Paper Mill Facility, Plot C Airfields, Northern Gateway

Industrie Cartarie Tronchetti (ICT) UK Limited and Crag Hill Estates Limited (CHEL)

Marine Discharges Assessment

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Paper Mill Facility, Plot C Airfields, Northern Gateway

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Author	H. Roberts / N. Cramp
Checker	E. Coward
Reviewer	L. Driscoll
Approver	L. Driscoll
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1 Introduction

1.1 Background

Arcadis Consulting (UK) Limited ('Arcadis') has been commissioned by Industrie Cartarie Tronchetti UK Limited (ICT) to undertake a surface water impact assessment to support an application for consent to discharge trade effluent to the Dee estuary. The discharge is from a proposed tissue paper processing and production facility at the Airfield Site, part of the Northern Gateway in Queensferry, Flintshire.

1.2 Aims and Objectives

The aims of this desk study were to:

- Define the expected water quality of the proposed paper mill trade discharge.
- Characterise the existing water quality of the Dee estuary, local to the proposed site of the paper mill discharge and determine its current Water Framework Directive (WFD) status.
- Apply the Natural Resource Wales (NRW) H1 surface water pollution risk assessment screening tests for estuaries and coastal waters[1].
- Undertake 1D hydrodynamic and temperature modelling to assess the thermal impacts of the discharge on the Dee estuary.
- Produce a technical note detailing the findings of the study to support the environmental permit application.

[1] Natural Resources Wales / Horizontal Guidance

2 Site Overview

2.1 Site Description

The proposed paper mill site is located approximately 0.4 km from the northern bank of the River Dee at approximate National Grid Reference (NGR) 332172, 369910. Adjacent to the site, the river is canalised between substantial earth embankments and its flow regime is tidally dominated. The Dee estuary is a designated nature conservation site comprising a Special Area of Conservation (SAC), Special Protection Area (SPA) and Site of Specific Scientific Interest (SSSI).

The effluent from the paper mill would be treated on site and discharged from a single outfall to the Dee estuary. The location for the discharge to the Dee estuary is at National Grid Reference (NGR): 331835, 368995, as shown in Figure 2-1.

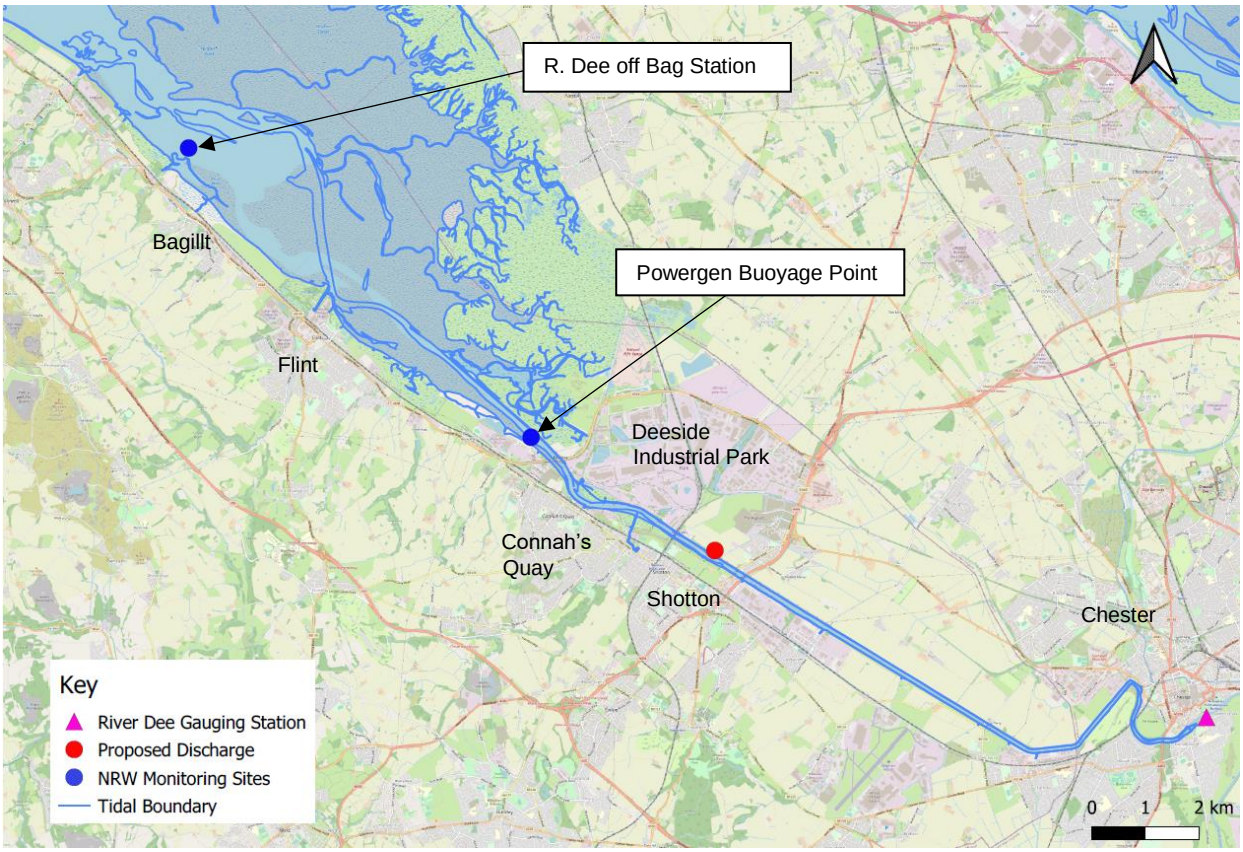

Figure 2-1 Study Area

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The tidal range in the Dee estuary is detailed in Table 2-1 for Connah's Quay, which is the closest secondary port to the site, and Hilbre Island which has been used to inform the temperature modelling (see Section 3.3).

Table 2-1 Tidal Water Levels in the Dee Estuary[2]

Tidal State	Water Level (mAOD*)	
	Connah's Quay	Hilbre Island
Lowest Astronomical Tide (LAT)	-0.75	-4.93
Mean Low Water Spring (MLWS)	-0.75	-3.63
Mean Low Water Neap (MLWN)	-0.75	-1.83
Mean Sea Level (MSL)	-0.75	0.22
Mean High Water Neap (MHWN)	2.25	2.27
Mean High Water Spring (MHWS)	3.95	4.07
Highest Astronomical Tide (HAT)	4.85	5.27

**Meters above Ordnance Survey Datum (mAOD)*

Bathymetry data that Arcadis hold (original source unknown) for the river reach adjacent to the proposed paper mill show that bed levels range from approximately 0.1 mAOD to 0.2 mAOD.

The tidal water level data for Connah's Quay (as detailed in Table 2-1) show that for much of the tidal cycle, the water levels in the area of the proposed discharge are below the riverbed levels, therefore, the depth of water would be determined by the river flow during these tidal conditions.

