H Fraser Consulting
Contaminated Land and Hydrogeology

Glan Llyn residential surface drainage assessment

H1 assessment of discharge to Monks' Ditch

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Version History

Version	Author	Approved by	Issue date	Comment
30937 R1D1	Joe Gomme		03/07/25	Draft report issued for comment
30937 R1	Joe Gomme	Hannah Fraser	04/07/25	Final report issued to client

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TABLES

APPENDICES

1. INTRODUCTION

1.1 Background

Brighton STM Developments Ltd, on behalf of Revantage, has appointed H Fraser Consulting Ltd (HFCL) to assist with the assessment of surface water quality at the Glan Llyn residential development, at the former Llanwern Steelworks site in South Wales. Also on behalf of Revantage Ltd, Rodgers Leask Ltd (RLL) presented an application (PAN-029406) for a discharge consent for drainage water from the site. NRW responded with a request for additional information.

The site is drained by a network of interconnected pools and reens. Ultimately these need to discharge to a drainage channel called Monks' Ditch. Because of the site history there are concerns about the potential for the surface water to contain leached contaminants that may impact the receiving watercourse. Data presented with the discharge consent application includes contaminants that may be of concern. For this reason Natural Resources Wales (NRW) has requested further information, including a H1 assessment of the impact of the discharge on Monks' Ditch.

1.2 This report

This report provides a summary of the surface water chemistry. It then sets out the results of the H1 assessment requested by NRW.

2 SURFACE WATER DRAINAGE SYSTEM

2.1 Development context

The Glan Llyn development is proceeding by stages. Remediation of the site, involving turnover, testing and engineered re-placement of the Made Ground that comprises the upper layer of soils, is nearly completed, and the western part of the site has already been redeveloped with housing. Housing development is proceeding in the centre of the site.

Drainage from the site is planned to be discharged to Monks' Ditch, which runs along the eastern boundary and passes into the Gwent Levels Site of Special Scientific Interest (SSSI).

2.2 Existing drainage plan

The site contains significant quantities of Made Ground and has long been occupied by a potentially polluting industry (the steelworks), and it was likely that contaminants might be mobilised during the remediation and development works. The current drainage is therefore routed to the south, to a third-party treatment plant, to ensure that any contaminants are adequately dealt with before discharge to controlled waters.

2.3 Long term drainage arrangements

Once the development of the reen network and the remediation works are completed the drainage directions will change. At this time the off-site connection from D2-S will be removed, discharge to the south will be reversed and flow will be directed to the basin in the east of the site, for discharge to Monks' Ditch.

