BLANCHARD WELLS

Structures & Civils

For PMC Construction & Development Services Ltd.

River Wall Replacement Works

Method Statement

08.07.2021

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2 PROPOSED SOUTH ELEVATION
1 : 500

Kingston Wharf, Shoreham, BN43 6RN

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1. Introduction

1.1. General

Blanchard Wells Ltd. (BWL) are working with PMC Construction and Development Services Ltd. (PMC) to provide construction solutions for the 'proposed' River Wall Replacement Works at Kingston Wharf, Brighton Road, Shoreham, West Sussex, BN43 6RN (the 'site').

The site is being developed by Hyde Housing, covers an area of approximately 1.56 Ha and will consist of three 4 to 8 storey residential blocks and a commercial / mixed use business center, all complete with a riverside walkway, landscaping, and ancillary car parking.

The river frontage to the site covers a portion of the existing Kingston Railway Wharf (part west and east) and a portion of the existing Kingston Wharf (west and center), spanning approximately 340 lin.m.

1.2. Background

Based on the 2014 Shoreham Port Survey report which estimated that based on the survey findings the residual life of most of the existing river wall ranged between 60 and > 100 years, the original scheme did not envisage the need to replace the existing river wall.

Ongoing surveys have uncovered more detail resulting in the latest HOP report ('Existing River Wall – Inspection Report'; Ref: 12276/07/HOP/RPT/01 – P02 dated 19th February 2021) which concludes that the corrosion is significantly more severe than originally envisaged and that Accelerated Low Water Corrosion (ALWC) is present in all walls.

Various solution options were presented in the HOP report 'Outline Options & Feasibility, River Wall Remediation – Interim Report'; Ref: 12276/07/HOP/RPT/01 – P02 dated 12th March 2021, which were coordinated with the requirements for the landside development, the existing conditions described by the 'Kingston Wharf – Existing River Wall Structures, Based on Historic Record Drawings from Shoreham Port; ref: 12276-HOP-07-SK-TB03a' document and the existing GI information, to consider the various challenges they present, including:

i) Project Legacy

ii) Encroachment into the river

iii) Extent of EA / MMO licensing requirements

iv) Complexity (/ Simplicity) of Design (/ Construction)

v) Management of the existing wall / Stability during construction

vi) Marine Environment impact considerations

vii) Interaction with landside works

viii) Piling Risk

ix) Pile Sections and Craneage

x) Cost and availability of materials

xi) Scale and extent of Temporary Works

xii) Wall deflections and anchorage

xiii) Tidal Influence

xiv) Contamination risk and risk of draw-down

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xv) Excavation and removal of existing retained materials.

1.3. Outline of Proposed River Wall Replacement Works

With the above in mind, the optimum solution being proposed is to over-pile (that is river side of existing river wall) Walls 1, 2 and 3, approximately 270m of the existing frontage, and under-pile (that is land side of the existing river wall) Wall 4, approximately 70m. Anchorage for all new Steel Sheet Pile (SSP) works will be by fixing back to a reinforced concrete relieving deck anchored by two rows of tubular piles.

The following Method Statement with accompanying Risk Assessments describes the methods, sequencing, and controls to be employed in undertaking these works.

1.4. Stakeholders

Stakeholder	**Interest**
Hyde Housing	Landowner / Developer
PMC Construction & Development Services Ltd.	Principle Contractor
HOP Consulting Ltd.	Specialist Designer
Preene Groundwater Consulting	Specialist Groundwater Consultant
Blanchard Wells Ltd.	Civil Engineering Contractor
Berryrange Ltd.	Specialist Piling Contractor
Environment Agency (EA)	Regulator
Marine Management Organisation (MMO)	Regulator
Health & Safety Executive (HSE)	Regulator
Adur District Council	Local Planning Authority
Southern Water	Statutory Undertaker
Premier Guarantee	Building Control

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2. Scope of Works

2.1. Principle Works Elements

Note: all sizes and methods described here-in are subject to refinement on the production of detailed design and risk assessment.

2.1.1. Replacement of the existing (poor condition) SSP River Wall with a new SSP River Wall by over-piling to existing River Wall sections 1, 2 and 3 (c.270m), and under-piling to existing River Wall section 4 (c.70m).

- Wall 1 (Over-Pile) is approx. 105m long, and, subject to confirmation by detailed design including for long term durability and installation requirements, will consist of SSP's in the region of 16m long.
- Wall 2 (Over-Pile) is approx. 85m long, and, subject to confirmation by detailed design including for long term durability and installation requirements, will consist of SSP's in the region of 16m long.
- Wall 3 (Over-Pile) is approx. 80.0m long, and, subject to confirmation by detailed design including for long term durability and installation requirements, will consist of SSP's in the region of 16m long.
- Wall 4 (Under-Pile) is approx. 70m long, and, subject to confirmation by detailed design including for long term durability and installation requirements, will consist of SSP's in the region of 16m long.

2.1.2. Careful coordination to maintain the integrity and stability of the existing SSP river wall whilst installing the new SSP river wall is required which will include stand-off areas to avoid overloading the existing wall with construction plant, and temporary works to support the existing wall whilst anchors are removed, and new support established - in particular for wall 4 this requires a significant temporary works exercise to maintain stability.

2.1.3. Divert 1 Nr. 900mm dia. existing Southern Water Surface Water Outfall, 1 Nr. 600mm dia. existing Southern Water Combined Sewer Outfall, and 1 Nr. 300mm dia. existing Highways Drainage Outfall - through new SSP wall, c/w non-return flap valve, to be coordinated with SSP wall installation.

2.1.4. Installation of 5 new 250mm dia. drainage outfalls for surface water drainage catchments within the new development area - all complete with non-return flap valve outlets through the new SSP wall.

2.1.5. Installation of a new SSP River Wall anchorage system comprising of a reinforced concrete relieving slab (c/w drainage 'weep' holes) connected to the back of the new SSP wall with 'shear studs' and anchored back to pairs of 610mm diameter, 25mm wall thickness and 14 m long tubular piles at max. 4.5m c/c's.

2.1.6. Removal of existing SSP River Wall 4 to below bed level including excavation of the 1-2m thick 'wedge' of retained material between the existing SSP River Wall and the new SSP River Wall.

2.1.7. Installation of reinforced concrete Capping Beam to top of new SSP wall and reinforced concrete backing to back of new SSP wall (between Capping Beam and Relieving Slab).

2.1.8. Installation of Back-of-Wall Drainage and Backfill with site won 6N/P to release for follow-on EA Flood Protection works and Site Construction Activities.

2.1.9. Establishment of Vertipool Clusters (9 per cluster) at 100m centers to the face of the new SSP River Wall, to provide environmental enhancements.

