

East Lancashire Paper Mill

784-B038963



Water Framework Directive Assessment



Version 2

Morris Homes

23/11/2023

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TABLE OF CONTENTS

1.0	INTRODUCTION	5
1.1	Background	5
1.2	Scope of this report.....	5
1.3	Limitations of this report	5
2.0	EXECUTIVE SUMMARY.....	7
3.0	ASSESSMENT APPROACH	9
3.2	Assessment stages	10
4.0	SCREENING	13
4.1	Catchment management.....	13
4.2	Water bodies.....	16
4.3	Downstream water body	24
5.0	SCOPING.....	25
6.0	IMPACT ASSESSMENT	26
6.1	Impact Assessment- River Irwell.....	26
6.2	Impact assessment- Hutchinson's Goit.....	34
6.3	Residual risks.....	40
6.4	Additional benefits	40
7.0	COMPLIANCE ASSESSMENT	41
8.0	CONCLUSION	43

LIST OF TABLES

Table 1: Environmental quality receptors	10
Table 2: WFD compliance criteria.....	12
Table 3- Measures for improvement defined in North West RBMP.....	14
Table 4- Roch (Spodden to Irwell) attributes.....	16
Table 5- Irwell (Rossendale STW to Croal) attributes.....	16
Table 6- Irwell (Roch to Croal) attributes.....	18
Table 7- Irwell (Roch to Croal) classifications.....	18
Table 8- Irwell (Croal to Irk) attributes.....	24
Table 9- Scoping of environmental receptors	25
Table 10- Impact Assessment on the River Irwell	26
Table 11- Impact assessment on the Hutchinson's Goit	34
Table 12- WFD criteria compliance	41
Table 13- RBMP objective compliance.....	41

LIST OF FIGURES

Figure 1- Site boundary.	6
Figure 2- North West River Basin district	13
Figure 3- Water body catchments of the Irwell basin.	17
Figure 4- Site plan.	23

APPENDICES

Appendix A: Drawings
Appendix B: Geomorphology report
Appendix C: Geo-environmental map

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
BG	Bealey's Goit
EA	Environment Agency
HG	Hutchinson's Goit
RBMP	River basin management plan
WFD	Water framework directive
WFDA	Water framework directive assessment

1.0 INTRODUCTION

1.1 BACKGROUND

- 1.1.1 The purpose of a Water Framework Directive Assessment (WFDA) is to ensure that compliance with the Water Framework Directive (WFD) is considered for any proposed development that has the potential to impact a water body. A WFD assessment will ensure that the proposed development will contribute to the achievement of the environmental objectives, or at a minimum, prevent any deterioration in status.
- 1.1.2 Tetra Tech Ltd. have been appointed by Morris Homes (the 'Client') to prepare a WFDA of the proposed development of East Lancashire Paper Mill, Radcliffe, Greater Manchester (the 'Site') (Figure 1). The WFDA will assess if this will impact upstream/ downstream waterbodies and the water body the site resides within.
- 1.1.3 The assessment supports the discharge of Planning Condition 21 for the Section 73 application reference 67597.

1.2 SCOPE OF THIS REPORT

- 1.2.1 To address the compliance of the site with the WFD, this assessment will:
- Outline the proposed development and present the current baseline data for the water body.
 - Consider impact of the proposed development on the environmental receptors within the water body.
 - Propose mitigation where detrimental impacts are identified.
 - Evaluate the proposed development against the mitigation measures and environmental objectives set out for the water body in the river basin management plan (RBMP).
 - Assess the compliance of the proposed development with the environmental objectives of the Water Framework Directive.

1.3 LIMITATIONS OF THIS REPORT

- 1.3.1 This report has been prepared by Tetra Tech Ltd. on behalf of the client in connection with the scope of the report as described in Section 1.2 above and taking into account the particular instructions and requirements set out in Tetra Tech's fee proposal and the Client's acceptance. It is not intended for and should not be relied on by any third party and no responsibility is undertaken to any third party.
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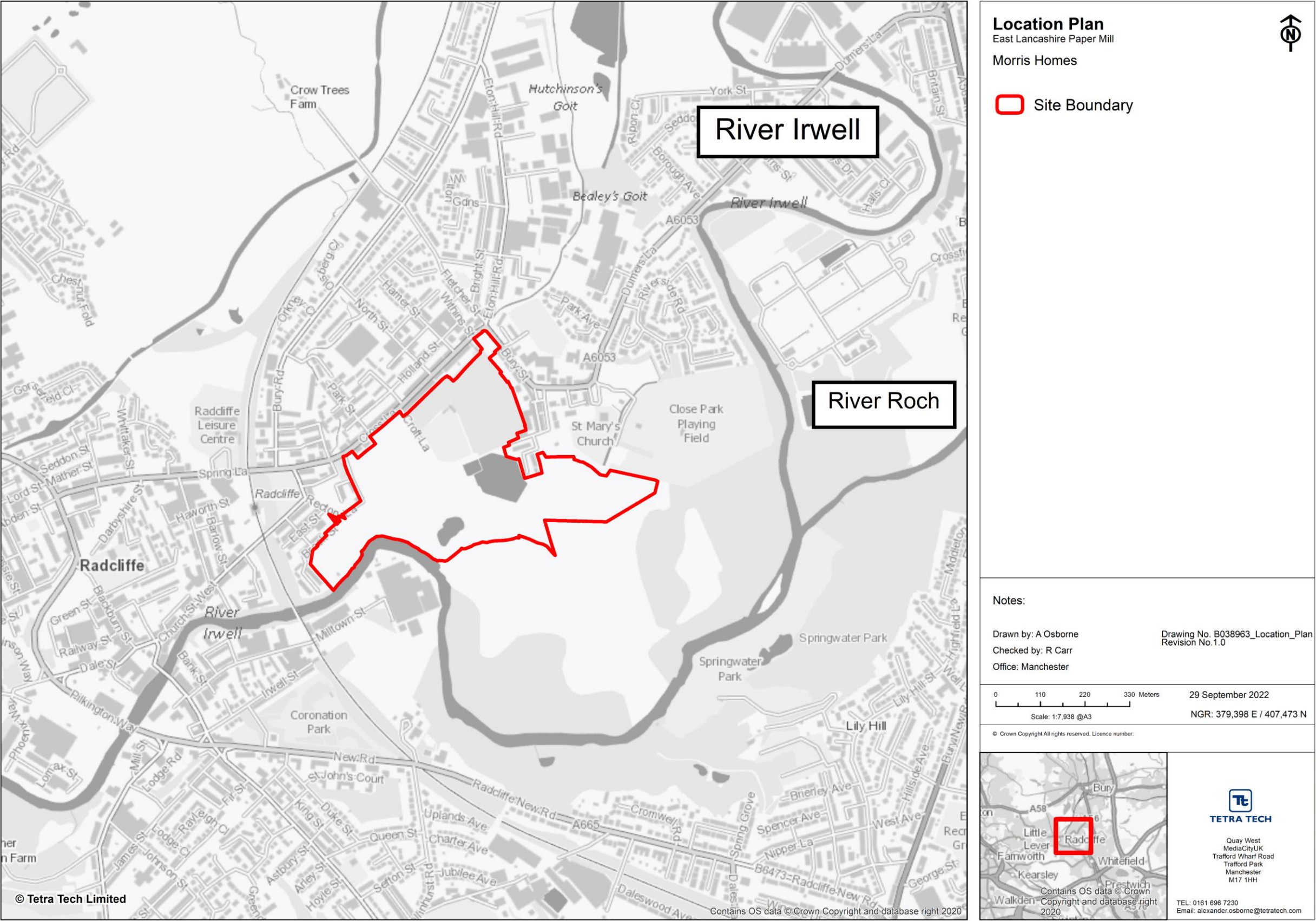


Figure 1- Site boundary.

2.0 EXECUTIVE SUMMARY

- 2.1.1 Morris Homes (the ‘client’) are undertaking the construction of a residential development at the East Lancashire Paper Mill, Radcliffe, Greater Manchester (the ‘Site’). The creation of the residential development adjacent to the River Irwell is being assessed for compliance with the WFD.
- 2.1.2 The site of the proposed development is located within the water body identified as ‘Irwell (Roch to Croal)’. The proposed development will reprofile river banks and will discharge surface water from the site into the River Irwell, through the intermediary reservoir (Lodge). The Hutchinson’s Goit (HG) will be connected from its outflow at the culvert on the northeast of the site to the Lodge. Additionally a section of bank wall within the Irwell adjacent to the site will be lower, to be reprofiled to more natural graded earth bank.
- 2.1.3 It was determined that most receptors will experience negligible or no impacts from the proposed development. Where positive impacts have been identified these are at a localised scale and as such, the impact on the whole water body can be considered negligible. Where negative impacts are determined, these will be short term and through mitigation can be reduced to negligible.
- 2.1.4 Positive localised impacts were identified, namely the improvement of river depth and width variation and riparian zone structure and condition in the River Irwell. The HG new channel will create a new riparian zone which will be of benefit over the current derelict site. The site’s current use is derelict land and the change of use to residential will improve the drainage routes on site, through the use of SuDs.
- 2.1.5 The proposed reprofiling of the bank wall along the River Irwell to a graded earth bank with a more natural gradient is likely to enable the development of a more natural riparian zone which will benefit the flow regime of the river. In turn the removal of the channel constriction is likely to improve sediment transport dynamics, with less surplus of fine sediment expected, thus benefitting the bedload. In turn this is expected to benefit fish populations within the river. In addition the reprofiled bank is likely to enable the natural colonisation of vegetation and natural bank reinforcement through root systems, which will enable natural development of riparian habitats.
- 2.1.6 Following the impact assessment, compliance with the WFD for the proposed development was considered. The scheme is considered to be compliant as it will contribute to, or not prevent, the achievement of the WFD and RBMP objectives applicable to the site.

Objective	Objective met? Y/N
The proposed development does not cause a deterioration in status for an environmental quality element.	Y
The proposed development will not negatively affect any elements of high status.	Y
The proposed development does not cause a significant localized impact on an element.	Y
The proposed development does not prevent the water body from achieving good surface water or groundwater status.	Y
The proposed development does not contribute to the pollution of surface waters or groundwater.	Y
The proposed development aids with (or does not prevent) the cessation of discharges, emissions and losses of priority hazardous substances into surface waters.	Y
The proposed development will not include changes that will permanently prevent the environmental objectives being met in other waterbodies.	Y
There are no residual risks following the implementation of the mitigation measures.	Y

3.0 ASSESSMENT APPROACH

- 3.1.1 The Water Framework Directive requires that environmental objectives be set for all water bodies (surface and ground).
- 3.1.2 The environmental objectives are outlined in Article 4 of the EU *Directive 2000/60/EC (The Water Framework Directive)* and are enforced in UK law under Article 13 of UK *The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017*. These objectives are defined as:
- Prevention of deterioration of the status of all waterbodies.
 - Protection, enhancement and restoration of all waterbodies with the aim of achieving good surface water status.
 - Reversing any significant and sustained upward trends in pollutant concentrations in groundwater.
 - Cessation of discharges, emissions and losses of priority hazardous substances into surface waters.
 - Progressively reducing the pollution of groundwater and preventing or limiting the entry of pollutants.
- 3.1.3 The WFD aims for all waterbodies to achieve at least ‘good ecological status’ (or for heavily modified waterbodies, to achieve ‘potential for good status’) within a specific timeframe. The progress is monitored through the biological, chemical and hydromorphological quality elements listed in section 3.1.2. The status of the biological and hydromorphological elements are determined to be either ‘Poor’, ‘Moderate’, ‘Good’ or ‘High’ and the chemical status is classed as either ‘Good’ or ‘Fail’. The overall status of a water body is determined by the lowest element status.
- 3.1.4 River Basin Management Plans (RBMPs) produced by the Environment Agency (EA) lay out the measures to be followed for each water body within the river basin to achieve the environmental objectives and attain good status.
- 3.1.5 Any proposed development that has the potential to impact environmental quality elements (“receptors”) in the water body must be assessed to determine whether it will prevent or delay the achievement of the environmental objectives. If any detrimental impacts are identified mitigation options should be proposed.

3.2 ASSESSMENT STAGES

- 3.2.1 The assessment will be undertaken in 4 sections: Screening, Scoping, Impact Assessment and Compliance Assessment.

SCREENING

- 3.2.2 Existing data for the water body will be collated and presented, as well as the data for any relevant upstream or downstream bodies. The objectives for the water body will be identified, as well as the timelines for achieving these.
- 3.2.3 The proposed development will be discussed in detail, and activities involved in the construction, operation and decommissioning of the development will be screened at a high level for potential impact. Any activities involved in the proposed development that are identified as being negligible risk at this screening stage are deemed in compliance with the WFD and will not progress to the scoping or impact assessment stages of the report.
- 3.2.4 If previous WFD assessments have been completed for the project, the outcomes of these will be considered at this screening stage.

SCOPING

- 3.2.5 The environmental quality elements at risk from activities involved in the proposed development (both in operation and construction) will be identified and scoped into the impact assessment. The quality elements are categorised into 4 groups for this assessment: biological, hydromorphological, physico-chemical and chemical. The individual receptors within these categories are shown in Table 1 below.

Table 1: Environmental quality receptors

Biological
Fish
Phytoplankton
Benthic Macroinvertebrates
Macrophytes and phytobenthos
Invasive Non-Native Species (INNS)
Hydromorphological
Hydrological regime: - Quantity and dynamics of flow - Connection to groundwater
River continuity
Morphological conditions: - River depth and width variation - Structure and substrate of riverbed - Riparian zone structure and condition

Physico-chemical
General conditions - pH - Temperature - Dissolved oxygen - Phosphate - Ammonia
Chemical
Priority substances and priority hazardous substances
Pollutants

- 3.2.6 The decision to scope out any receptors from the impact assessment will be clearly justified.

IMPACT ASSESSMENT

- 3.2.7 The impact assessment will identify the potential risks to the environmental quality elements defined within the scoping exercise. The effects of activities identified within screening will be considered.
- 3.2.8 The impact on the quality element will be categorised as either ‘negligible’, ‘positive impact’, ‘negative impact’ or ‘no change’ at a water body scale. Additionally, significant localised impacts may also be identified. A significant localised impact is defined as an effect that is either long-lasting, causes severe harm or affects a wide area within the water body but not the entire water body.
- 3.2.9 Where the impact is determined to be negative then the likelihood of the impact occurring will be assessed and mitigation measures will be suggested. The degree to which the impact will be assessed is dependent on the level of uncertainty (based on the scale, risk, complexity, and sensitivity). The higher the uncertainty, the more assessment will be carried out to give a high level of confidence in the results.
- 3.2.10 Where an element is classed as at high status, to be compliant with the WFD it needs to demonstrate that the impact of the proposed development will be negligible impact.

