme identified the main types of impact on ecology to be physical damage to, loss of, or change in habitats as well as disturbance to wildlife. For the relevant Reach (considering a wider area in the 2013 ES), the (unmitigated) impacts on intertidal mudflats and brackish water habitats were considered to be of minor adverse significance at the national level.

Fish and elvers

There could also potentially be a major adverse impacts at a national level for fish, due to vibration impacts. However, as already discussed in Section 4.1, it has been agreed that the use of vibro-piling will have negated these potential impacts. The use of percussive piling, although highly unlikely to be required, is retained as an option of last resort, in the event that unanticipated obstructions are encountered at the toe of the piling and where engineering agreement is secured for its limited use in proximity to buildings.

Bats

The bat inspection survey (Keystone Ecology- August, 2017) indicates that no direct impacts will occur to the building adjacent to the riverbank Site, which has moderate bat roosting potential during the summer, but is considered unlikely to support hibernating bats. In the event that bats are present on site, they are considered to already be habituated to high levels of frequent disturbance from vibration of compressor machinery; as such, a short-term increase in noise/vibrations will not prevent bats from continuing to function on site or in the locality. However, the project construction phase is proposed to be scheduled in winter 2017/18 when bats are not active and considered unlikely to be present. The likelihood of delay causing a shift in

the season in which proposed works are delivered is negligible, and as such the risk of effects to bats from noise disturbance is assessed as negligible.

4.3.3 Mitigation

As part of the EIA activities for the 2013 ES for the substantive Scheme, ecological mitigation measures had been discussed and agreed with various stakeholders, including Natural England, the Royal Society for the Protection of Birds, and the Fisheries and Biodiversity Team within the Environment Agency.

Mudflats

Loss of <40m² intertidal mudflat habitats associated with the current proposed works have been previously compensated by the mudflat created within the managed realignment work undertaken north of the site (in Reach 6), in mitigation and enhancement of the substantive scheme, within which the Reach 4 works are situated.

Fish

Impacts on potentially affected habitats of fish in the water column will be minimised by means of sensitive working and seasonal constraint (vibro-piling will be used to drive the piles in winter) Only a last resort measure of slow start percussive piling where unavoidable obstructions cannot be otherwise piled will be retained for the unlikely event that this is required although this is not anticipated.

The following measures consented within the ES for the substantive scheme and relevant to the current scope of work within Reach 4 will be retained, and have been adopted into this document:

Standard site procedures, such as PPG5—Works and Maintenance and other relevant pollution prevention guides, will be adopted for any works in or near water to prevent contaminants and/or effluents from being released into the aquatic environment. A EAP has been produced which describes mitigation measures, and controls for pollution and working methods. A SWMP is also produced to detail waste disposal and controls, and a contingency in the event of adverse weather and tide has been produced to the satisfaction of the EA Flood Risk Permitting Team.

Use of existing tracks, marked access routes, and existing haul roads will be adhered to by all contractors.

Restoration of disturbed habitats as soon as practicable upon completion of the construction works, in order to minimise loss of opportunity for key species and prevent colonisation by invasive plant species.

Incorporated additional ecological compensation and enhancement of this works either at the site, or within the vicinity of the works will include:

- Establishment of vertipools into the vertical sheet pile façade - a compensation for loss of voids within the timber defences.
- Timber ledges to provide perching/attachment opportunities - a compensation for loss of timbers within the existing defences.
- Bat boxes - an enhancement at a location to be approved within close proximity. Favoured locations discussed include at the undercarriage of a Highways bridge adjacent saltmarsh to the north of Tarmac landholding. Permission is being sought and HA agreement of assistance with placement has been confirmed at several candidate locations.

- Additional bird boxes or bird features -an enhancement at a location to be approved within close proximity.
- Monitoring of eel and saltmarsh/mudflat assemblage establishment is agreed in association with the substantive scheme, of which this project forms a part. This is supported by compliance with updated EIA Regulations (2017) for monitoring of significant effects (and mitigations made).

4.3.4 Residual impacts

It is expected that the implementation of the mitigation measures identified in the previous subsection (Section 4.3.3) will significantly reduce the impacts on sensitive receptors within the identified habitats. The original ES (EA 2013) indicates that post-mitigation, there will be negligible residual impacts on brackish water habitats, and a net beneficial impact on intertidal mudflat, owing to the creation of additional mudflat (with saltmarsh) in Reach 6, as part of the managed realignment. Negligible residual impacts in construction or operational phase have also been identified for bats, birds, fish, and aquatic invertebrates that could be present at the Site, due to the relative scale of the proposed works at Reach 4, and compensation delivered for the extent within the substantive scheme (mudflats with saltmarsh), and through the provision of compensation proportional to this element within the design (vertipools, timber ledges) with enhancements including bird and bat boxes (habitat).

4.4 Ground conditions

The proposed works will be undertaken entirely on the riverward side of the Site and of existing defences, using a jack-up rig with access via the water. No disturbance is anticipated on the land adjacent to the site. As such, the potential for the works to result in contamination, associated with past and present land use in the immediate area, is very low.

The flood risk assessment and buildability statement prepared detail consideration of surface water and drainage. There are no identified highways drains affected, and surface water drainage from the adjacent plot is to be released a series of drainage holes drilled into the pans in the piling and through adjacent retained soils.

Furthermore, the small scale of the current scope of work and existing permeability of the tidal wall means that proposed works has negligible impact on existing groundwater at the Site, thereby precluding the potential for releasing contaminated groundwater.

The low likelihood of existing works to interact with groundwater present at or adjacent to the site is discussed in more detail within the Water Framework Directive Assessment report produced for the Project.

