5 Construction Strategy

5.1 Introduction

This chapter describes the strategy to construct the proposed development. The design, operation and decommissioning elements of the proposed development are described separately in **Chapter 4**.

This chapter has been prepared in accordance with Part 1 of Annex IV of the EIA Directive. This chapter has therefore been structured to describe the following:

- Indicative duration and phasing during the construction period;
- Land use requirements to support the construction of the proposed development;
- Likely activities required to prepare the site and undertake the enabling works to support the construction of the proposed development;
- Methodologies to undertake demolition and construction activities;
- An overview of anticipated construction traffic, relevant diversions, access points and haulage routes that are likely to be used during construction;
- An overview of employment and typical site management measures associated with the construction of the proposed development; and
- An overview of the Outline Construction Environmental Management Plan to provide minimum requirements that the Contractor(s) will be required to implement (Refer to Appendix 5.1 for the Outline CEMP).

5.2 Approach

The approach to construction which has been assumed for the purpose of this EIAR is illustrated in **Sections 5.3 - 5.9** herein. This information describes the main construction activities that are relevant for the assessment of likely significant environmental effects.

It should be noted that Irish Water proposes to procure the construction works by means of a Design and Build type contract. This type of contract has the benefit of encouraging innovation and value engineering, particularly for a project of this nature and scale, by giving the contractor ownership of the detailed design and construction. Under this type of contract the successful contractor will ultimately be responsible for the final detailed design and determination of appropriate construction activities required for the proposed development.

Notwithstanding, the approach to construction outlined in **Sections 5.3 - 5.9** herein is considered to be the reasonable worst case scenario, given the existing site constraints, the adjacent land uses and the various construction methodologies which could be considered by the contractor. The construction of the proposed development will require a combination of marine, riverine and land-based works.

It will be the responsibility of the contractor (under the obligations of the Design and Build type contract) to ensure compliance with those measures that have been outlined in this EIAR to avoid and/or reduce significant adverse effects that have been identified. Where the contractor proposes from the methodologies and working areas outlined herein and defined in the granted planning consent, it will be the responsibility of the contractor to ensure compliance with or obtain the relevant licenses, permits and consents for such changes.

5.3 Indicative Duration and Phasing

5.3.1 Overview

The construction of the proposed development is estimated at between 3.5 and 4 years, based on the reasonable worst case assessed herein. The programme is divided into two main elements:

- Construction of the interceptor sewer pipe network; and
- Works associated with the WwTP and surrounding site.

Refer to **Appendix 5.2** for the estimated construction programme that has been outlined for the proposed development.

5.3.2 Sequencing

5.3.2.1 Interceptor Sewers

Overview

Upon award of the contract, the contractor is likely to require an initial approximately 6 month period to undertake site investigations and detailed design of the interceptor sewer network. Following this period, the contractor will mobilise onsite to undertake the enabling works described in **Section 5.5** (i.e. to setup compounds and initiate the diversion of existing utilities to facilitate the installation of new pipelines, manholes, tunnels and shafts associated with the sewers).

The sewers will be constructed using tunnelling and open cut methods. The first element of work that the contractor will undertake, is the tunnelling of the sewer.

Tunnelling

Approximately 1,250m of the sewer will be constructed by tunnelling methods using a series of tunnel shafts and a tunnel boring machine (TBM) for those segments of the sewer downstream on South Quay, the river crossing and along North Quay (Refer to **Section 5.6.3.4** for further detail).

Once the necessary utilities have been diverted, the vertical tunnel shafts will be constructed (ranging in depth from approximately 7m to approximately 16m below ground level).

The eight tunnel shafts to the north of the river channel will be constructed first, commencing adjacent to the WwTP site (at TSN8) and proceed upstream along North Quay (to TSN1). Upon completion of the tunnel shafts on North Quay, the works will then transfer to the remaining four shafts to the south of the river channel. The tunnel shafts to the south of the river channel will commence downstream (at TSS3) and proceed upstream (to TSS1).

The working areas provided for each tunnel shaft have been selected and sequenced to take account of traffic flows, ensuring that access around the working areas is maintained at all times throughout the construction of the tunnel shafts and the tunnel construction itself (Refer to **Section 5.7** for further detail).

Once the required number of tunnel shafts have been constructed in a given working area, the excavation and tunnelling will commence. The working areas around the launch and reception shafts (i.e. at each end of the pipeline) will be used while tunnelling is taking place. Tunnelling will occur 24-hours a day, seven days per week. Typically works at each shaft location will take approximately 3 months. Shafts that are mid tunnel length (i.e. where the TBM approaches the shaft from one direction and then continues on to the next shaft), will be operational for approximately 3 months as the TBM approaches and also a further 3 months until the TBM reaches the subsequent shaft down the tunnel line and the fit-out of the shaft as a permanent chamber has been completed. On completion of a section of tunnelling and fitout of the permanent manhole chambers, the working areas around the launch and reception shafts will be reinstated and reopened.

Two sizes of sewer (Approximately 1200mm and 1500mm diameter pipelines) will be tunnelled as part of the proposed development.

Open Cut

The remaining approximately 865m of sewer will be constructed using open cut methods. This open cut method will require excavations (approximately 4m in depth) and the subsequent installation of the pipelines.

Open cut installation of the sewer to the north of the river channel will be over a length of approximately 46m to the west of 1 Ferrybank (i.e. between TSN1 to MHN1). Open cut installation of the sewer to the south of the river channel will be over a length of approximately 746m between MHS1 (adjacent to the Alps SWO and tank) and TSS1 (located on South Quay). These works will commence downstream (at TSS1) and proceed upstream (to MHS1). It is anticipated that the Alps SWO and stormwater storage tank will be constructed in parallel with the installation of the adjacent sewer between River Lane East and Chateaudune Promenade (i.e. the sewer between MHS1 - MHS5).

5.3.2.2 WwTP

Overview

The demolition of the structures on the WwTP site and construction of the WwTP will require a longer time period to construct than the interceptor sewers.

Whilst the final sequencing and phasing of the works will be for the contractor to determine, we have considered the various likely options in this regard and have set out below, a likely sequence of works that will enable the assessment of the reasonable worst case to be considered herein.

Given that the WwTP construction is likely to take longer to construct than the interceptor sewers, it is envisaged that the contractor will mobilise on the WwTP site and set up a compound immediately after contract award. Following completion of bat surveys in the existing buildings, a three month period (approximately) will be allocated for the diversion or termination of existing utilities within the WwTP site (Refer to **Section 5.5.2**). This will be followed by the sequential activities as outlined below (Refer to **Drawing No.'s 247825-00-C-P-1001 to 247825-00-C-P-1006 in Volume 3** for further detail):

- Asbestos removal;
- Demolition of existing structures;
- Excavation, remediation and dewatering where appropriate;
- Upgrade to Section A of the revetment and installation of the cofferdam for the SWO;
- Deep excavation works for WwTP buildings;
- Construction of building foundations, subsurface structures and installation of the SWO;
- Construction of above ground structures, installation of the long sea outfall and upgrade to Section B of the revetment;
- Finishing and fitout of buildings and site-wide landscaping;
- Testing and commissioning of buildings; and
- Connection to the sewers and commissioning of the proposed development.

Stripout and demolition of existing structures

The first phase of work to be undertaken within the WwTP site will be the removal of asbestos containing materials and then stripping out of the existing structures on the WwTP site (as described in detail in **Section 5.5.5.2**). Once this task is complete, the demolition of structures across the WwTP site will commence (as described in detail in **Section 5.5.5.3**).

Following site clearance and demolition of all structures to ground level, site investigations works will be undertaken to confirm the ground conditions and characterise the extent of any contaminated material beneath the footprint of the existing Old Wallboard factory building.

A remediation strategy will then be finalised (based on the information gathered during the site investigation) in advance of the commencement of any excavation works.

Exacavation and removal of contaminated material, upgrade of Section A revetment and SWO cofferdam installation

Contaminated soil within the footprint of the proposed WwTP buildings will be excavated out and disposed of off site (i.e. transferred to an authorised facility in respect of which a waste permit or a waste licence is granted) as described in **Section 5.5.5.4**. In parallel with the excavation of contaminated material, a temporary sheetpile cofferdam will be constructed in the area of the existing revetment to facilitate the excavation and construction of the SWO through the revetment. Upgrade to the first half of the revetment (as described in detail in **Section 5.6.6**) will also commence at this stage.

It is preferable to upgrade the revetment outside of the winter months in order to reduce the likelihood of delays due to weather constraints. The upgrade of the revetment will generally proceed from north to south, with the exception of the area required to construct the SWO (until works in the cofferdam have been completed).

Deep excavation works

Deep excavation will be required to accommodate sumps, tanks, service corridor and foundations beneath the WwTP buildings (as described in detail in **Section 5.6.4.2**). Excavation within the cofferdam for the SWO will also be completed during this phase. Further, the trenching of the long sea outfall would occur (if this is the chosen construction methodology).

Deep excavation would range from approximately 1.2m to 18.5m below ground level. The excavations will require robust temporary support systems including sheet piles and secant piles and dewatering systems will also be employed to facilitate dry excavation areas (as described in detail in **Section 5.6.4.2**).

Construction of subsurface structures

Once the deep excavations have been completed to the required depths, the subsurface elements of the WwTP will be constructed. As described in **Section 5.6.4.2**, this will involve piling and construction of large reinforced concrete structures for the inlet sump, stormwater storage tank in the Inlet Works building, the service corridor and building foundations.

The SWO and long sea outfall (using open cut methods as appropriate) will also be constructed at this stage, backfilled and the temporary cofferdam removed, allowing for completion of the upgrade to the revetment.

On completion of the foundation and floor slab for the Process building, it is envisaged that the long sea outfall will be constructed (using one of the three construction methods described herein). The foundations for the Process building will be completed prior to the more complex below ground structures to provide a suitable time period to accommodate the construction of the long sea outfall.

For the ‘flood and float’ or ‘bottom pull’ method of construction, a temporary sheet pile cofferdam will be required to facilitate the outfall installation through the existing revetment. If the horizontal directional drilling method is selected, a large working platform, on the floor slab of the Process building will be required to accommodate the drilling equipment.

Construction of above-ground structures and upgrade to Section B of the revetment

On completion of below ground structures, the SWO and the long sea outfall, the above ground construction works for the WwTP will commence. These structures will likely be primarily constructed of steel and concrete and be constructed using conventional methods (Refer to **Section 5.6.4.2** for further information). In parallel with these works, the remaining section of the revetment will be upgraded, again preferably occurring outside of the winter months.

External finishing and internal fitout

On completion of all structures, the external hard standing (i.e. roads and car parking) as well as the soft landscaping (i.e. planting, landscaping etc.) will be installed (Refer to **Section 5.6.4.4** for further detail). This will be followed by finishing works including the erection of on-site security lighting, provision of markings on the roadway etc.

In parallel, the installation of all process, mechanical and electrical equipment will take place in the buildings (Refer to **Section 5.6.4.3** for further detail).

Commissioning and Connection of Existing Outfalls to New Sewer Network

Once construction works are complete, the testing and commissioning phase will commence (Refer to **Section 5.6.4.5** for further detail).

Once the WwTP is commissioned and ready for initial wastewater reception, the existing outfalls will be connected to the proposed interceptor sewer with flows diverted to the WwTP. This will involve returning to working areas along North Quay and River Walk - South Quay to install the connections manholes along the interceptor sewer network (as described detail in in Seciton 5.6.3.8).

5.3.3 Duration and Phasing

In summary, the estimated construction programme is anticipated to take approximately 3.5 – 4 years (refer to **Appendix 5.2**). It is anticipated that the following would occur :

- Detailed design by the contractor would take approximately 8 months;
- Establishment of the site compound and enabling works for the interceptor sewer would take approximately 8 months;
- Installation of the temporary causeway would occur during the summer of 2020;
- Installation of the tunnel shafts would take approximately 15 months, (i.e. up to approximately 35 days per shaft);

- Tunnelling of the interceptor sewer would take approximately one year;
- Open cut construction of the interceptor sewer would take approximately 9 months;
- Removal of the temporary causeway would occur during the summer of 2021;
- Civil works (to construct the subsurface and above ground structures, as well as the SWO, long sea outfall and the revetment) for the WwTP would take approximately 22 months;
- Installation of process, mechanical and electrical equipment as well as site landscaping at the WwTP site would take approximately one year; and
- Testing and commissioning would take approximately 7 months.

Some of the above activities will overlap as described in detail in **Section 5.3.2**. It should be noted that some of the construction activities could be subject to seasonality restrictions, e.g. the construction and removal of the temporary causeway may only be undertaken during the Inland Fisheries Ireland season (July to September inclusive), unless the consent of Inland Fisheries Ireland is obtained. Any delays to the consent and/or appointment of the contractor will need to be cognisant of these seasonality restrictions and the construction programme will be required to be revised accordingly.

5.3.4 Interaction with Proposed Arklow Flood Relief Scheme

Wicklow County Council, on behalf of Office of Public Works intends to proceed with the proposed Arklow Flood Relief Scheme in the near future as described in **Section 2.6.7 of Chapter 2.** As currently proposed, the proposed Arklow Flood Relief Scheme works will overlap with the proposed development, both in terms of geographical location and possibly construction programme. It is understood that the construction of the proposed Arklow Flood Relief Scheme will be undertaken in a particular sequence in order to mitigate against any increased flood risk.

The commencement of construction for the proposed Arklow Flood Relief Scheme will be subject to the timely submission, consents and appropriate procurement. At the time of writing, the outline programme that has been provided by the design team shows a commencement date of early 2019, with the following key work sequencing:

- Bridge underpinning (Phase 1) in 2019;
- Bridge underpinning (Phase 2) in 2020;
- The flood defences works on the South Quays being undertaken over approximately 12 months following on from the end of the bridge underpinning (Phase 1);
- The dredging being carried out in the river in 2021; and
- The flood embankment adjacent to Arklow Town Marsh being undertaken following the dredging works, in late 2021/early 2022.

If the proposed Arklow Flood Relief Scheme proceeds in accordance with this outline programme, it is likely that construction works may overlap with the proposed development.

All works on Arklow Bridge, in particular, those requiring traffic management and out of hours works, will be coordinated with the proposed Arklow Flood Relief Scheme wherever possible, to ensure that disruptions to the public are minimised. It is envisaged that collaborative working practices will also be required for works on South Quay and River Walk, in an effort to minimise disruption to businesses and local residents. It is not foreseen that works between the two schemes will significantly overlap in other areas, however both project teams and the contractors will collaborate on management plans (including environmental and construction traffic management) prior to implementation and commencement of the works.

Irish Water and Wicklow County Council will continue to endeavour to minimise in combination effects of both schemes. This potential for cumulative effects has been addressed in **Chapters 7 – 20** (Refer to **Chapter 20** for a summary of cumulative effects), with the reasonable worst case considered in terms of such effects for each environmental aspect. This is based on the currently available information available from the proposed Arklow Flood Relief Scheme and the outline programme provided by the design team.

5.4 Land Use Requirements

5.4.1 Overview

Construction of the proposed development will require temporary land take to accommodate construction activities in addition to the permanent land take required to accommodate specific above ground elements of the proposed development (as described in detail in **Section 4.3.1 in Chapter 4**).

Land will be temporarily required to accommodate construction compounds and temporary on-site activities as illustrated in Figure 5.1. Refer to **Drawing No.'s 247825-00-C-IS-001-004 and 247825-00-C-IS-005 and Drawing No.'s 247825-00-C-IS-1500 to 247825-00-C-IS-1516 of Volume 3** for detailed drawings of the land to be acquired temporarily during construction, hereafter referred to as the 'working areas'.

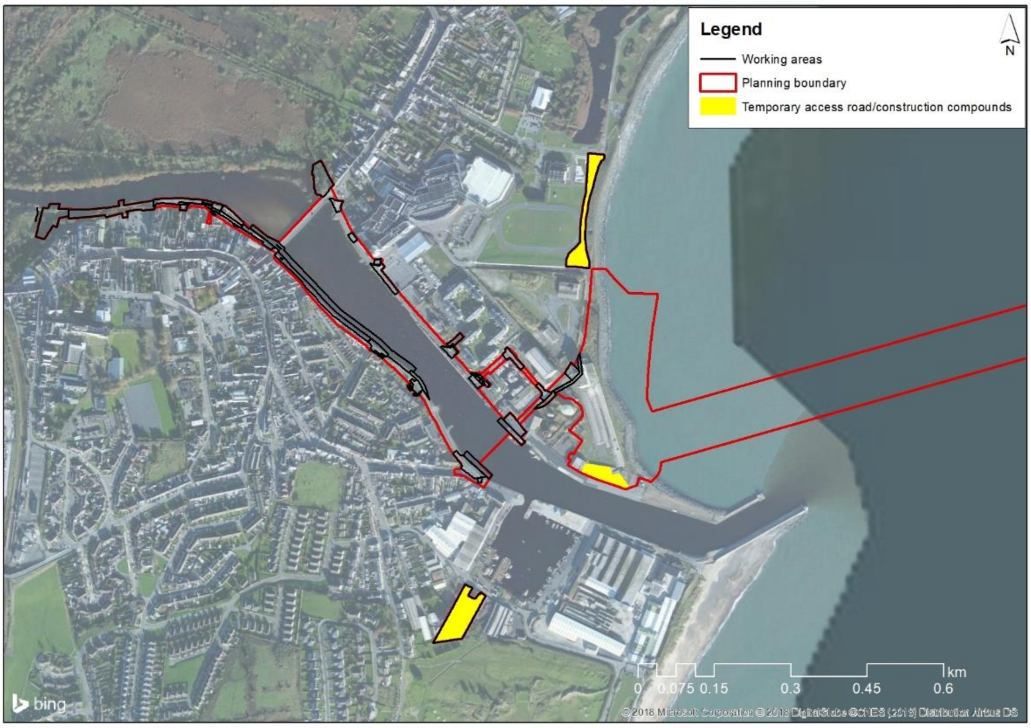

Figure 5.1: Overview of working areas required for the proposed development

5.4.2 Construction Compounds and Working Areas

Construction compounds have been, as far as possible, located close to the working areas. Two construction compounds have been identified and are considered to be capable of accommodating the construction activities. The construction compounds and working areas have been included in the planning boundary for the proposed development as illustratred in Figure 5.1 above and **Drawing No. 247825-00-C-IS-1400 of Volume 3.**

The main construction compound will be located on the WwTP site and will provide site offices and welfare facilities for construction employees, as well as providing an area for material storage. This compound will facilitate the construction of the WwTP, long sea outfall, SWO, revetment and associated infrastructure works on site, as well as slong North Quay.

