



**WATER FRAMEWORK DIRECTIVE RISK ASSESSMENT
FOR
PROPOSED RESIDENTIAL DEVELOPMENT, FORMER TETROSYL SITE
WALMERSLEY OLD ROAD, BURY, GREATER MANCHESTER
ON BEHALF OF
BARRATT HOMES MANCHESTER**

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0.0 SUMMARY

- 0.1 This *Water Framework Directive (WFD) Risk Assessment* has been prepared by Cole Easdon Consultants Limited (CEC) in relation to a proposal comprising the redevelopment of a former industrial site (Tetrosyl Site) for residential housing, including the removal of an existing reservoir and the de-culverting of part of an existing watercourse downstream of the reservoir that is routed through the site. The Report sets out to establish the risk to WFD receptors and River Basin Management Plan objectives arising from the development proposals.

Current Site Operations

- 0.2 The site has previously been used for industrial use (manufacture of oils and lubricants), however, operations have ceased and the site is currently vacant. The site is largely occupied by former industrial buildings and associated hardstanding.

Site Water Management

- 0.3 The site is drained by an un-named tributary of Pigs Lee Brook (referred to hereafter as PLB Tributary), which flows south through the site, through an existing reservoir (Mill Reservoir), within the site. Outflow from the Mill Reservoir is controlled by a weir, with downstream flow being culverted for over a distance of 340m through the development site, discharging to an open channel some 175m to the south east of the site boundary. The watercourse continues through the Bevis Green area of Bury to its confluence with Pigs Lee Brook.
- 0.4 Under the development proposal, much of the existing Mill Reservoir will be filled in to facilitate development and much of the downstream culvert through the site will be decommissioned and removed. Part of the reservoir will be modified and retained as a Flood Storage Area (FSA) post development. The course of the PLB Tributary will flow through the FSA. During periods of low flow when there has been no or minor rainfall events, the majority of this area will be dry. The FSA will fill during more significant events with outflow from the FSA restricted by a flow control located at the downstream end. A new reach of watercourse channel (some 300m long) will be constructed downstream of the FSA and will be routed along the eastern boundary of the site. The watercourse will discharge to a new 1.2m diameter culvert at the downstream end, some 35m in length, before discharging flow to the existing culvert that is to be retained.

Summary of Impact on Receptors

Impact on Physical Habitat

- 0.5 The proposed redevelopment will involve the removal of much of the existing Mill Reservoir. The reservoir represents Priority Habitat on account of it having a breeding population of common toad. Therefore, the short term impact of the construction phase is likely to be negative.
- 0.6 Part of the reservoir will be retained as a Flood Storage Area (FSA) post development. The course of the PLB Tributary will flow through the FSA. During periods of low flow when there has been no or minor rainfall events, the majority of this area will be dry. The FSA will fill during more significant events with outflow from the FSA restricted by a flow control located at the downstream end. It is recommended that the sides of the FSA are seeded with native wildflower grassland, and that the sides are landscaped with gently sloping sides, in order to permit access to the PLB Tributary for wildlife during periods of low flow.
- 0.7 Flow through the site will be largely deculverted and a new watercourse channel constructed. Post development flow along the PLB tributary will be permanently diverted along the new channel. The new watercourse will enhance the overall ecological value of the site. The long term impact of the development on physical habitat will be positive, due to the creation of new riparian habitat.
- 0.8 Bat activity surveys of the culvert entrance in 2017 and 2018 have not detected any evidence of use of the culvert by roosting bats, however a precautionary approach will be applied as detailed in the Ecological Survey and assessment report (ERAP (Consultant Ecologists) Ltd, December 2018).

Impact on Water Quality

- 0.9 The water quality at the site is currently poor, due to historic industrial contamination. The contamination sources will be removed during the construction phase, and remediation of contaminated land and water will be carried out before the site is redeveloped for housing. Therefore, the construction phase of the development will have a positive impact on water quality, due to the removal of contamination sources.
- 0.10 The new reach of watercourse channel will be colonised by aquatic vegetation over time, which is likely to lead to an improvement in dissolved oxygen levels and reduced levels of

ammonia and phosphorus in the PLB Tributary. Therefore, the long term impact of the development on water quality will be positive.

Impact on Fish and Eels

- 0.11 The existing Mill Reservoir is currently stocked with carp, which will need to be relocated before the removal of the reservoir. Therefore, the construction phase will have a negative impact on the fish population. The proposed redevelopment of the site will entail the loss of the open water body of the Mill Reservoir, and the de-culverted stream is unlikely to be sufficiently large to support a fish population. Therefore, the permanent works are likely to have a minor negative impact on fish populations.
- 0.12 No eel population has been recorded within the Mill Reservoir. The de-culverted PLB Tributary will discharge post development flow to an existing culvert at the southern end of the site via a vertical drop structure of several metres. The presence of this drop structure and other physical barriers such as the M66 motorway will continue to preclude the colonisation of the site by eels, therefore, it is considered that there will be no impact on eel population prior to and following redevelopment.

Impact on Macrophytes

- 0.13 A limited amount of vegetation is currently present within the Mill Reservoir, due to the steep sides and depth of the reservoir. Therefore, the removal of the water body is likely to result in a very limited impact on macrophytes. The development proposals for the site include the creation of 300m of new open water channel, and removal of most of the existing culvert through the site. This will result in the creation of a much larger area which could support the growth of macrophytes, which, in turn, may potentially lead to the establishment of new plant communities over time. Therefore, the development is likely to have a positive impact on macrophyte population.

Impact on Invertebrates

- 0.14 A limited invertebrate species diversity within the Mill Reservoir has been recorded, due to low habitat diversity. The existing downstream culvert through the site does not currently offer any habitat potential for invertebrates. The creation of the reach of new open channel will create a much larger area for potential colonisation by invertebrates. Therefore, the development is likely to have a positive impact on invertebrate population.

Impact on Diatoms

- 0.15 The significant depth of the existing Mill Reservoir (up to 4m deep) is such that only limited numbers of diatoms are currently likely to be present around the margins of the reservoir. Flow along the PLB Tributary will be conveyed along a permanent low flow channel within the proposed FSA. The depth of this channel will be shallow, and as such will be exposed for the majority of the time. This will facilitate the growth of diatoms. The de-culverting of the PLB Tributary will facilitate the growth of diatoms along the length of the proposed new open water channel. Therefore, the development is likely to have a positive impact on the diatom population.

Risk to River Basin Management Plan (RBMP) Objectives

- 0.16 The site is located within the River Irwell catchment (Rossendale to Roch STW), which is currently categorised as 'Moderate' status under the WFD classification. The RBMP (North West) states that '*The Irwell catchment partnership's 3 key objectives are cleaner water, more naturally functioning and resilient water bodies, better connected and managed habitats*'. The development proposals for this site will contribute to meeting these objectives, as the water quality and physical habitat will improve post development.
- 0.17 The River Irwell (Rossendale to Roch STW) is classified as a 'Heavily Modified' water body, and therefore, the objective for improvement is 'Good Ecological Potential'. The proposed development will contribute to meeting this objective.

Conclusion

- 0.18 In view of the findings of this Report, it is concluded that the proposed reservoir removal & deculverting works, and creation of a flood storage area and open channel will support the objectives of the WFD & RBMP, and contribute to improvement of the water environment.

1.0 INTRODUCTION

- 1.1 This *Water Framework Directive (WFD) Risk Assessment* has been prepared by Cole Easdon Consultants Ltd (CEC) in relation to a proposal comprising the redevelopment of a former industrial site (Tetrosyl Site) for residential housing, including the removal of an existing reservoir and the de-culverting of part of an existing watercourse downstream of the reservoir that is routed through the site. Refer to CEC Figure 6155/500/Figure 1 [*Site Location Plan*] in Appendix 1.

Aim, Scope and Methodology of Assessment

- 1.2 The aim of this study is to determine the potential impact of proposed reservoir removal and deculverting works (hereafter referred to as ‘the development’) may have on the environmental objectives as set out in the WFD, during and post construction works. The study also considers the risk to the objectives of the local River Basin Management Plan (RBMP) (North West).
- 1.3 The collection and interpretation of baseline data has facilitated an understanding of the nature of, and interactions between, the physical habitat, water quality and ecology within and around the Site. This understanding of baseline conditions (conceptual model) has been employed to aid determination of the likely impacts of the proposed development upon the water environment. Significant potential impacts identified during the course of investigations have been addressed by the incorporation of mitigation measures into the design of the proposed development.
- 1.4 Where appropriate, the assessment methodology has been informed by prevailing guidance, most notably the *Water Framework Directive* (2000) and the *River Basin Management Plan (North West River Basin District)*, March 2015. In addition, the scope of investigations has been informed by local planning policies, which reinforce the need to pay due regard to the likely effect of development upon various aspects of the water environment.
- 1.5 The WFD is a European directive that imposes legal requirements to protect and improve the water environment. Physical works can modify the size and shape of a watercourse, reduce or increase the flow of water, introduce artificial materials or remove sediment and/or vegetation. These can all affect the receptors below:

- Physical habitat: The distribution and diversity of habitat including the physical processes that sustain and create new habitat. Physical habitat is essential for the ecological receptors listed below.
- Water Quality
- Fish and eels
- Macrophytes (Visible water plants)
- Invertebrates (Insects, worms, molluscs, etc living in the water environment)
- Diatoms (Algae living on rocks and plants)

Report Structure

- 1.6 Baseline data describing the physical environment, water quality and ecology of the study area, which are drawn together to inform a conceptual model of the extant hydrological regime, are presented at Section 2.0. Assessment of the potential impacts of the proposed development upon the water environment and description of mitigation measures proposed to ameliorate significant such impacts are made in Section 3.0. A summary of the findings of the WFD assessment, together with Report conclusions and recommendations, is given in Section 4.0.

Background

- 1.7 The former Tetrosyl works (the Site) has ceased operation, and the site is to be redeveloped to provide 268 residential dwellings. The site is currently brownfield, and is occupied by former industrial buildings and associated hardstanding. When operational, the former industrial complex specialised in the manufacture of oils and lubricants.
- 1.8 The site includes a reservoir, located in the northeastern site sector known as Mill Reservoir and a watercourse (PLB tributary) which is culverted beneath the site downstream of the Mill Reservoir over a 340m length within the site. The reservoir dates back to at least the late 1800s, and is understood to have been originally constructed to supply water to the Lumn cotton mill, the site's original occupant. The culvert varies in size along the route but is fundamentally of rectangular stone block construction. Buildings and hardstanding are located at ground level above the culvert.

Proposed Changes to the Water Environment

- 1.9 In order to facilitate the redevelopment, the Mill Reservoir will be largely removed and the reach of culverted PLB tributary within the site will be de-culverted and diverted to create

an open channel along the site's eastern extent. Refer to CEC Plan 6155/510(A) [*Proposed Watercourse Diversion*] in Appendix 7.

Reservoir Removal

- 1.10 The Mill Reservoir currently attenuates flood flows from the upstream catchment. In order to mitigate flood risk for the post development site, it will be necessary to retain part of the reservoir as a Flood Storage Area (FSA). The FSA will include a permanent low flow channel through the middle. The remainder of the FSA will comprise a vegetated basin, which will be dry except for rainfall events. Outflow from the FSA to the proposed open channel will be restricted via a flow control. The FSA will have sufficient storage capacity, as determined by hydraulic modelling, so as to attenuate flow arising from storm return events up to the 1:100 year + 35 % climate change event in order to prevent increased downstream flood risk.

De-Culverting of Watercourse

- 1.11 The existing watercourse (PLB Tributary) will be de-culverted as part of the development, and a new open channel will be constructed over a 300m length. The watercourse will flow from north to south within the open channel, and will discharge into an existing culvert at the southern end of the site, and flow south and east, away from the site. The watercourse will be constructed and vegetated so as to mimic the geometry and ecology of a natural watercourse.
- 1.12 The following resources have been used for this study:
- *Ecological Survey and Assessment (Report No. 2018-202) by ERAP, December 2018;*
 - *Ecological Survey Report (Report No. 4639-001-rep2-ph-tl) by Baker Shepherd Gillespie, February 2011;*
 - *Geological Map - British Geological Survey (BGS);*
 - *Phase 1 and Phase 2 Geo-Environmental Site Investigation (Report No. 10-110-r1 by E3P, May 2014); and*
 - *Topographical Survey Drawing (Drawing Ref SDL 2140/1 by Survey & Design Limited, March 2015).*
- 1.13 The following publicly available documents have also been reviewed as part of this assessment:
- *Building Regulations 2010 - Approved Document H (Drainage and Waste Disposal);*
 - *Bury Metropolitan Borough Council Local Plan (under consultation) (2018);*
 - *Bury, Rochdale and Oldham Strategic Flood Risk Assessment Level 1 (November 2009);*



- *C753 The SuDS Manual (CIRIA, November 2015);*
- *Greater Manchester Surface Water Management Plan (January 2013);*
- *National Planning Policy Framework (NPPF) (2018);*
- *Non-Statutory Technical Standards for Sustainable Drainage Systems (Defra, March 2015);*
- *Planning Practice Guidance (PPG) (March 2014);*
- *Rainfall Runoff Management for Developments (R&D Technical Report W5-074/A/TR/1 Revision E, Defra, June 2012);*
- *River Basin Management Plan (North West River Basin District) (EA, December 2015);*
and
- *Water Framework Directive Risk Assessment: How to assess the risk of your activity (EA, April 2016).*

1.14 The following abbreviations are used in this Report:

- AOD - Above Ordnance Datum;
- BGS - British Geological Society;
- BHM - Barratt Homes Manchester;
- BRO - Bury, Rochdale and Oldham;
- EA - Environment Agency;
- FSA - Flood Storage Area;
- FZM - Flood Zone Map prepared by the EA;
- NPPF - National Planning Policy Framework;
- PLB - Pigs Lee Brook;
- RBMP - River Basin Management Plan;
- SFRA - Strategic Flood Risk Assessment;
- SuDS - Sustainable Urban Drainage Systems;
- SWMP - Surface Water Management Plan; and
- WFD - Water Framework Directive.

2.0 BASELINE STUDY

Refer to CEC Plans 6155/501 [*Existing Site Layout (3 No. Sheets)*] & 6155/510(A) [*Proposed Watercourse Diversion*] in Appendix 7.

Site Location

- 2.1 The proposed development site comprises a 10.88ha area of brownfield land located in Walmersley, to the north of Bury town centre. Walmersley Old Road forms the site's western boundary. The site's southern boundary is formed by Mill Road. The north western boundary is formed by Bentley Lane with the M66 motorway bounding the site to the north east. The site's eastern boundary is formed by an un-named road which connects Mill Road to the south and White Carr Lane to the north. Land use to the south and east of the site is predominantly residential, with greenfield land to the north and east. Refer to CEC Figure 6155/500 Figure 1 [*Site Location Plan*] in Appendix 1.

Topographic Setting

- 2.2 The topographical survey indicates the site falls in a southerly direction. Levels vary between 159.6m -162.0m AOD along the northern boundary and 136.5m - 142.0m AOD to the south of the site. Refer to Drawing No. SDL 2140/1 [*Extension to Topo Survey*] (by Survey & Design Ltd) in Appendix 8.

Site Operations

- 2.3 The site has previously been used for industrial use, however, operations have ceased and the site is currently vacant. Large industrial buildings and associated hardstanding from the site's former use cover the southern and north-western parts of the site.

Water Management

- 2.4 The site is drained by an un-named tributary of Pigs Lee Brook (referred to hereafter as PLB Tributary), which rises on the southern edge of Harden Moor, near Nangreaves. It flows in a generally southerly direction through open farmland and 3 smaller reservoirs at Whitewall Wood before passing beneath the M66 motorway. Downstream of the motorway culvert the PLB Tributary continues for approximately 100m before entering an existing reservoir (Mill Reservoir), within the northern site sector.
- 2.5 Outflow from the Mill Reservoir is controlled by a weir, with downstream flow being culverted for a length in excess of 340m through the development site, discharging to an open channel

some 175m to the south east of the site boundary. The watercourse continues through the Bevis Green area of Bury to its confluence with Pigs Lee Brook.

Sensitive Land Uses

- 2.6 No Sites of Special Scientific Interest (SSSIs), Special Areas of Conservation (SACs), or other sensitive land uses are indicated within 1km of the site. The site is within the Impact Risk Zone for the West Pennine Moors SSSI, some 2.5km north-west of the site at its closest point.

Geological Setting

- 2.7 Records from the British Geological Society (BGS) indicate the site is underlain by superficial deposits of Glacial Till. The solid geology underlying the site is indicated to be Rough Rock (Sandstone). The site is brownfield, and data from a ground investigation undertaken at the site in March 2014 indicates that extensive Made Ground is present across the majority of the site.

Ecological Setting (Water Framework Directive)

- 2.8 The culverted watercourse beneath the site is part of the catchment of the River Irwell (Rossendale STW to Roch) reach, which is categorised as 'Heavily Modified' water body under the WFD classification. The overall WFD classification for the site is 'Moderate' as recorded in the North West River Basin Management Plan (RBMP) (December 2015). Refer to RBMP data in Appendix 2. This is defined as *'Moderate change from natural conditions as a result of human activity. Some restriction on beneficial use of the water body. No impact on amenity. Some impact on wildlife and fisheries'*.

Baseline Assessment (WFD Receptors)

- 2.9 The WFD sets out a number of receptors, the impact of which needs to be assessed in terms of the development proposal. A baseline assessment of the receptors is presented below.

Physical Habitat

- 2.10 The watercourse that is routed below the site is currently culverted through most of the site over a 340m length. The culvert varies in size along the route but is fundamentally of rectangular stone block construction. Buildings and hardstanding are located at ground level above the culvert. As such the watercourse currently has no inherent ecological value as physical habitat.

- 2.11 The existing Mill Reservoir has limited ecological value as physical habitat. An ecological survey carried out in February 2011 states that *'70% of the banks (of the reservoir) are constructed of vertical stone walls'*. Refer to extracts from the Ecology Survey Report (by Baker Shepherd Gillespie) in Appendix 4. This limits the value of the current physical habitat.
- 2.12 A subsequent ecological survey carried out and reported by ERAP (Consultant Ecologists) Ltd, and states that *'owing to the reported presence of breeding common toad, a Priority Species, the lodge [Mill Reservoir] meets the criteria under the Pond Priority Habitat description'*. Refer to extracts from the Ecological Survey and Assessment Report (by ERAP) in Appendix 3. Therefore, the reservoir does possess some value as physical habitat that is able to support species.

Water Quality

- 2.13 The site has a history of industrial use dating back to the 19th Century, with an associated legacy of land and water contamination. A desktop contamination assessment and intrusive ground investigation was carried out at the site in March 2014. A number of current and historic storage tanks for solvents and hydrocarbons were identified on the site.
- 2.14 The ground investigation found that *'Significantly elevated concentrations of volatile [hydrocarbons] has been identified within the immediate vicinity of the above ground storage tanks in the northern sector of the site. The reported concentrations would pose an unacceptable level of risk to the critical on-site controlled waters receptors (reservoir and culvert)'*. Refer to extracts from the Phase 1 & Phase 2 Geo-Environmental Site Investigation Report (by E3P) in Appendix 5.
- 2.15 The River Basin Management Plan (RBMP) North West currently classifies the River Irwell (Rossendale to Roch STW), which includes the site, as 'Moderate' for physico-chemical quality elements. Refer to data in Appendix 2.

Fish and Eels

- 2.16 The Mill Reservoir is an artificial water body. An ecological survey undertaken at the site states that *'the waterbody (Mill Reservoir) was used for coarse fishing and has been stocked with carp in the past'*. Refer to extracts from the Ecology Survey Report (by Baker Shepherd Gillespie) in Appendix 4. No other fish species were noted.