COMPLIANCE ASSESSMENT

- 3.2.11 Following the impact assessment, the overall impact on the ability to achieve the water body objectives will be considered. The proposed development will be considered in compliance if all the compliance criteria in Table 2 are met to a high level of confidence:

Table 2: WFD compliance criteria

A. The proposed development does not cause a deterioration in status for an environmental quality element
B. The proposed development will not negatively affect any elements of high status.
C. The proposed development does not cause a significant localised impact on an element
D. The proposed development does not prevent the water body from achieving good surface water or groundwater status.
E. The proposed development does not contribute to the pollution of surface waters or groundwater.
F. The proposed development aids with (or does not prevent) the cessation of discharges, emissions and losses of priority hazardous substances into surface waters.
G. The proposed development will not include changes that will permanently prevent the environmental objectives being met in other waterbodies.
H. The proposed development complies with the RBMP objectives.
I. There are no residual risks following the implementation of the mitigation measures.

SUPPORTING INFORMATION AND DATA USED

- 3.2.12 The status classifications are obtained from the Environment Agency Catchment Data Explorer latest data from 2019. This is considered to be the current best estimate. This data will be used as the baseline in assessing the potential for status deterioration.
- 3.2.13 The latest RBMP were produced in 2015 for Cycle 2 and these plans will be used in the assessment of objectives. Cycle 3 RBMPs will be aligned with the UK guidance: The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017, following the end of the transition period of UK's withdrawal from the EU in January 2021. This assessment has considered the objectives set in the UK guidance in addition to the WFD.

4.0 SCREENING

4.1 CATCHMENT MANAGEMENT

- 4.1.1 The site of the proposed development lies within the North West River basin in the Irwell catchment (Figure 2).

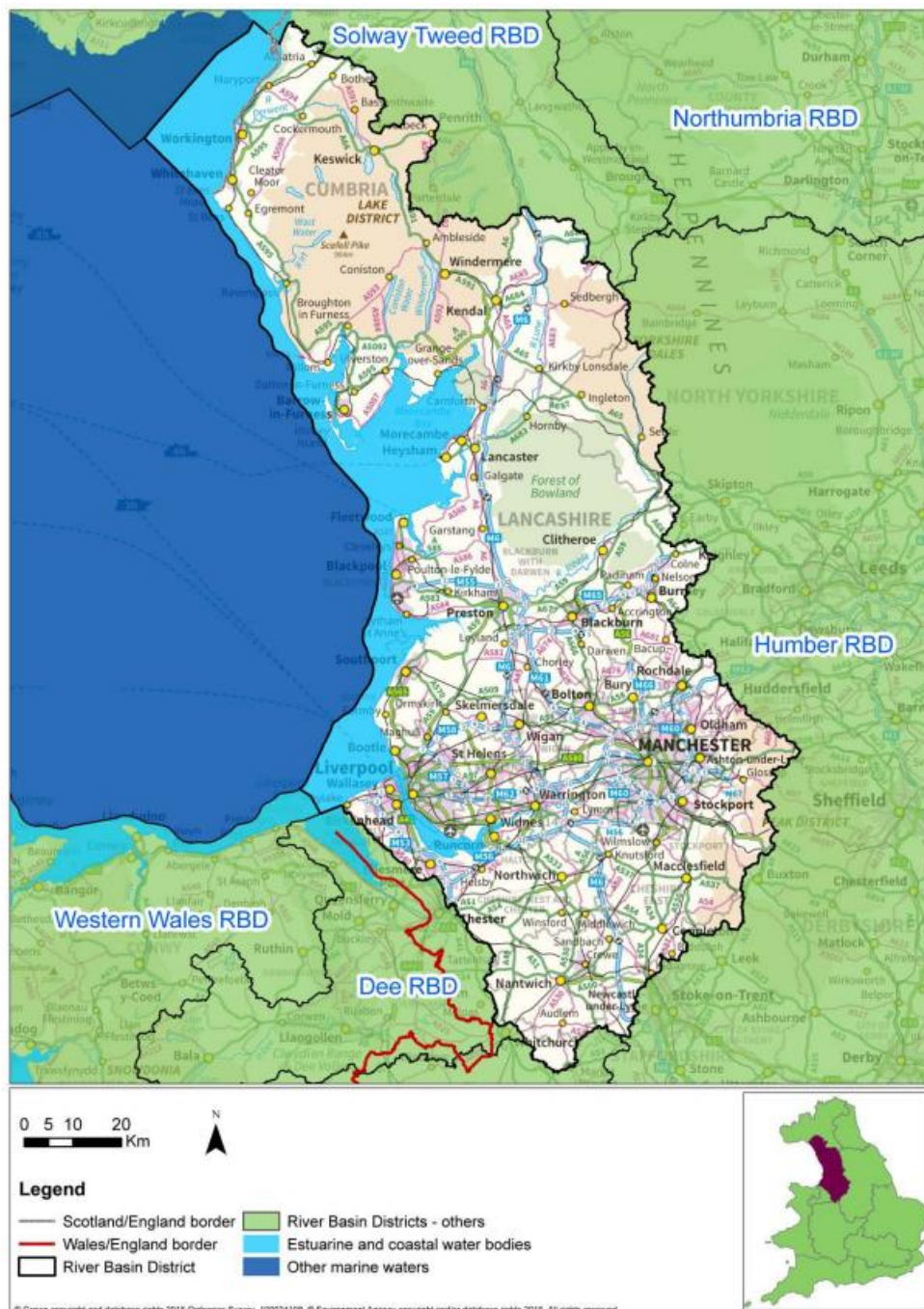


Figure 2- North West River Basin district (<https://www.gov.uk/government/publications/north-west-river-basin-district-river-basin-management-plan>)

- 4.1.2 This catchment is managed by the North West RBMP, which sets out measures at a river basin level and local level to achieve good status for the water bodies within the catchment.
- 4.1.3 The North West RBMP is produced for Cycle 2 (2015-2021) with Cycle 3 plan still under consultation. However, the current 2015 RBMP sets out basin-wide measures for improvement up until 2027 (Table 3).

Table 3- Measures for improvement defined in North West RBMP.

Measures to address physical modification
Improvement to condition of channel/bed and/or banks/shoreline
Removal or easement of barriers to fish migration
Improvement to condition of riparian zone and/or wetland habitats
Removal or modification of engineering structure
Change to operations and maintenance
Vegetation management
Measures to address pollution from waste water
Mitigate/Remediate point source impacts on receptor
Reduce point source pathways (i.e. control entry to water environment)
Reduce diffuse pollution at source
Reduce diffuse pollution pathways (i.e. control entry to water environment)
Mitigate/ Remediate diffuse pollution impacts on receptor
Measures to manage pollution from towns, cities, and transport
Reduce diffuse pollution pathways (i.e. control entry to water environment)
Mitigate/Remediate diffuse pollution impacts on receptor
Measures to address changes to natural flow and level of water
Control pattern/timing of abstraction
Measures to address pollution from rural areas
Reduce diffuse pollution at source
Mitigate/Remediate diffuse pollution impacts on receptor
Measures to manage invasive non-native species
Mitigation, control and eradication (to reduce extent)
Measures to manage pollution from minewaters
Mitigate/Remediate point source impacts on receptor

4.1.4 The 2015 North West RBMP sets specific objectives at a local level for the Irwell catchment:

- Implement evidence based measures and projects where benefits for the public and nature will be greatest.
- Make in-stream and riparian habitat improvements in identified locations within the catchment.
- Coordinate engagement programmes to address urban diffuse pollution.
- Implement catchment wide green infrastructure interventions, including urban forestry and sustainable urban drainage systems.
- Implement a cohesive package of measures to tackle leachate from contaminated land in key locations within the catchment.
- Remove or bypass significant physical modifications that act as barriers to fish migration and present risks to public and property.

4.1.5 In absence of the Cycle 3 RBMP, this assessment will consider whether the proposed development would have a detrimental impact on the achievement of these objectives if they were applied to the waterbodies considered in this report.

4.2 WATER BODIES

- 4.2.1 The site is situated within the Irwell (Roch to Croal) water body, with the river flowing into Irwell (Croal to Irk) as defined by Environment Agency's Catchment Data Explorer (Figure 3). The site is located within the midstream reaches of the water body and is adjacent to the River Irwell. Upstream waterbodies are the Irwell (Rossendale STW to Roch) and the Roch (Spodden to Irwell), with the downstream water body as the Irwell (Croal to Irk).

UPSTREAM WATER BODIES

- 4.2.2 There are two waterbodies upstream of the Irwell (Roch to Croal) water body. These are Roch (Spodden to Irwell) and Irwell (Rossendale STW to Roch). The confluence of the Irwell and Roch is approximately 1.5 km from the site.

Table 4- Roch (Spodden to Irwell) attributes.

Water Body name	Roch (Spodden to Irwell)
Water Body ID	GB112069064600
Water Body Type	River
Hydromorphological designation	Heavily modified
Length	21.7 km
Catchment area	42.6 km ²

Table 5- Irwell (Rossendale STW to Croal) attributes.

Water Body name	Irwell (Rossendale STW to Croal)
Water Body ID	GB112069064620
Water Body Type	River
Hydromorphological designation	Heavily modified
Length	32.8 km
Catchment area	42.9 km ²

- 4.2.3 It is unlikely that any changes to the site will impact upstream waterbodies. Therefore, the impact on upstream catchments is screened out.

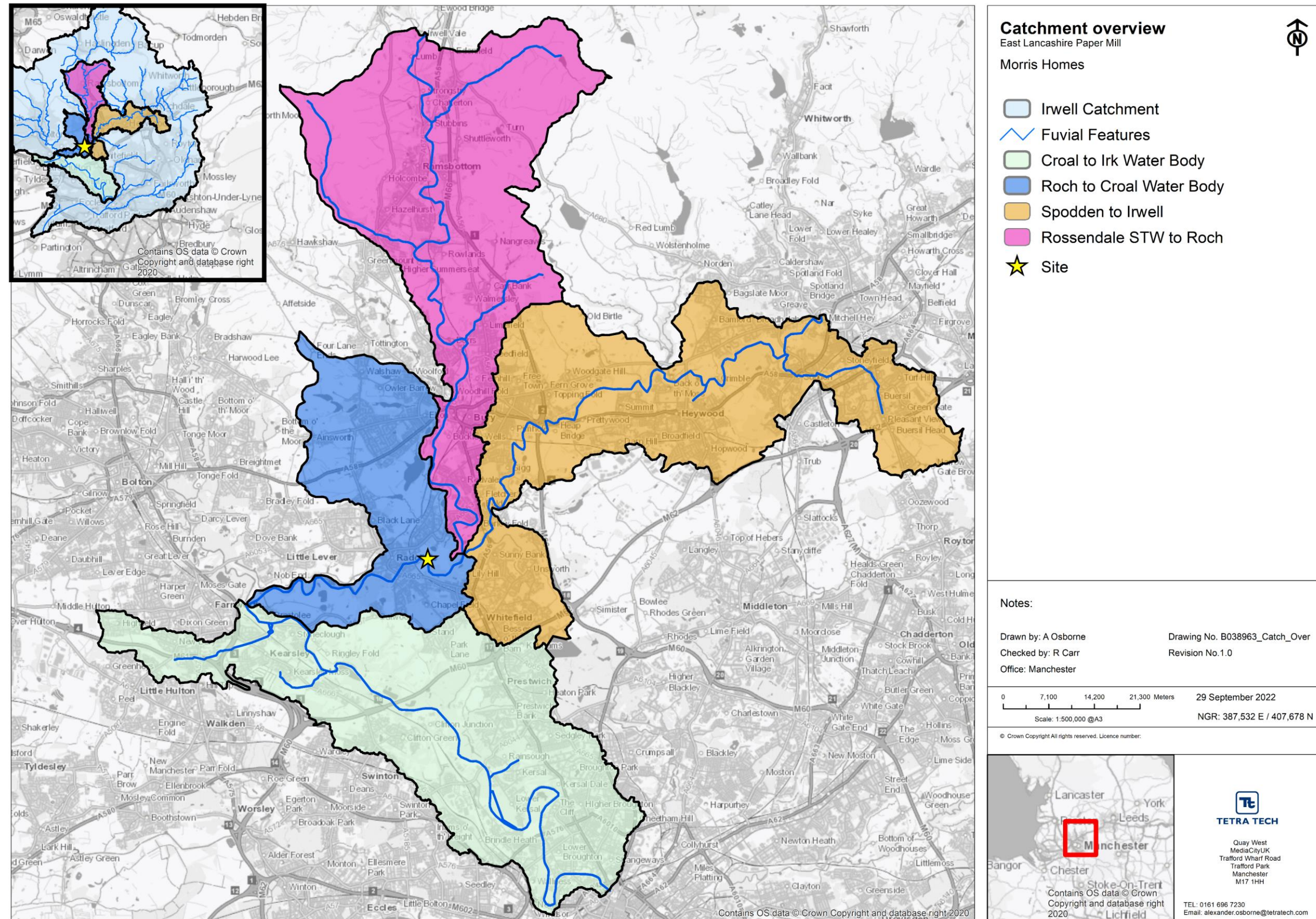


Figure 3- Water body catchments of the Irwell basin.

RESIDENT WATER BODY

4.2.4 The water body that the site will reside within is the Irwell (Roach to Croal) (Table 6).

Table 6- Irwell (Roch to Croal) attributes.

Water Body name	Irwell (Roch to Croal)
Water Body ID	GB112069060840
Water Body Type	River
Hydromorphological designation	Heavily modified
Length	7.8 km
Catchment area	20.1 km ²

4.2.5 The most recent classifications for the Irwell (Roch to Croal) from 2019 are shown in (Table 7).

Table 7- Irwell (Roch to Croal) classifications.

Quality element	2019
Ecological	Moderate
• Biological	Bad
• Physico-chemical	Moderate
Hydromorphological	Supports Good
Surface Water	Moderate
Specific pollutants	High
Chemical	Fail
• Priority hazardous substances	Fail
• Priority substances	Fail

4.2.6 Currently the water body is classed as in 'Moderate Ecological condition' and is given 'Fail' status for the chemical condition. These are determined by the lowest status of elements in the category.

4.2.7 The elements at the lowest status are:

- Biological- Invertebrates (Poor)
- Chemical – Mercury and its compounds (Fail), PFOS (Fail), PBDE (Fail)

4.2.8 Elements that are currently classified as being at 'High' status are:

- Dissolved oxygen

- Temperature
- pH
- Specific pollutant levels

4.2.9 The Cycle 2 overall objective for the site is to achieve 'moderate' status by 2027. The site does not have 'good' status as the objective as to achieve good status is determined to be disproportionately expensive, involve disproportionate burdens and is technically infeasible as no known technical solution is available.