A second construction compound, to service River Walk/South Quay (Working Area S19) will be established, predominantly for material storage. Material storage will also be permitted at another working area (Working Area S1) adjacent to the Alps SWO and Stormwater tank.

The construction of the interceptor sewers is linear in nature, requiring a number of working areas (that have been identified within the planning boundary) to accommodate the construction compounds and relevant activities on a temporary basis (as illustrated on **Drawing No.'s 247825-00-C-IS-1500 to 247825-00-C-IS-1516 of Volume 3**).

The working areas will be made available to the contractor for use during the construction period. The working areas will be secured and will not be accessible to the public for the duration of the construction works in the relevant areas.

5.5 Enabling Works

Enabling works are required for various aspects of the proposed development, in order to prepare the working areas identified and the WwTP site for construction activities. A description of the enabling works required is provided in **Sections 5.5.2 - 5.5.5**.

5.5.1 Overview

Enabling works will be required to prepare the various working areas for construction. The following will typically be required at each of the working areas, with certain site specific enabling works set out in **Section 5.5.4** for specific working areas and **Section 5.5.5** for the WwTP site:

- Establish and get appropriate approvals for construction traffic management requirements for diversions and haulage routes (refer to **Section 5.7** for further details);
- Establish and implement appropriate surface water management procedures in accordance with the requirements set out in the Outline CEMP in **Appendix 5.1**;
- Construct temporary site access from the existing road network and install trafficable surfaces where required (Refer to **Section 5.7** for further details);
- Install secure hoarding and fencing (2.4m in height as a minimum) that will remain in-situ for the duration of the construction works (Refer to **Section 5.8.3** for further details);
- Install vehicle set down and material storage areas (typically by laying down harcore to a depth of approximately 300mm) in relevant working areas;
- Undertake vegetation removal and stripping of topsoil as required in relevant working areas;
- Install the main construction compound to accommodate site offices and welfare facilities at WwTP site (Refer to **Section 5.6.4** for further details);
- Install a further construction compound on South Quay (as described in **Section 5.4.2**) predominantly for material storage; and
- Undertake all required utility and services diversions and provide a connection to the local sewerage network, water distribution and electrical networks as required.

5.5.2 Utilities and Services

Due to the urban nature of the location of the proposed development there are a large number of utilities and services located in the public road and footpaths along River Walk, South Quay and North Quay.

These existing utilities and services include gas mains, watermains, surface water drainage, telecommunications, public lighting and electricity supplies servicing both domestic and commercial customers.

Generally, the areas most affected by diversions will be the tunnel shafts where all services that run directly under the location of the tunnel shafts will be required to be re-routed locally around the shaft.

It should be noted that the Contractor will be responsible for agreeing all connections to existing utilities that are required in advance of the commencement of any works. The specific details of all permanent diversion works will be set out and agreed by the contractor in advance with the utility provider and any likely significant effects are considered herein in **Chapter 18**. No significant disruption to service is anticipated.

5.5.3 Site Investigation

It is anticipated that the contractor may undertake further site investigation works within the planning boundary to confirm the existing information on the land and soils (as described in detail in **Section 14.3 of Chapter 14**). At this stage, it is possible that further site investigation may be required along the alignment of the interceptor sewer and within the WwTP site under the footprint of the existing buildings. The specification of such works will be developed by the contractor during the detailed design.

5.5.4 Enabling Works for Alps SWO and Stormwater Storage Tank and Interceptor Sewers

5.5.4.1 Working Areas

Enabling works that will be specifically required at individual working areas are detailed in the following sections. Further detail on the specific methodologies and activities during construction at each of these working areas is available in **Section 5.6**.

Working Areas S1, S2 and S3

Working Areas S1, S2 and S3 (as illustrated on **Drawing No.'s 247825-00-C-IS-1501 and 247825-00-C-IS-1502 in Volume 3**) are located adjacent to the Alps development site and on the western side of River Walk. These working areas will support the construction of the Alps SWO and storage tank as well as the interceptor sewer on River Walk.

These working areas will be subject to typical enabling works as outlined in Section 5.5.1.

Working Area S4

Working Area S4 is located on River Walk (as illustrated in **Drawing No. 247825-00-C-IS-1502 in Volume 3**) and will support the construction of the interceptor sewer on River Walk.

An existing wall to the north-east of Working Area S4 (fronting onto River Walk) will require demolition to facilitate traffic movements around Working Area S3. A temporary trafficable surface will also be installed as part of the enabling works.

Working Areas S5 and S6

Working Areas S5 and S6 (as illustrated in **Drawing No. 247825-00-C-IS-1503 in Volume 3**) are located on River Walk and will support the construction of the interceptor sewer on River Walk.

These working areas will be subject to typical enabling works as outlined in Section 5.5.1. Working Area S6 will also require the removal of a timber fence from the corner property to the west of the Condren’s Lane Upper and River Walk junction and removal of the footpath to the east of the junction .

Working Area S7, S8 and S11

Working Areas S7, S8 and S11 are located on River Walk (as illustrated in **Drawing No. 247825-00-C-IS-1503 of Volume 3**). These working areas will support the construction of the interceptor sewer on River Walk.

These working areas will be required to facilitate traffic movements around the adjoining working areas on the landside of River Walk (i.e. Working Areas S5, S6 and S9). A temporary trafficable surface will be installed as part of the enabling works.

Working Areas S9 and S10

Working Areas S9 and S10 are located on River Walk (as illustrated in **Drawing No. 247825-00-C-IS-1503 of Volume 3**) and will support the construction of the interceptor sewer on River Walk. Working Area S10 will extend into the river channel.

These working areas will be subject to typical enabling works as outlined in **Section 5.5.1**.

Working Area S11

Working Area S11 is located on River Walk (as illustrated in **Drawing No. 247825-00-C-IS-1503 in Volume 3**) and will support the construction of the interceptor sewer on River Walk.

This working area will be required to facilitate traffic movements around the adjoining working areas on the landside of River Walk (i.e. Working Areas S5, S6 and S9). A temporary trafficable surface will be installed as part of the enabling works.

Working Areas S12 and S13

Working Areas S12 and S13 are located on South Quay and extend into the river channel (as illustrated in **Drawing No.’s 247825-00-C-IS-1504 and 247825-00-C-IS-1505 of Volume 3**).

These working areas will support the construction of the interceptor sewer on South Quay including the construction of the tunnel shaft (TSS1).

These working areas will be subject to typical enabling works as outlined in **Section 5.5.1**.

Working Area S14

Working Area S14 is located on South Quay and extends into the river channel (as illustrated in **Drawing No. 247825-00-C-IS-1506 of Volume 3**). This working area will support the construction of the tunnel shaft (TSS1) and interceptor sewer on South Quay.

Working Area S14 will be required to provide access and parking for local residents, therefore a temporary pedestrian walkway and two temporary on street parking spaces will be provided as part of the enabling works.

Working Areas S15A & S15B

Working Areas S15A and S15B are located on South Quay (as illustrated in **Drawing No. 247825-00-C-IS-1506 of Volume 3**) and will support the construction of the tunnel shaft (TSS2) and interceptor sewer on South Quay.

Working Areas 15A and 15B will be required to provide a shared temporary trafficable access road (in each working area) while works are ongoing at the adjoining working area (Working Area S16). Each access road will serve two properties and there will be a requirement to create an access through the dividing garden wall as part of the enabling works.

Working Area S16

Working Area S16 is located on South Quay (as illustrated in **Drawing No. 247825-00-C-IS-1506 of Volume 3**) and will support the construction of the tunnel shaft (TSS2) and interceptor sewer on South Quay.

This working area will be subject to typical enabling works as outlined in **Section 5.5.1**.

Working Area S17

Working Area S17 is located on South Quay (as illustrated in **Drawing No. 247825-00-C-IS-1506 of Volume 3**) and will support the construction of the tunnel shaft (TSS2) and interceptor sewer on South Quay.

This working area will be required to facilitate traffic movements around the adjoining working area S16. A temporary trafficable surface will be installed as part of the enabling works.

Working Area S18 and S20

Working Areas S18 and S20 are located on South Quay (as illustrated in **Drawing No. 247825-00-C-IS-1507 of Volume 3**) and will support the construction of the tunnel shafts (TSS2A and TSS3) and interceptor sewer on South Quay.

These working areas will be subject to typical enabling works as outlined in **Section 5.5.1**.

Working Area S19

Working Area S19 is located on South Quay, south of the harbour (as illustrated in **Drawing No. 247825-00-C-IS-1508 of Volume 3**). This working area will be a construction compound to support the construction of the interceptor sewer on River Walk/South Quay. Further details are provided in **Section 5.4.2**.

River Working Area S1

River Working Area S1 is located in the river channel, extending from upstream of Arklow Bridge to just upstream of the tunnel shaft (TSS2) on South Quay (as illustrated in **Drawing No.'s 247825-00-C-IS-1503 to 247825-00-C-IS-1506 of Volume 3**).

This working area will support the construction of the interceptor sewer directly upstream of Arklow Bridge (adjacent to River Walk), the works at Arklow Bridge and the construction of the river based interceptor sewer from manhole (MHS9) to tunnel shaft (TSS1). A temporary causeway would be constructed in this working area to facilitate the construction of the proposed interceptor sewer as discussed in detail in **Section 5.6.3.3**.

River Working Area S2

River Working Area S2 is located in the river channel, in the vicinity of the proposed river crossing at tunnel shaft (TSS3) on South Quay (as illustrated in **Drawing No. 247825-00-C-IS-1507 of Volume 3**).

This working area will support the construction of the river crossing as the tunnel passes through the existing quay wall at this location.

River Working Area N1

River Working Area N1 is located in the river channel, in the vicinity of the proposed river crossing at tunnel shaft (TSN6) on North Quay (as illustrated in **Drawing No. 247825-00-C-IS-1509 of Volume 3**).

This working area would support the construction of the river crossing as the tunnel passes through the existing quay wall at this location.

Working Area N1

Working Area N1 is located at No 1 Ferrybank (as illustrated in **Drawing No. 247825-00-C-IS-1511 of Volume 3**) and will support the construction of the interceptor sewer on North Quay, specifically tunnel shaft (TSN1) and connection pipework between the proposed interceptor sewer and the existing foul sewer adjacent to Arklow Town Marsh.

This working area will be subject to typical enabling works as outlined in **Section 5.5.1**.

Working Areas N2 and N3

Working Areas N2 and N3 are located on North Quay (as illustrated in **Drawing No's. 247825-00-C-IS-1511 and 247825-00-C-IS-1512 of Volume 3**) and will support the construction of the interceptor sewer on North Quay, specifically connection pipework between the proposed interceptor sewer and the existing foul sewer network.

These working areas will be subject to typical enabling works as outlined in **Section 5.5.1**.

Working Areas N4 and N5

Working Areas N4 and N5 are located on the North Quay (as illustrated in **Drawing No. 247825-00-C-IS-1512 of Volume 3**) and will support the construction of the interceptor sewer on the North Quay, specifically tunnel shaft (TSN2) and connection pipework between the proposed interceptor sewer and the existing foul sewer network.

These working areas will be subject to typical enabling works as outlined in **Section 5.5.1**.

Working Area N6

Working Area N6 is located on North Quay (as illustrated in in **Drawing No.'s 247825-00-C-IS-1513 and 247825-00-C-IS-1514 of Volume 3**). This working area will support the construction of the tunnel shaft (TSN3) and interceptor sewer on North Quay.

For Working Area N6 there will also be a requirement to provide a temporary pedestrian walkway to facilitate pedestrian movements around Working Area N6 as part of the enabling works.

Working Area N7

Working Area N7 is located on North Quay (as illustrated in **Drawing No. 247825-00-C-IS-1513 of Volume 3).** This working area will support the construction of the interceptor sewer on North Quay, specifically connection pipework between the proposed interceptor sewer and the existing foul sewer network

This working area will be subject to typical enabling works as outlined in **Section 5.5.1.**

Working Areas N8 and N9

Working Areas N8 and N9 are located on North Quay (as illustrated in **Drawing No. 247825-00-C-IS-1514 of Volume 3**) and will support the construction of the interceptor sewer on North Quay, specifically tunnel shaft (TSN4) and connection pipework between the proposed interceptor sewer and the existing foul sewer network.

Working Area N8 will be subject to typical enabling works as outlined in **Section 5.5.1**.

For Working Area N9, there will be a requirement to provide a temporary pedestrian walkway and temporary access road around the adjoining working area to the north (Working Area N8). Further, the existing boundary wall for Marina Village will be removed and a new vehicular entrance will also be required as part of the enabling works.

Working Area N10

Working Area N10 is located on North Quay (as illustrated in **Drawing No. 247825-00-C-IS-1515 of Volume 3**) and will support the construction of the interceptor sewer on the North Quay, specifically tunnel shaft (TSN5).

This working area will be subject to typical enabling works as outlined in **Section 5.5.1**.

Working Areas N11 and N13

Working Areas N11 and N13 are located on Mill Road (as illustrated in **Drawing No.'s 247825-00-C-IS-1511 and 247825-00-C-IS-1515 of Volume 3**). These working areas will support the construction of the tunnel shaft (TSN7 and TSN8) and the interceptor sewer on Mill Road.

For Working Areas N11 and N13 there will also be a requirement to provide a temporary haul access road to facilitate vehicular movements as part of the enabling works. These roads will be 6m wide temporary trafficable surfaces to accommodate construction vehicles entering the adjoining WwTP site.

Working Area N12

Working Area N12 is located on Mill Road (as illustrated in **Drawing No. 247825-00-C-IS-1509 of Volume 3**) and will support the construction of the tunnel shafts (TSN6) and the interceptor sewer on Mill Road and connection pipework between the proposed interceptor sewer and the existing foul sewer network

This working area will be subject to typical enabling works as outlined in **Section 5.5.1**.

Working Area N14

Working Area N14 is located between Seaview Avenue and Mill Road (as illustrated in **Drawing No. 247825-00-C-IS-1516 of Volume 3**). This working area will accommodate the temporary access road that will run alongside the running track and connect Seaview Avenue to Mill Road. Further details are provided in **Section 5.4.2**.

5.5.5 Enabling Works at WwTP

5.5.5.1 Overview

Construction of the WwTP will be undertaken on the Old Wallboard site at Ferrybank, which has a history of industrial use as described in **Section 2.6 of Chapter 2**. In order to construct the WwTP, a suite of enabling works will be required. Enabling works for the WwTP will comprise the following activities that would likely occur in sequence, with the sequencing to be determined by the contractor based on his programme of work. The reasonable worst case has been considered herein.

- Removal of asbestos from the existing structures and site;
- Demolition of the existing structures on the site; and
- Excavation of soil and remediation of contaminated land and groundwater.

5.5.5.2 Asbestos Removal

An asbestos survey of the WwTP site has been undertaken by OHSS and the report is available in **Appendix 5.3**. This survey has identified asbestos containing material in the following areas on the site:

- The wall and roof cladding of the Old Wallboard building comprises asbestos cement sheets;
- The wall and roof cladding of the Stores building is asbestos sheet cladding;
- The ceiling of the stores building is asbestos sheet cladding;
- The roof cladding to the high section of the Wallboard building is asbestos cement sheets;
- The wall and roof cladding of the Masterglaze building is asbestos cement sheets;
- Rope seals to the lights in the Masterglaze building contain asbestos;
- Lino with asbestos paper backing is present in the electrical room of the Wallboard building;
- Vinyl floor tiles and bitumen containing asbestos are present in the locker room of the Wallboard building;
- Rain water goods in the buildings contain asbestos;
- The internal walls and ceiling of the prefab building contain asbestos;
- Asbestos cement debris is present around and within all of the buildings on the site; and
- Asbestos cement debris is present in the existing rock armour revetment on the seaward side of the site.

In the first instance, a Refurbishment / Demolition Asbestos Survey (RDAS) will be undertaken by the contractor so that all asbestos containing materials are correctly identified before any demolition works take place and so that they can be dealt with in accordance with the Safety, Health and Welfare at Work (Exposure to Asbestos) Regulations, 2006, as amended and all relevant guidelines[1].

All asbestos containing materials will be required to be removed by a competent contractor, with the appropriate trained staff, equipment and resources. All asbestos containing material will be extracted from the relevant locations and will be required to be double wrapped and labelled before being safely stored in an appropriately protected area, located away from most of the construction traffic on the WwTP site.

All of the asbestos containing material will be removed from the WwTP site and disposed of at an appropriately licensed facility in respect of which a waste permit or a waste licence is granted in accordance with the relevant procedures and legislation. No other construction activities will occur on the site during this phase of works.

5.5.5.3 Site demolition

Upon completion of the asbestos removal, demolition of the existing buildings and structures on site will occur. These structures are structurally unstable and partially collapsed in some areas of the site. The following structures will be demolished (following the removal of asbestos containing material):

- Gate Building;
- Storage Tank;
- Single Storey Prefab Units situated to the west of the site;
- Masterglaze Building;
- Stores Building;
- Substation;
- Wallboard Building;
- Metalclad Building; and
- Outbuilding to the north of the site.

