Geosyntec consultants

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[redacted]

14th October 2024
Our Ref: GCU0355001/AM/141024

Angus Fire Ltd
Station Road
Bentham
Lancaster
LA2 7NA.

For the attention of: [redacted].

Interim PFAS Impacted Stormwater Management Status, Future Full Scale Stormwater Treatment Discharge Criteria and Associated Permitting Mechanism

This letter has been prepared to fulfil an action noted during the meeting between the stormwater management project team (Angus Fire Ltd and Geosyntec Consultants), the Environment Agency and United Utilities on Wednesday 9th October at Angus Fire Ltd, High Bentham (the Site). This letter focusses upon the discussion and assessment undertaken in relation to:

1. Managing PFAS impacted stormwater currently being collected and stored on the Site as an interim measure
2. Discharge criteria and permitting mechanism for the proposed on-Site stormwater treatment system, both of which require regulatory agreement to inform procurement decisions, mobilisation and commissioning to provide a long term solution to stormwater management.

Interim PFAS Impacted Stormwater Management Status.

During the meeting, the project team discussed in detail the evolving interim PFAS impacted stormwater containment situation at the Site which is becoming increasingly challenging to manage, where off-site disposal or treatment is not currently viable. The key points of the discussion were:

- Whilst being expensive and unsustainable long-term, AFL were committed to continue with the offsite disposal route, which had been previously implemented with 257 m³ of water being incinerated off site. However, three UK waste brokers, who we believe have full market coverage, are no longer able to provide a viable off-site disposal route. We discussed the potential that an alternative treatment route in Swansea is the only option currently under consideration, but were warned by the contractor that this was unlikely to be acceptable based to the PFAS concentrations in stormwater.
- The project team have estimated the volume of stormwater currently in storage on-Site is 1,178 m³ and, as observed on the Site walk during meeting, the available area to store more IBCs is increasingly limited.

- The project team discussed with United Utilities their previous request, during our meeting on 26th September regarding any potential to discharge various components (downpipe rainwater, stored IBC water, and direct stormwater from onsite drains) of the stormwater to the UU waste water treatment plant without treatment. United Utilities stated that, with PFAS being an emerging contaminant of concern in UK and the waste water treatment plant at High Bentham having no specific PFAS treatment element included within it, their position was to take a precautionary approach and not accept any level of PFAS to their treatment plant currently. United Utilities noted that they had considered accepting the stormwater at an alternative facility with greater capacity but the Environment Agency declined this option based on dilution of effluents which are not collected local to the alternative facility being impermissible.

Further to the meeting, the project team have undertaken additional assessment to allow the project stakeholders to be more informed in relation to both the urgency and the timeframe upon which the site limitations are reached. We have calculated based on site space currently available and the average stormwater collection rates the site has capacity to store stormwater for up to 30 more days (dependent on rainfall and the additional capture of the French drain water at S35).

The proposed on-Site treatment system will take up to 12 weeks to mobilise and commission from point of authorisation. The Environment Agency stated that variation of the site permit was infeasible within this timeframe. Also, mobilisation of the treatment system is impermissible before a mobile plant permit is in place. ***Exceeding the on-Site storage capacity is therefore foreseeable in the imminent future unless a solution to this interim management is found. Neither United Utilities nor Environment Agency was able to agree upon a solution, and therefore the Site remains in a situation that is critical and unresolved.***

Question 1: Based on the situation outlined above could the Environment Agency or United Utilities identify and consider any short-term emergency solutions/consents which they are able to deploy to allow the imminent site storage capacity issue to be addressed?

Clarification of Proposed Full-Scale Treatment Discharge Criteria.

Based on the stated position of United Utilities, and appreciating the Environment Agency's position in relation to minimising the impact on the River Wenning and deployment of best available techniques (BAT), Geosyntec stated that the originally proposed discharge criteria be reduced from <50 ng/l PFOS to **10 ng/l PFOS**; as the current only regulated PFAS in the River Wenning.