2.2. Documentation

2.2.1. Drawings (Appendix A – Drawings):

12276-HOP-ZZ-XX-DR-C-0601 rev P2 - Key Plan/Marine Chart

12276-HOP-ZZ-XX-DR-C-0602 rev P3 - Site Block Plan showing existing arrangement

12276-HOP-ZZ-XX-DR-C-0605 rev P3 - Existing General Arrangement Sheet 1 of 2

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12276-HOP-ZZ-XX-DR-C-0606 rev P3 - Existing General Arrangement Sheet 2 of 2

12276-HOP-ZZ-XX-DR-C-0610 rev P1 - Proposed General Arrangement Sheet 1 of 2

12276-HOP-ZZ-XX-DR-C-0611 rev P1 - Proposed General Arrangement Sheet 2 of 2

12276-HOP-ZZ-XX-DR-C-0612 rev P1 - Typical Sections Sheet 1 Sections A and B

12276-HOP-ZZ-XX-DR-C-0613 rev P1 - Typical Sections Sheet 2 Sections C and D

12276-HOP-ZZ-XX-DR-C-0614 rev P1 - Typical Sections Sheet 3 Section E

12276-HOP-ZZ-XX-DR-C-0626 rev P1 - Indicative Construction Sequence Walls 1, 2 & 3

12276-HOP-ZZ-XX-DR-C-0627 rev P1 - Sequencing Drawing Wall 4 Sheet 1 of 2

12276-HOP-ZZ-XX-DR-C-0628 rev P1 - Sequencing Drawing Wall 4 Sheet 2 of 2

12276-HOP-ZZ-XX-DR-C-0670 rev P1 - River Wall Area and Volume Summary

12276-HOP-ZZ-XX-DR-C-0675 rev P1 - Proposed Environmental Enhancements - Elevation and Details

2.2.2. Design Assessments / Specifications (Appendix B – Background Information):

12276/07/HOP/RPT/01 - P3; Existing River Wall - Inspection Report

12276/07/HOP/WFD/01: Water Framework Directive (WFD) Assessment

12276-HOP-00-XX-RP-S-5002: HOP Designers Risk Register

12276-7; Map of Land and Marine Based Designations

12276-HOP-07-sk-TB03a: Existing River Wall Structures based on Historic Record Drawings from Shoreham Port

20-497.103.V1: Preene Groundwater Consulting, Groundwater Control Strategy

A1072v4.0 Revised; Tier II Supplementary Controlled Waters Risk Assessment

2.2.3. Regulator Permits / Licenses Required:

- MMO License
- FRAP
- Abstraction & Discharge Consents / Licenses
- Materials Management Plan (Claire Protocol)
- Shoreham Port License
- S.185 to divert public sewer & s.106 for sewer connections (& s.278 for works in the public highway)

2.2.4. Operational Permits to Work:

- Construction Phase Plan (CPP).
- Construction Environmental Management Plan (CEMP).
- Permit to Dig/Break Ground - The issuing of a Permit to Dig must be accompanied by all pre-digging investigations into the presence of any possible services within the dig area in the following pre-dig sequence is: -
    - View and analyse existing service drawings.
    - Visually survey the proposed dig area and surrounding area to assess any surface markers/pits.
    - CAT Scan the proposed dig area.

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  - Mark-out and hand dig to locate services identified from the existing service drawings, visual assessment, and CAT scans.
- Working Platform/Pile Mat - Permit to Load.
- Permit to Lift/Lifting Plan.
- Hot Works Permit.
- Traffic Management Plan.

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3. Methodology

3.1. Piling Works General – Piling Logistics (Appendix C – Piling Logistics Plan), Crane Platform, Surcharge Limitations, Ground Conditions and Groundwater Control:

Note: Access from landside and landside construction techniques are largely adopted for these activities except for a few marine activities (such as 'verti-pool' installation).

3.1.1. The existing hardstandings underlain with significant granular materials and having been historically trafficked by heavy construction plant are expected to be suitable for use as a crane platform (90t Crawler Crane). Trial Pits and in-situ CBR / Plate Load testing will be undertaken to check and ensure the existing condition is suitable for the crane and loading condition expected. The existing surface will be 'beefed-up' with additional granular materials (and possibly reinforced with geogrid) should the investigation and crane platform design so require.

3.1.2. Crane stand-off limits for surcharge loading to the river wall and edge of excavation for the new relieving deck will be provided by the Engineer (coordinating with the lifting plan), de-marked on the ground and protected by baulk timbers to prevent encroachment into surcharge limited areas.

3.1.3. Surcharge loading limitations for works behind the river wall, including any stand-off, will be provided by the Engineer and plant, and working methods will be strictly controlled to comply with these, including for establishment of piling gates, excavation works, filling works, reinforced concrete works.

3.1.4. All Piling Materials, including SSP's and Tubular Piles and bracing materials, will be stored in bundles following the manufacturers guidance, established perpendicular to the Northern boundary of the site, furthest away from the river wall.

3.1.5. The top of the existing river wall (8m high at low tide and currently a free / unrestrained edge) will be protected by baulk timbers fixed to the edge of the existing hardstanding (i.e., not on top of the capping beam) and scaffold 'A' frame handrail.

3.1.6. When required to work river side of the handrail all personnel will utilize fall arrest lanyards.

3.1.7. Existing ground conditions are likely to be relatively permeable and it is likely that excavations will be tidally influenced primarily during spring tides for a few short hours. In general, it is not the intention to pump against the tide. Perforations will be provided in 'blinding' layers (see below) to permit the tidally influenced groundwater to continue to rise and fall un-impeded.

3.1.8. Where suppression of the maximum groundwater level is found to be required (for installation of some of the deeper elements such as for diversion of the existing sewers and later construction of lift pits) a series of 300 dia. sump wells at 10-20m centers and 7m deep will be installed parallel to the existing SSP River Wall along the land side of the relieving deck.

3.1.9. Pumping Trials will be undertaken (Section 32 Consent) along with trial pits to observe the rise and fall of tidally influenced groundwaters and define the parameters for when groundwater control will be required and the pumping rates.

3.1.10. Groundwater samples will also be taken to ensure treatment requirements for discharge back to the River Adur meet discharge consent limitations (current background tests indicate groundwater chemical profiles match the background Marine / River conditions).

3.1.11. Surface Water (including residual groundwater trapped after the tide cycle) will be 'gripped' to shallow sump point and pumped via 'siltbuster' type settlement tanks for discharge back to the River Adur. A suitable discharge point / arrangement will be detailed as part of the discharge consent.

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3.1.12. Apart from the LNAPL 'plume' identified in the west of the site (treated by 'Soilfix') no other gross contamination has been identified along the river wall works (whilst the ground is historically reclaimed and used as an industrial wharf, numerous boreholes along the front have not identified contamination – except for the western corner arising from an off-site source). The base of excavations will be sealed with 'blinding' to maintain a suitable working surface and prevent the generation of silt and slurry whilst (foot) trafficking these areas. All excavations will be monitored for signs of gross contamination (including the LNAPL 'plume' area) and if contamination is found within exposed faces of excavations (batters) it will be covered with a layer of polythene and 'back blinded' to seal in-place and prevent migration / dissolution during the tide cycle.

3.2. River Wall Replacement by Over-Piling (Walls 1, 2 & 3):

Refer HOP Drawing 12276-HOP-ZZ-XX-DR-C-0626 'Indicative Construction Sequence Walls 1, 2, and 3'.

3.2.1. Setout the works by marking out the center line of the existing river wall along the top of the existing capping beam and providing off-sets to the center line of the new SSP wall (NOTE: each wall type will have a slightly different off-set according to the rake of the existing SSP wall).

3.2.2. Over-pile sections of wall are to be installed using 'Panel Driving' techniques (**Appendix D – Piling Gates** 'E8001A - Conventional Piling Installation' Drawing, Dwg. No. E8001A-BRL-00-XX-DR-X-0501). This technique consists of standing the piles on the ground within a support frame ('gate') in a 'panel' of multiple piles before driving the piles in. In this way the interlock between the piles acts to support adjacent piles when being driven and provides the maximum control and accuracy (verticality, alignment, overcome driving difficulties and risk of de-clutching) when being driven into the ground.

3.2.3. A 90t Crane will carry-out all the lifting requirements for the piling works. Materials will be stored such that the crane can lift requirements from stockpiles and place them in the works without the need to track.