Subsequently, no further assessment of ground conditions is considered to be necessary or relevant for the current scope of works.

4.5 Landscape, townscape, and visual issues

Landscape and visual impacts associated with the proposed works within Reach 4 are dealt with in this subsection. Assessment was undertaken primarily through a desktop review of the original ES (EA 2013), which broadly followed guidance from the Landscape Institute (UK) and the Institute of Environmental Management and Assessment. As the initial assessment was undertaken in order to guide the design of

the substantive Scheme with respect to impacts on the existing landscape and townscape, within which Reach 4 is situated. The current scope merely aims to complete the gap in the Flood Defence System, and the major design components have already been determined. A repeat of the assessment for the short, 26.7m segment within Reach 4 is not required as this would necessarily already have been done during the initial design works. Nevertheless, relevant elements from within the landscape assessment undertaken for the substantive Scheme are incorporated into this document, as they relate to the proposed scope of works within Reach 4.

4.5.1 Existing conditions

The Site is located adjacent to the River Road, and is therefore proximate to an area of medium landscape sensitivity. The original ES reports the Littlehampton Harbour Board to River Road area as being characterised by almost continuous frontage of residential development.

4.5.2 Likely significant impacts

In consideration of the presence of the River Road residential townscape in the backdrop of the proposed Site, there is potential for construction works to pose a temporary, adverse impact on landscape character, due to the presence of construction machinery in the landscape (e.g. piling rig).

During the operational phase, the visual separation of the river from the adjacent road and footpath has had to occur as a result of the need to raise defences by 1.7 m, and therefore becoming more of a feature in the landscape, and introducing an engineered element. This impact had been assessed in the original ES (EA 2013) as having a moderate adverse impact on the character of the area.

With respect to the presence of a 26.7m gap in the substantive Flood Defence Scheme, the current scope of works will merely complete the continuum of the tidal defence wall, and therefore complement the existing flood defence configurations either side of the site. The flood defence wall has also been designed in a way that does not undermine the setting of the existing structures on the site. It is considered that the proposed defences will not have any significant visual impact on the Littlehampton River Road Conservation Area or its setting, or on any locally important existing buildings currently on the site or in the area as seen from the river or elsewhere.

4.5.3 Mitigation

The original ES indicated that the substantive Scheme had been designed such that the location of the defence wall has allowed for the creation of space for a wider footpath that incorporates steps up to a raised area with views to the river over the defences. The Scheme had also been designed to use appropriate materials and detailing to match the existing details, thereby visually linking the new wall into the adjacent landscape. This minimises the effect on the setting of historic riverside buildings.

4.5.4 Residual impacts

A number of residual impacts, both adverse and beneficial, on the character of the landscape remain. The original ES (EA 2013) cites a slight adverse impact at Reach 4 due to the visual separation of the river from the footpath and road, although the raised area, allowing views over the defences ameliorates this impact.

Overall the flood defence project as a whole will be providing long-term protection for residential and commercial premises in Littlehampton, highways infrastructure, Littlehampton Railway line and station, industrial areas around Littlehampton Harbour and recreational assets including public rights of way, public slipways and public open spaces. The increased flood protection will also protect Littlehampton's commercial core and a large number of listed and locally designated buildings.

With the site situated within the Littlehampton River Road Conservation Area, the shoring up of flood defences on this site will help protect heritage assets in the area from flooding and maximise the positive impact of the existing flood defences already *in situ* either side of the application site.

4.6 Land use and socio-economy

The current proposed work will serve to complete the existing Flood Defence Scheme on the east bank of the River Arun. The original ES (EA 2013) provided discussion on the major beneficial impacts of the wider Scheme on land use and socio-economy within Littlehampton as a result of its ability to provide flood protection to recreational assets and transport infrastructure within the town.

In the context of the proposed work being a necessary activity to complete the flood defence line along the east bank of the River Arun, the project is considered to contribute further to the beneficial impacts brought by the substantive Flood Defence Scheme. The construction work is expected to incur a minor disruption to the business immediately adjacent to the Site, namely, the Riverside Autos, which primarily functions as a vehicle garage. Owing to the current condition of the Riverside Autos building, there is a potential vibration risk and for safety purposes the building will need to be vacant during pile driving. Pile driving is expected to occur for two weeks and discussions have occurred between the EA and proponent regarding the disruption.

Where feasible, equipment will be brought into the construction site via a barge so that vehicle movements along nearby roads are minimised. Vehicle movements through River Road will also be managed by the contractors to minimise any disruption for local residents e.g. by making deliveries outside of peak times. No TMO is requested.

As such, the current scope of work is not expected to have any adverse impacts on local land use and socio-economy in Littlehampton.

The benefits of the built scheme to date, have been measured and are recognised (RTPI awards 2017) as delivering profound and lasting economic and environmental benefits to the town, reducing the flood risk for 2000 homes and businesses, while at the same time becoming a destination place that has significantly increased visitor numbers, dwell times and spend, in turn creating jobs, new open space areas and refurbishments.

This has therefore not been further assessed within this document.

4.7 Traffic and transportation

Due to the small scale of the project, and the preferential use of barge to transport equipment and materials to the site via the river, impacts on traffic at, and access to, the site are not anticipated to be significant. Nevertheless, some consideration has been provided with respect to managing the minimal impacts expected during delivery of equipment and/or materials to the Site.

The sheet piles are intended to be installed via a jack up barge, which will limit the number of vehicles that will need to access the site via River Road during the construction phase. The sheet piles will be delivered to the Tarmac wharf, located upstream of the construction site and either floated to the barge, or placed on the barge prior to the barge being mobilised to the site.

