Dimlington Gas Terminal

Water Quality Assessment (PFOS)

ENV-22995
WQ Assessment
v04
19 March 2026

Document status

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01	Client Issue	Bryn Kearsey	Tom Hancox	Chris Rogers	19/08/2025
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Approval for issue

Chris Rogers	19/03/2026

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1 Introduction & Background

TT-RPS have been commissioned to undertake an H1 screening assessment and water quality modelling to quantify the impact of a surface water discharge from the Dimlington Gas Terminal in Easington, East Yorkshire.

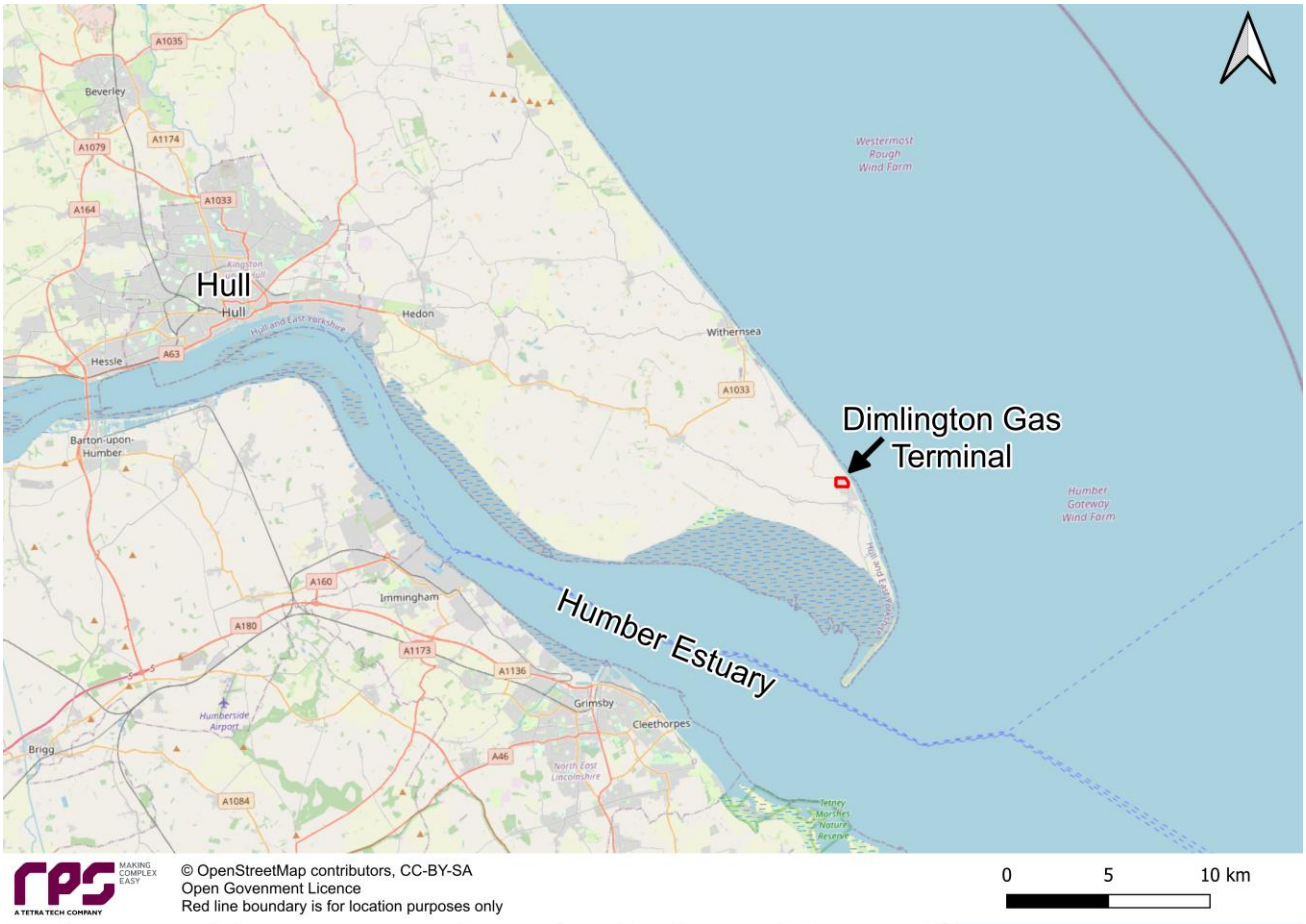


Figure 1 - Site Location Within East Yorkshire

The water quality assessment has been requested by the Environment Agency (EA) as part of the application for an environmental permit to discharge surface water from drainage ponds to ditches. While the discharge is surface water, rather than process water or other type of effluent, the EA has requested a water quality assessment is undertaken due to concentrations of Perfluorooctanesulfonic acid (PFOS) present at the site from the historic use of Aqueous Film Forming Foam (AFFF) firefighting foams.

The surface water from the site is treated using an activated carbon filtration system which, under intended operating conditions has been reducing PFOS concentrations to below detection limits before discharge to a drainage ditch on the southern boundary of the site.

The aim of the water quality assessment is to quantify the effects of the discharge on the receiving watercourses and provide evidence of the calculations used. Following on-site treatment, the surface water is discharged to an unnamed seasonal drainage ditch which flows to the Humber Estuary via Fosse Drain, which is a main river. The assessment will only cover concentrations of PFOS and no other determinants.

2 Policy Context

Applications to discharge effluent to watercourses that contains chemicals designated as “specific pollutants” or “priority hazardous substances” are generally risk-assessed using the Environment Agency’s H1 tool.

Under the H1 process, progressively more detailed screening tests are undertaken using data regarding the chemistry and flow of the effluent and receiving watercourse. Where chemicals in the effluent “pass” the screening tests, they are not considered a risk to the environment and no further assessment is required.

Some priority hazardous substances are subject to an additional screening test to calculate whether the annual loading (the total mass of a substance entering a receiving watercourse), rather than concentration poses a risk to the environment.

Where chemicals in the effluent “fail” all of the screening tests, more detailed chemical modelling is required. Monte Carlo modelling is used to quantify the effect of discharges on the chemistry of receiving watercourses, this is undertaken using the Environment Agency’s River Quality Planning (RQP) tool.

