South Bank Arterial Drainage Network: Asset Maintenance Plan

Version 1

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This report describes work commissioned by Teesworks, by an email dated 4th August 2021. Steven Thomson of JBA Consulting carried out this work.

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Purpose

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1 Introduction

This document details the maintenance and management requirements for each of the proposed drainage features in the South Bank area. The type and location of each drainage feature is shown in Figure 1.

2 Site Description

The South Bank is the western most point of Teesworks. sitting on the banks of the River Tees, and is zoned for manufacturing, logistics and distribution.

The South Bank area sits within the borough of Redcar and Cleveland and is situated at the mouth of the River Tees. The site is formed on land reclaimed from the estuary in the early 20th century and previously featured extensive large scale steel works and associated industries. The site is bound to the north by the tidal River Tees, east and west by Teesport industrial developments and the southern boundary by High Tip (hazardous landfill site) and Network Rail's Tees Valley Line.

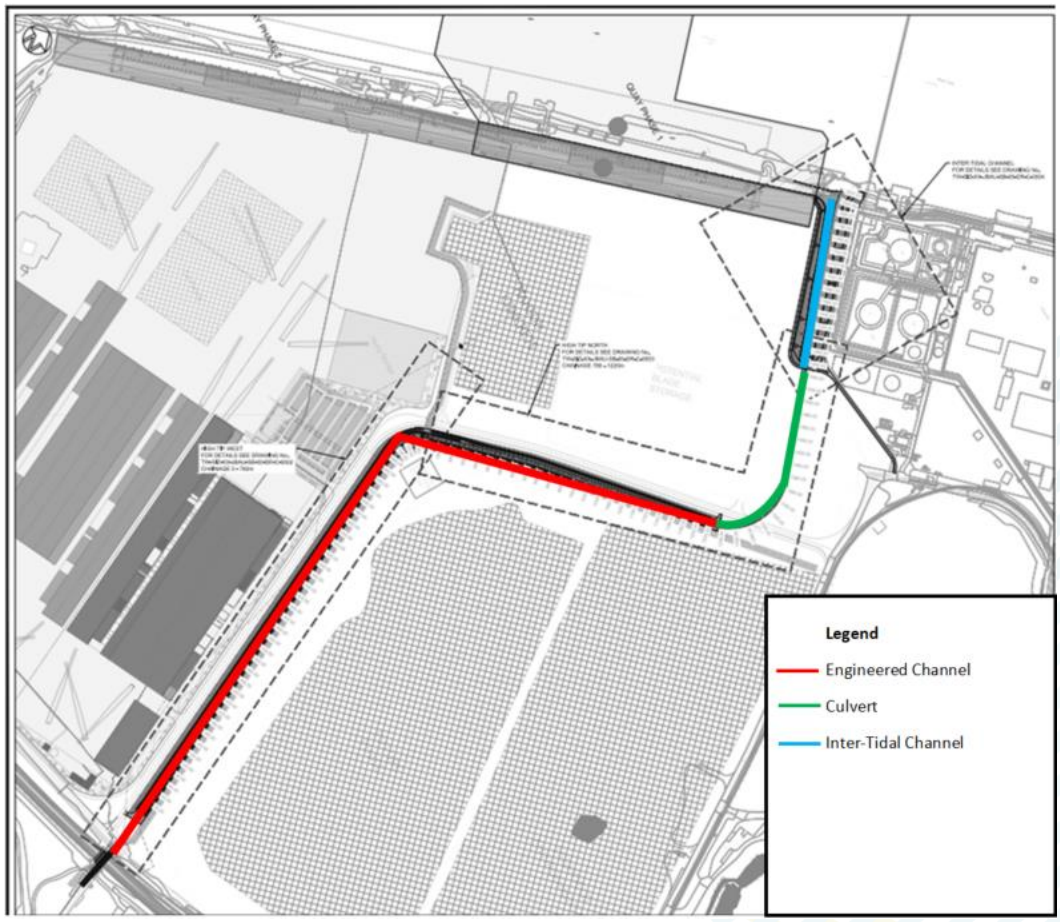

Figure 2-1 - Drainage component location

Figure 1 above shows the proposed arterial drainage network which involves reaches of large engineered open channel, large box culverts and an inter-tidal open channel.