SITE INVESTIGATION

4.2.10 The site was walked over on the 30th August with an evaluation of the current River Irwell being undertaken, supported by photographs shown below. In general, the River Irwell is heavily modified in the reach, with banks being surrounded by walls and large earth embankments.

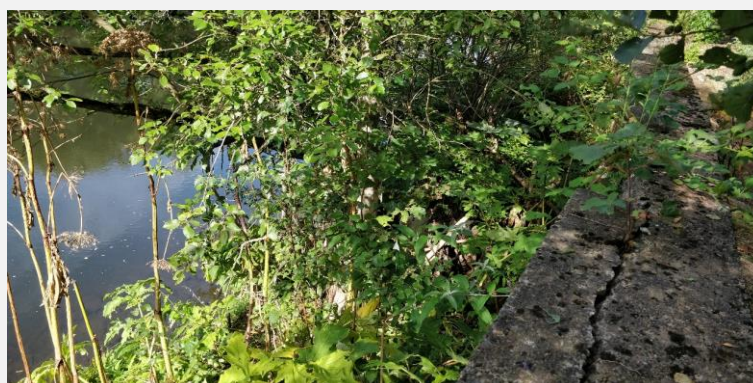
Site images



- Reinforced whole bank
- Vegetation degrading wall



- Left bank is partially contained with a brick wall
- Right bank is embanked with earth



- Right bank is in poor state of repair and failing.



- Bank and general site has a large amount of detritus.
-

SITE PROPOSAL

- 4.2.11 The proposal for the site is for the construction of a residential development and infrastructure. It will involve the reprofiling of the right bank of the Irwell, which is understood to involve removal of the existing wall, to be replaced by a more natural earth bank at a gradient of approximately 1:3; along with a modification to the HG outflow. The HG which currently has no defined outflow is to be diverted into the reservoir (Lodge) onsite and for an outflow via a spillway to the Irwell (Figure 4). It is calculated through modelling that a discharge of $0.75 \text{ m}^3 \text{ s}^{-1}$ can be expected from the spillway. The HG will undergo modification in the proposal so is also identified as at risk from this development. Further works will involve the modification of the right bank to provide protection to the housing development from flooding from the Irwell, while creating a flood conveyance corridor. Therefore, any changes made along the river bank may have the potential to impact on the current water body.

CONSTRUCTION PROCESS

- 4.2.12 During construction near the watercourse there will be bank reprofiling done and therefore existing material being removed or redispersed on site. HG will be redirected from its existing path towards the reservoir in an open channel, the HG is expected to be retained to allow these works to commence. The reservoir is expected to be lowered and banks to be disturbed or reprofiled. Pollutants such as waste left onsite and the risk of the underground waste would be encountered and require removing of. The construction process will involve an interface with the water body, therefore construction process is screened in.
- 4.2.13 The existing wall adjacent to the site along the River Irwell is proposed to be lower and replaced with a more natural graded bank. It is anticipated that this will involve earthworks.

SCHEME DESIGN

- 4.2.14 The proposed layout of the scheme is found in Appendix A, which includes the redirection of the HG from the site boundary towards the reservoir and then a spillway towards the River Irwell. There will be reprofiling of the banks around the Irwell to increase flood accommodation space on site. The development will include the inclusion of swales and retention pond structures throughout the site. Water will be kept onsite in SUD schemes with water being directed towards the HG and eventually the reservoir.
- 4.2.15 The reservoir before works was estimated to hold 17.21 ML of water, with the HG now proposed to drain into it along with additional surface water, a spillway will take water towards the River Irwell. The spillway will only be active during periods of wet weather.

DECOMISSIONING

- 4.2.16 Won't be decommissioned as lifetime is long so is screened out from the assessment.

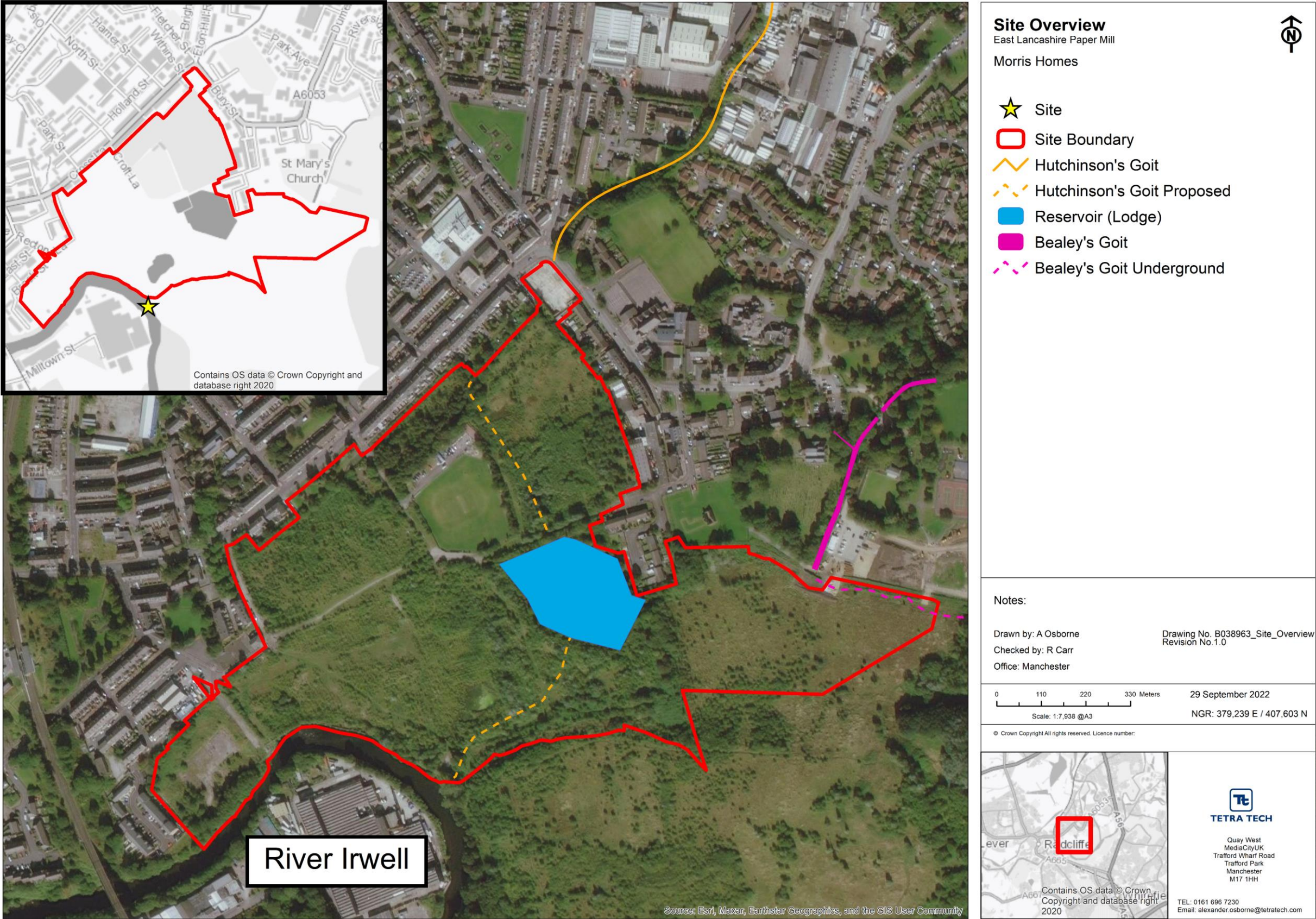


Figure 4- Site plan.

DOWNSTREAM WATER BODY

4.2.17 The downstream catchment is the Irwell (Croal to Irk), beginning approximately 6.3 km downstream from the site (Table 8).

Table 8- Irwell (Croal to Irk) attributes.

Water Body name	Irwell (Roch to Croal)
Water Body ID	GB112069061451
Water Body Type	River
Hydromorphological designation	Heavily modified
Length	25.2 km
Catchment area	41.9 km ²

4.2.18 Due to the distance downstream, no impact on the downstream water body is expected. Therefore, impacts on the Irwell (Croal to Irk) is screened out.

5.0 SCOPING

- 5.1.1 The proposed development has the potential to alter the current status of the water body through impacts on the environmental receptors. The elements in Table 9 have been scoped in or out of the impact assessment. Justification has been given where an environmental receptor has been scoped out.

Table 9- Scoping of environmental receptors

Receptor	In/Out
Biological	
Fish	In
Phytoplankton	In
Benthic Macroinvertebrates	In
Macrophytes and phytobenthos	In
Invasive Non-Native Species (INNS)	In
Hydromorphological	
<i>Hydrological Regime</i>	
Quantity and dynamics of flow	In
Connection to groundwater	Out – Proposed activity will not reach the groundwater interface.
River continuity	In
<i>Morphological conditions</i>	
River depth and width variation	In
Structure and substrate of riverbed	In
Riparian zone structure and condition	In
Physico-chemical	
General conditions pH Temperature Dissolved oxygen Phosphate Ammonia	In
Chemical	
Priority substances and priority hazardous substances	In
Pollutants	In

6.0 IMPACT ASSESSMENT

Two areas of impact are assessed, the River Irwell and the HG given that the impacts will affect each of them differently. A Geomorphology report is written for impacts relating to flow and sediment transfer (Appendix B).

6.1 IMPACT ASSESSMENT- RIVER IRWELL

Table 10- Impact Assessment on the River Irwell

Key:			
Negative impact	Negligible	Positive impact	No change
N/D. = not defined; N/A = not applicable			
WFD receptor	Current water body WFD classification	Description of impact to status (Construction)	Description of impact to status (Operation)
Ecological	Moderate		
Fish	N/D	During construction near the banks, sediment may enter the river. Water quality may become affected. Given the current sediment load of the Irwell the impact is seen as negligible. Mitigation required, i.e. sediment traps.	During operation the Irwell may see increased inputs of sediment originating from the proposed HG outlet. The levels of sedimentation will be very low and any impact negligible. It is likely that any operational increase in sediment load will be offset by the bank reprofiling within the Irwell, and the

WFD receptor	Current water body WFD classification	Description of impact to status (Construction)	Description of impact to status (Operation)
			consequential channel widening will result in a more natural hydrological regime and a reduction in overall surplus of fine sediment deposition. Overall this is likely to result in a positive overall impact.
Phytoplankton	N/D	During construction near the banks, sediment may enter the river. Water quality may become affected. Given the current sediment load of the Irwell the impact is seen as negligible. Mitigation required, i.e. sediment traps.	During operation the Irwell may see increased inputs of sediment originating from the proposed HG outlet. The levels of sedimentation will be very low and any impact negligible. It is likely that any operational increase in sediment load will be offset by the bank reprofiling within the Irwell, and the consequential channel widening will result in a more natural hydrological regime, and a reduction in overall surplus of fine sediment deposition. Overall this is likely to result in a positive overall impact.
Benthic Macroinvertebrates	N/D	During construction near the banks, sediment may enter the river. Water quality may become affected. Given the current sediment load of the Irwell the impact is seen as negligible. Mitigation required, i.e. sediment traps.	During operation the Irwell may see increased inputs of sediment originating from the proposed HG outlet. The levels of sedimentation will be very low and any impact negligible. It is likely that any operational increase in sediment load will be offset by the bank reprofiling within the Irwell, and the consequential channel widening will result in a

WFD receptor	Current water body WFD classification	Description of impact to status (Construction)	Description of impact to status (Operation)
			more natural hydrological regime and a reduction in overall surplus of fine sediment deposition. Overall this is likely to result in a positive overall impact.
Macrophytes and phytobenthos	Moderate	During construction near the banks, sediment may enter the river. Water quality may become affected. Given the current sediment load of the Irwell the impact is seen as negligible. Mitigation required, i.e. sediment traps.	During operation the Irwell may see increased inputs of sediment originating from the proposed HG outlet. The levels of sedimentation will be very low and any impact negligible. It is likely that any operational increase in sediment load will be offset by the bank reprofiling within the Irwell, and the consequential channel widening will result in a more natural hydrological regime, an improvement in sediment transport, and a reduction in an overall surplus of fine sediment deposition. Overall this is likely to result in a positive overall impact.
Invasive Non-Native Species (INNS)	N/D	Onsite INNS are identified. Construction will have a negligible effect on INNS since they are found throughout the water body. Construction machinery will be cleaned and checked for INNS prior to use to avoid additional spread of INNS.	No expected change during operation.

WFD receptor	Current water body WFD classification	Description of impact to status (Construction)	Description of impact to status (Operation)
Hydromorphological	Supports Good		
Quantity and dynamics of flow	N/D	No expected change during construction.	The spillway to the Irwell will have negligible impact since outflow is expected to be at $0.75 \text{ m}^3 \text{ s}^{-1}$ during flood conditions which in comparison to the Irwell is insignificant, with discharge in excess of $100 \text{ m}^3 \text{ s}^{-1}$. The water body will have negligible impact. It is likely that any operational changes in flows will be offset by the bank reprofiling within the Irwell, and the consequential channel widening will result in a more natural hydrological regime that is less constrained by the existing wall. Overall this is likely to result in a positive overall impact on the flow conditions within the River Irwell.
River continuity	N/D	No expected change during construction.	No expected change during operation.
River depth and width variation	N/D	No expected change during construction.	The Irwell will experience an increase in channel width. The re-profiling of the bank and wall removal within the Irwell will enable the river to take a more natural form consistent with recognised hydromorphological indices including a suitable width and depth. The existing wall

WFD receptor	Current water body WFD classification	Description of impact to status (Construction)	Description of impact to status (Operation)
			forces the Irwell into an area that is too narrow, which may exacerbate flooding and increase sediment surpluses and deficits, and therefore removal of this constraint is likely to result in an overall positive impact as it will act to improve flood impact and habitat quality in the area.
Structure and substrate of riverbed	N/D	Reprofiling of the banks will allow unconsolidated sediment to potentially flow into the Irwell during the implementation stage. It is likely that this is overall negligible.	Negligible change locally to the HG outflow into the Irwell, with some sediment transfer occurring. The variation in river depth and width associated with the bank re-profiling is likely to have an overall positive effect on the flows within the river, which is likely to reduce the excessive deposition of fine sediment both upstream and downstream of the site. In turn this is likely to have an overall positive impact on the river bed. Proportionally to the Irwell, the water body will not adversely be affected.
Riparian zone structure and condition	N/D	The existing riparian zone will be modified by the works. Existing vegetation will be removed. This will result in a temporary negative impact; however, this will be offset by an overall positive operational impact.	Once works are complete it is expected that the riparian zone will be improved over current conditions. The planting of suitable vegetation will enhance the riparian zone and will become more stable as a result of the works.