The peak water depths along the section of the Dee estuary that the discharge would be located range from 2.05 to 2.15m during MHWN and from 3.75 to 3.85 m during MHWS tidal conditions.

2.2 River Dee Flow Data

River Dee flows have been determined using the river flow record from Chester Suspension Bridge gauging station[3] (NGR: 341020, 365973), located just upstream of the Normal Tidal Limit (NTL), as shown in Figure 2-1.

Key flow data statistics, based on the available data series from January 1994 to March 2013, are summarised below:

- Annual mean flow – 34.1 m^3/s.
- Annual 95 percentile (Q95) low flow – 5.1 m^3/s.
- Mean winter flow (December to February inclusive) – 59.6 m^3/s.
- Winter Q95 low flow – 9.2 m^3/s
- Mean summer flow (June to August inclusive) – 13.4 m^3/s.
- Summer Q95 low flow – 4.8 m^3/s

[2] Sefton Council, December 2013 North West Estuaries Processes Reports, Dee Estuary.

[3] NRFA Station Data for 67033 - Dee at Chester Suspension Bridge (ceh.ac.uk)

2.3 Water Framework Directive Status for the Dee Estuary

Standards for the Dee (transitional waters) waterbody (ID GB531106708200: Dee N. Wales) are recorded in the Dee River Basin Management Plan (RBMP)[4]. The Dee is classified as a Heavily Modified Waterbody (HMWB).

Its current Water Framework Directive (WFD) status is reported in the WFD River Basin District Cycle 2 Rivers and Waterbodies dataset. The WFD Overall Status of the Dee Transitional waterbody is Moderate. The Chemical Status of the Dee is characterised as a Fail. The target water body status is to achieve 'Good' by 2021.

2.4 Water Quality Data for the Dee Estuary

Water quality data for the Dee estuary were obtained from NRW for use in the current study (NRW data reference ATI-22791a, 2022).

The NRW water quality data set for the Dee estuary includes many sites, however, many of these do not include recent data. Therefore, the nearest water quality monitoring sites to the site of interest which have recent data have been used. Where available, data from 2011 to present have been used to define the background parameter concentrations in the surface water impact assessment (see Section 3).

The NRW water quality monitoring locations used to inform the current study are listed below and are shown in Figure 2-1:

- Powergen Buoyage Point (NGR: 328400, 371200)
- R. Dee off Bag Station 9 (NGR: 332200, 368700)

2.5 Water Quality Data for the Proposed Paper Mill Discharge

There are no data available to characterise the paper mill operational discharge as the facility has not been constructed. Therefore, it was agreed in discussion with NRW, that data from a proxy site could be used. This was on condition that the proxy site selected was similar in its operational capacity and manufacturing process and processed a similar quality of raw materials.

Data for the proxy was supplied by ICT for a site in France that is understood to be a similar type of plant as the one proposed in Queensferry (see correspondence in Appendix A). The discharge data has been reviewed and the key water quality parameters are summarised in Table 2-2. Additional analysis was undertaken quarterly, including analysis for a range of metals, and the results are summarised in Table 2-3. The original laboratory certificates are given in Appendix B.

The results of the metals analysis (Table 2-3) show that the concentrations were generally below the limit of detection (LOD), therefore, an accurate assessment of the impact of these parameters on the receiving water is not possible. To obtain an indication of the potential risk to the Dee estuary that the discharge may pose, where the measurements are below the LOD, the LOD values have been adopted. This provides a worst-case approach. However, the sample data that were obtained for chromium, together with several the samples for mercury, were analysed to a LOD that was nearly an order of magnitude higher than the relevant environmental quality standards (EQS) and, therefore, are

[4] https://environment.data.gov.uk/catchment-planning/OperationalCatchment/3127

unsuitable for inclusion in the surface water impact assessment. It was agreed, in discussion with NRW (meeting held 22/02/22), that determinands analysed to an inappropriate LOD would be excluded from the assessment.

The measured values for a range of determinands have been given in Table 2-2 for information purposes but have not been included in the impact assessment, either because there are no corresponding EQS for estuaries, or for the reasons discussed below.

The data for the proxy site includes relatively high nitrate concentrations, leading to a high estimate of Dissolved Inorganic Nitrogen (DIN). It is understood that the proxy site is situated in an intensive agricultural region, leading to high nitrate levels in the source water that is abstracted to feed the paper mill process. It is understood that the water supply to the proposed paper mill will be from the Dŵr Cymru Welsh Water Ashgrove water treatment works, with the raw source water abstracted from the River Dee at Heronbridge. ICT have confirmed that the paper manufacturing process would not add any additional source of DIN and consequently, the proposed discharge would not be expected to impact DIN in the Dee estuary. As such, the surface water discharge assessment does not include DIN.

