Coal Products Limited

Immingham Briquetting Works – Environmental Permit Application

Environmental Assessment – Water Quality

April 2022

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1 Introduction

Bureau Veritas has been commissioned by Coal Products Ltd (CPL) to undertake an environmental assessment to support an Environmental Permit (EP) variation application for operations at their Immingham Briquetting Works. The variation application includes the request to increase the water discharge limit from 500 m^3/day to 1,200 m^3/day as a seven-day rolling average. It also includes a request to operate the current Hydrothermal Carbonisation (HTC) unit (pilot plant) as a fully-fledged unit, from which process effluent will need to be treated and discharged to water.

In view of the proposed changes to the existing permitted installation, it has been identified that an assessment of the potential impact of the proposals on the water quality environment is required.

An initial screening of emissions to water was performed following the Environment Agency – Surface Water Pollution Risk (SWPR) assessment for the environmental permit[1], which replaced the Environment Agency H1 Environmental Risk Assessment methodology, Annex D (Discharges to Surface Waters), withdrawn in February 2016.

This report presents the methodology, input parameters and results undertaken as part of this assessment.

1.1 Scope of Assessment

It is important to note that the current discharges to water from the CPL site are made up of the following:

- Process wastewater (i.e., from existing briquetting and carbon regeneration processes).
- Surface water runoff (i.e., from rainfall).

Wastewater from the caustic wash and impregnation processes has not been included within the scope of this assessment, due to there being no additional wastewater resulting from this plant - this is detailed within the main permit variation application report (section 3.2) . Therefore, the only additional process wastewater as a result of the permit variation will be as a result of amending the current HTC pilot plant to a fully-fledged operational unit.

The primary reasoning behind the request to increase the water discharge limit from 500 m^3/day to 1,200 m^3/day as a seven-day rolling average is to incorporate an increase in surface water runoff. However, in order to demonstrate a worst-case assessment (on the basis that additional dilution is not incorporated), this assessment only focuses on the change in process wastewater (i.e., including effluent from the proposed HTC unit increased usage).

[1] https://www.gov.uk/guidance/surface-water-pollution-risk-assessment-for-your-environmental-permit

2 Methodology

Screening of emissions to water is required when any of the following conditions are met:

- Take the water from groundwater and discharge it to surface water.
- Use the water in a process which concentrates the existing pollutants before it's discharged, for example water which is used for cooling and therefore partially evaporates.
- Keep the water before you discharge it, and you make the quality of river worse than its quality when the water was taken.

Whilst the varied process therefore meets the above criteria and therefore the screening of emissions to water is required, it should be noted that there are no new point source emissions to water associated with the requested permit variation.

The existing process wastewater from Site is mainly associated with cooling related activities associated with the briquetting and, to a lesser extent, with the carbon regeneration processes (the majority of the water is recycled). This is in addition to the site surface drainage. On this basis, the most appropriate screening is therefore that for discharges into cooling water which are then discharged to estuaries or coastal waters.

There are three stages to the SWPR screening process:

- Identify the pollutants released from your plant.
- Gather data on your pollutants before screening them.
- Carry out screening tests on the data.

The SWPR screening assessment presented herein has therefore been undertaken in line with the above methodology.

2.1 Identify the Pollutants Released from Your Plant

The first stage of the screening process requires identification of any hazardous pollutants that are likely to be in the discharge from the site. Potentially hazardous pollutants of relevance to this study are listed in the following tables:

- Estuaries and coastal waters specific pollutants and operational environmental quality standards (EQS).
- Estuaries and coastal waters priority hazardous substances, priority substances and other pollutants.

EQSs are provided for long-term and short-term averaging periods in the form of Annual Average EQS (AA-EQS) and Maximum Allowable Concentration EQS (MAC-EQS)[2].

2.2 Gather Data on Your Pollutants before Screening Them

Where there is no or limited discharge monitoring data available, e.g., for new discharges associated with new processes (as is a similar case here with respect the wastewater discharge arising from the caustic washing and HTC processes), it is necessary to provide an estimate of pollutant data. The SWPR methodology recommends that for screening against the AA-EQS,

[2]https://www.gov.uk/guidance/surface-water-pollution-risk-assessment-for-your-environmental-permit

average discharge concentrations are required based upon a minimum of 12 individual sample results from on-site tests or a proxy site (a similar sized site and manufacturing process which is likely to have a similar discharge).