Specific pollutants and priority hazardous substances are assessed against the Environmental Quality Standards (EQSs). An EQS may be set for the annual mean (AA) concentration of a substance, maximum concentration (MAC) or both.

3 Receiving Watercourse

Surface water discharge from the site outfalls to a seasonal drainage ditch, which flows southwest to a larger perennial field drain, which has been considered as the receiving watercourse for the purposes of the water quality assessment.

Flows in the watercourses at various thresholds were modelled using the LowFlows2 software, which uses a statistical method to estimate flow in a catchment based on rainfall, infiltration rates and local geology. Catchments for each of the points that were modelled were delineated using publicly available LIDAR data from DEFRA.

The H1 screening results are determined based on the annual Q95 flow (the flow that is exceeded 95% of the time in a normal year) in the receiving watercourse. Due to the seasonal nature of the drainage ditch immediately downstream of the outfall, annual Q95 flow was zero. Flows in the larger drain, downstream (1 l/s) have therefore been used for the purposes of this assessment. Full LowFlows results for this catchment are included as Appendix A.

Background concentration of PFOS in local watercourses was determined using a sample taken in the drainage ditch upstream of the discharge, the background PFOS concentration was determined to be 13.2ng/l (1 sample). Following consultation with the Environment Agency, it was agreed that a background concentration 0.325ng/l (50% of the freshwater EQS) should be used as this would be more representative of environmental concentrations than the single background sample taken.

A map of the receiving watercourses, sample points and the catchment used for LowFlow modelling are included as Figure 2 below.

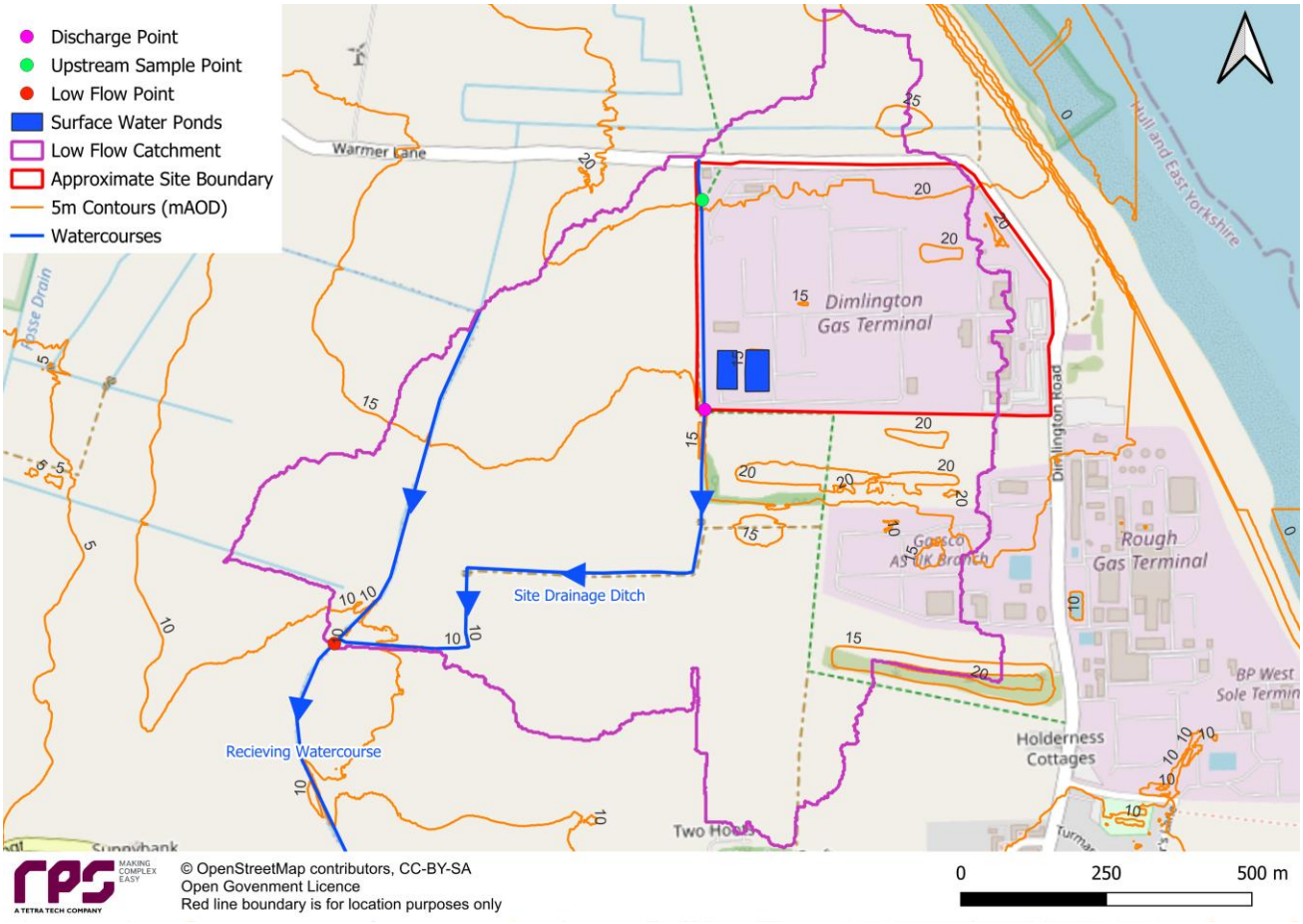


Figure 2 - Site Hydrology

The receiving watercourses are part of the Fosse drain/Skeffing Drain Water Body (GB104026066530) for the purposes of Water Framework Directive (WFD) assessment. The waterbody currently has “Good” status for PFOS concentrations meaning watercourses within the waterbody do not generally exceed the Environmental Quality Standards (EQSs) for PFOS.

4 Discharge

The discharge at Dimlington conveys surface water overflowing from storage ponds during rainfall events to the south flowing seasonal drainage ditch at the southwest corner of the site. While surface water discharges are not usually subject to water quality assessments for permit applications, the EA has requested an assessment be undertaken in this case due to concentrations of PFOS from historic use of AFFF firefighting foams on site.