WFD receptor	Current water body WFD classification	Description of impact to status (Construction)	Description of impact to status (Operation)
Physico-chemical conditions	Moderate		
pH	High	No change expected to pH conditions.	No change expected to pH conditions
Temperature	High	No change expected to temperature.	No change expected to temperature.
Dissolved oxygen (DO)	High	No change expected.	No change expected.
Phosphate	Poor	No change expected.	The connection of the reservoir to the Irwell will have negligible impact. Water sampling of reservoir indicated 20.5 µg/l which is rated as good (APEM P00007490, 04/22). When diluted into the Irwell overtime it will have negligible impact locally. The water body will not be adversely impacted by potential changes in phosphate levels from the proposed connection Change of site to residential from brown field may introduce sources of pollution i.e. fertilisers. It is assumed that these will be used on a small scale and following manufacturers instructions. Therefore, the potential use of fertilisers will have a negligible impact on the water body.

WFD receptor	Current water body WFD classification	Description of impact to status (Construction)	Description of impact to status (Operation)
Ammonia	Moderate	No change expected.	The connection of the reservoir to the Irwell will have a negligible impact. Water sampling of reservoir indicated 0.03 mg/l which is rated as high compared to the water body at moderate (APEM P00007490, 04/22). Change of site to residential from brown field may introduce sources of pollution i.e. fertilisers. It is assumed that these will be used on a small scale and following manufacturers instructions. Therefore, the potential use of fertilisers will have a negligible impact on the water body.
Biochemical Oxygen Demand (BOD)	n.d.	No change. No increase in waste organic matter expected to occur from development – maintain current oxygen levels.	No change. No increase in waste organic matter expected to occur from development – maintain current oxygen levels.
Acid Neutralising Capacity	High	No change. No change in acidic/base inputs into river from geology or organic sources.	No change. No change in acidic/base inputs into river from geology or organic sources.
Chemical	Fail		
Priority substances and priority hazardous substances	Fail	The site is an ex-industrial site which has been abandoned for several years. Within the site there is potential for significant levels of mobile substances within the made ground. Particularly in the southern section with in-ground asbestos,	The connection of the HG to the Irwell through the site has the potential of being a point source of substances when in flood. With the reservoir an integral part of the flood strategy, concentrations may build up, which then get deposited into the Irwell. The reservoir currently

WFD receptor	Current water body WFD classification	Description of impact to status (Construction)	Description of impact to status (Operation)
		elevated levels of lead and free phase hydrocarbons. (See Appendix C). Land to the east was a previous landfill site. This will not be touched by the works. However, leaching has been indicated. The impact of works would have a negligible impact to the water body if mitigation is undertaken to prevent sediment transfer/ surface water to the Irwell and that site monitoring is undertaken to measure water runoff off the site. Currently there is no formal drainage onsite, allowing water to drain over the entire area. During construction temporary drainage will be created.	tests 'good' for pollutants, with no samples above exceeding permitted levels. Testing of the reservoir should be undertaken once works are complete to detect any rises to baseline conditions. Testing in 2017 indicated that the reservoir was similar to groundwater levels on site. No change is expected once works are completed and the site is allowed to stabilise.
Pollutants	N/D	Works will disturb the surface which may contain pollutants. Any water run off would either go towards the reservoir or to the Irwell. The impact of works would have a negligible impact to the water body if mitigation is undertaken to prevent sediment transfer/ surface water to the Irwell and that site monitoring is undertaken to measure water runoff off the site. Any pollution from construction machinery will be mitigated against in the CEMP.	Slight positive impact. The proposed HG channel will input runoff from site directly into the River Irwell. Current drainage off site is unregulated. With drainage and SuDS, pollution from site runoff will be treated with an appropriate treatment train and the design will limit contact with the made ground. With a drainage point of the spillway, water quality can be monitored.

6.2 IMPACT ASSESSMENT- HUTCHINSON'S GOIT

Table 11- Impact assessment on the Hutchinson's Goit.

WFD receptor	Current water body WFD classification	Description of impact to status (Construction)	Description of impact to status (Operation)
Ecological	Moderate		
Fish	N/D	Works will commence past the current known extent of the HG at the culvert entering the site. No change to habitat of or flow to any existing fish. Flow may be reduced or stopped to allow works to commence. The HG is already very slow and congested with vegetation. Negligible impact would be experienced as the connection back to the Irwell would still be open.	The connection of the HG to the reservoir and then spillway will open a new flow path. Risk is minimal since the Irwell feeds into the HG and then will reconnect to the Irwell through the spillway. Current HG is degraded and unlikely to form a meaningful migration route. Destination of fish may be improved by connection to the reservoir, rather than a bottleneck. The naturalisation of the flow regime and bedload within the channel that is likely to occur in conjunction with the reprofiled river bank is likely to have an overall positive effect on the ability of fish populations to spawn and thrive. Overall impact will be positive given the creation of new habitat and the optimisation of the existing habitat within the Irwell.

WFD receptor	Current water body WFD classification	Description of impact to status (Construction)	Description of impact to status (Operation)
Phytoplankton	N/D	Flow may be stopped in HG. Light and nutrient levels will remain the same. As the HG has minimal flow already, any changes would have a negligible impact.	There will be improvement of flow through the HG to the reservoir. With new habitat being created with the proposed channel being daylight. The impact of the bank re-profiling within the Irwell is likely to have a negligible impact, however on account of the HG there will be an overall positive impact.
Benthic Macroinvertebrates	N/D	Flow may be stopped in HG. Light and nutrient levels will remain the same. As the HG has minimal flow already, any changes would have a negligible impact.	There will be improvement of flow through the HG to the reservoir. With new habitat being created with the proposed channel being daylight.
Macrophytes and phytobenthos	Moderate	Flow may be stopped in HG. Light and nutrient levels will remain the same. As the HG has minimal flow already, any changes would have a negligible impact.	There will be improvement of flow through the HG to the reservoir. With new habitat being created with the proposed channel being daylight. The impact of the bank reprofiling upon the hydrology within the channel and the sediment transport is likely to be favourable for the development of macrophytes and phytobenthos.

WFD receptor	Current water body WFD classification	Description of impact to status (Construction)	Description of impact to status (Operation)
Invasive Non-Native Species (INNS)	N/D	INNS are identified onsite. Through the works these have been found and have been treated against. Construction will have a negligible effect on INNS since they are found throughout the water body.	No change is to be expected, as the HG is fed by the River Irwell, and will flow eventually back to the Irwell. No new connection paths for INNS in either the HG or River Irwell will be made.
Hydromorphological	Supports Good		
Quantity and dynamics of flow	N/D	During construction the HG might need to be dammed to allow for works to commence. The affect will be negligible as flow into the HG is through the Irwell, so therefore there will not be any build-up of water. Flow is already minimal given the build up of vegetation and the flow limiting in operation upstream. Any damming of water will not greatly affect the water body.	The HG during normal conditions is limited upstream by a retention structure, limiting flow to $0.5 \text{ m}^3 \text{ s}^{-1}$. At low flows the HG has limited flow due to sediment build up and vegetation. The diversion of flow into the reservoir will not cause any change to the flow dynamics.
River continuity	N/D	There will be negligible impact to continuity as if the HG is dammed for construction, the flow route upstream will still be open given that it is fed from the Irwell.	Improved continuity as the HG is connected to the Irwell again through the spillway. Flow path is improved. Similarly the reprofiled Irwell river bank will improve consistency of flows within the Irwell.

WFD receptor	Current water body WFD classification	Description of impact to status (Construction)	Description of impact to status (Operation)
River depth and width variation	N/D	No change expected during construction.	The proposed HG channel will create a section of new river depth/ width towards the reservoir. Compared to existing flow paths, a defined channel will have a positive impact.
Structure and substrate of riverbed	N/D	No change expected during construction.	No change is expected during operation.
Riparian zone structure and condition	N/D	No change expected during construction.	Once works are complete it is expected that the riparian zone will be improved over current conditions. The planting of suitable vegetation will enhance the riparian zone and will become more stable as a result of the works. A new riparian zone will be introduced by the creation of a channel from the HG culvert to the reservoir. The reprofiling of the Irwell bank will improve the riparian zone, and the graded bank will allow for the colonisation of vegetation. In turn the roots are likely to consolidate the bank against excessive erosion, thus maintaining the condition.
Physico-chemical conditions	Moderate		
pH	High	No change expected to pH conditions.	No change expected to pH conditions

WFD receptor	Current water body WFD classification	Description of impact to status (Construction)	Description of impact to status (Operation)
Temperature	High	No change expected to temperature.	No change expected to temperature.
Dissolved oxygen (DO)	High	No change expected.	No change expected.
Phosphate	Poor	No change expected.	No change expected. No new inputs to the original HG.
Ammonia	Moderate	No change expected.	No change expected. No new inputs to HG.
Biochemical Oxygen Demand (BOD)	n.d.	No change. No increase in waste organic matter expected to occur from development – maintain current oxygen levels.	No change. No increase in waste organic matter expected to occur from development – maintain current oxygen levels.
Acid Neutralising Capacity	High	No change. No change in acidic/base inputs into river from geology or organic sources.	No change. No change in acidic/base inputs into river from geology or organic sources.
Chemical	Fail		
Priority substances and priority hazardous substances	Fail	No change expected. Works will commence after the current HG.	No change expected. Works will commence after the current HG.
Pollutants	N/D	No change expected. Works will commence after the current HG.	No change expected to current HG. Works will commence after the current HG.

6.3 RESIDUAL RISKS

- 6.3.1 Taking into consideration the impacts identified above as well as any mitigation measures suggested, it can be concluded that there are no residual risks to the status of the water body.

6.4 ADDITIONAL BENEFITS

- 6.4.1 The proposed development has the potential to include some environmental enhancements to the area being developed. There is the opportunity to provide habitats and improve riparian vegetation at the site. The provision of these areas of natural vegetation goes beyond the baseline aim of the WFD which requires the proposed development to 'not cause deterioration in status'. By implementing the enhancements, this is actively improving the condition of the riparian and aquatic flora and meeting the following RBMP long-term objectives for this localised area:

- Improvement to condition of riparian zone and/or wetland habitats
- Vegetation management

- 6.4.2 By utilising the site rather than being left as derelict land, there is additional benefit to the public and nature. Currently the site is a mixture of unused roads/ paths and fly tipping. The risk to the water body is from the continued declination of the site from current conditions, through the deterioration of existing networks and the risk of contaminated surface waters reaching the Irwell unchecked. With the implementation of a drainage strategy and being able to test surface waters, using sampling of the Lodge periodically to determine if there is a change in baseline condition caused by the connection of the HG. There would be a benefit to the WFD in terms of identifying any potential risks for mediation.
- 6.4.3 The re-profiled banks within the Irwell allow for the colonisation of heterogenous vegetation, which is likely to develop and naturally diversify over time. In turn, the roots would consolidate the bank against excessive erosion.

7.0 COMPLIANCE ASSESSMENT

- 7.1.1 The conclusions of the impact assessment above have led to the WFD water body objectives in Table 12 being met:

Table 12- WFD criteria compliance

	Objective met? Y/N
The proposed development does not cause a deterioration in status for an environmental quality element	Y
The proposed development will not negatively affect any elements of high status.	Y
The proposed development does not cause a significant localised impact on an element	Y
The proposed development does not prevent the water body from achieving good surface water or groundwater status;	Y
The proposed development does not contribute to the pollution of surface waters or groundwater.	Y
The proposed development aids with (or does not prevent) the cessation of discharges, emissions and losses of priority hazardous substances into surface waters.	Y
The proposed development will not include changes that will permanently prevent the environmental objectives being met in other waterbodies.	Y
There are no residual risks following the implementation of the mitigation measures.	Y

- 7.1.2 The proposed scheme works towards, or does not prevent, the RBMP objectives in Table 13. Long-term objectives that are not relevant to the proposed scheme have not been included in the table.

Table 13- RBMP objective compliance

Long term objectives - 2027	
Measures to address physical modification	
Improvement to condition of channel/bed and/or banks/shoreline	Y- The banks will become more stable because of the works.
Improvement to condition of riparian zone and/or wetland habitats	Y- New riparian zone will be created around HG, and bank of the Irwell will be reprofiled to a more appropriate condition, including earth banks

	optimised and profiled to a suitable gradient for habitat development.
Vegetation management	Y
Measures to manage pollution from towns, cities, and transport	
Reduce diffuse pollution pathways (i.e., control entry to water environment)	Y- Water will be treated within the site through the use of SuDS and the use of the reservoir.
Mitigate/Remediate diffuse pollution impacts on receptor	Y- Site being used for residential use improves the mitigation strategies of pollution impact over that of a derelict site.
Measures to manage invasive non-native species	
Mitigation, control and eradication (to reduce extent)	Y- INNS will be reduced within the site.