3.2.4. The gate for the first panel of SSP's will be setup working from the West, ensuring all handrails, safety ropes, access platforms / 'gang planks', etc. are correctly set up and secure. Two beams will be placed on top of the existing SSP wall capping beam / adjacent hardstanding, perpendicular to the new SSP line, approximately 10m apart and projecting over the wall by approximately 2.5m and secured on the land side by kentledge blocks. Two Waling's (Horizontal steels running parallel with the SSP wall line used to support the SSP's when stood up prior to driving and control pile verticality during driving) will be placed spanning across the two cantilevered beams and welded to secure. The waling's will define the inside face and outside face of the new SSP wall with a < 10mm gap tolerance. Waling's will be sufficiently robust to ensure that piles a rigidly supported during driving.

3.2.5. Piles will be lifted using a 'ground release shackle' and the release rope will be no longer than the pile. The release rope will be regularly checked for knots, cuts and frays and replaced as required.

3.2.6. The first pile will be lifted and installed ensuring correct positioning and 'plumbed' within the piling gate (pitched).

3.2.7. This pile will then be partly driven using the vibrator suspended from the crane, to form a guide for the adjacent piles.

3.2.8. The remaining ten or so piles will be pitched and interlocked within the gate. Piles will be interlocked manually at the head of the preceding pile, by the slinger / signaler working from a MEWP located on the hardstanding behind the edge protection.

3.2.9. Panels will be back driven working along the panel from the leading piles towards the start, by crane suspended vibratory hammer, down to the level of the first pile, taking care to maintain verticality.

3.2.10. The piling gate will then be stripped out and the piles driven to final level leaving the last pair 'up' to provide a support for a hanger to receive the next (and subsequent) establishment of the gate adjacent the leading edge of the piles. Overall, total pile driving time is estimated at 2.5 – 3hrs a day, with the remaining time spent erecting

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gates, pitching piles and dismantling gates. All pile driving (both Vibro and Impact Hammer) will be undertaken using a 'soft start' so as not to shock nearby marine life with maximum energy driving at the outset. Energy for driving will be gradually increased to suit the increased resistance of the ground and maintain penetration rates, without immediately resorting to maximum energy settings.

3.2.11. Daily, at the start of each shift and/or prior to pitching the first pile within a gate (whichever is more frequent) the Piling Supervisor will inspect and ensure the temporary works has been, and remains, on the correct alignment and is stable. The Temporary Works Coordinator will undertake initial inspections with the Piling Supervisor and once satisfied, will thereafter delegate daily condition inspections, whilst maintaining a programme of monitoring inspections.

3.2.12. Strict wind limits will apply to all lift works, and all lift works will be the subject of detailed lift planning. During windy conditions SSP's act like a sale and so the Piling Supervisor will continuously assess conditions to decide when not to pitch piles. These periods may be suitable for back-driving piles – this will be assessed on a case-by-case basis.

3.2.13. Generally, the borehole records indicate the toe of the SSP's will be founded in very weak to weak chalk beneath beach and tidal flat deposits of between 3.5m and 6.5m deep. The vibrating hammer should drive SSP's to the required depth but where refusal may be encountered (flint layers have been identified at around 1m above toe level) final driving with an impact hammer may be required. If required this is expected to be for only exceptional occasions and for short (< 1hr) periods per day. Impact driving will be undertaken during low tide periods.

3.2.14. Coordinated with installation of the new SSP wall from west to east will be the diversion of the existing Southern Water 900mm diameter combined sewer outfall. This currently runs from the west boundary eastwards across the site, turning south to outfall about halfway (c.170m from the West corner of the site) across the site. It is intended for this sewer to be straightened-up along the west of the site to outfall c.70-75m from the west corner.

3.2.15. Prior to SSP's being installed up to and past this point the sewer diversion will have been installed and connected through the existing SSP River Wall. Subject to detailed design, the connection of the non-return flap valve will be made such that it can be easily removed and to allow the sewer to be extended through the new SSP River Wall once installed and the non-return flap valve fixed to the newly extended outfall end.

3.2.16. For the outfall connection through the existing SSP River Wall the existing hardstanding' s and the capping beam will be broken-out up to 10m back from the river wall 10m either side of the outfall pipeline. Concrete will be stockpiled in the western corner of the site for crushing and re-using as granular fills for the works.

3.2.17. 'Soft' materials will be excavated down to the underside of relieving deck level. 'Soft' materials are expected to comprise variable layers generally consisting granular materials (300mm – 600mm variable thickness) overlaying land reclamation 'fill' / beach and tidal flat materials. Granular materials (including 'clean-ish', not too silty, sands & gravels, crushed rocks and secondary brick / concrete aggregates will be stockpiled to the west, near the concrete for crushing, for screening and re-use as granular fills for the works. Remaining materials will be stockpile near to the site entrance for WAC testing and subsequent disposal off-site.

3.2.18 During reduced excavation several existing obstructions will be exposed, including existing and historical river wall anchors, historical sections of river wall, ancestral timber wall remnants as well as 'other' as yet unknown obstructions. Care will be taken to ensure the existing river wall anchors are not damaged by excavating around all obstructions to verify they are not existing anchors prior to breaking-out / cutting and removal.

3.2.19. The existing waling and anchor ties will then be inspected with the Engineer to ensure they are in a suitable condition to continue. Any remedials will be determined by the Engineer to be undertaken before the following works continue.

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3.2.20. Until the 'new' SSP wall is closed the 'old' existing SSP wall must remain intact to retain flood resilience. This includes the returns at the end of the 'new' SSP River Wall. Until then the methods employed will ensure that the integrity of the existing SSP River Wall is maintained.

3.2.21. The 900mm diameter combined sewer diversions outfall invert is c.1.0m below the formation for the relieving deck / existing tie-rod level. The sewer outfall will be located between exposed existing tie-rods and a short trench excavated behind the existing river wall. The trench will be shored (Trench Box / Trench Sheets and Frame t.b.a.) and the pipe bedding placed all in one tide cycle to protect from deterioration. These works will likely require assistance from the dewatering sumps to suppress the tidally influenced maximum groundwater level. Ideally these works will be targeted to occur during a neap tide albeit the diversion working away from the river wall will still require dewatering and will last longer than the neap tide period.

3.2.22. In one tide cycle, the pipe penetrations will be cut, outfall pipe inserted complete with the non-return flap valve fixed to the end, external face shutter fixed around the outfall pipe, a 'letter-box' shutter fitted around the outfall pipe on the land side of the 'old' wall and the 'old' wall penetration sealed by concrete.

3.2.23. Prior to the tide cycle for breaching and sealing the river wall all works will be prepared to minimize activity on the day. This will include pre-fabricating shutters, installing the bottom shutter for the external face (Dawson 'Redab' system or similar), pre-fitting the non-return flap valve to the outfall pipe and the like.

3.2.24. Working away from the river wall the remainder of the 900mm dia. sewer diversion will be installed and the diversion undertaken and commissioned.

3.2.25. As the 'new' SSP River Wall is progressed past the outfall, a pipe penetration will be cut and the outfall pipe, complete with non-return flap valve, extended through. The integrity of the penetration through the existing river wall will be maintained until the backfill and re-instatement can be undertaken once the 'new' river wall is 'closed'.

3.2.26. Once the 'new' river wall is sufficiently advanced reduced excavation landside of the wall shall commence, to release installation of the relieving deck tubular anchor piles followed by construction of the relieving deck.

3.2.27. Concurrent with the over-pile installation will be the under-pile works. It is currently envisaged that closing of the entire 'new' SSP River Wall will be required before any part of the existing SSP River Wall can be cut down and removed – all to ensure the existing flood and tidal defenses remain robust. To this end, cutting down the existing river wall, infilling between the existing river wall and new river wall, welding of shear studs to anchor the new wall to the relieving deck and casting the relieving deck, upstand wall and capping beam are all dependent on completing installation of the SSP's to both the over-pile and under-pile sections.

