Surface Water Risk Assessment

Environmental Permit Application

Yew Tree Dairy Partco Ltd

Prepared by:

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Basis of Report

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Appendices

1.0 Introduction

Yew Tree Dairy Partco Ltd (YTD) has instructed SLR Consulting Ltd (SLR) to undertake a Surface Water Pollution Risk Assessment (often referred to as an H1 assessment) for the discharge of effluent from their dairy production site at 1 Pit Hey Place, Skelmersdale. This report will form part of an application for an environmental installation permit to the Environment Agency (EA).

The effluent from the site arises from the production of dried milk powder which following on-site treatment utilising Reverse Osmosis technology produces a condensate containing residual concentrations of biochemical oxygen demand (BOD) and suspended solids. The effluent is discharged to foul sewer under a trade effluent discharge consent (TEDC) issued by United Utilities.

The effluent then undergoes further treatment at the Newborough Sewage Treatment Works (STW) operated by United Utilities, before eventually being discharged to the River Douglas.

An H1 assessment quantifies the environmental impact of discharging hazardous pollutants to a receiving watercourse (i.e. the River Douglas). If a hazardous pollutant is screened from the H1 Assessment, it is deemed by the EA as not being liable to cause pollution to the receiving watercourse.

This report details the methodology, data inputs and findings from the H1 Assessment for the discharge of effluent from Yew Tree Dairy.

2.0 Surface Water Pollution Risk Assessment Methodology

An H1 Assessment is sometimes required when applying for a bespoke environmental permit that includes discharging hazardous pollutants or certain other potentially polluting substances to surface water, or if a variation of an existing permit is required to cover an increase in quantity and/or concentration of pollutants to surface water under the Environmental Permitting Regulations[1].

The purpose of an H1 assessment is to quantify the environmental impact of discharging hazardous chemicals and elements to a receiving watercourse to assess whether they are a risk to the environment.

This includes discharging to:

- Freshwaters;
- Estuaries and coastal waters; and
- Sewers

The EA methodology contained in the "*Surface water pollution risk assessment for your environmental permit"* guidance[2] provides guidance on assessing effluent discharges containing potentially polluting substances to surface water.

Hazardous pollutants are the pollutants listed in the tables of the guidance (specific pollutants list and priority hazardous substances list).

[1] Environmental Permitting (England and Wales) Regulations 2016

[2] Environment Agency and DEFRA, (2020). Surface water pollution risk assessment for your environmental permit. [Available at]: https://www.gov.uk/guidance/surface-water-pollution-risk-assessment-for-your-environmental-permit

The EA's "*H1 Annex D2 – Assessment of sanitary and other pollutants within surface water"* guidance[3] was also used, which provides guidance on assessing effluent discharges containing sanitary and other pollutants within surface water.

Most substances are assessed using a series of screening tests, beyond which further modelling may be required for those which fail (cannot be screened out). Some substances are assessed using a Monte Carlo modelling approach via the EA's River Quality Planning (RQP) tool.

2.1 Environmental Quality Standards

The surface water risk assessment guidance contains a list of environmental quality standards (EQS) for hazardous chemicals and elements.

There are two types of EQS values that might apply:

- Maximum Allowable Concentration EQS (MAC-EQS) - to evaluate the short-term environmental impact of emissions to a receiving watercourse; and
- Annual Average (AA-EQS) - to evaluate the long-term environmental impact of emissions to a receiving watercourse.

A hazardous chemical or element may only have a corresponding AA-EQS value, a MAC-EQS value or both an AA-EQS and MAC-EQS value.

Some substances require site specific EQS values to be determined, based on site setting and local water quality data.

2.2 Modelling of Sanitary and "Other" Pollutants

Modelling[4] is required for assessing the effect of discharging sanitary and "other" pollutants (described in "*H1 Annex D2 – Assessment of sanitary and other pollutants within surface water"* guidance[5]). Modelling consists of additional tests which assess whether the discharge is a risk to the environment. If the modelling tests show the discharge is an unacceptable risk to the environment, then the EA may include conditions on the permit to control certain pollutants.

The following subsections detail the modelling methodology outlined in the EA's modelling guidance.

2.2.1 Modelling Test 1 – Risk to EQS

Modelling Test 1 assesses whether the proposed load could cause failure of the receiving water EQS using the RQP Monte Carlo simulation tool.

For 90th percentile EQSs, if the 90th percentile downstream quality is less than the EQS, the discharge is not predicted to cause an EQS failure, and this modelling test has been passed. If instead the 90th percentile downstream quality exceeds the EQS, the substance is considered significant and a numeric emission limit for this substance will be required on the permit.

[3] Environment Agency, (2014). H1 Annex D2: Assessment of Sanitary and Other Pollutants within Surface Water Discharges (v1.0). [Available at]: https://www.gov.uk/government/publications/h1-annex-d2-assessment-of-sanitary-and-other-pollutants-insurface-water-discharges

[4] Environment Agency (2014). LIT 10419 Modelling: surface water pollution risk assessment. [Available at]: https://www.gov.uk/government/publications/modelling-surface-water-pollution-risk-assessment

[5] Environment Agency, (2014). H1 Annex D2: Assessment of Sanitary and Other Pollutants within Surface Water Discharges (v1.0). [Available at]: https://www.gov.uk/government/publications/h1-annex-d2-assessment-of-sanitary-and-other-pollutants-insurface-water-discharges

For annual average EQSs, if the mean downstream quality is less than the EQS, the discharge is not predicted to cause an EQS failure, and this modelling test has been passed. If instead the mean downstream quality exceeds the EQS, the substance is considered significant and a numeric emission limit for this substance will be required on the permit.