The following activities will take place as part of the demolition (following the removal of asbests containing material):

- Removal of all materials from the ground floor of each of the buildings on the site;
- Removal of metal cladding sheets generally;

[1] Health and Safety Authority (2013) Asbestos-containing materials (ACMs) in Workplaces: Practical Guidelines on ACM Management and Abatement. Available from: http://www.hsa.ie/eng/Publications_and_Forms/Publications/Chemical_and_Hazardous_Substances/Asbestos_Guidelines.pdf [Accessed 28 June 2018]

- Demolition of building frames; and
- Demolition of ground floor slabs/ grubbing up of foundations.

All demolition materials deemed to be waste would be removed from the site and transferred to an appropriately authorised facility in respect of which a waste permit or a waste licence is granted. No other construction activities will occur on the site during this phase of works.

5.5.5.4 Excavation, remediation and dewatering

On the basis of preliminary ground investigations carried out to date, the following contaminants are present in the soil on the Old Wallboard site at Ferrybank (Refer to **Section 14.3 of Chapter 14** for further detail):

- Made ground containing heavy metals (arsenic in one discrete location and lead between approximately 0.4m to 2.5m below ground level across the site);
- Nitrocellulose (also referred to as guncotton) at four discrete locations around the site between approximately 0.4 to 2.5m below ground level;
- Asbestos containing materials in four discrete locations around the site; and
- Nickel, zinc, lead, cadmium, barium, phosphate and ammoniacal nitrogen are present in the groundwater beneath the site.

Excavation

Soil and unsuitable material under the footprint of the buildings will be excavated to allow for the construction of the foundations. The excavated material will likely comprise a mixture of made ground and natural soils (Refer to **Section 14.3 in Chapter 14** for further detail on the baseline conditions). All excavated material would be disposed of at a suitable licensed facility in respect of which a waste permit or a waste licence is granted, if there is no opportunity for reuse on site identified during the detailed design.

During the construction of the vehicle access areas approximately 375mm of existing hardstanding and soil will be removed to enable the ground bearing slab to be constructed. In addition, approximately 300mm of hardstanding and soil beneath the landscaped areas will be removed to allow a suitable growing medium (topsoil) for the landscaping to be placed.

Dewatering

During the construction of the subsurface structures (i.e. the inlet sump, storm tanks, the service corridor and the outfalls), the depth of excavation will be below the water table. It would therefore be necessary to prevent groundwater ingress or dewater the water bearing sand and gravel soil. Considering the high permeability of the sand and gravels, groundwater exclusion will be achieved by installing deep temporary sheet pile walls.

Despite the groundwater exclusion, some dewatering from the areas of excavation will be necessary to remove residual groundwater within the sheet pile wall, manage surface water and to manage any small amounts of seepage through the sheet pile wall. The volume of water is not likely to exceed approximately 250m^3/day, with this volume considered as the reasonable worst case in the assessment.

Due to contamination of the groundwater it will not be possible to discharge directly into the Irish Sea. The strategy for removing groundwater from the site is likely to comprise either tankering off site to a suitable licenced facility in respect of which a waste permit or a waste licence is granted or treatment on site.

Onsite treatment, which is considered the most likely option, will likely occur by means of a coagulation-flocculation and filtration or other suitable proprietary treatment process. This will comprise the following activities:

- Dose the groundwater with a coagulant to support coagulation of contaminants;
- Remove the coagulant and contaminants by flocculation and filtration;
- Generation of a sludge that would contain coagulant material and the flocculated heavy metal contaminants;
- Remove the sludge from the site by tanker and disposal at an appropriately licensed facility. The quantity of tanker trips would depend on the level of groundwater being treated and the storage on site but it is anticipated that this may be up to approximately one tank visit per day.
- Discharge of the treated groundwater to sea, under a Section 4 licence from Wicklow County Council in accordance with the Local Government (Water Pollution) Acts, 1977 - 2007.

This treatment will be provided in readily available, mobile shipping containers that will facilitate quick installation and demobilisation as required during construction. The area required for treatment is expected to be in the order of a 15m x 15m compound to house the treatment units, chemical storage, and pump systems. An additional area of a similar size will also be required for waste sludge and backwash water tanks. The system can be powered by conventional low voltage generators on site.

Remediation strategy

The soils on the site present a risk to site users, however the construction of the proposed development will ensure that this risk is minimised, by either removing those contaminated soils from the excavations, or ensuring soils are covered, thus breaking the source-pathway-receptor linkage. This will be undertaken and managed by conventional construction practices including:

- Construction of buildings and hardstanding will provide a hard barrier that would prevent exposure.

- In areas of landscaping up to approximately 300mm depth of made ground will be removed to allow clean topsoil to be placed on the areas of landscaping. The topsoil will be underlain by a geotextile material to limit mixing of the underlying made ground with the topsoil. This will also prevent made ground from being exposed at the surface. Soft landscaping will include planting of low lying vegetation with shallow roots. Where larger plants are proposed e.g. gorse or trees, they will be planted in mounds of clean topsoil to provide them with a greater depth of topsoil and avoid the excavation of any contaminated soils.

5.6 Indicative Construction Methods for the Proposed Development

The main construction activities are listed below and discussed in detail in **Sections 5.6.1 - 5.6.6**:

- Diversion of existing foul sewers;
- Construction of the interceptor sewer network;
- Construction of the Alps SWO and Stormwater Storage Tank (including testing and commissioning);
- Construction of the WwTP (including testing and commissioning);
- Construction of the WwTP SWO and long sea outfall; and
- Upgrade of the revetment.

Those construction activities will occur in the sequence as described in **Section 5.3.2**.

5.6.1 Sewer Diversions

5.6.1.1 Overview

The interceptor sewer network and the Alps SWO and stormwater storage tank will not be commissioned until such time as the WwTP is fully commissioned and accepting wastewater for treatment. The existing wastewater and stormwater network will therefore be required to be functional until the proposed development becomes operational (i.e. throughout construction), therefore the sewer diversions described in **Section 5.6.1.2** will be required.

The interceptor sewer, Alps SWO and stormwater storage tank will be constructed off-line of the existing wastewater network without disturbing the current regime. This will be achieved by maintaining all current SWO discharge pipework, likely by sleeving the existing outfall pipes through working areas or alternatively locally diverting flows to the nearest existing SWO discharge pipe. The exception to this is at the Alps SWO and Stormwater Storage site where specific sewer diversions will be required.

Upon completion of the enabling works (described in detail in **Section 5.5**) sewer diversions will be required to maintain the operational wastewater network at this location as described in detail in **Section 5.6.1.2**.

5.6.1.2 Sewer Diversions for Alps SWO and Stormwater Storage Tank

New manholes MHA1 and MHA2 will be constructed using open cut techniques on the alignment of the existing 225mm diameter sewer (to the south of the Alps site). From MHA1 flows will be diverted to MHA2 via a new approximately 225mm diameter pipeline (extending from the existing sewer).

This diversion will enable all wastewater (in the existing 225mm diameter pipeline) to be temporarily diverted through to the existing sewer to the south (1200mm diameter pipeline). From MHA2, flows will continue to pass through the existing sewer and through to the existing SWO discharge point (into the Aovca River) for the duration of the construction works.

Some of the existing manholes (MH1, MH2, MH4 and MH21) and all associated wastewater pipelines will remain live until the proposed interceptor sewer becomes operational.

5.6.2 Alps SWO and Stormwater Storage Tank

5.6.2.1 Excavation

As discussed in detail in **Section 14.3 of Chapter 14**, bedrock in this area is classified as weak to medium strong, partially weathered, moderately fractured Shale/ Sandstone. On the basis of this information and the Rock Quality Designation (RQD) values detailed on the borehole logs, rock breaking or rock ripping would be required to form the excavations required to construct the Alps SWO and stormwater storage tank. These rock breaking or ripping techniques are described in detail in **Section 5.6.3.2**.

During excavation, measures will be required to protect the existing wastewater network in the area (particularly the 1200mm diameter pipeline that runs parallel to the proposed SWO and Stormwater Storage Tank). These protection measures will likely include installation of a row of sheet piles. Temporary support for the adjacent embankment to the south and the excavation itself may also be required, likely be achieved through the installation of additional sheet piles.

5.6.2.2 Installation of the SWO and Stormwater Storage Tank

Upon completion of excavation and once formation level is reached, a layer of concrete blinding will be installed and construction of the tank itself will commence. The tank will likely be reinforced concrete cast in-situ and the roof may be standard in-situ reinforced concrete or alternatively pre-cast concrete units may be used, with concrete poured to finished roof level. Once constructed, a number of spring assisted, lockable access covers will be installed in the roof.

Once the SWO and tank are in place, the proposed manholes (MHA3, MHA5, MHA6 and MHA7) will be constructed, using open cut techniques, in parallel with the construction of the associated sewers and pipework.

Mechanical and electrical installation will comprise the construction of a small electrical kiosk to provide a power source to enable monitoring of tank levels and overflow events. A non-powered static overflow screen will also be installed inside the tank and a water supply hose reel will be incorporated to allow wash down of the overflow screen/chamber floor within the tank.

5.6.2.3 Reinstatement, Levelling and Landscaping

This portion of the site willbe landscaped, with ground regraded locally to provide approximately 300mm thick layer of topsoil to bring the finished ground level above the SWO and stormwater tank to approximately 5.2mOD. Gabion basket retaining walls will be required at the northern and western sides of the SWO and tank.

Once the levels are regraded, the site will be seeded. A bitumen vehicular access route and parking facilities will be provided to the north to allow vehicular access from the gate for routine maintenance. Stairs and a 1.2m wide concrete footpath (approximately) will also be provided between the site and the manholes to the south.

A security fence (up to approximately 2.4m in height) complete with vehicle access gate will be installed around the full extent of the operational site boundary.

5.6.2.4 Testing and Commissioning

Following construction, testing will be undertaken for water-tightness in accordance with the guidance[2]. This will involve the tank being filled to its full capacity and water levels measured to ascertain if they drop (i.e. confirm that there if no loss of water from the tank) over a period of time. It will be the responsibility of the contractor to source the required water, however it is anticipated that it is likely that it would be sourced either through a connection to the local mains or via tankering to site.

Upon completion of the testing, the contractor will empty the structure. Any water used during the testing will be treated accordingly (to remove silt or other contaminants) and discharged (in accordance with an approved discharge licence) to a local water course or to the drainage network.

At this stage the manhole (MHA4) and adjacent sewer (Approximately 900mm diameter pipeline) will be constructed, again using open cut techniques, to the north-east of the SWO and tank. This manhole will be located on the alignment of the existing foul sewer (1200mm diameter pipeline) and provide the connection between the SWO and tank and the existing box culvert (and associated storm overflow sewer that currently discharges to the Avoca River).

[2] CEWSI (2011) Civil Engineering Specificaton for the Water Industry, 7th Edition

Flows will be diverted to the SWO and tank when the WwTP is fully commissioned and accepting wastewater for treatment. At this point all flows will be diverted from MHA2, through the SWO and tank and into the proposed interceptor sewer at MHA7.

The existing wastewater network pipes (to the north) will become redundant and abandoned. The pipes will be left in situ and typically concrete will be pumped to form a plug at either end of the sewer.

5.6.3 Interceptor Sewers

5.6.3.1 Overview

It is envisaged that the interceptor sewers will be constructed using a combination of open cut and tunnelling methods. In summary, the sewer on River Walk/South Quay between MHS1 to MHS15 will be laid using open cut methods. Tunnelling methods will be used to install the remainder of the interceptor sewer on South Quay (between TSS1 and TSS3), the river crossing and the North Quay interceptor sewer (between TSN1 and TSN8).

Sections 5.6.3.2 –5.6.3.4 describe the indicative construction activities associated with constructing the sewers using these methods. **Sections 5.6.3.5 - 5.6.3.9** describe the indicative associated works required to support the construction of the sewers.

5.6.3.2 Open cut Sewers (Land based)

Overview

It is proposed to construct the sewer using open cut methods on the upstream, land based sections on River Walk (i.e. between MHS1-MHS8). It should be noted that construction activities between (MHS5 and MHS8) will occur during October to March following consulation with Wicklow County Council.

As described in **Section 4.2.3 of Chapter 4**, the pipeline ranges from approximately 450mm to 750mm in diameter and invert levels are between approximately 2m - 4m below existing ground level in this section. Rock is at shallow depths (in some areas rock was encountered as shallow as approximately 1.5m below ground level) and the bedrock is classified as weak to medium strong, partially weathered, moderately fractured Shale/Sandstone, therefore rock breaking or ripping will be required as described below.

Rock breaking

The ground conditions in this area indicate that rock breaking or rock ripping is likely to be required to enable the contractor to undertake the excavation required to construct the proposed interceptor sewer. A number of techniques are available to the contractor which can be employed in combination or in isolation, such as percussive breaking, rock ripping, mechanical rock splitting, energetic materials or non-explosive demolition agents. Blasting with high explosives will not be allowed under the contract due to the proximity of sensitive receptors.

Mechanical rock splitting involves hydraulic splitting equipment forcing a wedge into a predrilled hole. However, due to the close spacing of drilling required, the technique can be slow and more suited to the accurate splitting of stone for commercial use.

Rock fracture due to energetic materials involves explosives which in effect burn extremely rapidly when ignited or 'initiated'. As a result of the chemical reaction thus triggered, energy is released at such a high rate that the material itself vigorously expands almost instantaneously and explodes imparting high forces into the surroundings. This technique is typically employed in large areas of bulk excavation.

A number of highly expansive chemicals (non-explosive demolition agents) are now available for 'low energy' breaking of concrete and rock. However, the productive effectiveness of the materials is limited by their mode of action, which is slow, taking around 12 hours per round, and sensitive to both the care taken in the mode of application and the properties of the host material.

Due to the volume and location of rock likely to be encountered at this location and generally as part of the proposed development, percussive breaking and rock ripping are the most likely techniques to be used by the contractor in this instance. Both methods are summarised below:

[1] Percussive Breaking

- Breaking rock or cemented material by purely surface impact percussive means is a constant activity that imparts high levels of energy directly into the ground, thereby generating relatively high levels of vibration.
- This technique and the machinery associated with it are often used to break hard materials at the surface, e.g. digging up roads with a concrete base; or for trimming the edges of excavations in rock.
- It may be used in similar circumstances to construct the interceptor sewers, i.e. for breaking small quantities of hard materials in confined areas (such as the trenches) or below ground for breaking up larger lumps of rock or concrete and 'tidying up' larger excavations.

[2] Rock Ripping

- If the strength of the rock allows, rock cane be fractured simply by 'ripping'. Rock ripping is typically undertaken by an excavator with a specialised ripper attachment.
- Again, this method means imparts high levels of energy directly into the ground, thereby generating relatively high levels of vibration, although less than blasting.

Construction Process

To form the trench for the sewer, the overburden will be excavated and a drag box or trench box will be installed as the excavation progresses. The excavation areas will be sized accordingly to accommodate the trench box/drag box.

The use of a trench box/drag box will minimise the working area by providing stability to the upper sides of the excavation.

Following the excavation of overburden, rock breaking or rock ripping will take place as described above. Following this, the excavated material will be removed (using excavators at ground level). This process will be repeated until formation level has been reached to enable the laying of the sewer.

Due to the relatively high-water table in the area (approximately 2m below ground level), dewatering works will be required to support the open cut construction of the sewer. Dewatering will typically be achieved by using a series of sumps and submersible pumps. To reduce the amount of dewatering required at any given time, it is likely that the contractor will construct the sewer in sections. Due to the nature of the weathered rock groundwater cut off will not be possible using trench boxes and would only be achieved if temporary sheet piles are employed on either side of the trench excavation. This is thought to be an unlikely approach for the contractor.

Discharge from the dewatering process will be passed to a suitably sized propriety silt removal system, before discharge to the Avoca River or the local sewer network. Any discharge to either sewer network or watercourse will be subject to and discharged in accordance with the licence granted by Wicklow County Council under the Local Government (Water Pollution) Acts, 1977 to 2007.

Once the excavation is dewatered, the sewer will be laid on its bedding material and the trench will be filled with suitable fill material to ground level. The area will subsequently be reinstated to its pre-construction condition.

5.6.3.3 Open cut Sewers (River based)

Overview

It is proposed to construct the sewer using open cut methods in the river based sections on River Walk and South Quay (i.e. between MHS9 - MHS15). As described in **Section 4.3.3 of Chapter 4**, in this section the pipeline ranges from approximately 750mm to 1200mm in diameter and has invert levels of approximately 2.5m – 4.5m below existing ground level.

An overview of the typical construction of the river based sewers that will be constructed using open cut methods is provided in Figure 5.2.