Reducing PFOS to 10 ng/l would represent greater than two-order of magnitude reduction in concentration (>99%) through treatment compared to the influent concentration, as reported to be achievable in bench scale pilot testing. We believe this criterion supports the current most technically achievable PFAS treatment performance. The Environment Agency PFAS team noted that this proposed PFOS criteria should be assessed against the overall impact to the River Wenning. Based on this advice we have undertaken the following assessment following the EA guidance entitled "Surface water pollution risk assessment for your environmental permit"[1]. This guidance outlines how to carry out a risk assessment if you are applying for a bespoke permit that includes discharging hazardous chemical and elements to surface water and

[1] Surface water pollution risk assessment for your environmental permit - GOV.UK (www.gov.uk)

therefore we believe this is applicable to our current situation. We present below how we have followed this framework:

Test 1

Check whether the concentration of the chemical and element in the discharge is more than 10% of the environmental quality standard (EQS).

If it's less than 10% you do not need to collect the data for the next 3 tests – you do not need to do anything more as your hazardous chemicals and elements are not a risk to the environment.

If it's more than 10%, carry out test 2.

If you have 2 or more discharges of the same chemical and element from different parts of your plant you will need to test them separately.

Current PFOS concentrations in stormwater show that the effluent would be greater than 10% of EQS and therefore fail this test and need to progress to Test 2.

Test 2

This test introduces the dilution available in the receiving water. You will need the river flow data and daily discharge volume for this test.

Check whether the process contribution (PC) of your chemical and element is more than 4% of the EQS. PC is the concentration of a discharged chemical and element in the water after it's been diluted.

Contact the Environment Agency to get the river flow data for the water you are discharging to.

Do the following steps to work out the PC.

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

If your value for PC is 4% or less of the EQS, you do not need to carry out tests 3 and 4.

If the PC is more than 4% of the EQS you will need to carry out tests 3 and 4.

Further to collating the flow rate data required for each of the elements of this test we have completed the test for two potential discharge scenarios:

1. Scenario 1 which is considered to be a conservative assessment as it uses a higher effluent discharge rate of 100 m^3/day, a 50% higher discharge criteria than we are currently proposing (i.e. 15 ng/l compared to 10 ng/l) and a lower river flow rate of 1 m^3/s compared to published data (<2.5 m^3/s).
2. The second scenario is considered to be more reasonable where we reduce the effluent discharge rate (80 m^3/day) based on recorded discharge volumes from the Site, and proposed PFOS discharge criteria (10 ng/l), whilst still using the lower river flow rate of 1 m^3/s.

Both scenario calculations are illustrated below: -

Scenario 1: Conservative Assessement - High Discharge Rate, Higher than Proposed Discharge Criteria & Reduced River Wenning Flow Rate			
Effulent Flow Rate (EFR)	100	m3/day	Maximum Consent discharge allowance
release concentration (RC)	15	ng/l	50% greater than our proposed discharge criteria of 10n/gl
River Flow Rate (RFR)	1	cumecs	Envirocheck data reports upstream of the site the River Wennigng discharges are less than 2.5cumecs - we have therefore conservatively used 1 cumec
	60		m3/min conversion
	3600		m3/hr conversion
	86400		m3/day
Step 1			
EFR x RC	1500		100*15
Step 2			
EFR + RFR	86500	m3/day	86,400+100
Step 3			
EFR x RC / EFR + RFR	0.017341		
PFOS AA-EQS	0.65		ng/l
PC = step 3 result / AA-EQS * 100	**2.67**		% - test passed <4%