3 Details of the Surface Water Drainage Strategy

The following drainage features are proposed in order to effectively manage surface water runoff from the South Bank and Dorman Point sites as well as the fluvial flows from the diverted Knitting Wife Beck and Holme Beck. Initially the South Bank drainage channel will receive only pluvial flows from the South Bank development area. Upstream works to facilitate the diversion of the currently culvert watercourses will take time to implement (2-3years).

The proposed drainage strategy is shown in Figure 1.

- **Engineered Open Channel –** the engineered open channel sits approximately 4-6m below the development level and is formed of 2 distinct parts.

  The lower channel is formed of a precast concrete U-shaped channel measuring 5.4m wide and 2m high. This contains a single layer of erosion resistant well rounded substrate placed at the bottom of the channel as well as a number of boulders placed at random intervals on alternating sides in order to promote sidebar formations and vegetation establishment. This channel shall contain all flows up to the 1:100year flood event.

  The upper channel consists of a 3.5m wide vehicular access track and gabion basket retaining wall. This also functions as a second stage 'exceedance' channel and has significant capacity for both current day extreme flood flows as well as climate change events.

  On the approach to culverted sections the access track ramps up to the development level at a 1:12 gradient.

- **Culverts –** there are culverted sections within the South Bank Channel.

  Shortly after the channel bends to the east there is a 15m long 5.4m wide 3.6m high concrete box culvert. This is to facilitate services crossings. This culvert also features a 1.2m wide pedestrian footpath along the left bank. with an adjacent footpath with the total structure size 7m wide x 4.6m high.

  The second culvert conveys flows from the engineered open channel to the intertidal channel. This section is approximately 320m long, 5.4m wide and 2.6m in height. There is no dry access to this culvert.

- **Culvert outfall and inter-tidal channel –** The culvert outfall structure features a reinforced concrete apron, low flow channel to facilitate eel passage and high flows spillway followed by a stilling basin. The outfall structure and inter-tidal channel have been designed to reduce flow velocities substantially prior to reaching the confluence with the Tees estuary, particularly during flood events.

  The inter-tidal channel is approximately 300m in length, 20m wide with banks at a 1:3 slope. The entire channel will be inundated during high tide. The channel invert is formed of a coarse aggregate substrate designed to accrete tidal sediment and promote the establishment of salt marsh habitat. The channel slopes consist of 150mm thick low nutrient topsoil seeded with a low maintenance wildflower meadow grass mix.

4 Management and maintenance general requirements

Maintenance activities can be broadly categorised into:

- **Regular maintenance:** Basic tasks carried out on a frequent, predictable schedule (e.g. Inspections, silt removal, vegetation management, surface sweeping and debris removal).
- **Occasional maintenance:** Required regularly, but on a much less frequent and predictable basis.
- **Remedial maintenance:** Intermittent tasks, usually to rectify faults associated with the drainage components. This can be minimised by good design, construction and regular maintenance activities. (e.g. repairs, erosion remediation, realignment, infiltration surface rehabilitation).

5 Responsibility for maintenance

The responsibility of ensuring the proper maintenance of the South Bank Arterial Drainage Network falls to Teesworks. The drainage network has been designed to be robust, resilient, easy to access, inspect and maintain. As such the maintenance requirements are minimal.

6 Drainage management strategy

This section contains specific details on the maintenance requirements for Teeswork, for each of the drainage assets they will maintain across the development site. It is important to note that the site is a Freeport. As such it is not open to the public and has stringent security requirements.

6.1 Engineered channel

Description of drainage feature: The engineered channel consists of a precast concrete channel with a naturalised invert. The substrate has been designed to be erosion resistant given the predicted flows. The grading of the substrate and use of sporadic boulders placement shall enable the channel to form its own sinuous path and accrete sediment which over time will form sidebars and vegetate. This will promote sediment transport and reduce the requirement for periodic sediment removal.

There is a 3.5m wide vehicular access track adjacent to the channel which is large enough to hold medium sized plant facilitating easy access for maintenance and inspection. An excavator on the access track can reach the full width of the channel invert if required.

Edge protection is formed of a 0.2m concrete upstand to help retain vehicle/plant and pedestrian handrail for safety. There are also gated access points to the channel invert at 200m intervals via fixed ladders. Life rings are placed at all access points. Careful placement of boulders upstream of the ladders will promote sidebars to form over time meaning that during low flows the ladders would descend to dry ground. The access ladders are primarily for emergency egress from the channel. The channel has been designed so that there is no need for maintenance staff to enter the channel during routine operation and maintenance.