The site operators have developed a treatment system of carbon filtration to reduce PFOS concentrations in the discharge. Initial water samples have been taken at the inlet and outlet of this system from February 2024 to April 2024 with subsequent sampling taken from June to December 2025. During the initial sampling period a limit of detection for PFOS of 1ng/l was used, this is above the EQS for freshwater of 0.65ng/l. For the second sampling period a limit of detection of 0.65 ng/l was achieved in line with the EQS.

From the 18th March 2024 to 10th November 2025 the system was proving effective in reducing PFOS concentrations with an average concentration over this period of 787ng/l (13 samples) at the inlet and concentrations below detection limits at the outlet across the period excluding one sample of 0.92 ng/l. The average total PFOS from 18th March 2024 to 10th November 2025 is 0.805231 ng/l (0.000805231 µg/l), which has been used in the H1 assessment.

Mean PFOS concentrations in the sampling period from 18th March 2024 to 10th November 2025 were 0.44*ng/l (13 samples). Outside of this period there were two periods where the system did not perform as expected. From the 18th February 2024 to 8th March 2024, which was the initial commissioning period of the system, outlet concentrations averaged 2.55*ng/l (3 samples). From the 17th November 2025 to 27th December 2025 outlet concentrations averaged 3.42*ng/l (4 samples). While these results are greater than anticipated they are believed to have been caused by a period of higher flow rates which are likely to have caused a change in the treatment efficiency. This change is likely to have caused the carbon in the treatment system to have been used up faster, and therefore turned into spent carbon. It is understood that, following upgrades to the treatment system, it will be able to operate with outlet PFOS concentrations staying consistently below the lower detection limit of 0.65ng/l. These upgrades are detailed in the non-technical summary.

While the discharge is rainfall dependant, the maximum flow rate of the system is 80 m^3/hour or 22.22 l/s. This assessment used a worse-case scenario in terms of flow rate, in the absence of detailed flow data. As a result, the discharge rate for the purposes of the water quality assessment has been assumed to be a constant 22.22 l/s (80 m^3/hr). Additionally, larger carbon filters are being installed which will support this flow rate. Following the success of the permit variation application, 12 months of flow data will be provided.

* Where measured outlet concentrations were below the lower detection limit, concentrations were assumed to be 50% of the lower detection limit.

5 Impact of Discharge

The impact assessment for the discharge has been undertaken using samples from the period between the 18th March 2024 and 10th November 2025 as, during this period, the treatment system was operating at a flow rate of 6 m^3/hour. The discharge rate for the purposes of this water quality assessment has been assumed to be a constant 22.22 l/s (80 m^3/hr) as a worse-case scenario.

5.1 H1 Screening Assessment

The PFOS concentrations detected in the effluent were subjected to screening tests within the H1 tool. The results of each test are outlined below. Results from the H1 tool are included as Appendix C.

The screening assessment is based on the Environmental Quality Standards (EQSs) for the subject determinant. For PFOS both and Annual Average EQS (0.65ng/l) and a Maximum Allowable Concentration EQS (36ng/l) are applicable.

For the purposes of the H1 assessment, where PFOS concentrations are recorded as being below the detection limit, concentration is assumed to be 100% of the lower detection limit.

Test 1

Substances can be screened out as not posing a risk to the environment under Test 1 of the H1 methodology if mean and maximum concentrations of the substance do not exceed 10% of the EQS.

Mean concentrations of PFOS in the discharge exceed 10% of the EQS therefore PFOS could not be screened using Test 1. Maximum concentrations do not exceed the EQS for maximum concentrations.

Test 2

Substances can be screened out as not posing a risk to the environment under Test 2 if the Process Contribution (the concentration of a substance after it has been diluted in the receiving watercourse) does not exceed 4% of the EQS.

Process contribution for PFOS in the discharge exceeded 4% of the Annual Average EQS, therefore PFOS could not be screened out using Test 2.

Tests 3, 4A and 4B

Substances not screened out under Tests 1 and 2 must pass Tests 3, 4A and 4B in order to be screened out as not posing a risk to the environment. Tests 3, 4A and 4B test the Predicted Environmental Concentration (PEC) (the Process Contribution plus the background concentration of the substance in the receiving watercourse) or PEC against the EQS. All three tests in this section must be passed for a discharge to be screened out.

To pass Test 3, the difference in the PEC and background concentration of a substance must not exceed 10%.

To pass Test 4A the PEC must not exceed the Annual Average EQS, Test 4B applies the same test to the Maximum Allowable Concentration EQS.

PFOS concentrations in the discharge passed Tests 3 and 4B but not 4A, therefore PFOS concentrations in the discharge cannot been screened out as not posing a risk to the environment under the H1 screening process.

Significant Load Test

An additional test is applied to some priority hazardous pollutants to ensure a risk is not posed to the environment from loading of these pollutants rather than concentration. The Significant Load Test is not applied to PFOS.

5.2 Monte-Carlo Modelling

Determinants that cannot be screened out using the H1 methodology can be further assessed for environmental risk using Monte-Carlo modelling under the method and distributions proposed by Warn and Brew (1980)[1]. Monte-Carlo modelling for water quality assessments is undertaken in the River Quality Planning (RQP) tool provided by the EA.

The RQP tool estimates concentrations of given determinants downstream of a discharge using concentration and flow data. This downstream concentration can be compared to the relevant EQS. Where the receiving watercourse already exceeds the relevant EQS, results from the Monte-Carlo simulation can be used to determine whether the discharge will cause a deterioration or betterment in water quality in the receiving watercourse with respect to the relevant determinant. Values used in the Monte-Carlo modelling are included as Table 1 below.

For the purposes of Monte-Carlo modelling, where PFOS concentrations are recorded as being below the detection limit, concentration is assumed to be 50% of the lower detection limit.