Scenario 2: Reasonable Assessement - High Discharge Rate, Proposed Discharge Criteria & Reduced River Wenning Flow Rate Remains			
Effulent Flow Rate (EFR)	80	m3/day	Reduced to 80m3/day - this is still double the average weekly volume reported from S1 between January and July 2024.
release concentration (RC)	10	ng/l	50% greater than our proposed discharge criteria of 10n/gl
River Flow Rate (RFR)	1	cumecs	Envirocheck data reports upstream of the site the River Wennigng discharges are less than 2.5cumecs - we have therefore conservatively used 1 cumec
	60		m3/min conversion
	3600		m3/hr conversion
	86400		m3/day
Step 1			
EFR x RC	800		80*10
Step 2			
EFR + RFR	86480		86,400+80
Step 3			
EFR x RC / EFR + RFR	0.0092507		
PFOS AA-EQS	0.65		ng/l
PC = step 3 result / AA-EQS * 100	**1.42**		% - test passed <4%

Both scenarios demonstrate the process contribution (PC) is <4% of PFOS AA-EQS (0.65 ng/l). Based on these results the guidance stipulates "If your value of PC is 4% or less of the EQS, you do not need to complete any further tests".

In addition the analysis focused upon of the discharge concentrations, the project team have also undertaken additional investigation into alternative discharge points. The viability of utilising S2 as the treatment system discharge point has been investigated and the project team believe the proposed treatment flow rates (≤100 m^3/day or ≤0.7 l/s) could be accommodated by this discharge, thus allowing diversion from the S1 v-notch and the wastewater treatment system, as currently recommended United Utilities.

During the meeting the Environment Agency PFAS team also asked the project team to consider the overall PFAS treatment efficiency. Table 1 below illustrates the bench scale surface activation foam fractionation (SAFF) treatment results for the PFAS 50 Suite plus 6:2FTAB.

Table 1: Bench Scale SAFF Treatability Results.

	Baseline Pre-Treatment Concentration	Post Bench Scale SAFF Treatment Concentration	Estimated Removal Rate	LOD/LOR	Units
Regulated Substances					
PFOS	5.24	*0.05*	>99.05%	<0.05	ug/l
PFAS Component Substances >1ug/l					
6:2 FTAB (Capstone B)	4000	5.00	99.88%	<4	ug/l
6:2 FTS	137.7	*0.20*	99.85%	<0.2	ug/l
PFHxA	18.17	0.09	99.50%	<0.05	ug/l
8:2 FTS	15.5	0.20	98.71%	<0.2	ug/l
PFPeA	3.39	1.68	50.44%	<0.05	ug/l
PFHpA	2.46	0.05	97.97%	<0.05	ug/l
PFBA	1.84	1.46	20.65%	<0.05	ug/l
PFOA	1.74	0.05	97.13%	<0.05	ug/l
5:3 FTCA	1.2	0.50	58.33%	<0.5	ug/l
PFAS Component Substances <1ug/l					
PFHxS	0.61	0.05	91.80%	<0.05	ug/l
PFNA	0.22	0.05	77.27%	<0.05	ug/l
PFDA	0.27	0.05	81.48%	<0.05	ug/l
PFUnA	0.08	0.05	37.50%	<0.05	ug/l
PFDoA	0.2	0.05	75.00%	<0.05	ug/l
PFTrDA	0.05	0.05	0.00%	<0.05	ug/l
PFTeDA	0.05	0.05	0.00%	<0.05	ug/l
PFHxDA	0.1	0.10	0.00%	<0.1	ug/l
PFODA	0.1	0.10	0.00%	<0.1	ug/l
PFBS	0.12	0.05	58.33%	<0.05	ug/l
PFPeS	0.09	0.05	44.44%	<0.05	ug/l
PFHpS	0.07	0.05	28.57%	<0.05	ug/l
3:3 FTCA	0.1	0.30	-200.00%	<0.1	ug/l
7:3 FTCA	0.1	0.10	0.00%	<0.1	ug/l
4:2 FTS	0.5	0.20	60.00%	<0.2	ug/l
FHxSA	0.06	0.05	16.67%	<0.05	ug/l
FOSA	1	1.00	0.00%	<1	ug/l
*Green text illustrates post treatment results which equal PFAS 50 standard laboratory detection limits					

PFOS is effectively treated by SAFF, and using our previous project team experience, we are confident to propose a lower discharge concentration criterion than the standard laboratory detection limit for this regulated substance (i.e. 10 ng/l).