Localised objectives - 2015	
Implement evidence based measures and projects where benefits for the public and nature will be greatest.	The change of land use from a derelict site to a modern residential development will be an improvement to the public and wider areas appeal.
Make in-stream and riparian habitat improvements in identified locations within the catchment.	Riparian zone by the Irwell and the creation of a new zone of the HG. Reprofiling of the existing bank to improve riparian zone for the benefit of flow conveyance, lateral connectivity, vegetation colonization and optimization of habitat availability.
Coordinate engagement programmes to address urban diffuse pollution.	N/A
Implement catchment wide green infrastructure interventions, including urban forestry and sustainable urban drainage systems.	Inclusion of SuDs within the site. Reprofiling of banks to enable diverse colonization of vegetation.
Implement a cohesive package of measures to tackle leachate from contaminated land in key locations within the catchment.	Neutral- The plan will neither improve nor worsen leachate from neighboring landfill.
Remove or bypass significant physical modifications that act as barriers to fish migration and present risks to public and property.	N/A

8.0 CONCLUSION

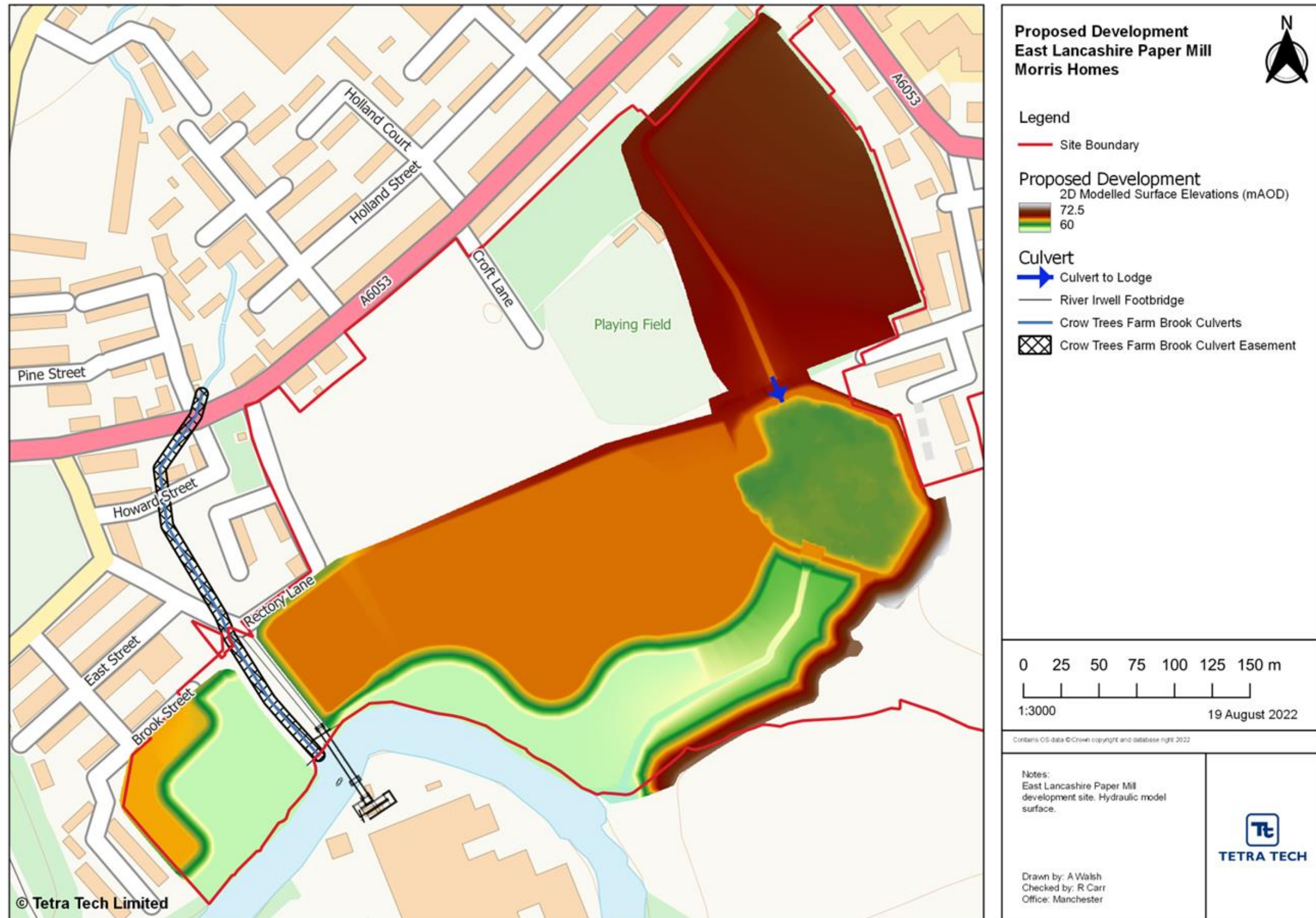
8.1.1 The purpose of this report is to address the compliance of the site with the WFD through:

- Considering the impact of the proposed development on the environmental receptors within the water body,
- Proposing mitigation where detrimental impacts are identified,
- Evaluating the proposed development against the mitigation measures and environmental objectives set out for the water body in the RBMP and,
- Assessing the compliance of the proposed development with the environmental objectives of the Water Framework Directive.

8.1.2 The proposed new channel of the HG and reprofiled bank of the River Irwell at the East Lancashire Paper Mill, Radcliffe, have been assessed for compliance with the WFD. No negative impacts have been identified during the operation phase and most environmental receptors will experience negligible or positive impacts from the proposed development. Where negative impacts are found, these are within the construction phase and will be temporary, with any mitigation strategies used are considered to reduce the impact to negligible. Where positive impacts have been identified these are at a localised scale and as such, the impact on the water body, can be considered negligible. The water body is not given the WFD objective to achieve 'good' status as this is determined to be disproportionately expensive, involve disproportionate burdens and is technically infeasible as no known technical solution is available. The proposed development would not be able to deliver any meaningful improvements to the River Irwell in terms of the WFD, as this would involve disproportionate costs and is technically infeasible as stated above. The proposed development does not prevent any future improvements to the River Irwell when considering the WFD objectives.

8.1.3 It has been determined that the proposed development is in compliance and will contribute to, or not prevent, the achievement of the WFD and RBMP objectives applicable to the site.

APPENDIX A: DRAWINGS



APPENDIX B: GEOMORPHOLOGY REPORT

East Lancashire Paper Mill

784-B038963



Geomorphology Assessment



Version 2

Morris Homes

23/11/2023

Document prepared on behalf of Tetra Tech Limited. Registered in England number: 01959704



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TABLE OF CONTENTS

1.0	INTRODUCTION	5
1.1	Background	5
1.2	Scope of report.....	5
1.3	Limitations of this report	6
2.0	ASSESSMENT APPROACH	7
2.2	Methodology	8
3.0	DESK-BASED ASSESSMENT.....	9
3.1	Catchment overview	9
3.2	Historic overview.....	9
3.3	Study area.....	12
4.0	FIELD SURVEY.....	16
5.0	GEOMORPHOLOGICAL IMPACT	25
6.0	RECOMMENDATIONS AND CONCLUSION	26
6.1	Recommendations.....	26
6.2	Conclusion.....	26
	REFERENCES.....	27

LIST OF TABLES

Table 1- Summary of study site.....	15
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LIST OF FIGURES

Figure 1- Map overview of site.....	5
Figure 2- Time and spatial scale in the formation of UK fluvial landscapes.....	7
Figure 3- Hjulström curve of sediment mobility.....	7
Figure 4- Catchment overview	10
Figure 5- Historic overview.....	11
Figure 6- Hydrograph of the River Irwell located at Pioneer Mill.....	13
Figure 7 – Study site.....	14
Figure 8- Map of photo locations.....	17

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
BG	Bealey's Goit
HG	Hutchinson's Goit

1.0 INTRODUCTION

1.1 BACKGROUND

- 1.1.1 Tetra Tech was commissioned to perform a geomorphological assessment on behalf of Morris Homes for their site located at the former East Lancashire Paper Mill, Radcliffe, Greater Manchester (Figure 1). The assessment supports the wider Water Framework Directive Assessment in the discharge of Planning Condition 21 for the Section 73 application reference 67597. There is a proposed introduction of a new channel connecting the Hutchinson's Goit (HG) to the River Irwell, through a reservoir (Lodge) and spillway, utilising an existing outflow point used previously by Bealey's Goit (BG).
- 1.1.2 It is also proposed to lower the wall along the outer bank of the River Irwell adjacent to the site to form compensatory flood storage and increase the Irwell's functional flood plain.
- 1.1.3 The creation of a new channel and wall lowering is to be assessed against the geomorphological impact to the existing fluvial network.

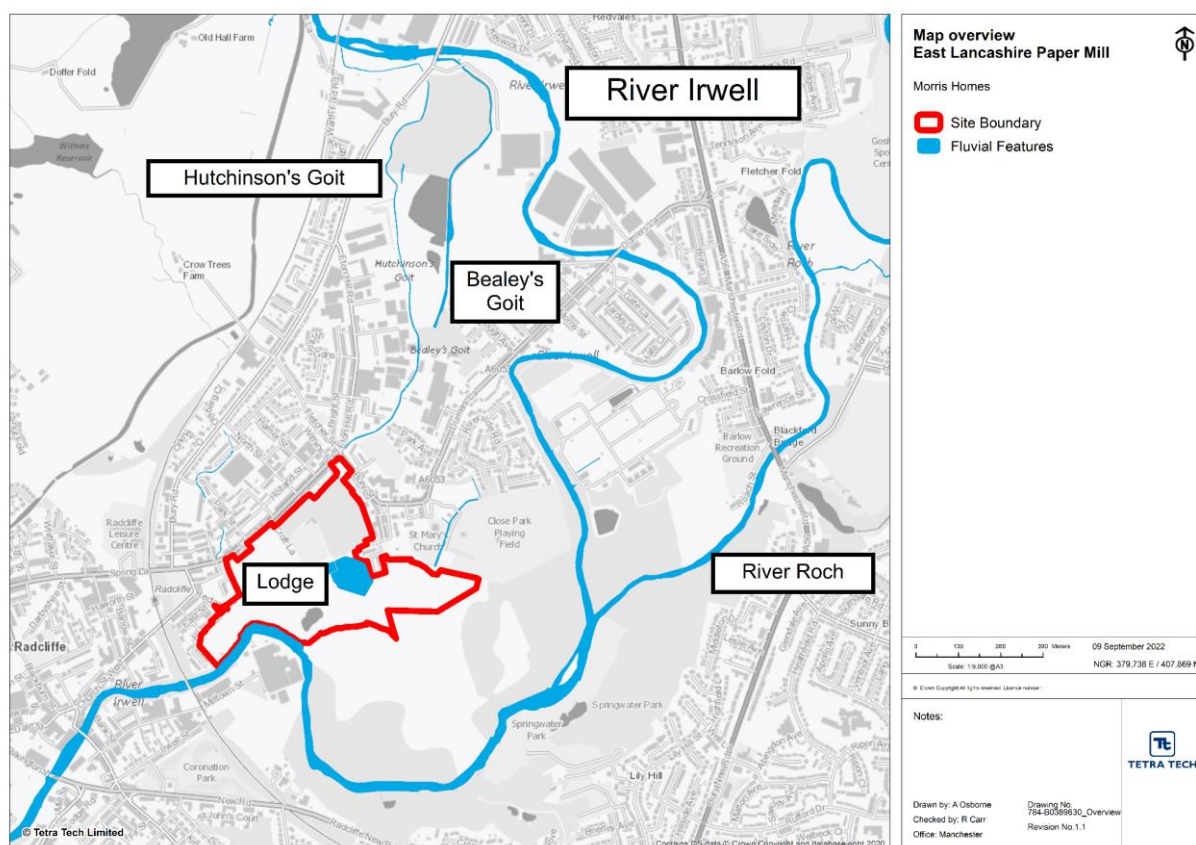


Figure 1- Map overview of site

1.2 SCOPE OF REPORT

- 1.2.1 The purpose of the report is to provide a baseline understanding of the geomorphological state of the Irwell, it's connection to the proposed HG outflow, the re-profiling of the existing river bank, and any impact to the River Irwell after being established.

1.2.2 The following objectives are set out:

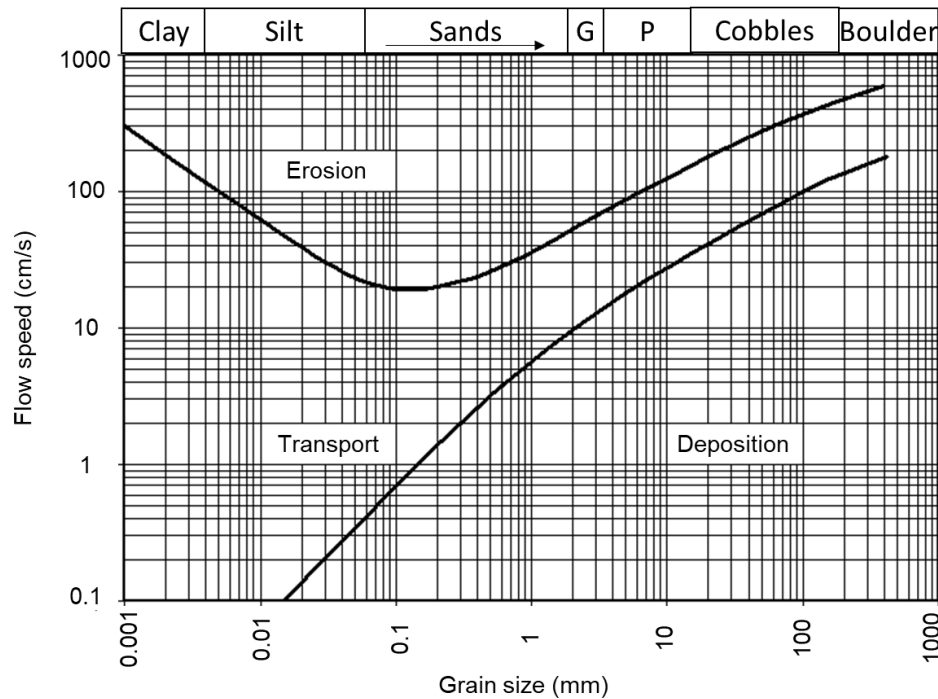
- To examine the River Irwell's geomorphological condition and current processes within the vicinity of the HG's new outflow, and along the length of the existing wall along the bank of the Irwell.
- To identify the impact of establishing a new HG channel planform and its connection to the River Irwell.
- To identify the impact of re-profiling the river bank adjacent to the site.

1.3 LIMITATIONS OF THIS REPORT

- 1.3.1 This report has been prepared by Tetra Tech Ltd. on behalf of the client in connection with the scope of the report as described in Section 1.1 above and taking into account the particular instructions and requirements set out in Tetra Tech's fee proposal and the Client's acceptance. It is not intended for and should not be relied on by any third party and no responsibility is undertaken to any third party.
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2.0 ASSESSMENT APPROACH

2.1.1 Fluvial geomorphology is concerned with the study of sediment sources, transport and deposition within a catchment and their effect on the floodplain, channel morphology over short to long time periods (Figure 2 and 3)



). Fluvial assessments are carried out with the understanding of equilibrium, to determine whether it can be reached and if the landscape will equivocally change.

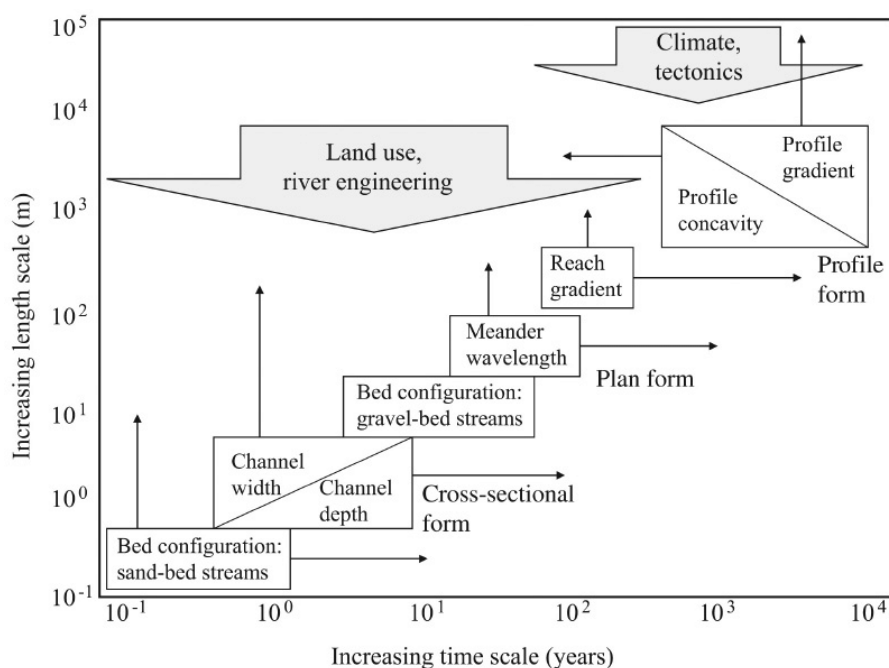


Figure 2- Time and spatial scale in the formation of UK fluvial landscapes (Giardino and Houser, 2015).