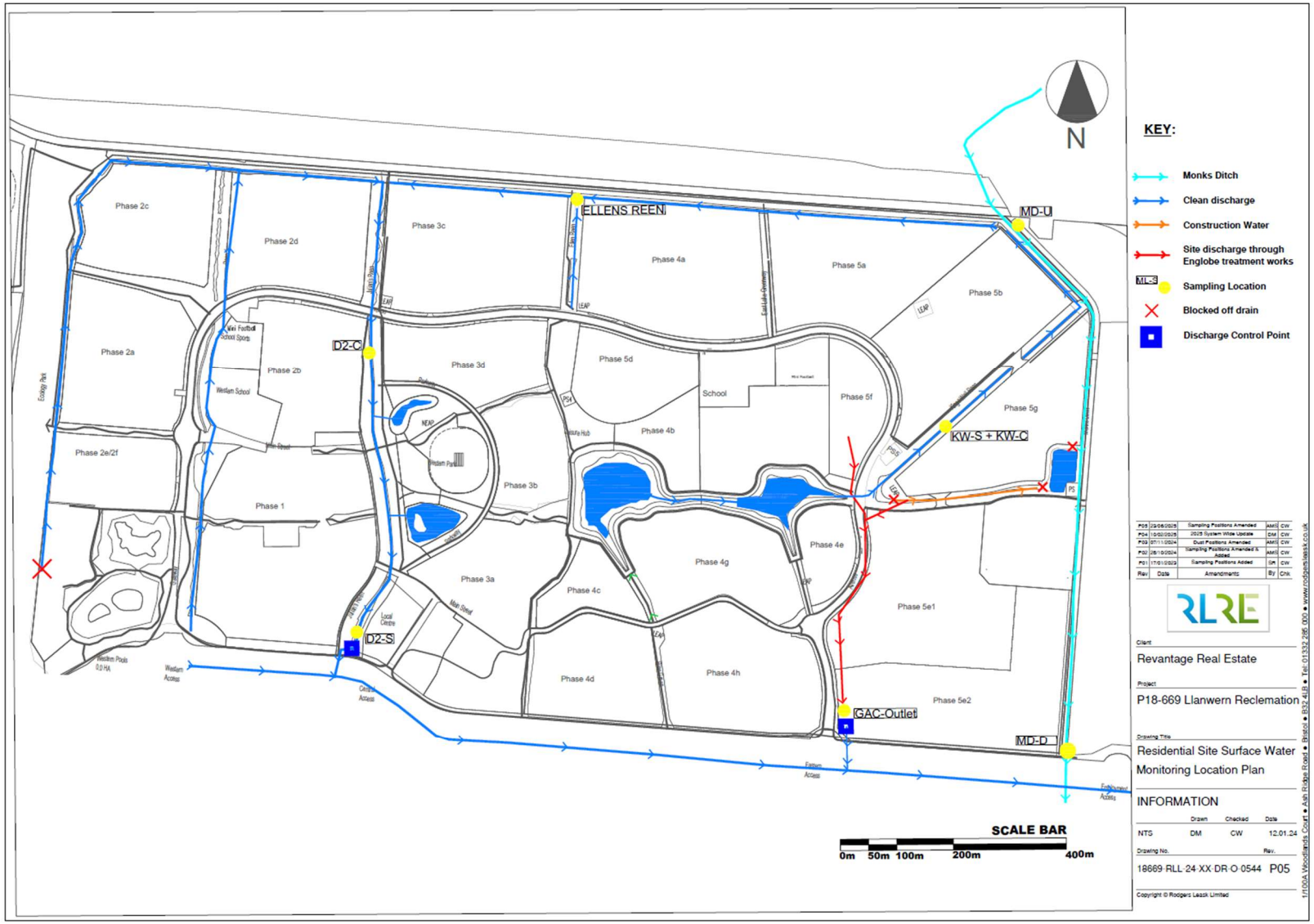

Figure 2.1 Existing drainage arrangements

3 WATER QUALITY REVIEW

3.1 Data available

A very large number of water samples has been taken from surface water on the site. The data presented with the discharge consent application relate to a sample point on Drain 2 South (D2-S in Figure 2.1). Analysis is available for 1,068 samples taken between May 2021 and June 2025. Analyses cover 226 determinands (though a number of these are duplicated, as discussed below). A spreadsheet of these data, with relevant statistics, is presented in Appendix A.

The data provided include appropriate screening values for potential environmental impact. These are either Gwent Levels SSSI water quality standards, or in their absence Water Framework Directive Environmental Quality Standards (EQS).

3.2 Summary of water quality analytical results

Statistics for each determinand analysed are shown at the right-hand side of the spreadsheet in Appendix A. Using Column I on the spreadsheet, we can see that 148 determinands have no assigned screening value. The remaining 79 have screening values assigned.

3.2.1 Determinands without assigned screening values

There are several reasons why screening values may not have been applied to a determinand. Column I of the spreadsheet in Appendix A contains comments for many of the determinands that have no assigned value, which explain why this is the case. We believe that this justifies their exclusion from screening.

1. 98 determinands have not been detected in any sample analysis. (With the exception of beryllium these are all organic species included in routine analytical suites.)
2. 31 determinands are duplicated. (For example, total iron and dissolved iron are both analysed.) In these cases RLL has selected the appropriate determinand for screening. In the case of metals, the dissolved concentration is relevant, rather than the total concentration. For some metals it is the bioavailable concentration that is important and this has been used for screening. For hydrocarbons, totals of aliphatic and aromatic species, for example, duplicate the fractions that have separate analyses provided.
3. Nine determinands are not relevant for a chemical screening in relation to a controlled waters discharge. These include measures that are not related to a specific chemical species: electrical conductivity, total dissolved solids, chemical oxygen demand, dissolved oxygen, redox potential, dissolved organic carbon and total organic carbon and total inorganic carbon.
4. Five species have no screening value because they are deemed not to be harmful. These are calcium, magnesium, total calcium, total magnesium and hardness.

Beyond these cases there are seven additional determinands that do not have screening values. These are shown in Table 3.1.