In relation to non-regulated PFAS substances which report pre-treatment concentrations greater than 1µg/l, we see similar concentration reduction of ~80% on average. This performance is conservatively based on substituting laboratory detection limits for the treated water (i.e. <50 ng/l = 50 ng/l). Full scale SAFF

treatment is more effective and efficient. With a full-scale SAFF treatment system including a secondary adsorption polishing phase prior to discharge, we expect an average 90% reduction in concentrations for these non-regulated PFAS substances also. As outlined in Table 1, of the ten PFAS component substances with a baseline pre-treatment concentration **>1ug/l,** seven of these have already demonstrated an estimated concentration removal rate, via bench scale SAFF, in excess of 97%. Therefore, to achieve an average removal rate in excess of 90% for non-regulated substances, the primary contribution to this improvement has to be achieved by focusing upon specific PFAS substances which have had a lower removal rate from SAFF alone. These PFAS component substances will be the core focus of optimising the polishing stages of the final commissioned treatment train.

It should also be noted that the overall approach of the full-scale Stormwater Treatment Plant will not be to just meet these proposed concentrations, but to achieve lowest achievable concentration levels from the applied technologies and this will be an evolving process.

As discussed during our meeting we have also received approval from Cornelsen to provide the case studies relating to SAFF / treatment train systems which have similarly been deployed in the UK, these are attached for completion and comparison.

Question 2 – Do the EA, as the principal regulatory enforcement agency, based on the quantified assessments completed herein consider the proposed discharge concentrations as appropriate for submission within the future permitting approach and subsequent planned discharge once permitting approval is granted?

Stormwater Permitting Mechanism

During the meeting discussion the permitting mechanism for stormwater treatment train system was discussed. The project team identified two principal permitting mechanisms: -

- System deployment under Cornelsen's Mobile Plant License (appreciating subsequent transition into the Site Environmental Permit would be required towards the end of the first year of operation)
- A formal variation to the site permit directly for the treatment system.

In addition to above points, the Ramboll permitting team also questioned specific elements of the site permit which could be potentially leveraged to facilitate deployment and installation of the treatment system in the timeliest manner (to be addressed under separate cover). In essence the project team do not have one specific preference on the permitting route, and it was clearly stated the most expedient approach should be followed.

The Environment Agency Permitting team stated they would revert back to us as soon as possible with information regarding which permitting mechanism is currently the most time efficient from their perspective. The permitting team clarified that a Local Enforcement Position (LEP) could not be applied for until an application (whichever route) is submitted. The project team acknowledged this clarification and noted that an LEP would likely follow any application request to the current site situation.

Question 3 – Based on the critical operational risk at the Site, can the EA please advise, which would be the most expedient route to seek permitted approval to release water managed through the planned

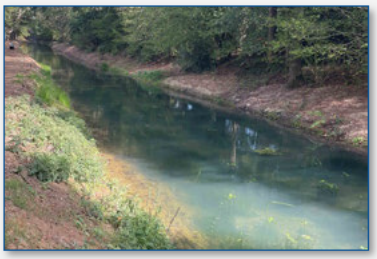
stormwater processing plant (using best available techniques) based on the proposed discharge concentrations outlined in this report.

We trust the above and attached provides clarity and focusses upon the regulatory responses we urgently require to maintain the momentum in this project and proactively manage the urgent site situation. Obviously if you have any further comments or queries, please do not hesitate to contact us.