There is a 1m wide ledge at the toe of the gabions. This is formed of concrete which prevents scour of the gabion foundation and prevents vegetation growth.

There is also a 1m offset between the rear of the gabion wall and the post and wire fence. This features a thin layer of concrete on the surface to prevent vegetation growth and remove the need for maintenance staff crossing the fence line. On development side of the fence the ground cover consists of 150mm thick low nutrient topsoil seeded with a low maintenance wildflower meadow grass mix.

The debris load is likely to be minimal due to constraints in the upstream catchment. As previously discussed, the site is a Freeport which has restricted access hence the fly tipping risk is also minimal. Any debris (wooded or urban) that made it into the channel could be flushed down to the inter-tidal channel where it could be safely recovered.

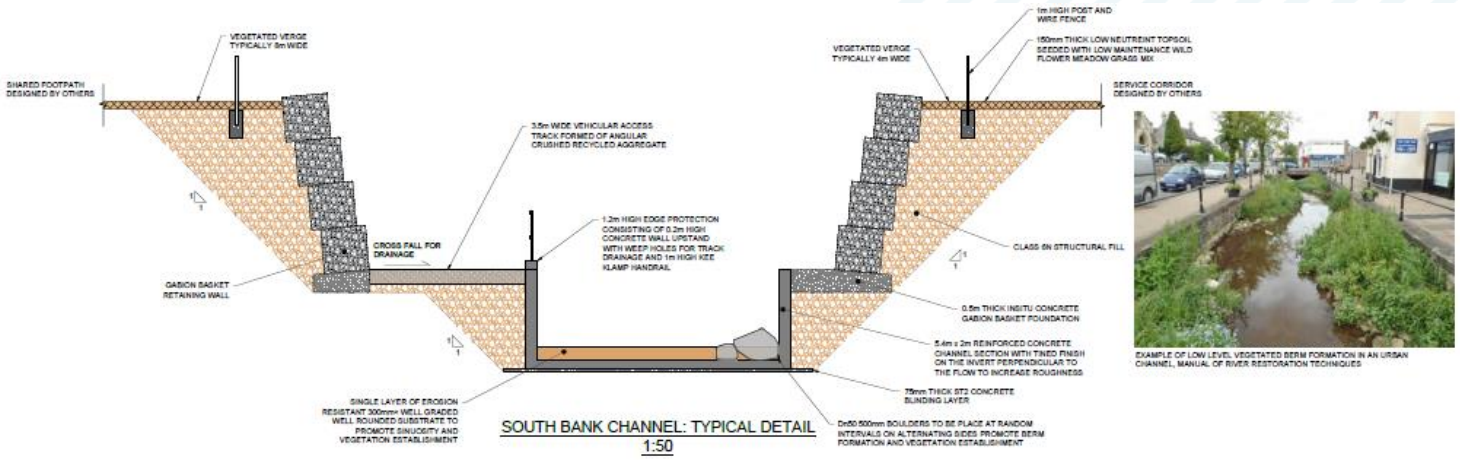

Figure 6-1: Typical channel detail (extract from drawing TW-SIZ-XX-JBAU-SB-00-DR-C-0304-S3-P01-South_Bank_Details_Sheet_4_of_4)

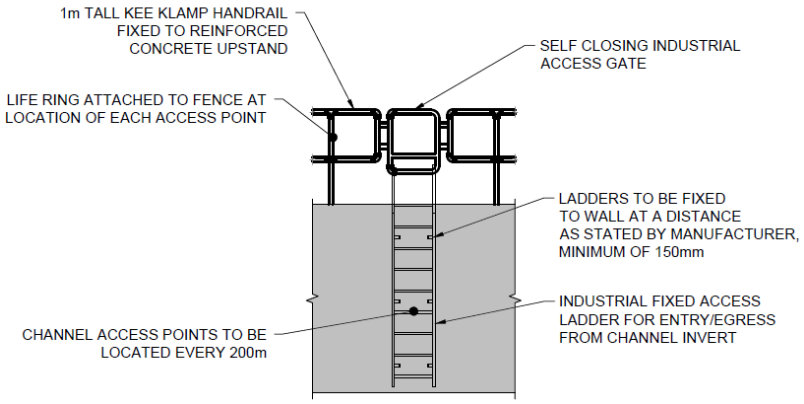

Figure 6-2: Channel Invert Access (extract from drawing TW-SIZ-XX-JBAU-SB-00-DR-C-0304-S3-P01-South_Bank_Details_Sheet_4_of_4)

Maintenance requirements: A maintenance schedule is shown below.

