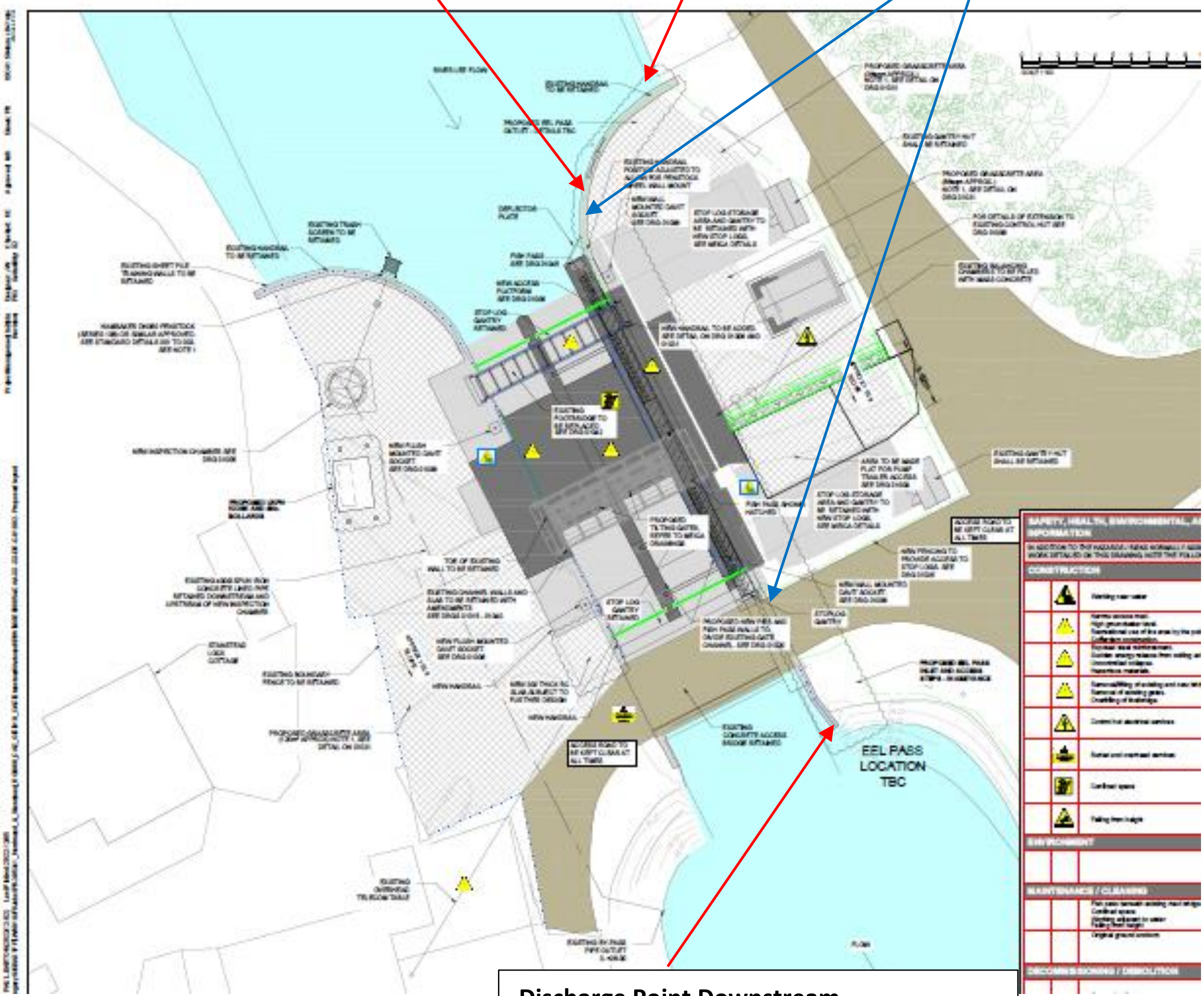
Stanstead Water Transfer Licence Application