Table 3.1 Statistics for determinands with no screening value

Determinand	Units	No. detects	No. samples	% detects	Maximum	Minimum	Average	Monk's Ditch upstream average
Thiocyanate	mg/l	10	1068	1%	8.90	<0.50	0.51	0.54
Sulphide	mg/l	113	1068	11%	0.23	<0.05	0.05	0.12
Barium (Dissolved)	µg/l	1058	1068	99%	200.00	<5.00	60.40	114.02
Antimony (Dissolved)	µg/l	924	1068	87%	2.80	<0.50	0.84	0.52
Selenium (Dissolved)	µg/l	997	1068	93%	8.80	<0.50	1.69	0.68
Pyrene	µg/l	4	427	1%	0.65	<0.50	0.50	0.50

3.2.2 These determinands are further assessed in Section 4.2.Determinands with assigned screening values

49 determinands have maximum concentrations exceeding the relevant screening values. However, most of these are occasional outlier results, with fewer than 1% of samples exceeding the screening values. Only 13 determinands show exceedances of the relevant screening value in more than 1% of samples analysed. These are summarised in Table 3.2. The screening values are shown in Section 4.1, where these determinands are further assessed.

Table 3.2 Statistics for determinands exceeding screening values

Determinand	Units	No exceed	No. sample	% exceed	Max	Min	Ave	MD ave
pH	pH units	27	1068	3%	10.80	6.20	8.21	8.30
Suspended Solids At 105C	mg/l	81	1067	8%	550.00	5.00	25.65	27.18
Biochemical Oxygen Demand	mg O2/l	193	1067	18%	36.00	4.00	5.34	4.61
Ammonia (Free) as N	mg/l	48	794	6%	1.40	0.05	0.09	0.06
Ammoniacal Nitrogen	mg/l	208	1067	19.5%	8.60	0.05	0.69	0.35
Phosphorus (Dissolved)	mg/l	40	1068	3.7%	2.40	0.02	0.05	0.06
Sulphate	mg/l	16	1068	1.5%	390.00	12.00	156.19	29.17
Chromium (Dissolved)	µg/l	207	1068	19.4%	300.00	0.11	2.64	2.17
Copper (Bioavailable)	µg/l	73	1068	6.8%	7.90	0.01	0.38	0.24
Mercury (Dissolved)	µg/l	18	1068	1.7%	0.91	0.05	0.05	0.05
Manganese (Bioavailable)	µg/l	134	1068	12.5%	2970.44	0.05	61.06	12.50
Nickel (Bioavailable)	µg/l	13	1068	1.2%	37.99	0.06	1.00	0.46
Aliphatic TPH >C21-C35	µg/l	26	1068	2.4%	1600.00	0.10	6.68	0.92

4 POTENTIAL RISK TO MONKS' DITCH

The water body that will receive the site discharge is Monks' Ditch. It is important to consider the potential risk to Monks' Ditch, which is a sensitive waterway leading directly to the Gwent Levels Site of Special Scientific Interest (SSSI).

Where the existing water quality falls within the relevant standards it can be concluded that the discharge would not present a significant risk to water quality in Monks' Ditch. Where the water quality exceeds standards, further assessment is needed. If appropriate, an H1 assessment can be undertaken.

Some determinands do not have a defined water quality standard, and these also need further review.

4.1 H1 assessment of risk to Monks' Ditch

The H1 assessment framework was developed by the Environment Agency to facilitate the assessment of risks from various environmental emissions, including emissions to controlled waters. The approach is described on the government website[1]. The current version of the H1 risk assessment tool, developed to support the H1 assessment process unfortunately does not cover controlled waters discharge. However, the website also sets out the relevant methodology, including methods to use when standards such as environmental quality standards have not been derived for a given determinand.[2]

We took forward the 13 determinands listed in Table 3.2 for examination under the H1 assessment.

Two of the 13 (pH and suspended solids) are not appropriate for assessment using the H1 methodology:

- Suspended solids currently exceed screening level occasionally because of the earthworks that have been ongoing for several years and are now coming to a close. Once ground cover is established on the restored and redeveloped site suspended solids are expected to be well controlled within the reen system.
- pH will be buffered by the vegetated system and even in the assessed data set is normally within the screening limits. Its average value is very close to the average upstream value for Monks' Ditch.

The remaining 11 determinands have been assessed using a spreadsheet tool developed by HFCL, which applies the formulae provided in the H1 guidance to determine the maximum allowable Release Concentration (RC) for the discharge. There are four tests described by the guidance, which are applied sequentially.