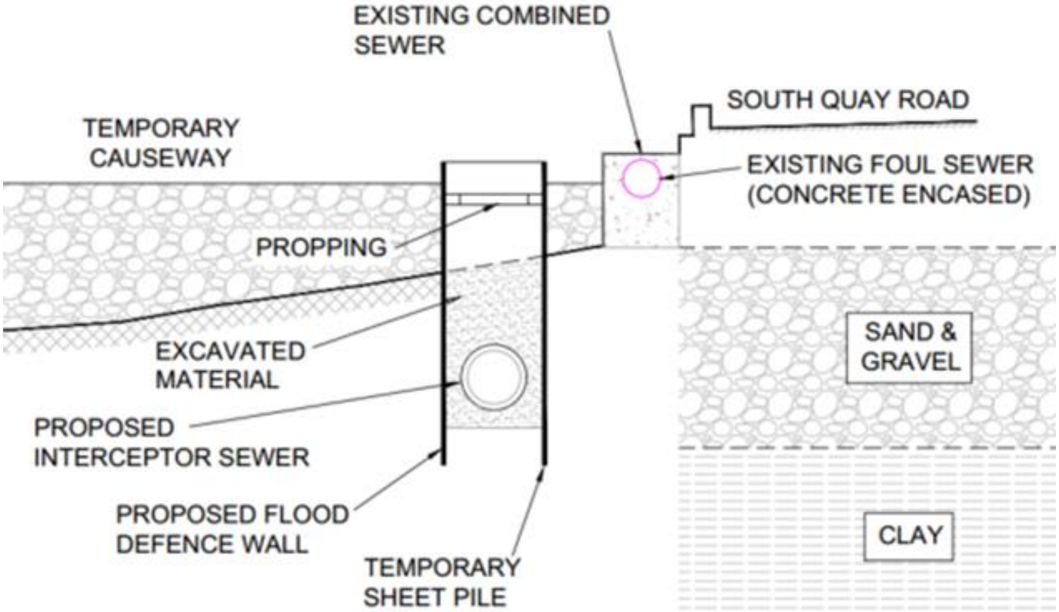

Figure 5.2: Overview of proposed open cut construction of the river based sewers

As outlined in **Section 4.3.2 of Chapter 4**, two areas of land will be reclaimed from the river channel (upstream of Arklow Bridge around MHS9 and downstream of Arklow Bridge between MHS10 to MHS15) to facilitate the construction of the interceptor sewer and to provide access for maintenance.

Scheme Integration (with Arklow Flood Relief Scheme)

This section of works physically overlaps with the proposed Arklow Flood Relief Scheme. Permanent sheet piles will be required to retain the reclaimed land (included as part of the proposed development). As currently proposed, these permanent sheet piles willdouble as the foundation of the flood defence wall planned as part of the proposed Arklow Flood Relief Scheme. The detailed design of the sheet pile wall that will be undertaken by the contractor will account for the requirements of the proposed Arklow Flood Relief Scheme. If the proposed Arklow Flood Relief Scheme was to commence in advance of the proposed development, then by agreement by both project proponents, these works may be undertaken by the contractors for the proposed Arklow Flood Relief Scheme.

The proposed development will terminate the sheet pile wall structure at capping beam level (as currently designed). The proposed Arklow Flood Relief Scheme will then install the flood defence wall and undertake all associated public realm works, including installation of any cladding materials. On the basis of the current design, we anticipate that the Arklow Flood Relief Scheme will use the sheet pile wall and capping beam (installed as part of the proposed development) as the foundation for its flood defence wall.

Construction process

Temporary Causeway

To facilitate construction of the interceptor sewer in the river channel, a temporary causeway will be required to support construction activities. The temporary causeway will include a sufficient working area for installing manholes, the interceptor sewer and sheet pile walls. The causeway would also include provision for approximately 10m wide haul road for HGVs and larger construction plant required to allow excavated material to be removed from the working area during the excavation of the trench.

The temporary causeway will be constructed from clean, suitable engineered fill (coarse granular material free from fines with a maximum particle size of 500mm) in a sequential manner from upstream (approximately 10m upstream of Arklow Bridge) to downstream (approximately 50m downstream of TSS1).

An overview of the temporay causeway is illustrated in Figure 5.2.

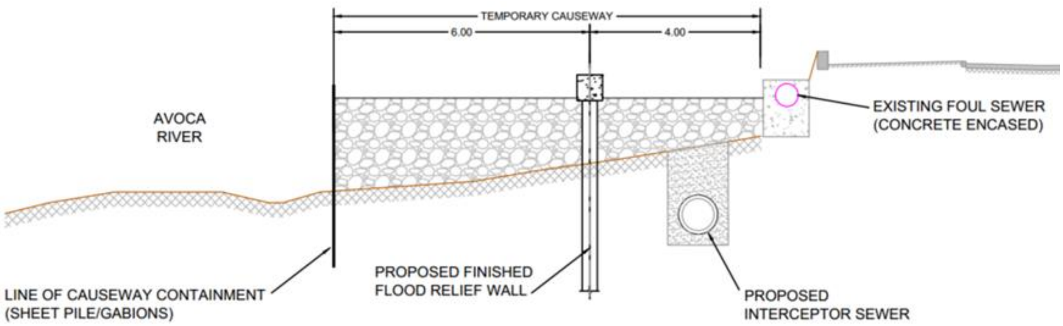

Figure 5.3: Overview of proposed temporary causeway required to construct the river based sewers

In order to mitigate and minimise the potential flood impact caused by the construction of the temporary causeway all instream works upstream of Arklow Bridge near MHS9, including the installation of the interceptor sewer under the bed of the southernmost arch and the underpinning and lowering of the second arch need to be completed in advance of the installation of the temporary causeway downstream of the Arklow Bridge.

A typical sequence for the construction of a temporary causeway of this nature is summarised below:

1. Access route from South Quay will be constructed from downstream to upstream (i.e. from east to west direction). It is proposed to commence works from the eastern side to reduce construction traffic in Arklow town centre.
2. The causeway will be contained on the river side to mitigate against siltation migration into the Avoca River. The two most likely methods to achieve this containment will by via either be an additional row of sheet piles on the river side of the causeway or alternatively a row of stone gabions wrapped in a geotextile membrane.

Either method will require that the containing material (ie the sheet piles or the gabion walls) are extended (i.e. to a height above the surface of the causeway) to be effective.

3. The clean engineered fill material will be transported to the site using tipping vehicles. This will be used as deposit material and be tipped directly into the previously contained area of the river channel from the vehicles by means of suitable plant. The tipping vehicles will be reversed along the causeway with material deposited directly from the end of the causeway in order to avoid large turning circles and double handling of material. A smaller size clean engineering fill material may be used along the line of the permanent sheet piles to aid their installation.
4. Following the deposition of initial loads, material will be spread out to form the temporary causeway. The deposit material will be spread within the contained area using a combination of excavators and dozers. Fill material will then be compacted using tracked machines to provide a suitable running platform for subsequent lorries. The height of the causeway will be in the order of approximately 300mm above mean high water spring levels.
5. The construction of the temporary causeway will continue upstream in this manner until the full route of the temporary causeway is constructed.
6. Following completion of construction of the river based sewer (i.e. when the causeway is no longer required), the causeway will be removed in a similar sequential manner. Long reach excavators will excavate and remove the deposit material from the river channel and place the material in tipping vehicles to be removed from site.

The installation of a temporary causeway is considered in stream works (i.e. within the river channel), therefore the contractor will be required to seek full approval from Inland Fisheries Ireland for all activities in the river channel prior to the commencement of works.

All temporary measures in the river channel will be required to be carried out in accordance with the Inland Fisheries Ireland guidance[3]. The seasonal restriction contained in the guidance (i.e. July to September inclusive) will apply to both the installation and removal of the causeway. As outlined in **Section 5.3.3**, it is likely that the contained causeway will be installed during one season, remain in place year round and be removed during the next available season when it is no longer required.

Standard best practice measures in accordance with the Construction Industry Research and Information Association (CIRIA) guidance[4] will be required to be employed by the contractor to manage silt run-off and pollution control.

[3] Inland Fisheries Ireland (2016) Guidelines on Protection of Fisheries During Construction Works in and adjacent to Water
[4] CIRIA (2015) Environmental Good Practice on Site Guide, 4th Edition.

Installation of sheet piles

Once the temporary causeway is in place, the sheet pile wall will be formed by vibrating steel sheets into the ground and the sheet piles will be interlocked to provide continuity.

Downstream of Arklow Bridge (between MHS10 and MHS15), the existing wastewater sewer is encased in concrete and runs parallel to South Quay on the riverside of the quay wall. Due to the historical nature and unknown depth of the quay wall, additional temporary support will likely be required to maintain this foul sewer and protect the existing quay wall. This additional support will typically comprise an additional row of temporary sheet piles installed close to the existing sewer. Propping may be required between the quay wall and the temporary sheet pile wall.

Dewatering

To provide groundwater cut off, the temporary sheet piles should extend into the underlying Cohesive Deposits (which based on existing ground investigation data were encountered at approximately 5.2m below the existing ground level). Once both lines of sheet piles are in place, the excavation will be dewatered.

Dewatering will typically be achieved by using a series of sumps and submersible pumps. To reduce the amount of dewatering required at any given time, it is likely that the contractor will construct the sewer in sections.

Discharge from the dewatering process will be passed to a suitably sized propriety silt removal system, before discharge to the Avoca River or the local sewer network. Any discharge to either sewer or watercourse will be subject to and discharged in accordance with a discharge licence granted by Wicklow County Council under the Local Government (Water Pollution) Acts, 1997 – 2007.

Laying the sewer

Once dewatered, the sewer will be laid on its bedding material and the trench will be filled with lean, suitable engineered fill, free from contamination and in accordance with the relevant engineering specificiations.

The row of temporary sheet piles may then by removed whilst the permanent row of sheet piles will be completed by installing a reinforced concrete capping beam (approx. 600mm x 600mm). The proposed finished level of the capping beam will be approximately 1.26mOD.

Public realm

Once the sheet piles have been capped, landscaping will occur at ground level in the areas of reclaimed land. The proposed ground levels (along the reclaimed land) will tie in with existing road levels (approximately 1.24mOD), therefore this area would receive approximately 300mm of topsoil and be seeded. As noted in **Section 5.3.4**, the proposed Arklow Flood Relief Scheme intends to complete public realm works in this area once consented.

5.6.3.4 Tunnelled sewers

Overview

It is proposed to construct the interceptor sewer using tunnelling methods in specific areas. Tunnelling will occur on a 24-hour basis 7 days a week between the launch and reception shaft until completion.

On the South Quay (Between TSS1 and TSS3), the pipeline will be tunnelled to an approximate minimum depth of 5m below ground level, up to an approximate maximum depth of 12m below ground level and the river crossing will be tunnelled to an average depth of approximately 10 - 12.5m below ground level. Similarly, on North Quay the tunnel will commence (at TSN1) at an approximate minimum depth of 5m below ground level up to an approximate maximum depth of 13m below ground level as the interceptor sewer reaches the WwTP site (at TSN8).

The ground where tunnelling is proposed is generally underlain by highly permeable and water bearing sands and gravels. The ground conditions have determined that tunnelling will be undertaken using a closed face TBM system, to prevent significant inflows of groundwater into the tunnel during installation of the interceptor sewers.

An overview of a typical setup of the TBM and pipe jacking frame in a tunnel shaft is illustrated in Figure 5.4.

Figure 5.4: Typical setup of the jacking frame installing the pipeline in a tunnel shaft

Tunnel Shafts

Overview

Tunnel shafts will be required during construction to facilitate the subsurface tunnelling. The tunnel shafts will comprise launch shafts, reception shafts or a shaft may serve as both launch and reception shafts (dependent on the specific contractor tunnelling methodology).

An overview of typical top-down construction of a tunnel shaft is illustrated in Figure 5.5.

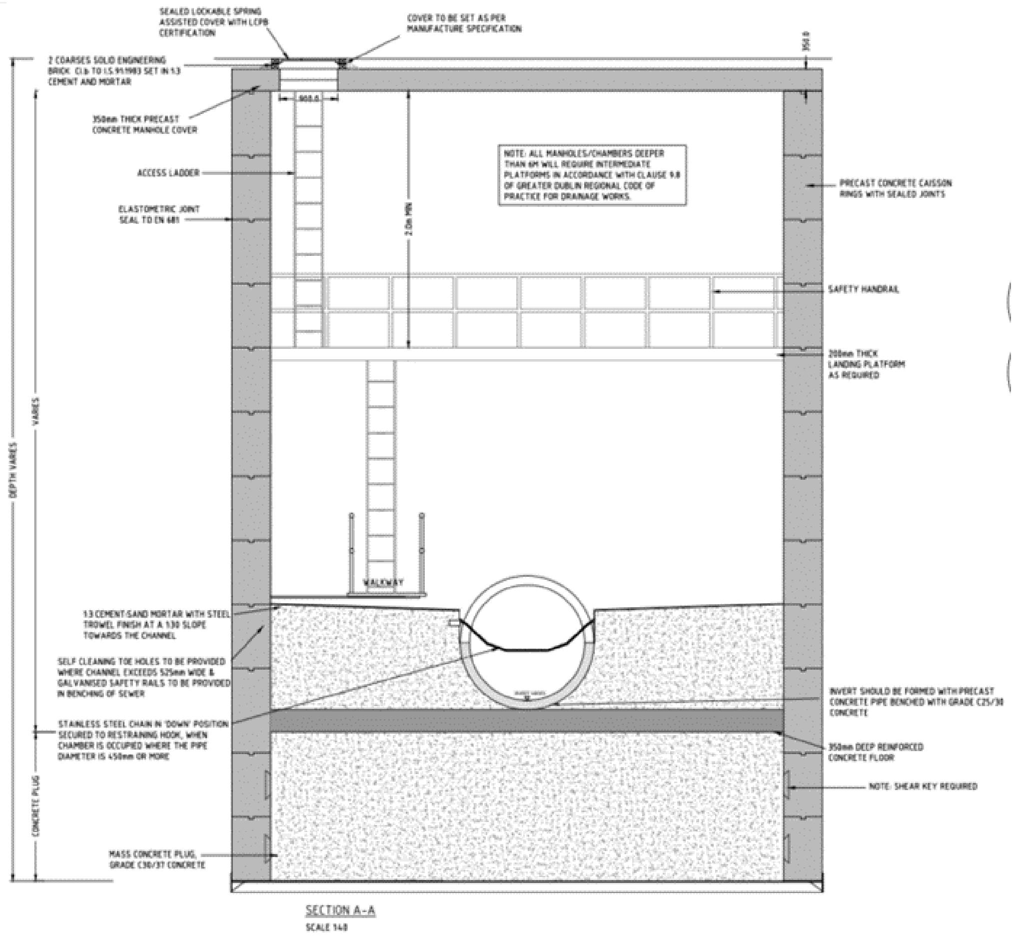

Figure 5.5: Typical top down caisson construction of a tunnel shaft

Construction process

The typical works that will take place to construct each of the tunnel shafts include (Refer to **Section 5.3.2.1** for further detail on the sequence of works):

- A circular shaft (approximately 8m in diameter) will be installed using a caisson top down construction method. Using this method, the shaft will be sunk beneath ground level by means of a series of concrete elements stacked from ground level.

- A jacking pressure will be applied (from ground level) to force the caisson elements in to the ground, aided by the excavation of the ground trapped within the caisson.
- As the top of each element drops below ground level a new element will be placed on top. As a consequence, the first caisson element will form the lowest segment of the shaft.
- The caisson elements will form the permanent works for the shaft, although an internal permanent structure could be formed as an addition to, or to replace, the caisson elements.
- The tunnel shafts and associated manholes will be installed to provide access to the interceptor sewer.
- The tunnel shafts willbe installed in the wet, i.e. this method would involve construction of the shaft without local dewatering. As a consequence, the shaft will contain water until a base plug (i.e. a depth of concrete) is installed. In order to resist uplift water pressures, the underwater base plug, will be of sufficient depth below the invert level of the tunnel shaft to resist the buoyant uplift forces on the shaft. It should be noted that typically, 1m of concrete is required for every 2m below groundwater level.
- The base plug may be poured by means of a tremie pipe with concrete that cures underwater. This method will require the removal of water from the tunnel shaft (by pumping), after the concrete has cured. All water extracted from the tunnel shaft will pass through a proprietary silt removal/treatment system and will be discharged to a local water course or drainage network (once an appropriate discharge licence is in place). Refer to **Section 5.9** and the Outline CEMP (**Appendix 5.1**) for further details.
- The weight of the shaft walls cannot be mobilised against buoyant forces as it will be impossible to form a connection between the base plug and the shaft walls with the shaft flooded.

Tunnelled Sewer Construction process

<u>Launching the TBM and pipejacking</u>

Once the tunnel shafts have been constructed, the pipeline will be installed using standard micro-tunnelling methods. Micro-tunnelling will be achieved by using a TBM to install the pipeline. The TBM will enter the ground from a launch shaft and pass to a reception shaft using pipe jacking techniques.

The typical works that will take place to construct the interceptor sewer from each of the launch tunnel shafts include:

- A jacking wall will be installed within the launch shaft to resist forces generated by the jacking frame;
- A headwall will be installed within the launch shaft to facilitate launching of the TBM into the soil. The headwall will incorporate a launch seal (located at the location where the pipeline would enter the tunnel) to create a water tight seal;

- The TBM will be lowered into the launch shaft using a mobile crane;
- Powerful hydraulic jacks will push the TBM and specially designed jacking pipes through the headwall, through the launch seal and into the soil;
- The TBM will excavate the soil by using cutting wheels located on the face of the TBM;
- As the soil along the alignment of the tunnel is excavated, the pipeline will be jacked into position, the hydraulic jacks will contract and the pipeline will be placed in the launch shaft. The pipeline will then be pushed into position by the hydraulic jacks; and
- The process will be repeated until the tunnel and pipeline reaches the reception shaft.

Management of excavated soil

The tunnelling equipment will generally comprise the following components:

- TBM;
- Control container including guidance system;
- Jacking frame; and
- Separation plant and water circuit equipment.

The TBM will be pushed into the soil by the jacking frame for excavation. The excavated soil will enter a crushing chamber located behind the cutting wheels of the TBM, where particles greater than a certain size would be crushed. Water will be pumped into the crushing chamber (from an above ground header tank that would be filled by tanker), to create a slurry water mixture. Once formed, the slurry will be pumped to the surface at the launch shaft.

The control container is typically located at the top of the launch shaft. This control container will house the control station for the TBM operators to enable them to manage all aspects of the tunnelling operation from ground level.