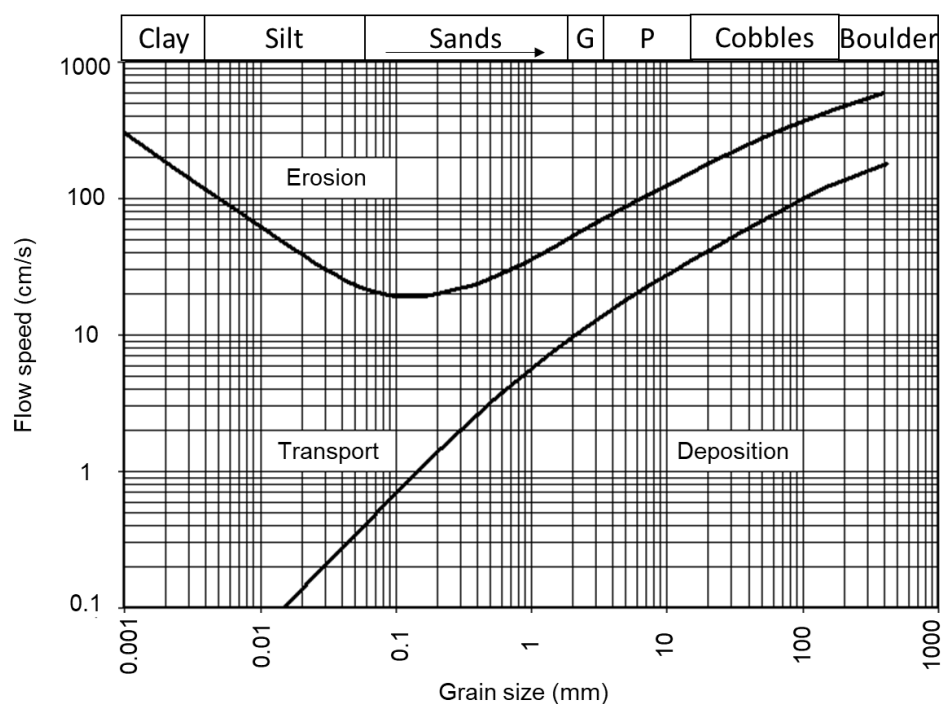


Figure 3- Hjulström curve of sediment mobility (Hjulström, 1935).

2.2 METHODOLOGY

- 2.2.1 A geomorphological assessment based upon a fluvial audit has been carried out to determine a baseline condition of the current study area. The assessment will provide both a current and historic overview of the catchment, aiding the impact assessment of current and proposed changes. Split into two sections; desk-based and a field survey, the existing sediment and

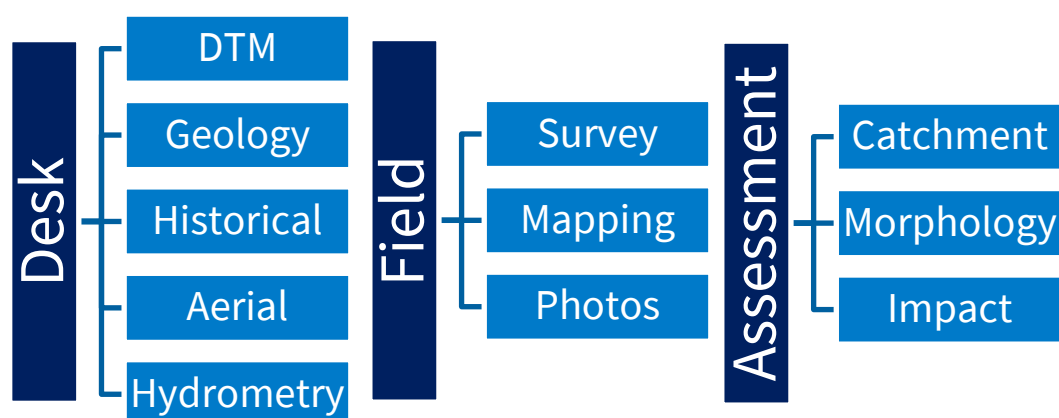
morphological regime will be reviewed. The proposed changes to the area will be assessed using the baseline conditions and the potential sediment and morphological impact.

DESK-BASED ASSESSMENT

- 2.2.2 A desk-based assessment was undertaken to determine the current catchments' fluvial network and its relationship with the landscape. Using remote sensed data from DTMs (OS Terrain 50 and LiDAR 1 m), fluvial features were extracted. Aerial images (Google Earth and Esri UK) are used to identify morphology within river channels and with respect to change. Historic maps were used to delineate the previous fluvial system and understand how much change has recently occurred. Catchment wide surveying of superficial geology, borehole surveys (British Geological Survey), catchment land use and land designations (MAGIC) to understand the sediment dynamics in the landscape. Flow data from the gauge at Pioneer Mills (EA) is used to understand the catchment response.

FIELD SURVEY

- 2.2.3 A field survey was undertaken on the 30th and 31st August 2022 by Tetra Tech geomorphologist Alexander Osborne. The site and its immediate vicinity were walked over to identify the baseline condition of the River Irwell (upstream and downstream of HG proposed outflow). The HG was inaccessible due to high levels of vegetation and lack of public access. Channel material, geometry, flow type, dynamics and stability will be assessed following a standardised field reconnaissance logging sheet. Morphological data was subdivided into appropriate reach scales of similar character, aiding in the study of sediment sources, sinks and transport processes. Photographs were taken to highlight reach characteristics.



3.0 DESK-BASED ASSESSMENT

3.1 CATCHMENT OVERVIEW

- 3.1.1 The River Irwell and subsequently the HG are sourced from the north in Lancashire, with a catchment area of 168 km² as shown in (Figure 4). The River Roch, a major tributary joins 3.0 km downstream passed the inflow point of the HG, with a catchment area of 193 km². Each river flows through farmland, villages and towns before reaching the study area. The catchment drains a combined total area of 361 km² at the proposed outflow of the HG, a further 1.5 km downstream of the Irwell/Roch confluence.
- 3.1.2 From the Headwaters to the site, the River Irwell meanders across a glacial and glaciofluvial till superficial deposit. The River Roch is more linked to its headwaters, however, also meanders across glacial dominated sediment. Primarily the sediment is sand and gravels. Access of sediment from the piedmont to the river is unlikely given the size of the valley floors are up to 1.6 km wide. In entering the flood plain, the River Irwell still actively meanders, however, there is significant channel works which have either straightened (e.g. the section through Bury) or introduced structures such as weirs and culverts, giving a hydromorphological definition of heavily modified. Each of these structures will influence the transport, deposition and behaviour of the river. Active bank protection, as found near the study site will prohibit the natural meandering course of the river.

3.2 HISTORIC OVERVIEW

- 3.2.1 The River Irwell in this area has an industrial background, with the proposed site being an ex-papermill. The requirement for water led to the creation of artificial channels (Goit), allowing the abstraction of water from the River Irwell. Two channels were created, the HG and Bealey's Goit (BG), taking water from the River Irwell approximately 1.5 km north of the site.
- 3.2.2 The BG directly discharged into the Irwell from as early as 1844, using an outflow point at the west of the meander, appearing to follow the outline of a previously abandoned meander (Figure 5). The BG outflow was then redirected to the east of the meander, where the new proposed HG outflow is. The HG has had no direct outflow into the Irwell since its creation, with wastewater being passed through filter beds on the north bank of the BG or being stored in reservoirs. The BG has been subsequently redirected away from the site outflow, with the channel being infilled. The current outflow of the HG is undetermined.

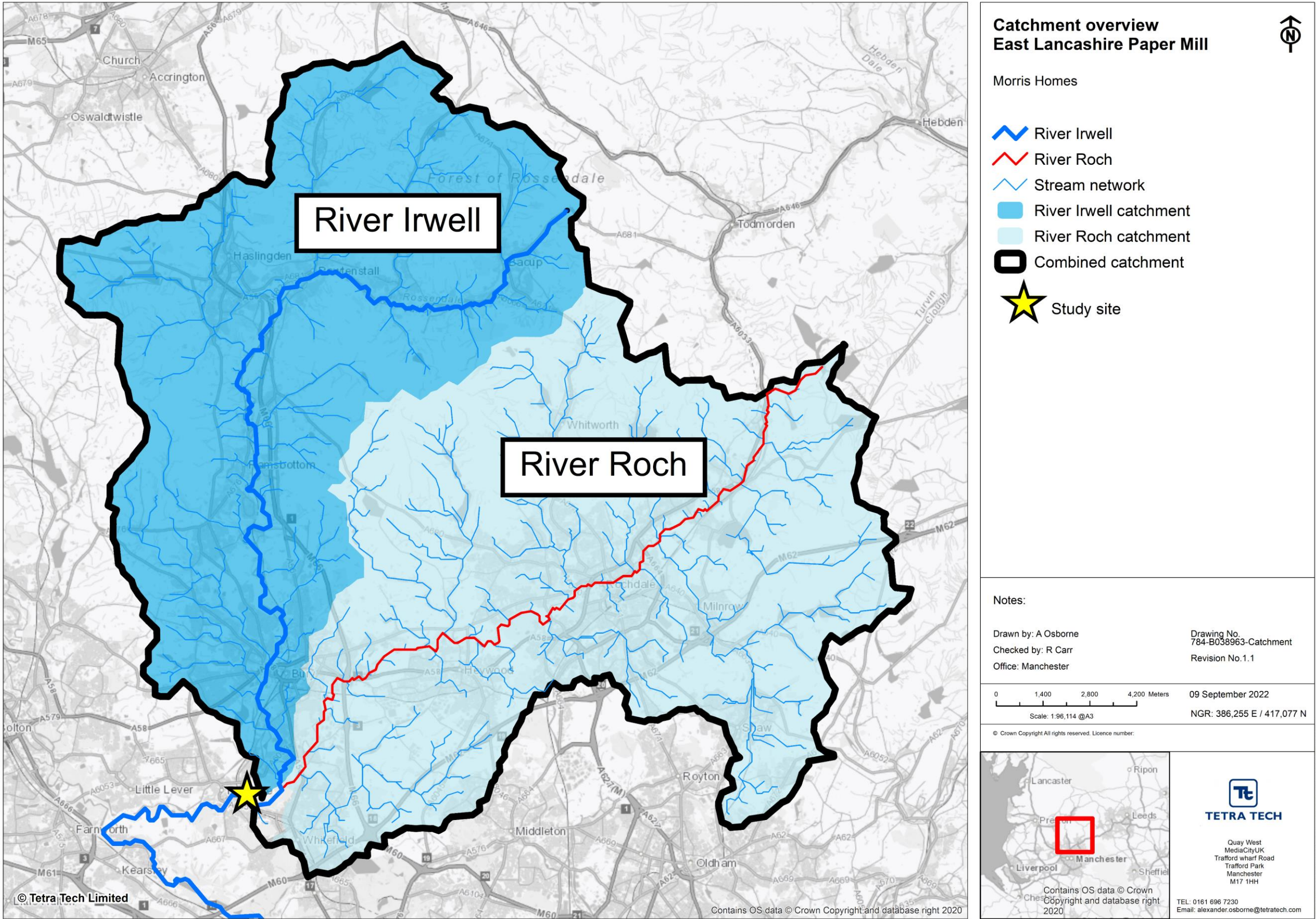


Figure 4- Catchment overview

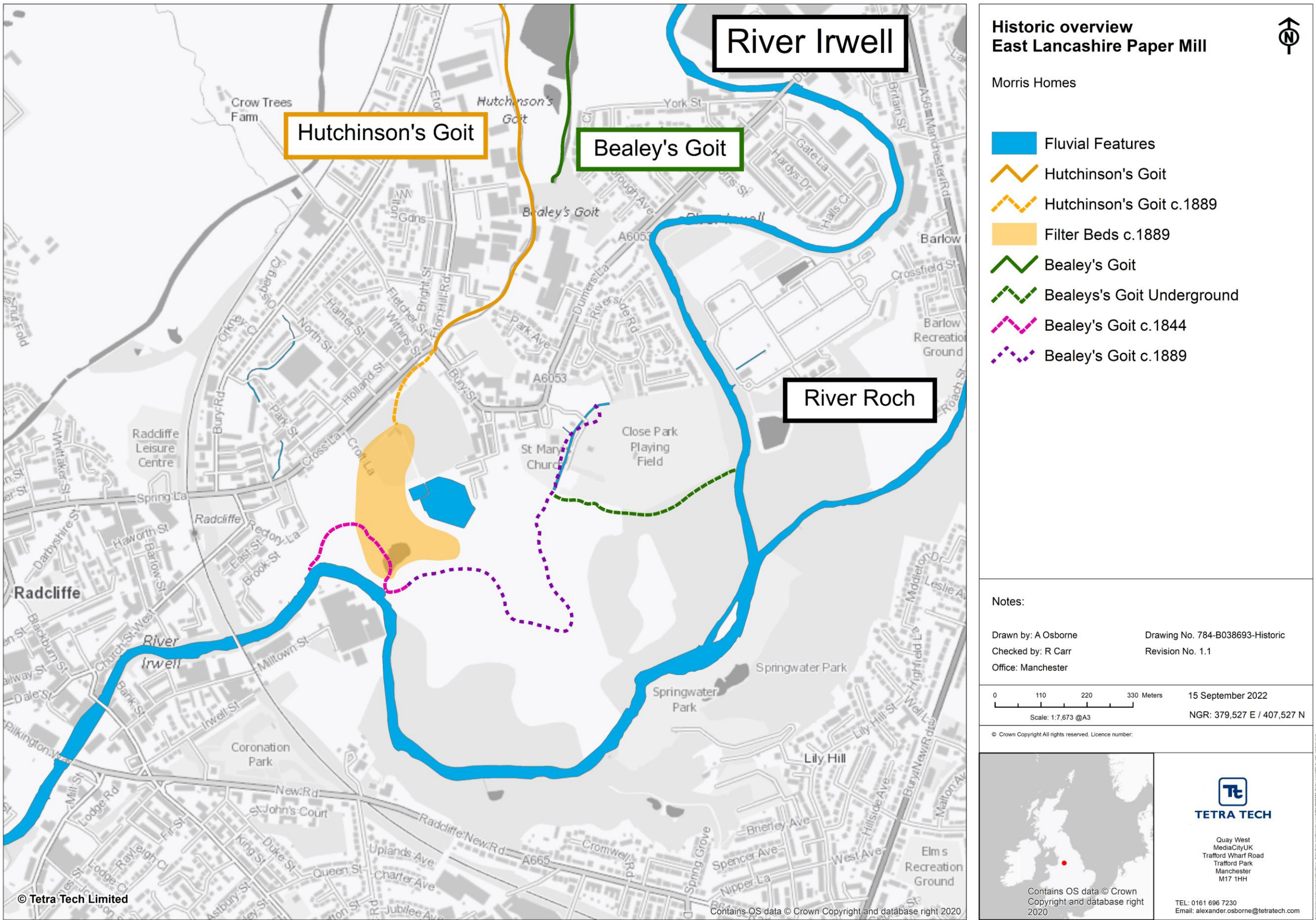


Figure 5- Historic overview.