- Test 1 checks whether the RC is greater than 10% of the screening value. If a determinand passes Test 1 no further checks are required. Otherwise it passes on to Test 2.
- Test 2 checks whether the Process Contribution (PC) resulting after dilution of the discharge in the receiving water is greater than 4% of the screening value. If Test 2 is passed, no further checks are required. Otherwise a determinand passes on to Tests 3 and 4.

[1] Environment Agency, 2023: Risk assessments for specific activities: environmental permits; https://www.gov.uk/government/collections/risk-assessments-for-specific-activities-environmental-permits

[2] Environment Agency, 2025: Surface water pollution risk assessment for your environmental permit; https://www.gov.uk/guidance/surface-water-pollution-risk-assessment-for-your-environmental-permit

- Test 3 assesses the predicted increase in the concentration from upstream of the discharge to downstream, using the Background Concentration (BC) and the PC, as well as the flows in the discharge and the receiving watercourse. If this increase is greater than 10% of the screening value then further modelling work is required.
- Test 4 checks whether the Predicted Environmental Concentration (PEC) downstream of the discharge is greater than the screening value. Again, if this is the case then further modelling is required.

Flow data are needed for Tests 2 to 4. RLL has collected data on discharge rates from the existing reen system, which drains the entire residential site at Glan Llyn. We have used these data to provide an average daily discharge rate for the future into Monks' Ditch.

There are no publicly available flow rates for Monks' Ditch. We have therefore estimated the flow rate in Monk's Ditch by multiplying the site's measured flows by a ratio of the site catchment area and the Monk's Ditch catchment area. This assumes that drainage is proportional to the area of catchment, which we consider to be a reasonable assumption since the catchments are contiguous, low-lying, coastal plain environments.

RLL has also collected samples from Monks' Ditch that allow the average background concentrations to be calculated for Tests 3 and 4.

The H1 calculations are provided in Appendix B and summarised in Table 4.1.

Table 4.1 H1 assessment results

Determinand	Units	Screening value	RC	BC	Test1	Test2	Test3	Test4
Biochemical Oxygen Demand	mg 02/l	6.50	5.34	4.61	Fail	Pass	nr	nr
Ammonia (Free) as N	mg/l	0.20	0.09	0.06	Fail	Fail	Pass	Pass
Ammoniacal Nitrogen	mg/l	1.10	0.69	0.35	Fail	Pass	nr	nr
Phosphorus (Dissolved)	mg/l	0.10	0.05	0.06	Fail	Pass	nr	nr
Sulphate	mg/l	300	156.19	29.17	Fail	Pass	nr	nr
Chromium (Dissolved)	µg/l	3.40	2.64	2.17	Fail	Pass	nr	nr
Copper (Bioavailabile)	µg/l	1.00	0.38	0.24	Fail	Fail	Pass	Pass
Mercury (Dissolved)	µg/l	0.07	0.05	0.05	Fail	Pass	nr	nr
Manganese (Bioavailable)	µg/l	123	61.06	12.5	Fail	Fail	Pass	Pass
Nickel (Bioavailable)	µg/l	4.00	1	0.46	Fail	Fail	Pass	Pass
Aliphatic TPH >C21-C35	µg/l	10.00	6.68	0.92	Fail	Pass	nr	nr

RC = release (discharge) concentration; BC = background concentration in Monks' Ditch; nr = not required

The table shows that all 11 determinands fail Test 1, but seven of them pass Test 2, which means that Tests 3 and 4 are only required for the remaining four determinands. All of those determinands pass Test 3 and Test 4.

4.2 Determinands with no available screening value

This section reviews the determinands listed in Table 3.1, which have no available environmental quality standard against which to screen concentrations. For these determinands, consideration needs to be given to Predicted No-Effect Concentrations (PNEC) derived from ecotoxicological studies.

Thiocyanate: Thermo Fisher[3] indicate a freshwater PNEC value of 0.095 mg/l for ammonium thiocyanate and the same value for sodium thiocyanate. These are two of the common forms of thiocyanate in the environment. Only 1% of analysed samples have detected thiocyanate above the laboratory detection limit of 0.5 mg/l, and although the average appears high this is due to a small number of outlier values in the data set. Occasional detections are similarly seen in the Monks' Ditch data. We do not consider that the occasional detections are representative of the discharge water and conclude that H1 screening of thiocyanate is not required.