- 2.17 No evidence of eels has been recorded in the previous ecological surveys undertaken at the site. An article on the Inside Ecology website (<https://insideecology.com/2017/12/22/habitat-preferences-of-the-critically-endangered-european-eel/> accessed June 2019) states that *'featureless water bodies with little refuge for eels are poor quality habitat for this species'*. The Mill Reservoir currently includes banks constructed with vertical stone walls, which are unlikely to provide refuge. The PLB tributary is currently culverted through the site and contains a number of stepped weir drops in excess of 1m, that is likely to preclude eels reaching the Mill Reservoir. Therefore, it is considered unlikely that eels are currently present on the site.
- 2.18 The River Basin Management Plan (RBMP) North West currently classifies the River Irwell (Rossendale to Roch STW), as 'Moderate' for biological quality elements, which includes fish and eels. Refer to data in Appendix 2.

Macrophytes

- 2.19 The ecological survey undertaken by ERAP recorded that *'the lodge (Mill Reservoir) supports limited vegetation with exceptions of local stands of Brooklime and Yellow Water-Lily associated with the shallow water near the weir'*. Refer to extracts from Report No. 2018-202 [Ecological Survey and Assessment] (by ERAP) in Appendix 3. Most of the Mill Reservoir has a water depth in excess of 3m depth and is some 4.3m deep at its maximum (in the centre). Refer to CEC Plan 6155/501 [Existing Site Layout (3 No. Sheets)] in Appendix 7. The lack of light and nutrients at this depth is likely to preclude the establishment of macrophytes (water plants visible to the naked eye). The downstream culverted watercourse currently has no ecological value for plant growth. Therefore, it is considered unlikely that significant numbers or diversity of aquatic macrophytes are currently present on the site.
- 2.20 The River Basin Management Plan (RBMP) North West currently classifies the River Irwell (Rossendale to Roch STW), as 'Moderate' for macrophytes and phytobenthos. Refer to data in Appendix 2.

Invertebrates

- 2.21 An aquatic invertebrate survey was undertaken at the Mill Reservoir and inflow stream, by ERAP in August 2018. This survey recorded the presence of sixty species. None of the recorded species were European Protected Species or Priority Species. The report stated that *'the limited diversity of macroinvertebrate fauna is attributed to the low habitat*

diversity within the lodge (Mill Reservoir)'. Refer to extracts from the Ecological Survey and Assessment Report (by ERAP) in Appendix 3.

- 2.22 The River Basin Management Plan (RBMP) North West currently classifies the River Irwell (Rossendale to Roch STW), as 'Good' for invertebrates. Refer to data in Appendix 2.

Diatoms

- 2.23 No surveys have been undertaken for the presence of diatoms (microscopic algae found on rocks and plants). The existing culverted watercourse lacks the conditions required for the establishment of a diatom population. The reservoir water depth (in excess of 3m for much of the reservoir), is unlikely to support the establishment of diatoms. If present, diatoms are most likely to be found at the margins of the Mill Reservoir.
- 2.24 The River Basin Management Plan (RBMP) North West currently classifies the River Irwell (Rossendale to Roch STW), as 'Moderate' for ecological status. Refer to data in Appendix 2.

3.0 RISK ASSESSMENT AND MITIGATION MEASURES

Refer to CEC Plans 6155/501 [*Existing Site Layout (3 No. Sheets)*], 6155/507(D) [*Proposed Cross-sections (2 No. Sheets)*], 6155/508(B) [*Long Section Through Proposed Flood Storage Area & Proposed Watercourse Diversion*] & 6155/510(A) [*Proposed Watercourse Diversion*], in Appendix 7.

Background

- 3.1 Baseline assessment presented in Section 2.0 has facilitated the conceptualisation of the extant environmental standards within the Site. In turn, this understanding has been utilised to inform assessment of the risks that are potentially posed by the development proposals upon the water environment. Where significant potential for adverse impact is identified, specific mitigation measures have been devised. These are described and summarised in Tables 4.1 and 4.2 at the end of this Section.

Generic Potential Impacts

- 3.2 Construction of the proposed works has the potential to impact upon the water environment in the following primary ways:
- i) Potential modification of physical habitat due to removal of the reservoir and de-culverting of the PLB Tributary;
 - ii) Potential for degradation of water quality;
 - iii) Potential for degradation of fish and eel habitat & populations;
 - iv) Potential for degradation of macrophyte habitat & populations;
 - v) Potential for degradation of invertebrate habitat & populations;
 - vi) Potential for degradation of diatom habitat & populations;
 - vii) Potential for degradation of the water environment.

Assessment of Risk

Risk to Physical Habitat

Short Term Risk: Construction Phase

- 3.3 The reservoir represents Priority Habitat on account of it having a breeding population of common toad. The proposed works will involve the drawdown and removal of most of the existing Mill Reservoir. This will result in the removal of a large body of water, which acts as a water source for species currently present on the site, and as a refuge for water birds. Therefore, the short term impact of the construction phase is likely to be minor negative. In order to minimise impact works should take place outside of the breeding season in consultation with the ecologist. A Method Statement for the mitigation of impact on the

common toad population has been prepared by ERAP and will be applied during construction works. Refer to Appendix 11.

- 3.4 The route of the existing culvert to be abandoned currently has no ecological value, therefore, there will be no effects on physical habitat during the construction phase.
- 3.5 Bat activity surveys of the culvert entrance in 2017 and 2018 have not detected any evidence of use of the culvert by roosting bats, however a precautionary approach will be applied as detailed in the Ecological Survey and assessment report (ERAP (Consultant Ecologists) Ltd, December 2018).

Long Term Risk Following Construction

- 3.6 A part of the Mill Reservoir will be retained and modified to create a Flood Storage Area (FSA). Refer to CEC Plan 6155/510(A) [*Proposed Watercourse Diversion*] in Appendix 7. The PLB Tributary will flow through the FSA via a low flow channel to be created. The FSA will typically remain dry except during significant rainfall events when the FSA will fill or partly fill depending upon the severity of the rainstorm. Maximum water depth will be 2.5m. The FSA bed and low flow channel will be planted with appropriate vegetation species that can tolerate periodic inundation, to create habitat. Refer to Drawing No. c-1339-01(B) [*Outline Landscape Masterplan*] (by PDP Associates) in Appendix 8.
- 3.7 The banks of the FSA will be no steeper than a gradient of 1:3 and seeded with a grassland mix, so as to create access and habitat for wildlife. It may be possible to provide a permanent water body in this area, subject to health & safety considerations.
- 3.8 The existing culvert will be abandoned and the PLB tributary will be diverted along a new channel to be constructed along the eastern site extent over a length of some 300m. This will result in the creation of new habitat within the site that will enhance the overall ecological value of the watercourse. A Geomorphology Study and concept design has been undertaken by JBA Consulting. Refer to Appendix 9. The Report sets out recommended geomorphology based on low flow modelling and replication of existing upstream analogue features such as bars and riffles, step pools and rapids along the new section of open watercourse. In order to maximise the potential of this new habitat, these geomorphological features will be implemented where possible. The aim will be to create a natural water environment and habitat similar to the River Ravensbourne case study provided within

Appendix 6 taken from the *Manual of River Restoration Techniques 1.6 - Opening up a Culverted Stream*.

- 3.9 The overall impact for habitat will be positive.

Risk to Water Quality

Short Term Risk: Construction Phase

- 3.10 The Contractor has prepared a Method Statement detailing how he proposes to prevent pollution and sedimentation of the PLB Tributary. The procedures will ensure that no water quality degradation occurs during the construction phase. Refer to Appendix 10.

Long Term Risk Following Construction

- 3.11 The ground investigation undertaken at the site in March 2014 found ‘*significant elevated concentrations of hydrocarbon (solvent contamination) within perched groundwater*’. The source of this contamination was found to be the existing hydrocarbon and storage tanks within the site. Refer to Appendix 5. These tanks will be decommissioned and removed as part of the redevelopment of the site, and remediation of contaminated land and water will be carried out before the site is redeveloped for housing. Therefore, there will be a will positive impact on water quality due to the removal of contamination sources.
- 3.12 No information is available regarding the indicators of physico-chemical aspects of water quality for the existing site. However, these are likely to be poor, due to the presence of water contamination within the existing site and the significant water depth (in excess of 3m) within the Mill Reservoir. The proposed works will create appropriate conditions for the aeration of flow and colonisation of aquatic vegetation over time, which is likely to lead to an improvement in dissolved oxygen levels and reduced levels of phosphorus and ammonia in the PLB Tributary. Therefore, the long term impact of the works is likely to be positive.

Risk to Fish and Eel Populations

Short Term Risk: Construction Phase

- 3.13 The existing Mill Reservoir is currently stocked with carp, which will need to be relocated before the removal of the reservoir. A Lodge Drainage and Fish Rescue Strategy has been prepared and the work has been permitted by the Environment Agency, albeit the permit will need to be renewed. Refer to Appendix 11. Therefore, the construction phase will have a minor negative impact on the fish population.

Long Term Risk Following Construction

- 3.14 The proposed redevelopment of the site will entail the loss of an open water body through the removal of the Mill Reservoir. The FSA will comprise a dry basin that intermittently fills during rainstorms and will be unable to support a fish population. Therefore, the development will have a negative impact on the fish population.
- 3.15 No eels have been recorded on the site. The de-culverted PLB Tributary will discharge to an existing culvert at the southern end of the site post development. Refer to CEC Plan 6155/510(A) [*Proposed Watercourse Diversion*] in Appendix 7. The de-culverted PLB Tributary will discharge post development flow to an existing culvert at the southern end of the site via a vertical cascading drop structure of some 10 metres. The presence of this drop structure **and other physical barriers such as the M66 motorway** will continue to preclude the colonisation of the site by eels, therefore, it is considered that there will be no impact on eel population **prior to and following** redevelopment.

Risk to Macrophytes

Short Term Risk: Construction Phase

- 3.16 The ecological survey by BSG (survey carried out in February 2010) records that a limited amount of vegetation is currently present within the Mill Reservoir, due to the steep sides and water depth of the reservoir (in excess of 3m). Refer to Appendix 4. Therefore, the removal of the water body during construction works is likely to result in a very limited impact in terms of loss of macrophyte population. The downstream culvert to be abandoned has no ecological value for plant growth, and therefore, the construction phase will have a negligible impact.

Long Term Risk Following Construction

- 3.17 The development proposals for the site include the construction of a 300m length of new open channel, facilitated by removal of the existing culvert and diversion of the PLB Tributary. This will result in the creation of a much larger area which could potentially support the growth of macrophytes, which in turn would lead to the establishment of new plant communities over time. Therefore, the development will have a positive effect on the macrophyte population in the long term.

Risk to Invertebrates

Short Term Risk: Construction Phase

- 3.18 The ecological survey undertaken at the site by ERAP in August 2018 has recorded that invertebrate diversity within the Mill Reservoir is limited due to low habitat diversity. None of the recorded species are European Protected Species or Priority Species. Refer to Appendix 3. The existing culverted watercourse to be abandoned does not offer any habitat potential for invertebrates. Therefore, the impact on invertebrates arising from the removal of the Mill Reservoir and downstream culvert is considered to be minor.

Long Term Risk Following Construction

- 3.19 The construction of the new FSA and downstream open channel will create appropriate habitat conditions for colonisation by invertebrates. Therefore, the development will have a positive effect on the status of invertebrates in the long term.

Risk to Diatoms

Short Term Risk: Construction Phase

- 3.20 The water depth of the existing Mill Reservoir (in excess of 3m) suggests that only limited numbers of diatoms are currently likely to be present at the margins of the reservoir. The existing downstream culverted watercourse does not currently offer any habitat potential for diatoms. Therefore, the impact on diatoms arising from the removal of the Mill Reservoir is considered to be minor.

Long Term Risk Following Construction

- 3.21 The route of the PLB Tributary will form a permanent low flow channel within the proposed FSA. The depth of this channel will be shallow, and as such will be exposed to sunlight for the majority of the time. This will facilitate the growth of diatoms. Furthermore, the de-culverting and diversion of the downstream PLB Tributary will allow the growth of diatoms along the length of the proposed new open channel. Therefore, the development will have a positive effect on the diatom population over the long term.

Risk to RBMP Objectives

- 3.22 The River Irwell catchment (Rossendale to Roch STW) is currently classified as 'Moderate' status under the WFD. The RBMP (North West) states that '*The Irwell catchment partnership's 3 key objectives are cleaner water, more naturally functioning and resilient water bodies, better connected and managed habitats*'. Refer to Appendix 2. The

development proposals for this site will contribute to meeting these objectives, as the water quality and physical habitat needed to support ecology will improve post development.

- 3.23 The River Irwell (Rossendale to Roch STW) is classified as a ‘Heavily Modified’ water body, and therefore, the objective for improvement is ‘Good Ecological Potential’. The proposed development will contribute to meeting this objective.

Table 3.1: Summary table of the construction phase impact on WFD receptors arising from deculverting & removal of the Mill Reservoir

Activity	Receptor	Unmitigated Impact	Comment/Mitigation	Residual Impact
Removal of Mill Reservoir	Physical Habitat	Minor Negative	Works to be undertaken outside of the breeding season in consultation with ecologist. A method statement has been prepared that setouts how the impact on the common Toad population will be minimised.	Negligible
	Water Quality	Minor Negative	Removal of contaminant sources & remediation (if required) during construction phase will minimise contamination potential to the water environment. The Contractor has prepared a Method Statement detailing how he proposes to prevent pollution & sedimentation of the PLB Tributary.	Positive
	Fish and Eels	Minor Negative	Existing fish stock will need to be relocated before reservoir is removed. No eels are indicated to be present.	Negligible
	Macrophytes	Minor Negative	Currently limited macrophyte population present due to depth and steep sides of reservoir. These will be removed during construction phase.	Minor Negative
	Invertebrates	Minor Negative	Limited diversity of invertebrate species currently present within reservoir.	Minor Negative
	Diatoms	Minor Negative	Limited numbers of diatoms likely to be present within the reservoir.	Minor Negative
De-culverting of PLB Tributary	Physical Habitat	Negligible	Culvert currently has no ecological value.	Negligible
	Water Quality	Minor Negative	Removal of contaminant sources & remediation (if required) during construction phase will minimise contamination potential to the water environment. The Contractor has prepared a Method Statement detailing how he proposes to prevent pollution & sedimentation of the PLB Tributary	Positive

Activity	Receptor	Unmitigated Impact	Comment/Mitigation	Residual Impact
De-culverting of PLB Tributary	Fish and Eels	Negligible	Culvert currently has no ecological value.	Negligible
	Macrophytes	Negligible		Negligible
	Invertebrates	Negligible		Negligible
	Diatoms	Negligible		Negligible

Table 3.2: Summary table of the permanent works impact on WFD receptors arising from deculverting & removal of the Mill Reservoir

Activity	Receptor	Unmitigated Impact	Comment/Mitigation	Residual Impact
Replacement of Mill Reservoir with controlled flow through smaller Flood Storage Area	Physical Habitat	Minor Negative	Open water habitat will be lost, however, the PLB Tributary will continue to flow through FSA via a low flow channel and provide a water source. Sides and bed of FSA to be seeded with native plants and sides to be graded at no steeper than 1:3 to allow access for wildlife. There is also potential to create habitat through the incorporation of a permanent water area subject to health & safety requirements	Positive
	Water Quality	Positive	Positive impact on water quality due to the removal of contamination sources. The new open channel to be created will aerate & expose flow to sunlight and will be available for colonisation by aquatic plants. This will lead to an improvement in dissolved oxygen levels and reduced levels of ammonia and phosphorus in the PLB Tributary.	Positive
	Fish and Eels	Minor Negative	Habitat for existing fish will be lost.	Minor
	Macrophytes	Positive	New shallow low flow channel with gently sloping sides will provide new habitat for macrophytes.	Positive
	Invertebrates	Positive	New shallow low flow channel with gently sloping sides will provide new habitat for invertebrates.	Positive
	Diatoms	Positive	New shallow water channel with gently sloping sides will provide new habitat for diatoms.	Positive

Activity	Receptor	Unmitigated Impact	Comment/Mitigation	Residual Impact
De-culverting of PLB Tributary & creation of new open channel	Physical Habitat	Positive	A 360m length of new open channel will be created, which will enhance ecological value and create new habitat. Geomorphological features will be introduced into the new open channel to maximise potential for habitat creation.	Positive
	Water Quality	Positive	Positive impact on water quality due to the removal of contamination sources. The new open channel to be created will aerate & expose flow to sunlight and will be available for colonisation by aquatic plants. This will lead to an improvement in dissolved oxygen levels and reduced levels of ammonia and phosphorus in the PLB Tributary.	Positive
	Fish and Eels	Negligible	The de-culverted PLB Tributary will discharge post development flow to an existing culvert at the southern end of the site via a vertical drop structure of several metres. The presence of this drop structure and other physical barriers such as the M66 motorway will continue to preclude the colonisation of the site by eels, therefore, it is considered that there will be no impact on fish & eel population prior to and following redevelopment.	Negligible
	Macrophytes	Positive	The new open channel will provide new habitat for macrophytes	Positive
	Invertebrates	Positive	The new open channel will provide new habitat for invertebrates	Positive
	Diatoms	Positive	The new open channel will provide new habitat for diatoms	Positive

4.0 SUMMARY AND CONCLUSIONS

4.1 CEC have undertaken a Water Framework Directive risk assessment in relation to the proposal for the removal of an existing reservoir and culvert at a former industrial site at Tetrosyl, Bury, Lancashire. The assessment has been prepared to accompany a planning application. The site is to be redeveloped for residential housing with associated access roadways, gardens and Public Open Space. The existing industrial buildings and infrastructure are to be removed. In order to facilitate the redevelopment, the Mill Reservoir will be removed and a reach of the culverted PLB tributary which crosses the site will be de-culverted, to create an open channel watercourse.

4.2 This Risk Assessment has established baseline conditions and examined the risk of the proposed works to the following Water Framework Directive receptors:

- i) Potential modification of physical habitat due to removal of the reservoir and de-culverting of the PLB;
- ii) Potential for degradation of water quality;
- iii) Potential for degradation of fish and eel habitat & populations;
- iv) Potential for degradation of macrophyte habitat & populations;
- v) Potential for degradation of invertebrate habitat & populations;
- vi) Potential for degradation of diatom habitat & populations; and
- vii) Potential for deterioration of the water environment.

4.3 The assessment has found that, whilst risk to receptors will be either minor negative or negligible during the construction phase, the permanent works will result in a positive impact on all receptors through the creation of new habitat and appropriate conditions for the establishment of ecology.

River Basin Management Plan (RBMP) Objectives

4.4 The RBMP (North West) states that '*The Irwell catchment partnership's 3 key objectives are cleaner water, more naturally functioning and resilient water bodies, better connected and managed habitats*'. The development proposals for this site will contribute to meeting these objectives, as the water quality and physical habitat will improve post development.

4.5 The River Irwell is classified as a 'Heavily Modified' water body, and therefore, the objective for improvement is 'Good Ecological Potential'. The proposed development will contribute to meeting this objective.