Table 1 - Maintenance Schedule for Engineered Channel

Maintenance schedule	Actions required	Typical frequency	Resources required
Monitoring	Visual Inspections, this can be carried out via light vehicle using the access road and includes a general inspection of the channel as to its general condition highlighting any remedial action that may be required. The channel includes inspection of the surrounding gabion baskets.	Annually or as and when required following fluvial or tidal flood events.	1 person
Vegetation Management	Strimming of wildflower grass beyond the boundary fence of the gabions baskets to either the highway (left bank) or service corridor (right bank)	Twice Annually	1 person
General Inspection	A general inspection shall comprise a visual inspection of all parts of the structure(s) that can be inspected without the need for additional access equipment, using safe, ground level viewing positions around the structure. (all aspect of the engineered open channel) As per DMRB CS 450	Every 2 years	1 person
Principal Inspection	A principal inspection shall comprise a close examination, within touching distance, of all accessible parts of a	Every 6 years	As determined by SSoW

	structure. (SSoW to be developed to undertake these works) As per DMRB CS 450		
Remedial Action	Determined by inspection and remedial action taken where necessary. Vehicular access provided for plant. SSoW to be developed specific to each remedial activity	As required	As determined by SSoW

6.2 Culverts

Description of drainage feature: As previously discussed there are 2 culverted sections within the drainage network. Both culverts span the full width of the channel (are flush with the upstream channel) and have considerable height hence are not at risk of blockage.

The 15m long service crossing culvert has a footpath with handrail which connects to the engineered open channel at both ends. The footpath will be inundated at during flood events in excess of the 1:100year event. Weep holes will facilitate drainage of pedestrian access as levels in the watercourse subside.

The second culvert is located at the end of the engineered open channel and measures 5.4m x 2.6m (internal dimensions). The culvert is approximately 340m in length with a large radius allowing the watercourse to sweep to the north toward the Tees Estuary. There is no fixed access to this culvert. Should access be required this should be undertaken with a specific SSoW. Given the size of the culvert maintenance and inspection could be safely achieved from the channel invert during times of low flow. Pedestrian access could be maintained from the outfall structure or an upstream fixed ladder access point. As previously discussed, there are no requirements for routine maintenance of the channel in terms of sediment management or debris removal. The only foreseeable requirement to enter the structure will be during principal examinations. Other inspection techniques such as drones should be considered. The culvert is large enough to facilitate small plant tracking up from the downstream face or from a purpose-built temporary access ramp upstream. Activities such as this cannot be reasonably foreseen however the drainage system can accommodate if required.

Maintenance requirements: Maintenance requirements are shown in the table below

Table 2 – Maintenance Schedule for Culvert

Maintenance schedule	Actions required	Typical frequency	Resources required
Monitoring	Visual Inspections, this can be done from a position of safety using binoculars from the upstream or downstream face, or as the culvert is large enough in low flow situations within the culvert itself. All of which will require generation of a SSoW	Annually or as and when required	As required by SSoW
General Inspection	A general inspection shall comprise a visual inspection of all parts of the structure that can be inspected without the need for additional access equipment, using safe, ground level viewing positions around the structure. The use of remote surveying is advised (drones). SSoW	Every 2 years	As required by SSoW

	required for walking through the culvert during low flows. As per DMRB CS 450		
Principal Inspection	A principal inspection shall comprise a close examination, within touching distance, of all accessible parts of a structure. (SSoW to be developed to undertake these works) As per DMRB CS 450	Every 6 years	As determined by SSoW
Remedial Action	Determined by inspection and action taken where necessary, likely to be removal of blockages using service corridor, pedestrian access or culvert itself.	As required	As determined by SSoW

6.3 Inter-Tidal Channel & Culvert Outfall Structure

Description of drainage feature: The inter-tidal channel is approximately 300m in length with an invert which is 20m wide. The 1:3 sloped banks connect to the development level, typically 2-4m above the channel bed. The channel slopes consist of 150mm thick low nutrient topsoil seeded with a low maintenance wildflower meadow grass mix. The channel invert consists of a coarse aggregate deign to accrete tidal sediment and promote the establishment of salt marsh habitat. The Channel is located at the outfall of the culvert. The culvert outfall incorporates the headwall, wingwalls, spillway, stilling basin and a low flow channel to facilitate eel passage. It is anticipated the stilling basin will accrete sediment over time however this will be flushed out during storm events. Hence, routine sediment management shall not be required.