Table 2-2 Paper Mill Discharge Data – Monthly Sample Results for the Proxy Site

Sample Date	Temperature (°C)	pH	Total Ammonia (mg N/l)	Unionised Ammonia[a] (mg N/l)	NO2 (mg N/l)	NO3 (mg N/l)	Dissolved Inorganic Nitrogen (DIN)[b] (mg N/l)	Phosphorous (mg P/l)	BOD (mg/l)	Adsorbable Organic Halogens (AOX) (µg/l)
11/01/2018	23.9	7.8	< 0.389	< 0.013	0.021	1.45	< 1.86	< 0.1	< 3	170
08/02/2018	13.1	7.8	< 0.389	< 0.006	0.022	2.9	< 3.311	< 0.1	< 3	360
15/03/2018	20.3	7.7	0.702	0.014	0.02	0.70	3.812	0.154	< 3	410
05/04/2018	23.4	7.5	< 0.389	< 0.006	0.343	3.49	< 4.222	< 0.01	36	500
03/05/2018	7.9	7.9	< 0.389	< 0.005	0.023	0.81	< 1.222	0.156	3.7	480
06/06/2018	10.1	7.7	< 0.389	< 0.004	0.082	1.72	< 2.191	< 0.1	7.73	290
05/07/2018	NR	6.7	< 0.389	NR	0.037	1.47	< 1.896	< 0.1	< 3	510
09/08/2018	9.4	7.3	< 0.389	< 0.001	0.031	1.76	< 2.18	< 0.1	3.1	340
06/09/2018	9.6	7.4	< 0.389	< 0.002	0.03	1.4	< 1.819	0.127	3	320
04/10/2018	8.7	6.8	0.702	0.001	0.028	0.98	1.71	0.275	10	820
08/11/2018	8.3	7.3	< 0.389	< 0.001	0.137	6.15	< 6.676	< 0.1	7	790
13/12/2018	7.2	8.2	1.21	0.028	0.031	0.94	2.181	0.136	4	600
09/01/2020	23.7	7.9	0.463	0.018	0.018	2.60	3.081	0.243	3	760
02/04/2020	20.5	8.0	< 0.389	< 0.015	< 0.015	1.65	< 2.054	0.103	4.2	860
02/07/2020	27.0	8.0	< 0.389	0.024	< 0.015	2.63	3.034	0.117	< 3	340
14/10/2020	NR	7.1	0.471	NR	0.03	4.35	4.851	0.172	< 3	580
07/01/2021	21.8	7.9	< 0.389	< 0.013	0.049	2.34	< 2.778	0.158	3.5	310
04/02/2021	NR	8.0	< 0.389	< NR	< 0.015	2.89	< 3.294	0.116	< 3	290
04/03/2021	25.4	8.1	2.80	0.192	0.03	2.27	5.10	0.174	6.5	350
08/04/2021	23.8	8.0	< 0.389	< 0.19	0.016	1.33	< 1.735	< 0.1	11.9	650
06/05/2021	25.6	7.9	< 0.389	< 0.018	< 0.015	0.73	< 1.134	0.201	5.06	190
03/06/2021	28.6	7.9	< 0.389	< 0.021	< 0.015	0.95	< 1.354	0.326	4.89	300
08/07/2021	26.7	7.1	0.649	0.005	< 0.015	1.38	< 2.044	0.213	6.43	420
05/08/2021	27.5	7.9	< 0.389	< 0.02	0.119	< 0.23	< 0.738	0.222	< 3	260
02/09/2021	28.2	7.8	< 0.389	< 0.017	0.019	2.22	< 2.628	0.186	< 3	110
07/10/2021	24.7	8.0	< 0.389	< 0.021	0.042	3.23	< 3.661	0.374	< 3	390
04/11/2021	24.6	8.1	1.23	0.08	0.041	1.66	2.931	0.337	12.1	460
Mean	**19.6**	**7.7**	**< 0.578**	**< 0.030**	**< 0.047**	**< 2.01**	**< 2.722**	**< 0.167**	**< 6.00**	**439**
Maximum	**28.6**	**8.2**	**2.800**	**0.192**	**0.343**	**6.15**	**6.676**	**0.374**	**36**	**860**

[a] *Unionised ammonia has been calculated from measured values of total ammonia, temperature and pH.*

[b] *DIN has been calculated by summing the measured values of total ammonia, NO2 and NO3.*

NR – No result

Table 2-3 Paper Mill Discharge Data – Quarterly Results for Total Metals Recorded at the Proxy Site

Sample Date	Specific Pollutants				Priority Substances			
	Iron (mg/l)	Arsenic (mg/l)	Zinc (mg/l)	Copper (mg/l)	Cadmiun (mg/l)	Mercury (mg/l)	Lead (mg/l)	Nickel (mg/l)
11/01/2018	< 0.02	< 0.01	< 0.01	< 0.005	< 0.002	< 0.0005	< 0.01	< 0.01
05/04/2018	< 0.02	< 0.01	< 0.01	< 0.005	< 0.002	< 0.0005	< 0.01	< 0.01
05/07/2018	< 0.02	< 0.01	< 0.01	< 0.005	< 0.002	< 0.0005	< 0.01	< 0.01
04/10/2018	0.02	< 0.01	0.01	< 0.005	0.003	< 0.0005	0.02	< 0.01
09/01/2020	NR	< 0.005	0.0144	< 0.005	< 0.001	< 0.00005	< 0.002	< 0.005
02/04/2020	NR	< 0.005	0.009	< 0.005	< 0.001	< 0.00005	< 0.002	< 0.005
02/07/2020	NR	< 0.005	< 0.02	< 0.005	< 0.001	< 0.00005	< 0.002	< 0.005
14/10/2020	NR	< 0.005	< 0.005	< 0.005	< 0.001	< 0.00005	< 0.002	< 0.005
07/01/2021	NR	< 0.005	< 0.005	< 0.005	< 0.001	< 0.00005	< 0.002	< 0.005
08/04/2021	NR	< 0.005	< 0.005	< 0.005	< 0.001	< 0.00005	< 0.002	< 0.005
08/07/2021	NR	< 0.005	0.0077	< 0.005	< 0.001	< 0.00005	< 0.002	< 0.005
07/10/2021	NR	< 0.005	0.0104	< 0.005	< 0.001	< 0.00005	< 0.002	< 0.005
Mean	**< 0.02**	**< 0.007**	**< 0.0097**	**< 0.005**	**< 0.001**	**< 0.00005**	**< 0.006**	**< 0.007**
Maximum	**0.02**	**< 0.01**	**< 0.02**	**< 0.005**	**0.003**	**< 0.00005**	**0.02**	**< 0.01**

Notes:
Results are believed to be measures of total metal concentration rather than dissolved (i.e., bioavailable) concentrations.
NR – No Results
In agreement with NRW (meeting held 22/02/22), values highlighted in orange have been excluded from the assessment due to the samples being analysed to an inappropriate LOD
The proxy site included analysis for chromium, however, the data were analysed to an inappropriate LOD, with all samples being reported as <0.005 mg/l. Therefore, as agreed with NRW (meeting held 22/02/22), the data was not suitable for inclusion in the surface water impact assessment.

2.6 Target Water Quality Standards for the Dee Estuary

The current study has been undertaken to assess the impact of the proposed discharge against water quality standards for estuaries.

The water quality data for the proxy paper mill site were reviewed to determine what pollutants it may contain that could pose a potential risk to the receiving waters. The corresponding EQS's for 'Good' status (i.e., the WFD target for the Dee estuary) for these pollutants in estuaries have been listed in Table 2-4. These standards have been derived from the Water Framework Directive (Standards and Classification) 2015[5].

It stated in the H1 Annex D2[6], there are no temperature standards defined for estuaries. However, there are assessment criteria for predicting the mixing zone for thermal discharges in estuaries. In consultation with NRW (letter dated 23/12/21, Ref: CAS-176142-P8Y6), they stated:

> *'For temperature, the applicant will need to show the size of the mixing zone (23°C and 3°C uplift) from releasing water at an elevated temperature. We advise that the different seasons and therefore differing background temperatures are considered. We also advise that numerical modelling is conducted to predict the size of the mixing zone.'*

In agreement with NRW (meeting held 22/02/22), a dynamic 1D hydraulic and temperature modelling approach has been applied to meet the above requirement, and the results are presented in Section 3.3.