During pumping, the slurry will typically pass through a flow meter to enable the TBM operator to record and monitor the amount of slurry being produced. After passing through the flow meter, the slurry water mixture will be separated via vibrating shakers and screens that will remove gravel and coarse sand particles, cyclones that will remove fine sand and silt particles and a centrifuge will remove clay particles.

When these particles are removed from the slurry, they will be stockpiled for removal from the working area for disposal at an appropriately licensed facility in respect of which a waste permit or a waste licence is granted. The water portion of the slurry will be pumped back to the crushing chamber for reuse. This process will be repeated as the tunnelling progresses between tunnel shafts. On completion of a full section of tunnelling works between shafts, the residual slurry water will be tankered off site for disposal at an appropriately licensed facility in respect of which a waste permit or a waste licence is granted.

This recycled slurry water will also be passed through a flow meter, to provide the operator with information on the quantities of water entering and leaving the tunnelling process, in order to facilitate effective slurry removal. Slurry pressures will be monitored throughout to ensure that all pressures are sufficient to accommodate the insitu stresses acting on the face of the TBM. This pressure management, in conjunction with the jacking forces, will maintain stability, avoid groundwater intrusion and mitigate against excess excavation.

Ground stablisation

As the tunnelling and laying of the pipeline progresses, bentonite will be used as a lubricant. Bentonite will be pumped into the void between the soil and the pipeline (i.e. the annulus) at regular intervals (typically every 5 pipe lengths, i.e. approximately 12.5m). Bentonite will be mixed at ground level and constantly pumped along the pipeline for discharge via the lubrication ports.

The bentonite will be discharged through the lubrication ports to provide support for the ground around the annulus and minimise friction that may impact on the jacking forces. Lubrication pressures will be closely monitored to prevent ground movement and/or settlement as a result of any excess pressure.

Receiving the TBM

As the TBM reaches the reception shaft, it will enter a reception seal and be jacked until the entire TBM is clear of the reception seal and the shaft wall.

Once clear, the TBM will be removed from the reception shaft using a mobile crane. As outlined in **Section 5.3.2.1**, the TBM will then proceed to the next launch shaft to continue the tunnelling process.

Grouting

Once the pipeline is constructed and the TBM is removed, the annulus between the pipeline and soil will be grouted (via the same ports that were used to install the bentonite) to protect the interceptor sewer. The grout will be produced at ground level and pumped along the pipeline from the launch site in a similar manner to the bentonite.

5.6.3.5 Arklow Bridge works

Overview

The proposed interceptor sewer will pass under the most southern arch of Arklow Bridge. At this point, the sewer is approximately 3m - 3.5m below ground level and approximately 1m below the existing river bed. Similar to the open cut works in the river channel (as described in **Section 5.6.3.3**), this section physically overlaps the proposed Arklow Flood Relief Scheme.

Underpinning

Underpinning of two arches of the Arklow Bridge is required, to facilitate the construction of the sewer through the first arch and, for the second arch to mitigate any potential flood risk associated with the proposed development.

While both arches will be underpinned, only the second arch will require works to lower the floor of the bridge.

In order to mitigate and minimise the potential flood impact caused by the construction of the temporary causeway (Refer to **Section 5.6.3.3**) all instream works upstream of Arklow Bridge (near MHS9), including the installation of the interceptor sewer under the bed of southernmost arch and the underpinning and lowering of the second arch need to be completed in advance of the installation of the temporary causeway downstream of the bridge.

The underpinning and lowering of the floor of the bridge is likely to entail the following activities:

- Grouting each of the piers and the abutments of Arklow Bridge and the river bed to a depth of up to 2m below the piers and abutments, including drilling of holes to accommodate the grouting from the bridge deck, in order to stabilise the bridge and its formation during the underpinning works (Refer to Figure 5.6);
- Construction of a temporary causeway from the river bank to provide access to each of the piers and abutments;
- Creation of a bund around each pier or group of piers to allow works to be carried out in a dry environment;
- Removal of existing formation in a phased manner from the underside of each pier and abutment to a depth of approximately 1.6m below existing bed level and replacement with concrete (Refer to Figure 5.7); OR
- Construction of mini-piles around each pier to support the pier foundation (Refer to Figure 5.8); OR
- Construction of piles through the piers and abutments from the bridge deck to support the bridge during the underpinning works (Refer to Figure 5.9);
- Demolition of the existing concrete scour protection slabs and lowering of the floor of the bridge by approximately 1m on average (It should be noted that the floor of the second arch will be lowered by approximately 1.2m); and
- Construction of a new concrete scour protection slab between approximately 10m upstream to approximately 15m downstream of the bridge and beneath the arches of the bridge and the placement of riprap along the upstream and downstream edges of the concrete slab.

Grouting Works

Grouting of the bridge piers, pier foundations and the underlying natural materials beneath formation level is proposed for a number of reasons:

- To improve the structural strength of the bridge piers;
- To improve the bearing capacity of the underlying natural material below pier formation level; and
- To control ground water flow where excavations are required below existing river bed level.

Grouting will involve the drilling of holes using an Odex system and installation of temporary steel casings to support the holes.

A tube will then be installed in the hole and grout will beintroduced under pressure from the bottom of the hole upwards. Grouting will be carried out from the bridge deck for the piers and areas immediately beneath the piers.

Grouting will also be carried out from river bed level for areas adjacent to the piers below bed level and to augment the grouting beneath the piers. The grouting will be carried out to a depth of approximately 3m below existing river bed level. The grouting material will consist of cement only or a mixture of cement and bentonite, depending on the purpose of the grouting and the permeability of the material to be grouted. Figure 5.6 illustrates proposed grouting works at bridge piers.

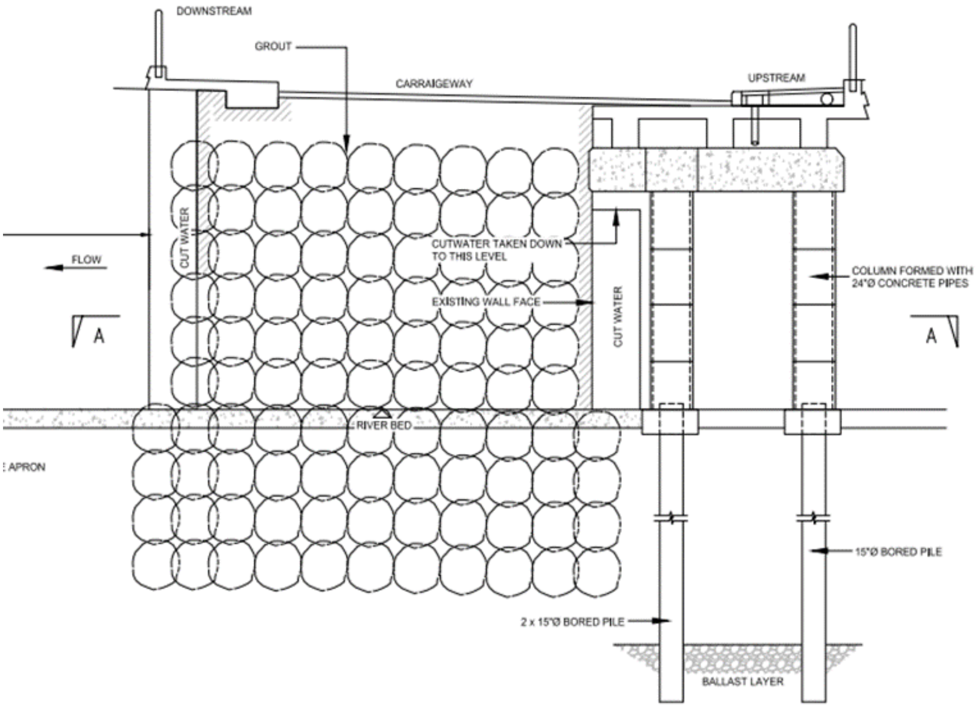

Figure 5.6: Typical grouting works at bridge piers

Traditional Underpinning

Traditional underpinning will comprise the removal of existing natural material below existing formation level in a phased manner from the underside of each pier to a depth of approximately 1.6m below existing bed level and replacement with concrete. The work would be carried out from the existing bed level. Grouting would be utilised under the arches to control groundwater and support the sides of the excavations.

It is expected that the underpinning would be carried out in two stages with the first stage taking a row of pins down to approximately 800mm below existing bed level and the second stage taking a second row of pins from the underside of the first row of pins to the final formation level. The dimensions of each pin would be approximately 1.0m wide by 0.8m long by half of the pier depth (0.7m – 0.9m approximately).

The depth would be limited to approximately 0.9m for the central pin. Construction of pins would be staggered to avoid working adjacent to a recently constructed pin. Figure 5.6 illustrates the traditional underpinning option.

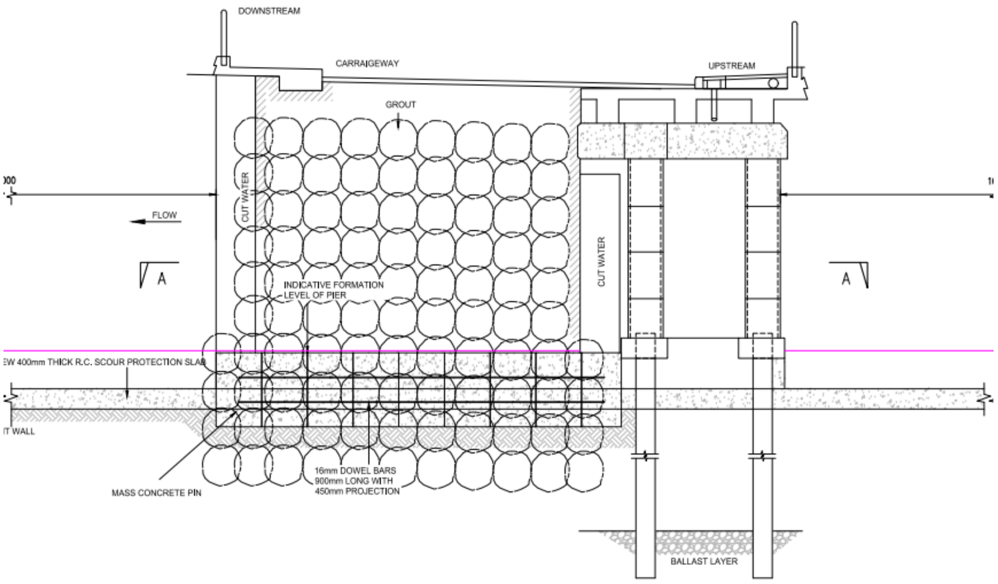

Figure 5.7: Traditional underpinning option

Mini- Piling

Mini-piling would be carried out from river bed level. Rotary drilling would be used to form a hole approximately 250mm diameter. Reinforcement and grout would be installed in each hole. Approximately 70 no. mini-piles would be installed around the perimeter of each pier. The top of the mini-piles would be encased in a reinforced concrete ring mean.

Following the completion of the mini-piling and the lowering of the bed level, the face of the mini-piles would be clad with concrete to a depth of approximately 200mm. Figure 5.7 below illustrates the mini-piling option.

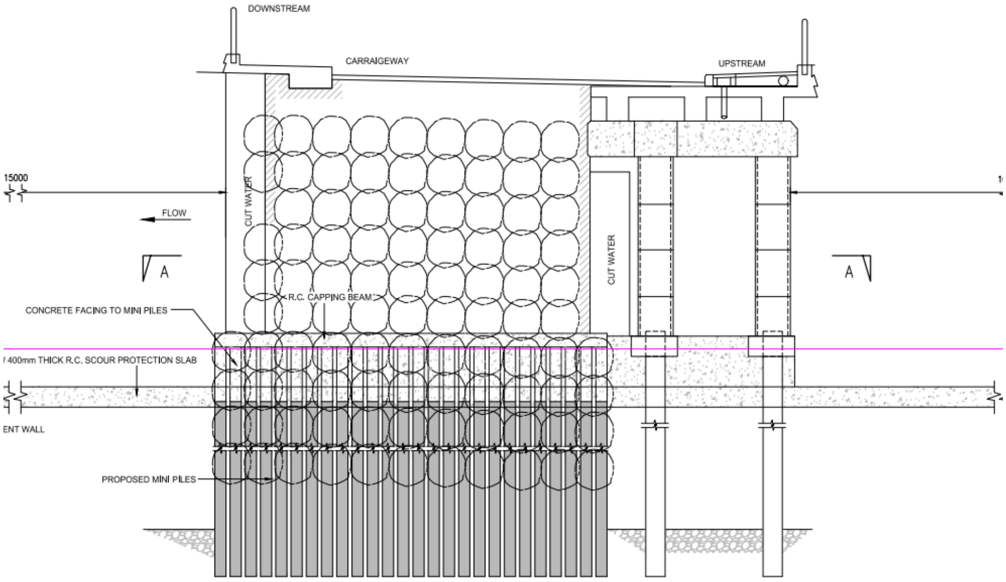

Figure 5.8: Mini piling option

Piling

Piling would be carried out from bridge deck (road) level. It would comprise the boring of appximately 350mm diameter holes and the placing of reinforcement and concrete within the hole. The piles would be founded approximately 10m below existing river bed level. Approximately seven piles would be constructed at each pier.

Following the completion of the piling and the lowering of the bed level, the face of the material below pier level would be faced with concrete to a depth of approximately 300mm in a similar fashion to the underpinning i.e. the natural material would be excavated to a depth of approximately 300mm from the face of the existing pier and replaced with concrete. Figure 5.8 shows a typical load bearing pile.

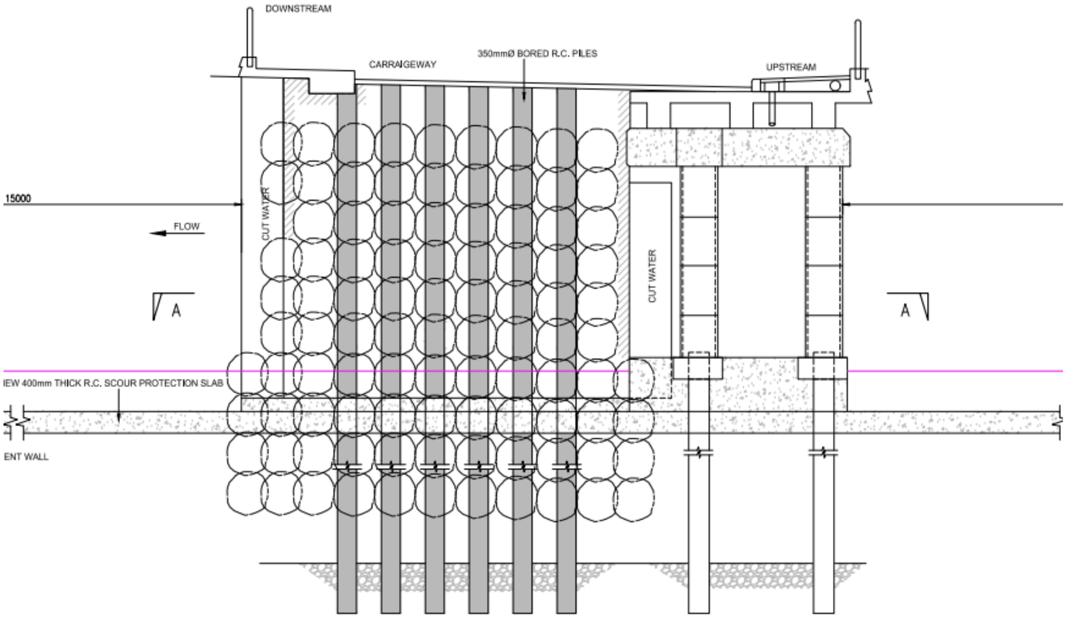

Figure 5.9: Load bearing pile

5.6.3.6 River Crossing

Overview

A tunnelled crossing of the interceptor sewer (approximately 120m in length) would be required under the Avoca River. The river crossing comprises approximately 1500mm diameter pipeline that will extend from TSS3 on South Quay (approximately 10m below ground ground level) to TSN6 on North Quay (approximately 12.5m below ground level).

Given current knowledge, it is believed that the existing sheet pile quay walls on the northern and southern sides of the river channel are approximately 12m long and supported by a series of tie back anchors that extend into the landside and possibly connect to either anchor blocks or a historical quay wall (Refer to Figure 5.10). Construction of the river crossing will therefore require cutting through the toe of the existing sheet pile quay walls.

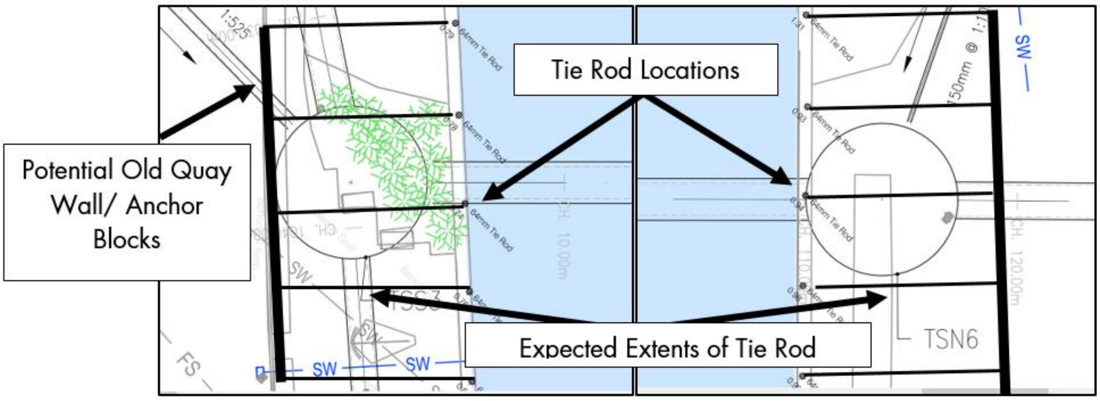

Figure 5.10: Indicative layout of existing infrastructure at the river crossing

Construction process

Construction of the tunnelled river crossing will require the installation of two tunnel shafts (TSS3 on South Quay and TSN6 on North Quay).