The access route for the sheet piles is shown in Figure 4-3, Sheet Pile Access Route.

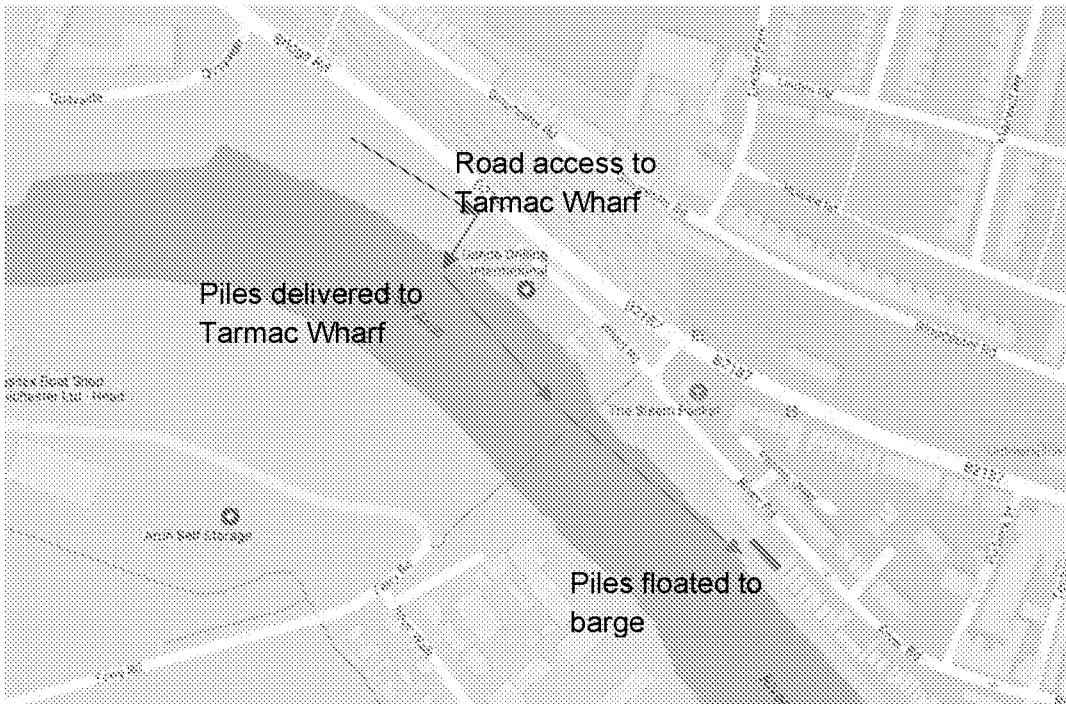


Figure 4-3 Sheet Pile Access Route

Table 4-2 below shows the estimated number of vehicles, which are expected to require access to the site.

Table 4-2 Indicative Vehicle Numbers

Type	Description	Est. Volume	Unit	Required Number of Loads
Establishment	Welfare delivery	1	No.	1
Establishment	Welfare removal	1	No.	1
Establishment	Site container	1	No.	1
Establishment	Site container	1	No.	1
Fill Material	20 tonne lorry, 450 tonne of soil in bulk condition	450	tonne	23
Construction Equipment	Sheet piles	3	No.	3
Reinforcement	Delivery of reinforcement	4	No.	4
Concrete	6 m3 tonne concrete mixer, 100 tonne of concrete	100	tonne	8
Personnel Access	Personnel Access – 6 days a week for 6 weeks and 7 days a week for 2 weeks (crew of 6)	180	No.	180 (cars)
Total (loads only) + 20% contingency				50

Access to the site during deliveries is intended to follow the path shown in Figure 4-4.

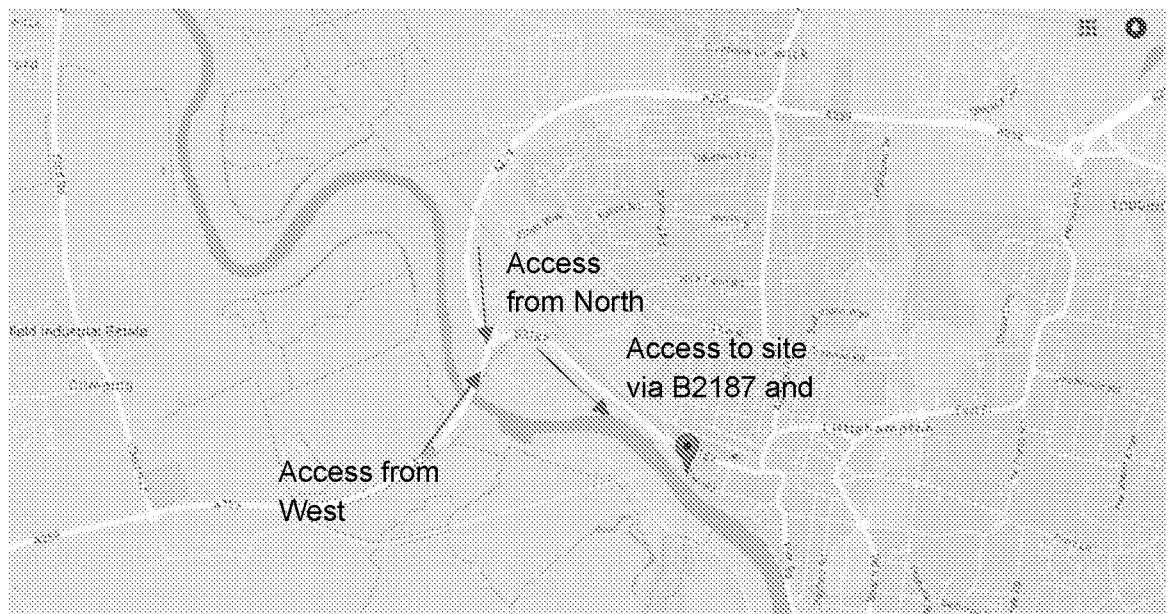


Figure 4-4 Access route to site for construction vehicles (Source: Google)

The completed scheme will have significant benefits for roads, the railway and public access by reducing the risk of disruption due to tidal flooding.