Abstraction Point Upstream
Estimated location
X: 538078; Y: 212193

Discharge Point Upstream
Estimated location X: 538078; Y: 212198

Eel Pass Alignment



Discharge Point Downstream
Estimated location X: 538093; Y: 212162

West Street
Hunton
Maidstone
Kent ME15 ORR
Tel: 01622 820643
www.huntonengineering.co.uk

Stanstead Eel Pass Design Statement		
Client	BAM Nuttall	
Author	Joe Evans	
Revision	P01	28.04.2023

Contents

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Kent ME15 ORR
Tel: 01622 820643
www.huntonengineering.co.uk

1 Introduction

The Environment Agency are upgrading the weirs at Hardmead and Stanstead in 2023 and 2024 respectively and as part of these upgrade works installing an eel pass at both sites. The outline design of the eel pass to be installed at Hardmead was carried out by others with the design for the Stanstead eel pass being carried out by Hunton Engineering. The following document has been produced to accompany the design drawings for the eel pass design to be installed as part of the Stanstead Weir upgrade works. Additionally Huntons have been commissioned to detail design eh mechanical and electrical works for the Hardmead eel pass so that there is some cross over of design elements.

The design of the eel pass is fairly complex and must consider multiple factors across all of the design disciplines, those being mechanical, electrical, civil and environmental, and a number of the decisions made are a compromise that best fulfils the needs but not necessarily all of the needs.

The specification for the design is largely taken from the Environment Agencies Elver and Eel pass design guide – LIT 55615 version 1.0. Due to the Hardmead design already having been completed to an outline stage, this design will be used as a basis for the Stanstead design where possible to provide compatibility between sites.

The eel pass is approximately 40m long with a fall in water level of approximately 2.5m between upstream and downstream typical water levels, this does not account for additional height of fall of the splitter box.

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2 Control Philosophy

There are two pumps which operate in a duty/standby configuration which is set suing the HMI. The duty pump will run for 6 hours after which the control system will stop the pump and start the standby pump, they will continue to swap every 6 hours, which is a user adjustable setting on the HMI. During the changeover there will be a period of a few seconds of low flow, the flow sensor will not report this as an error.

The expected flow is 2L/s, if the flow meter detects a low flow of less than 1L/s (user adjustable) the control system will shut down the pump and lock it out, raise an alarm and start the standby pump. If the standby pump also has a low flow rate it will be shut down, locked out and require user intervention to re start.

If the low level electrode in the pump chamber detects a low level both pumps are shut down and locked out.

Either pump can be run in manual mode using start/stop buttons on the pump starter section in the control building which bypasses both the flow and electrode interlocks, this is to allow fault finding/maintenance and the removes the single points of failure of the flow sensor and the electrode.

The control system prevents two pumps running simultaneously, however this interlock is not present in manual mode.

Hours run meters will be used for each pump starter to allow monitoring of each pumps usage.

3 Design Of Eel Pass

3.1 Flow Type

Both eel passes are to be of the pumped variety. This is a stipulation that has been given to Huntons as a result of the flow requirements in the river, specifically due to the water extraction limitations. With a pumped eel pass the extraction rate from the upstream pound is fixed across all river levels.

A flow requirement of 2L/s has been states, 1 L/s to flow along the main eel pass and 1 L/s to flow down the exit pipe. As a result of the extraction limitations there is not enough capacity to have an attraction flow to the entrance of the eel pass.

3.2 Pump Selection

The chosen pump needs to deliver 2L/s or 120L/minute to the splitter box with a head of approximately 1.2m.

A Rotor flush pump has been requested as it is eel friendly and also self-cleaning.