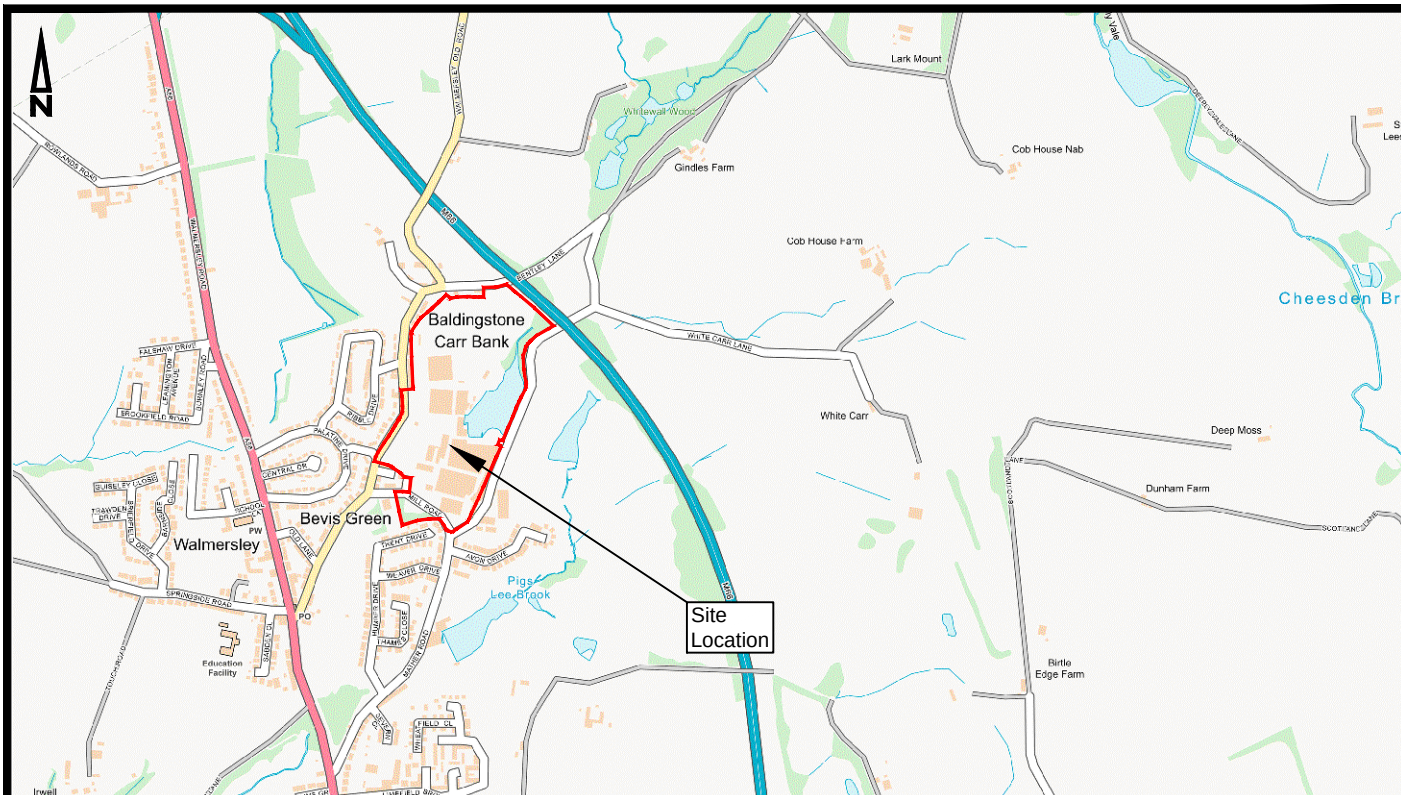


Conclusion

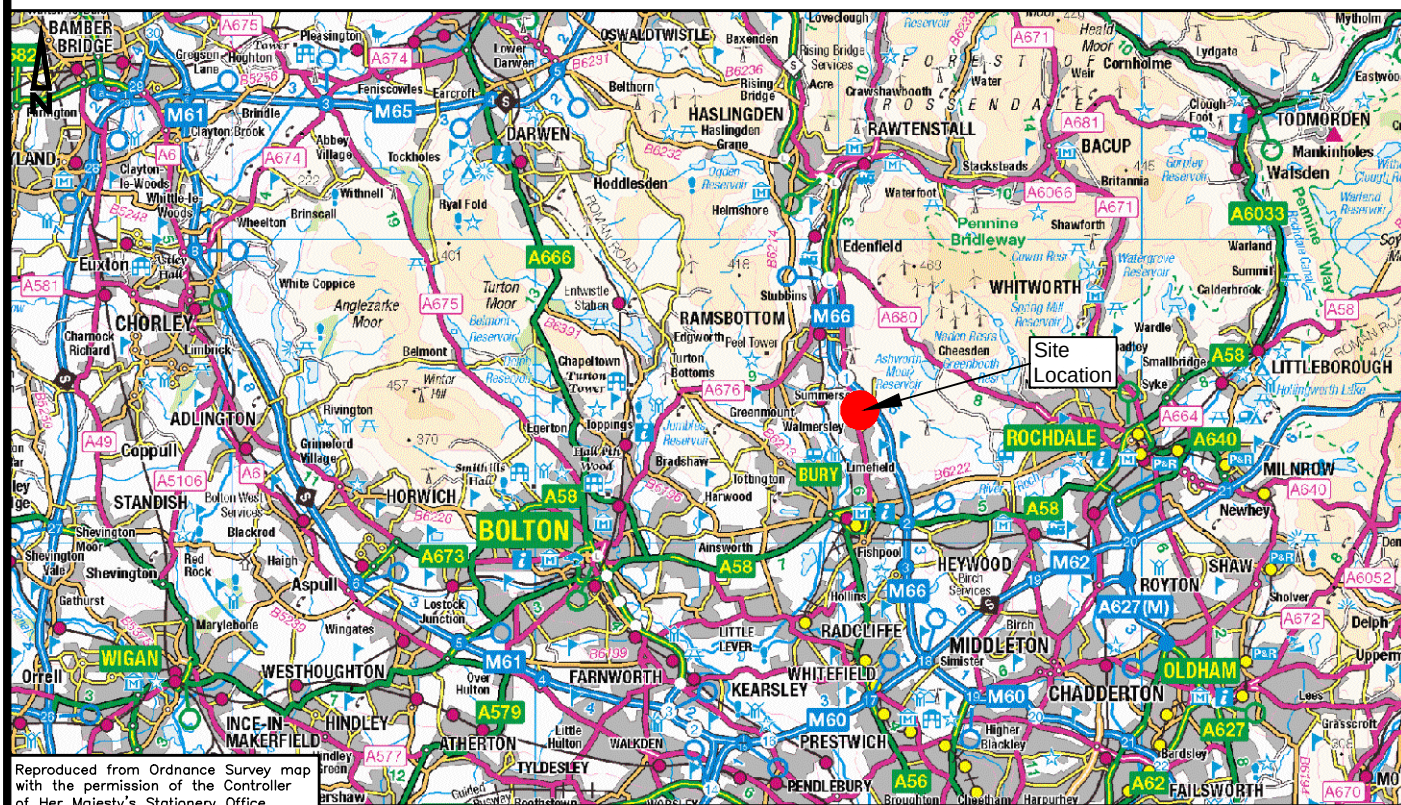
- 4.6 In view of the findings of this Report, it is concluded that the proposed reservoir removal & deculverting works, and creation of a flood storage area and open channel will support the objectives of the WFD & RBMP, and contribute to improvement of the water environment.
- 4.7 There are considered to be no over-riding water quality, habitat or ecological based reasons as to why the proposed works should not proceed. This conclusion assumes that any permission, if granted, should be conditioned by implementation and adherence to any relevant recommendations advanced within this Report and other such conditions that may be reasonably imposed by the Planning Authority.

Cole Easdon Consultants Limited
February 2021

Appendix 1



Scale 1:16,000



Scale 1:250,000

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Job Title:

Proposed Residential Development
Former Tetrosyl Site
Walmersley Old Road
Bury

Drawing Title:

Site Location Plan

Client:

Barratt Homes (Manchester)

Drawn By

NJ

Checked By

DF

Date Drawn

April 2018

Drawing No.

6155/500 Figure 1

Drawing Status:

FOR COMMENT	
FOR PLANNING	
FOR TENDER	
FOR APPROVAL	
FOR CONSTRUCTION	
AS BUILT	

Scale

As shown (A4)

Revision

Appendix 2

River Basin District	Manageme	Operational Ca	Waterbody ID	water body	water body easting	northing	ngr	Hydromorphological deYear	Status	Cycle	Classification Level	Classification Item
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Moderate		2 Ecological, chemical or quantitative status	Ecological
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Good		2 Ecological, chemical or quantitative status	Chemical
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Moderate		2 Component	Biological quality elements
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Supports Good		2 Component	Hydromorphological Supporting Elements
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Moderate		2 Component	Physico-chemical quality elements
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Not assessed		2 Component	Specific pollutants
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Does not require assessment		2 Component	Priority hazardous substances
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2027 Good		2 Element	Mitigation Measures Assessment
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Good		2 Element	Invertebrates
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Moderate		2 Overall Waterbody	Overall Water Body
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Supports Good		2 Element	Hydrological Regime
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Good		2 Element	Ammonia (Phys-Chem)
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Good		2 Element	Dissolved oxygen
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Moderate		2 Element	Macrophytes and Phytobenthos Combined
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Good		2 Element	pH
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Poor		2 Element	Phosphate
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Good		2 Element	Temperature
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Does not require assessment		2 Component	Other Pollutants
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2015 Does not require assessment		2 Component	Priority substances
North West	Irwell	Croal Irwell	G8112069064620	Irwell (Rossendale STW to Roch)	River	379442	413659	SD7944213heavily modified	2027 Good		2 Component	Supporting elements (Surface Water)

Catchment partnership local measures

Measures in the Irwell catchment

Catchment partnership(s): The Irwell catchment partnership, also known as Rivers Return, is made up of a number of organisations from the public, private and voluntary sectors, including local authorities, United Utilities, academia, local interest groups and various charitable trusts, who participate in its steering group and/or project group according to their interests. The priority river basin management issues to tackle in this catchment are diffuse urban pollution, physical modification and contamination from sewage treatment.

The Irwell catchment partnership's 3 key objectives are cleaner water, more naturally functioning and resilient water bodies better connected, and managed habitats. The partnership is also keen to provide additional benefits to wildlife and people through all its collaborative project delivery.

Contribution to environmental outcomes for 2021

A number of projects are in progress as part of the partnership's Aspirational Delivery Programme. Examples of these include:

- Moston Brook Restoration: Projects under this heading will result in improvements in phosphates, ammonia and dissolved oxygen. Additional environmental and social benefits will be brought to bear through public engagement activities and community action.
- Other projects are confirmed or in development. Confirmed projects include tackling urban diffuse pollution (Street Trees and Industrial Estates Engagement); addressing physical modifications (Good Ecological Potential project); and protecting drinking water in the rural uplands (Cloughbottom Safeguard Zone Protection project).
- The partnership is currently mapping further opportunities, for example to identify where in the catchment green infrastructure can be used to address urban diffuse pollution and surface water flooding.

Future aims

Ideas for additional measures with £100,000 per year:

- 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
- action high priority safeguard zone measures

Ideas for additional measures with £1,000,000 per year (as above plus the following):

- 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 the public and property

Further information on the partnership is available at:

<http://www.catchmentbasedapproach.org/north-west/irwell>

Appendix 3

4.3 Vegetation and Habitats

- 4.3.1 None of the habitats present are species-rich or of rare or restricted distribution with the UK. The NVC communities present are typical of the geographical area and conditions present.
- 4.3.2 Approximately 6 hectares (almost 60%) of the site is occupied by buildings and hard-standing which is devoid of vegetation and therefore of no ecological value in terms of plant species.
- 4.3.3 The woodland habitats, particularly the established woodland associated with the eastern and north-western margins of the lodge to total an area of c. 0.4 hectares is characteristic of the W10 woodland community and is therefore Lowland Mixed Deciduous Woodland Priority Habitat. The presence of Priority Habitat, albeit limited in area, and the habitat connectivity function and opportunities for biodiversity it provides is of value at the local level.
- 4.3.4 Owing to the reported presence of breeding common toad, a Priority Species, the lodge meets the criteria under the Pond Priority Habitat description.
- 4.3.5 The presence of invasive species listed on Schedule 9 of the *Wildlife and Countryside Act 1981* (as amended), namely Japanese Knotweed, Indian Balsam, Rhododendron and Montbretia is a consideration. The redevelopment will provide a mechanism to eradicate these species from the site and / or prevent the risk of spread into the retained habitat in the site and habitats in the wider area; guidance is provided at **Section 5.5**.

4.4 Protected Species and Other Wildlife

Bats

- 4.4.1 As detailed at **Appendix 2**, appropriate and proportionate survey effort, in accordance with standard survey guidelines (Collins, J. (ed), 2016), has been applied to survey and assess the buildings / structures and trees for their suitability for use by roosting bats.
- 4.4.2 The common pipistrelle day roost recorded at Building 3 (Roost 1) is of 'low' conservation significance in accordance with Figure 4 of the *Bat Mitigation Guidelines* (Mitchell-Jones, 2004), and appropriate and proportionate mitigation for the loss of the roost as a result of the demolition is entirely feasible.
- 4.4.3 No further survey or assessment in relation to bats is needed to inform the application for the relevant Natural England licence to facilitate the demolition, *provided* works are carried out before May 2019 (i.e. the next bat activity season). If commencement of works is delayed beyond May 2019, an updated bat activity survey will be required to inform the licence application.
- 4.4.4 Habitats within and adjacent to the site are suitable for foraging and commuting bats. Recommendations relating to the retention of features suitable for use by foraging and commuting bats, and features to enhance habitats for roosting bats at the site are presented at **Section 5.8**.

Badger

- 4.4.5 The Badger Survey and Assessment addendum (ERAP (Consultant Ecologists) Ltd, December 2018) provides an evaluation and assessment of the site and proposals in relation to badger.

Other Protected Species

- 4.4.6 Appropriate and proportionate survey effort and assessment have been applied to examine the site for other protected species.
- 4.4.7 The proposals can be achieved with no adverse effect on other relevant protected species namely water vole, otter, Schedule 1 birds, great crested newt and reptile species.

- 3.2.26 The lodge supports limited vegetation with the exception of local stands of Brooklime (*Veronica beccabunga*) and Yellow Water-lily (*Nuphar lutea*) associated with the shallow water near the weir.

Land South of Mill Road

- 3.2.27 The site boundary includes a small (0.2 hectares) parcel of land outside of the Tetrosyl site border and south of Mill Road.
- 3.2.28 The area supports neutral grassland composed of Red Fescue, Cock's-foot and Ribwort Plantain bordered by dense Bramble scrub and Great Willowherb tall-herb vegetation and semi-mature Goat Willow, Crack Willow (*Salix fragilis*) and Ash trees.

Invasive Plant Species

- 3.2.29 As annotated on **Figure 8.2**, four invasive non-native species (INNS) were recorded at the site namely:
- a. An established stand of Japanese Knotweed at the southern site boundary;
 - b. A couple of plants of Montbretia (*Crocasmia x crocosmiiflora*) at the margin of the compacted ground storage area in the north-western area of the site;
 - c. Scattered plants of Indian Balsam around the margins of the compacted ground storage area in the north-western area of the site and at the weir where water from the lodge enters a culvert beneath Building 4; and
 - d. Rhododendron shrubs within the oak woodland (not annotated on Figure 8.2).
- 3.2.30 All these INNS are listed on Schedule 9 of the *Wildlife and Countryside Act 1981* (as amended), and it is an offence to spread or cause their spread in the wild. This is considered further at **Section 4.3**.

3.3 Animal Life

Badger

- 3.3.1 Please refer to the separate 'Badger Survey and Assessment' addendum (ERAP (Consultant Ecologists) Ltd, December 2018).

Bat Species

Roosting Bats

- 3.3.2 The report of licensed bat surveys carried out in 2017 and 2018 is appended at **Appendix 2**.
- 3.3.3 In summary:
- a. Buildings 3, 5, 6 and 7 are assessed to have a high suitability for use by roosting bats;
 - b. Buildings 9 and 11c are assessed to have a moderate suitability for use by roosting bats;
 - c. Buildings 4, 13 and 14 are assessed to have a low suitability for use by roosting bats;
 - d. Buildings 1, 2, 8, 10, 11a, 11b and 11d, 12, 15, 16 are assessed to have negligible suitability for use by roosting bats;
 - e. A common pipistrelle bat day roost (maximum three bats) was recorded in the stone wall at the northern elevation of Building 3 on all survey dates (Roost 1);
 - f. No bat exit or entry activity was recorded at the culvert entrances;

- 3.3.17 The site is not adjacent or linked to any areas of favourable habitat for reptile species, and there are no records of reptile for the site or the wider area. The presence of reptiles within the site is reasonably discounted.

Water Vole

- 3.3.18 The banks of the channel leading from the M66 to the lodge are stone lined and unsuitable for use by water vole. The lodge retaining banks are constructed from large boulders and solid stone retaining walls, refer to **Photo 6**; none of these conditions are suitable for use by water vole. No evidence of water vole was detected during the survey in July 2018; the presence of this species is reasonably discounted.

Otter

- 3.3.19 No evidence of an otter holt was found at the margins of the lodge.
- 3.3.20 No field signs of otter (such as spraints or dead fish) were recorded at the site. There are no reported records of otter in the area and / or the lodges north of the site and the connectivity to other watercourses to the south is limited by the presence of culverts and existing developed land.
- 3.3.21 Owing to the presence of connectivity between the lodge at the site and the watercourse and fishing lodges north of the site (Baldingstone SBI and Gindles Farm BHS) use of the site by feeding otter cannot be entirely discounted, however, for reasons given above the presence of this species is not reasonably likely.

Aquatic Invertebrates

- 3.3.22 **Table 8.11**, appended presents a list of the aquatic invertebrates recorded at the lodge and inflow stream. Sixty species were recorded in total (41 at the lodge and 27 at the inflow stream).
- 3.3.23 One adult brown hawker dragonfly (*Aeshna grandis*) was observed. Larvae of brown hawker were found in the lodge together with larvae of the large red damselfly (*Pyrhosoma nymphula*); larvae of two other species of damselfly were found in the lodge but were too young and small for accurate identification.
- 3.3.24 A single adult specimen of the iron blue mayfly (*Baetis muticus*) was seen flying by the inflow stream where one other adult mayfly was seen but not caught. Adults of the Willow Stonefly (*Leuctra geniculata*) were seen by the inflow stream where their larvae were also seen. No adult caddisflies were detected.
- 3.3.25 None of the recorded species are European protected species, protected under the *Wildlife and Countryside Act 1981* (as amended), are Priority Species or Greater Manchester BAP species. None of the recorded species are listed as invasive species on Schedule 9 of the *Wildlife and Countryside Act 1981* (as amended).
- 3.3.26 The surveyors reported that the limited diversity of macroinvertebrate fauna is attributed to the low habitat diversity within the lodge and that the presence of abundant shredders of dead leaves; such as the water hoglouse is attributed to the overhanging trees and availability of leaf detritus.
- 3.3.27 No swan mussels were detected, although a single empty shell of the duck mussel (*Anodonta anatina*) was brought up by the dredge.

5.6 Badger

- 5.6.1 The strategy as outlined in the Badger Survey and Assessment addendum (ERAP (Consultant Ecologists) Ltd, December 2018) has been incorporated into the site layout and the specific actions for the protection of badger both during the construction phase and in the long-term will be applied.

5.7 Lodge Drainage and Fish Rescue Strategy and Common Toad Mitigation Strategy

- 5.7.1 To ensure the protection of biodiversity, a Lodge Drainage and Fish Rescue Strategy will be prepared. The Strategy will detail:
- a. The appropriate timing of works to avoid adverse effects on breeding waterfowl, invertebrates and amphibians;
 - b. The services of a Fish Handler such as Blue Slate Fisheries (<http://blueslatefishery.co.uk/contact/>) will be commissioned to ensure the appropriate permits are obtained and measures are applied for the protection of fish welfare. ERAP (Consultant Ecologists) Ltd has been in discussion with the fish handler in relation to the strategy to be applied;
 - c. The sequence of works to minimise disruption to wildlife; and
 - d. Measures to be applied to attempt to deter mass predation by gulls of relatively immobile aquatic fauna such as molluscs.
- 5.7.2 A Common Toad Mitigation Strategy will be prepared to describe the measures to be applied to avoid impacts on common toad during the draining down of the lodge and site preparation works.