Table 1 - Values Used for Monte-Carlo Simulation

Parameter	Units	Value
Mean Upstream Flow	Megalitres / Day	0.3456
Q95 River Flow	Megalitres / Day	0.0864
Mean Discharge Flow	Megalitres / Day	1.9200
PFOS – Mean Upstream Concentration	Micrograms / Litre	0.0003 (0.3ng/l)
PFOS – Mean Discharge Quality	Micrograms / Litre	0.00044 (0.44ng/l)
PFOS – Max Discharge Quality (95th Percentile)	Micrograms / Litre	0.00067 (0.67ng/l)

Monte-Carlo Modelling of the discharge with respect to the Annual Average concentrations predicted a mean downstream PFOS concentration of 0.4 ng/l (Ϭ 0.1 ng/l). This is below the freshwater EQS for Annual Average concentrations of 0.65 ng/l.

There is some uncertainty in this conclusion as a result of the limited sampling for background concentrations that has taken place in receiving watercourses. It is therefore recommended that more background sampling be undertaken. It is also important to note that discharge rates were based on the maximum discharge at any one time, not on long-term flow data, so the PFOS concentrations in the receiving watercourses will likely be less than that anticipated by the model. The mean annual PFOS concentrations could only be properly calculated with more detailed discharge flow data. Full Monte-Carlo modelling results are included as Appendix D.

[1] Warn, A.E. and Brew, J.S., 1980. Mass balance. Water Research, 14(10), pp.1427-1434.

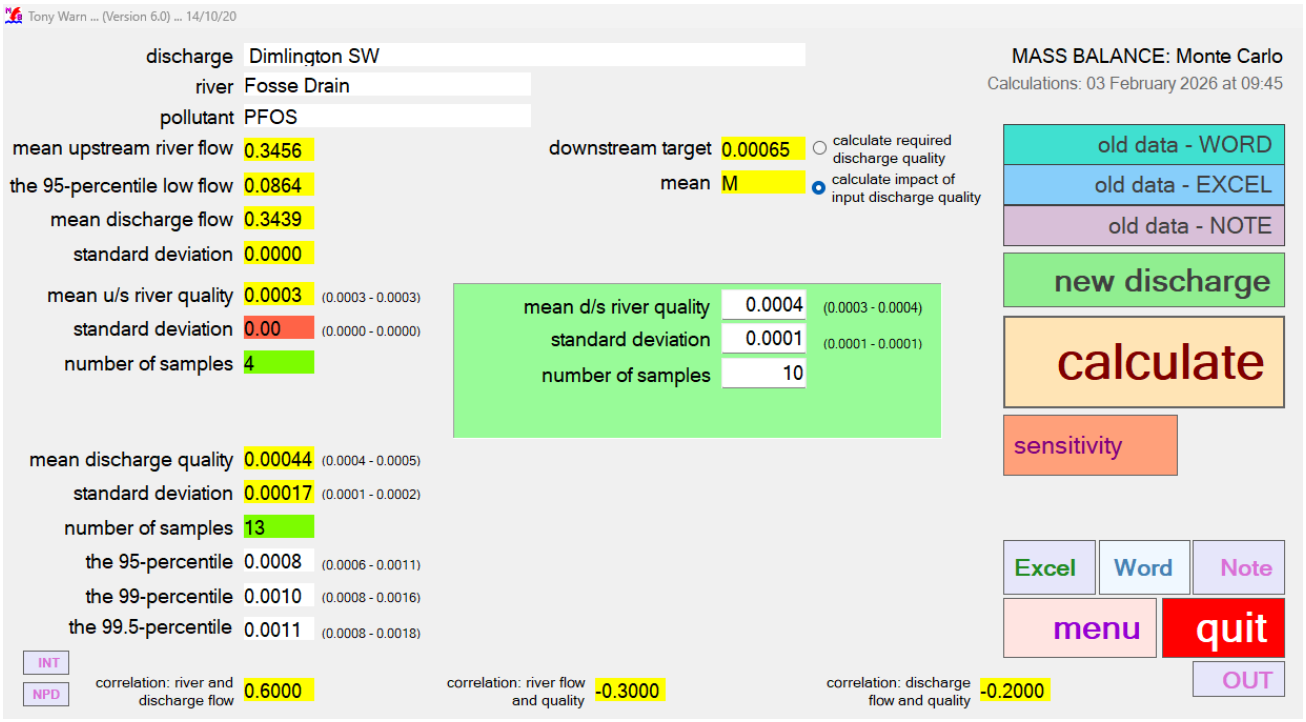


Figure 3 - Monte-Carlo Results for Annual Average Concentrations

Monte-Carlo Modelling of the discharge with respect to the Maximum Allowable Concentration EQSs (95th Percentile) predicted a maximum downstream PFOS concentration of 0.6 ng/l (Ó 0.1 ng/l). This concentration does not exceed the Maximum Allowable Concentration EQS, therefore the discharge is not likely to pose a risk to the environment with respect to this standard.

There is some uncertainty in this conclusion as a result of the limited sampling for background concentrations that has taken place in receiving watercourses. It is therefore recommended that more sampling be undertaken. Full Monte-Carlo modelling results are included as Appendix D.