2.3 Carry out Screening Tests on the Data

With respect to the screening tests for discharges into cooling water which are then discharged to estuaries or coastal waters, Environment Agency SWPR guidance requires two screening tests to be performed. Details of these tests and the associated calculation methodologies are as follows:

- **Screening Test 1** - Work out the predicted average concentration in the cooling water:
  1. Multiply the average background concentration by the average cooling water flow.
  2. Add the average load of the pollutant in your waste stream to the result from step 1.
  3. Add the average process waste stream flow to the average cooling water flow.
  4. Divide the result of step 2 by the result of step 3.
- **Screening Test 2** - Work out the predicted maximum concentration in the cooling water.
  1. Multiply the maximum background concentration by the minimum cooling water flow.
  2. Add the maximum load of the pollutant in your waste stream to the result from step 1.
  3. Add the average process waste stream flow to the minimum cooling water flow.
  4. Divide the result of step 2 by the result of step 3.

Detailed modelling is deemed to be required if the concentration of the pollutant in the water is identified to be more than the relevant AA-EQS or MAC-EQS. If it is found to be less, then no further action is required.

3 Current Baseline Water Environment

Table S3.2 of the existing Environmental Permit (DP3134LK) for the site stipulates several limits in relation to the water discharged via the release point W1. These are detailed in Table 3.1 below:

Table 3.1 - Limits relating to Point Source Emissions to Water

Emission Point Ref. & Location	Source	Parameter	Limit (including unit)	Reference Period	Monitoring Frequency	Monitoring Standard or Method
W1 on site plan in Schedule 2 emission to ABP drainage system	Effluent Treatment Plant	Flowrate	500 m^3/day	Seven day rolling average	Continuous	Permanent sampling access not required
		Temperature	40 °C	24-hour period	Continuous	Permanent sampling access not required
		pH	6 – 10	Instantaneous	Continuous	BS6068-2.50
		Oil and Grease	No visible emission	24-hour flow proportional sample	Analysed weekly	Permanent sampling access not required

Wastewater discharge from the briquetting and carbon regeneration processes, and the site surface drainage, currently passes through settlement pits and an effluent treatment plant prior to discharge to the ABP Immingham Docks on the Humber Estuary. It should be noted that the wastewater is not directly discharged to either surface water or sewer.

Figure 3.1 details the average monthly volume discharged from Site, from January to December 2021, inclusive. This is indicative of higher discharge rates during winter months, when rainfall is expected to be higher.

Figure 3.1 - Site Discharge Flowrate (Monthly Average 2021)

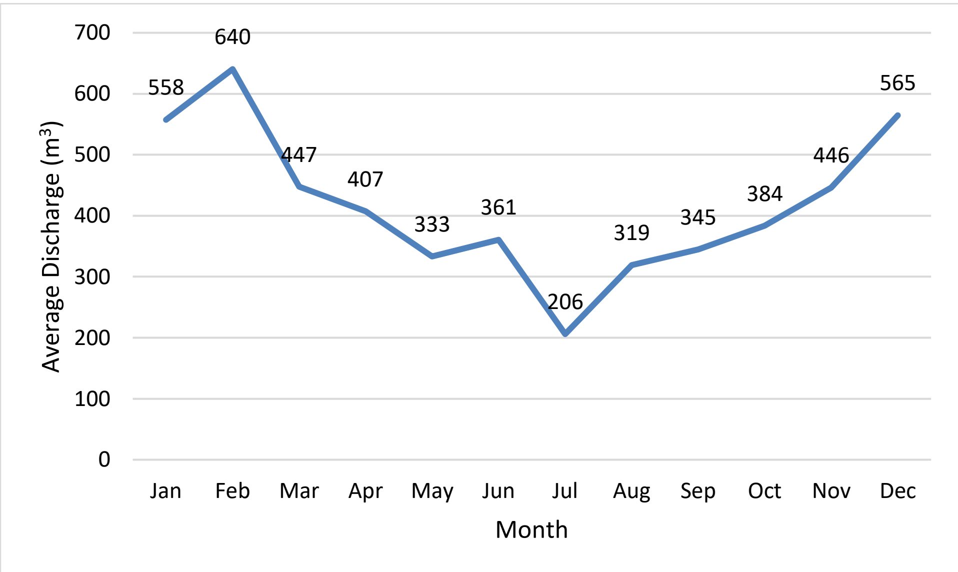

Table S4.3 of the existing EP for the site also places a requirement on CPL to provide various performance parameters on a monthly basis, in relation to the water discharged via the release point W1. These are summarised for January 2020 to December 2021 and January – February 2022 in Table 3.2.