5.8 Bats

Mitigation Strategy

- 5.8.1 A Bat Mitigation Strategy and consideration of licensing requirements are detailed at **Appendix 2**.

Updated Surveys

- 5.8.2 The 2017 and 2018 survey data are only valid until May 2019. As detailed in **Section 9.11**, and in accordance with Natural England guidance, if a licence application is delayed beyond May 2019, an updated bat activity survey will be required to support the licence application and facilitate the demolition works.

Lighting

- 5.8.3 Paragraph 180, bullet point 'c' in Chapter 15 (conserving and enhancing the natural environment) of the NPPF states that development should:
- 'limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.'*
- 5.8.4 The lighting scheme to be implemented at the redeveloped site must involve the use of appropriate products and screening, where necessary, to ensure no excessive artificial lighting shines over habitats identified to be of value for use by foraging bats and other fauna such as the retained woodlands, the new pond and the new open water channel, as lighting overspill may deter use by wildlife.
- 5.8.5 The lighting scheme will be designed with reference to current guidance, namely:

Figure 8.2: Phase 1 Habitat Survey and Vegetation Map



Appendix 4

4). The ground layer supports creeping soft-grass *Holcus mollis*, bracken *Pteridium aquilinum*, bramble and bluebell *Hyacinthoides non-scripta*.

A fast-flowing watercourse enters the wooded valley from the north-east (Target Note 5, see Photograph 5). As the watercourse enters the site it is canalised within a stone channel. As the channel widens into the reservoir within the site, the banks are formed by wooded banks.

Photograph 5: Watercourse entering north east corner of the site



Photograph 6: Watercourse flowing south into reservoir showing a well-worn badger path along bank top leading towards badger sett in rhododendron



The lake is approximately 75m x 140m (Target Note 7), and is fed by a stream from the north. Water flows from the south-western corner of the lake, running south beneath Building 4. The lake is very open, with no visible aquatic vegetation, and marginal vegetation is limited to occasional stands of vegetation along the northern and eastern margins. The water is turbid. Approximately 70% of the banks are constructed of vertical stone walls; the remainder are generally composed of steep-sided stone/rubble banks. Broadleaved woodland forms the northern and eastern bank tops, and part of the western bank top. Hard-standing is located adjacent to the southern bank and south-western corner of the lake, with occasional immature goat willow *Salix caprea* and alder *Alnus glutinosa* trees along the top of the concrete vertical banks.

3.2.2 Protected Species

3.2.2.1 Bats

No obvious signs of roosting bats were located during the survey. It should however be noted that the survey was an initial external and detailed surveys were not carried out. The study site supports a number of buildings with a range of features, such as gaps in the stonework, missing tiles and gaps between lintels and windows that may have potential to support roosting bats.

Natural England would be likely to require proof that badgers are using the artificial sett before they will issue a licence for the exclusion of the sett.

Loss of foraging/commuting habitat

The development will not result in the loss of the grassland or woodland adjacent to the badger sett, these are the main suitable foraging habitats within the site. There is no clear evidence to suggest badgers cross the grassland area or forage in the south-west area of the site. The badgers appear to move north from the site in the direction of the open rural land to the north of the M66.

4.2.3.4 Amphibians

Great crested newts and their habitats in water and on land are protected under the Wildlife and Countryside Act 1981 (as amended by the CROW Act 2000), and by the Habitats Regulations 1994. In summary, these make it an offence to damage or destroy a breeding site or resting place, intentionally or recklessly obstruct any place used for shelter or protection, deliberately, intentionally or recklessly disturb a great crested newt or intentionally kill, injure or take any great crested newt.

In contrast, Common toad, common frog and smooth newt are given only partial protection by Section 9(5) of the Wildlife and Countryside Act 1981. This means that wild animals are only protected through prohibiting sale, transporting or advertising for sale.

Common toad and great crested newts are UK Biodiversity Action Plan (BAP) Priority Species and are listed as Species of Principal Importance in response to Section 41 of the NERC Act 2006 as Species of Principal Importance. The Government indicates in PPS9 paragraph 16, that local authorities should take steps to further the conservation of such species and should ensure that these species are "*protected from adverse effects of development, where appropriate, by using planning conditions or obligations*"..

No amphibians were located during the survey. The only waterbody within the site is the large lake on the eastern half of the site. The waterbody was previously used for coarse fishing and has been stocked with carp in the past (pers. comm. staff on site). Great crested newts generally prefer small to medium sized breeding ponds with extensive aquatic vegetation for egg laying².

The lake is considered to be sub-optimal for breeding great crested newts due to its large size and the presence of large numbers of fish and only limited supply of aquatic vegetation. It is therefore considered unlikely that this waterbody would support great crested newts.

There are two reservoirs, situated approximately 100m east and 330 m south east of the survey site. No records for great crested newts were provided for these reservoirs and from the aerial photographs.

There are two ponds with records for great crested newts located over 900m south east of the site. However, the M66 motorway forms a significant barrier between these two ponds and the survey site. The majority of great crested newts stay within around 250m of the breeding pond. However, newts may travel further if there are areas of high quality foraging and refuge habitat beyond this range. Great crested newts may colonise other water bodies if they provide a suitable breeding habitat and if it is sufficiently close to the existing population and if the intervening habitat is suitable to promote dispersal and there are no significant barriers to movement². Due to the lack of good connecting habitat and the presence of the motorway separating the proposed development site from the known great crested newt population it is considered highly unlikely newts would be present within the water body on the survey site.

² Froglife 2001 Great crested newt Conservation Handbook

Appendix 5

Poly Hydrocarbons	Cyclic	Aromatic	Ingestion Vapour Inhalation	Construction Workers Future Residents
Discussion				
The former site use as a cotton mill and dye works will have resulted in the wide spread use of naphthalene as a dyeing agent and as such it is anticipated that the underling soils will be impacted by this semi-volatile compound.				
It is considered that the use of coal as a fuel will have resulted in significant quantities of ash Made Ground across the site resulting is low level non-volatile PAH impact to the soil.				
Controlled Water				
Hydrocarbon Compounds and VOC's	Vertical Migration Lateral Migration		Secondary A Aquifer	
Discussion				
The primary risk to controlled waters, including the on-site reservoir & Lee Brook (culvert) will form the primary controlled water risk assessment. However; the underlying Secondary A Aquifer is also identified as a critical receptor.				
The site has been utilised for the storage of bulk hydrocarbon solvents (aliphatic & aromatic) C7-12, which while predominantly Light Non Aqueous Phase Liquid (LNAPL) will migrate as both a separate and dissolved phase plume toward the on-site surface water features and underlying aquifer.				
Buildings and Infrastructure				
Sulphate / pH	Leachate and Corrosion		Buried Concrete	
Discussion				
Made Ground associated with the former quarry, and reservoir can be a source of sulphate and other corrosive compounds which can pose a risk to underground structures.				
Ecological				
Hydrocarbon Compounds, PAH's and Solvent Compounds	Consumption Ingestion Vapour Inhalation		Protected Species	
Discussion				
Any protected species on site may be affected by any contamination to surface water which they consume, or by any dust associated with made ground, or contact with hydrocarbon compounds.				

Referring to Table 9.2, the results of this direct comparison indicates that the data does not exceed any of the screening criteria for a residential end use. However it is important to note that this dataset has been obtained from limited sampling data obtained from an initial phase of intrusive investigation given the operational nature of the subject site.

No detectable concentrations of chlorinated solvent compounds have been identified within any of the soil or groundwater samples analysed during this (and previous) phase of intrusive investigation.

Results of groundwater samples collected from WS104 & WS106 installed adjacent to the main solvent tank farm / former solvent recovery plant within the northern sector of the site confirmed the presence of elevated volatile phase C5-C12 hydrocarbon compounds which would pose an unacceptable level of risk through volatilisation to indoor air from impacted groundwater.

The presence of significantly elevated concentrations of hydrocarbon (solvent contamination) within the perched groundwater is indicative of a wider plume as would be expected given the high risk associated with the historic storage of bulk solvents. It must therefore be inferred that the soils within the immediate vicinity of the solvent recovery works and tank farm are impacted by volatile phase hydrocarbon compounds that would pose an unacceptable level of risk to the identified receptors and thus trigger further assessment works and land remediation.

The identified volatile hydrocarbon contamination within the northern tank-farm and solvent recovery area confirms the findings of previous phases of intrusive investigation.

No detectable concentrations of chlorinated solvents have been identified which generally confirms the reported historical site use associated with aromatic and aliphatic petroleum range solvents (BTEX).

E3P would suggest that once the site has been decommissioned with all above and below ground storage tanks and associated infrastructure having been safely removed, the localised hydrocarbon impact identified as part of this phase of investigation should be delineated vertically and laterally. The results of this delineation exercise should be used to inform the production of a detailed Tier 2 Quantitative Risk Assessment (DQRA) that will determine the Site Specific Remediation Targets (SSRT) and define the extent of future remediation works to treat the impacted soil and groundwater once the source (tanks) have been removed.

The above mentioned works will include the following key elements:

- ***Safe decommissioning of all above ground and below ground solvent, petroleum and diesel storage tanks and associated infrastructure;***
- ***Further detailed contamination investigation within the immediate vicinity of each and every identified tank / piece of infrastructure to accurately define the extent of vertical and lateral migration of soluble / volatile hydrocarbon impact within the underlying soils;***
- ***Conformation with respect to the absence of any soluble phase hydrocarbon impact to the underlying aquifer within the superficial drift deposits and solid rock formations;***
- ***Development of Site Specific Remediation Targets to inform the pragmatic remediation of impacted soil and groundwater;***

Development of a suitable on-site (in-situ / ex-situ) remediation solution to treat impacted soils to ensure they comply with the SSRT's;

The entire site is underlain with a layer of Made Ground which will contain unacceptable levels of heavy metals, non-volatile PAH and trace asbestos fibres which could pose a theoretical risk to human health of future site occupants. This risk associated with the aforementioned contaminants of concern can be mitigated through the incorporation of the following mitigation measures within the proposed development:

Suitable cover system (nominally 600mm) to be confirmed on completion of site decommissioning and supplementary investigation & sampling works.

9.3 Controlled Waters

Significantly elevated concentrations of volatile, soluble phase C5-C12 (aliphatic & Aromatic) hydrocarbon impact has been identified within the immediate vicinity of the Above-ground Storage Tanks (AST's) in the northern sector of the site.

The reported concentrations would pose an unacceptable level of risk to the critical on-site controlled waters receptors (reservoir & culvert) and underlying aquifer.

The identified soluble phase impact is representative of plume that has migrated a short distance from the known source. It will therefore be necessary to remove the source (AST's) and undertake further delineation sampling in the vicinity of these tanks to inform the production of a Tier 2 DQRA & SSRT defining the extent of land remediation works required to ensure the residual soil and groundwater poses no unacceptable level of risk to controlled waters.

It is considered that a similar exercise (albeit to a lesser degree) will be required within the central sector of the site, where further solvent storage tanks are present and at the tank farm in the far southern portion of the landholding.

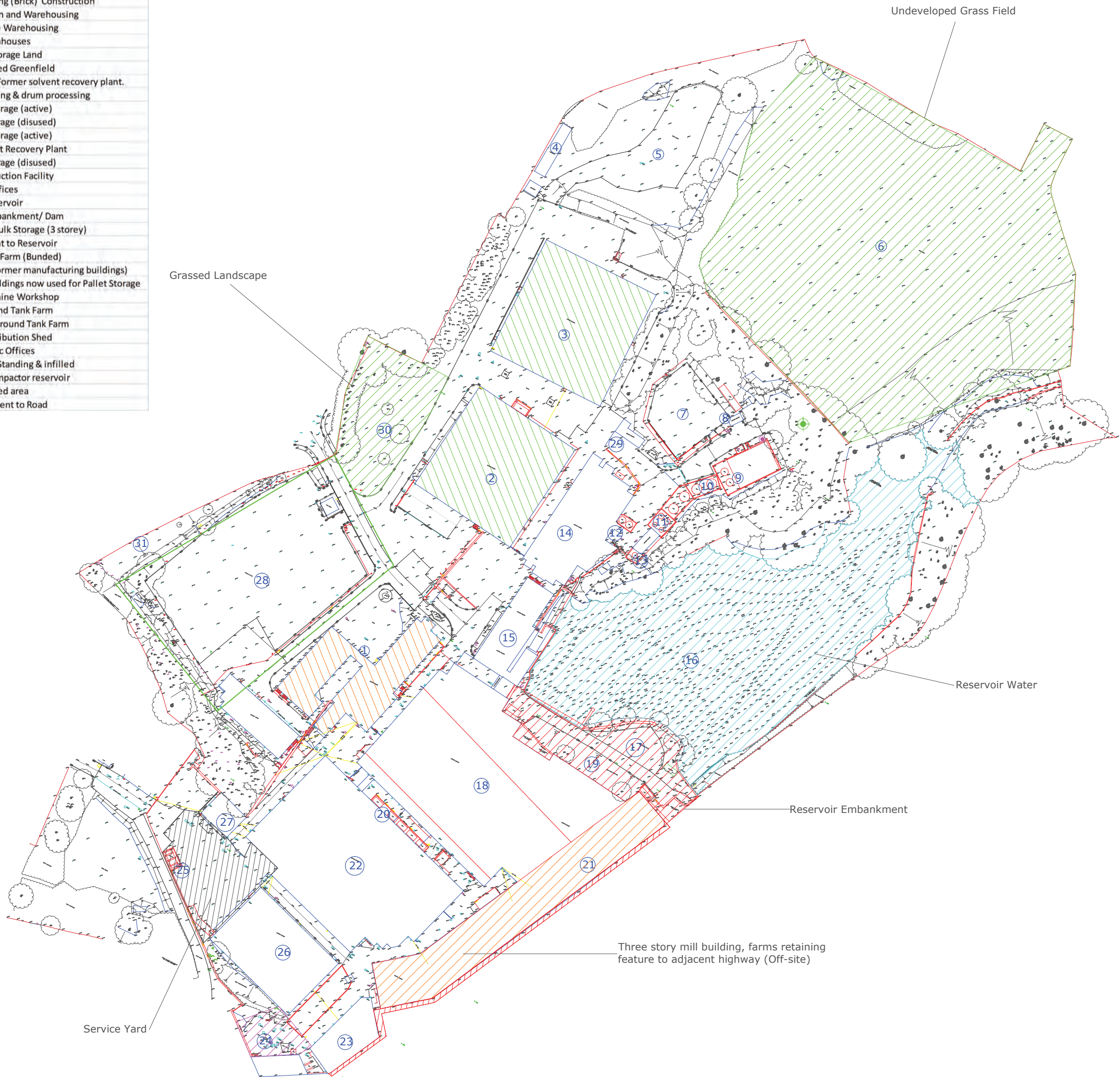
It is considered that once the tanks have been decommissioned and all residually impacted soil and ground water has been treated, the site will be rendered suitable for redevelopment for a low rise residential end use and the risk to controlled waters and the wider environment will be negated.

The identified dissolved phase (volatile) hydrocarbon impact is primarily associated with C5-C12 hydrocarbon compounds which are volatile in composition, therefore on removal of the primary source (AST's) the risk to controlled waters will be dramatically reduced. If the underlying soil and perched groundwater is deemed to pose a risk as a secondary source, it is likely that in-situ soil vapour extraction and bio-remediation (soil) will provide viable remediation technologies. However the selection of suitable technologies to achieve the SSRT will ultimately be the responsibility of the preferred remediation contractor.

Further groundwater sampling will be required within the areas of deep Made Ground (backfilled reservoirs & Quarry) to confirm the absence of any impacted perched groundwater within the base of the Made Ground.

In summary, further intrusive sampling will be required as and when the site has been fully decommissioned to inform the production of a robust Tier 2 DQRA that will define the Site Specific Remediation Targets to ensure the site is developed in a manner that will pose no unacceptable level of risk to controlled waters and the wider environment.

Area	Current Land Use
1	Tetrosyl Office Building (Brick) Construction
2	Portal Distribution and Warehousing
3	Portal Frame Warehousing
4	Greenhouses
5	Open Storage Land
6	Undeveloped Greenfield
7	Bulk Raw Product Storage & Former solvent recovery plant.
8	Former Product Mixing & drum processing
9	Solvent Storage (active)
10	Solvent Storage (disused)
11	Solvent Storage (active)
12	Former Solvent Recovery Plant
13	Solvent Storage (disused)
14	Paint Production Facility
15	Offices
16	Reservoir
17	Reservoir Embankment/ Dam
18	Stone Mixing and Bulk Storage (3 storey)
19	Embankment to Reservoir
20	Solvent Tank Farm (Bunded)
21	Disused Buildings (3 storey former manufacturing buildings)
22	4 storey stone Historical Mill Buildings now used for Pallet Storage
23	Former Machine Workshop
24	Underground Tank Farm
25	Diesel Above Ground Tank Farm
26	Pallet Distribution Shed
27	Historic Offices
28	Aggregate Hard Standing & infilled
29	Waste point compactor reservoir
30	Grassed area
31	Embankment to Road



20 - Current Site Features

R0	07/03/14	Original	JN	MD
Note	Date	Revision	Initial	Checked
Drawing Title:		Job No:	Date:	
Current Land uses		10-110	07/03/2014	
		Drawing No:	Scale:	
		002	NTS	
Job Title:		Client:		
Tetrosyl		WHR Property Consultants LLP		



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Appendix 6

1



Restoring Meanders to Straightened Rivers

1.6 Opening up a culverted stream

RIVER RAVENSBOURNE

LOCATION - NORMAN PARK, BROMLEY TQ412674

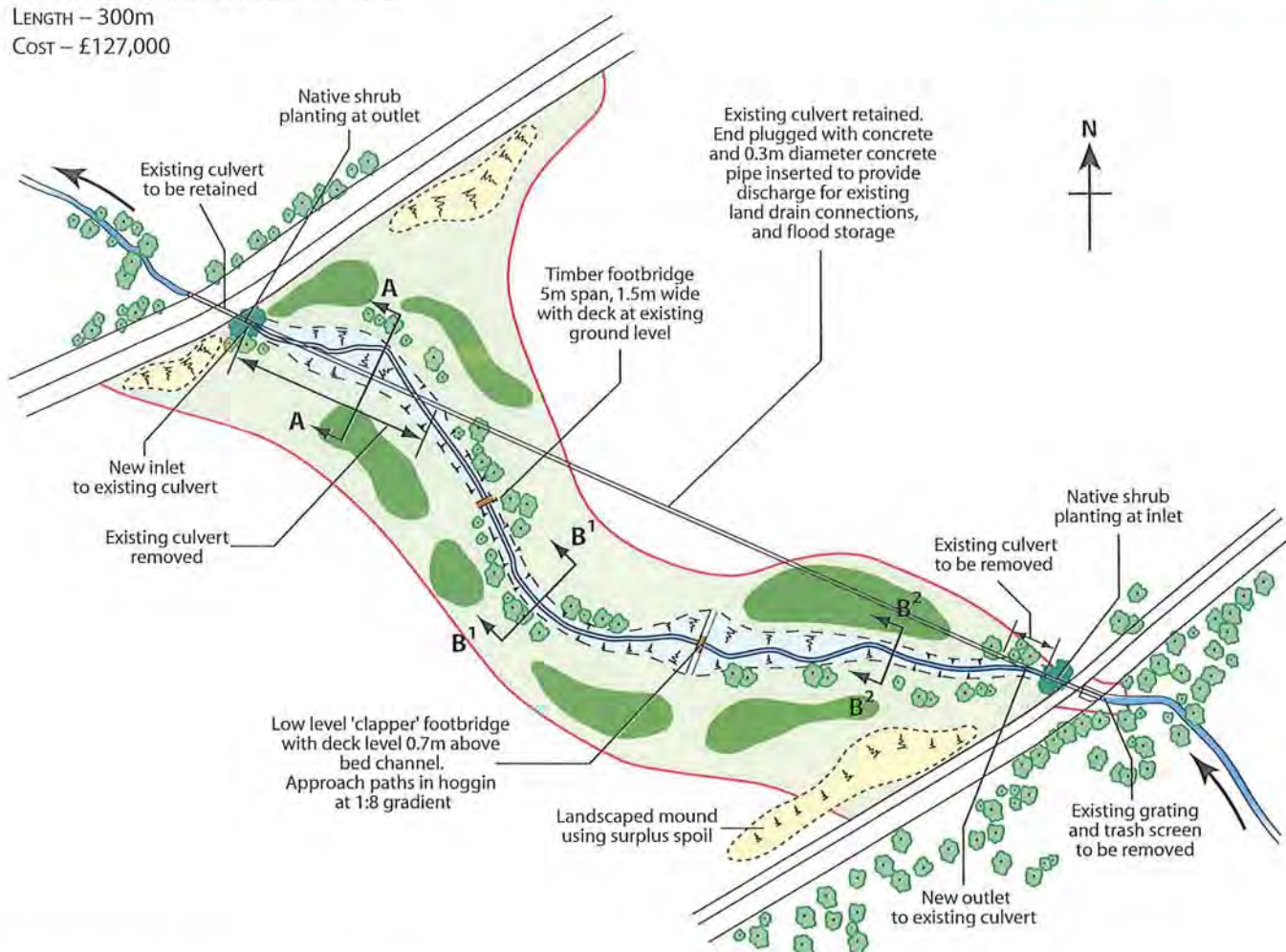
DATE OF CONSTRUCTION - MARCH TO JUNE 2000

LENGTH - 300m

COST - £127,000

Figure 1.6.1

PLAN OF NEW CHANNEL



Description

The Ravensbourne is a spring-fed stream flowing from its source near Keston, on the north slope of the North Downs, northwards through Bromley, Catford and Lewisham to join the Thames at Deptford Creek. In many areas such as Norman Park the stream was confined within a culvert.