[5] The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 (legislation.gov.uk)
[6] 1076_14 H1 Annex D2 - Assessment of sanitary and other pollutants within Surface Water Discharges (publishing.service.gov.uk)

Table 2-4 Environmental Quality Standards Adopted in Current Study for 'Good' Status

Parameter	'Good' Threshold Value		Comment
	Annual Average (AA) or Long-Term Mean	Maximum Allowable Concentration (MAC)	
Temperature (°C)	N/A	23	There are no temperature standards for estuaries. The River Dee is a salmonid river[7], therefore, for the purposes of this assessment, the temperature standards for rivers of this type have been adopted. This approach was recommended by NRW (Letter dated 23/12/21 Ref: CAS-176142-P8Y6). Maximum allowable temperate as an annual 98 percentile standard.
		3	Maximum allowable change in temperature in relation to the ambient river temperature as an annual 98 percentile standard.
Unionised Ammonia (mg N/l)	0.021	N/A	
Lead (mg/l)	0.0013	0.014	Dissolved concentration
Mercury (mg/l)	N/A	0.00007	Dissolved concentration
Copper (mg/l)	3.52	N/A	The long term (mean) standard varies depending on the Dissolved Organic Carbon (DOC) content of the receiving water. Mean DOC concentration recorded in the Dee is 2.63 mg/l. As the DOC is >1mg/l the following standard applies 3.76 + (2.677 x ((DOC/2) –0.5)) µg/l.
Zinc (mg/l)	0.0079	N/A	Standard is for the dissolved concentration. Long term (mean) standard is 0.0068 mg/l plus ambient background concentration, with a value for saltwater of 0.0011mg/l recommended[5].
Nickel (mg/l)	0.0086	0.034	Dissolved concentration
Arsenic (mg/l)	0.025	N/A	Dissolved concentration.
Cadmium (mg/l)	0.0002	N/A	Dissolved concentration
Iron (mg/l)	1.0	N/A	

[7] Natural Resources Wales / Salmon and sea trout catchment summaries

3 Surface Water Pollution Risk Assessment

3.1 Data Collation

The surface water impact assessment tests that have been applied to the proposed discharge to the Dee estuary are detailed in this Section.

Given the tidal nature of the Dee, the impact of the paper mill discharge on receiving water quality would vary significantly depending on tidal conditions. To assess a likely worst-case, the assessment has been undertaken assuming low tide conditions and a Q95 river flow, as this combination provides the minimum level of dilution of the discharge effluent.

The assessment has been done for those parameters that are likely to be contained within the proposed discharge, as identified from the proxy site data, and for which EQS have been identified for the receiving estuarine waters. The values adopted in the assessment for the paper mill discharge are given in Table 3-1.

The H1 assessment states that, for estuaries, where the background quality can vary depending on the tide, the maximum recorded background value for the pollutant concentration should be used rather than the average value. The background Dee estuary values that have been adopted in the study are given in Table 3-2. While the maximum recorded values have been adopted in the H1 screening assessment, the average values have also been provided for information purposes.

The H1 screening assessment requires that, where a determinand has both an AA and a MAC standard, the discharge should be assessed against both. The mean concentrations recorded at the proxy site have been used to assess the potential long-term impact of the discharge and compared against the AA standards. The maximum recorded concentrations have been used to assess the potential for short term impacts and compared against the MAC standards.

Table 3-1 Paper Mill Discharge - Values Adopted in the Surface Water Impact Assessment

Parameter	Mean Value	Maximum Value	Comment
Discharge flow (l/s)	N/A	60	The maximum expected flow rate once the plant is fully operational (phases 1,2 and 3) has been used throughout the surface water impact assessment to represent a worst case.
Temperature (°C)	19.6	30	The maximum expected temperature (as confirmed by ICT) has been used throughout the assessment as this represents a worst case. Note: this is higher than the 28.6 °C maximum temperature recorded at the proxy site.
Unionised Ammonia (mg/l)	0.030	0.192	N.B. Most of the metal measurements in the proxy dataset were below the laboratory LOD and, therefore, the values adopted are an overestimate of the average metal concentrations.
Lead (mg/l)	0.006	0.02	
Mercury (mg/l)	0.00005	0.00005	
Copper (mg/l)	0.005	0.005	
Zinc (mg/l)	0.0097	0.02	
Nickel (mg/l)	0.007	0.01	
Arsenic (mg/l)	0.007	0.01	
Cadmium (mg/l)	0.001	0.003	
Iron (mg/l)	0.02	0.02	

Table 3-2 Dee Estuary Water Quality - Values Adopted in the Surface Water Impact Assessment

Parameter	Average Measured Value	Maximum Measured Value	Comment
River Dee flow (l/s)	5,100	N/A	Annual Q95 flow rate as reported at the Chester Suspension Bridge River Dee gauging station
Temperature (°C)	17.3	21.1	Summer temperature (June to Aug)
	6.0	8.6	Winter temperature (Dec to Feb)
Unionised Ammonia (mg/l)	0.0014	0.0034	
Lead (mg/l)	<0.0001	0.0004	Dissolved concentrations.
Mercury (mg/l)	<0.00002	0.00052	
Copper (mg/l)	0.0011	0.0023	
Zinc (mg/l)	0.0059	0.021	
Nickel (mg/l)	<0.0008	0.004	
Arsenic (mg/l)	<0.002	0.003	
Cadmium (mg/l)	<0.000031	<0.00004	
Iron (mg/l)	<0.1	<0.1	

3.2 H1 Screening Assessment

Screening Test 1

The first screening test checks whether the concentration of the pollutant in the discharge is more than the estuary EQS. If it is less than the EQS there is no requirement to undertake the remaining screening tests as the pollutant is not considered to pose a risk to the receiving water environment. If the level of pollutant in the proposed discharge is more than the EQS then Test 2 must be carried out.

Where the determinand has both annual average limits and maximum allowable concentrations, then the screening test has been undertaken for both types of EQS.

The results of Screening Test 1 against the AA and MAC standards are given in Table 3-3 and Table 3-4, respectively. The results show that the levels of un-ionised ammonia, lead, zinc and cadmium in the discharge exceed their EQS thresholds and, therefore, Screening Test 2 should be undertaken for these determinands. All other potential pollutants assessed are screened out.

Table 3-3 Screening Test 1 Results – Annual Average EQS

Parameter	Average Release Concentration	AA EQS
Un-ionised ammonia (mg/l)	0.03	0.021
Lead (mg/l)	0.006	0.0013
Copper (mg/l)	0.005	3.82
Zinc (mg/l)	0.0097	0.0079
Nickel (mg/l)	0.007	0.0086
Arsenic (mg/l)	0.007	0.025
Cadmium (mg/l)	0.001	0.0002
Iron (mg/l)	0.02	1.0

Table 3-4 Screening Test 1 Results – Maximum Allowable Concentration EQS

Parameter	Maximum Release Concentration	MAC EQS
Lead (mg/l)	0.02	0.014
Mercury (mg/l)	0.00005	0.00007
Nickel (mg/l)	0.01	0.034

Fails Screening Test
Passes Screening Test

Screening Test 2

Given the site's location in the upper estuary, together with the assumption that the proposed outfall would discharge directly to the low water channel, in line with the H1 Screening guidance, the freshwater screening test methodology has been adopted for Screening Test 2 (and Tests 3 & 4 – see next section). The screening test calculations apply the freshwater flow rate and upstream quality but use the EQSs for estuaries.