Table 3.2 – 2020-22 Water Performance Parameters – Average Monthly Values

Parameter	Average Value Jan-Dec 2020	Average Value Jan-Dec 2021	Average Value Jan – Feb 2022	Units
Total mass of COD	505	702	345	mg/l
Total mass of BOD	276	350	216	mg/l
Total mass of Copper (Cu)	194	299	57	µg/l
Total mass of Zinc (Zn)	420	760	375	µg/l
Total mass of Lead (Pb)	11	10	8	µg/l
Total mass of Chromium (Cr)	72	61	47	µg/l
Total mass of Nickel (Ni)	136	136	120	µg/l
Total mass of Arsenic (As)	104	79	81	µg/l
Total mass of Cadmium (Cd)	0.34	0.19	0.21	µg/l
Total mass of Mercury (Hg)	0.04	0.05	0.03	µg/l

In addition, CPL report annual performance parameters to the EA, termed 'bulk discharges', which are assessed against the relevant reporting limits. Data on the total annual discharge of pollutants for the past three years are provided in Table 3.3 below. Those results shaded green are below the relevant limit.

There are four species for which the bulk discharge value has been above the reporting limit in the past couple of years; Arsenic, Copper, Nickel and Zinc. In most instances these were due to abnormal conditions and CPL have been able to take action to rectify consequent emissions.

For example, the briquetting plants are subject to corrosion and in 2020/2021 the number 2 plant had issues with SO_2 emissions. The resulting investigation uncovered plant corrosion and, as such, CPL has invested in a refurbish programme to remove older, damaged equipment. This was completed in late 2021.The latest 2022 concentrations indicate that Zinc and, to lesser extent, Nickel concentrations have returned to lower levels prior to the increases in 2020 and 2021 levels. This can be seen in Table 3.2.

Arsenic is derived from the coal used in the briquetting plants – the loss of indigenous coals, coupled with the effects of COVID-19 have left the Immingham Works sourcing coals from more diverse sources, which has led to this increase. It is important to note however, that the briquetting plants are not subject to this permit variation, as this is unrelated to carbon regeneration and the HTC. Inversely,

Copper is derived from the regeneration process when incoming spent carbon for processing has had copper salts impregnated to increase its absorbency. There is a marked reduction in copper in the 2022 year-to-date (YTD) figures. This is due to the increasing price of copper, leading to a reduction in copper use during impregnation of activated carbons, and this trend is expected to continue. On the other hand, caustic impregnation methods are on the increase, which is the primary process being introduced as part of this permit variation.

It is also important to note that these bulk discharge data occur at the point of release. The discharge goes to the ABP drainage system and then to the Humber Estuary; at both points the discharge undergoes further dilution.

Table 3.3 – Bulk Discharge Data (kg)

Year	TOC	Cl	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
2019	32,224	40,016	14.29	0.075	26.66	48.03	0.126	27.8	2.03	82.1
2020	19,928	70,880	16.35	0.054	11.24	30.53	0.006	21.3	1.68	66.0
2021	26,415	79,725	9.43	0.028	9.25	45.40	0.007	20.6	1.51	115.5
Reporting Limit (kg)	**50,000**	**2,000,000**	**5**	**1**	**20**	**20**	**0.1**	**20**	**20**	**100**
Comments	Below reporting limit.	Below reporting limit.	As derived from trace amounts in coal.2021 is significantly lower than 2019/20 and the average thus far for 2022 is more in line with 2021	Below reporting limit.	Below reporting limit for last two years.	Derived from impregnated carbon. 2022 YTD data is lower due to moving away from copper impregnation, this trend is expected to continue.	Below reporting limit for last two years.	Corrosion in the plant identified and refurbished.	Below reporting limit.	Corrosion in the plant identified and refurbished.

4 SWPR Results

4.1 Wastewater Flowrate

Table 4.1 provides for an estimate of the total discharge flowrate via release point W1 for the current baseline scenario and for the varied operational scenario, which incorporates the site activities as proposed within this variation.