3.2.28. Reduced excavation and tubular pile installation can however be progressed without compromising the integrity of the existing SSP River Wall. Reduced excavation will be synchronized to commence sufficiently ahead of either the under-pile or over-pile operation completing (whichever is first – they will take a similar amount of time) so that the crane can be re-deployed onto the tubular piling, but not so far ahead as to leave the excavation open for too long a period. Subject to ongoing wall condition and stability assessment it may be required to alleviate load from the existing wall. Reduced excavation may be needed to achieve this, which may require this activity being bought forward in the construction sequence. Temporary Works for access and Piling Gates will be adjusted to suit this re-sequence.

3.2.29. As above, the reduced excavation will uncover several existing obstructions, including existing and historical river wall anchors, historical sections of river wall, ancestral timber wall remnants as well as 'other' as yet unknown obstructions. Care will be taken to ensure the existing river wall anchors are not damaged by excavating around all obstructions to verify they are not existing anchors prior to breaking out / cutting and removal.

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3.2.29. The formation will be sealed with a blinding layer of semi-dry concrete, screeded by excavator and roller compacted. The blinding will be punctured on a 2m square grid, by excavator mounted demolition hammer (pecker), to maintain drainage for the tidal rise and fall of groundwater.

3.2.30. Again, the existing waling and anchor ties will be inspected with the Engineer to ensure they are in a suitable condition to continue. Any remedials will be determined by the Engineer to be undertaken before the following works continue.

3.2.31. Tubular pile positions will be set out in pairs (3m & 5m off-set to the back of the existing SSP River Wall) at 4.5m centers running parallel with the river wall. Where tubular pile positions clash with existing tie-rod positions generally the centers will be reduced to avoid this clash (where the clash would increase the pile spacing by < 50% the pile diameter this will be referred to the Engineer before significant increases in tubular pile requirements are incurred).

3.2.32. Tubular pile locations will be probed by excavator mounted probe (to remove the risk of surcharge loading to the existing wall due larger drilling rigs), down to 3m deep to check for obstructions and, where obstructions encountered these will either be removed or, if impractical to remove, pile locations adjusted.

3.2.33. As with the SSP over-piling, a gate will be used to stand the piles in and provide control and accuracy during driving. The gate will accommodate a pair of piles at a time and will consist of steel support frames ('A' frames) across which support beams will span one-way, supporting walkway beams (working platform) spanning the other way. The arrangement of the beams provides three support edges to guide the pile between. The fourth edge is then closed by use of angle steel sections welded to the underside of the working platform (to avoid creating a trip hazard at height). All beams will be installed to a < 10mm tolerance for tube support (i.e. max. 620x620 opening).

3.2.34. As with the gate for the SSP's, the Piling Supervisor will ensure all handrails, safety ropes, access platforms etc. are correctly set up and secure before use.

3.2.35. Piles will be lifted using a 'ground release shackle' and the release rope will be no longer than the pile. The release rope will be regularly checked for knots, cuts and frays and replaced as required.

3.2.36. The first pile will be lifted and installed ensuring correct positioning and 'plumbed' within the piling gate (pitched).

3.2.37. This pile will then be partly driven using the vibrator suspended from the crane, down to the top of the gate.

3.2.38. The second tube will then be installed in the same way, the gate removed and both piles driven down to just above the level where the jaws would clash with the ground / refusal, whichever is higher.

3.2.39. With the assistance of a 2m 'dolly' (driving cap inserted into the top of the tube to protect the tube and enable the pile to be driven to level below the leg guides of the hammer – which are required to maintain a 'snug' fit for the hammer and maintain verticality) the tubes will be driven to finished level.

3.2.40. This process will continue for all required pairs of tubes along the length of the river wall.

3.2.41. Once the second crane becomes available the relieving deck works will commence.

3.2.42. The existing river wall will be cut down in sections (or bays – anticipate 30m bays at a time to coordinate the below activity, to be confirmed with the Engineer) and the gap between the 'new' and 'existing' river walls filled to underside of relieving deck level with site won gravels processed to a 6N specification.

3.2.43. Using mobile stud welding equipment, shear studs will be welded to the back of the 'new' SSP's to tie the SSP wall into the relieving deck. Shear studs at the lower relieving deck slab level will be installed first to release the slab construction works and, as slab bays are concreted the higher-level studs will follow. All shear studs will

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be checked by the welder using the 'ring test', and at a frequency of around 1:50 shear studs will be checked using the 'bend test'.

3.2.44. Tops of tubular piles will be cleaned out to the concrete plug depth, formwork and reinforcement installed for the relieving deck slab complete with starter bars for the walls, and the relieving deck slab concreted.

3.2.45. Outfall pipes for the new site drainage complete with non-return flap valves will be cut into the 'new' SSP wall and concreted in (in the same manner as the 900mm dia. Sewer above) on a single tide cycle.

3.2.46. Dawson 'Redeb' shuttering (or similar) will be used to form the river side soffit of the new capping beam, reinforcement for the back SSP wall reinforced concrete wall and the capping beam will be fixed, shutters erected, and wall and capping beam concreted.

3.2.47. Relieving Deck works will progress from the west to the east working. All concreting works to the relieving deck will be carried-out landside of the river wall. Once the relieving deck concrete has achieved the 28-day cube strength, the anchors to the 'old' river wall can be cut and removed. Initially tie-rods and anchors beneath the commercial building will be removed.

3.2.48. One at a time, tie-rods will be exposed within a small pit behind the relieving deck and, using excavator mounted demolition shears, cut within the pit. In this way, any tension in the tie-rod is resisted by existing skin friction in the ground and the tension should be released in a controlled manner. Once cut, the tie-rod will be traced back along its length to the anchor point, slowly releasing any residual tension, and the tie-rod and anchor removed.

3.2.47. Back-of-wall drainage will be installed, and the relieving deck backfilled with site won processed 6N, and the works released for follow-on landside development works to be sequenced with the new internal (site side) flood 'resilience' wall and river walkway finishes.

3.3. River Wall Replacement by Under-Piling (Wall 4):

Refer HOP Drawings 12276-HOP-ZZ-XX-DR-C-0627 & 0628 'Sequencing Drawing Wall 4 Sheet 1 of 2' and 'Sequencing Drawing Wall 4 Sheet 2 of 2' respectively.

3.3.1. Given the natural restrictions to the river channel imposed by 'Soldiers Point' directly opposite Wall 4, it is considered more prudent to provide an under-pile solution in this location.

3.3.2. Under-piling will require the existing SSP River Wall tie-rods to be severed before the 'new' SSP River Wall can be installed.

3.3.3. This in turn will require the existing SSP River Wall to be supported whilst the 'new' SSP River Wall is being constructed.

3.3.4. To achieve this, the relieving deck anchor piles and the 'pile cap' section of the relieving deck will be installed to provide a temporary anchor point for temporary bracing and ties used to support the existing SSP River Wall whilst the 'new' SSP River Wall is being installed. In effect, the reverse of the over-piling sequencing described above.

3.3.5. Prior to any works landside of the existing SSP River Wall, 'gallows brackets' will be fixed riverside of the river wall at a level slightly above the existing tie-rod level. These 'gallows brackets' are to receive the large primary waling required to temporarily support the river wall once existing tie-rods are cut. 'Gallows brackets' would normally be welded to the SSP's but if the piles prove to be in such a condition that competent welds cannot be achieved, bolted connections will be formed by cutting and drilling holes through the webs of the piles behind the riverside face of the pans to provide robust connections for the 'gallows brackets' to carry the waling and the waling to be used as a walkway. Access for these works will be by MEWP.

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3.3.6. 'Gallows brackets' will be established along the full length of the under-pile wall and the first three waling's installed and bolted together end-on-end, secured to the 'gallows brackets' with welds and be completed with handrails and secure enclosed ladder access.