Screening Test 2 introduces the dilution available in the receiving water, using river flow and daily discharge volume data. The test checks whether the process contribution (PC) of the pollutant is more than 4% of the EQS (PC is the concentration of a discharged pollutant in the water after it's been diluted). The following steps are required to work out the PC:

- Multiply the effluent flow rate (EFR) by the release concentration of the pollutant in the effluent (RC).
- Add your value for the EFR to the river flow rate (RFR).
- Divide the result of step 1 by the result of step 2.

If the value for PC is 4% or less of the EQS there is no requirement to carry out Screening Test 3. However, if the PC is more than 4% of the EQS, Screening Test 3 is required.

The results of Screening Test 2 against the AA and MAC standards are given in Table 3-5 and Table 3-6, respectively. The results show that unionised ammonia and zinc are predicted to be within acceptable limits and, therefore, are screened out of further assessment. However, the PC for lead and cadmium are predicted to exceed 4% of the AA EQS, therefore, Screening Tests 3 and 4 should be undertaken. Note: lead passes the screening test against the MAC EQS and so the short-term impact is not assessed further.

Table 3-5 Screening Test 2 Results – Annual Average EQS

Parameter	EFR (l/day) x RC	EFR + RFR (l/day)	PC	% of EQS **AA**
Unionised Ammonia (mg/l)	155,520	445,824,000	0.00035	1.7%
Lead (mg/l)	31,104		0.00007	5.4%
Zinc (mg/l)	50,285		0.000113	1.4%
Cadmium (mg/l)	5,184		0.000012	6.0%

Table 3-6 Screening Test 2 Results – Maximum Allowable Concentration EQS

Parameter	EFR (l/day) x RC	EFR + RFR (l/day)	PC	% of EQS **MAC**
Lead (mg/l)	103,680	445,824,000	0.000233	1.7%

Fails Screening Test
Passes Screening Test

Screening Tests 3 and 4

Screening Test 3 has been undertaken to determine whether the discharge would be likely to increase the concentrations of lead and cadmium in the Dee estuary downstream of the discharge by more than 10% of their respective EQS values.

Screening Test 4 requires a check as to whether the predicted environmental concentration (PEC) is higher than the corresponding EQS.

The PEC in the water downstream of the discharge is a combination of the PC and background concentration (BC). To work out the PEC, the PC is added to the average BC. The screening test is passed if the increase downstream of the discharge (i.e., PEC) compared to the BC is less than 10% of the respective EQS.

The results of Screening Test 3 (Table 3-7) for the two determinands that failed Screening Test 2, shows that these are screened out.

As can be seen from Table 3.7, the PEC concentrations for lead and cadmium are below their EQS limits (0.0013 mg/l and 0.0002 mg/l, respectively) and, therefore, Screening Test 4 is passed, and no further assessment is required.

Table 3-7 Screening Test 3 Results – Annual Average EQS

Parameter	PC	BC	PEC	Change in BC as % of the AA EQS
Lead (mg/l)	0.00007	0.0004	0.00047	5.4%
Cadmium (mg/l)	0.000012	0.00004	0.000052	5.8%

Fails Screening Test

Passes Screening Test

All the parameters tested are screened out and, therefore, no further tests are required as part of the H1 risk assessment procedure. However, temperature cannot be assessed through the H1 screening approach and, therefore, has been assessed separately, as discussed in Section 3.3.

3.3 Temperature Assessment

In consultation with NRW (Letter dated 23/12/21, Ref: CAS-176142-P8Y6) it was confirmed that temperature modelling would be required to assess the potential plume extent of the proposed paper mill discharge. NRW advised that the assessment should be undertaken for different seasons so that the impact under differing ambient water temperatures could be defined.

NRW confirmed that the impact should be assessed against the temperature standards as detailed in Table 2.4 (i.e., a maximum allowable temperature of 23˚C and a maximum change from background temperature of 3˚C).

Thermal Plume Modelling

Modelling Approach

A 1D hydrodynamic and temperature model of the Dee estuary has been constructed using HEC RAS software. The 1D HEC RAS model is based on a flood model that has been used to inform recent Flood Consequences Assessment studies (FCA) for the wider Northern Gateway development site. The model extends from upstream of the NTL at Chester to the coast (NGR: 318450, 387625).

The HEC RAS temperature model allows the effect of meteorological conditions, such as ambient air temperature, solar radiation, cloud cover, etc., to be included. However, to simplify the assessment and improve interpretation of the results, meteorological conditions have been set to minimise their influence i.e., without the inclusion of the paper mill discharge, the estuary temperatures remain stable at their initial conditions for the duration of the simulation.

Modelling has been undertaken to assess the impact of the discharge during winter and summer seasons as this encompasses the range of temperature conditions that would occur through the year.

Boundary conditions

The tidal boundary conditions have been extracted from the existing FCA model for both spring and neap tides. The model uses tidal water levels predicted at Hilbre Island, (as detailed in Table 2.1) and a tide curve was derived using the Admiralty tide tables for the UK and Ireland for MHWS and MHWN. The standard port data for Liverpool was used and adjustments made based on the secondary port of Hilbre Island. The resulting modelled MHWS and MHWN curves for Hilbre Island are shown in Figure 3-1