Culverting of small watercourses in urban and parkland areas has been common in the recent past. Burying the river was felt to reduce the flooding potential, minimise safety issues associated with open water and maximise land available for development or use as open space/playing fields. Little consideration was given to habitat loss, aesthetic and landscape appeal of rivers or the potential benefits of surface water storage.

The Ravensbourne flowed for 300m through a 1m diameter concrete-lined steel culvert. Smaller land drains, which had been ditches before the area was levelled to form the park, flowed into the culvert at intervals along its length.

Park access tracks and major services, including a gas pipeline and electrical supply cables, crossed the culvert at the north end and a water pipe and local electrical supply cables at the southern end.

Deculverting (daylighting) this section of the Ravensbourne provided an exciting opportunity to restore a more 'natural' stream with diverse in-channel and bankside habitats that link with Scrogginhall Woods just upstream. It also provides an interesting recreational facility for the local public.

Restoring Meanders to
Straightened Rivers

1

View of headscreen
prior to removal'Daylighting' of the
Ravensbourne

Design

Financial justification for the scheme was threefold: reduction in costly maintenance for a culvert, the removal of a trash screen that also required regular clearing and was a safety issue, and an increase in flood storage. There was also a positive environmental gain.

The culvert was severed and approximately 70m of the 300m long culvert was removed, isolating 180m of the remaining section. Two short lengths were left to maintain the existing access track and service crossings. As the culvert was ruler straight, simply excavating the watercourse and removing the concrete would produce a far from natural channel. In addition, culvert removal, backfilling and reshaping is considerably more expensive than plugging and digging an alternative, though longer, course.

The design of the river channel was based on the historical layout, fluvio-geomorphology, flooding considerations and present day use of the park (cricket pitches). To avoid being overly prescriptive, the design drawings were kept relatively simple. The conditions encountered on site meant the final course is slightly different from the design plan (Figure 1.6.1). Indicative cross sections were provided at key locations with the main objective always a shallow, safe, accessible bank (Figures 1.6.2 and 1.6.3).

The new channel varied in bank slope and bed width, but followed a smooth longitudinal bed profile. By then infilling with an excess of gravel, the stream was allowed to shape its new bed, rather than 'constructing' pools and riffles.

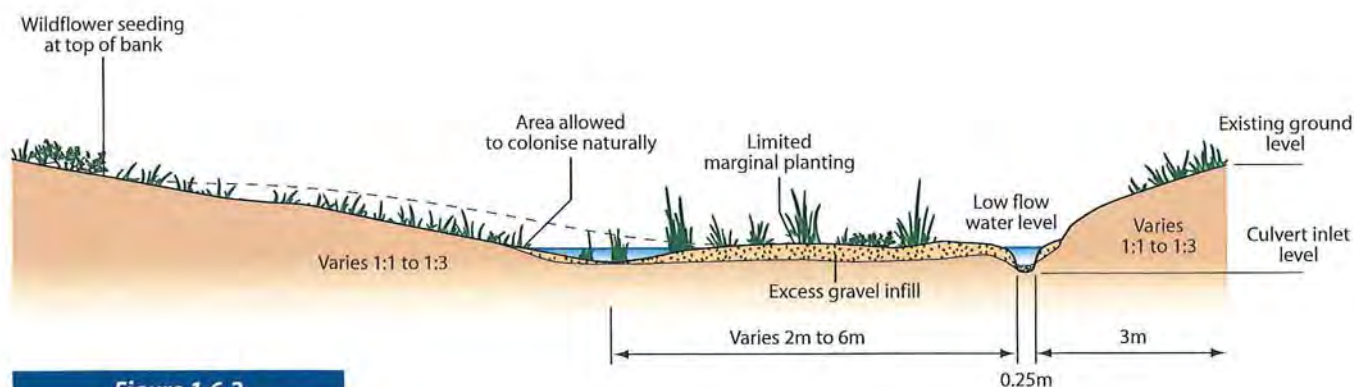


Figure 1.6.2

SECTION A THROUGH RAISED BED
AND MARGINAL SHOAL



Restoring Meanders to Straightened Rivers



Looking downstream at the shallow bank slopes. The severed culvert still visible



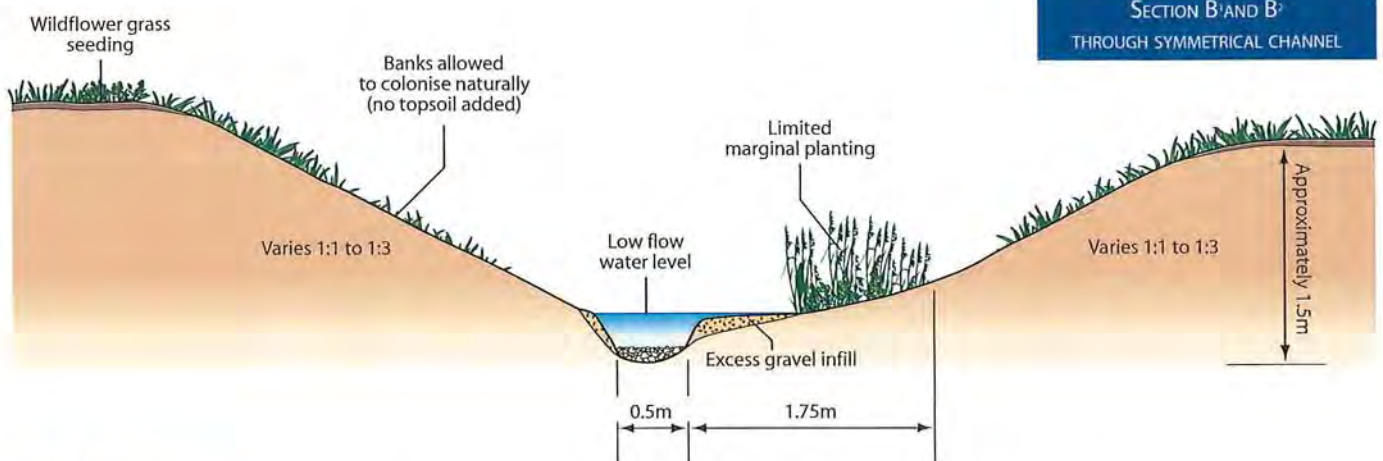
The new sinuous course and extent of wildflower seeding

The new course is 12.5% longer than the culvert, sinuous, with varying bed and top-of-bank widths. A shallow (1:8 batter) 'beach' area, as a result of an exposed gravel lens, and new meanders (1:5 inside batters) form the focal points for access to the stream.

When considering this type of scheme, where the stream emerges and then re-enters a culvert, it is good practice to build in 'sediment traps'. These can take many forms and do not have to resemble deep holes or even be maintained once the site has stabilised. At Norman Park the channel was greatly widened at the downstream end of the works forming a damp gravelly area which would act as a silt trap. This also allows the stream to find its own natural path within the confines of the overall channel width.

Spoil from the excavation remained on site, and the landscape architect located the mounds at either end of the new course, to ensure that they were subtle and blended into the park.

Two crossings have been constructed over the new channel, one a 'clapper' type bridge constructed of concrete (but looking like stone) and the other a timber structure. Both provide easy access across the stream and access to the water's edge is made possible along most of the course by shallow bank slopes.



Restoring Meanders to Straightened Rivers

1

Planting up the 'wet berm' area
and shielding the culvert
entrance with shrub planting



Topsoil was not replaced on the riverbanks in order to attain a low fertility substrate suitable for the natural colonisation of wildflowers and plants from upstream. A 'buffer zone' between the amenity grassland and the top of the bank was seeded with a low-density wildflower mix from an approved source. This creates a visually pleasing edge to the playing fields and provides a suitable seed source for the banks. On the river's edge native provenance marginal plants were carefully sourced from a local nursery. School children were involved in some of the marginal planting. Wildflower plugs were also planted. The culvert entry and exit were both screened using a variety of native shrub species.

The marginal planting is suffering disturbance from early use and may take longer than expected to establish a good cover, though this should eventually produce a good diversity of edge habitats. The wildflower plugs have been decimated by crows in search of worms. About a third were removed from the ground and died.

The planting scheme was designed as a balance between creating an instant impact for the local users and allowing the natural processes of colonisation to occur. Even so the local users have stated that they would have liked more immediate impact from the planting.

Subsequent performance 2000 – 2001

The park users, particularly dog walkers, now see the open Ravensbourne as a focal point, circling the area and making use of the crossing points. Children and dogs play along the banks even though the site has still to mature.

The gravel bed has been redistributed by the flow creating riffles and pools (down to the clay bed in places).



Initial invertebrate and fish surveys have shown little change, but this should improve with time as the site matures and the marginal and emergent vegetation develops.

The early success of the project can be attributed to the multi-disciplinary project team and the Partnership between the Borough Council and the Environment Agency.

Original Information Providers:
Trevor Odell
Julie Baxter

Completion was celebrated
at a launch ceremony
in June 2000



1

1.6 River

Morphologic
this de-culve
and depositi

channel and flow variability has developed. Areas of fast flow are evident in the shallower riffles and there is slower flowing water at the margins where the water level is deeper. Within a month of the works being completed the gravel had been redistributed as expected. The river had exposed the clay subsoil and has now created a stable channel.

Opening up the culvert has reconnected the river to the floodplain. This provides an opportunity for floodwaters to be stored on the floodplain, reducing the flood risk downstream.

The park area is well used by local people for recreational purposes and a site visit and talk was given at a local school following the works.

- Improve floodplain connectivity
- Increase in-channel morphological diversity
- Preserve and, where possible, restore historic aquatic habitats
- Removal of hard bank reinforcement / revetment, or replacement with soft engineering solution
- Re-opening existing culverts
- Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone

[Click Here
to Hide details](#)

[Click Here
to view details](#)

Low energy, gravel

GB106039023260

Designation

None

**Project specific
monitoring**

Macroinvertebrate

Effective narrowing of the channel, and asymmetric shallowing of the bed has occurred following restoration – 2012

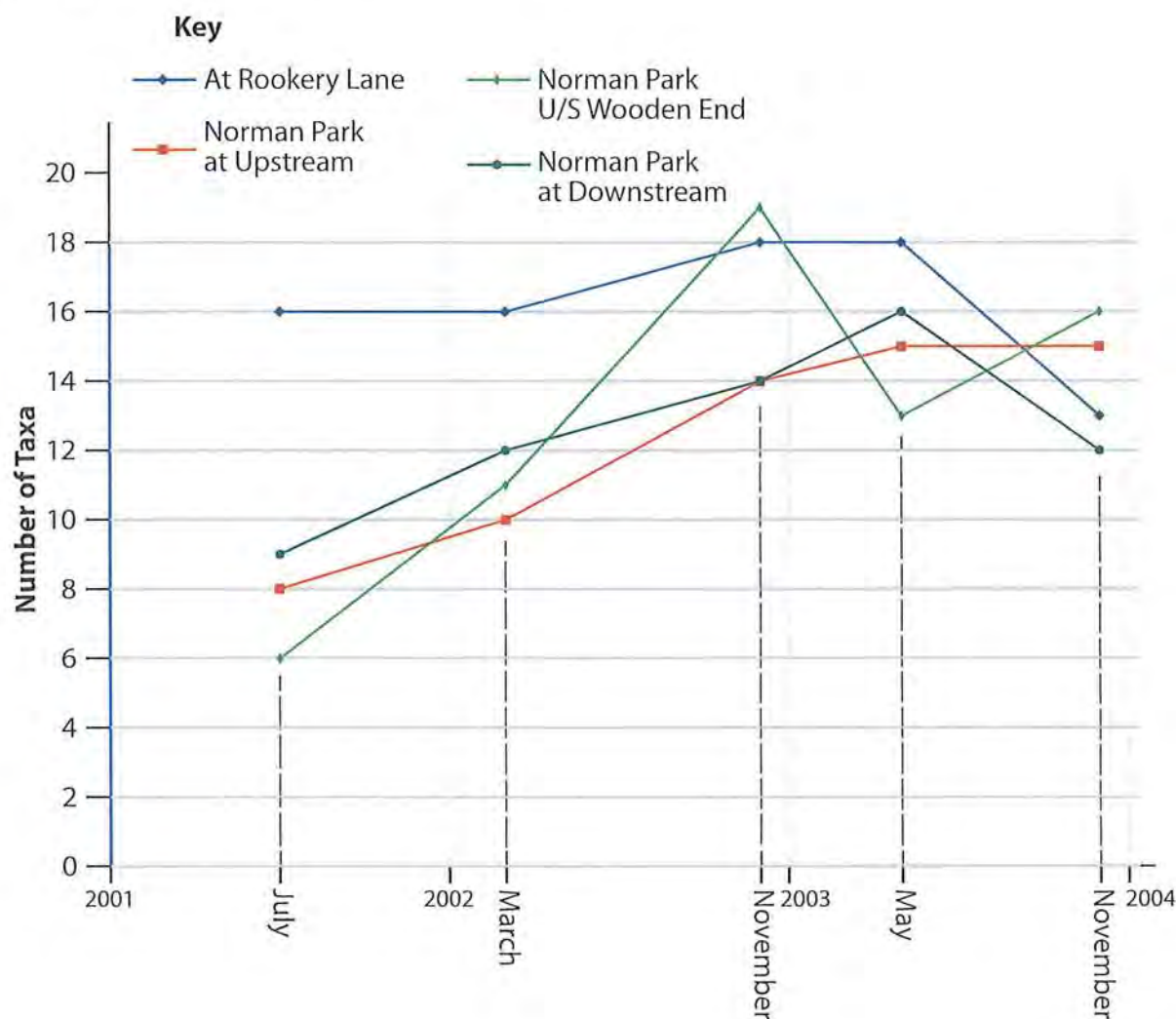


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Restoring Meanders to Straightened Rivers

1

Macroinvertebrate sampling was undertaken between 2001 and 2003 and this showed an increase in the number of taxa recorded following the works. Further sampling is planned for 2013 in order to compile a more complete dataset.



Changes in the number of invertebrates between 2001 and 2003.

By 2003 numbers for the control site (Rookery Lane) and the restored sites were similar demonstrating ecological improvement in the de-culverted stretch of the river.
(River Ravensbourne, EA data)

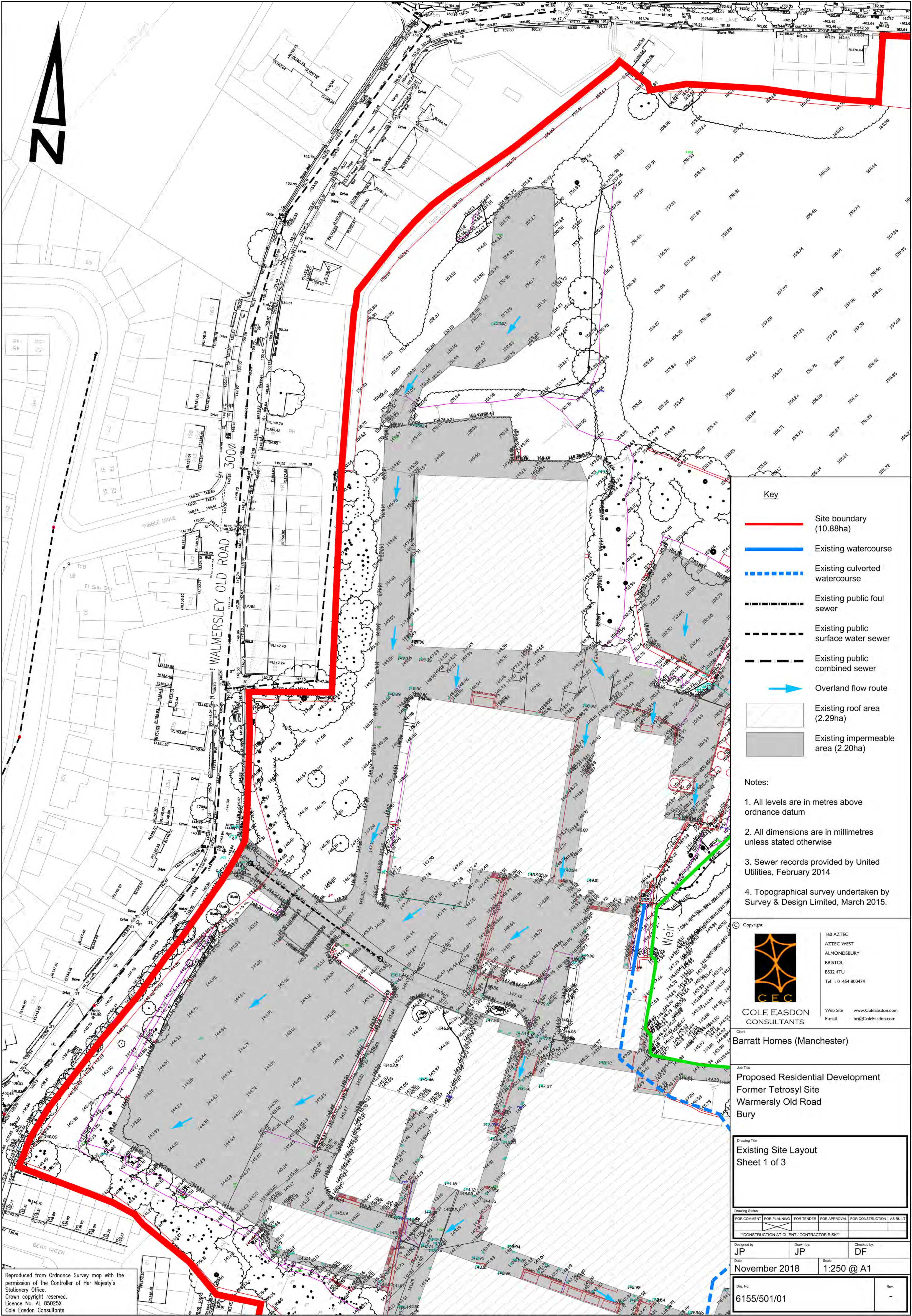
Contacts

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Lizzie McClintock, Environment Agency (South East)
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Appendix 7



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Key

- Site boundary (10.88ha)
- Existing watercourse
- Existing culverted watercourse
- Existing public foul sewer
- Existing public surface water sewer
- Existing public combined sewer
- Overland flow route
- Existing roof area (2.29ha)
- Existing impermeable area (2.20ha)

Notes:

- All levels are in metres above ordnance datum
- All dimensions are in millimetres unless stated otherwise
- Sewer records provided by United Utilities, February 2014
- Topographical survey undertaken by Survey & Design Limited, March 2015.