As the sheet piles will be driven by the equipment located on the floating barge, it is expected that the piles will be delivered to the nearby Tarmac Wharf and floated to the barge.

Moving sheet piling along the river could disrupt boat movement. Therefore, all movements will be agreed with Littlehampton Harbour Board and with priority given to commercial shipping. An exclusion zone around the barge will also be set up in accordance with requirements of the Littlehampton Harbour Board. With these measures in place, the impacts on road and river users during construction will be slight, but cannot be eliminated completely.

On completion, operational traffic movements to the site is not envisaged to increase beyond existing levels to the yard and autos building, unless for any future unexpected necessary maintenance of the wall.

4.8 Water resources and flood risk

This subsection discusses the key issues associated with potential construction impacts on surface water and groundwater resources. It also includes a brief discussion on compliance with the Water Framework Directive (WFD) and an assessment of potential flood risk.

The Water Framework Directive (Directive 2000/60/EC) established a framework for action in the field of water policy, and is being implemented in England and Wales by the Water Environment (WFD) Regulations SI 3242/2003, which aims to protect and enhance the quality of surface and ground water bodies.

The Framework requires the preparation of a River Basin Management Plan (RBMP) for each River Basin District (RBD), designed to assess the existing status of water bodies and designate objectives and recommend mitigating measures or actions to achieve the following main objectives of the WFD:

- Preventing deterioration in and improving the status of aquatic ecosystems

- Aiming to achieve good status for all waters by 2015, or where justified, by 2012 or 2027
- Promoting the sustainable use of water
- Conserve habitats and species that depend on water
- Reducing or eliminating the release of harmful pollutants
- Reducing the effects of floods and droughts.

The WFD Assessment Report was undertaken with respect to the WFD assessment for the substantive tidal flood defence scheme, which was informed by consultation with the Environment Agency Area Principal Environmental Planning Officer, the Fisheries Biodiversity and Geomorphology Technical Advisor, and the Marine Advisor.

A Flood Risk Statement was also prepared for the project, in reference to the “Flood Risk Statement for Littlehampton Arun East Bank Tidal Walls Flood Defence Scheme” (EA, May 2013), which set out the background, strategy and proposed construction for the flood defences that have been constructed. The new section of wall is an integral part of this strategy and is designed to complement the existing flood defence walls.

4.8.1 Existing conditions

The site is located to the west of the Littlehampton town centre and is bounded by the Arun River to the west, an auto mechanic shop to the north and residential properties to the immediate south and east. It is located within Reach 4 of the Littlehampton Arun East Bank Tidal Walls Flood Defence Scheme, constructed following planning permission in 2013.

The work will involve the installation of steel sheet piles across a 26m length along the east bank of the Arun River, and will improve the defence provided by timber walls at this location. It will include a concrete capping beam, and will advance approximately 1.85m riverward. The backfill between the existing defence and the new sheet pile wall will be completely land-based in an urban setting with no riparian habitat (Figure 4-5).



Figure 4-5 Frontage at the proposed works within Reach 4

The site of the proposed works is not located within an ecologically designated site, nor is it considered to effect one through flows or proximity. The site is located on the east bank of the river, which comprises predominantly urban habitats with residential housing, light industrial premises and footpaths or roads. Vertical pilings form the water's edge.

The installation riverward of an existing defence, removes approximately 1.85m x 26m of intertidal mud the effect of which was incorporated in mitigation comprising mudflat creation undertaken north of LR4, delivered within the substantive scheme.

In addition, the brackish water within the river is known to support coarse and sea fish, including European eel, common roach, European flounder, sand goby, grey mullet, European sea bass, European plaice, solenette, sea lamprey, and sea trout.

The proposed works is on the Arun Transitional water body (GB540704105000), which has been designated as heavily modified (HMWB) with an objective to achieve GEP by 2027. The biological elements (status) are Fish (Moderate). The supporting elements are Dissolved Inorganic Nitrogen (Moderate) and Dissolved Oxygen (High) and supporting conditions are Tidal Regime: freshwater flow (supports good).

The following mitigation measures have been listed for the Arun Transitional waterbody in the South East RBMP and were considered within mitigation of the substantive scheme. Mitigation measures below informed methodologies and consents agreed in 2013 and apply similarly to this scheme:

- Indirect / offsite mitigation (offsetting measures)
- Retain marginal aquatic and riparian habitats (channel alteration)
- Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone
- Structures or other mechanisms in place and managed to enable fish to access waters upstream and downstream of impounding works

- Removal of hard bank reinforcement / revetment or replacement with soft engineering solution.

The following water bodies also exist adjacent to the full Littlehampton Arun East Bank Tidal Walls Flood Defence Scheme, and have already been assessed as part of the full scheme. Due to the nature, scale and duration of the gap infill at LR4, potential impacts on these water bodies are not considered further.