3.3.7. Once the riverside preparation works has been done the area for the relieving deck behind the river wall can be excavated.

3.3.8. As with the reduced excavation for the over-pile works, the reduced excavation for the under-pile works will uncover several existing obstructions, including existing and historical river wall anchors, historical sections of river wall, ancestral timber wall remnants as well as 'other' as yet unknown obstructions. Care will be taken to ensure the existing river wall anchors are not damaged by excavating around all obstructions to verify they are not existing anchors prior to breaking out / cutting and removal.

3.3.9. The existing capping beam and adjacent hardstandings will be broken-up and transported to the northwest of the site for crushing and processing into suitable granular fills for re-use within the works.

3.3.10. 'Soft' materials will be excavated down to the underside of relieving deck level. 'Soft' materials are expected to comprise variable layers generally consisting granular materials (300mm – 600mm variable thickness) overlaying land reclamation 'fill' / beach and tidal flat materials. Granular materials (including 'clean-ish', not too silty, sands & gravels, crushed rocks and secondary brick / concrete aggregates will be stockpiled to the west, near the concrete for crushing, for screening and re-use as granular fills for the works. Remaining materials will be stockpile near to the site entrance for WAC testing and subsequent disposal off-site.

3.3.11. The formation will be blinded with semi-dry concrete, screeded by excavator and roller compacted (light pedestrian roller) to seal against degradation due to the tide, groundwater, and precipitation. The blinding will be punctured on a 2m square grid, by pecker, to maintain drainage for the tidal rise and fall of groundwater.

3.3.12. The existing waling and tie-rods will then be inspected with the Engineer to ensure they are in a suitable condition to continue. Any remedials will be determined by the Engineer to be undertaken before the following works continue.

3.3.13. Following the same process as for the tubular piling for the over-pile, the tubular piles for the relieving deck anchorage will be set out and installed.

3.3.14. The relieving deck 'pile cap' section complete with HALFEN 'kwikastrip' (or similar) type starter bar connections for the remaining relieving deck (see later), will be constructed as the tube installation progresses. In bays (estimated at 30m long) the tubes will be cleared and 'pile caps' spanning the tubes shuttered, steel fixed and concreted.

3.3.15. It is anticipated that tie rods for this section of wall will be slightly above the formation level for the relieving deck. If so, tie rods will be sleeved by wrapping with a split plastic duct, through the relieving deck pour.

3.3.16. The existing 600mm dia. sewer and 300mm dia. highways drainage both currently outfall through Wall 3 and are required to be diverted to outfall at the eastern corner of the site. The invert of these outfalls is slightly above the formation for the new relieving deck. These diversions need to be carefully coordinated with the 'new' SSP River Wall installation.

3.3.17. Diversion routes will be installed ahead of 'new' SSP River Wall installation and valves will be installed at the existing Manhole's to enable the 'new' discharge lines to be commissioned, and existing lines to be isolated once outfalls are installed through the 'new' SSP River Wall. Discharge lines will be installed up to and through the relieving deck 'pile cap' (exact arrangement subject to detailed design).

3.3.18. Prior to installation of the first 'new' SSP panel, the outfalls will be cut into the existing SSP River Wall and short sections of pipe, complete with non-return flap valves (accessed by MEWP), installed and concreted in.

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3.3.19. Once the first panel of 'new' SSP's has been installed and secondary bracing completed pipe penetrations will be cut through the 'new' SSP's and the 'new' discharge pipework temporarily connected to the outfall pipes installed through the existing SSP River Wall and the penetrations concreted and sealed. This then enables the 'new' discharges to be commissioned and the existing outfalls to be decommissioned to permit SSP's to continue across these locations in due course.

3.3.20. On removal of the existing 'old' SSP River Wall (see later) the outfalls will be cut back to the 'new' SSP River Wall and non-return flap valves repositioned.

3.3.21. Early strike cubes will be taken to agree with the Engineer when the concrete has reached sufficient strength to resist the loadings from the temporary works.

3.3.22. Whilst the concrete is gaining strength the initial sequence of primary tie beams (4 / 6 Nr. – detailed design to confirm, current 'worst case' 2 per waling section) will be lifted into position by crane and fixed – one end by burning through the river wall and bolting to the large waling, and the other end by drilling into the 'pile cap' and bolting down, using chemical anchors. Working with the Engineer, care will be taken locating the primary tie beam positions relative to the existing tie-bars to optimize their position so that the piler can continue at least four piles forward once the secondary braces are installed and the leading-edge primary brace removed, prior to replacing the primary brace and the next 'primary panel' of tie-bars being cut.

3.3.23. Detailed design will determine whether a 'return wall' is required to return the 'new' SSP River Wall back into the site (to reduce tidal influence on groundwater in the site). If so, SSP's will commence from the end of the return wall and progress to the corner, turn 90 deg.'s and continue west towards the over-piling to be 'closed' at the transition between the under-pile section (Wall 4) and the over-pile section (Wall 3).

3.3.24. To limit the imposition of dynamic loading on the existing SSP River Wall once tie-bars are cut, silent – vibrationless piling techniques have been selected. Whilst this technique is less versatile when working around the existing tie-rod constraints it is considered the safest approach to maintaining temporary stability of the existing SSP River Wall.

3.3.25. This method of pile installation utilizes a hydraulic press-in system. The piler 'grips' the previously installed piles with hydraulic clamps ('legs') to provide the reaction force for the piler to then 'press-in' the new leading-edge pile via the piling 'chuck' (part of the piler which 'grabs and pushes', with hydraulic rams, the pile into the ground). When starting piling there are no piles on which to grip. To install the first piles, ahead of any tie-rod cutting activities, either a 'gate' will be setup and an initial panel of four piles installed using traditional techniques or, if exposed tie-rod constraints prevent this approach, either a reaction stand will be established (preferred) or tension piles installed (later become redundant) – to be assessed in detailed design and the impacts of surcharge loads on the existing SSP River Wall.

3.3.26. The reaction stand consists of a purpose-built frame setup on a 6m x 6m concrete base and loaded with four 7t kentledge blocks to provide the reaction forces. After driving the first four piles the reaction stand will be decommissioned and removed, and piling will continue with the piler effectively progressing forward by 'walking' forward on the installed SSP line. The piler with the reaction stand will be the heaviest lift (at 12t) and the crane will be sized and positioned suitable for this maximum lift.

3.3.27. It is anticipated that water jetting will be required to lubricate pile installation and penetrate any gravel layers encountered during driving. A lance is welded to the pile with a hose connector at the top of the lance. The operator will adjust water pressure to the minimum required to overcome obstruction / resistance to driving encountered.

3.3.28. Initially, the center line of the 'new' SSP River Wall will be marked on the ground. Pegs will be established on this line providing 'top-of-pile' level. A laser will be used to control both line and level of the SSP's by aiming between the established pegs.

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3.3.29. Piles will be lifted, complete with lance pipe fitted, from the pile bundles located within the lifting radius of the crane, using a 'euro-shackle' complete with a 25mm dia. pin located in the pitching hole at the top of the pile, and positioned and clamped within the jaws of Berryrange's ZU100 Piler.

3.3.30. Water is switched on and the pile initially driven around 0.5m, to provide stability, ahead of the shackle being released.

3.3.31. The operator will check for line and verticality before then pressing the pile to final level.

3.3.32. The lance is then removed, by pulling vertically with the crane to break the temporary welds and attached to the next pile which is then pitched as above.