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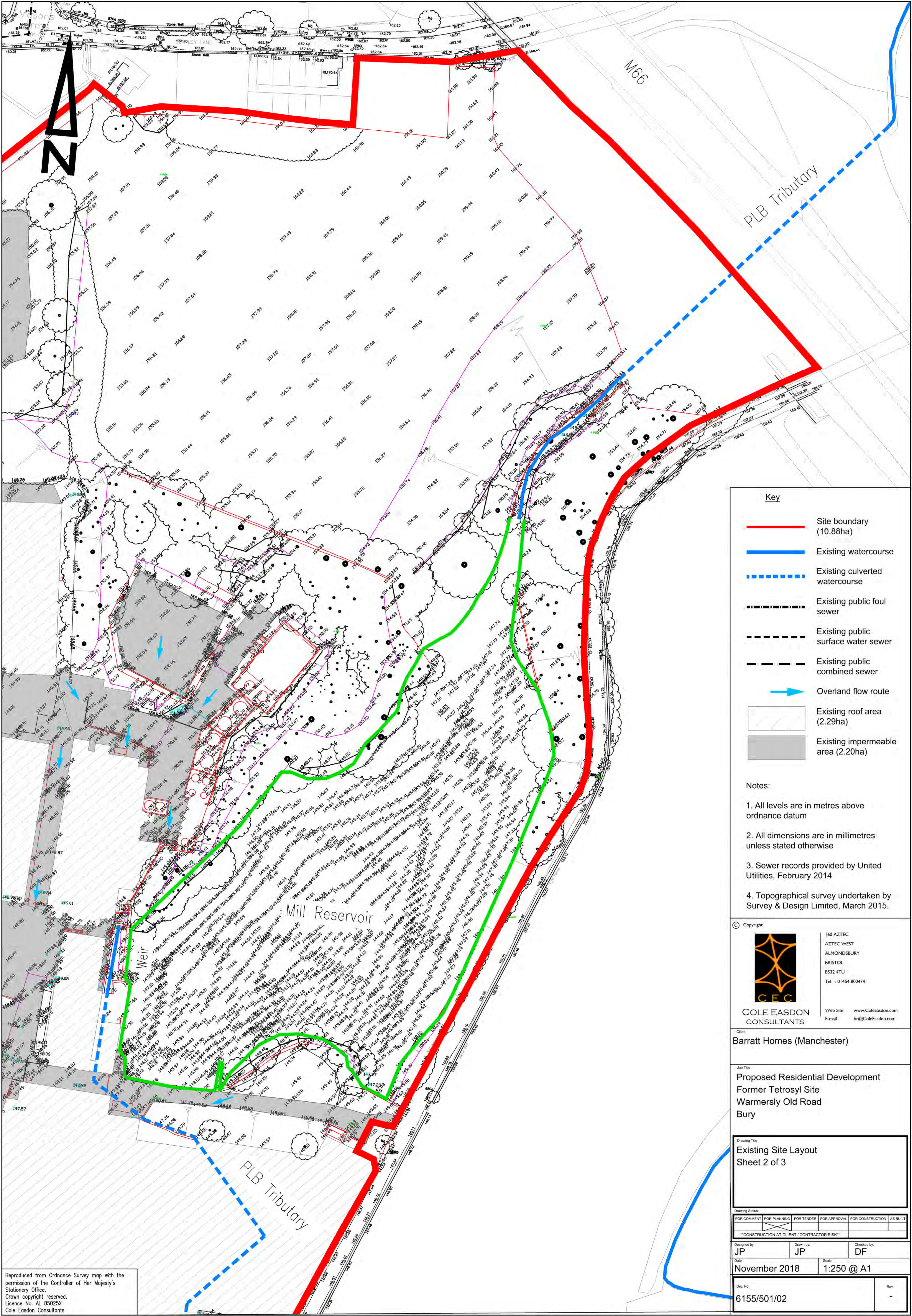
Web Site : www.ColeEasdon.com
E-mail : br@ColeEasdon.com

Barratt Homes (Manchester)

Proposed Residential Development
Former Tetrosyl Site
Walmersley Old Road
Bury

Existing Site Layout
Sheet 1 of 3

FOR COMMENT	FOR TENDER	FOR APPROVAL	FOR CONSTRUCTION	AS BUILT
CONSTRUCTION AT CLIENT / CONTRACTOR RISK				
Designed by: JP	Drawn by: JP	Checked by: DF		
Date: November 2018	Scale: 1:250 @ A1			
Dwg. No. 6155/501/01	Rev. -			



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Client

Barratt Homes (Manchester)

Job Title

**Proposed Residential Development
Former Tetrosyl Site
Warmersly Old Road
Bury**

Drawing Title

**Existing Site Layout
Sheet 2 of 3**

Drawing Status

FOR COMMENT	FOR TENDER	FOR APPROVAL	FOR CONSTRUCTION	AS BUILT
CONSTRUCTION AT CLIENT / CONTRACTOR RISK				

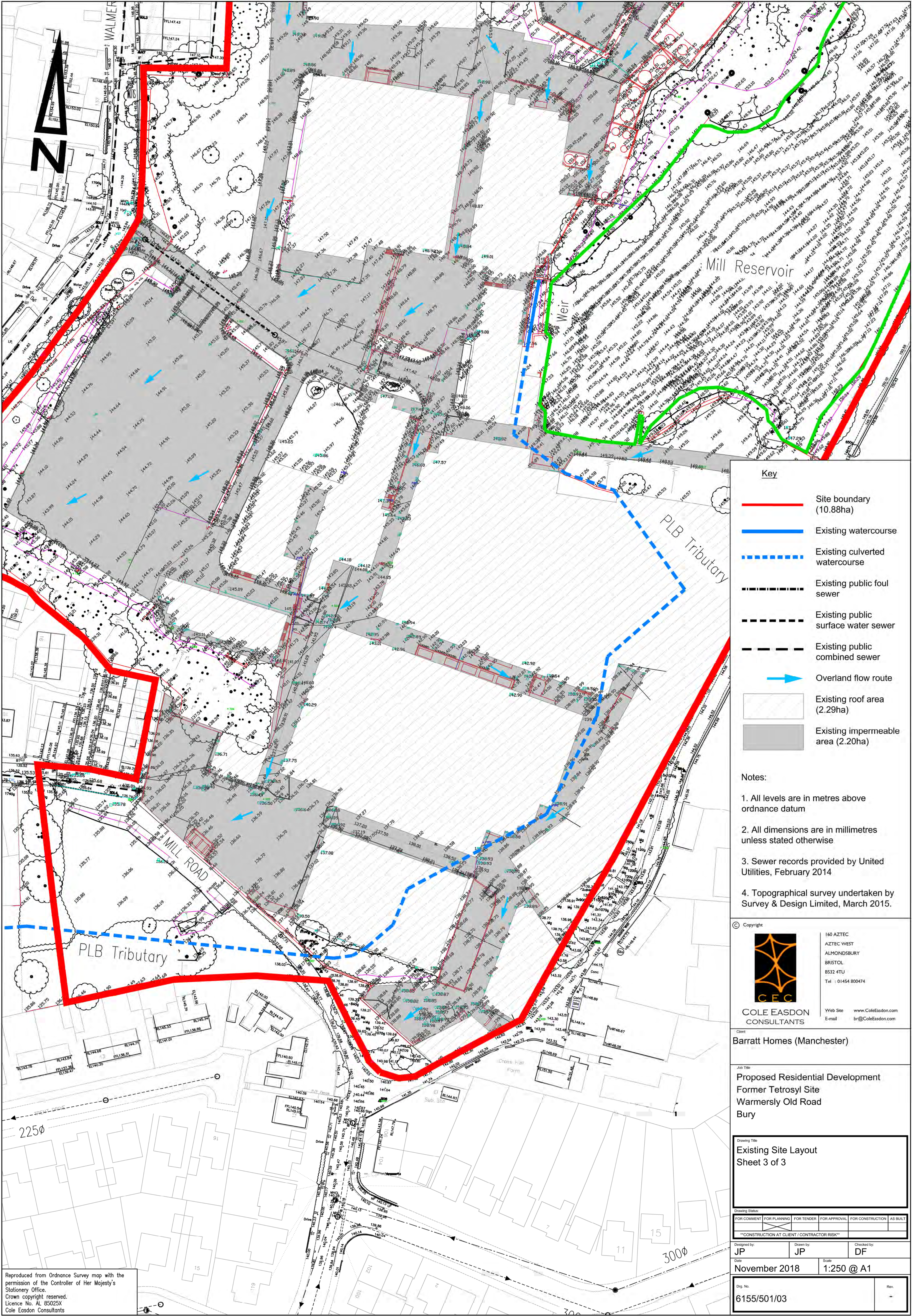
Designed by: JP
Date: November 2018

Drawn by: JP
Scale: 1:250 @ A1

Checked by: DF

Dwg. No. 6155/501/02

Rev. -



Key

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- Existing public foul sewer
- Existing public surface water sewer
- Existing public combined sewer
- Overland flow route
- Existing roof area (2.29ha)
- Existing impermeable area (2.20ha)

Notes:

- All levels are in metres above ordnance datum
- All dimensions are in millimetres unless stated otherwise
- Sewer records provided by United Utilities, February 2014
- Topographical survey undertaken by Survey & Design Limited, March 2015.

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Client
Barratt Homes (Manchester)

Job Title
Proposed Residential Development
Former Tetrosyl Site
Warmersly Old Road
Bury

Drawing Title
Existing Site Layout
Sheet 3 of 3

Drawing Status:

FOR COMMENT	FOR PLANNING	FOR TENDER	FOR APPROVAL	FOR CONSTRUCTION	AS BUILT

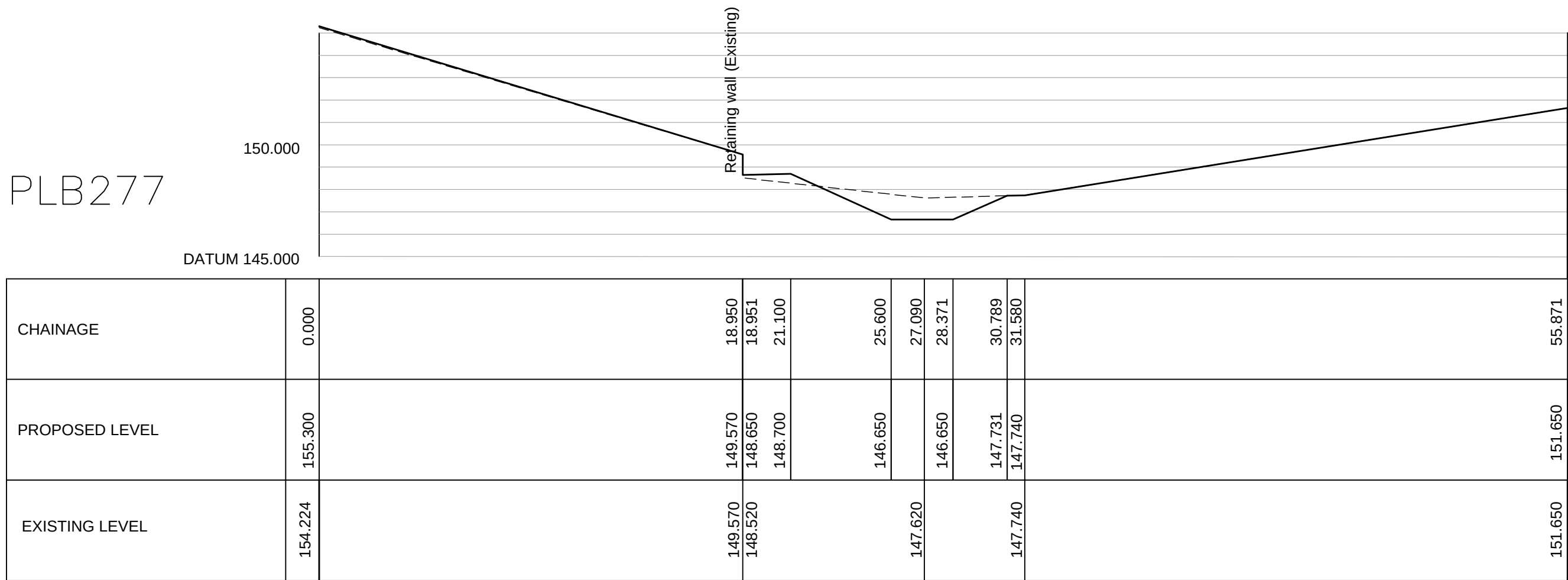
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Date: November 2018	Scale: 1:250 @ A1	