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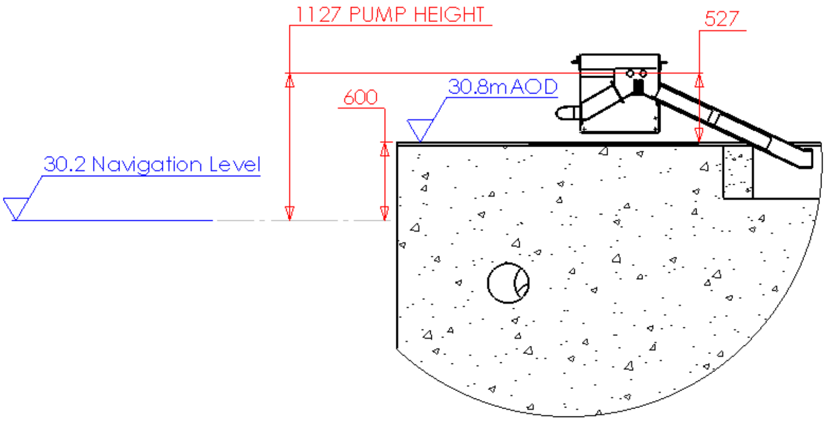

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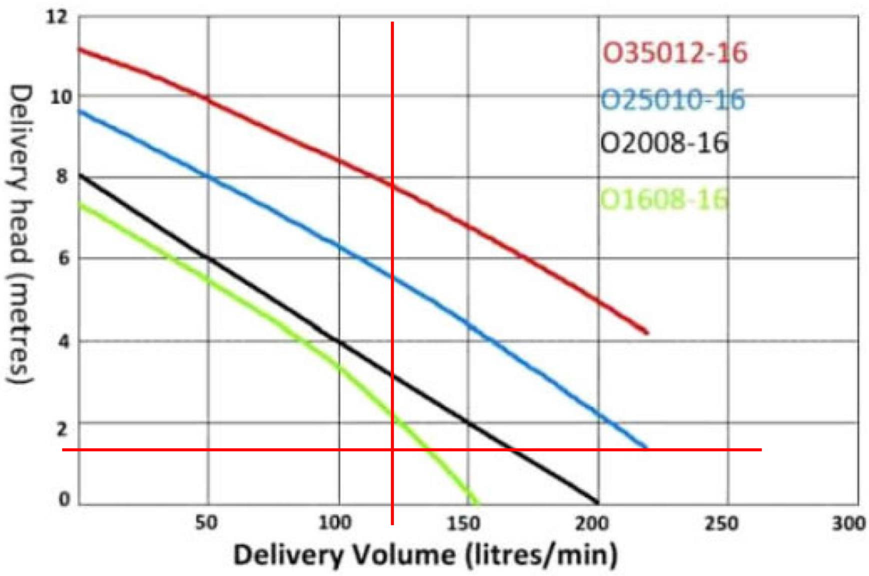
From Rotorflushes data sheet the 01608-16 model will deliver these flow requirements, however accounting for a flow meter and several bends this this flow rate may not be achievable. Therefore the next model up, the 025010-16 will be sued. This pump is a 230v single phase 0.55kW pump operating at 2850rpm.

The maximum flow rate for this pump at the given head is approximately 220 L/minute or 3.6 L/s which can be throttled back using the inline ball valves.

The outlet of the pump is 1 ¼" pipe which is 42.2mm O/D, approximately 35mm bore.



Model	Volts	kW	Outlet	L/min Max	Head (metres) Max
O1608-16	230	0.4	1 ¼" BSP Male	150	7
O25010-16*	230	0.55	1 ¼" BSP Male	225	10
O35012-16	230	0.8	1 ¼" BSP Male	225	11
O2008-16	110	0.55	1 ¼" BSP Male	200	8

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3.3 Pipework Pressure

The chosen pump can deliver a maximum head of water just under 10m, this represents just under 1 bar of pressure. All of the pipework is proposed to be stainless steel to ASME B36.19M in schedule 10 wall thickness. The pipe has a pressure rating of over 100 bar. The joints will be welded off site and where possible with site joints to either be bolted flanges of threaded joints. All flanges will be PN16 which has a pressure rating of 16 bar. The IMF SM9000 flow meter has a pressure rating of 16 bar. The ball valves and check valves have integral PN16 flanges also giving them a 16 bar rating.

Therefore the pressure rating of the system is 16 bar and can comfortably handle both pumps acting simultaneously which will create around 2 bar of pressure if this accidental scenario is to occur.