2.2.2 Modelling Test 2 – Significant Deterioration of Receiving Water Quality

Test 2 determines whether the discharge causes upstream/background quality to deteriorate by more than 10 percent of the EQS.

If the calculated downstream concentration is higher than the upstream concentration plus 10 percent of the EQS, the substance is considered significant, and a numeric emission limit is required for this substance on the permit.

3.0 Effluent Management and Treatment

Effluent from Yew Tree Dairy undergoes treatment by a Reverse Osmosis based treatment system and the concentrate produced by the treatment process is then discharged to foul sewer under a trade effluent discharge consent (TEDC) regulated by United Utilities. The effluent then undergoes further treatment at Newborough STW.

The discharge from Newborough STW discharges into the River Douglas. Given its proximity to Wigan STW, which is located approximately 300m to the North West of Newborough STW, it is assumed that both treated effluent streams combine within the Wigan STW site and discharge to the River Douglas at SD 48156 12053.

4.0 Data Inputs to Surface Water Pollution Risk Assessment

4.1 Assumptions

The following assumptions have been made by SLR in preparing this H1 Assessment:

- The effluent quality and volume data obtained from YTD is accurate and representative of conditions which are present on site;
- Data relating to hazardous chemicals and elements referenced in the EA guidance[6] only has been reviewed; and
- Substances which are referenced in the EA guidance and for which no data has been provided, have not been considered in this report.

4.2 Effluent Quality

YTD has supplied sample analysis data for samples taken by United Utilities for trade effluent analysis. This data is presented in Table 4-1. The analysis undertaken is reflective of the anticipated contaminants of concern.

A sewage treatment reduction factor (STRF) was applied to the biochemical oxygen demand (BOD) concentration to reflect the additional treatment applied at the sewage treatment works prior to discharge to the receiving watercourse.

[6] Environment Agency and DEFRA, (2020). *Surface water pollution risk assessment for your environmental permit.* [Available at]: https://www.gov.uk/guidance/surface-water-pollution-risk-assessment-for-your-environmental-permit

The STRF for BOD was calculated using data for Wigan STW raw and treated effluent (in the absence of data for Newborough STW) obtained for the period February – August 2024 from the EA's Water Quality Archive[7].

No STRF was applied for pH or Suspended Solids.

Table 4-1: Effluent Sample Analysis Data

Substance	Average Concentration	Maximum Concentration	STRF	Average Release Concentration	Maximum Release Concentration
BOD	1,662,000 µg/l	2,780,000 µg/l	0.388	664,473 µg/l	107,864 µg/l
pH	7.67	8	N/A	7.67	8
Suspended Solids	216,000 µg/l	470,000 µg/l	1	216,000 µg/l	470,000 µg/l

4.3 Effluent Flow Rate

4.3.1 YTD Site Discharge Flow Rate

The site's TEDC stipulates a maximum discharge flow rate of 4 l/s (0.004 m^3/s) and a maximum volume of 350 m^3 per 24-hour period. To maintain a conservative approach, the maximum flow rate of 0.004 m^3/s has been used as both the average and maximum flow rate from the Site.

4.3.2 STW Discharge Flow Rate

According to information published in the Urban Wastewater Treatment Directive Treatment Plants[8] document, Newborough STW (also known as Skelmersdale STW) has a design capacity of 68,513 population equivalent (PE) and the average load entering the STW was 52,539 PE (year unknown).

Wigan STW has a design capacity of 410,498 population equivalent (PE) and the average load entering the STW was 375,749 PE (year unknown).

To determine a dry weather flow rate from Skelmersdale STW, the average load entering the STW was obtained from the Urban Wastewater Treatment Directive Treatment Plants, equivalent to 52,539 PE. In accordance with Metcalf & Eddy[9], 1.p.e. equates to 200l per head per day; therefore, the volume of effluent at Skelmersdale STW is estimated to be 10,508 m^3/day. This equates to a flow rate of 0.122 m^3/s, assuming continuous discharge.

To determine a dry weather flow rate from Wigan STW, the average load entering the STW was obtained from the Urban Wastewater Treatment Directive Treatment Plants[10], equivalent to 375,749 PE. In accordance with Metcalf & Eddy[11], 1.p.e. equates to 200l per head per day; therefore, the volume of effluent at Wigan STW is estimated to be 75,150 m^3/day. This equates to a flow rate of 0.870 m^3/s, assuming continuous discharge.

[7] Environment Agency Water Quality Archive - https://environment.data.gov.uk/water-quality/view/landing

[8] Environment Agency STW Dataset - https://www.data.gov.uk/dataset/0f76a1c3-1368-476b-a4df-7ef32bfd9a8b/urban-waste-water-treatment-directive-treatment-plants

[9] Metcalf & Eddy (2003), *Wastewater Engineering Treatment and Reuse. 4th Ed. Published by McGraw-Hill*

[10] Environment Agency STW Dataset - https://www.data.gov.uk/dataset/0f76a1c3-1368-476b-a4df-7ef32bfd9a8b/urban-waste-water-treatment-directive-treatment-plants

[11] Metcalf & Eddy (2003), *Wastewater Engineering Treatment and Reuse. 4th Ed. Published by McGraw-Hill*

The combined flow of treated sewage effluent from Skelmersdale and Wigan STW is therefore estimated to be 0.992 m^3/s. This compares to a maximum effluent discharge flow rate of 0.004 m^3/s from the YTD site.