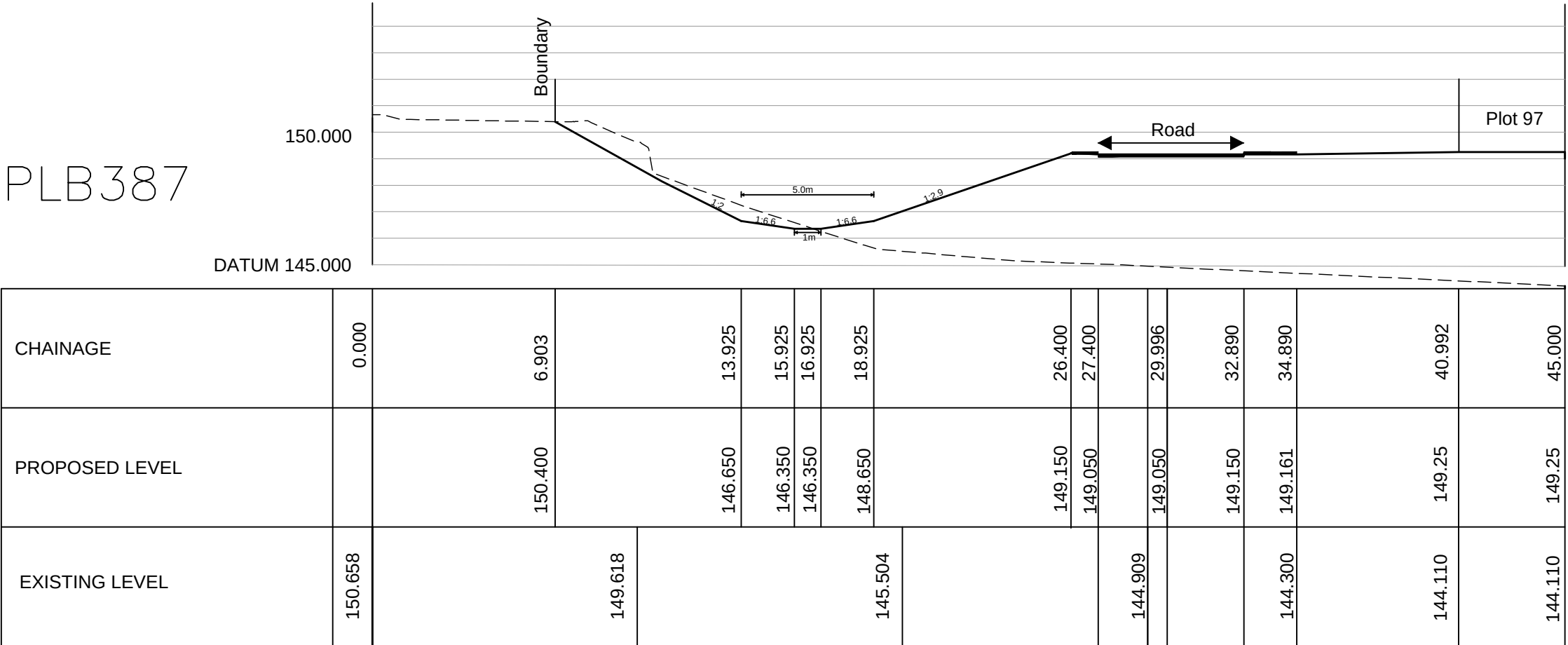
Dwg. No. 6155/501/03	Rev. -
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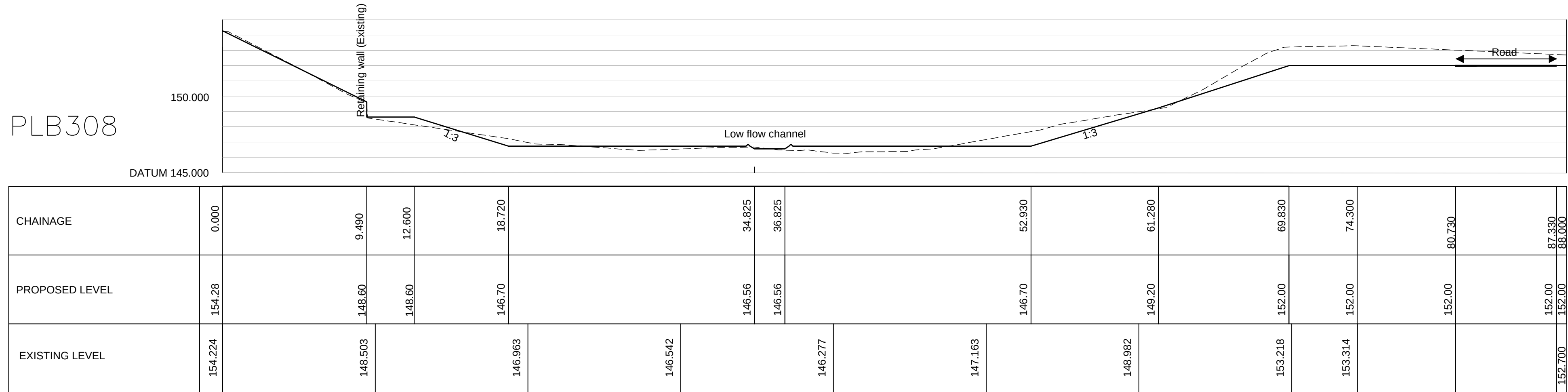
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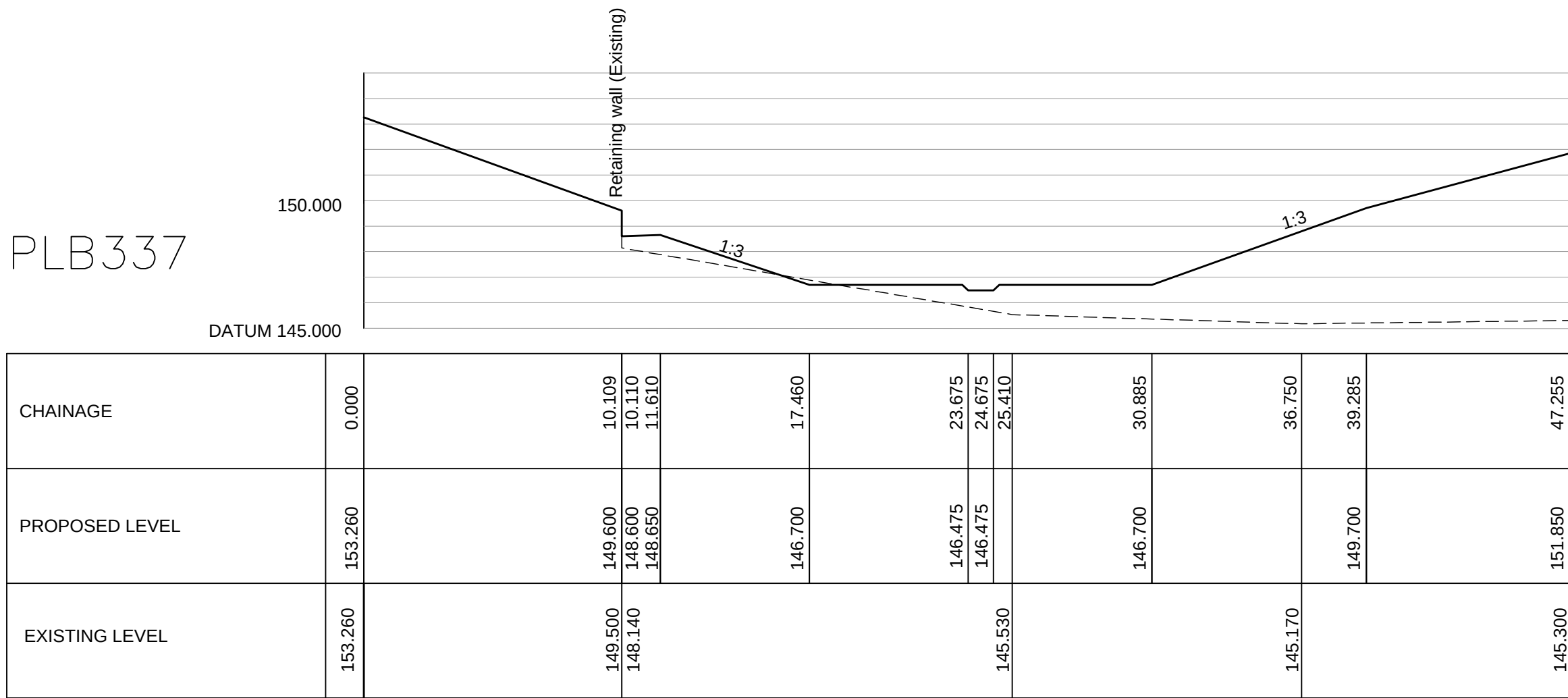
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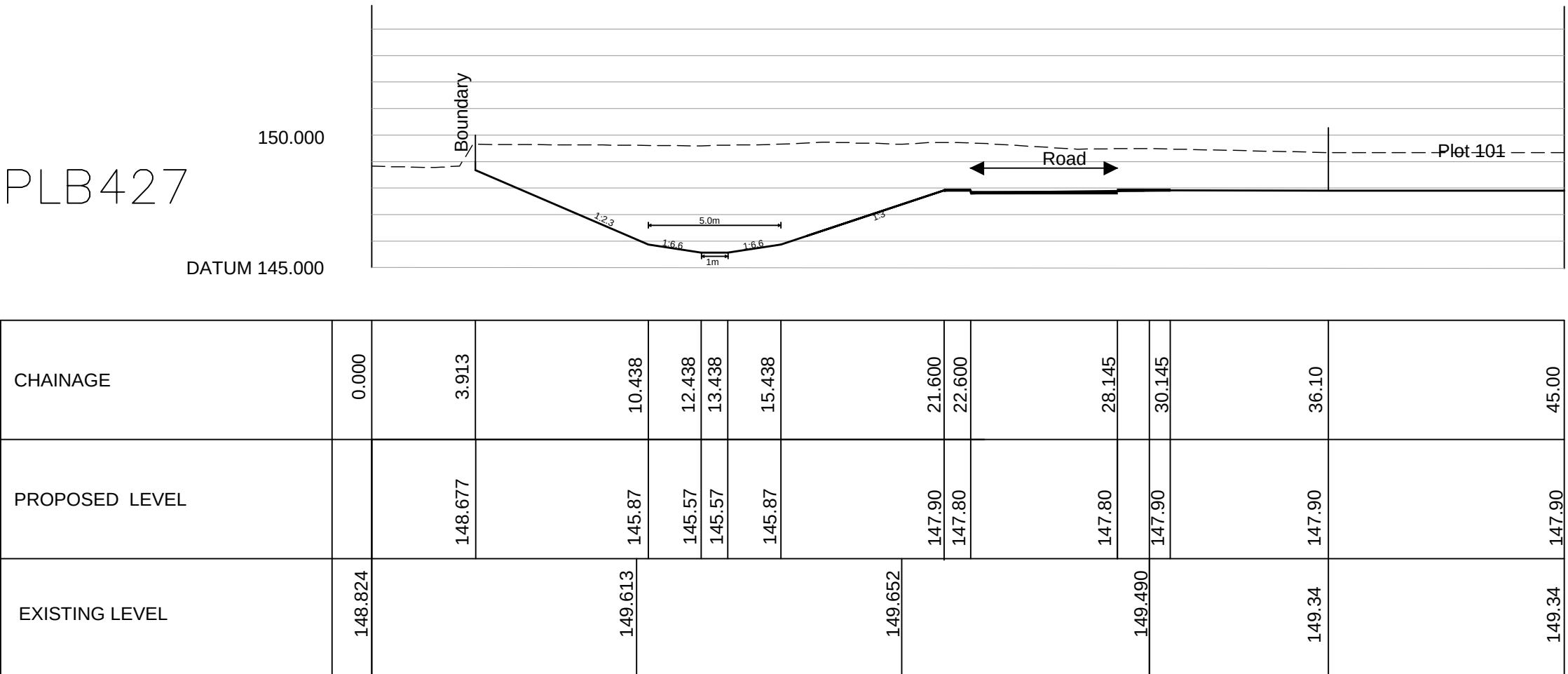
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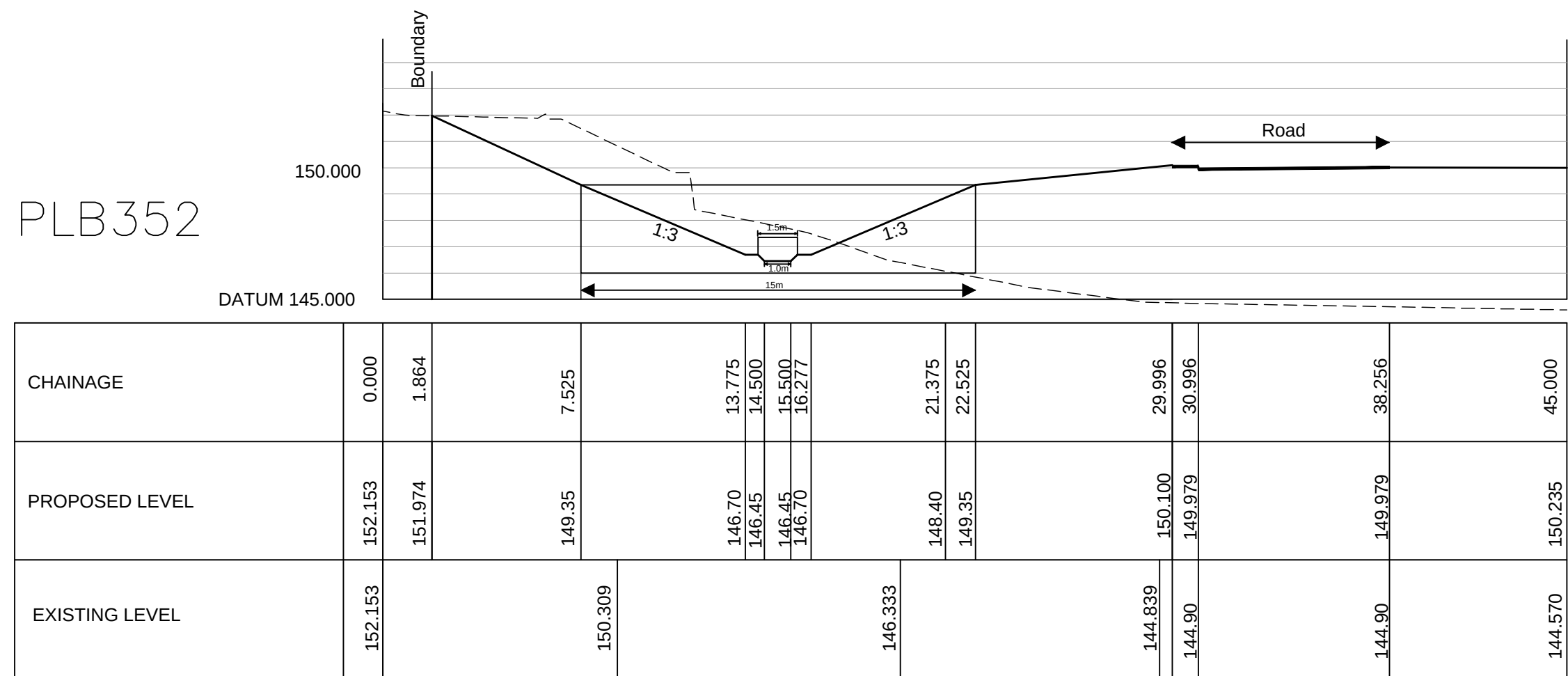
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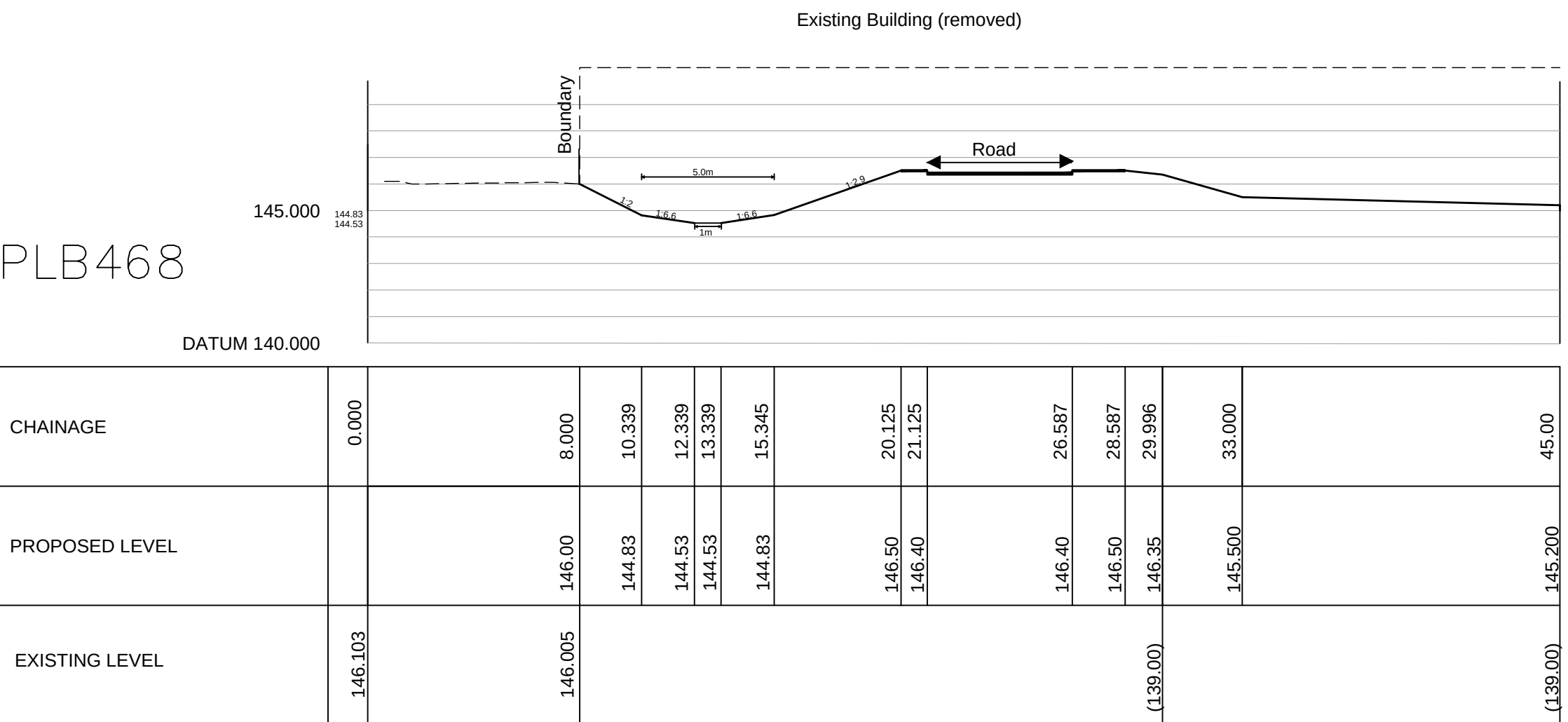
PLB427



PLB352



PLB468



Notes

1. All levels in meters above ordnance datum.
2. All sections are viewed downstream.
3. Refer to Drawing 6155/502 for section locations

Key

———— Proposed ground profile
----- Existing ground profile

Refer to sheet 2 for cross section location insert

D	NJ	02.02.21	PLB628 updated
C	NJ	15.12.20	Retaining Wall Added
B	NJ	09.10.20	Low flow channels added
A	SS	30.09.19	Existing ground profile added

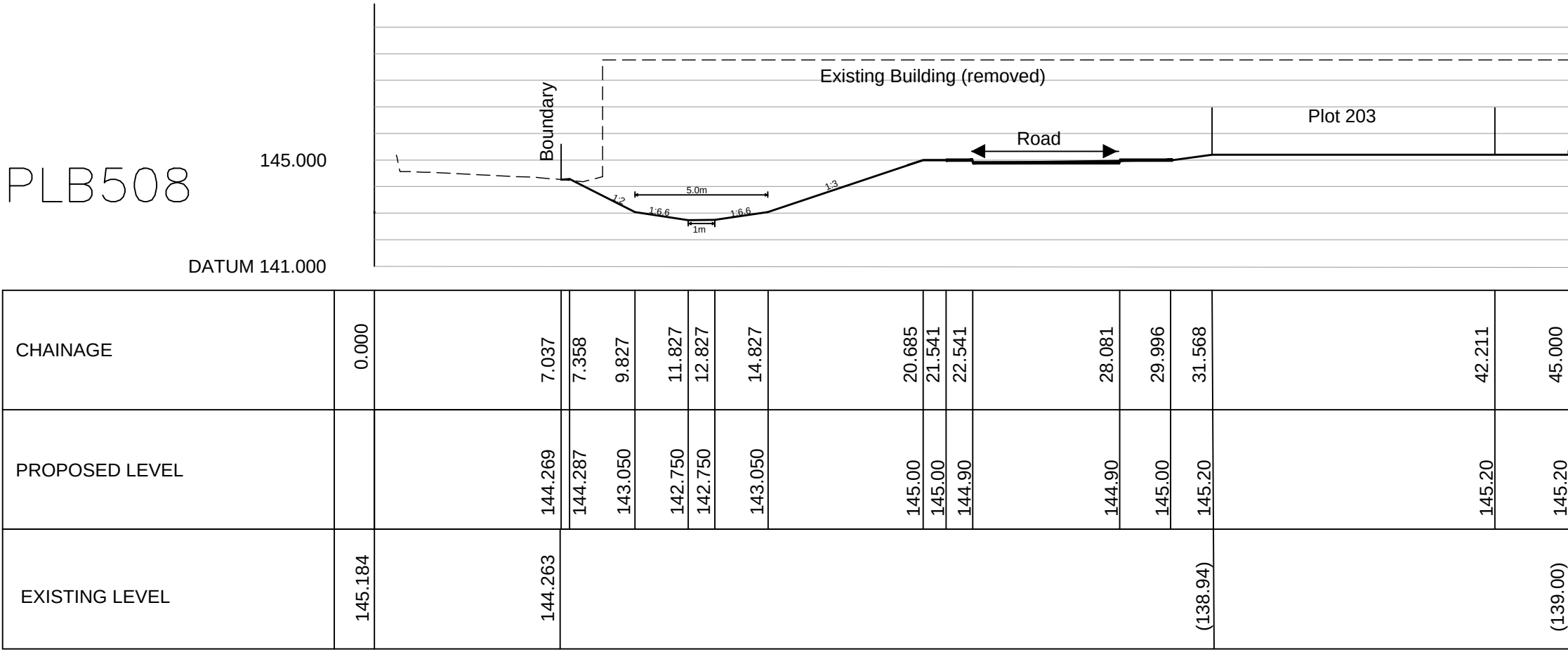
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Job Title
Proposed Development Tetrosyl Site Walmersley Old Road Bury

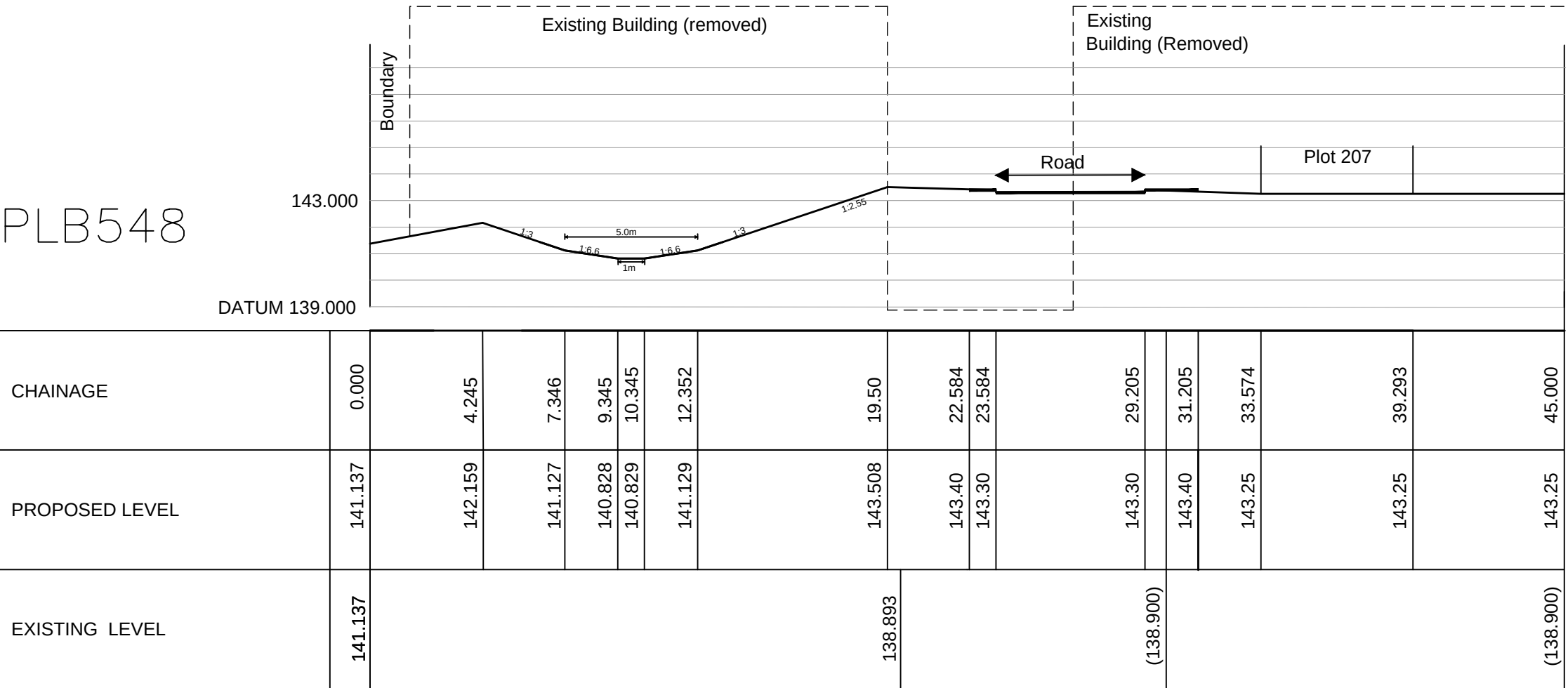
Drawing Title
Deculverted Watercourse Proposed Cross-sections Page 1 of 2
Drawing Status
FOR COMMENT FOR TENDER FOR APPROVAL FOR CONSTRUCTION AS BUILT ***CONSTRUCTION AT CLIENT / CONTRACTOR RISK***