It is considered that a rectangular sheet pile cofferdam would be the most likely solution for tunnel shafts in these areas given the existing infrastructure constraints.The following sections describe a typical indicative construction sequence for installing a rectangular sheet pile cofferdam and the subsequent construction of the river crossing, which is further detailed in **Drawing No.'s 247825-00-C-IS-708 to 247825-00-C-IS-710 of Volume 3**.

<u>Installing the cofferdams</u>

1. The cofferdams will be located to minimise disruption to the existing tie back anchors. The tie back anchors are spaced at approximately 4.2m centre to centre and as such it is likely that at least two tie back anchors will need to be removed from the existing quay wall.
2. The stability of the quay wall (to allow removal of tie back anchors) will need to be addressed prior to the installation of the cofferdam. It is anticipated that additional tie back anchors will be installed adjacent to the proposed tunnel shafts (TSS3 and TSN6). These additional tie back anchors will be connected to each other and to the existing quay wall by a whaler beam. The additional tie back anchors will be ground anchors installed at 45°, and grouted into the competent soils below ground level. The whaler beam will be installed to transfer the load to the new tie back anchors at either side of the existing quay wall area that will be cut to facilitate tunnelling.
3. The rectangular cofferdams will be constructed at the proposed tunnel shaft locations (TSS3 and TSN6) by installing sheet piles to form a rectangular shape. The sheet piles will be interlocked to provide continuity between sheets. The western side of the sheet piles at TSS3 and corresponding eastern side of the sheet piles at TSN6 will be positioned to avoid the historic quay wall/anchor blocks.

Preparation works at the reception shaft (TSS3)

1. Once the cofferdam and any necessary propping frames are installed, partial excavation will be undertaken to below the invert level of the sewer at TSS3. It is anticipated that the contractor's likely sequencing will identify TSS3 as a reception shaft to facilitate other works likely to occur (around TSS3) concurrent with the installation of the river crossing.
2. Based on the geotechnical investigation information available (refer to **Section 14.3 of Chapter 14** for further detail), the invert level at TSS3 is likely to be within the water bearing sands and gravels that will require preparatory works prior to cutting through the existing quay wall. These preparatory works may include installing a well to dewater the area (at the point of entry) or grouting the area where the tunnel will pass through the existing quay wall (using grout lances) from the inside of the cofferdam to form a barrier. Holes in the existing quay wall may also be locally cut to accommodate grout lances to enable grouting.
3. Following the preparatory works at TSS3, an opening may be cut in the sheet piles to allow the pipeline to extend into the cofferdam. The area around the tunnel will then be sealed to prevent any further water ingress.
4. The cofferdam will then be fully excavated to formation level. Excavation may take place using long reach excavators or excavators placed directly into the cofferdam. The excavated material will be lifted to ground level and transported offsite to a suitably licenced waste facility for disposal. To prevent uplift in the permanent case a grout plug will be required.

Preparation works at the launch shaft (TSN6)

1. Should granular water bearing deposits be evident at the launch tunnel shaft (TSN6), pre-grouting of these deposits may be required to allow the TBM to launch.
2. Following excavation of the cofferdam to formation, holes in existing sheet piles may be locally cut to accommodate grout lances to enable grouting of the soil locally. This area will be grouted to ensure full coverage and thus provide water cut off and prevent migration of granular material during subsequent tunnelling operations.
3. Following grouting, the sheet piles will be cut at the location of the river crossing to allow tunnelling to commence between TSS3 and TSN6.

Tunnelling Works

1. A depth of overburden of 4m over the tunnelled crossing (greater that the guidance[5] of two times the pipe diameter) has been allowed for in order to prevent 'blow out' occurring during tunnelling operations. The overburden depth has also been designed to accommodate any future dredging that may be required in the river channel by Wicklow County Council.
2. Tunnelling of the river crossing will be undertaken in accordance with the same methodology as described in **Section 5.6.3.4**.

[5] British Tunnelling Society (2010) Specification for Tunnelling, 3rd Edition.

3. Once tunnelling works are complete and the TBM removed, a suitably sized manhole will be constructed at the location of both tunnel shafts (TSS3 and TSN6) within the confines of the rectangular cofferdam and the cofferdam backfilled with suitable material. An SWO will also be constructed at TSS3, which is predicted to spill on average once per bathing season or in the event of an extended power cut at the WwTP. The SWO will comprise approximately 1200 mm diameter pipeline, extending from TSS3 through the quay wall. A 10mm screen will be fitted within TSS3 to screen flows through this SWO.
4. The cofferdam sheet pile may then be removed or remain in place permanently.

5.6.3.7 Vent Stacks

12 vent stacks will be provided along the length of the interceptor sewers to vent any odour that may arise during operation. The vent stacks are propriety systems, similar to lighting columns.

The concrete foundation required will be approximately 1m x 1m x 1m deep and will be placed approximately 1m below ground level. Ducting will be installed using open cut techniques to connect the vent stacks to the interceptor sewer.

5.6.3.8 Connection Manholes

Along South Quay, connections will be required between the existing wastewater network and the proposed interceptor sewer network (via the spur pipelines as described in **Section 4.2.3 of Chapter 4**). The existing manholes on the wastewater network will be used as connection points insofar as possible however, a number of new manholes (i.e. MHS2A, MHS3A and MHS4A) and associated spur pipelines will be constructed using open cut techniques to link the existing sewers to the proposed interceptor sewer. If invert levels dictate, some of the additional manholes will be backdrop manholes (i.e. there may be a significant difference in the invert level of the existing and proposed sewers).

A similar methodology will be adopted along North Quay. However, where connections are required between the existing wastewater network and the proposed interceptor sewer inbetween tunnel shafts (e.g. MHN2A and MHN3), the contractor will typically construct additional manholes directly over the proposed interceptor sewer, rather than off-line. These connection manholes will be installed sequentially using open cut techniques.

5.6.3.9 Testing and Commissioning

The pipelines up to 1000mm diameter will be tested by means of either a water test (taken from existing adjacent watermain), an air test or by a visual inspection in accordance with the guidance[6]. Infiltration will also be tested in accordance with this guidance[6].

The pipelines greater than 1000mm diameter will be subjected to a visual inspection and infiltration test as per the relevant specification[7].

Prior to commissioning of the interceptor sewer network, a CCTV survey will be undertaken through all of the pipelines to close out testing.

The interceptor sewers will not be commissioned until such time as the WwTP is wastewater for treatment (i.e. fully commissioned). During commissioning, a series of activities will be required to turn in flows to the interceptor sewer network as outlined below:

- Flows in the existing foul sewer network will be temporarily over-pumped further downstream during construction into the existing foul network (i.e. the adjacent manhole) during the construction of connection manholes;
- On completion of the connection manholes and sewers, flows will be diverted to the proposed interceptor sewer, commencing at the downstream end with the flows nearest the WwTP turned in first until such time as all flows are diverted into the proposed interceptor sewer; and
- A number of existing foul sewers will then be abandoned and pumped with concrete to seal both ends of the pipeline.

5.6.4 WwTP

5.6.4.1 Overview

Construction of the WwTP will be undertaken on the Old Wallboard site at Ferrybank and generally comprise the following sequential activities:

- Construction of the building structures;
- Process, Mechanical and Electrical Installation in each of the buildings;
- Landscaping and development of site infrastructure; and
- Testing and Commissioning of the WwTP, SWO and long sea outfall.

[6] UK Water Industry Research Limited (2011) Civil Engineering Specification for the Water Industry, 7th Edition
[7] British Tunnelling Society (2010) Specification for Tunnelling, 3rd Edition

5.6.4.2 WwTP Structures and Buildings

Inlet Works building

Overview

The Inlet Works building is located to the north-west of the WwTP site and will extend up to approximately 16.5m above ground level and up to approximately 18.5m below ground level. A vent stack will also be incorporated and extend 1m above the maximum height of the building (Refer to **Section 4.3 of Chapter 4** for further detail).

Excavation will be required in this portion of the site (as described in detail in **Section 5.5.5.4**) to accommodate the Inlet Works building and groundwater controls will be installed as detailed in the Outline CEMP (Refer to **Appendix 5.1**). Given the depth below ground level of the excavation, piling will be required to provide support to the temporary excavations and permanent tension piles will also be required to resist uplift of the deeper underground structures.

Construction process

Following the enabling works described in **Section 5.5.5**, construction of the Inlet Works building will likely progress as per the following sequence of works:

- Phase 1:
    - Installation of the secant piles around the inlet sump to temporarily shore the sides of the excavation;
    - Installation of the capping beams to the secant pile walls; and
    - Installation of the sheet piles for the storm tank excavation.
- Phase 2:
    - Begin excavation of inlet sump;
    - Install temporary supports (top and intermediate waling beam supports) as excavation progresses; and
    - Dewater as required during the excavation.
- Phase 3 :
    - Excavate to the base of the inlet sump;
    - Progress excavation of the storm tank;
    - Install tension piles at the base of the inlet sump.
- Phase 4:
    - Construct the base slab of the inlet sump and first rise of the walls to the underside of the intermediate waling beam;
    - Backfill the cavity in the inlet sump between the secant pile wall and the permanent wall; and
    - Install tension piles at the base of the storm tank.

- Phase 5:
  - Remove the temporary intermediate supports in the inlet sump;
  - Progress construction of the inlet sump walls (to the underside of the upper waling beam) whilst continuing to backfill between the secant pile walls and the permanent walls of the inlet sump; and
  - Install the base of the storm tank.
- Phase 6:
  - Remove the upper waling support beam and cap off the inlet sump;
  - Cast the walls of the storm tank; and
  - Backfill between the storm tank wall and the sheet piles.
- Phase 7: Remove the temporary sheet pile walls.
- Phase 8:
  - Excavate approx. 2-2.5m below ground to remove made ground across the remainder of the building footprint;
  - Excavate further locally for those columns directly adjacent to the storm tank whose formation level will be at the base level of the storm tank; and
  - Excavate for the service tunnel between the Inlet Works Building and the process building; and
  - Dewater as required during excavation.
- Phase 9:
  - Construct the service corridor connecting the Inlet Works building to the process building, possibly from precast concrete culvert sections;
  - Cast concrete pad foundations and concrete columns; and
  - Backfill around the column locations and the service corridor;
- Phase 10: Construct the superstructure included the frame, slabs, shear walls and cores.

Process building

<u>Overview</u>

The Process building is located to the south-east of the WwTP site and will extend up to approximately14.5m above ground level and up to approximately 4.5m below ground level. A vent stack will also be incorporated and will extend 1m above the maximum height of the building (Refer to **Section 4.2 in Chapter 4** for further detail).

Excavation will be required in this portion of the site to accommodate the Process building (as described in detail in **Section 5.5.5.4**) and groundwater controls will be installed as detailed in the Outline CEMP (Refer to **Appendix 5.1**).

Construction process

Following the enabling works described in **Section 5.5.5**, construction of the process building will likely progress as per the following sequence of works:

- Phase 1:
  - Excavate the made ground over the footprint of the process building and continue to excavate if required until a suitable sub-formation level is met;
- Phase 2:
  - Complete the construction of the service corridor connecting the Inlet Works building to the process building; and
  - Backfill to ground level with engineered fill.
- Phase 3:
  - Construct the base slab of the process tanks (incorporating the footing of the steel frame); and
  - Construct the strip footings to support load bearing internal walls as required.
- Phase 4:
  - Construct the walls of the process tanks; and
  - Construct the frame of the superstructure enclosing the tanks.
- Phase 5:
  - Construct internal rooms and fit-out.

Sludge tank enclosure

Overview

The sludge tank enclosure is located to the east of the WwTP site and will extend up to approximately 8.5m above ground level. The sludge enclosure will comprise a fully open façade located around the tanks that will be contained therein (Refer to **Section 4.3 in Chapter 4** for further detail). Deep excavation will not be required in this portion of the site.

Construction process

Following the enabling works described in **Section 5.5.5**, construction of the sludge tank enclosure will likely progress as per the following sequence of works:

- Phase 1: Excavate the made ground over the footprint of the tank enclosure and continue to excavate if required until a suitable sub-formation level is met;
- Phase 2: Construct the concrete raft slab which supports the tanks and odour control unit;
- Phase 3: Install sludge tanks and odour control unit; and
- Phase 4: Install steel frame around the perimeter of the tanks.

Administration building

Overview

The Administration building is located to the south of the WwTP site and would extend to up to approximately 10.1m above ground level. Deep excavation would not be required in this portion of the site.

Construction process

Following the enabling works described in **Section 5.5.5**, construction of the Administration building is anticipated to employ a typical domestic scale method of construction. This will generally comprise:

- Phase 1: Excavation of made ground and construction of foundations;
- Phase 2: Construct walls and floors as the building progresses;
- Phase 3: Construct the roof;
- Phase 4: Installation of windows etc. to make the building weather tight; and
- Phase 5: Internal fit-out of the building.

5.6.4.3 Process, Mechanical and Electrical Installation

The process, mechanical and electrical equipment will be brought to site and installed upon completion of the construction of the buildings. It is likely that major installations such as the process equipment, the transformer and substation will be installed in the first instance followed by smaller equipment (such as the air handling unit [AHU] and odour control unit [OCU]) and then services in the buildings.

The contractor will be responsible for determining the specific methods and sequence of works for the process, mechanical and electrical installation in each of the buildings.

5.6.4.4 Landscaping and Site Infrastructure

It is anticipated that drainage, utilities and services infrastructure will be installed as required during the construction of the building structures on the WwTP site. Any ancillary civil infrastructure works will be completed once the structures have been constructed.

There is an area of public realm being provided by Irish Water to Wicklow County Council. This will be constructed using conventional methods.

The landscaping works associated with the WwTP site will be implemented upon completion of construction activities at this location. Hard landscaping will be installed between the buildings in the form of kerbs, roads and pathways with concrete and gravel finishes and appropriate marking and parking added. Soft landscaping in the form of the placing of soil, levelling and planting of vegetation will also be undertaken.

5.6.4.5 Testing and Commissioning

Upon completion of construction of the proposed development, a period of testing and commissioning will be undertaken. Testing and commissioning will comprise the following activities occurring in sequence:

- Level 1 testing - Pre-commissioning;
- Level 2 testing – Site acceptance tests; and
- Level 3 testing – Performance tests.

Level 1 Testing - Pre-commissioning

Level 1 testing will encompass all off line testing associated with pre-commissioning and start-up activities including the completion of all tests that can be conducted without the connection of any services (i.e. electrical power, chemicals, compressed air, fuel, or pressurisation), other than for the purpose of hydrostatic testing, any part of the equipment. Pre-commissioning will include commissioning checks including mechanical, electrical and instrumentation, control and automation elements as a minimum.

Level 2 Testing - Site Acceptance Tests

Level 2 testing will comprise any on line dry and wet functionality testing required following connection of services. Site acceptance testing will incorporate:

- Testing of each piece of plant and equipment individually;
- Testing of each system within the works both manually and automatically; and
- The interactions of the various systems and the setting to work of the plant as a whole.

Once each of the principal systems has been tested and accepted, the works will be process commissioned and optimised to achieve a status of process established. Site acceptance testing will include general testing (including domestic electrical installation, emergency lighting, fire and intruder alarms) in addition to functional testing of preliminary, secondary processes, sludge processes and associated pumping systems, generator changeover and a full (clean water) operational test of the WwTP.

Level 3 Testing - Performance Tests

Level 3 testing will comprise performance testing during which the contractor must ensure that the WwTP complies with the performance requirements as outlined in the tender documents. Performance tests will be undertaken following completion of the entire WwTP and will not accommodate testing of individual items or sections within the WwTP. Performance tests will include:

- Process commissioning including flow diversion and initial wastewater reception; and
- Final test on completion including continuous plant operation for a fixed period of time.

5.6.5 SWO and Long Sea Outfall

5.6.5.1 Long Sea Outfall

Overview

There are several methods by which the long sea outfall can be constructed and the contractor's methodology will ultimately depend on their available plant and equipment as well as their previous experience with laying marine outfalls. The contractor is responsible for determining which method is most appropriate.

The likely methods to construct the long sea outfall are presented in the following sections, based on current practice and site constraints/characteristics. These are:

- Horizontal directional drilling method;
- Flood and float method; and
- Bottom-pull method.

Construction of the outfall will include works from both the land and sea. It is expected that several vessels may be required during the construction of the outfall and that diving support is likely to be required at times.

Horizontal Directional Drilling method

Construction of the outfall using the horizontal directional drilling method would comprise three phases: pilot boring, pre-reaming and pipe positioning, each of which are described in the following sections and illustrated in Figure 5.11.

The following section assumes that the process would occur from a drilling rig located on the WwTP site (as this is the reasonable worst case for the purpose of the assessment).

It is noted that this method would not involve any change in the seabed geometry during construction or operation (as the pipeline would be tunnelled) and therefore there is no need to install scour protection along the route of the outfall.

It should be noted that the contractor may locate the rig on a suitable barge or jack-up platform (i.e. on the seaward end of the outfall). In this case, pilot boring would be undertaken from the seaward end of the outfall towards the landward end and thus geotechnical risks associated with exiting the seabed would be avoided. This would avoid loose sand material at the exit point and improve support to the hole at the seaward end of the outfall (as the hole can be supported with casing from the platform). The reaming and pull-back stages would be undertaken in a similar manner to that described below, from the landward side of the outfall.