4.3.3 Discharge Flow Rate Used in Assessment

The H1 assessment process is designed to initially determine the impact of the discharge from the site in isolation of dilution influence from other effluent. Should any substances be found not to pass the initial screening tests, then dilution with other effluents can be accounted for in further modelling exercises. For this reason and given the scale of difference between the flow rate from the site compared to the flow rates of the STWs, the site's discharge flow rate of 0.004 m^3/s has been used in the assessment.

4.4 Receiving Water Quality

The River Douglas is described by the EA's Catchment Data Explorer[12] as a heavily modified water body. From the latest publicly available data, the river had a designated overall "moderate" classification in 2019 in accordance with the Water Framework Directive.

The EA's water quality archive was also searched to obtain background quality data for the River Douglas. However, relevant data for BOD and suspended solids was not available. Therefore, it has been assumed that the upstream quality was 50% of the relevant EQS, as supported by the H1 Assessment guidance[13].

4.5 EQS Values

4.5.1 BOD

A site specific EQS value was determined for BOD. This was determined by site altitude, alkalinity (as mg/l $CaCO_3$) of receiving watercourse and the status of the river (i.e. High, Good, Moderate, Poor).

A search of the EA's Water Quality Archive for sampling location NW-88003137, River Douglas at Three Bridges Parbold, indicated alkalinity in the range of 100 – 200 mg/l $CaCO_3$, whilst the altitude at the point of discharge is less than 80m, indicating a type 5 BOD standard. The EA's Catchment Data Explorer indicated that the River Douglas has a high-quality rating for dissolved oxygen. Therefore the 90th percentile EQS standard for BOD was determined to be 4,000 µg/l.

4.5.2 Suspended Solids

A suspended Solids guideline standard of 25 mg/l (25,000 µg/l) was used, as given in the Freshwater Fish Directive.

4.6 Receiving Water Flow Rate

Flow rates of the receiving watercourse, the River Douglas have been obtained from a National River Flow Archive[14] gauging station with gauging records from between 1973 and 2020, at Douglas at Wanes Blades Bridge (NRFA ref: 70002), grid reference SD476125.

[12] Environment Agency Catchment Data Explorer. [Available at]: https://environment.data.gov.uk/catchment-planning/

[13] Environment Agency (2014). LIT 10419 Modelling: surface water pollution risk assessment. [Available at]: https://www.gov.uk/government/publications/modelling-surface-water-pollution-risk-assessment

[14] National River Flow Archive https://nrfa.ceh.ac.uk/data/station/meanflow/70002

This gauging station was the closest to the point of discharge, and whilst slightly downstream, was deemed to provide the most representative flow figure for the H1 assessment.

The receiving water flow rate figures used in the H1 assessment were:

Mean – 4.367 m^3/s

Q95 - 1.13 m^3/s

5.0 H1 Assessment Results

5.1 RQP Modelling

5.1.1 BOD

Modelling of the impact of the discharge was undertaken for BOD using the RQP software with the parameters presented in Table 5-1.

Table 5-1: BOD Modelling Parameters

Parameter	Value
Mean Upstream River Flow	4.367 m^3/s
95th Percentile River Flow	1.13 m^3/s
Mean Discharge Flow	0.004 m^3/s
Standard Deviation of Discharge Flow	0.0004 m^3/s (Estimated as 10% of mean flow)
Mean Upstream BOD Concentration	2,000 µg/l (Estimated as 50% of EQS)
Standard Deviation of Upstream BOD Concentration	200 µg/l (10% of assumed upstream concentration used in order to provide a range for calculations)
Number of Upstream Samples	14 (Default sample number used in order to provide a range for calculations)
Mean Discharge BOD Concentration	64,437 µg/l
Standard Deviation of Discharge BOD Concentration	45,971 µg/l
Number of Discharge Samples	3 (Automatically increased to the required minimum of 4 by the software)
Target Average Downstream BOD Concentration	2,400 µg/l (Upstream concentration plus 10% of EQS)
Correlation: River and Discharge Flow	0.6
Correlation: River Flow and Quality	-0.3
Correlation: Discharge Flow and Quality	-0.2

5.1.1.1 Test 1 – Risk to EQS

Test 1 assesses whether the proposed load could cause failure of the receiving water EQS for BOD, i.e. 4,000 µg/l.

The RQP software calculated the discharge from the Site will result in a 90th percentile downstream quality of 2,388 µg/l for BOD (See Appendix A). This value is below the EQS for BOD and has therefore means that screening test 1 has been passed.

This value was assessed using the RQP compliance with a percentile standards software to determine the percentage confidence of the 90th percentile EQS being exceeded, which gave a value of 0.00%. Therefore, the discharge of BOD is unlikely to risk failure of the receiving water EQS.

5.1.1.2 Test 2 – Significant Deterioration of Receiving Water Quality

Test 2 determines whether the discharge causes upstream/background quality to deteriorate by more than 10 per cent of the EQS.