Regards

Water Treatment ♦ **PFAS Treatment** ♦ Remediation

Case Study



Source Water Body

Primary and Secondary Stages

Surface Active Foam Fractionation (SAFF®)

PFAS Treatment of Surface Water Body - Former Airfield

Client: Confidential

Location: South UK

Contaminants: PFAS

Site Characteristics

- Former airfield
- Multiple PFAS sources
- PFAS contaminated surface water body.
- Baseline PFOS concentrations ranged from 150-4,000ng/L

Treatment Plant

- Surface Active Foam Fractionation (SAFF®)
- Associated treatment plant including TSS removal & organoclay polishing system
- Treatment rate: ~20 m^3/hr

Total Volume Treated

- ~80,000 m^3 over 9 months

SAFF® Performance (1)

- Avg PFOS influent: 421ng/l
- Avg PFOS effluent: 14ng/l
- Avg PFOS Removal: **97%**
- Avg PFAS 19 Removal: 71%

Total PFAS Waste

- 550 Litres(2) waste volume

Challenges

- Complex surface water quality with high suspended solids, TOC and algae

Note 1: Prior to final organoclay polishing

Note 2: Consider the enormous mass of activated carbon which would otherwise have required disposal/incineration

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Water Treatment ♦ PFAS Treatment ♦ Remediation

Case Study

Typical tank farm store tanks

Primary and Secondary Stages

Surface Active Foam Fractionation (SAFF®)

PFAS Treatment of spent fire fighting water—Major O&G

Client: Confidential, O&G

Location: South UK, 3 sites

Contaminants: PFAS

Site Characteristics

- Operational Fuel Stores
- AFFF systems
- PFAS contaminated water stored in large tanks
- PFAS concentrations ranged from 40,000-120,000ng/L
- High DOC ruled out the use of GAC

Treatment Plant

- Bench testing undertaken to assess feasibility
- SAFF® 40
- SAFF system remained on haulier trailer for ease of moves
- Add-on 'foam tank' with suppression system
- Treatment rate: ~4-5 m³/hr

Total Volume Treated

- ~12,000 m³ over 3 months

SAFF® Performance (1)

- Avg PFOS influent: 300ng/l
- Avg PFOS effluent: <3ng/l (ND); <0.65ng/l (ND)
- Avg PFAS 37 influent 110ug/l
- Avg PFAS 37 Removal: 95%

Total PFAS Waste

- 1000 Litres(2) waste volume

Challenges

- Complex water quality (high DOC) with high-foaming characteristics, required development of add on system.
- Sites were operational fuel terminals
- Discharge water went into sensitive areas / SSSI
- First full scale use of SAFF technology in UK

QCS INTERNATIONAL Environmental ISO 14001 | QCS INTERNATIONAL Quality Assurance ISO 9001

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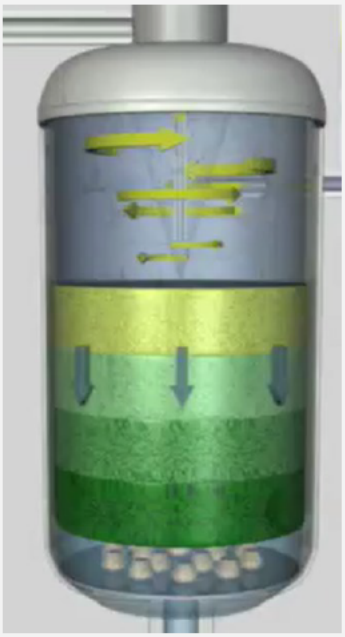
Water Treatment ♦ PFAS Treatment ♦ Remediation Technologies

Automated Abstraction & Filtration Plant

Containerised hydraulic containment of site water

Suspended Solids removal to improve PFAS treatment

Energy efficient positive displacement abstraction pumps draw from the site and deliver to storage lagoon, prior to filtration, by the multi-layer glass media Dual Vortex Filter



The containerised DVF system draws water from the lagoon once levels are high enough, filters it and delivers it to the SAFF plant for PFAS treatment.

The control system in the DVF unit controls the abstraction system, lagoon levels, discharge pumping and calls on the SAFF to process the water as required.

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