3.4 Width of pass

The design guide gives a recommended width of eel pass as between 300-500mm. The design of the eel pass at Hardmead is 200mm wide and this has effectively been stipulated to Huntons as the width to be used at Stanstead. It would be possible to have a 300mm wide eel pass at Stanstead but we believe the knock effect to the overall civil structure makes this challenging leading the client to request a 200mm wide pass.

It should also be noted that the majority of pumped eel passes we have installed are not 300mm wide (Viaduct Sluice and Island Barn on the Lower Mole, Leigh Barrier)

Commented [PB1]: Each site will be bespoke in nature, maybe Huntons have only needed to build passes of this width in the past. A 200mm wide pass is more likely to be less effective than a wider pass in any given situation.

3.5 Substrate

The substrate options for this type of eel pas are brushes or stud type boards. As the studs boards come in a standard width of 500mm, and the brush bristle boards come in a standard width of 100mm, brushes will be used to avoid cutting down stud boards.

The arrangement of bristle boards is two boards wide. One board will be higher density 20mm pitch bristles, and one board will be lower density 30mm pitch will be used.

Commented [PB2]: Ensure no gaps between boards

3.6 Lids

Lids will be provided along the entire length of the eel pass to prevent predators as will as health and safety considerations.

Commented [PB3]: Provide lid design an see comments on drawings

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3.7 Stairs

The stairs at the downstream end of the eel pass can be considered to be a utility stair, defined as access for maintenance which is not a usual route, taken from Approved document K as part of the building regulations.

This gives a rise between 150-190mm and a going between 250-320mm.

Using the extreme limits of a 150mm rise and a 320 going gives the 2R+G check as 620mm which is within the 550-700mm limits, therefore it is ok. This gives an angle of 25 degrees which matches the eel pass.

Table 1 Rise and going

	Rise		Going	
	Minimum (mm)	Maximum (mm)	Minimum (mm)	Maximum (mm)
Private stair	150	220†	245	260
	165	200†	223	300
Institutional and assembly stair	135	180	280*	340
Utility stair	150	190	250	320
Easy access stair	150	170	250**	320

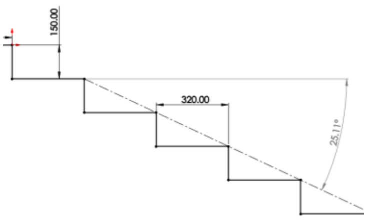
Private: Intended to be used for only one dwelling.
Institutional and assembly: Serving a place where many people gather.
Utility: Used for escape, access for maintenance, or purposes other than as the usual route for moving between levels on a day-to-day basis.
Easy access: Used by a broad range of users, and on a day-to day-basis, as the usual route between levels.
Note:
† The maximum pitch for a private stair is 42°.
* If the area of a floor of the building is less than 100m², you may reduce the going to 250mm.
**For school buildings, the minimum going is 280mm.
The normal relationship between the dimensions of the rise and going is: twice the rise plus the going (2R + G) equals 550–700mm.

The design is also within the guidance of BS 5395-1

BS 5395-1:2010 BRITISH STANDARD

Table 1 Recommended sizes for straight stairs and winders

Stair category	Rise, *r* mm		Going, *g* mm		Stair clear width (see Note 2) mm	Handrail height mm	
	Min.	Max.	Min.	Max.	Min.	Min.	Max.
Private stair	150	200	250	400	800 [A)]	900	1 000
Normal-use stair	150	180	300	450	1 000 [B)]	900	1 000



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3.8 Trash Screens

The Rotorflush pumps are provided with self-cleaning mesh screens to prevent the pumping of eels or fish. The entrance to the pipe which feeds the pump chamber has an existing trash screen fitted which will stop objects larger than around 100mm diameter from entering the pump chamber. Due to the layout of the site the main flow will always attract debris over the fish pass and the gates rather than being sucked into the pump chamber.