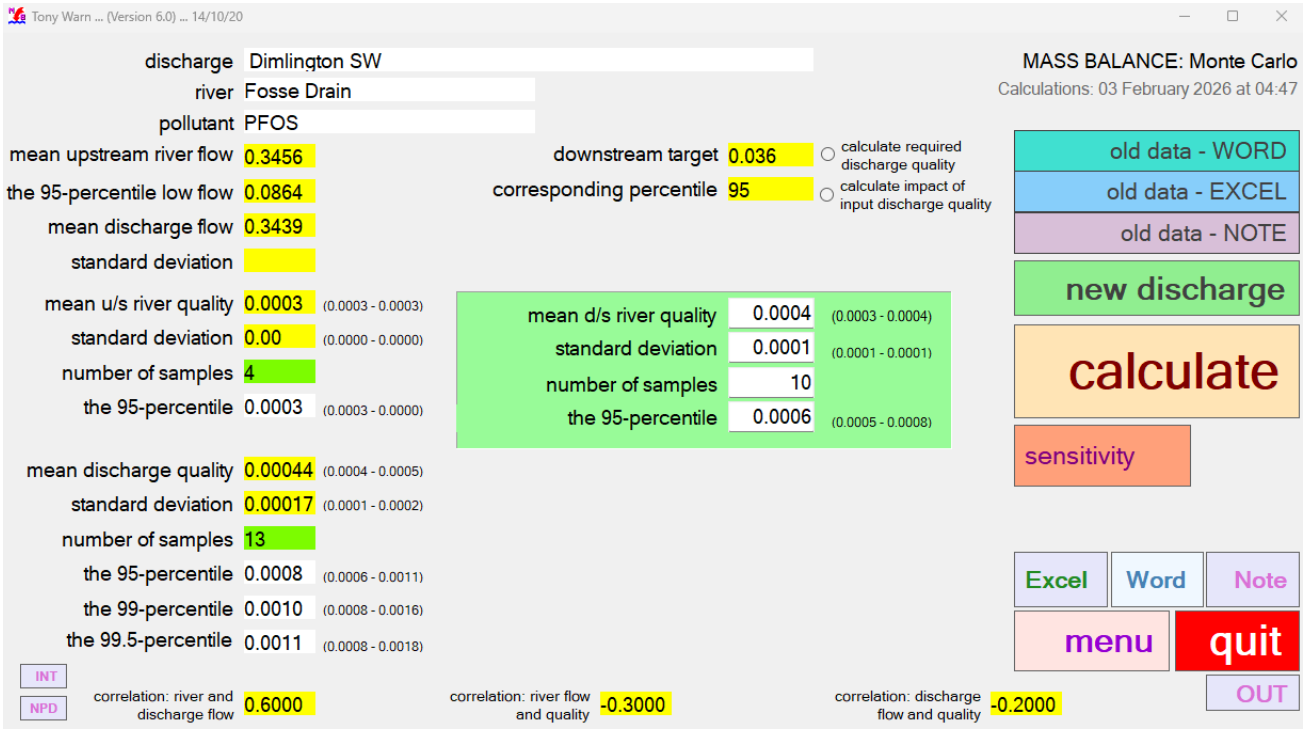


Figure 4 - Monte-Carlo Results for Maximum Allowable Concentrations

6 Summary and conclusions

TT-RPS have been commissioned to undertake an H1 screening assessment and water quality modelling to quantify the impact of a surface water discharge from the Dimlington Gas Terminal in Easington, East Yorkshire. The assessment has been undertaken with a limited dataset from the client (20 discharge samples, 1 background concentration sample).

The EA has asked for a water quality assessment to be prepared in line with the H1 risk assessment methodology due to concentrations of Perfluorooctanesulfonic acid (PFOS) in the surface water due to historic use of AFFF firefighting foams at the site.

A treatment system consisting of carbon filtration has been effective at removing PFOS from the surface water prior to discharge outside of two periods where the system did not operate correctly.

The impact of the discharge was assessed using data from the period where the system operated correctly (18th March 2024 to 10th November 2025) using the H1 screening assessment methodology and Monte-Carlo modelling.

The H1 risk assessment undertaken revealed that with the currently available data, the discharge cannot be screened out as not posing a risk to the environment using the H1 screening process. Further chemical modelling using a Monte-Carlo model has demonstrated, however, that when the system is operating at its design flow rate, the impact of the discharge is likely to be compliant with the Environmental Quality Standards for Total PFOS levels. A background concentration of half of the EQS (0.325ng/l) was assumed for this assessment. Further sampling is therefore recommended of both the discharge and receiving watercourses.

Appendices

Appendix A LowFlows2 Results

Catchment Characteristics	
Region	England: Northeast
Area	(26) Hull
Boundary source	Imported polygon
Catchment Area (km²)	1.011
No significant lakes in catchment	
Grid-resolution used for derivation of catchment characteristics (m)	20
Runoff (mm)	132.5
BFI	0.43
	Annual
Qmean	0.004
Q(0.1)	0.078
Q(1)	0.038
Q(2)	0.026
Q(3)	0.021
Q(4)	0.017
Q(5)	0.015
Q(6)	0.013
Q(7)	0.012
Q(8)	0.011
Q(9)	0.01
Q(10)	0.009
Q(11)	0.009
Q(12)	0.008
Q(13)	0.008
Q(14)	0.007
Q(15)	0.007
Q(16)	0.006
Q(17)	0.006
Q(18)	0.006
Q(19)	0.006

Q(20)	0.005
Q(21)	0.005
Q(22)	0.005
Q(23)	0.005
Q(24)	0.005
Q(25)	0.004
Q(26)	0.004
Q(27)	0.004
Q(28)	0.004
Q(29)	0.004
Q(30)	0.004
Q(31)	0.004
Q(32)	0.003
Q(33)	0.003
Q(34)	0.003
Q(35)	0.003
Q(36)	0.003
Q(37)	0.003
Q(38)	0.003
Q(39)	0.003
Q(40)	0.003
Q(41)	0.003
Q(42)	0.003
Q(43)	0.002
Q(44)	0.002
Q(45)	0.002
Q(46)	0.002
Q(47)	0.002
Q(48)	0.002
Q(49)	0.002
Q(50)	0.002
Q(51)	0.002
Q(52)	0.002
Q(53)	0.002
Q(54)	0.002
Q(55)	0.002
Q(56)	0.002

Q(57)	0.002
Q(58)	0.002
Q(59)	0.002
Q(60)	0.001
Q(61)	0.001
Q(62)	0.001
Q(63)	0.001
Q(64)	0.001
Q(65)	0.001
Q(66)	0.001
Q(67)	0.001
Q(68)	0.001
Q(69)	0.001
Q(70)	0.001
Q(71)	0.001
Q(72)	0.001
Q(73)	0.001
Q(74)	0.001
Q(75)	0.001
Q(76)	0.001
Q(77)	0.001
Q(78)	0.001
Q(79)	0.001
Q(80)	0.001
Q(81)	0.001
Q(82)	0.001
Q(83)	0.001
Q(84)	0.001
Q(85)	0.001
Q(86)	0.001
Q(87)	0.001
Q(88)	0.001
Q(89)	0.001
Q(90)	0.001
Q(91)	0.001
Q(92)	0.001
Q(93)	0.001