3.3.33. The piler 'walks' by pushing the pitched pile into the ground to provide enough resistance for the pile clutch to be released and moved higher to re-grip the pitched pile at this higher level, then release the legs / clamps and self-lift the machine body and clamps, moves forward and lower onto the last pile previously driven to final level, re-clamp the pile tops and drive the pitched pile to final level. A small weld is made at the top of the piles once installed to level, to assist with the reaction force and help keep the pile tops to level.

3.3.34. Again, the lance is then removed, by pulling vertically with the crane to break the temporary welds and attached to the next pile, which is then pitched as above, and the cycle continued.

3.3.35. Piling is to be coordinated with bracing activities and it is considered this will be limited to 4 pairs (5.6lin.m.) per day, or approximately half a 'primary' braced bay.

3.3.36. If at any time the pile cannot be driven to design level, this will be referred to the Engineer for re-assessment to determine whether sufficient depth has been achieved for the top to be cut-off (if only one pile intermittently) or whether traditional driving required (if less than ½ the pile installed or more than 1 pile consecutively fails to meet toe depth).

3.3.37. Corner Piles / Changes in direction are installed either by crane assistance (preferred) or by self-moving, which will be determined once the constraints from the existing tie-rods are better known.

3.3.38. Cutting existing tie-bolts, moving Primary Bracing, relocating Temporary Large Waling's and installing the secondary waling's / wall ties and bracings will be carefully coordinated with piling activities.

3.3.39. Primary large waling's complete with primary bracing will be established in three bays ahead of piling activities.

3.3.40. Tie-bolts within the first 'primary panel' will be cut using excavator mounted hydraulic demolition shears and cleared from the line of the 'new' SSP River Wall. Bolts will be re-filled over to limit the uncovered length of 'tensioned' bolt whilst cutting.

3.3.41. As piling installation progresses, secondary bracing will be installed. Secondary bracing will be located slightly above primary bracing to aid installation. Secondary bracing will be completed for each day SSP installation ahead of the next days SSP installation (night shifts may be required once the sequence is established).

3.3.42. 'Gallows brackets' will be welded to the back (landside) of the newly installed SSP's, as the piles progress, to receive the secondary bracing waler section (5m sections), and holes will be cut in the existing and 'new' SSP River Walls for bolts to tie the walls together spanning through the secondary waler.

3.3.43. Once the piling is sufficiently advanced, the secondary waler will be installed (and bolted to the previous secondary waler for all subsequent waler's after the first) and bolts, complete with washer plates, installed through the waler and out to the river side face, to tie both walls together.

3.3.44. Secondary braces will be bolted to the secondary waler and drilled and fixed by chemical anchors into the reinforced concrete pile cap, concurrent with progressing the secondary waler and bolting activities above.

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3.3.45. Once the piling reaches the primary bracing at the leading edge, it will temporarily stop to allow the secondary bracing to be completed.

3.3.46. The primary bracing will then be removed, and the piling extended up to the next un-cut existing tie-bolt (min. 4 pairs of piles) / primary brace position.

3.3.47. The fourth pair from the leading edge will be cut down (and the cut down length marked and set aside to be welded back in place in due course) to primary waler level and the primary brace re-placed. Tie-bolts within the next panel can then be cut and the panel progressed as above.

3.3.48. Once the SSP enters the third 'primary waling bay' the first 'primary waling bay' can be decommissioned and 'flown-over' and installed to form the 'fourth primary waling bay'.

3.3.49. The process above will continue until the under-pile section (Wall 4) is closed with the over-pile section (Wall 3).

3.3.50. As primary waling bays are completed and decommissioned (with secondary bracing remaining in-place) the relieving deck will be completed.

3.3.51. Using mobile stud welding equipment, shear studs will be welded to the back of the 'new' SSP's to tie the SSP wall into the relieving deck. Shear studs at the lower relieving deck slab level will be installed first to release the slab construction works and, as slab bays are concreted the higher-level studs will follow. All shear studs will be checked by the welder using the 'ring test', and at a frequency of around 1:50 shear studs will be checked using the 'bend test'.

3.3.52. HALFEN 'Kwikastrip' cast-in reinforcement strip will be 'opened', formwork and reinforcement installed for the relieving deck slab, complete with starter bars for the walls, and the relieving deck slab concreted.

3.3.53. Outfall pipes for the new site drainage complete with non-return flap valves will be cut into the 'new' SSP wall and concreted in (in the same manner as the 900mm dia. Sewer above) on a single tide cycle.

3.3.54. Detailed design will be needed for the capping beam, to provide for the removal of the existing 'old' SSP River Wall once the relieving deck works has reached strength (see below). Dawson 'Redeb' shuttering (or similar – accessed and installed by MEWP) will be used to form the river side soffit and river side face (oversized shutter stood proud of finished concrete to prevent spillage of concrete river side) of the new capping beam, reinforcement for the back SSP wall reinforced concrete wall and the capping beam will be fixed, shutters erected, and wall and capping beam concreted – all working from the land side of the river wall.

3.3.55. Relieving Deck works will progress from the east to the west. Once the relieving deck concrete has achieved the 28-day cube strength, the secondary bracing including bolts between the 'old' SSP River Wall (riverside) and the 'new' SSP River Wall (currently landside) can be cut and removed, back of wall drainage installed and the reliving deck backfilled (with 6N recovered and processed from site won granular materials) prior to removal of the 'old' river wall.

3.3.56. Working from the backfilled platform behind the 'new' SSP River Wall, the existing SSP River Wall will be removed. Ideally this will be achieved by vibratory hammer suspended by 90t Crawler Crane, gripping, and extracting one pile at a time. This approach will depend on the condition of the existing piles and whether sufficient section is available to grip the piles and whether sufficient section remains at bed level for the piles to hold together. If not, specialist dive teams will be used to cut the piles at 1/2m below bed level. An attendant long reach excavator located on the backfill behind the 'new' SSP River Wall will dredge the bed at low tide sufficiently to provide access for the divers. The 90t Crawler Crane will lift and remove the piles as they are cut.

3.3.57. Historical records suggest the existing fill behind the existing SSP River Wall, is clean granular material. This is borne out by observation of the water draining from behind the wall through corroded holes in the wall, which is clear. During pile extraction the 1m wide 4-4m high column of fill remaining being the 'old' SSP River Wall

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between the 'new' SSP River Wall will slump down. To mitigate against any residual fines within this granular material silting the river the area will be encapsulated with a floating silt fence. As the piles are extracted and the fill slumps down, the attendant long reach excavator will dredge these 'spill' materials up to the site and they will be incorporated within the granular materials being retained and processed for re-use in the works.

3.3.58. Once the existing 'old' SSP River Wall has been removed the area will be released for the follow-on landside development works which will be sequenced with the new internal (site side) flood 'resilience' wall and river walkway finishes.

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4. Programme (Appendix E – Programme):

4.1. Over Piling Works (Walls 1,2 & 3)

Overall, the estimated duration is 32 weeks, generally in the following sequence:

1. Over Piling – 10 Weeks
2. Reduced Excavation and Tubular Piling – 19 Weeks
3. Relieving Slab, Reinforced Wall backing and Capping Beam to SSP's – 18 Weeks (running concurrently with reduced excavation and tubular piling, finishing c.3 weeks later).

4.2. Under Piling Works (Wall 4)

Overall, the estimated duration is 24 weeks, generally in the following sequence:

1. Reduced Excavation and Tubular Piling – 9-10 Weeks
2. Primary Bracing, Tie Rod Cutting, Under Piling and Secondary Bracing – 5 Weeks
3. Relieving Slab, Reinforced Wall backing and Capping Beam to SSP's – 9-10 Weeks.

There will be an overlap with all activities for the under piling works.

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5. Health & Safety (Appendix F – Risk Assessments)

The principal risks and controls for these works are:

5.1. Members of the Public, the Client and 'others' not familiar with the works

The site will be secured by hoarding and controlled access will be provided to prevent un-authorised access.