To achieve the downstream 90th percentile river quality of 2,400 µg/l BOD, the results from the RQP software indicate that the discharge mean Emission Limit Value (ELV) for BOD is 69,058 µg/l, i.e. a discharge mean below this value is not likely to significantly deteriorate the quality of the receiving water (See Appendix A).

As the discharge has a mean BOD concentration of 64,437 µg/l, screening test 2 has been passed.

5.1.2 Suspended Solids

Modelling of the impact of the discharge was undertaken for Suspended Solids using the RQP software with the parameters presented in Table 5-2.

Table 5-2: Suspended Solids Modelling Parameters

Parameter	Value
Mean Upstream River Flow	4.367 m^3/s
95th Percentile River Flow	1.13 m^3/s
Mean Discharge Flow	0.004 m^3/s
Standard Deviation of Discharge Flow	0.0004 m^3/s (Estimated as 10% of mean flow)
Mean Upstream Suspended Solids Concentration	12,500 µg/l (Estimated as 50% of EQS)
Standard Deviation of Upstream Suspended Solids Concentration	1,250 µg/l (10% of assumed upstream concentration used in order to provide a range for calculations)
Number of Upstream Samples	14 (Default sample number used in order to provide a range for calculations)
Mean Discharge Suspended Solids Concentration	216,000 µg/l

Parameter	Value
Standard Deviation of Discharge Suspended Solids Concentration	21,600 µg/l (10% of assumed upstream concentration used in order to provide a range for calculations)
Number of Discharge Samples	3 (Automatically increased to the required minimum of 4 by the software)
Target Average Downstream Suspended Solids Concentration	15,000 µg/l (Upstream concentration plus 10% of EQS)
Correlation: River and Discharge Flow	0.6
Correlation: River Flow and Quality	-0.3
Correlation: Discharge Flow and Quality	-0.2

5.1.2.1 Test 1 – Risk to EQS

Test 1 assesses whether the proposed load could cause failure of the receiving water EQS for Suspended Solids, i.e. 25,000 µg/l.

The RQP software calculated the discharge from the Site will result in a mean downstream quality of 13,372 µg/l for Suspended Solids (See Appendix A). This value is below the EQS for Suspended Solids and has therefore means that screening test 1 has been passed.

This value was assessed using the RQP compliance with mean standards software to determine the percentage confidence of the AA-EQS being exceeded, which gave a value of 0.00%. Therefore, the discharge of Suspended Solids is unlikely to risk failure of the receiving water EQS.

5.1.2.2 Test 2 – Significant Deterioration of Receiving Water Quality

Test 2 determines whether the discharge causes upstream/background quality to deteriorate by more than 10 per cent of the EQS.

To achieve the downstream mean river quality of 15,000 µg/l Suspended Solids, the results from the RQP software indicate that the discharge mean Emission Limit Value (ELV) for Suspended Solids is 304,142 µg/l, i.e. a discharge mean below this value is not likely to significantly deteriorate the quality of the receiving water (See Appendix A).

As the discharge has a mean Suspended Solids concentration of 216,000 µg/l, screening test 2 has been passed.

5.2 pH

The average and maximum pH of the effluent (7.67 and 8 respectively) is within the MAC-EQS range of 6-9 and therefore passing the H1 assessment screening.

6.0 Conclusion

A surface water pollution risk assessment (H1 assessment) was carried out on the discharge of effluent from Yew Tree Dairy Partco Ltd's site in Skelmersdale to the River Douglas via Newborough sewage treatment works.

Biological Oxygen Demand and Suspended Solids were modelled using the Environment Agency's River Quality Planning software and found not to pose a significant risk of EQS exceedance in the downstream watercourse quality. Furthermore, they were found not to

pose a significant risk of reducing the quality of the watercourse by a significant amount (more than 10% of the EQS compared to upstream quality).

The pH of the effluent was found to be within the acceptable limits of the MAC-EQS.

The discharge was therefore deemed to have passed the H1 assessment.