Table 4.1 - Estimated Wastewater Flowrate for W1

Process	Wastewater Discharge Flowrate (m^3/annum)	
	Baseline Scenario	Varied Operational Scenario
HTC Unit [a]	44	456
Existing site drainage [b]	137,722	137,766
Total Wastewater	**137,766**	**138,225**

[a] HTC unit operating as a pilot plant.

[b] Estimate based upon the average measured discharge via W1 between Jul-Dec 2021 inclusive.

It is estimated therefore that due to the varied site activities as detailed within this Permit Variation, there will typically be an increase in process wastewater discharged via W1 by approximately 456 m^3/annum, which is equivalent to a 0.33% increase relative to the current baseline scenario.

Any additional wastewater from future operation of the site will be as a result of surface water runoff from rainfall (i.e., not contaminated from CPL processes) rather than process wastewater.

4.2 Wastewater pH

No variation with regards to this aspect to the wastewater release via discharge point W1 is requested as a consequence of the varied site activities as detailed within this Permit Variation.

4.3 Wastewater Temperature

No variation with regards to this aspect to the wastewater release via discharge point W1 is requested as a consequence of the varied site activities as detailed within this Permit Variation.

4.4 Wastewater Oil and Grease

No variation with regards to this aspect to the wastewater release via discharge point W1 is requested as a consequence of the varied site activities as detailed within this Permit Variation.

4.5 Estimates of Contaminants

Process wastewater from the HTC pilot plant was sent for effluent analysis and potential contaminants identified. The potential pollutants identified in the effluent analysis were then subjected to a screen against the Environmental Quality Standards (EQSs) for estuaries and coastal waters; the Annual Average EQS (AA-EQS) and Maximum Allowable Concentration EQS (MAC-EQS), as provided in the EA's SWPR guidance. These analytical results are reproduced below in Table 4.2.

Table 4.2 - Estimates of HTC Process Water Effluent Contaminants

Parameter	Result from HTC Unit (mg/l)
NH_4^+	633
COD	13,550
As	<0.5*
Cd	<0.01*
Cr	<0.2*
Cu	0.21
Hg	<0.05*
Ni	<0.2*
Pb	<0.5*
Zn	21.6
Al	11.8
BOD	5,790

*Analysis result below the Limit of Detection.

Only one process water sample is available to be used for this screening assessment and it is important to highlight that some of the reported values are below the Limit of Detection (LoD). In some cases, the LoD is already above the EQS limits. It is therefore likely that the actual contaminant figures associated with the expanded HTC process effluent will be less than the values reported.

Whilst the sample number is limited, it is considered that these data provide for a representative estimate of the likely contamination levels that will be observed at the CPL site, given the sample was taken from the process wastewater as currently operating (i.e., with the same feedstock as is proposed within the variation).

These data have therefore been taken forward to the SWPR screening assessment, for comparison against the AA-EQS and MAC-EQS values for the following:

- Arsenic.
- Cadmium.
- Chromium.
- Copper.
- Mercury.
- Nickel.
- Lead.
- Zinc.

4.6 Baseline Contaminants in Existing Wastewater

To support the SWPR screening assessments, baseline measurements for the identified potential contaminants as presented above were taken at the CPL site. Table 4.3 provides a summary of the analytical results for the identified hazardous pollutants.

Table 4.3 - Baseline Contaminants in Existing Wastewater

Parameter	Average Value Jan-Dec 2021	Units
Total mass of COD	702	mg/l
Total mass of BOD	350	mg/l
Total mass of Copper (Cu)	299	µg/l
Total mass of Zinc (Zn)	760	µg/l
Total mass of Lead (Pb)	10	µg/l
Total mass of Chromium (Cr)	61	µg/l
Total mass of Nickel (Ni)	136	µg/l
Total mass of Arsenic (As)	79	µg/l
Total mass of Cadmium (Cd)	0.19	µg/l
Total mass of Mercury (Hg)	0.05	µg/l

The information as presented in Table 4.3 has therefore been used as the basis for the baseline contamination present in the wastewater associated with all existing CPL site activities.

4.7 Screening Results

The above information has been used to complete the required screening tests for discharges into cooling water which are then discharged to estuaries or coastal waters in line with the Environment Agency SWPR guidance. The following scenarios have been considered:

- Scenario 1: baseline scenario (as currently operating).
- Scenario 2: proposed scenario (current operations + full operational HTC unit).