Huntons do not believe there is a benefit in a trash screen inside the pump chamber for the following reasons:

1. The pump chamber is already overcrowded and there is not enough room to comfortably fit the trash screens.
2. The trash screens become a maintenance issue and are heavy to remove and clean
3. The entrance to the pump chamber is submerged and the flow of the river is via the fish pass and gates, it is difficult to see how floating debris could enter the pump chamber.
4. If there was a trash screen and debris floating in the water was trapped by the trash screen, it would soon block and limit flow to the pumps, activating an alarm due to low flow. The trash screens would not actually help in this scenario.
5. The main issue we can foresee is a slow build-up of silt which would not be prevented by trash screen.

For these reasons we have removed the debris screens.

Commented [PB4]: A trash screen will be required somewhere to help prevent entrainment of floating debris e.g. leaf litter

Commented [PB5]: See comment on drawing

3.9 Flow Sensor

The flow sensor used will be a IFM SM9000, data sheet embedded below. It will provide a 4-20mA output for the flow, and can detect 5-300L/min, which is 0.01-5L/s. Therefore if both pumps ran and delivered 2 L/s each the flow meter is still in range.

SM9000-00_EN-GB.pdf

3.10 Pump Protection

A Hawker probe will be installed in the pump chamber set to a level 25mm above the top of the pump as shown on drawing 8173-30 sheet 3. When the water level drops below this electrode the pumps are stopped and an alarm is sent out via telemetry.

All low river level alarms are dealt with by the electrodes monitoring the river level. There is one electrode in the pump chamber and its purpose is to protect the pumps.

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3.11 Pump Maintenance

The pumps will have a length of chain fixed to the top which is anchored to the top of the chamber. This will allow the operator to lift the pump up on its rails and land it safely on the bank side to carry out any maintenance. The pump weighs approx. 11kgs so does not need lifting equipment to lift.

Commented [PB6]: Ensure chains and ancillary equipment are long enough to extract pump onto bank at a safe distance from chamber edge

3.12 Pump Chamber Maintenance

The pump chamber has been designed to minimise the need for access into it. The pumps can be easily removed up to ground level, and the electrode can be worked on from ground level. The following are the foreseeable reasons to need to access into the chamber

1. Failure of the equipment such as the pump rails coming off the wall (highly unlikely)
2. Removal of the equipment
3. Replacement of the penstock

Commented [PB7]: Consider position of penstock

Given the unlikely requirement to need to access inside the chamber, and if this is required it will form part of a larger scope of works to replace equipment, no provision for access is provided for general usage.

3.13 Silt

If the chamber fills with silt over time which cause the pumps to operate at a reduced flow, the client will need to remove the silt using a mobile device which can such out the silt from the ground level.

3.14 Compliance with LIT13228 Version 2.0

The EA have a MEICA standard relating to pumps. Page 6 states that small pumps under the size of 2.2kw (specifically noting pumps for eel passes) do not need to meet the detailed requirements of the document.

Hardmead Pumped Eel Pass

Buildability & Design Philosophy Statement

To be read in conjunction with DRA and drawings 100 – 108_C01

Issue: v5 **29-07-22**

Background

The Environment Agency wishes to construct a pumped eel pass; to be integrated with the gate replacement works and fish pass at Hardmead. The existing weir currently represents a 1.77m head drop impedance to eel passage. The head difference, constrained nature of the site and existing EA operational facilities on site make a pumped eel pass the preferred solution on the grounds of technical viability and cost.

Key Design Issues

- The pumped pass must be integrated within an EA operational area and must address the following constraints:
    - There are stop-log lay down areas positioned at the upstream and downstream areas.
    - There is potentially live as well as redundant infrastructure to be crossed (e.g., drainage and chambers) positioned along the route.
    - There is a new footbridge access point and gate platform which must not be obstructed.
- The pumped pass eel return point on the river must be located upstream of the proposed fish pass.
- The eel pass crosses a highway.
- The eel pass crosses existing and proposed concrete slabs.
- The upstream left bank ground level has a relatively small freeboard above the upstream river level, which is controlled by the EA sluice gate.
- Deep water at both the downstream and upstream ends of the eel pass.
- The eel pass must be fully and safely accessible at all locations.
- The eel pass must be technically sound, in terms of eel passage, robustness and durability.