Appendix A H1 Screening RQP Tool Results

Surface Water Risk Assessment

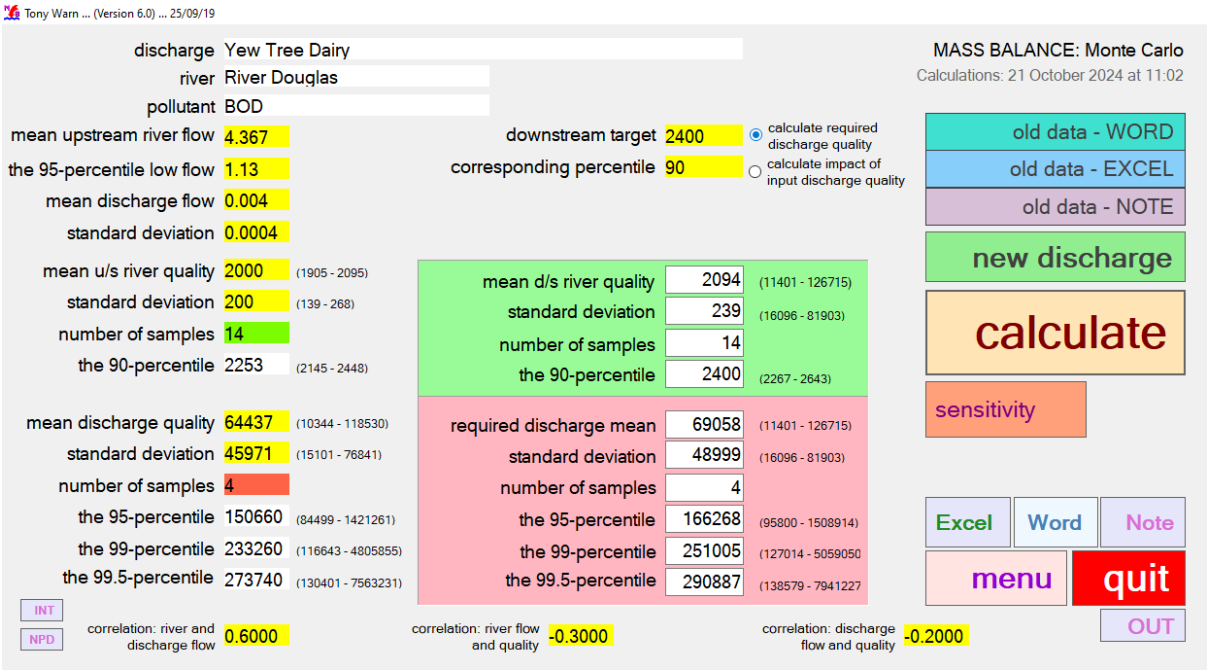
Environmental Permit Application

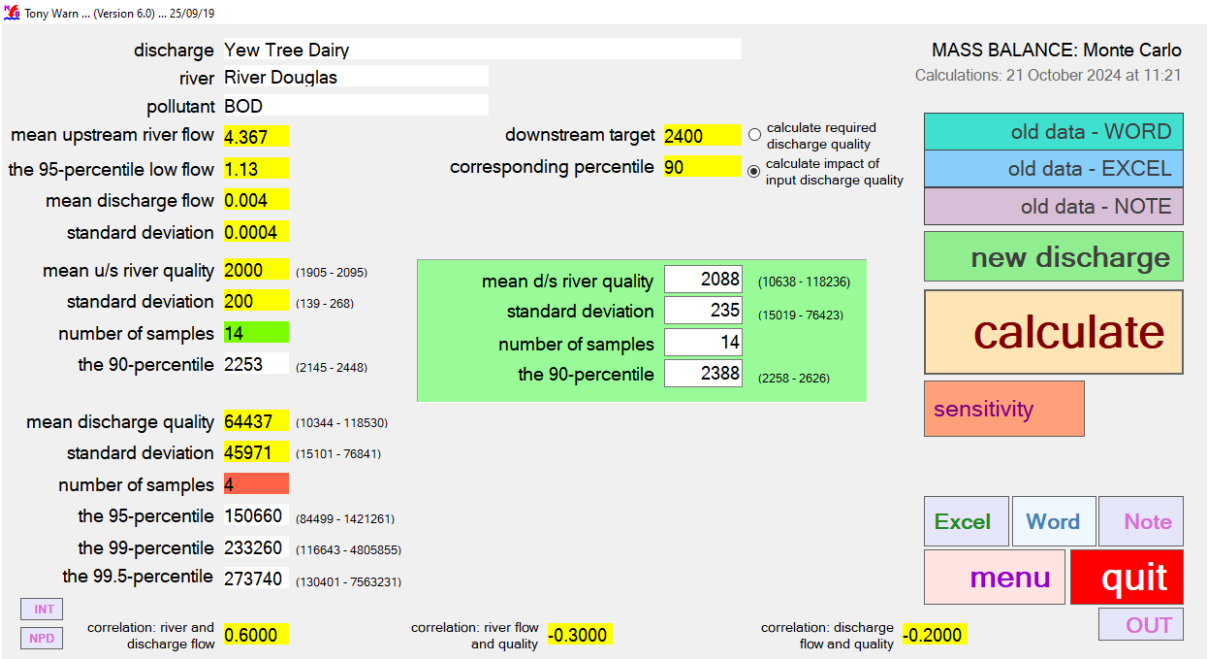
Yew Tree Dairy Partco Ltd

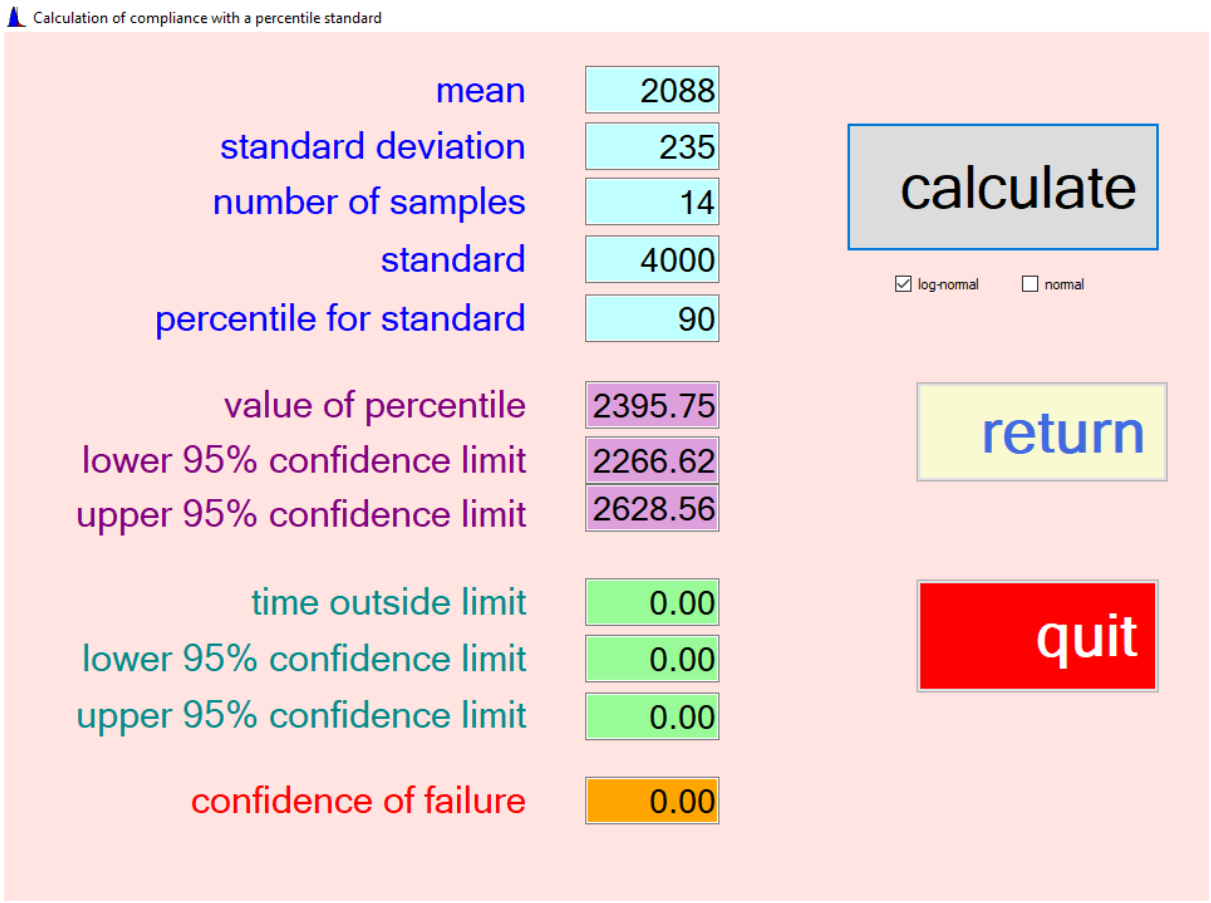
SLR Project No.: 416.065368.00001

22 October 2024

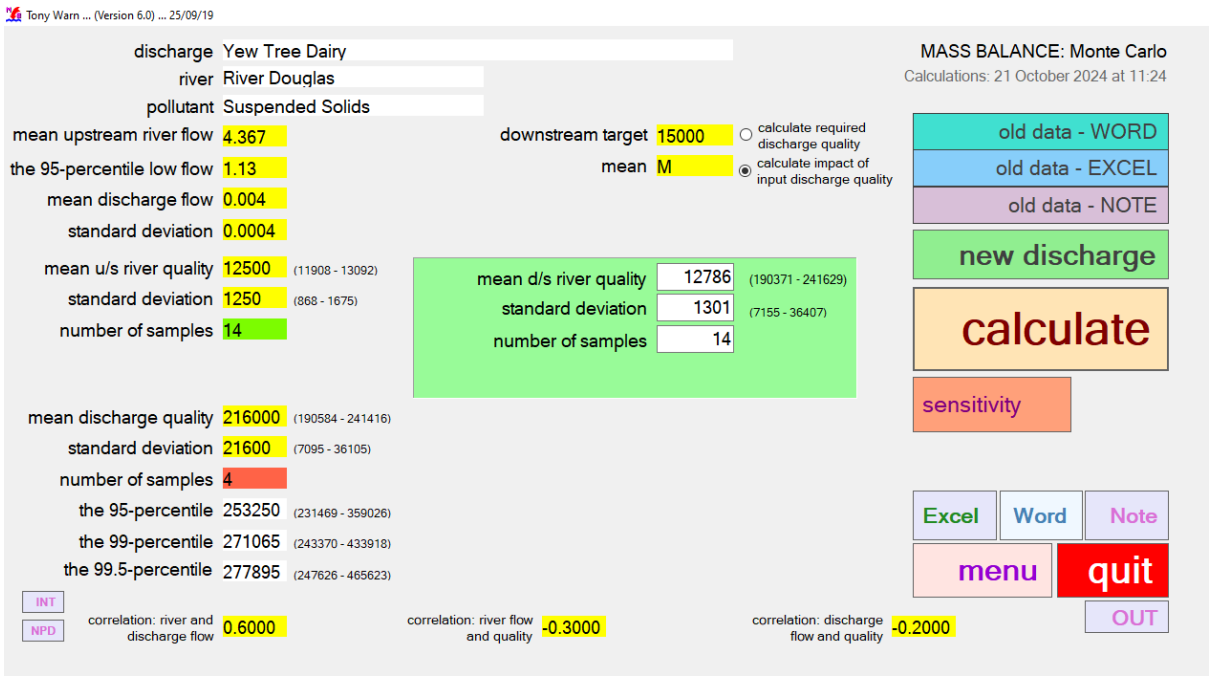
A.1 BOD Modelling Results

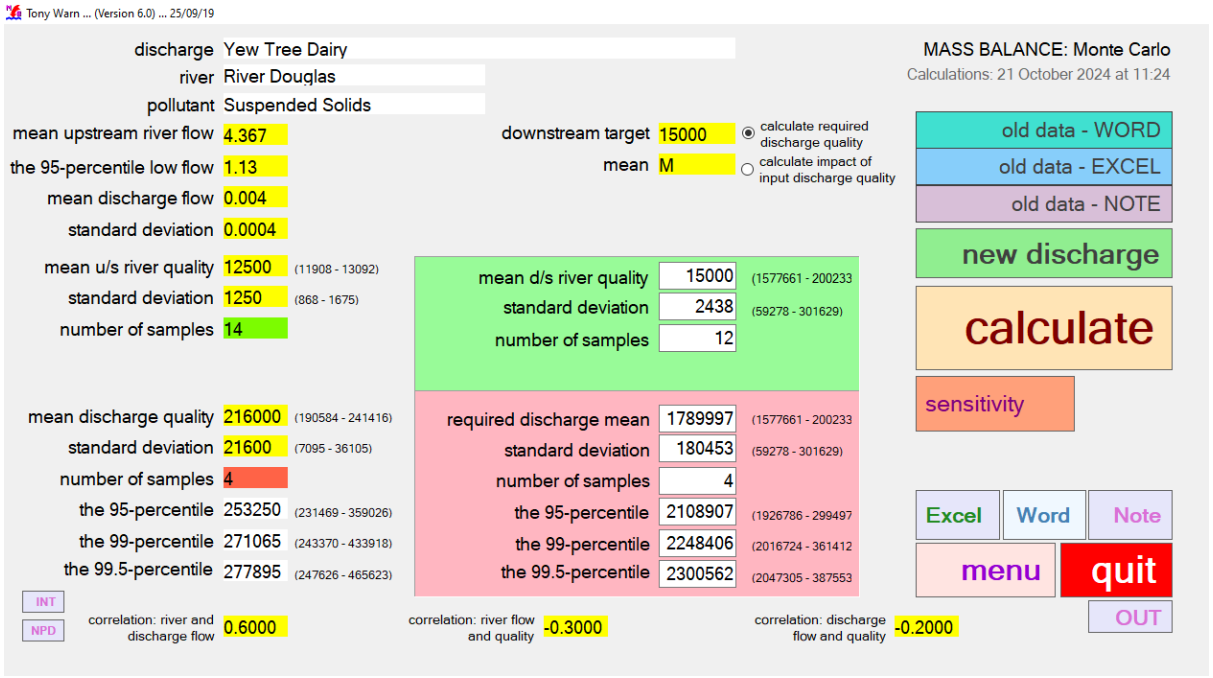






A.2 Suspended Solids Modelling Results