On arrival to site, ALL personnel will make themselves known to the Site Manager for induction and familiarization to the site and for instructions on works and access arrangements.

Weekly coordination meetings will be had.

Toolbox talk training will be conducted regularly.

RAMS will be discussed and signed by all operatives and/or visitors attending the works.

Daily Task briefings will be undertaken to keep personnel focused and refreshed.

5.2. Lifting Operations (LOLER)

Cranes / Lifting equipment will be sized to suit the most onerous lift (weight and/or lifting radius).

Working (Crane) Platforms will be designed to suit the applied (Crane) loadings.

A Crane coordinator will be appointed and all lifts pre-planned by way of a Lift Plan.

Certified Crane Operators will ONLY be permitted to operate Cranes and certified Banksman / Slingers will secure lifting equipment and direct lifts.

Cranes and Lifting Equipment will be furnished with all current test certificates.

Cranes and Lifting equipment will be inspected daily to ensure they remain suitable for use.

5.3. Plant and Working Equipment (PUWER)

All plant operatives will be suitable trained and have certificates of competency for the type of plant the are to operate.

All keys will be secured to the operative, by means of suitable 'Key Bungees', to avoid keys being left in machines when not being used.

Operatives will conduct daily inspections and maintenance of the plant and report weekly on it's condition.

5.4. Working at Height

The existing SSP River Wall is approximately 8m high at low tide and access will be required to the top of the wall and the riverside face for these works.

Access to the face and SSP installation will utilize MEWPS as well as Temporary Works Platforms (Waling's) accessed by ladders and gang planks.

Waling's and Gang Planks will all be secured and suitable for man-access, complete with hand rails and toe boards. Ladders will be caged, and both ladders and gang planks will be removable (to be removed at the end of each shift) to prevent un-authorised access when the site is not occupied (nights and weekends).

Edge restraint will be provided to the top of the wall suitable for preventing MEWPS being inadvertently driven over the edge, and handrails will be provided to keep personnel back from the edge.

Harnesses secured back to a suitable fixed point (e.g. rope across Kelly blocks, established anchors) will be used by all personnel working river side of the existing SSP River Wall.

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5.5. Working Adjacent Water & Tidal Working

Four rescue stations will be established along the top of the existing river wall, combined into the handrail above, complete with emergency response instructions, life buoys and rescue lines.

All personnel working riverside of the river wall will wear suitable life vests.

5.6. Collapse of Excavation

Generally, excavations will be constructed with banked sides stable and suitable for the works.

Where access restrictions apply, proprietary trench boxes or trench sheet shoring systems will be designed and used to maintain stability.

Materials and plant will be kept back from trench edges to prevent surcharge loading.

Special attention will be given to the location of the Crane to avoid surcharge loading of excavations (and the existing SSP Wall).

5.7. Collapse of Structures

The existing SSP River Wall will require the tie rods to be cut to enable the 'new' SSP wall to be installed.

Careful consideration is required to ensure stability is maintained when installing the 'new' SSP wall. Temporary support systems and sequences will be strictly adhered to maintain stability of the works.

Regular inspection and review with the Engineer.

For piling adjacent the existing SSP River Wall once tie rods are cut, vibrationless techniques will be used to limit dynamic loading on the existing SSP's.

5.8. Construction dust & Asbestos

There is a small risk of Asbestos and Contaminated Ground.

All operatives and supervision will receive awareness training sufficient to closely monitor excavations as they progress and raise concerns if conditions are so un-covered.

Contamination will be covered by polythene and blinded to seal the surface. Where visual (seepage) and/or smell evidence might suggest a significant contamination problem, works will cease until investigations and solutions found.

If signs of asbestos are uncovered a specialist asbestos consultant will be engaged to assist with assessing the risk and implementing an appropriate safe system of work.

5.9. Works requiring Supervision

An experienced and competent Site Manager / Foreman will directly supervise the works on a full-time basis.

A Project Manager shall be based on-site and will be responsible for translating all elements of the design into detailed, workmanlike planning and programming with associated Methodologies, Risk Assessments and Quality Procedures, all to provide appropriate support and guidance to the Site Manager / Foreman.

At least monthly progress reviews will be had and processes revised and updated as appropriate.

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6. Environmental

6.1. Flood Defense

The integrity of the existing SSP River Wall shall be maintained at all times until the 'new' SSP River Wall is installed and closed.

Emergency contact measures will be in-place in the event of an exceptional meteorological event potentially compromising the existing flood defenses.

As part of the induction all personnel will be made aware of the criticality of maintaining the existing defenses and instructed to STOP WORK in the event conditions are not as expected or excessive movements to the existing SSP River Wall are experienced. Conditions will be investigated and , where necessary, alternative restraints implemented after consultation with the Engineer.

6.2. Controlled Waters

These works abut the River Adur and will be affected by tidal groundwater.

Pumping Tests and Groundwater Quality analysis will be undertaken to refine the abstraction and discharge requirements and ensure suitable treatment facilities are put in place.

Regular inspection and sampling of discharges will be undertaken to maintain quality.

Fuels will be stored in purpose-built tanks, bunded to 110% capacity complete with securable filling hose and trigger and located to the North of the site, furthest from the river and clear of any gullies / drainage features.

Refueling will be undertaken at the storage location away from the river.

Drip Trays will be used during refueling and for all static plant.

Plant 'nappies' will be used for all mobile plant adjacent the river wall.

Fire extinguishers and emergency spill kits will be maintained at the fuel storage location.

Oils and Greases will be stored in suitable containers secured within a bunded COSHH store located on the Northern boundary farthest from the river.

Spent Oil and Grease Containers will be skipped and appropriately disposed of.

Accidental spillage will be immediately treated with spill kits and contaminated materials removed for appropriate off-site disposal.

More severe incidents (if they occur) will be contained whilst an action plan is instigated, and the Client and EA immediately notified.

6.3. Contaminated Land

Except for the Western boundary of the site (small LNAPL plume located) the Ground Investigation has found the existing ground to be relatively un-contaminated. Elevated determinants have largely been conjectured as mirroring background chemistry consistent with the marine conditions of the river.

The ground does consist of ancient reclamation overlaid by paving, consisting of gravels (of primary and secondary aggregates) topped in the most part by concrete and some asphalt bays.

The industrial past of the site was largely as a bulk materials wharfage, but it has been bounded by more contaminating industrial activity.

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Currently the investigations and background readings would suggest that if contamination is encountered it likely to be relatively insignificant in terms of the overall volume of excavation and the risks posed would be negligible.

That said, there remains a small risk of Asbestos and Contaminated Ground.

All operatives and supervision will receive awareness training sufficient to closely monitor excavations as they progress and raise concerns if conditions are so un-covered.

Contamination will be covered by polythene and blinded to seal the surface. Where visual (seepage) and/or smell evidence might suggest a significant contamination problem, works will cease until investigations and solutions found.

If signs of asbestos are uncovered a specialist asbestos consultant will be engaged to assist with assessing the risk and implementing an appropriate safe system of work.

6.4. Historic Obstructions / UXO

UXO risk is considered low.

Historic Obstructions will be encountered. Principally, the risk they pose is to the existing active tie-rods for the SSP River Wall and, where they cannot be removed / are encountered at depth, the line and spacing of the 'new' SSP and tubular pile works.

Care will be taken to expose existing obstructions prior to removal to ensure that existing tie-rods are not disturbed.

The risk of obstructions to the SSP line for Walls 1,2 & 3 is considered low, but for Wall 4 and the line of the tubular piles is considered highly likely.