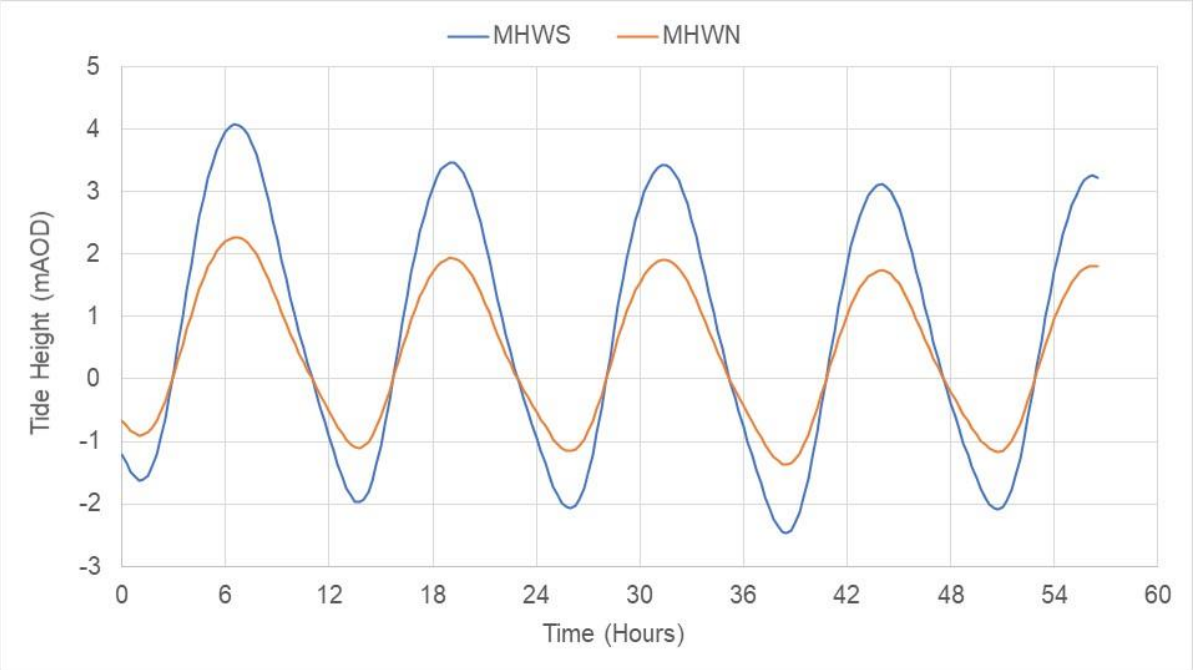

Figure 3-1: Downstream Boundary at Hilbre Island

Flows recorded at the River Dee gauge located at the NTL at Chester have been used to define the fluvial boundary flow conditions for both summer and winter, as summarised in Table 3.8. The Q95 low flow for

summer (June to August) and winter (December to February) have been adopted. No other freshwater inflows have been included in the model. This is a conservative approach as there are numerous stream inputs into the Dee estuary downstream of the discharge that would further dilute the discharge.

NRW water quality data recoded in the Dee estuary have been used to define ambient temperatures for summer and winter (see Table 3-8) and these temperatures have been applied at both the upstream and downstream boundaries.

Table 3-8 Upstream Boundary Conditions - River Dee Flow and Temperature

Season	River Dee Q95 Low Flow (m^3/s)	Temperature (˚C) *
Summer	4.8	17
Winter	9.2	6

**These temperatures have also been applied at the downstream tidal boundary*

The proposed paper mill discharge has been included in the HEC RAS model as a lateral inflow, discharging at a constant 60 l/s and 30˚C. The same paper mill discharge flow and temperature conditions have been adopted for both summer and winter scenarios.

Model Results

The HEC RAS model has been simulated for spring and neap tidal events under both summer and winter scenarios.

The results of the HEC RAS model have been extracted at Low Water (LW) and High Water (HW) to show the maximum temperature change (expected to occur at low water when there is no tidal dilution) and to define the maximum plume extent, both downstream and upstream of the discharge.

Winter

Long section plots showing the predicted temperature along the length of the Dee estuary during winter conditions, spring and neap tides are shown in Figures 3-2 and 3-3 respectively. The predicted maximum temperature increase from background and plume extents are summarised in Table 3-9.

The high-water plots in Figures 3-2 and 3-3, show a double peak in temperature. The upstream peak is due to the temperature plume being pushed back upstream on the incoming tide. Then, at high water, when there is little flow during the slack water period, the discharge is predicted to produce another small peak in temperature.

Table 3-9 Winter - Maximum Temperature Increase and Plume Extent

Tidal Condition	Maximum Temperature (°C)	Maximum Temperature Increase from Ambient (°C)	Maximum Temperature Plume Extent from Point of Discharge (m)	
			Downstream	Upstream
Spring Tide	6.15	0.15	5,000	9,200
Neap Tide	6.11	0.11	5,400	4,000

The results show that the proposed paper mill discharge would have no significant impact on the Dee estuary temperature during winter, with the peak increase in background temperature well within the maximum allowable 3°C threshold.