Results are presented in Table 4.4 and Table 4.5 for Scenario 1 and 2, respectively. Less than (<) signs indicate where HTC process effluent results have been added that are below the limit of detection. it is therefore likely that the actual contaminant figures associated with the expanded HTC process effluent will be less than the values reported.

Table 4.4 – Scenario 1: Water Screening Results

Parameter	AA-EQS (µg/l)	MAC-EQS (µg/l)	Average Concentration (µg/l)	Max Concentration (µg/l)
Cu	3.76	Not applicable	299	Not applicable
Zn	6.8	Not applicable	760	Not applicable
Pb	1.3	14	10	10
Cd	0.2	Not applicable	0.19	Not applicable
Hg	Not applicable	0.07	Not applicable	0.05
Ni	8.6	34	136	136
Cr	0.6	32 (95th percentile)	61	61
As	25	Not applicable	79	Not applicable

Table 4.5 – Scenario 2: Water Screening Results

Parameter	AA-EQS (µg/l)	MAC-EQS (µg/l)	Average Concentration (µg/l)	Max Concentration (µg/l)
Cu	3.76	Not applicable	299	Not applicable
Zn	6.8	Not applicable	829	Not applicable
Pb	1.3	14	<11.6	<12.9
Cd	0.2	Not applicable	<0.22	Not applicable
Hg	Not applicable	0.07	Not applicable	<0.35
Ni	8.6	34	<136.2	<136.4
Cr	0.6	32 (95th percentile)	<61.5	<61.8
As	25	Not applicable	<80.4	Not applicable

On the basis of the screening tests presented above, the parameters scoped into the assessment are shown to be above the water screening AA-EQS' and MAC-EQS'. However, this is the case for Scenario 1 (baseline) as well as Scenario 2 (proposed).

On this basis, the focus of the assessment is to evaluate the potential change in levels as a result of the HTC process, i.e., the change as a result of the proposed permit variation. This recognises that the screening criteria are conservative and apply at the point of discharge when, in fact, the CPL discharge will be further diluted in the ABP drainage system before being discharged to the Humber Estuary (where it will then be diluted even further).

Table 4.6 provides a comparison of water screening results between Scenarios 1 and 2. It demonstrates minimal changes with regards to increases in pollutant loadings. It is also important to note that Scenario 2 data is based on one sample from the existing HTC process effluent, where the majority of parameters were below the limit of detection, meaning the majority of contaminant figures used for the assessment of HTC effluent are less than the values reported.

Table 4.6 – Summary of Water Screening Results

Parameter	Scenario 1 Average Concentration (µg/l)	Scenario 2 Average Concentration (µg/l)	Percentage Change from Scenario 1 to Scenario 2
Cu	299	299	<0.01%
Zn	760	829	9.1%
Pb	10	<11.6	<16.0%
Cd	0.19	<0.22	<15.8%
Hg	-	-	-
Ni	136	<136.2	<0.2%
Cr	61	<61.5	<0.8%
As	79	<80.4	<1.8%

Given that the EA request bulk discharge data from CPL on an annual basis, a summary of the potential changes as a result of the addition of the HTC unit to a fully-fledged unit is provided in Table 4.7 below.

Again, it is important to note that Scenario 2 data is based on one sample from the HTC process effluent, where the majority of parameters were below the limit of detection.

2022 bulk discharge data has been estimated for comparison, based on the following:

- 2022 (estimated), which uses 2021 data + HTC data.
- 2022 (YTD scaled), which uses pro-rata data from January and February 2022 + HTC data.

When incorporating the HTC effluent values into the 2022 bulk discharge returns (estimated using 2021 data + HTC), the results remain consistent with the 2021 return, in that the addition of full operation of the HTC unit does not push parameters over the reporting limit. Note, due to refurbishment of some plant as detailed in Section 3, the existing pollutant loadings through 2022 are expected to decrease when compared with 2021, particularly for Zinc. Those results shaded green are below the relevant limit.