- Ryebank Rife (GB107041006620) - 160m south of west bank of River Arun,
- Sussex Coastal (GB640704540003) – coastline either side of the mouth of the River Arun , directly downstream of the substantive scheme
- Littlehampton Anticline West (GB40701G504900) – groundwater to west of River Arun
- Littlehampton Anticline East (GB40701G50340) –groundwater to east of River Arun

Figure 4-6 shows the extent of fluvial/tidal flooding that is predicted if the Flood Defences are not present and so highlights the importance of completing this section of flood defence wall.

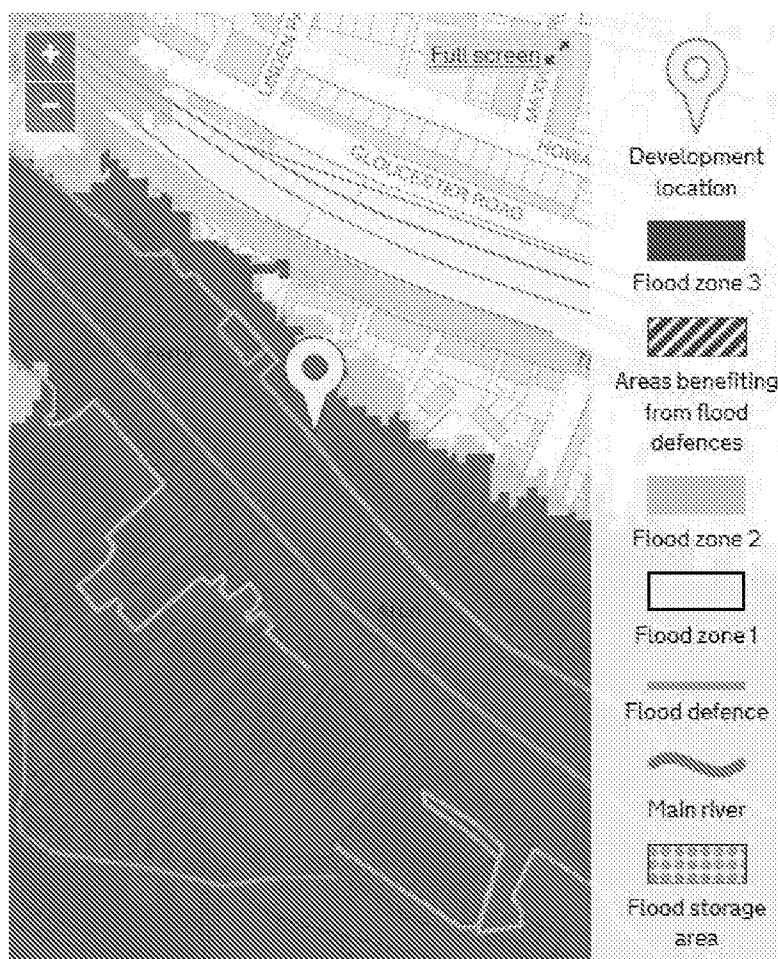


Figure 4-6 Fluvial / Tidal Flood Risk – EA Flood Risk Map

(Source: <https://flood-map-for-planning.service.gov.uk/summary/502415/102111>)

4.8.2 Likely significant impacts

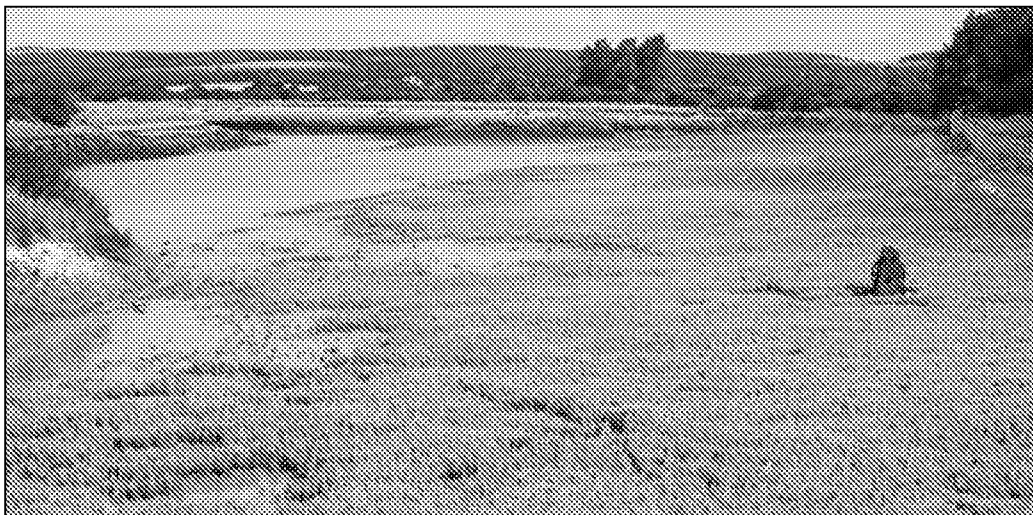
The potential for the proposed works (to infill the remaining 26m) to have an impact on the quality objectives of the Arun Transitional surface water body or impinge on its status is informed by details within the WFD Assessment that supported the Arun Tidal

Walls Flood Defence Scheme. Whilst effecting a change in the nature of the riverside defences, comprising the final piece in the full tidal defence wall; the proposed works complete the 2.5km Flood Defence Scheme, thereby ultimately allowing it to function more effectively. Within this context, any changes in the existing river dynamics are unlikely to be significant. Similarly, given the small scale and short duration of the works, any potential for long term change (damage) to occur during construction is unlikely.

As the proposed works will encroach approximately 1.85m riverward, there is potential for a loss of approximately 50m² of riverbed immediately adjacent to the flood defences. However, the effects of this loss has already been more than off-set by the mudflat created during by realignment undertaken north of the site, provided as habitat enhancement within the substantive Flood Defence Scheme.