Q(94)	0.001
Q(95)	0.001
Q(96)	0.001
Q(97)	0
Q(98)	0
Q(99)	0
Q(99.9)	0

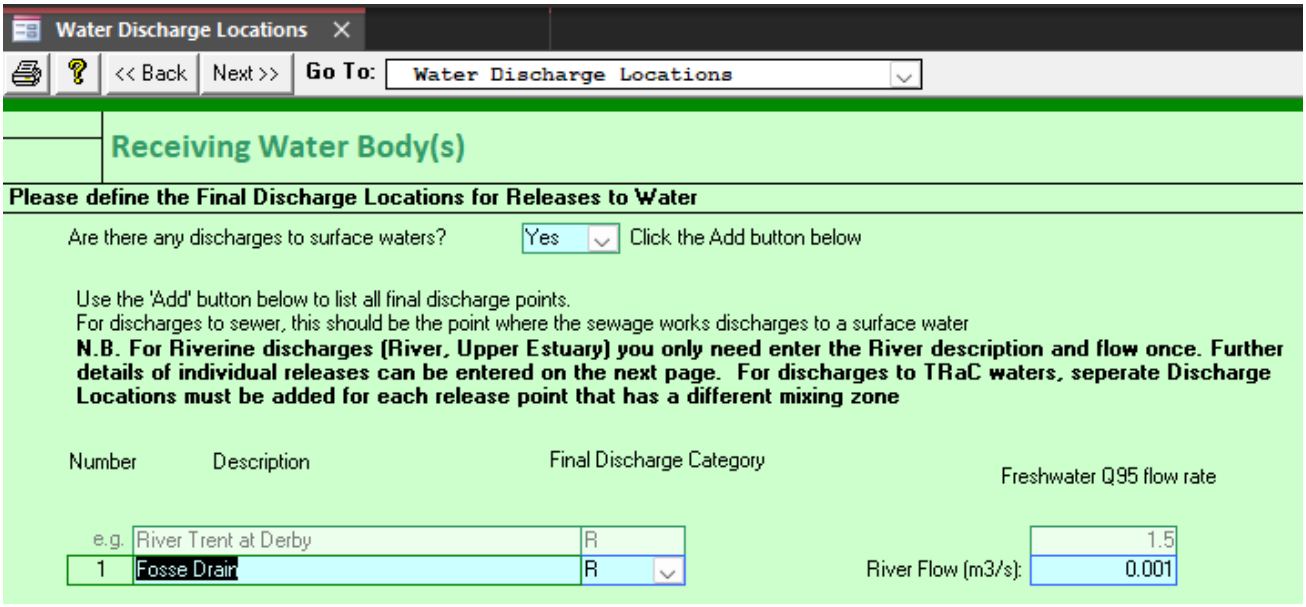
Appendix B Water Quality Sample Results

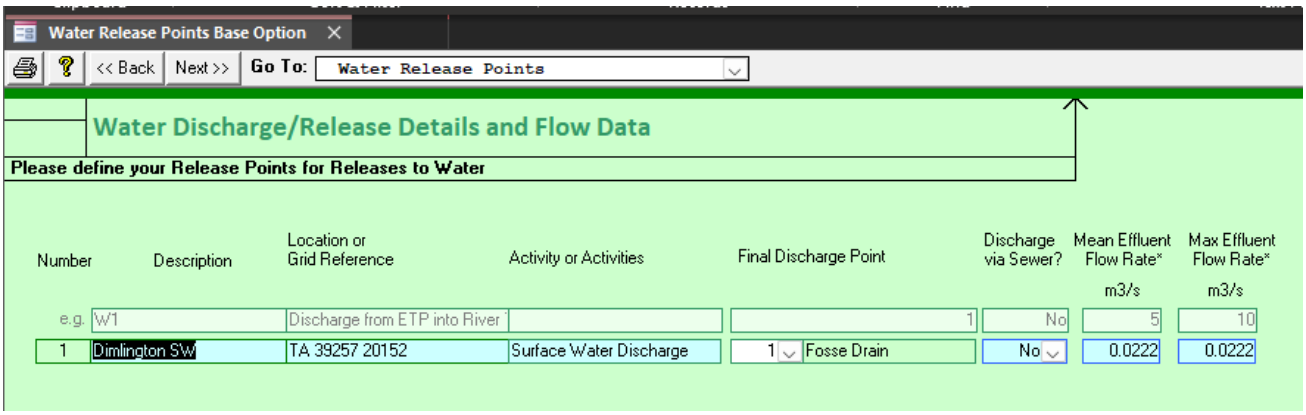
LAB Results – PFOS Concentrations* at Outlet Only

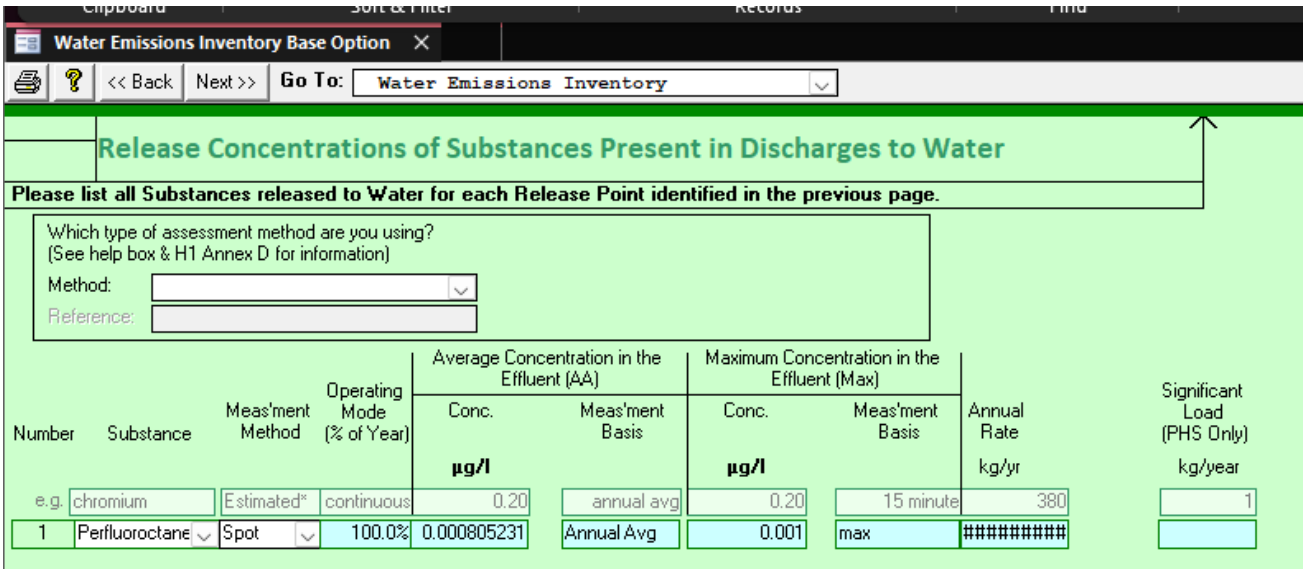
**Samples below Limit of Detection (LoD) listed as 100% of LoD and 50% LoD*