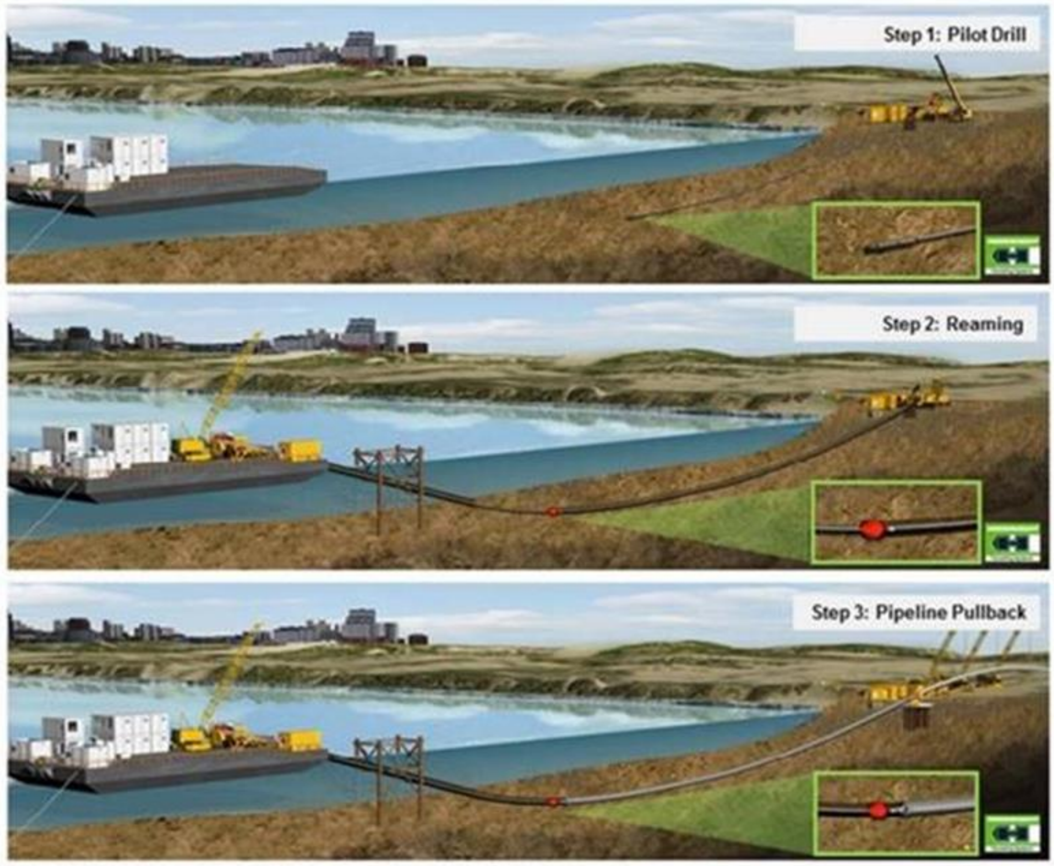

Figure 5.11: Typical HDD process for a sea outfall (Source: Stevens[8])

Pilot Boring

A drill rig would be positioned at a designated launch point (i.e. within the WwTP site), from which pilot boring would be carried out. The pilot boring would be undertaken to excavate along the alignment of the outfall.

Pilot boring would be carried out with a hollow bore pipe through the use of a mud-motor and a drill head. Boring fluid (generally a bentonite-water mixture) would be injected into the boring hole as excavation is occuring to transport the excavated soil and keep the borehole open. The boring pipe would be received on a barge or a jack-up platform located at the exit point (i.e. at the seaward end of the outfall).

Pre-reaming

Following the pilot boring, a reamer would be used to enlarge the hole in order to accommodate the outfall (i.e. the approximate 630mm diameter pipeline).

The drill head and steering tools would be removed as part of the pilot boring and the reamer would be installed from the barge or the jack-up platform (i.e. from the seaward end of the outfall).

[8] Stevens (2015) Trenchless solutions for sewer networks and sea outfalls. Available from: https://www.imesa.org.za/wp-content/uploads/2015/11/Paper-10-Trenchless-solutions-for-wewer-networks-and-sea-outfalls-Frank-Stevens.pdf [Accessed 11 June 2018]

Another hollow pipe would be connected behind the reamer to provide a connection between both sides of the drilling. The drill rig (located on the WwTP site) would then pull the reamer back into the hole and simultaneously rotate the pipe (that is undertaking the drilling) at the front.

The excavated soil would be transported through the reamed borehole with a return current of the drilling fluid with soil. The required number of reaming phases to achieve the final hole diameter would depend on the contractor's equipment.

It should be noted that the presence of sand/gravel materials at the site will require the contractor to consider and select the depth of cover, drill length, and specific methodology accordingly. It should be noted that loose sand materials at the exit point (i.e. on the WwTP site) may also lead to difficulties in keeping the hole open, although this can be mitigated through ground treatment, such as grouting, if necessary.

<u>Pipe positioning</u>

During this phase, the outfall pipeline would be laid out at the exit point and connected to the previous hollow pipe. A reamer would be placed between the pipes to ensure that the diameter of the hole is large enough to accommodate the approximately 630mm diameter pipeline. The rig would pull the pipes through the hole to the entry point, allowing the final pipe to be placed into the final position.

Following completion of the laying the oufall, the diffuser would be installed at the seaward end of the outfall pipe from barges or jack-up platforms and connected to the outfall pipe thereafter.

Flood and Float method

The use of the float and flood method would require the formation of trenches and the placement of suitable material to support and protect the long sea outfall once it is in position. The trench is described in **Section 4.2.5 of Chapter 4** and illustrated therein.

<u>Constructing the Culvert</u>

A temporary sheet pile cofferdam would likely be required to facilitate the installation of the outfall at the location of the revetment (similar to what is proposed for the SWO as described in detail in **Section 5.6.5.2**). This section of the long sea outfall would be routed underneath the upgraded revetment and would consist of a HDPE pipeline encased in a culvert. The installation of the outfall would take place prior to the revetment upgrade and dewatering would be undertaken as described in **Section 5.5.5.4**.

A precast concrete culvert would be constructed over the trenched outfall through the revetment to protect the outfall in this location. The culvert would be constructed using conventional methods.

The culvert would accommodate the outfall and thus facilitate the discharge of effluent under the revetment into the Irish Sea.

Trenching

Prior to the pipeline installation, the trench (in which the outfall is to be laid) would be excavated along the route of the long sea outfall. The seabed material (currently estimated to be up to 18,000m^3) would be removed to achieve the required depth and slope of the trench (which would be set out as part of the detailed design).

This trenching would be carried out through the use of barges that would be either anchored to the sea bed or jacked up using steel piles. The dredging equipment that will be used will depend on the contractor, but it is envisaged that either backhoe dredgers or grab dredgers will be used. It is anticipated that the excavated material would be left to the side of the trench, with some material being re-used as filter material in the trench, when the pipe has been laid and the rest naturally dispersing locally within the water column.

The Bedding Layer

Once the seabed material has been removed and the trench has been formed, the bedding stone would be placed along the bottom of the trench to form the bedding layer.

At this stage, it is anticipated that the bedding layer would be imported material brought to the site from local quarries on trucks or by sea. The laying of the bedding layer along the bottom of the trench is likely to be carried out through the use of barges, however the exact procedure would be confirmed by the contractor.

Laying the oufall pipeline

The float and flood method, also known to as the ‘S-Bend method’ would involve floating and towing the entire outfall pipeline into position on the surface of the sea and the subsequent lowering down of the pipe into the trench as illustrated in Figure 5.12.

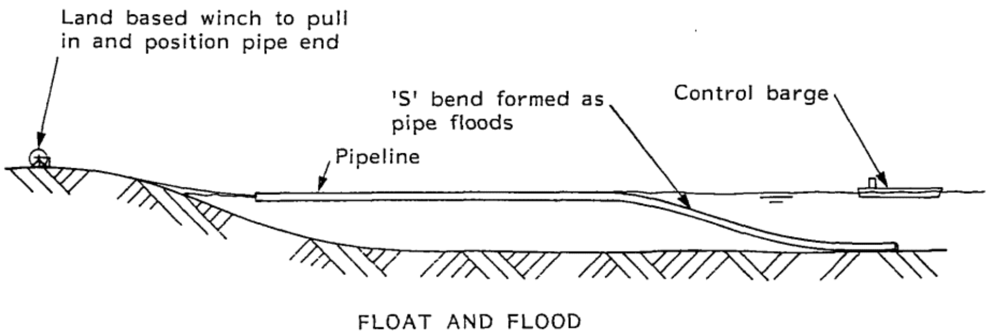

Figure 5.12: Flood and float method of installing the outfalls (Source: WRC[9])

Sections of the outfall pipe would be assembled on land (within the WwTP site) and readied for moving to the water. The pipe and diffuser would be sealed temporarily while full of air, which provides the buoyancy necessary to float.

[9] WRC (1990) Design guide for marine treatment schemes: Volumes I - IV

The pipeline would then be floated into the water using barges, which would tow and manoeuvre the outfall into position. The lowering operation would be achieved by replacing the air with water, which causes the outfall to sink into position. The rate of submergence would be controlled by the rate of air release.

Additional weight would be added where required (e.g. by using concrete ballast collars) in order to provide the negative buoyancy needed to sink the pipeline and place it in the bottom of the trench.

Backfilling the Trench

Once the outfall is laid in place, backfill material would be placed in the trench to protect and stabilise the outfall pipelines. First, a filter layer would be installed to surround the outfall pipe, followed by a rock armour layer to provide protection on the sea bed.

The exact procedure and depths of these backfill layers would depend on the equipment available from the contractor along with programme and cost considerations, however it is anticipated that this would be undertaken from the barges.

Diffuser assembly

Once the long sea outfall has been laid, the diffuser would be assembled at the seaward end of the outfall. The diffuser arrangement would include up to 6 diffusers of approximately 0.16m diameter at an approximate spacing of 10m intervals.

The diffuser would be prefabricated on land and placed on the seabed by barge as one complete unit. The exact procedure and depths of backfill required would depend on the equipment available from the contractor along with programme and cost considerations, however it is anticipated that this would be undertaken from the barges.

Scour Protection

To ensure against potential long term effect from scour on the seabed, suitable protection of the pipeline is required. A concrete mattress layer up to approximately 300mm thickness is proposed and would be finished at existing bed level so as to avoid any scour problems once operational.

Bottom Pull method

Overview

The use of the bottom-pull method would, in a similar manner to the flood and float method, require the formation of trenches and the placement of suitable bedding material to support and protect the positioned pipeline as described for the flood and float method above. The trenching, placement of the bedding layer, construction of the culvert, backfilling of the trench, the diffuser assembly and scour protection procedures would also be as described for the flood and float method above. Laying of the oufall would be undertaken as described below.

Laying the outfall pipeline

The bottom-pull method would involve joining and pulling sections of the outfall pipeline towards the sea by using a barge. The pipes would be pulled into place by the barge as illustrated in Figure 5.13.

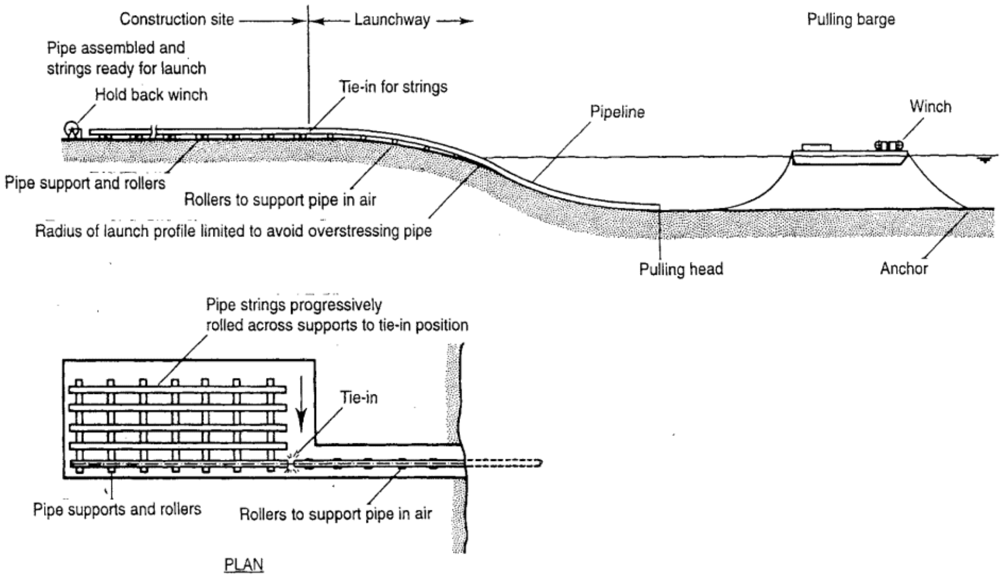

Figure 5.13: Bottom pull method of installing the outfalls (Source: CIRIA[10]

Sections of the outfall pipe would be arranged on land (within the WwTP site) and readied for placing on rollers. The rollers would be aligned with the route of the outfall and the location of the revetment crossing/culvert to ensure that the correct pipe alignment is achieved. Sections of the pipe would be joined in sequence to make pipe strings that could be placed onto the rollers.

The number and length of the pipe strings would be determined by the contractor based on the space that is made available within the WwTP site.

The pipe strings would be pulled by winches mounted on a barge anchored offshore in a stepped process. The first pipe string would be pulled towards the sea then the next string would be moved across the rollers and joined to the first string at the tie-in position. This procedure would be repeated until all the strings have been joined and the outfall pipe has been laid in position. Following the completion of pulling, the culvert (i.e. the interface between the outfall and the revetment) would be installed. The culvert would be installed thereafter in a similar to manner to the method proposed for the flood and float option.

[10] CIRIA (1996) Sea outfalls - construction, inspection and repair: Report 159.

5.6.5.2 SWO

Installation of cofferdam

A temporary sheetpile cofferdam will be constructed within the area of the existing revetment to facilitate the excavation and construction of the SWO that will discharge at the crest of the toe of the revetment.

A cofferdam will be required to facilitate excavation and dewatering will occur therein to provide a dry environment in a similar manner as described in **Section 5.5.5.4**. Following this, excavation will occur within the cofferdam.

Laying the outfall

Trenching will occur along the length of the SWO to the required depths, followed by the placement of the bedding layer, laying the pipeline and backfill of the trench as described in detail in **Section 5.6.5.1**.

It is anticipated that the construction of the SWO will be undertaken from within the WwTP site with the exception of the works in the revetment as described above.

Constructing the Outlet

As with the long sea outfall, an outlet structure will be required to be constructed over the SWO (i.e. at the crest of the toe of the revetment) to protect the pipeline in this location. The outlet structure will comprise a precast base slab, a headwall and wingwalls installed at the crest of the toe of the revetment that will be constructed upon removal of the existing rock armour, but prior to the replacement of the rock armour in this area using conventional methods. The outlet structure will accommodate the SWO and thus facilitate the discharge of excess stormwater under the revetment into the Irish Sea at Mean Low Water Springs level.

Non-return valves and Scour Protection

Appropriate non-return valves (flap valves or duckbill vales) will be fitted to the SWO in chambers within the WwTP site, to protect against sea ingress. A concrete apron will also be placed around the SWO discharge point at the toe of the revetment to protect against scour.

5.6.6 Revetment

5.6.6.1 Overview

Upgrading the revetment will require the removal of the existing rock revetment, its subsequent realignment and replacement of the rock armour as described in **Sections 5.6.6.2 - 5.6.6.4**. This will be carried out in a staged process along the revetment in sections of approximately 15 to 25m. It should be noted that no works will be undertaken within 10m of the GE cable which extends across the revetment.

By using this method, the section under construction can be quickly protected during storm events and thus flood risk for the WwTP site will be minimised during the revetment upgrade.

Construction of the revetment will be land-based, however diving works may be required e.g. to monitor the construction process.

5.6.6.2 Removing the Existing Revetment

Upon completion of the removal of any asbestos containing material in the revetment (as described in **Section 5.5.5.2**), the existing rock armour will be removed from crest to toe using excavators. Upon removal, the rock armour will be temporarily stored in a designated place within the site where it will be classified and sorted into suitable material for reuse and material to be transported offsite. Any material unsuitable for reuse would be removed from the site by trucks and transported to an appropriately licensed facility in respect of which a waste permit or a waste licence is granted for disposal.

The actual thickness and extent of the existing rock revetment is not known as there are no surveys available in this regard. Thus, it is not possible at this stage to determine the amount of rock armour that will need to be removed. Some of the rock armour material, if suitable, may be crushed on site (using a mobile crusher) and used as appropriate.

5.6.6.3 Importing Materials

It is envisaged that fill and rock armour material will be required to upgrade the revetment (Refer to **Section 5.8.5** and **Chapter 16** for further detail) and to form a temporary platform along the alignment of the existing revetment. This platform will enable the excavator to reach the toe of the revetment when the existing revetment has been removed.

At this stage, it is anticipated that the additional material required to be imported to construct the revetment will be transported to the site by road from a local quarry using trucks. This material, which will have been assessed and selected by the contractor for its compatibility in the existing marine environment at Arklow, will be brought to the site as close as possible to the construction stage, however storage will be made available on site if required.

5.6.6.4 Constructing the Upgraded Revetment

Construction of the upgraded revetment will be carried out from toe to crest by using suitable excavators located on the WwTP site. A schematic summary of the construction of the revetment is provided in Figure 5.14.