A small area of subtidal and intertidal habitat for fish, with potential to affect feeding areas, may occur as a result of the proposed works on the 26m gap in the flood defence wall. The same habitats may also be lost for benthic invertebrates. However, subtidal and intertidal mudflat was over-compensated within the wider scheme, to mitigate such losses, providing compensation of habitat area losses and also provision of feeding and nursery opportunities for a number of species including flounder, sand goby and grey mullet.

The managed realignment also provided a gradient for zonal plant colonisation.



Encroachment of 50m² within the 0.22ha compensation together with the retained 0.12ha of mudflat is not significant for assemblages at the waterbody scale. The loss does not remove rare features.

Piling works in the intertidal zone also have potential to harm fish directly, as well as to disrupt migration of protected species present in the Arun such as eel and sea trout. Therefore, seasonal constraint (working late Oct to March) has been applied to the programme, to minimise impact.

In addition, further methodological constraints will apply as follows

The Environment Agency have agreed that no further mitigation is required in respect of Vibro-piling where this technique is used in this reach of the Arun at this time of year. As a result they are of the view that there is no constraint in terms of the majority of the piling works upon the fish stocks in the River.

Where ground obstruction prevents vibro-piling and *unavoidably* requires percussive piling (and where this will not affect structures), this will be subject to additional constraints to minimise effects on biodiversity. Such constraints include working with an

incremental increase in pile power to full operational power (a soft-start) with not less than 20 minutes incremental increase to gain full power. Where there is a pause in the use of this method, for more than 10 minutes, the soft –start procedure must be repeated.

Several safeguards exist to minimise the effects of noise and vibration during the construction, including:

- The use of percussive piling is included as a methodology to be employed in last resort, to be used for a minimum duration, and must not be used without agreement and sign –off of four lead members of the design and engineering team, and the Environment Agency Environmental Lead, EA Project Manager and Project Executive.
- Restriction of piling hours to 09.00 to 18.00 Monday to Friday and Saturday 09.00 to 13.00 (with movement of barge and equipment from 07:00 in the week and 08:00 on Saturday).

While the proposed works will encroach into the river by approximately 1.85m riverward, in alignment with previously constructed elements to the north and south.

The small scale of the works means that the resultant reduction in channel cross-section is negligible, and will not significantly change the River's capacity or water levels. Effects on sediment supply and local deposition are not anticipated.

Hydromorphological diversity is maintained by creation of mudflats and saltmarsh within the substantive scheme. The reduction in river bed width occurs within a channel that is between approximately 36m (subtidal) and 110m (intertidal) wide. The narrowest point of the channel is currently at the river mouth where the entrained channel is approximately 32m wide, and this will remain unchanged. Therefore, there will be no new constraint on fluvial or tidal flow. The decrease in channel cross section in Reaches 1 to 5 is small (<21.6% at MLWS and <6.2% at MHWS) as is the increase in intertidal extent at Reach 6 (<1ha) and will not decrease or increase the tidal prism in the channel.

The new steel sheet pile walls will replace vertical walls fabricated from timber, and will not alter the flow characteristics or wave energy within the channel.

4.8.3 Mitigation

The impacts of the proposed works on the mitigation measures are described below:

- Indirect / offsite mitigation (offsetting measures). The proposed works on the 26m gap were accounted within the offsetting measure; to provide enhancement for the loss of mudflat as part of the substantive scheme. Mudflat 0.22ha (and saltmarsh 0.77ha) was created through managed realignment and by manipulating ground levels north of the LR4 site and is establishing well.
- Retain marginal aquatic and riparian habitats (channel alteration). As the proposed works will install a structure that is riverward of the existing wall, a narrow strip of intertidal mudflat (approximately 1.85m riverward x 26.7m) will be lost. However, as above, this has been offset in previous mitigation.
- Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone—whilst the proposed works will result in the loss of a small area of intertidal mudflat, this loss has already been off-set within calculations of habitat creation provided by the substantive scheme
- Structures or other mechanisms in place and managed to enable fish to access waters upstream and downstream of impounding work. *The proposed works will*

have no impact on this measure as there will be no impounding structures to be installed.

Removal of hard bank reinforcement/revetment or replacement with soft engineering solution. The proposed works will have no effect on this measure, as the new sheet pile will be installed in front of the existing timber wall and fill placed between the sheet pile wall and the existing timber wall. However, as microhabitat within existing aged timbers will be replaced with sheet pile, compensation of the removal of these will be made with the addition of vertipools and timber ledges. Furthermore, the potential to support protected species in the wider Reach will be supported by the addition of bat and bird boxes (that will be set in more suitable habitat).

4.8.4 Residual impacts

The proposed works were assessed with respect to the general objectives of the WFD, and with specific reference to whether modifications resulting from the proposed works:

1. will meet the legal compliance requirements for “no deterioration”
2. will not prevent the achievement of GES or GEP in any waterbodies within the Arun River catchment
3. will contribute to the delivery of the South East RBMP.

Details of the WFD Assessment that supported the consented 2.5km Arun Tidal Walls Flood Defence Scheme within which the proposed works is located, were used in providing this assessment of the potential for the proposed works to have an impact on the quality objectives of the Arun Transitional surface water body or impinge on its status.