Tony Warn ... (Version 6.0) ... 25/09/19
discharge Yew Tree Dairy
river River Douglas
pollutant Suspended Solids
MASS BALANCE: Monte Carlo
Calculations: 21 October 2024 at 11:24
mean upstream river flow 4.367
the 95-percentile low flow 1.13
mean discharge flow 0.004
standard deviation 0.0004
downstream target 15000
mean M
calculate required discharge quality
calculate impact of input discharge quality
old data - WORD
old data - EXCEL
old data - NOTE
new discharge
calculate
sensitivity
mean u/s river quality 12500 (11908 - 13092)
standard deviation 1250 (868 - 1675)
number of samples 14
mean d/s river quality 15000 (1577661 - 200233
standard deviation 2438 (59278 - 301629)
number of samples 12
mean discharge quality 216000 (190584 - 241416)
standard deviation 21600 (7095 - 36105)
number of samples 4
the 95-percentile 253250 (231469 - 359026)
the 99-percentile 271065 (243370 - 433918)
the 99.5-percentile 277895 (247626 - 465623)
required discharge mean 1789997 (1577661 - 200233
standard deviation 180453 (59278 - 301629)
number of samples 4
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the 99-percentile 2248406 (2016724 - 361412
the 99.5-percentile 2300562 (2047305 - 387553
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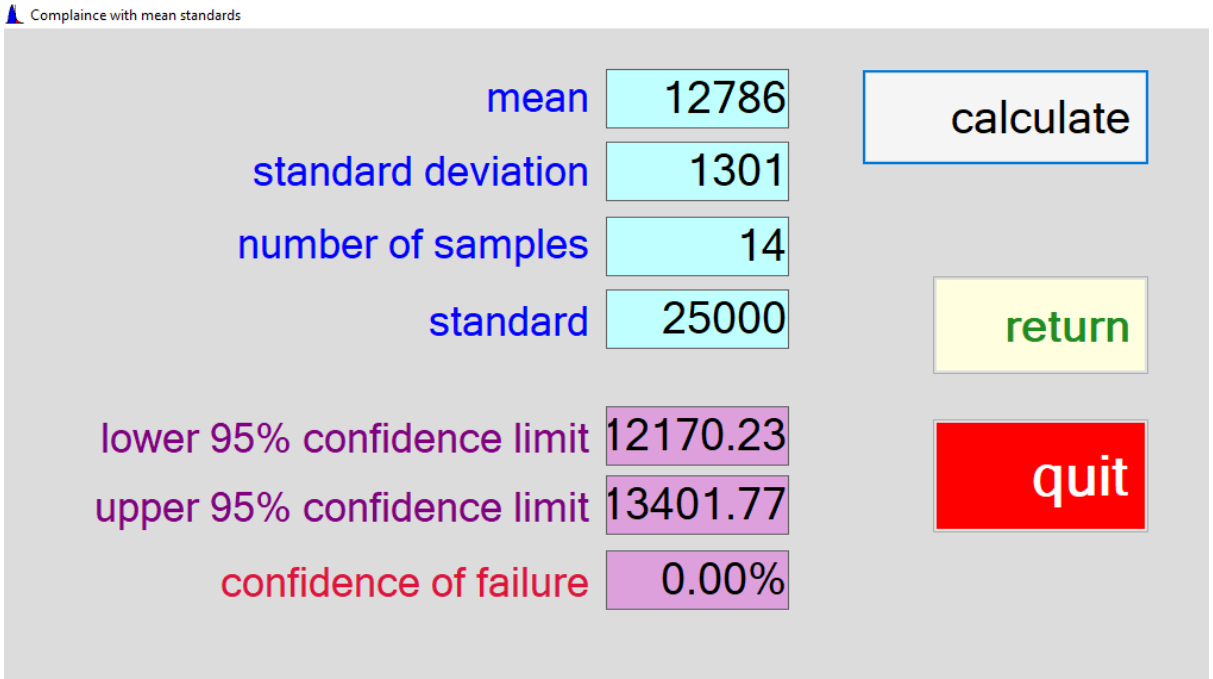
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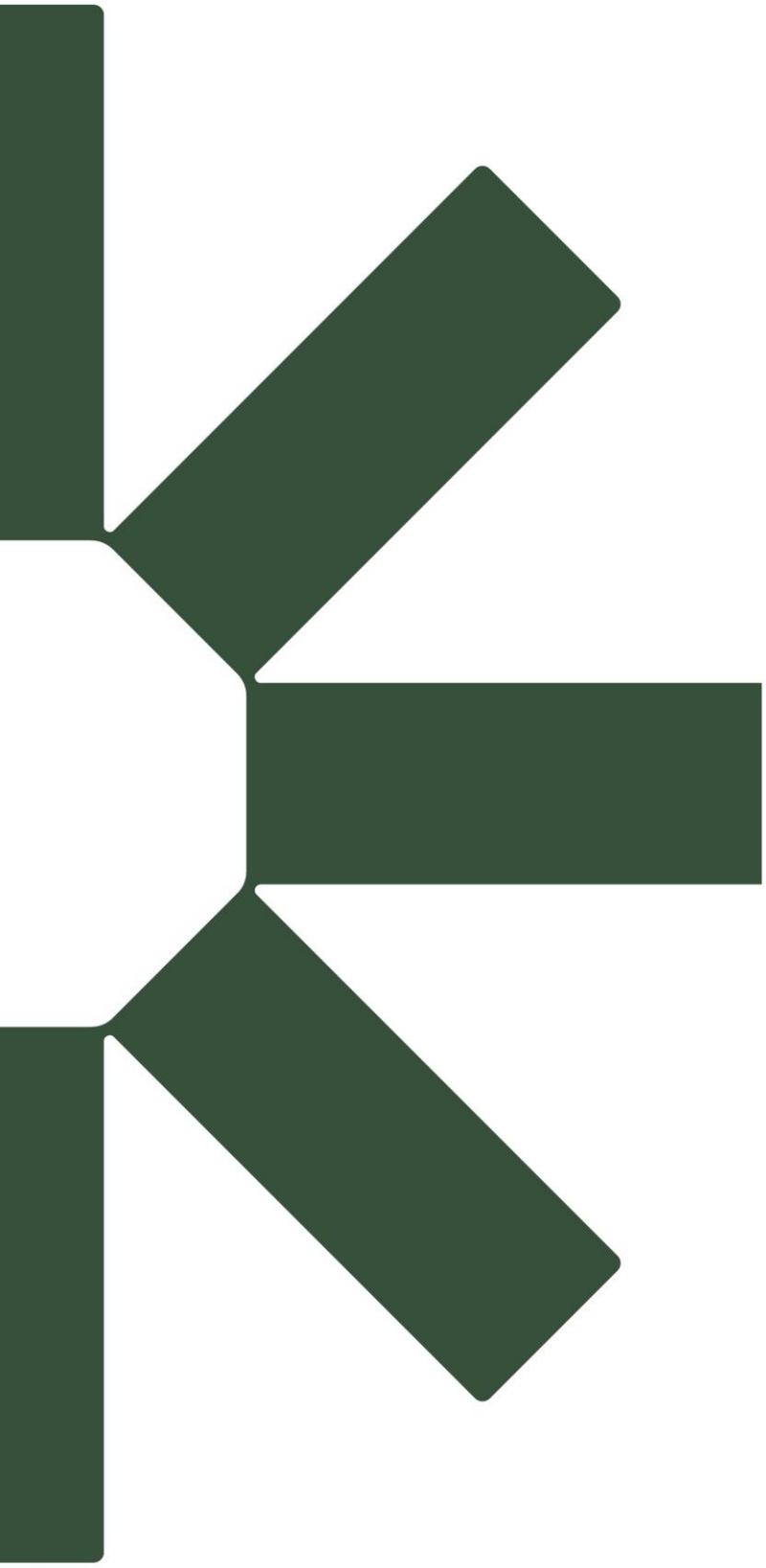

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