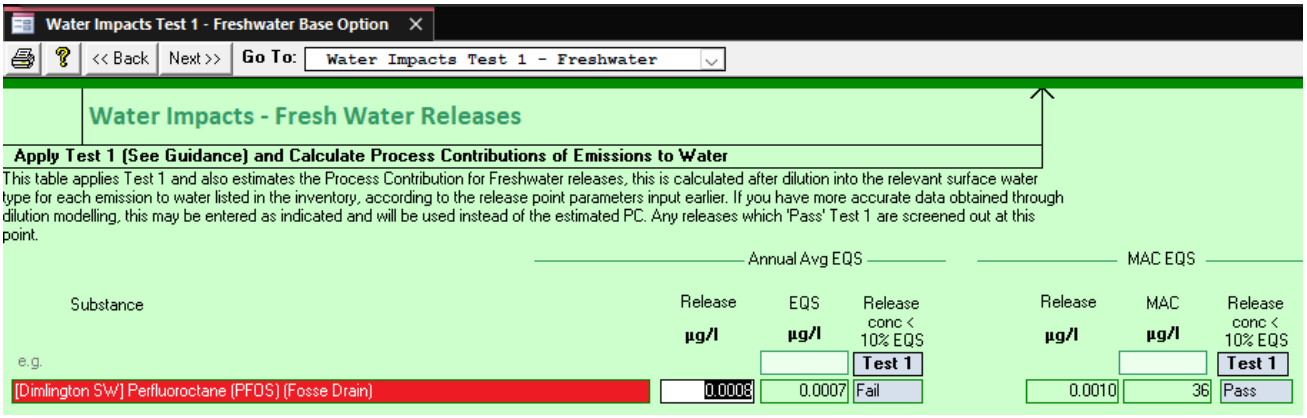
Date	Sample #	Total PFOS (LOD@100%) ng/l	Total PFOS (LOD@50%) ng/l
Mean		**1.59**	**1.35**
95th Percentile		**5.26**	**5.26**
18/02/2024	**23754908**	1.20	1.20
28/02/2024	**23789208**	5.22	5.22
08/03/2024	**23858609**	1.23	1.23
18/03/2024	**23858612**	1.00	0.50
28/03/2024	**23916511**	1.00	0.50
07/04/2024	**23916514**	1.00	0.50
17/04/2024	**24093291**	1.00	0.50
27/04/2024	**24093294**	1.00	0.50
05/07/2025	**25445196**	0.65	0.33
15/06/2025	**25445193**	0.65	0.33
05/08/2025	**25526198**	0.65	0.33
06/08/2025	**25526202**	0.65	0.33
12/09/2025	**25619499**	0.92	0.92
10/10/2025	**25698567**	0.65	0.325
28/10/2025	**25730664**	0.65	0.325
10/11/2025	**25780343**	0.65	0.325
17/11/2025	**25806509**	2.67	2.67
07/12/2025	**25854311**	2.9	2.9
17/12/2025	**25878475**	2.13	2.13
27/12/2025	**25892209**	5.99	5.99