Key Design Principles & Features

- 2 l/s of flow are pumped from the river and delivered to the flow splitter box; 1 l/s sent downstream via the eel pass system and 1 l/s sent upstream via the eel return system.
- The downstream eel pass length is ideally as short as is reasonably possible; with, the flow splitter box positioned as far downstream as possible. This is not possible as there is insufficient room to accommodate the flow return pipe a safe distance between the fish pass entrance and the pumped flow intake. Thus, it is necessary to position the flow splitter box further upstream, which enables the return pipe discharge of flow and eels safely away from the submersible pump intake, Larinier fish pass and enables eels to be more safely released amongst bankside vegetation mitigating risk of predation. This does have the advantage of grouping the key eel pass infrastructure (flow splitter box, submersible pumps, screens, and valve chamber) within a discrete zone which can be more easily managed on site. However, the risk of the increased length of the pass is mitigated covering the eel pass channel with solid removable covers (rather than gratings) to prevent debris entering the pass (e.g., grass cuttings) and eels escaping the pass. The eel brush substrates boards are also removable, to sweeten the delivery of flow if necessary and the delivery flow from the splitter box can also be adjusted.
- The **pumped flow split to the upstream flexible return pipe** is fed between the bars of the existing handrailing which runs alongside the river. The flexible outlet hose is held in position

at the required level below water level by J-pins driven in the riverbank.

- The **pumped flow split to the downstream eel pass flow system** is made via an inclined eel pass at 30° from the flow splitter box into a chamber, which provides transition into a polymer concrete u- channel system with a heavy-duty ductile iron grating cover. The inclined pass is formed using a 2no. 100mm wide eel bristle board (one pitch 20 / one pitch 30mm) set in an aluminium box and throughout the horizontal channel. The eel pass is sized to accommodate both larger eel and elvers.
- The concrete u-channel system crosses the concrete downstream stop-log laydown area and the highway and cover levels are designed to match the ground levels. The highway crossing is adjacent to the RC bridge deck and will match this deck level. Inspection chambers each side of the highway crossing provide access points at changes for direction and gradient.
- The use of the proprietary channels mitigates the risk to the environment and the aquifer: 1. The volume of concrete required is reduced. 2. The cementitious content of the concrete is reduced (GEN 3 used rather than RC45). 3. Complexity is reduced, formwork is reduced, and reinforcement removed, thus reducing the construction duration on site.
- Entry to the eel pass is via a 2no. 100mm wide eel bristle board (one pitch 20 / one pitch 30mm) aluminium box. The box is deepened to facilitate a 30° slope within the existing bank profile. Bristle boards are designed to be removable, with accessible bolt positions. The box is taken to a point where it is just drowned out by low tailwater levels. The existing inclined stone-pitching provides the 'to-bed' facility without the need for bristles.
- Delivery flow is designed to be taken from the soon to become redundant existing upstream inlet chamber. This provides a means of locating two no. submersible pumps (1 duty, 1 standby). This ensures that access can be made to the pumps without the need for access to the deep river.
- All works are designed to be undertaken within the left bank area using predominantly precast and prefabricated units at shallow depth.
- The channels will need to be fitted by disc-cutting through existing concrete slabs and breaking out concrete to form a structural bed of regulating concrete and haunching for the proprietary polymer concrete channels.
- Some pre-commencement investigation of the existing infrastructure will be required e.g., existing drainage systems and chambers within the left bank area is recommended prior to commencement of breakout.
- Concreting in shallow trenches is required to achieve a structural regulating bed & haunching for the precast eel pass units. No flowing water through the trench should be permitted to prevent washout of cement.
- The flow & eel return pipe is fed into the river via a flexible hose. All upstream works are undertaken outside of the river or at the shallow riverbank, without the need for diver or cofferdam working.
- The eel pass entry unit at the downstream end is designed to minimise the need for cofferdam works. Works are limited to placement of concrete sandbags to provide formation just below low flow level. Edge protection and / or pontoon facility may be required to facilitate safe construction.