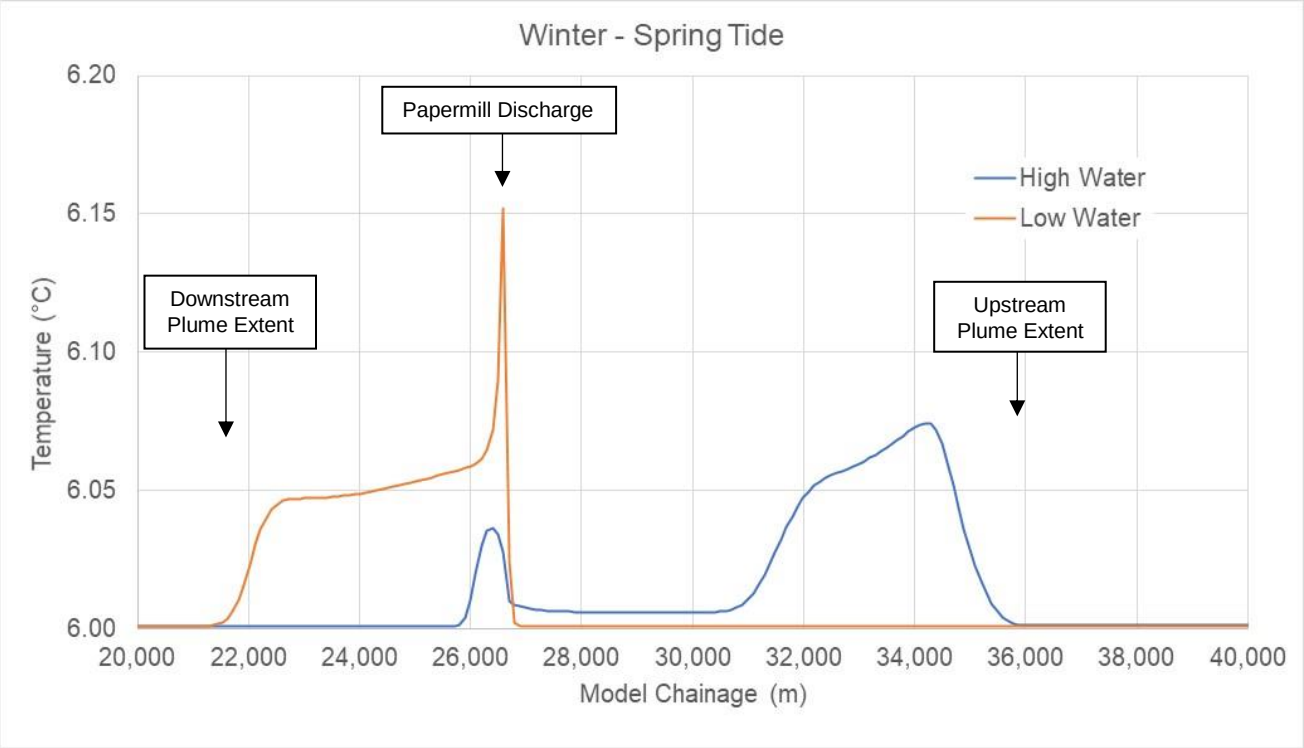

Figure 0-2 Winter - Spring Tide

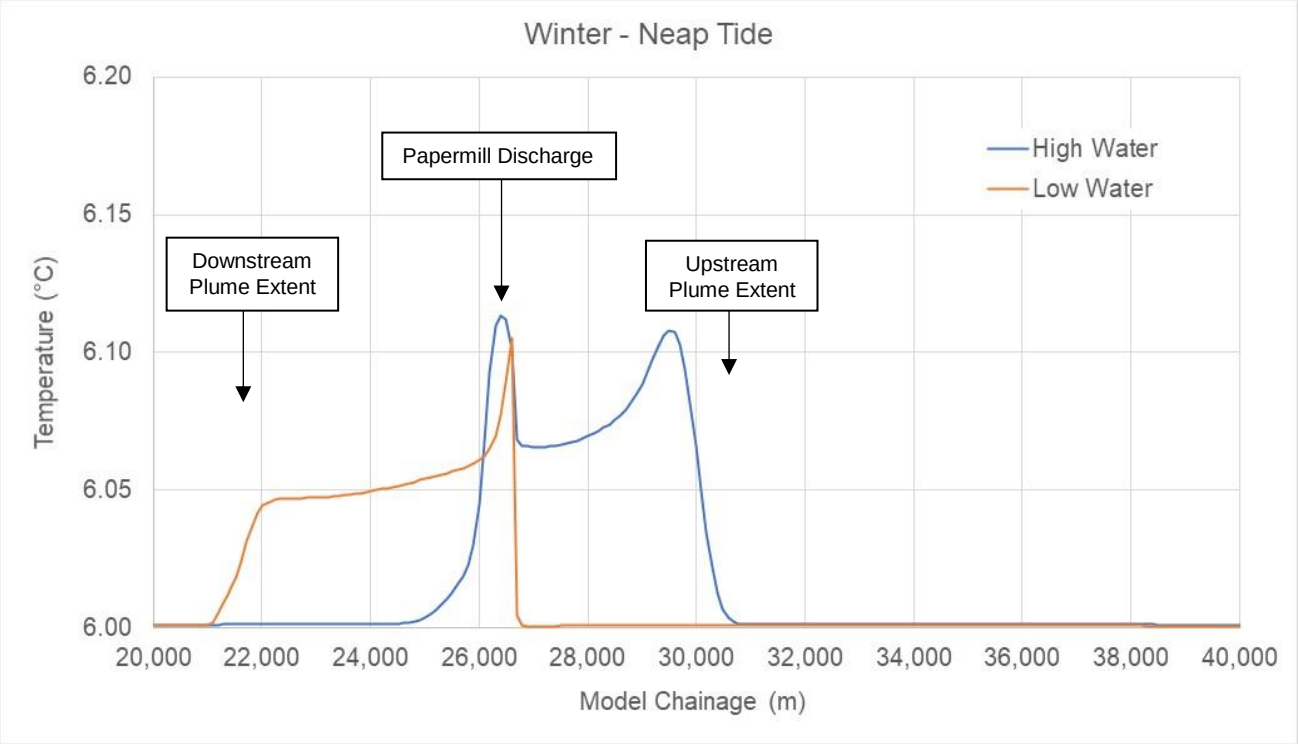

Figure 0-3 Winter - Neap Tide

Summer

The temperature plume extent during summer conditions during spring and neap tides are shown in Figures 3-4 and 3-5, respectively. The predicted maximum temperature increase from background and plume extents are given in Table 3-10.

Table 3-10 Summer - Maximum Temperature Increase and Plume Extent

Tidal Condition	Maximum Temperature (°C)	Maximum Temperature Increase from Ambient (°C)	Maximum Temperature Plume Extent from Point of Discharge (km)	
			Downstream	Upstream
Spring Tide	17.09	0.09	4,900	9,400
Neap Tide	17.07	0.07	5,200	4,500

The results show that the proposed paper mill discharge would have no significant impact on the Dee estuary temperature during summer, with the peak increase in background temperature well within the maximum allowable 3°C threshold.