Sulphide: PNEC values are not available for the sulphide ion, though there are PNEC values for sulphide complexed to organic chemicals. Sulphide is readily oxidised in surface waters to sulphate, which is not a significant environmental toxin (and has been separately examined). The detection of sulphide in approximately 1 in 10 samples in the data set is likely to reflect the developing nature of the reen system and periodic stagnation in flows. Once vegetated and flowing normally we would expect the water to be reasonably well oxygenated and sulphide to oxidise to sulphate. We conclude that H1 screening of sulphide is not required.

Barium: ECHA[4] provides a PNEC of 114.7 µg/l for freshwater. This value is well above the average value of 60 µg/l from the data set, which is also below the average background concentration recorded in Monks' Ditch. No further assessment is therefore required.

Selenium: Lemly (1997)[5] found that bioaccumulation could lead to environmental toxicity, particularly in water bodies with low or zero flow such as marshes and lakes, if concentrations exceeded 1 µg/l. ECHA[6] provides a PNEC of 2.67 µg/l (or 5.5 µg/l for intermittent releases). The measured concentration of selenium averages 1.69 µg/l and is below this PNEC. No further assessment is therefore required.

Antimony: ROTH[7] produced a chemical fact sheet on antimony that quotes a PNEC for freshwater of 0.113 mg/l for short-term exposure. This is the value from the EU-RAR (European Union Risk Assessment Report), as reported by the Dutch National Institute for Public Health and the Environment.[8] This value is well above the concentrations reported in the discharge (maximum concentration of 2.8 µg/l).

Pyrene is one of the PAH family, which is generally assessed through more mobile and more toxic members such as naphthalene and benzo(a)pyrene. These other PAH are among the screened determinands. Pyrene was detected in only 1% of samples, with a maximum concentration just above the detection limit. We consider that the assessment of other PAH is sufficient to characterise the risk from this family of chemicals. No further assessment is required.

[3] Thermo Fisher, 2023, Safety data sheet for ammonium thiocyanate.

[4] ECHA, https://echa.europa.eu/registration-dossier/-/registered-dossier/19625/6/1, accessed July 2025.

[5] Lemly, AD, 1997. Environmental Implications of Excessive Selenium: A Review. Biomedical and Environmenta Sciences 10. 415.435.

[6] ECHA, https://echa.europa.eu/registration-dossier/-/registered-dossier/15204/6/1, accessed July 2025.

[7] ROTH, 2024, Safety data sheet: Antimony. https://www.carlroth.com/medias/SDB-9258-GB-EN.pdf?context=bWFzdGVyfHNlY3VyaXR5RGF0YXNoZWV0c3wzMDM2NDV8YXBwbGljYXRpb24vcGRmfGFHVXhMMmhsWlM4NU1UYzRORE15T0RNeE5URTRMMU5FUWw4NU1qVTRYMGRDWDBWT0xuQmtaZ3xiMzUxYzJlOTJiZGY3NzM0MzU1MGFkODFjYzU1NTMzYzRiMjYyOWY3YzIwOThkY2VmMTc1MDBlMjIwNzUwZGM2

[8] Van Leeuwen, LC and Aldenburg, T, 2012. Environmental risk limits for antimony.

5 CONCLUSIONS

We have reviewed the large data set available for surface water chemistry at the Glan Llyn residential development site. Review of the determinands that have been detected in surface water shows that a number have exceeded the appropriate quality standards (screening values) in at least 1% of the analyses. After discounting determinands that are effectively duplicated by related determinands more appropriate for risk assessment in surface waters, we have further examined the remaining 11 determinands.

For the determinands that have exceeded screening values we have applied the Environment Agency's H1 assessment approach, as set out in government guidance. The H1 tests indicate that none of these poses a significant risk to the quality of water in Monks' Ditch.

There are an additional six determinands that have been detected in at least 1% of the analyses and have no defined screening value.

For the determinands with no screening value, PNEC values have been taken from the available literature and databases, and none have concentrations exceeding these PNEC values.

It is concluded, on the basis of the available surface water quality monitoring data and current regulatory guidance, that discharge of surface water from the site reen system to the Monk's Ditch does not pose an unacceptable risk to the water environment.

APPENDIX A

Analytical chemistry data spreadsheet

APPENDIX B

H1 spreadsheet calculation