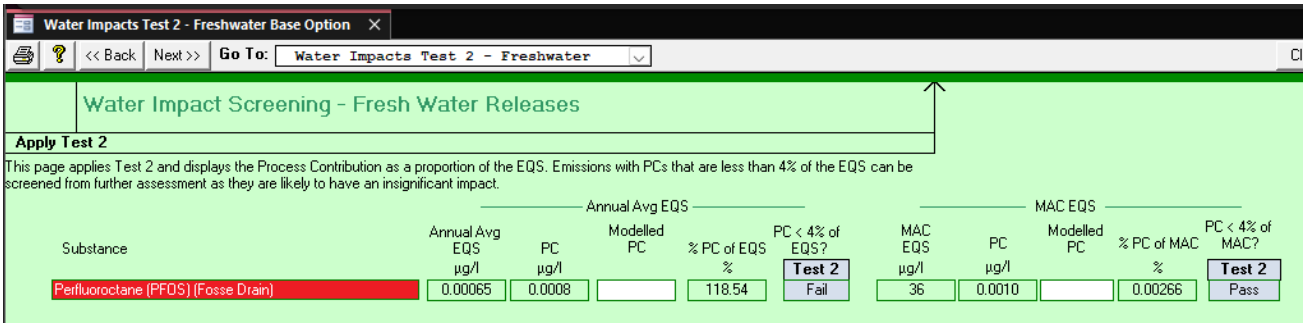
Appendix C H1 Tool Screenshots

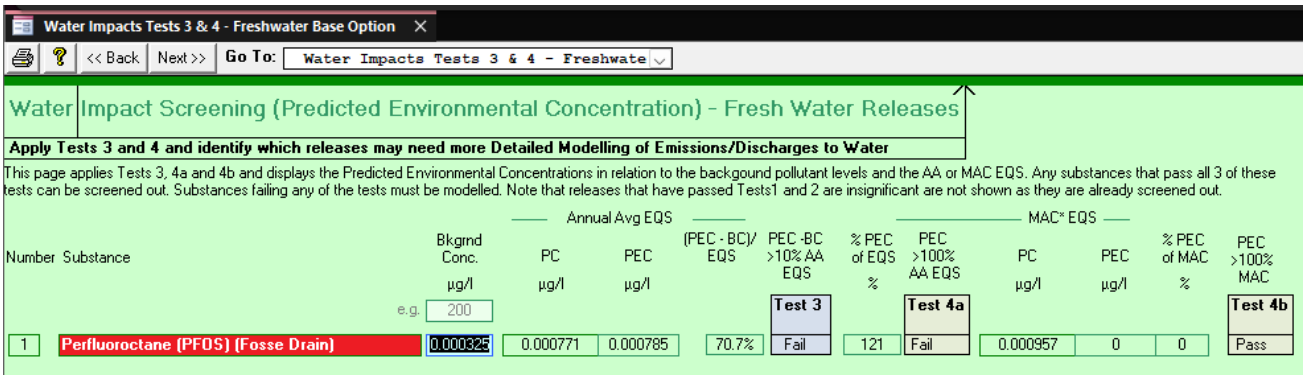







Water Impacts Test 1 - Freshwater Base Option
<< Back
Next >>
Go To:
Water Impacts Test 1 - Freshwater
Water Impacts - Fresh Water Releases
Apply Test 1 (See Guidance) and Calculate Process Contributions of Emissions to Water
This table applies Test 1 and also estimates the Process Contribution for Freshwater releases, this is calculated after dilution into the relevant surface water type for each emission to water listed in the inventory, according to the release point parameters input earlier. If you have more accurate data obtained through dilution modelling, this may be entered as indicated and will be used instead of the estimated PC. Any releases which 'Pass' Test 1 are screened out at this point.
Annual Avg EQS
MAC EQS
Substance
Release µg/l
EQS µg/l
Release conc < 10% EQS
Test 1
Release µg/l
MAC µg/l
Release conc < 10% EQS
Test 1
e.g.
[Dimlington SW] Perfluoroctane (PFOS) (Fosse Drain)
0.0008
0.0007
Fail
0.0010
36
Pass


Water Impacts Test 2 - Freshwater Base Option
<< Back
Next >>
Go To:
Water Impacts Test 2 - Freshwater
Water Impact Screening - Fresh Water Releases
Apply Test 2
This page applies Test 2 and displays the Process Contribution as a proportion of the EQS. Emissions with PCs that are less than 4% of the EQS can be screened from further assessment as they are likely to have an insignificant impact.
Annual Avg EQS
MAC EQS
Substance
Annual Avg EQS µg/l
PC µg/l
Modelled PC
% PC of EQS %
PC < 4% of EQS? Test 2
MAC EQS µg/l
PC µg/l
Modelled PC
% PC of MAC %
PC < 4% of MAC? Test 2
Perfluoroctane (PFOS) (Fosse Drain)
0.00065
0.0008
118.54
Fail
36
0.0010
0.00266
Pass


Water Impacts Tests 3 & 4 - Freshwater Base Option
<< Back
Next >>
Go To:
Water Impacts Tests 3 & 4 - Freshwate
Water Impact Screening (Predicted Environmental Concentration) - Fresh Water Releases
Apply Tests 3 and 4 and identify which releases may need more Detailed Modelling of Emissions/Discharges to Water
This page applies Tests 3, 4a and 4b and displays the Predicted Environmental Concentrations in relation to the backgound pollutant levels and the AA or MAC EQS. Any substances that pass all 3 of these tests can be screened out. Substances failing any of the tests must be modelled. Note that releases that have passed Tests1 and 2 are insignificant are not shown as they are already screened out.
Annual Avg EQS
MAC* EQS
Number
Substance
Bkgrnd Conc. µg/l
PC µg/l
PEC µg/l
(PEC - BC)/ EQS
PEC -BC >10% AA EQS Test 3
% PEC of EQS %
PEC >100% AA EQS Test 4a
PC µg/l
PEC µg/l
% PEC of MAC %
PEC >100% MAC Test 4b
e.g.
200
1
Perfluoroctane (PFOS) (Fosse Drain)
0.000325
0.000771
0.000785
70.7%
Fail
121
Fail
0.000957
0
0
Pass

Appendix D Monte-Carlo Results

MASS BALANCE (MONTE CARLO): Version 6.0

Calculations: 03 February 2026 at 10:19

Discharge:	Dimlington SW			
River:	Fosse Drain			1
Pollutant:	PFOS	Target:	36	95-percentile

Mean u/s river flow	0.35		Mean discharge flow	0.34	
95-percentile low flow	0.086		Standard deviation	0.0000	
		(confidence)			(confidence)
Mean u/s river quality	0.0003	(0.0003 - 0.0003)	Mean d/s river quality	0.0004	(0.0003 - 0.0004)
Standard deviation	0.00	(0.0000 - 0.0000)	Standard deviation	0.0001	(0.0001 - 0.0001)
Number of samples	4		Number of samples	10	
95-percentile	0.0003	(0.0003 - - 0.0048)	95-percentile	0.0006	(0.0005 - 0.0008)
CURRENT DISCHARGE		(confidence)			
Mean discharge quality	0.00044	(0.0004 - 0.0005)			
Standard deviation	0.00017	(0.0001 - 0.0002)			
Number of samples	13				
95-percentile	0.0008	(0.0006 - 0.0011)			
99-percentile	0.0010	(0.0008 - 0.0016)			
99.5-percentile	0.0011	(0.0008 - 0.0018)			

CORRELATION COEFFICIENTS	
River and discharge flow	0.6000
River flow and quality	-0.3000
Discharge flow and quality	-0.2000

	FILES WITH NON-PARAMETRIC DATA
River flow	none
River quality	none
Discharge flow	none
Discharge quality	none
Intermittent discharge flow	

	INTERMTTENT DISCHARGE ADDED
% time in operation	0.0000
Mean flow (when operating)	0.0000
Standard deviation	0.0000
Correlation coefficient	0.0000
Mean quality	0.0000
Standard deviation	(0.0000 - 0.0000)
Correlation with flow	0