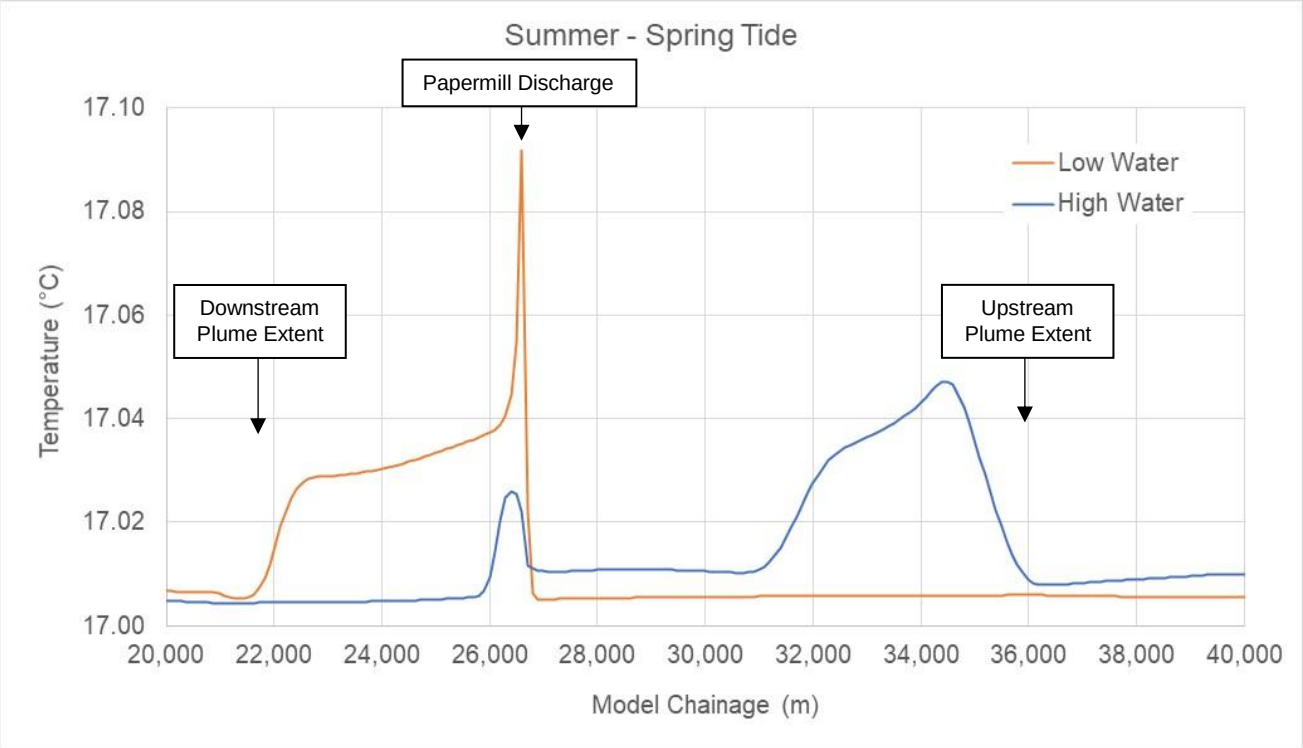

Figure 0-4 Summer - Spring Tide

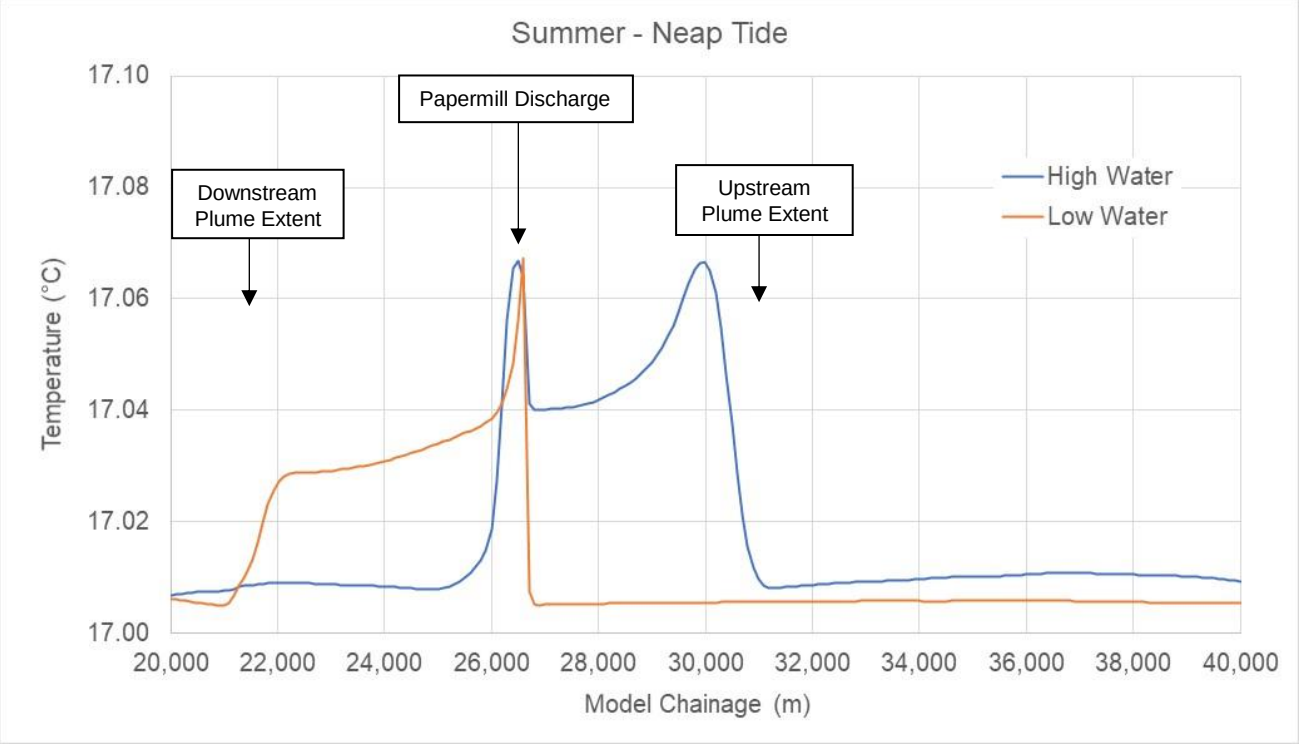

Figure 0-5 Summer - Neap Tide

4 Summary

Consultation with NRW has confirmed that there are no specific additional conditions on a discharge that would be applied due to the environmental designations and sensitivities of the River Dee.

The study has been undertaken in-line with feedback received from NRW, as detailed in their letter dated 23/12/21 (Ref: CAS-176142-P8Y6).

Following the four stages of H1 screening tests, all the parameters assessed in the proposed discharge are screened out.

1D hydraulic and temperature modelling was undertaken to assess the potential impact of the proposed discharge on water temperature in the Dee estuary and define the plume extent under a range of seasonal and tidal conditions. The modelling shows that the proposed discharge would have no significant impact on ambient temperatures within the Dee estuary.

It is concluded that, even during low tide and low river flow conditions (i.e., worst case), the proposed paper mill discharge would not result in unacceptable water quality impacts within the receiving water.

Appendix A

Correspondence

From: ICTUK General <uk.general@ictuk.eu>
Sent: 11 July 2019 18:28
To: Gavin Winter <Gavin.Winter@spawforths.co.uk>
Cc: taj@clearwatergroup.org; Driscoll, Lisa <Lisa.Driscoll@arcadis.com>; Casillo Valerio <v.casillo@ictit.eu>
Subject: R: Papermill Discharge Consent Proposal

Dear Gavin,

Our idea is to get samples from our mill in Montargis (France). The mill has been operating since 2011, then we have enough data to be share with you.

Raw material is virgin pulp from the same sources as for Deeside.

The paper machine in ICT France has the same concept as the one we are going to install in Deeside, therefore also the chemicals are the same. The water treatment plant has a biological treatment and filtration units as thought for Deeside.

Do you think this "declaration" is enough? If not, please let us have a draft for a declaration, and by whom has to be sign (ICT General Manager, for instance).

Kind Regards

Silvano

Da: Gavin Winter <Gavin.Winter@spawforths.co.uk>
Inviato: giovedì 11 luglio 2019 15:02
A: Casillo Valerio <v.casillo@ictit.eu>; ICTUK General <uk.general@ictuk.eu>
Cc: taj@clearwatergroup.org; Driscoll, Lisa <Lisa.Driscoll@arcadis.com>
Oggetto: FW: Papermill Discharge Consent Proposal

Valerio,

When you get an opportunity can you respond to the email below, particularly details as follows:

"Regarding use of proxy samples from another ICT facility in Europe, Rhys thinks this could be feasible. His caveat is that we need to demonstrate that the facility chosen as the proxy processes the same sort of raw material using similar technology and with common additives/coating products etc. We also need to make sure that the wastewater at the proxy site undergoes the same sort of treatment as we propose (e.g. use of flocculants, other dosing). In light of this caveat, could you advise if you think a suitable proxy site is available?"

Kind regards
GAVIN WINTER
Associate: Chartered Town Planner
Phone: 01924 873873 Mobile: 07939 037998

Appendix B

Water Quality Data for Proxy Paper Mill Site

Arcadis UK

Arcadis Cymru House,
St Mellons Business Park,
Fortran Rd,
Cardiff
CF3 0EY

United Kingdom
T: +44 (0)2920 729 800

arcadis.com