3.3 STUDY AREA

- 3.3.1 The site is located at a crest of a River Irwell meander in the town of Radcliffe, with the designated geomorphological area of interest extending further north into the HG and River. The proposed site has superficial deposits of alluvial sediment, meaning it has at some point been linked to the natural deposition and transport regime of the Irwell. Local boreholes have sand/ gravel units up to 7.1 m deep, with the subsurface having detritus. The HG and the proposed new section will predominantly flow through this alluvial sediment, with a short 400 m section already flowing through glaciofluvial deposits.
- 3.3.2 Within the Irwell area of interest, the meander crest is heavily modified with bank protection on both banks, giving an unnatural appearance to the shape. There is evidence of modification using bank protection, culverts and weirs, and evidence that the existing wall reinforcement of the bank is experiencing undercutting. There is evidence from aerial photography that active deposition is occurring within the meander, forming a point bar. Further evidence of deposition is seen upstream and downstream of the site. The flow gauge situated at the west of the meander shows the normal range near the site to be between 0.36 – 3.70 m, with the highest recorded at 5.92 m (Figure 6).
- 3.3.3 The HG is an artificial channel that carries water from the Irwell towards, and through the site. The HG is flow regulated using a flow restriction mechanism, limiting the maximum amount of water that can flow through, up to a maximum discharge of $0.5 \text{ m}^3\text{s}^{-1}$. The HG is therefore linked to the Irwell's flow regime, reaching a limit inflow. Sediment within the HG is thought to be localised sediment. Additional inflow increases the discharge to an estimated maximum of $0.75 \text{ m}^3\text{s}^{-1}$.

SITE PROPOSAL

- 3.3.4 The proposal for the HG on site is the establishment of a channel originating onsite connecting the HG to the reservoir (Lodge), with around 200 m of new channel (Figure 7). The reservoir is to then have an outflow, roughly 100 m from the entry point, through a spillway leading to the Irwell a further 225 m downstream. The outflow point was the previous outflow for the BG up until it was redirected. The proposed channel is to be up to 6 m wide.
- 3.3.5 The proposal for the River Irwell adjacent to the site is to lower the existing wall, to be replaced by a more naturally-graded earth bank with approximately a 1:3 gradient. At present, there is evidence that the wall is being undercut, suggesting that the channel is too narrow to convey the quantity of water within the river. It is anticipated that reprofiling the bank will increase the overall width of the channel, especially during higher flows, and that it will remove the existing artificial constraints on the channel dimensions. In turn it is anticipated that this will result in better conveyance of flows within the channel, and improvements on the spatial transport and deposition of sediment. In turn this is likely to improve conditions and to enable habitats to thrive within the river channel.

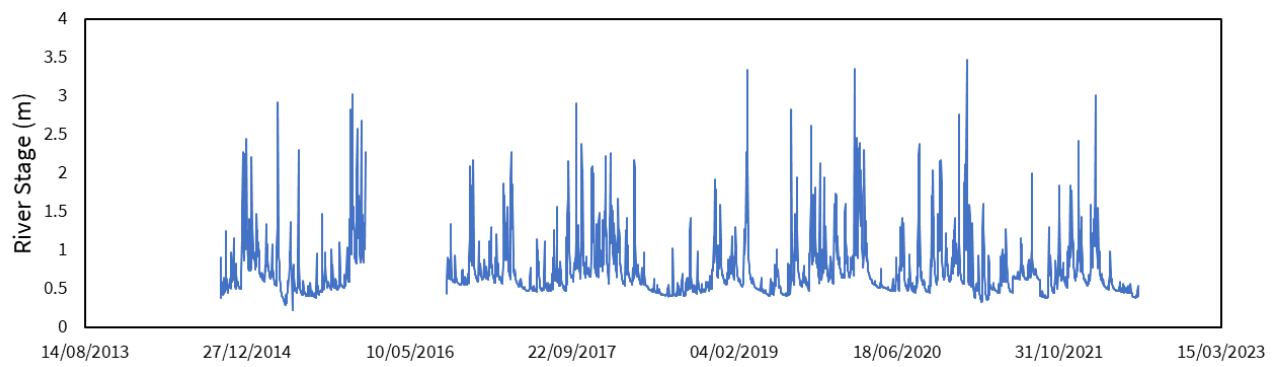


Figure 6- Hydrograph of the River Irwell located at Pioneer Mill (Data source: Environment Agency).

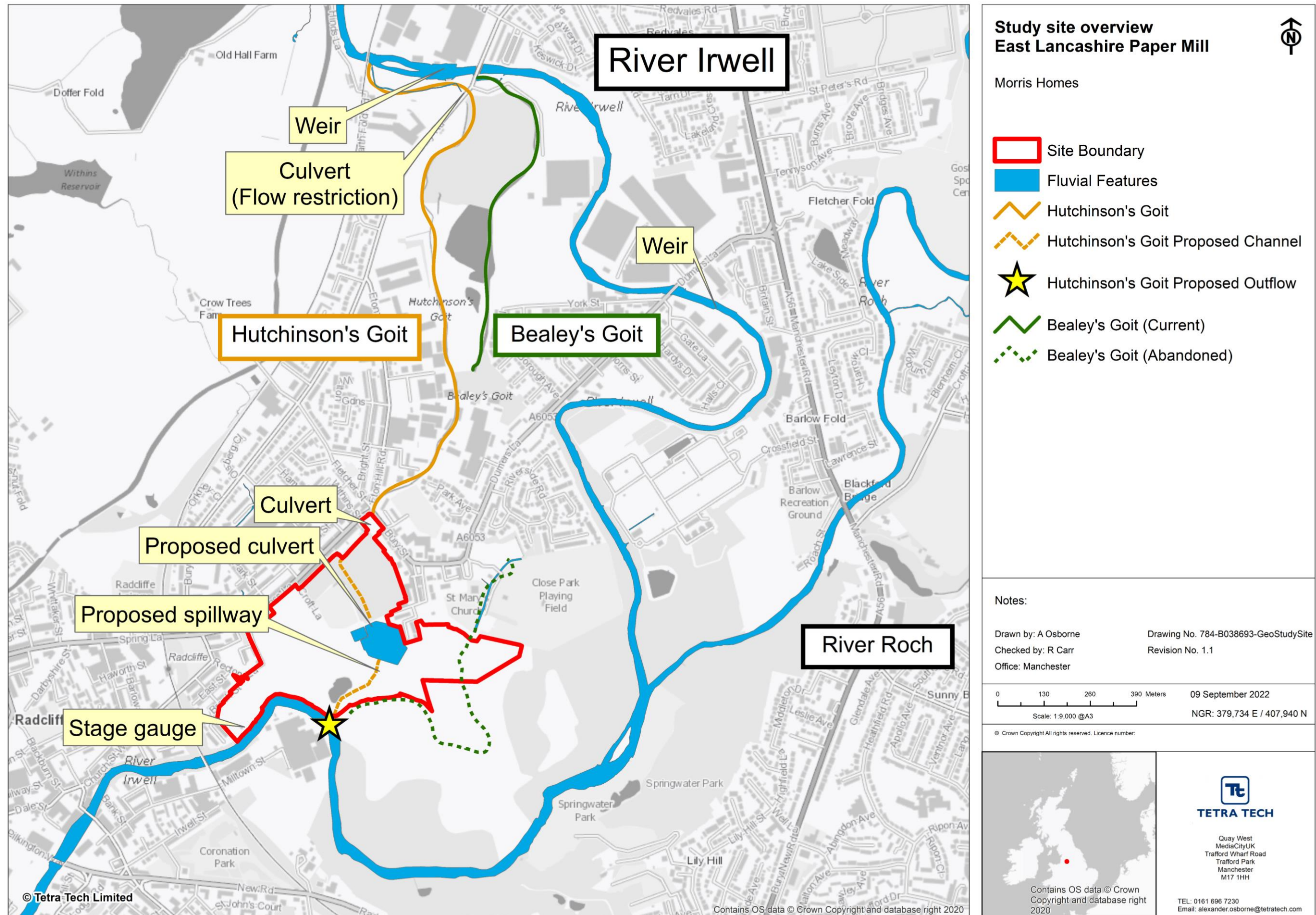


Figure 7 – Study site.

Table 1- Summary of study site.

Characteristic	Description
Site area	0.21 km ²
Superficial geology	Unconsolidated alluvial sediments (clay, silt, sand and gravels) sourced from the River Irwell. Towards the north of the site there are glaciofluvial deposits (sand and gravel). Geology may contain remnants from previous site usage.
Bedrock geology	Bedrock geology is formed from the Pennine Middle Coal Measures formation (locally up to 200 m thick). Composed of mudstone, siltstone, sandstone and coal seams.
Borehole	Mixture of silty sand and lenses of clay, woody debris, sand and gravels.
Hydrology	The Hutchinson's Goit is an artificial channel created to take water from the River Irwell. Flow is controlled at inflow from the Irwell with a maximum discharge of 0.5 m ³ s ⁻¹ . Water is held in a reservoir (Lodge). No current outflow is observed.
Water inflow	Hutchinson's Goit (River Irwell)
Water outflow	Unknown/ retained in reservoir.
Land use	Classification of brownfield site.
Designations	Site designated as built up area. Within SSSI impact zone for Ash Clough and Nob End SSSI. Ash Clough is a geological exposure on the river cliff downstream.

4.0 FIELD SURVEY

- 4.1.1 A field survey was conducted on the 30th and 31st August 2022, with the weather being dry and sunny. Antecedent conditions are relevant since as coming out of summer the river levels are low, enabling views of bed material to be seen. Due to high levels of vegetation and limited access the HG could not be surveyed safely. The River Irwell was surveyed in 3 specific reaches to include, before, at and after the proposed outflow of the HG, and including the existing bank wall along the length of the site. Land was accessed using public footpaths but due to the site condition and general Irwell riverscape certain sections were unable to be accessed. It would not be possible to walk a complete survey around the site, meaning aerial photos are used to fill in any gaps where possible.
- 4.1.2 Figure 8 shows the reach locations of the survey and broken down into cross sections. The bank direction is as directed from looking downstream.

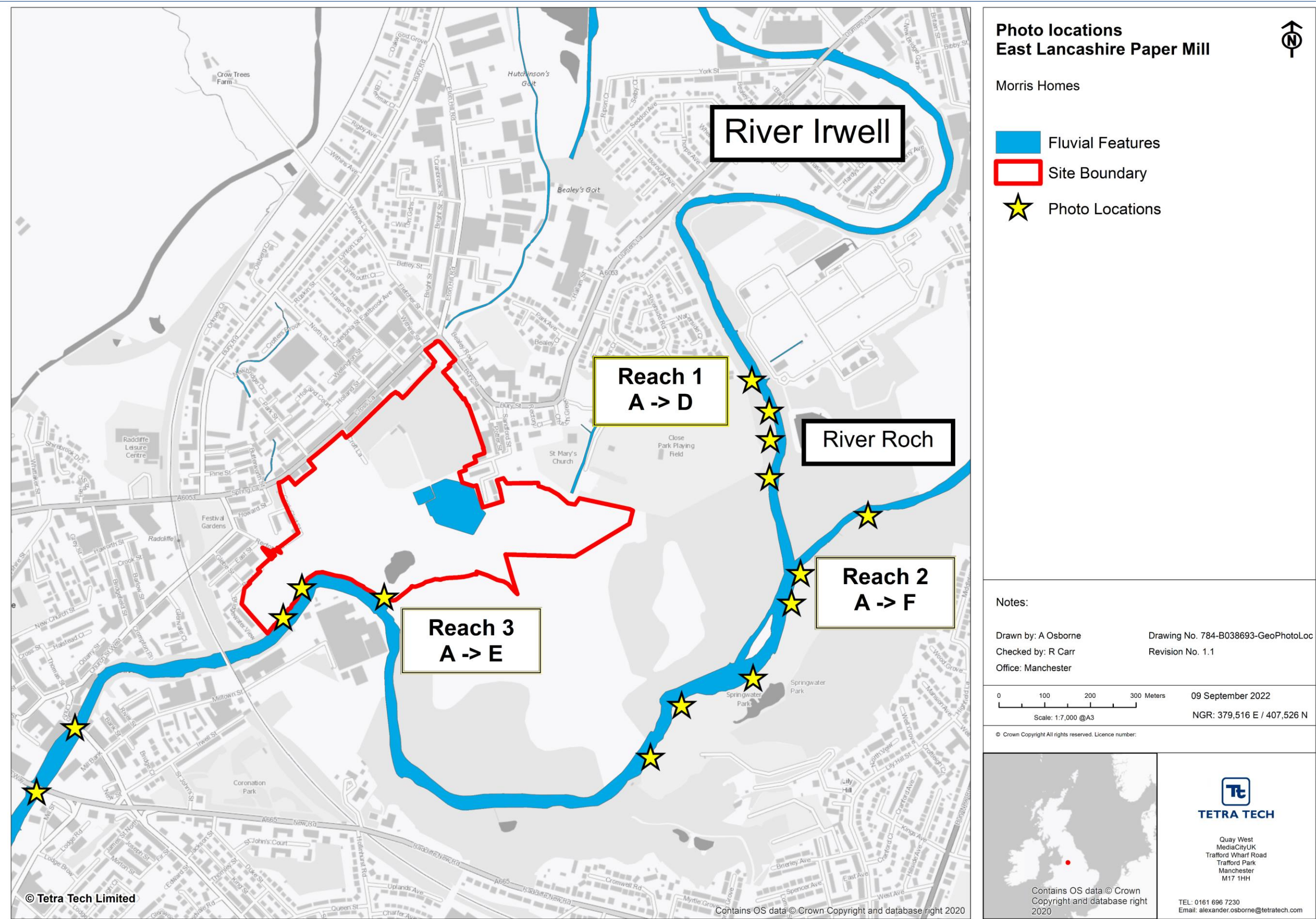


Figure 8- Map of photo locations.