Both the channel and outfall can be visually inspected from the banks of the open channel. Should plant access be require this is easily achievable via vehicular access tracks at the top of bank and the 1:3 side slopes. Although the channel will over time accrete sediment forming a mud like consistency the area will be underlain by a firm granular substrate.

Maintenance requirements: Maintenance requirements are shown in the table below

Table 3 - Maintenance schedule for Inter-Tidal Channel & Outfall Structure

Maintenance schedule	Actions required	Typical frequency	Resources required
Monitoring	Visual inspection. Access on foot on the large embankments can be used to perform a visual inspection.	Annually or as and when required	1 person
Vegetation Management	Strimming of wildflower grassed banks.	Once Annually in Autumn	1 person
General Inspection	A general inspection shall comprise a visual inspection of all parts of the structure(s) that can be inspected without the need for additional access equipment, using safe, ground level viewing positions around the structure. (outfall structure only) As per DMRB CS 450	Every 2 years	1 person
Principal Inspection	A principal inspection shall comprise a close examination, within touching	Every 6 years	As determined by SSoW

	distance, of all accessible parts of a structure. (outfall structure only) (SSoW to be developed to undertake these works) As per DMRB CS 450		
Remedial maintenance	Any remedial action that is deemed necessary can be completed using the embankments on either side of the channel as it is able to support plant or equipment needed to remediate the issue.	As required	As determined by SSoW
	Removal of sediment within channel or stilling basin	As required (Estimated 10 years)	As determined by SSoW

7 Access arrangements and requirements

The South Bank Arterial Drainage Network has been designed to provide an asset that has minimal maintenance requirements and can be safely inspected during routine and non-routine operations.

Given the scale of the asset and linear length vehicular access has been provided through out. Behind each of the headwall structures there are granular hardstanding's for storage of material, parking etc. The access tracks will operate a one-way system from upstream to downstream as there is no room to facilitate turning when adjacent to the channel. This is with the exception of 360-degree plant operating under specific SSoW which may track in either direction. At the start and end of each access ramp a vehicular gate will be provided to prevent unauthorised vehicle movements.

As discussed, there is no requirement for person entry into the watercourse (U-shaped concrete channel) for routine maintenance purposes. Only during principal examinations or remedial works will planned access to the channel be required. The width of the access track facilialtes the use of medium sized plant which could reach all areas within the channel if required. Should plant access be required in the channel itself then small plant could be tracked from the inter-tidal channel following a SSoW was in place. If larger plant requires access then temporary access ramps formed of compacted aggregate could be constructed within the U-shaped channel to facilitate access (requires a SSoW & ordinary watercourse consent)

In the unlikely event of accidental person entry into the channel fixed ladder access points are provided at 200m intervals. During day to day flows the channel will feature shallow sinuous flows with vegetated berms lining much of the banks, hence access or recovery or patients should be easily achievable providing a suitable SSoW is in place.

Access during extreme flood events (where the U-shaped channel is overtopped) is not advised or required.

Access to the culvert is obtained using the service corridor, the pedestrian access adjacent to the culvert or the culvert itself during low flow conditions. Access for inspection and remedial access can only be carried out through pedestrian access.

Access to the inter-tidal channel is obtained using the 1 in 3 banks to either inspect or carry out remedial action. The banks are designed for plant loading that is necessary to complete any remedial action such as removing excess silt.

8 Health and safety

In order to comply with the Construction (Design and Management) Regulations (CDM) 2015, drainage designers must assess all the foreseeable risks during the construction phase and during the ongoing maintenance of the schemes. The design of the drainage scheme must aim to reduce risk using the following principles:

- Avoid
- Reduce
- Identify and mitigate residual risks

Scheme designers should make contractors and those responsible for future maintenance aware of risks, keeping a record of the key health and safety factors that will need to be managed during future ongoing maintenance works. During construction, the residual rusks should be identified, and an action plan developed to deal with them appropriately.

The above information will be provided in the following document; Construction (Design and Management) CDM Regulations 2015 Health & Safety File.

All those responsible for maintenance should also take the appropriate health and safety precautions for all maintenance activities, this should additionally include lone working when relevant, and risk assessments should be undertaken for all activities.

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