Table 4.7 – Proposed Bulk Discharge Data (kg)

Parameter	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Reporting Limit (kg)	**5**	**1**	**20**	**20**	**0.1**	**20**	**20**	**100**
2021 (current)	9.43	0.028	9.25	45.40	0.007	20.6	1.51	115.5
HTC only	<0.23	<0.005	<0.09	0.10	<0.023	<0.1	<0.23	9.9
2022 (estimated)	<9.66	<0.033	<9.34	45.50	<0.030	<20.7	<1.74	125.4
2022 (YTD scaled)	<14.80	<0.04	<8.32	9.81	<0.01	<21.33	<1.41	67.89
% change (2022 YTD versus 2021)	<57%	<33%	-10%	-78%	-22%	<3%	-7%	-41%

4.8 Dilution into Humber Estuary

The Humber Estuary is one of the largest estuaries, going into the North Sea, with a catchment approximately 20% of the land area of England[3], incorporating catchment flows from the rivers Aire, Trent, Ouse, Derwent and Wharfe. As such, it follows that significant dilution will take place upon discharge.

The mean freshwater river flow[4] into the Humber Estuary is 240 m^3/s, with a total volume at high water of 2.5×10^9 m^3 and, at low water, 1.1×10^9 m^3. At the point of discharge from the Port of Immingham, the Humber Estuary is approximately 3.05 km wide at low water, with an average depth[5] of approximately 9.0 m.

Considering the tidal prism, that is the amount of water that flows into and out of an estuary or bay with the flood and ebb of the tide, discharges from the CPL site would be heavily diluted. For example, the tidal prism at neap tide[4] is 0.8×10^9 m^3. For context taking an estimated annual bulk discharge of copper in 2022 of 45.4 kg (see Table 4.7), and dilution in the neap tide volume, this would result in ~0.06 µg/l of copper, well below the AA-EQS for Cu of 3.76 µg/l. Note this would be even lower using the 2022 YTD data.

On this basis, releases to water as a consequence of the varied site activities as detailed within this permit variation are not expected to cause additional adverse effects upon the Humber Estuary, due to the small increase projected from the HTC. It should be emphasised that further dilution will also occur during the transport of the discharged wastewater as it passes through the ABP drainage system prior to its discharge in to the ABP Port of Immingham.

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3 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/297466/gene0611btzc-e-e.pdf

4 http://www.estuary-guide.net/pdfs/chapter3_estuary_setting.pdf

5 https://www.humber.com/Estuary_Information/Marine_Information/Chart_Catalogue/Current_Humber_Charts/

5 Conclusions

Following the SWPR assessment methodology, potential hazardous pollutants associated with the varied site activities as detailed within this variation were identified.

The collated information on potential contaminants was used to complete the required screening tests for discharges into cooling water, which are then discharged to estuaries or coastal waters, in line with the Environment Agency SWPR guidance. This was on the basis that the wastewater from on-site processes will be transferred to the existing works effluent system, whereby it will be mixed with the existing wastewater/surface water run-off from the Site before being discharged via the existing discharge point W1.

On the basis of the screening tests presented, the parameters scoped into the assessment are shown to be above the water screening AA-EQS' and MAC-EQS'. However, this is the case for Scenario 1 (baseline) as well as Scenario 2 (proposed).

On this basis, the focus of the assessment was to evaluate the potential change in levels as a result of the HTC process, i.e., the parameters set to change as a result of the proposed permit variation. This recognises that the screening criteria are conservative and apply at the point of discharge when, in fact, the CPL discharge will be further diluted in the ABP drainage system before being discharged to the Humber Estuary (where it will then be diluted even further).

Bulk discharge data for current and proposed processes was also compared, as this is what is currently reported to the EA on an annual basis. When incorporating the upper limit of HTC effluent values into the 2022 bulk discharge returns (estimated), the results remain consistent with the 2021 return, in that the addition of the full operation of the HTC unit does not push parameters over the reporting limit. In fact, through 2022 contaminant loading of some pollutants is expected to decrease, due to plant refurbishment through 2021 and increases in the price of copper reducing the amount used in the impregnation process.

Putting the results into context, it is important to note that the Humber Estuary is one of the largest estuaries, going into the North Sea. As such, it follows that significant dilution will take place upon discharge.

Considering the tidal prism, that is the amount of water that flows into and out of an estuary or bay with the flood and ebb of the tide, discharges from the CPL site would be heavily diluted. For example, the tidal prism at neap tide is $0.8x10^9$ m^3. Taking copper as an example, the dilution is so significant that the dilution would take copper concentrations well below the AA-EQS.

On this basis, releases to water as a consequence of the varied site activities as detailed within this variation are not expected to cause adverse effects upon the Humber Estuary.

Appendix A – HTC Process Water Effluent Analysis