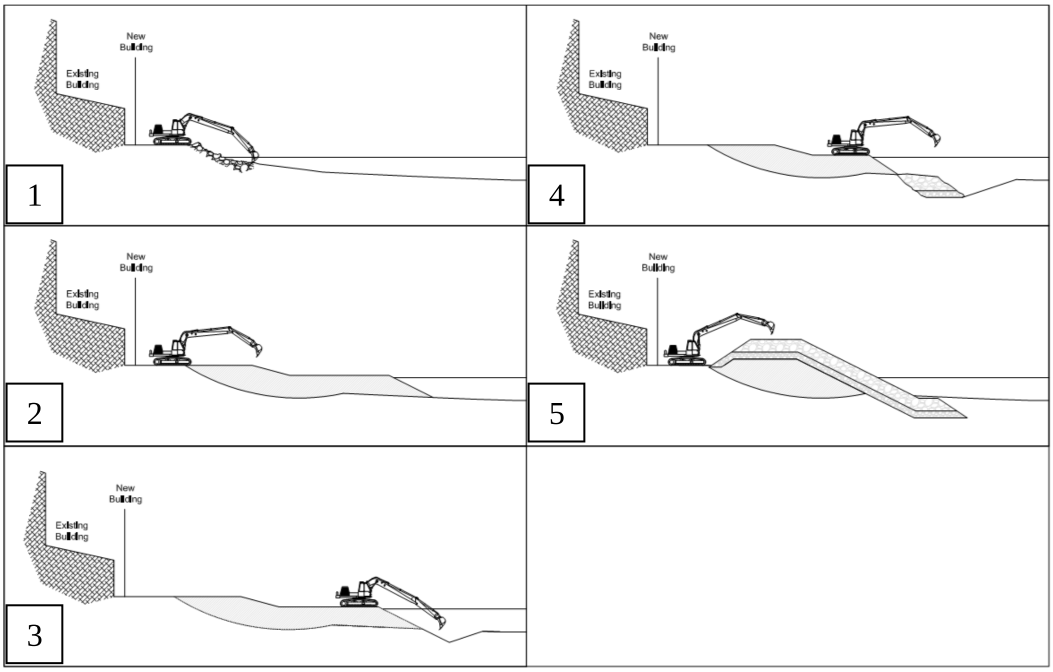

Figure 5.14: Envisaged procedure for the removal and subsequent replacement of the rock revetment

Fill material will be placed to form the foundation and new slope profile of the revetment. Once the foundation and slope profile has been formed, the geotextile layers will be spread along the slope and both layers of the rock armour will be laid on top of this. The armour layers and underlayer will be approximately 2.9m and 1.3m respectively and the toe of the revetment be buried underneath the level of the existing beach.

5.7 Traffic Management

5.7.1 Overview

A detailed construction traffic management plan will be prepared by the contractor in advance of any works taking place on site and submitted to Wicklow County Council for approval. This plan is required to control the impact of construction traffic on the local transport network and ensure compliance with the relevant measures outlined in this EIAR.

It should be noted that some strategic direction has been provided and high level agreements around traffic flows and diversions have been made with Wicklow County Council. The agreements have shaped the formation of the construction methodology and resulted in the proposed arragements outlined to support construction of the proposed development.

5.7.2 Construction Traffic

During the peak construction period, it is anticipated that up to 934 additional passenger car units per day may be generated during the peak construction period (Refer to **Chapter 7** for further information). Traffic flows and scheduling will be appropriately planned to ensure construction traffic flows in Arklow town are managed efficiently and effectively in accordance with the relevant legislative requirements.

Further detail on the assumptions made and a desciption of how the construction traffic has been quantified is provided in **Section 7.5 of Chapter 7**.

5.7.3 Site Access and Haulage

5.7.3.1 Overview

Dedicated construction access points will be required at each of the working areas as described in detail in **Sections 5.7.3.2 - 5.7.3.4**.

All site access routes will be connected to the existing local road network. Where an access point does not exist (e.g. traffic diversions via Seaview Avenue onto Bridgewater Northern Access Road), the footpath will be locally lowered as required to create the site entrance. Minor road works may also occur such as removal of existing kerbs, paving and a small amount of excavation prior to replacement of paving and realigned kerbs.

The contractor will be required to establish a temporary 6m wide trafficable paved area linking Seaview Avenue and Bridgewater Northern Road and in Working Area N14. This area will be reinstated to its pre-construction condition on completion of the works.

5.7.3.2 River Walk

Construction access and haulage routes will predominantly use the existing road network with some temporary site-specific diversions (Refer to **Chapter 7** for further detail on the existing road network). Temporary access roads will be required in some areas to navigate around construction activities (Refer to **Drawing No.'s 247825-00-C-IS-900 to 247825-00-C-IS-933 in Volume 3** for further detail).

The riverfront pathway to the west of River Walk (Chateaudune Promenade), will be closed for the full duration of the construction works in this area. The pedestrian walkway from Vale Road to Chateaudune Promenade will remain open to the public with a left turn only (i.e. pedestrians could travel westwards along the path).

Construction traffic will access this section of the site via River Lane (West), around Arklow town carpark onto Chateaudune Promenade and the exit will be via River Lane (East).

Construction and public access to River Walk will be via Condren's Lane Upper and exit will be via River Lane (East).

This section of River Walk (between Condren's Lane Upper and River Lane East) will become a one-way anticlockwise route of 5m width (including provision for pedestrian access). Construction activities in the working areas at the eastern end of River Walk are required to be complete and reopened before work in the western end of River Walk can commence.

To the west of River Walk, temporary works will be required to maintain access routes. Temporary structures will be provided along the northern and southern sections of the (eastern) River Walk carriageway and construction works will be centralised. Two-way traffic will be maintained. There are two areas in this portion of the site requiring night time works (short durations), therefore traffic will be be managed locally by the contractor.

Access to all residential and commercial properties will be provided for the full duration of the works, albeit through the one-way systems outlined above. At any given time a maximum of approximately 27 public parking spaces on River Walk will not be available for the duration of works in this area, however alternative public parking is available at the Arklow Town Council public car park located on River Lane East, a distance of approximately 200m away.

5.7.3.3 South Quay

Construction access and haulage routes will predominantly use the existing road network with some temporary site-specific diversions (Refer to **Chapter 7** for further detail on the existing road network). Temporary access roads would be required in some areas to navigate around construction activities.

During construction, construction traffic and public access to South Quay will remain from South Green or Harbour Road via Lower Main Street. However, the section between Doyle's Lane and Fogarty's Terrace will be one-way, in a westward direction. The current car park space opposite No.1 South Quay will also be unavailable throughout the duration of construction.

Construction on South Quay between South Green Junction to Harbour Road Junction will be ongoing for approximately 12 months. During construction works, there will be minor amendments to the current flow of traffic.

There are four tunnel shafts located in three discrete working areas (S13, S16 and S18) along this section. The contractor will only be permitted to occupy two of these working areas at any one time. Further, working area S13 (at TSS1) and working area S18 (at TSS2A and TSS3) cannot be occupied concurrently. This section of South Quay will not be a through road and will be made available to local residents only. A temporary surfaced access will be provided around TSS2 and to provide a driveway into the adjoining properties. All traffic to and from the Arklow Harbour willl use Harbour Road and turn right at the Harbour Road - South Quay junction to access the dock area.

5.7.3.4 North Quay

Similarly on North Quay, construction access and haulage routes will predominantly use the existing road network with some diversions to the current flow of traffic to facilitate construction activities. Activities at each of the working areas will progress on a sequential basis as described in detail in **Section 5.3.2**.

Access to all properties and business premises will be provided for the full duration of the works, however North Quay will not be a through road for a duration of approximately one year in total. Access to Mill Road will be maintained throughout.

Work between the roundabout to the north of Arklow Bridge and the Aldi junction will be carried out in two phases, the main works (i.e. construction of TSN1 and TSN2 and interconnecting pipeline that would take approximately 6 months) and minor works (i.e. construction of MHN2A, MHN3 & MHN4 that would take approximately 2 months).

For the main works listed above, a road closure will be required at TSN2, therefore construction and public access will be via Mill Road. For the minor works listed above, further road closures will be required (at MHN3 and MHN4) and diversions will be temporarily put in place around North Quay from the roundabout. These diversions will see vehicles use Seaview Avenue to access the Bridgewater Shopping Centre and North Quay. The contractor will be required to install a trafficable paved surface between Seaview Avenue and Mill Road adjacent to the running track (i.e. at Working Area N14).

Activities to the east of the Aldi junction and west of Marina Village (to support the construction of TSN3 and pipeline to TSN2) will take approximately six months. A road closure will be required and a diversion will be in place that willprovide construction and public access (to either side of two working areas) via Mill Road. Access to the Rowing Club and Arklow Shipping Limited will be provided through the Marina Village.

Two phases of activities to the east of Marina Village (to support the construction of TSN4 and pipeline to TSN3 and subsequent construction of TSN5 and pipeline to TSN4 and TSN7) will take approximately six months each. A road closure will be required and a diversion will be in place to provide construction and public access (to either side of the working areas) via Mill Road. Temporary access to local traffic accessing the Block 7 Apartments and Arklow Marina Village will be provided via Mill Road. Temporary access around TSN7 will also be provided.

Activities on Mill Road (to support the construction of TSN8) will require the provision of a temporary haul road. This haul road will allow vehicles to navigate around the working area and thus maintain traffic flows on Mill Road.

5.7.3.5 WwTP Site

Construction access and haulage routes will predominantly use the existing road network. It is anticipated that vehicles would access the site from Mill Road via those routes described above as access would be maintained to Mill Road throughout the construction period.

5.8 Site Management

5.8.1 Employment

Construction of the proposed development will generate employment opportunities as there will be a range of personnel employed directly to support the construction activites. As outlined in Table 5.1, it is anticipated that there will be up to approximately 150 construction employees on site during the peak construction period.

Table 5.1: Indicative construction employment associated with the proposed development

	Estimated Construction Employees															
	Year 1				Year 2				Year 3				Year 4			
Task	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Project Management Team/ HSQE / Employer's Reps	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	
Sewer Network (including Alps)																
Arklow Bridge Site Investigation Works Year 1			6													
Arklow Bridge Upgrade Works Year 2							8									
North of River				6	6	18	15	11							6	
South of River							16	27	12		10	15	15	15	6	
Total Staff on Sewer Network	*0*	*0*	*6*	*6*	*6*	*18*	*39*	*38*	*12*	*0*	*10*	*15*	*15*	*15*	*12*	*0*
Wastewater Treatment Plant																
Stripout & Demolition		30	40	30												
Short Sea Outfall Cofferdam & Pipeline Construction					20	20	15	10								
Revetment Upgrade					10	10	10	10								
Long Sea Outfall (Cofferdam worst case scenario)							10	10								
Treatment Plant Deep Excavation					40	40	20									
Treatment Plant Below Ground Construction						30	30	20								
Treatment Plant Above Ground Construction						20	30	60	60	50						
Treatment Plant External Finishes, Hardstands, Lighting & Landscaping										40	30					
Mechanical Fitout									5	5	10	20	20			
Electrical Fitout											5	15	15			
Commissioning													17	14	14	
Total Staff on Treatment Plant Site		*30*	*40*	*30*	*70*	*120*	*115*	*110*	*65*	*95*	*45*	*35*	*52*	*14*	*14*	
Total Staff on both Sites & Management Teams	**15**	**45**	**61**	**51**	**91**	**153**	**169**	**163**	**92**	**110**	**70**	**65**	**82**	**44**	**41**	**0**

Potential Shift Work (shaded cells)

5.8.2 Hours of Working

The timing of construction activities, core working hours and the rate of progress of construction works are a balance between efficiency of construction and minimising nuisance and significant effects.

The core construction working hours for the proposed development will be:

- 7am – 7pm: Monday to Friday;
- 8am – 2pm: Saturday; and
- Tunnelling works will occur 24 hours a day, 7 days a week as required.

These working hours correspond to the current construction programme, sequencing and durations as described in **Section 5.3**.

Underground activities serviced from the launch and reception tunnel shafts (i.e. construction of the tunnelled portion of the interceptor sewer) will occur 24-hours a day, 7-days a week. This will be undertaken in accordance with the permissible noise levels as described in detail in Chapter 10 (where 'daytime' noise limits are implemented during 7am to 7pm whilst lower permissible noise levels are stipulated outside of these hours).

All rock breaking/fracturing activities will be undertaken during daytime hours. The removal of waste material off site by road and regular deliveries to site will be generally confined to daytime hours but outside of peak traffic hours (i.e. 10am to 4pm).

It may be necessary in exceptional circumstances to undertake certain activities outside of the construction core working hours. Any construction outside of the construction core working hours will need to be agreed in advance with Wicklow County Council and scheduling of such works will have regard to nearby sensitive receptors.

5.8.3 Hoarding

A site boundary in the form of hoarding or fencing will be established around each of the working areas before any significant construction activity commences. The hoarding/fencing would be up to approximately 2.4m high to provide a secure boundary to what can be a dangerous environment for those that have not received the proper training and are unfamiliar with construction operations.

Site hoarding also performs an important function in relation to minimising nuisance and effects including:

- Noise emissions (by providing a buffer);
- Visual impact (by screening the working areas, plant and equipment); and
- Dust minimisation (by providing a buffer).

The erection of hoarding will be of a similar nature to what is carried out on most construction sites. Mounting posts will be erected by using a mini-digger and the posts would be set in concrete.

The size and nature of the posts and hoarding will depend on the requirements for any acoustic mitigation as well as preferences that the contractor may have. Where practicable, hoarding and fencing will be retained, re-configured and re-used between working areas as the construction activities progress.

5.8.4 Services and Site Lighting

Site services will be installed in parallel with the rearrangement and diversion of existing utilities, where relevant. The site will be powered by mains supplies or diesel generators where an electrical supply is not available.

Site lighting will typically be provided by tower mounted 1000W metal halide floodlights at each tunnel shaft. The floodlights will be cowled and angled downwards to minimise spillage to surrounding properties.

5.8.5 Materials

Construction of the proposed development will require the import of materials to site for construction activities as well as the export of materials generated and suplus to requirements. Where practicable, efforts will be made to manage materials in accordance with the waste hierarchy and promote the reuse and recycling of materials on site.

A summary of the estimated material types and indicative quantities of each type of material to be managed is provided in Table 5.2 and further detail on the indicative quantities and associated construction traffic to move these materials is available in **Chapters 7 and 16** respectively.

Temporary compounds have been provided within the site boundary for the storage of materials, with storage envisaged at the WwTP site, Working Area S19 and Working Area S1. The main construction compound located at the WwTP site will be used as the primary location for material storage. Stockpiling of materials outside of these working areas will not be permitted and management measures (as described in detail in the Outline CEMP in **Appendix 5.1**) will be implemented to ensure effective containment and handling of all materials during construction.

Table 5.2: Estimated Bulk Materials Quantities and Management during Construction

Nature	Aspect of the proposed development	Nature/ Source of Materials	Quantity and units of measurement
Import	Alps SWO and Stormwater Storage Tank	Topsoil	$120m^3$
		Site Grading/ Tank Perimeter Fill	$1000m^3$
		Concrete - Structures	$450m^3$
	Interceptor Sewers	Topsoil	$450m^3$
		Bitmac/Asphalt	$165m^3$

Nature	Aspect of the proposed development	Nature/ Source of Materials	Quantity and units of measurement
		As Dug material-under footpaths/grassed areas	385m^3
		Backfill under roads	865m^3
		Pea gravel bed & surround	575m^3
		Backfill	3755m^3
		B&S	2015m^3
		Haul Road Construction Material	8400m^3
		Concrete	9000t
		Concrete Pipes and Manhole Rings	4500t
		Stone Material	22000t
	Tunnel Shafts	Topsoil	745m^3
		Bitmac/Asphalt	1060m^3
		Concrete Base Plug	3075m^3
	WwTP	Granular Fill	9325m^3
	Revetment	Rock armour 6-10 tonne	51000m^3
		Underlayer Rock 0.3-1 tonne	27000m^3
		Granular Fill	25000m^3
	Outfall	Bedding layer	700m^3
		Filter layer	3700m^3
		Rock armour 60-300kg	6800m^3
Export	Alps SWO and Stormwater Storage Tank	Soil and rock	4,000t
	Interceptor Sewers	Open Cut Construction	9,700t
		tunnel shaft construction	23,600t
		river arch underpinning	1,400t
		tunnelling	6,110t
		service diversions	4,000t

Nature	Aspect of the proposed development	Nature/ Source of Materials	Quantity and units of measurement
		engineered fill from removal of the temporary haul road	17,000t
	WwTP	Inert Excavation Material	26,250t
		Non-hazardous Excavation Material	9,400t
		Hazardous Excavation Material	25,200t
	Revetment	Existing rock armour to be removed from site	42,000t
		Excavated seabed material for removal from site	50,000t
		Excavated material reused at revetment	32,000t

5.9 Environmental Management

An outline Construction Environmental Management Plan (CEMP) and schedule of mitigation measures has been prepared (Refer to Chapter 20). These documents define the minimum standards required of the contractor as they affect the environment, amenity and safety of local residents, businesses, the general public and the surroundings in the vicinity of the proposed development.

The contractor is required to integrate these measures into a detailed CEMP following appointment (prior to the commencement of any construction activities). Effective implementation of the CEMP will ensure that disruption and nuisance are kept to a minimum throughout the construction of the proposed development. The detailed CEMP will be required to have regard to the guidance[11] and industry best practice. The CEMP will be implemented throughout construction and the contractor will be required to review and update the CEMP as construction progresses.

In addition to the CEMP, it is anticipated that the contractor will prepare a Construction Management Plan and relevant Works Method Statements in advance of any works commencing on site. Every effort will be made to ensure that any significant environmental effects as described in this EIAR will be avoided, prevented or reduced by adopting the mitigation measures outlined in this EIAR.

[11] CIRIA (2015) Environmental Good Practice on Site Guide, 4th Edition

5.10 References

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