The substantive Flood Defence Scheme considered the following WFD objectives in its detailed assessments; that are here adopted for further assessment:

- **Objective 1:** No changes affecting high status sites—does not apply as high status sites are not present in the vicinity of the proposed works.
- **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 or potential.
- As the proposed works will encroach approximately 1.85m riverward, there is potential for a loss of approximately 50m² of riverbed immediately adjacent to the flood defences.
- A small loss of subtidal and intertidal habitat for fish, with potential to affect feeding and nursery areas, may occur as a result of the proposed works on the 26m gap in the flood defence wall. The same area will also be lost for benthic invertebrates. However, the habitat type is not localised within the wider waterbody and the impacts to the waterbody as a whole are considered to be negligible. Mitigation for the overall loss of mudflats as a consequence of the 2.5km scheme was provided within delivery following the 2013 consent (as 0.22ha mudflats and 0.7ha of saltmarsh, adjacent grassland).
- Piling works in the intertidal zone also have potential to harm fish directly, as well as to disrupt migration. Resonance free or low resonance vibro-piling is therefore the chosen construction method (rather than impact hammering), and is considered to be sufficient mitigation between lateOctober and March. Use of percussive hammering is limited to last resort, limited duration and sign –off

procedures, in combination with baffling. The method will also observe a slow start method to encourage elvers and fish to leave the area and avoid percussive shock.

- While the proposed works will encroach riverward approximately 1.85m, the small scale of the works means that the resultant reduction in channel cross section is negligible, and will therefore not significantly change the river's capacity or water levels. Similarly, effects on sediment supply and local deposition will be negligible as a result of the small scale of the proposed works in alignment with defences to the north and south.
- No other effects of the scheme are considered likely to significantly affect waterbody 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. *Other water bodies have not been included in this assessment, as due to the small scale and short duration of the works, impacts on other water bodies are not anticipated. Thus, 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. *Due to the small scale and short duration of the works, the proposed works 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 proposed works are not anticipated to give rise to negative effects at any waterbody designated under the Habitats, Birds, Nitrates, or Bathing Water Directives.

In summary: the proposed works will not result in deterioration in ecological potential in the Arun Transitional water body or in failure of the water body to achieve good potential in the future. The proposed works will also not result in any changes which will permanently prevent or compromise the environmental objectives being met in other waterbodies upstream or downstream of the site, nor will the works have any effect which could result in deterioration in status of any groundwater body. Protected Areas will also not be compromised by the proposed works.

The substantive scheme commits to the monitoring of effects in alignment with EA objectives, and legal duty of regard. This scheme, in association with the substantive scheme commits to provision of compensations (such as vertipools) and will contribute to elver monitoring on the Arun Catchment.

4.9 Other issues

This subsection discusses other environmental issues covered by the EIA Regulations which are considered to be of minor concern in relation to the proposed works. These have been scoped out of the EIA for the substantive Scheme, and so consequently of no applicability to the smaller works. Nevertheless, some treatment of standard mitigation has been incorporated into this document to ensure no adverse impact occurs.

4.9.1 Air quality

Air quality monitoring in Littlehampton is under the purview of the Arun District Council; there are reportedly currently no Air Quality Management Areas in Littlehampton.

The proposed works will consist of physical works, and potential air emissions will likely come from the use of construction plant equipment during the works, including the jack-up barge and vehicle use. In close proximity to residents and/or visitors, this could result in likely temporary impacts on human health.

Mitigation measures for potential impacts on air quality are referenced against those described in the original ES (EA 2013), and will include ensuring that construction proceeds in accordance with standard good working practices, such as turning off construction plant and vehicles whilst not in use.

4.9.2 Material assets

As works are to be undertaken adjacent to/within a marine environment, works on site will be conducted in accordance with PPG5 - Pollution Prevention Guidelines for works and maintenance in or near water (EA 2007) to prevent potential negative impacts to HPI Intertidal Mudflats and Running Water - Brackish.

4.9.3 Human health

No negative impact on human health and welfare is envisaged from the operation of the new flood defence wall.

Whilst local residents may be subject to some minimal noise disturbance during construction from machinery and vehicle movements, this will be minimised by good working practices such as avoidance of night-time working.

Vehicle movements through River Road will be managed by the contractors to minimise any disruption for local residents and the number of vehicle movements along the road is reduced by the use of a barge to carry equipment down the river where feasible.

The proposed works will have significant long-term benefits for the neighbours and the Littlehampton River Road Conservation Area as a whole by protecting properties from flooding.

4.9.4 Environmental management issues

The mitigation measures identified in this Environmental Review document have been incorporated into an Environmental Action Plan (EAP) prepared for the proposed works.

The EAP incorporates the actions required for the appropriate implementation of the environmental mitigation measures contained within this Environmental Report document for the completion of the Littlehampton Arun East Bank Tidal Wall Flood Defence Scheme. It has been prepared following Environment Agency Operational Instructions, and sets out specific objectives and targets for the delivery of the ER during project implementation. The EAP also presents the roles and responsibilities for the implementation of the Plan.

4.10 Cumulative impacts and inter-relationships

Cumulative impacts were considered in the original ES (EA 2013) for the substantive Scheme.

The original ES had undertaken an assessment of potential cumulative impacts on specific environmental receptors or resources arising from a number of different sources as a result of the proposed scheme, as well as an evaluation of any significant environmental impacts that are likely to result from the substantive Scheme in combination with other projects or activities that have been, or will have been, carried out in the vicinity.