Photo survey – Reach 1

R1A (53.56563, -2.30212)

River Irwell north of River Roch confluence.

- Heavily vegetated banks.
- Evidence of basal bank scour.
- Bed composition of cobble to gravel sediment.
- River noticeably clear of suspended sediment.



R1B (53.56502, -2.30154)

River Irwell north of River Roch confluence.

- Heavily vegetated banks.
- Banks composed of sand/ silt sediment.
- Basal scouring found.
- Proto-side bar formation
- No change to bed composition since previous.



R1C (53.56446, -2.30150)

River Irwell north of River Roch confluence.

- Bank protection using gabion baskets.
- Increase in suspended sediment.
- Full bank scour noticed on right bank.
- Pooling sequence.



R1D (53.56372, -2.30152)

River Irwell north of River Roch confluence and at Bealey's Goit outflow.

- Basal scour on left bank and side bar creation.
- Side bar formation and full bank scour on right bank.
- Riffle section.
- Sediment aggrading slightly finer to previous.



Photo survey – Reach 2

R2A (53.56298, -2.29826)

River Roch around 50 m upstream of confluence with Irwell.

- Basal scour on right hand bank with full scour on left.
- Built up embankment/ footpath.
- Bedload is predominantly cobble to gravel grade.



R2B (53.56183, -2.30048)

River Irwell/ Roch confluence.

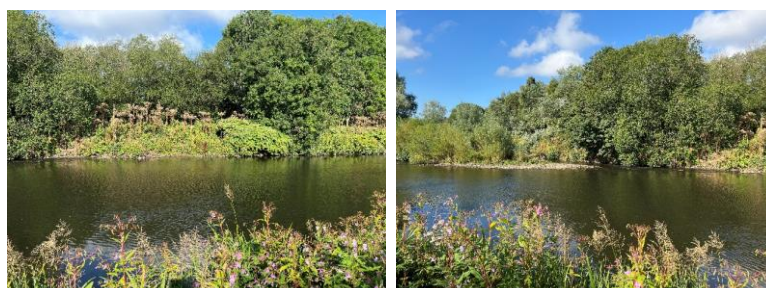
- Gravel to pebble sized side bar.
- Bedload is noticeably finer than the Roch.
- Banks are predominantly silt/sand.
- Bank stabilisation on left bank using green engineering.



R2C (53.56125, -2.30078)

River Irwell.

- Pool/ riffle sequence.
- Mature island in centre of channel, with cobble sized material.



R2D (53.55977, -2.30204)

River Irwell at middle of Island in channel.

- Near anabranching channel configuration.
- Banks are noticeably more exposed, with full scour occurring.
- Evidence of bank protection within the bank.
- Bed material is coated in silt.



R2E (53.55923, -2.30440)

River Irwell before landslide hazard.

- Active channel protection on right bank (site).
- Large side bar
- Artificial bank with green engineering. Partial failure of bank.



R2F (53.55820, -2.30542)

River Irwell. Last accessible location before site.

- Large side bar on right bank.
- Left hand bank has active bank protection.
- Channel appears deepened at this section.



Photo survey – Reach 3

R3A (53.56133, -2.31424)

River Irwell at proposed outflow of HG.

- Due to vegetation clear views of either bank are difficult.
- Right hand bank is made from silt/ sand material.
- Bedload is of gravel/pebble to sand in size.
- No relic sediment structures from previous BG outflow
- Unable to access relic channel due to prevalence of Giant Hogweed.



R3B (53.56151, -2.31696)

River Irwell at crest of meander.

- The River Irwell is constrained to follow the bank on the outer side. There is evidence that undercutting of the structure is occurring.
- Point bar is fragmented, with it being partially vegetated.
- Exposures of bedrock are found, especially near old bridge piers.



R3C (53.56092, -2.31758)

River Irwell past site boundary.

- The river is noticeably sediment laden in suspension.
- The bed is coated in fine silt.
- River condition is generally poor with detritus.



R3D (53.55873, -2.32444) River Irwell from Blackburn Street. - Channel is confined on both sides. - Deposition of pebble to cobble sized sediment in side and mid-bars. Mature island formed.	
R3E (53.55747, -2.32570) River Irwell from Pilkington Way. Mature depositional structures, with large bars being formed. Evidence of vegetation growing.	

- 4.1.3 The River Irwell shows evidence of pool-riffle sequencing throughout and has mature depositional landforms. Geomorphologically the Irwell is in equilibrium with its surroundings, with no evidence of extreme deposition or erosion. Substantial work around the Springwater Park has not adversely affected the river. River bed material is between cobble to gravel sized indicating that material of this level can be transported since local banks are not local sources. Suspended sediment sources are difficult to pinpoint, due to different mechanisms of entrainment. Around Reach 3C there was heightened suspended sediment indicating a potential point source, or that there is a local slowing of the river. It is noted that there is currently a wall along the river bank adjacent to and downstream of the site, which may serve to constrain the flow into a narrower width than appropriate for the river, thus possibly resulting in an artificially slowed flow. The River Irwell does contain suspended sediment and shows local dropout of this finer grade. Noted is how exceptionally dry it was at the time of undertaking the walkover, and that during normal flow condition these settled fines will be quickly transported.

5.0 GEOMORPHOLOGICAL IMPACT

- 5.1.1 The impact of the proposed works is assessed to be minimal regarding the sediment introduction to the Irwell. The new channel leading to the reservoir (Lodge) will carry the existing sediment into a new sediment sink, meaning any transported material will be deposited within the reservoir due to a sudden loss of flow velocity when entering. Since the outflow of the current HG is undetermined, existing sediment is being stored within the channel system. From aerial photography and Google Street view the HG appears to be sediment choked with vegetation impacting flow. Creating a new outflow will enable the channel to flow without obstacle, which should help relieve the impaction. With water leaving the reservoir through a spillway, the sediment being transported will be graded to fine particles (clay/ silt).
- 5.1.2 The spillway to the Irwell will be a new source of sediment to the Irwell, but localised. It is possible that larger sediment grains, up to sands and gravels will be mobilised and entrained in the flow. With the outflow into the Irwell being the same as the BG, it can be assumed that equilibrium was reached with the Irwell in the past. HG entry to the Irwell will cause a localised slowdown depending on the flow velocity of both, which can lead to local dropout of sediment. However, no noticeable delta was built by the BG and given that the sediment source is substantially smaller, it is unlikely to cause formation of river structures. Within the Irwell at this location there is already increased suspended sediment and settling.
- 5.1.3 There is an increased chance of suspended material being taken by the flow from the reservoir and the spillway. That will heavily depend on the antecedent condition, and if material can fallout in the reservoir. During periods of enhanced flow, suspended sediment will be more likely to flow from the reservoir to the Irwell. As the Irwell and HG are linked, the Irwell at that point would also be seeing an increase in suspended sediment, with local sources upstream for example at Springwater Park. Suspended sediment is part of the natural processes of a river when in flood, with the suspended sediment being deposited on floodplains.
- 5.1.4 The outflow is on the outer bank of the meander, meaning it has the greatest flow velocity, and a zone of transport and erosion. Any sediment entry to the meander at this site should be easily removed. Further downstream of the site there is adequate surplus in the Irwell's sediment budget, with no evidence of silting up of the channel. Given the survey was conducted during very low river levels, the flow of the Irwell was robust.
- 5.1.5 It is proposed that the wall along the bank adjacent to the site is lowered to bed level. It is understood that this will comprise a more naturally graded earth bank of approximately a 1:3 gradient, which will enable the river to function naturally in response to flow variations. If the reach downstream of the proposed HG outfall is not constrained by the presence of a wall, it is possible that slowing of flows will be mitigated, and consequently the excessive deposition of sediment may encourage natural river dynamics, including greater equilibrium in sediment size distribution across the reach and the wider catchment. In turn, this is likely to reduce any areas that may otherwise be choked by fine sediment, especially in case of a sediment influx from the HG outflow. As a result, the proposed bank is likely to have an overall positive effect on the morphological quality of the River Irwell adjacent to the site.

6.0 RECOMMENDATIONS AND CONCLUSION

6.1 RECOMMENDATIONS

6.1.1 The recommendations from this assessment are as follows:

- Sediment generated from site works is at risk from entering the Irwell, especially from bank working around the channel. That is a far greater risk to the channel geomorphology with bulk sediment being deposited into the channel, rather than a new channel being formed. It is recommended that sediment trapping is undertaken and that sediment being deposited into the channel is minimised.
- Newly exposed bank material in the compensation will be easily eroded. Bank stabilisation measures such as established grassed vegetation or harder engineered solutions may be required to allow bank stabilisation of loose material should be undertaken to avoid runoff into the Irwell.
- The new proposed channel is being created into old alluvial sediment which is very easily reworked by river processes. It is therefore important to consider the channel design and slope to avoid over steepening of the channel. Sediment will be reworked by the HG, but primarily during storm events when increased flow into the HG is facilitated by the Irwell.
- Over time the reservoir (Lodge) will become filled with fine sediment, leading to lower capacity within. It is recommended that sediment is removed from the reservoir to maintain its capacity.
- The proposed re-grading of the Irwell bank, including the lowering of the existing wall, may increase the sediment load on a local scale during the construction stage. However, post-implementation, this is likely to result in a river that is less constrained by its artificial bank, which will reduce likelihood of slower flows upstream. In turn the resulting sediment transport is likely to be more consistent on the reach scale, and is less likely to result in excessive deposition of fine sediment. It is recommended that the re-profiled bank is suitably maintained to ensure that excessive erosion does not occur and that the hydrological regime of the river in conjunction with the updated HG does not increase the deposition of fine sediment into the river.

6.2 CONCLUSION

- 6.2.1 The proposed outflow of the HG into the River Irwell is deemed to have a limited geomorphological impact if the recommendations are followed.
- 6.2.2 The proposed wall lowering is likely to improve the consistency of flows within the river, and is likely to encourage a more natural hydrological regime associated with variations in flow, and so is likely to have an overall positive impact on the channel condition.
- 6.2.3 Geomorphological time scales stretch from years to hundreds of years, therefore any changes to the system can potentially only manifest after significant time has passed. It is this assessment's conclusion that the long-term effect of the proposed development on the geomorphological condition of the Irwell is minimal.

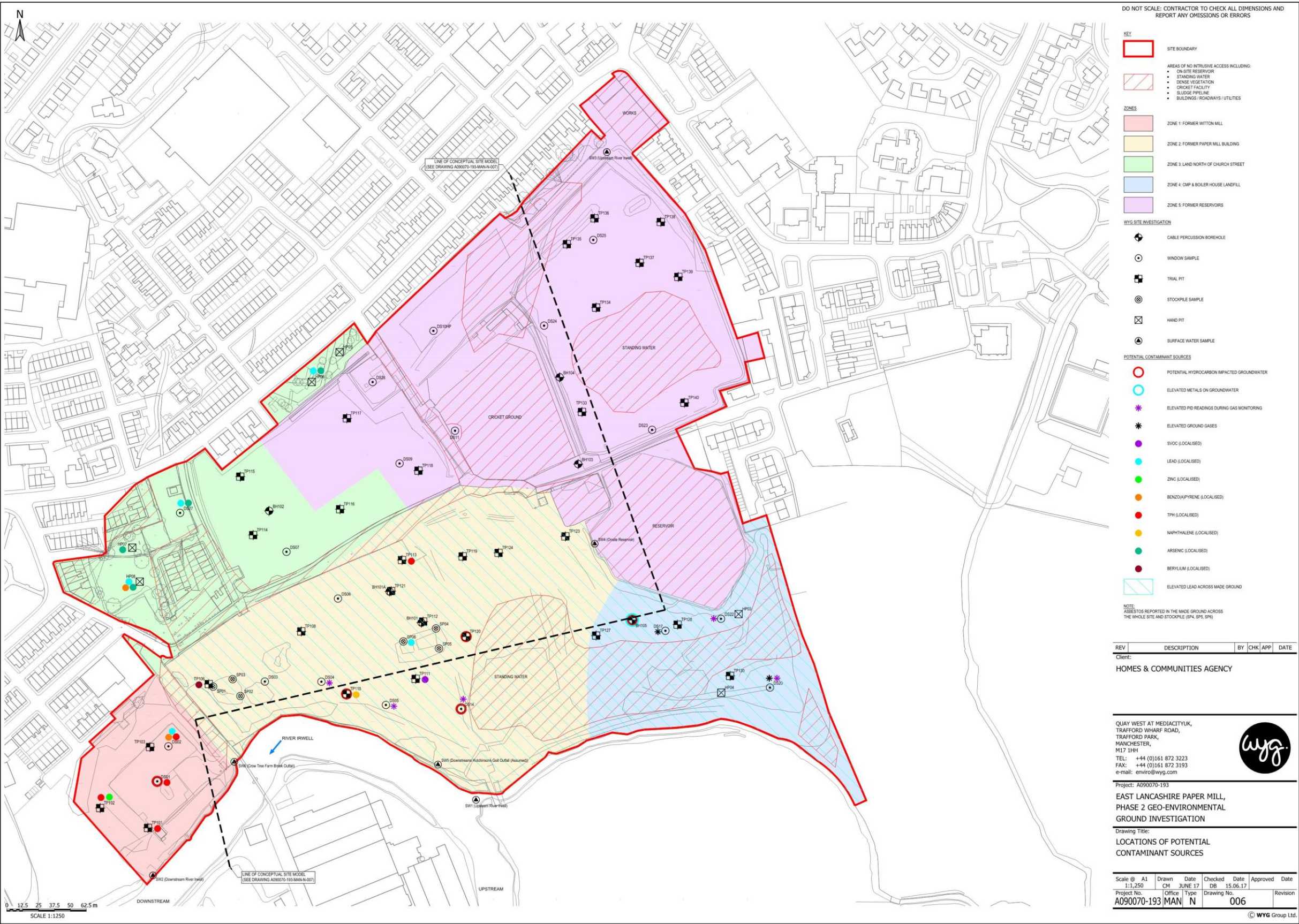
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APPENDIX C: GEO-ENVIRONMENTAL MAP



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