An excavator mounted probe will investigate obstructions to the line of Wall 4 and tubular pile positions, between existing tie-rods down to approximately 3m below relieving deck formation, to establish an optimum pile line and spacing ahead of installation works.

Where obstructions are encountered during installation of the SSP's these will be overcome either by cutting-off the pile where obstructions impede an individual pile and the pile has been driven to > ½ it's length (or deeper – subject to definition by the Engineer), or for shallower piles / consecutive piles the Engineer will be consulted to agree an appropriate course of action (e.g. re-alignment profile).

6.5. Noise & Vibration

The significant source of noise and vibration will be the use of traditional piling techniques.

Generally, the borehole records indicate the toe of the SSP's will be founded in very weak to weak chalk beneath beach and tidal flat deposits of between 3.5m and 6.5m deep. The vibrating hammer should drive SSP's to the required depth but where refusal may be encountered (flint layers have been identified at around 1m above toe level) final driving with an impact hammer will be required.

Impact Hammers are by far the noisiest activity and every effort will be made to avoid there use where possible. Where required driving with impact hammers will be < 1 hour per day, in normal working hours, and at low tide wherever possible.

Vibrating hammers provide the best opportunity to seat the piles without the need to resort to impact hammers.

After gate erection and pitching panels of piles, vibratory driving will take around 2.5 – 3 hours per day.

For the under-pile works (Wall 4) vibrationless techniques will be used to avoid dynamically loading the existing SSP's once tie-rods are cut. This may increase the risk that impact hammers may be required to seat the piles. In

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the first instance water jetting will be used to aid installation and try to avoid the requirement to final drive the piles.

6.6. Waste Management

The project strategy is to maximise the re-use of materials arising from the works.

Concrete and Asphalt will be crushed on-site and screened to produce 'secondary' aggregates in-place of importing primary aggregates.

Likewise, existing granular materials (primary and secondary aggregates, gravels, suitable sands) will be separated from materials containing excessive amounts of cohesive and/or silty / fine sand components, stockpiled and screened to produce 'secondary' aggregates in-place of importing primary aggregates.

Processing fines and cohesive / silty / fine sand materials will be disposed off-site.

A Material Management Plan will be developed in support of this strategy, to be agreed with the EA.

6.7. Marine Side Works

Access to the river side face for outfall / non-return flap valve installation, temporary works installation, and SSP installation will utilize MEWPS as well as Temporary Works Platforms (Waling's) accessed by ladders and gang planks.

Cutting penetrations through the river wall for outfalls will be undertaken only when all preparatory works are complete such that the penetrations can be opened, outfalls with non-return flap valves installed and penetrations re-sealed by concreting-in, all to ensure no risk of breach of the river wall by the tide.

Edge restraint provided to the top of the wall suitable for preventing MEWPS being inadvertently driven over the edge, will also provide protection from spillage of materials from reduced excavation works being inadvertently spilled into the river.

Because of the concern about the deteriorated condition of the existing river wall, ongoing condition and stability assessment may require early reduced excavation to alleviate the load currently on the wall. This may require early excavation of the 'active wedge' behind the river wall for the over-pile as well as the under-pile (early excavation required here to provide/install fixing of temporary works). Sequencing / Temporary Works for access and Piling Gates will be adjusted to suit, this may require temporary 'spud' (shallow driven tubular piles driven only to sufficient depth to be stable for temporary access, pitching and driving works) piles in the river to carry piling gates.

Wall 4 extraction will be dependent on the condition of the existing SSP's. Ideally it will be removed using traditional vibro-hammer / crane extraction techniques. If not, piles will have to be cut 500mm below bed level (this will require access by specialist dive teams) and the upper length removed by crane.

An attendant long reach excavator, working landside of the river wall and reaching over, will dredge 500mm for cutting down existing SSP's (if required) and dredge / remove over-spill materials 'held-up' behind the 'old' SSP River Wall and in front of the 'new' SSP River Wall (approximately 1m thick x 4m high). Historical records suggest the existing fill behind the existing SSP River Wall, is clean granular material which is borne out by observation of the water draining from behind the wall through corroded holes in the wall, which is clear.

To mitigate against any residual fines within this granular material silting the river the area will be encapsulated with a floating silt fence.

Capping beam construction will utilize purpose built shutters (Dawson 'Redeb' or similar) for the river side soffit of the capping beam to the SSP's and 'oversized' river side face shutters to prevent spillage of concrete river side. All capping beam concrete works will be accesses from the landside.

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Appendix A – Drawings:

12276-HOP-ZZ-XX-DR-C-0601 rev P2 - Key Plan/Marine Chart

12276-HOP-ZZ-XX-DR-C-0602 rev P3 - Site Block Plan showing existing arrangement

12276-HOP-ZZ-XX-DR-C-0605 rev P3 - Existing General Arrangement Sheet 1 of 2

12276-HOP-ZZ-XX-DR-C-0606 rev P3 - Existing General Arrangement Sheet 2 of 2

12276-HOP-ZZ-XX-DR-C-0610 rev P1 - Proposed General Arrangement Sheet 1 of 2

12276-HOP-ZZ-XX-DR-C-0611 rev P1 - Proposed General Arrangement Sheet 2 of 2

12276-HOP-ZZ-XX-DR-C-0612 rev P1 - Typical Sections Sheet 1 Sections A and B

12276-HOP-ZZ-XX-DR-C-0613 rev P1 - Typical Sections Sheet 2 Sections C and D

12276-HOP-ZZ-XX-DR-C-0614 rev P1 - Typical Sections Sheet 3 Section E

12276-HOP-ZZ-XX-DR-C-0626 rev P1 - Indicative Construction Sequence Walls 1, 2 & 3

12276-HOP-ZZ-XX-DR-C-0627 rev P1 - Sequencing Drawing Wall 4 Sheet 1 of 2

12276-HOP-ZZ-XX-DR-C-0628 rev P1 - Sequencing Drawing Wall 4 Sheet 2 of 2

12276-HOP-ZZ-XX-DR-C-0670 rev P1 - River Wall Area and Volume Summary

12276-HOP-ZZ-XX-DR-C-0675 rev P1 - Proposed Environmental Enhancements - Elevation and Details

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Appendix B – Background Information:

12276/07/HOP/RPT/01 - P3; Existing River Wall - Inspection Report

12276/07/HOP/WFD/01: Water Framework Directive (WFD) Assessment

12276-HOP-00-XX-RP-S-5002: HOP Designers Risk Register

12276-7; Map of Land and Marine Based Designations

12276-HOP-07-sk-TB03a: Existing River Wall Structures based on Historic Record Drawings from Shoreham Port

20-497.103.V1: Preene Groundwater Consulting, Groundwater Control Strategy

A1072v4.0 Revised; Tier II Supplementary Controlled Waters Risk Assessment

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Appendix C – Piling Logistics Plan

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Appendix D – Piling Gates

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Appendix E - Programme

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Appendix F – Risk Assessments (Activity Risks)

Blanchard Wells Risk Assessments:

- Site Set Up
- Traffic / Plant / Pedestrian Management
- Cranes
- Lifting Activities
- Working Near Water
- Excavations & Reduced Level Dig
- Drainage
- Formwork
- Heavy Construction Plant
- Ladders
- MEWPS
- Pouring Concrete
- PPE – Eye Protection
- Store / Use Hazardous Materials
- Noise

Berryrange Risk Assessments:

- General Site Risks
- Environmental Assessment
- Crane/Rig Stability Assessment
- Pile Installation
- Hydraulic Impact Hammer
- Moving Parts
- Use of Water
- Welding
- Oxygen, Propane & LPG
- Diesel
- Working at Heights
- Sealant
- Manual Handling
- COVID – 19
- COSHH summary

Durrant Divers Risk Assessments

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