Cumulative impacts on environmental receptors were identified through the use of an impact matrix showing the interaction of potential environmental impacts from different environmental aspects of the project with the identified environmental resource/receptor. The assessment showed that a range of different environmental impacts affecting the receptors to some degree, including by change in air quality, noise, land use, and waste, among others. However, with appropriate mitigation, it was considered that the majority of the impacts would be either negligible or beneficial, as any negative impacts were considered to be localised and/or temporary in nature. The ES (EA 2013) referenced the following potential developments whose environmental impacts might need to be considered in combination with the potential impacts from the full scheme:

- Raising of Pier Road in Reach 2—the option to raise the level of this Road, being considered by the West Sussex County Council during the preparation of the original ES (EA 2013), was also considered in the design of the Scheme. The substantive Scheme had been designed to accommodate any such works to the road.
- Redevelopment of Riverside Autos—Owners of Riverside Autos have now decided not to proceed with the redevelopment, thereby necessitating the completion of this section of the Flood Defence Wall by the EA.. As such, an assessment of cumulative impacts for this site is not applicable for this document.

4.11 Planning and legislation

4.11.1 Planning context

A Planning Statement has been prepared and (submitted 08-09-17) to Arun District Council in support of the planning application for this proposed works— a circa 25m length of flood defence wall outside 47 River Road (Riverside Autos), Littlehampton. This section of tidal wall along the frontage of 47 River Road was not completed as part of previous extensive flood defence works carried out by the Environment Agency at the East bank of the River Arun, which were approximately 2.5 km in length from the harbour mouth upstream but which included the footprint of this proposed works, and a level of assessment. The main portion of the Reach 4 tidal wall has been completed as part of the wider works carried out by the Environment Agency..

The Environment Agency previously worked in partnership with Arun District Council to produce the River Arun to Adur Flood and Erosion Management Strategy. The strategy, adopted in 2010, highlighted the area subject to this planning application as an area that would derive significant benefit from the provision of enhanced flood defences. The strategy identified, as the preferred option, the raising of flood defences to provide a consistent 1 in 300 year standard of defence for the full study area.

Previously in 2013 the Environment Agency (EA) undertook the installation of flood protection works along the River Arun in execution of planning permission LU/152/13. The previous downstream works were part of the Environment Agency Flood Protection Scheme, and included sheet pile wall and reinforced concrete, with a glass flood balustrade to a height of +4.8 m OD.

The previous upstream works (completed by the landowner of Lot 47) were part of the redevelopment of part of Lot 47 River Road (Riverside Wharf), and included a brick retaining wall with a concrete capping beam to a height of +4.9 OD.

During both these phases, the small section of the wall outside 47 River Road (Riverside Autos) was not installed. This small section of wall was going to be completed by the landowner but, due to changes in circumstances, this is now no longer possible and the Environment Agency will provide necessary works following the design and methodology of the wider scheme, as delivered in 2013. The installation of the small section of flood protection wall outside 47 River Road (Riverside Autos) will therefore tie into the previous flood protection works completed.

4.11.2 Compliance

The Development Plan consists of the Arun District Local Plan 2003. Paragraph 214 of the National Planning Policy Framework (NPPF) ensures specific local plan policies can carry weight according to their consistency with the various policies of the NPPF. NPPF paragraph 216 also confirms that weight can also be given to policies in emerging plans following publication. The emerging Arun District Local Plan 2011-2031 is therefore of material consideration.

The proposed works are compliant with key policies of the existing Arun District Local Plan 2003, including policy GE10 on tidal flooding and coastal defence, GE19 on Coastal Protection and Sea Defence Work and GE29 on Nature Conservation across the District; and key policies in the emerging plan including policies HER SP1 on Historic Environment, WD4 on Sea/Coastal Protection and HER DM3 on Conservation Areas.

The proposed development is considered to comply with relevant local and emerging local plan policies in that the development will have no materially adverse impact on the Littlehampton River Road Conservation Area, or the visual amenity or character of the local area. It will also be helping to reduce (rather than increase) flood risk and will have no unacceptably adverse impacts on the environment or biodiversity.

The proposed development is also consistent with the NPPF including its policies in section 10 on meeting the challenges of climate change, flooding and coastal change, 11 on conserving and enhancing the natural environment and 12 on conserving and enhancing the historic environment.

5 Summary

This Environmental Review presents an assessment of the relevant significant environmental impacts associated with the construction of a 26.7m vertical sheet pile segment of the Littlehampton East Bank Tidal Walls Reach 4 Flood Defence Project (the Project). The ER was prepared in support of the planning application for these works and the request for variation of the Marine Licence (reference no.MLA/2013/00212/7) for the activities required to complete the flood defence system.

The ER shows that whilst the proposed project will have some localised and temporary impacts during construction, they are able to be adequately managed through the implementation of mitigation measures identified for each key issue within this document, as well as in the EAP produced for the project.

In general, these mitigation measures were developed around appropriate management of works to reduce their impact, through:

- The adoption of Best Practicable Means as defined in the Control of Pollution Act 1974, which includes effective means of controlling emissions and discharges from construction sites.
- Timing of the works to daytime hours to prevent unnecessary disruption during resting time.
- 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.
- The restriction of construction activities to avoid sensitive times of the year for tourists and ecological interests, and restriction of the noise generating activities within working days and hours will help to avoid adverse impacts or reduce noise levels and nuisance for all sensitive receptors.
- Impacts on potentially affected migratory fish species will be minimised by means of sensitive working (e.g., use of vibro-piling and with exception and at last resort, slow start percussive piling to encourage fish to leave the area and avoid percussive shock).

In addition, the project will incorporate additional ecological enhancements into the project design, and will include:

- Establishment of vertipools into the vertical sheet pile façade
- Timber ledges to provide perching/attachment opportunities
- Offsite Bat habitat boxes
- Bird boxes.
- The wider project will also provide mudflat and saltmarsh monitoring and support eel monitoring.

Would you like to find out more about us,
or about your environment?



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.