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DF	ZB	DF
Date	Scale	
April 2019	1:200@A1	
Dwg. No.	Rev.	
6155/507/01	D	

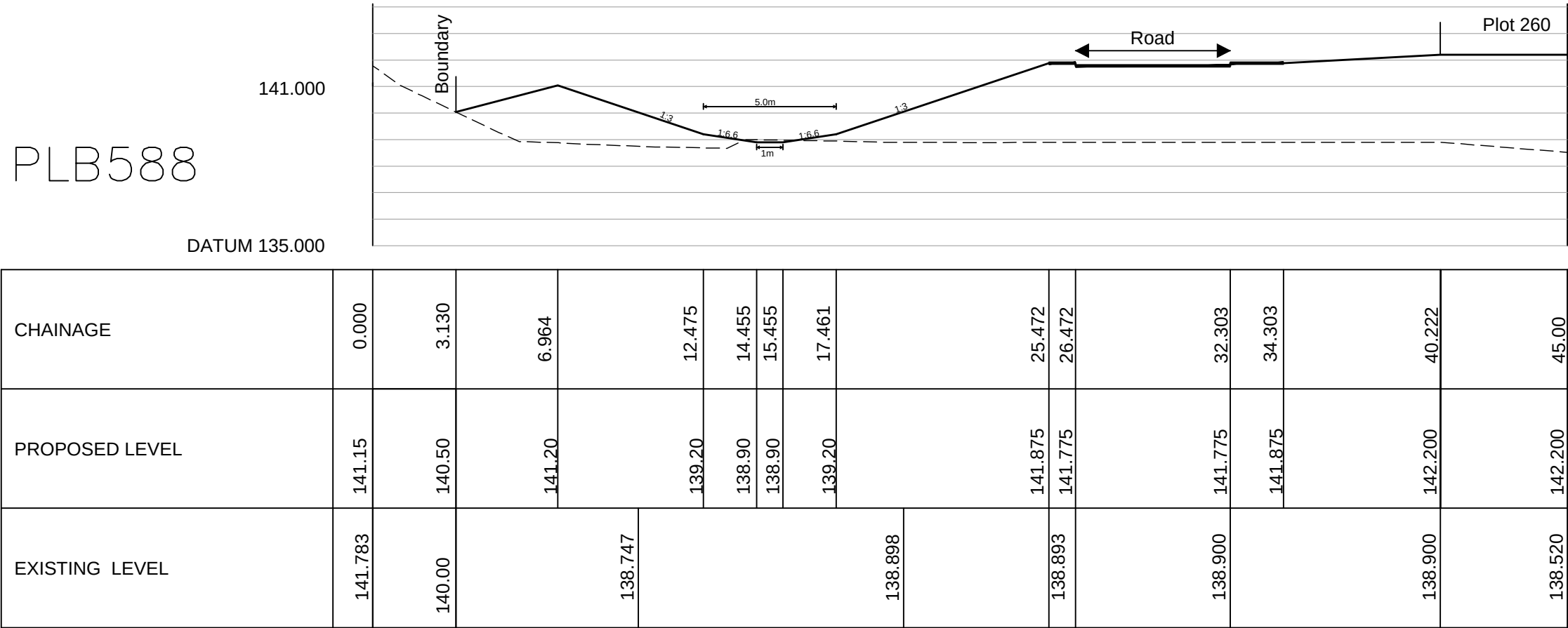
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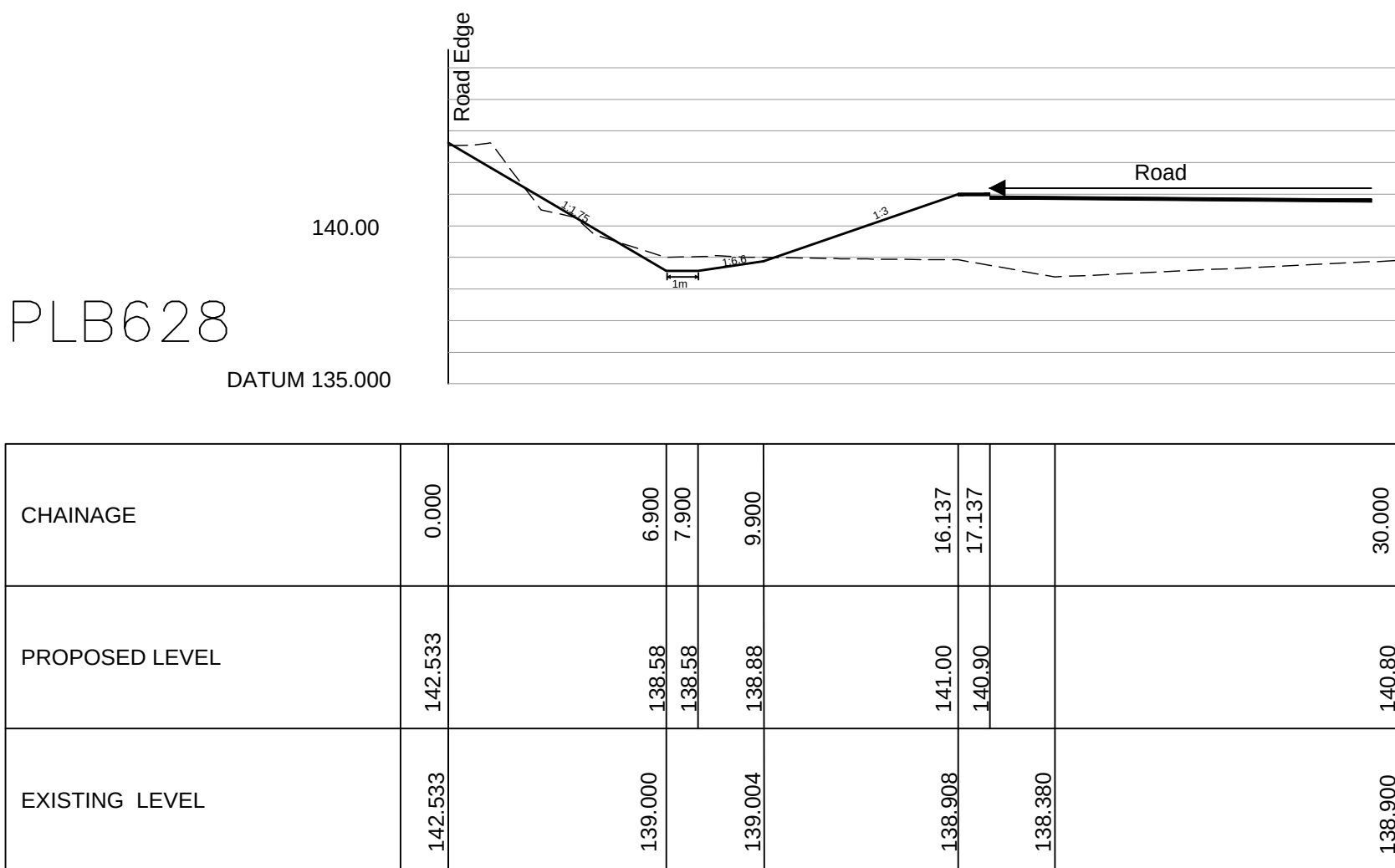
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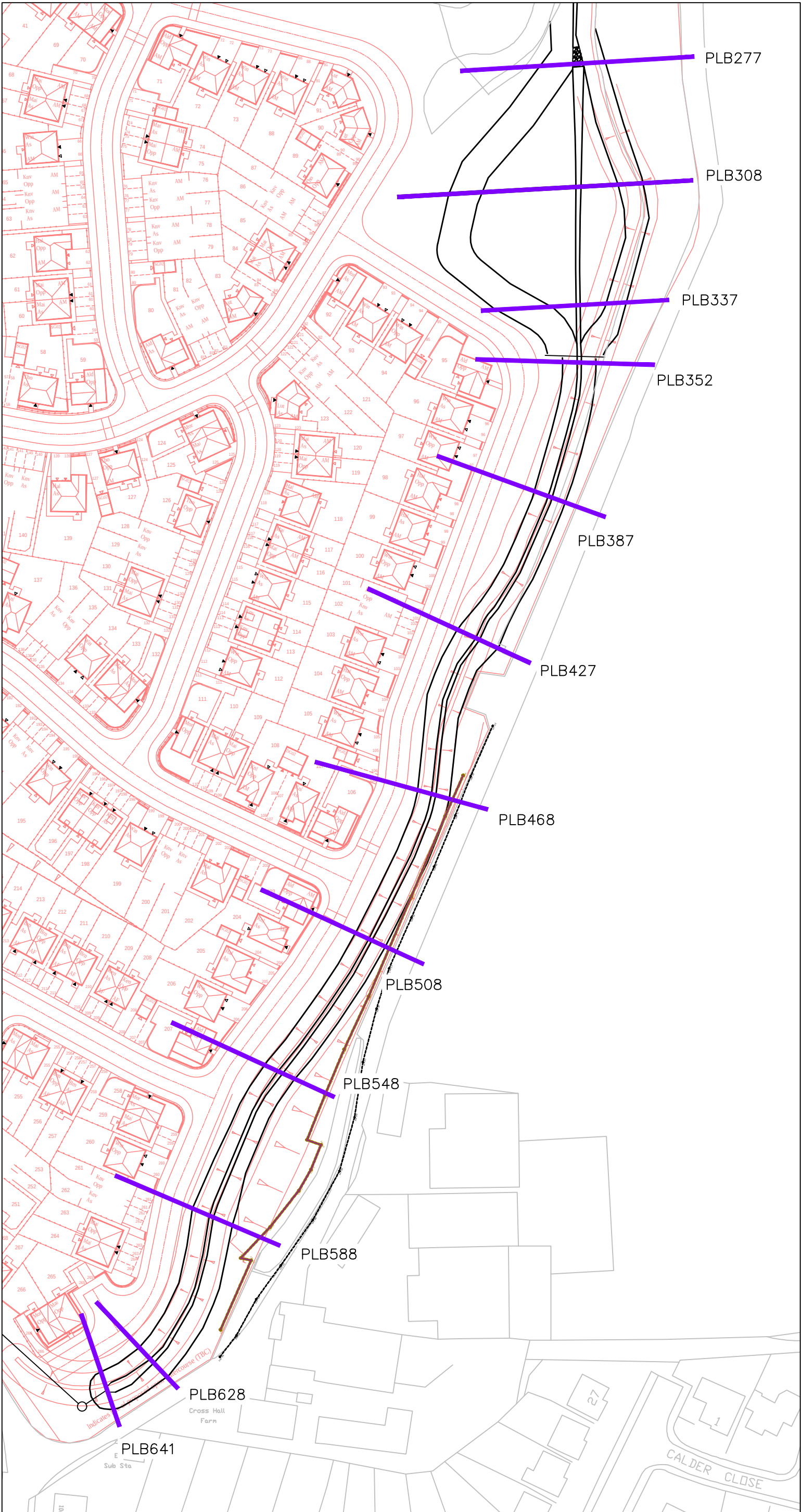
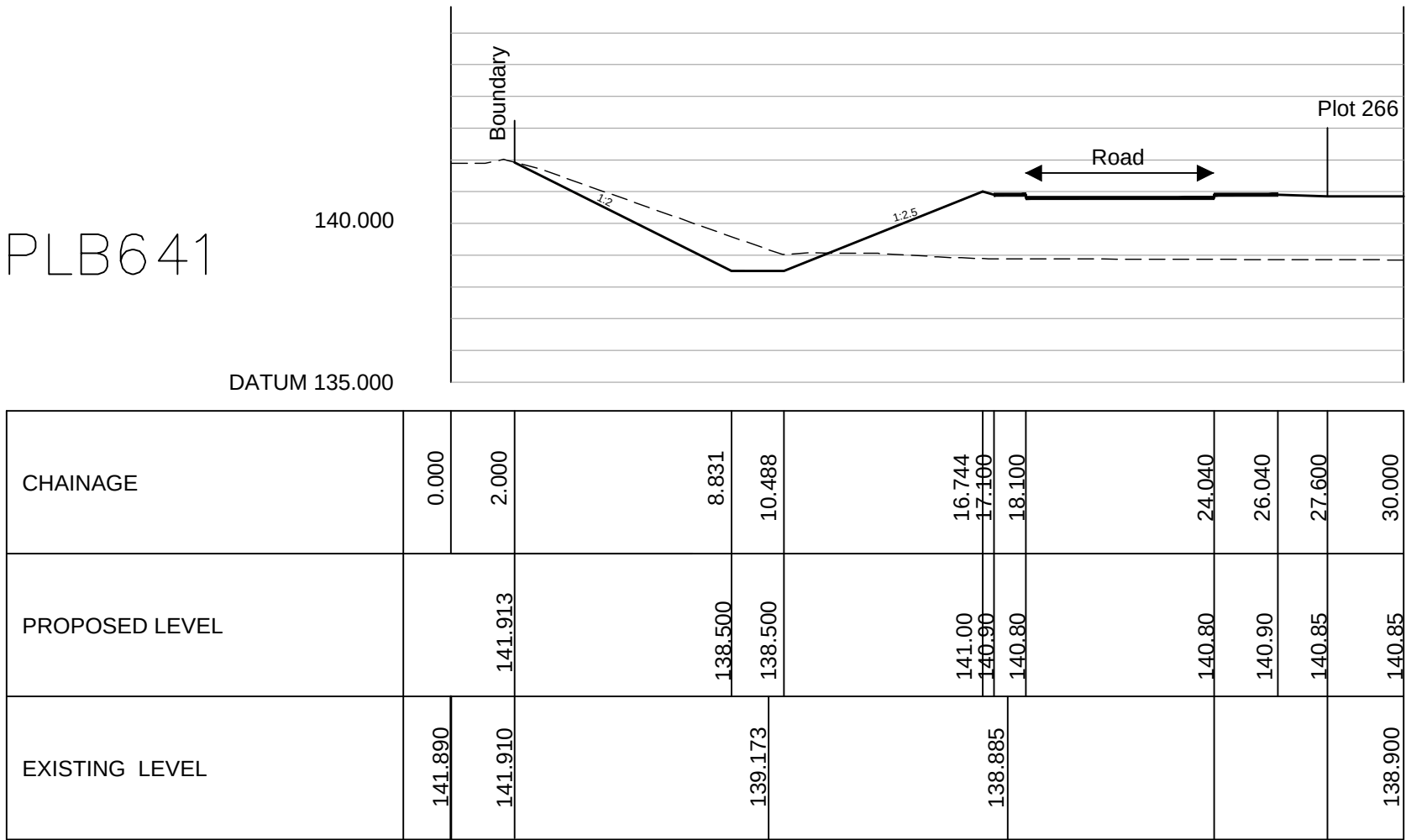
PLB588



PLB628



PLB641



Notes

1. All levels in meters above ordnance datum.
2. All sections are viewed downstream.
3. Refer to Drawing 6155/502 for section locations

Key

- Proposed ground profile
- - - Existing ground profile

Refer to sheet 2 for cross section location insert

D	NJ	02.02.21	PLB628 updated
C	NJ	15.12.20	Retaining Wall Added
B	NJ	09.10.20	Low flow channels added
A	SS	30.09.19	Existing ground profile added
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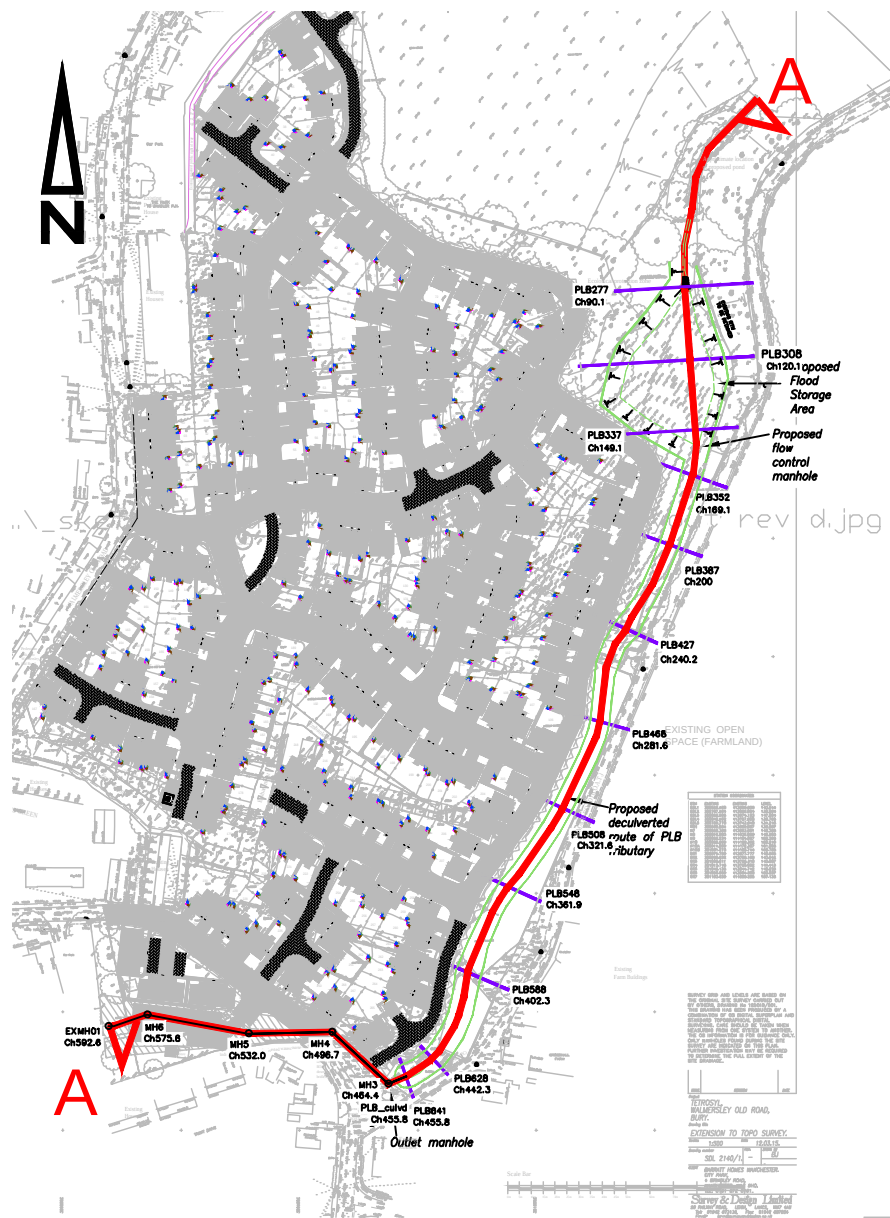
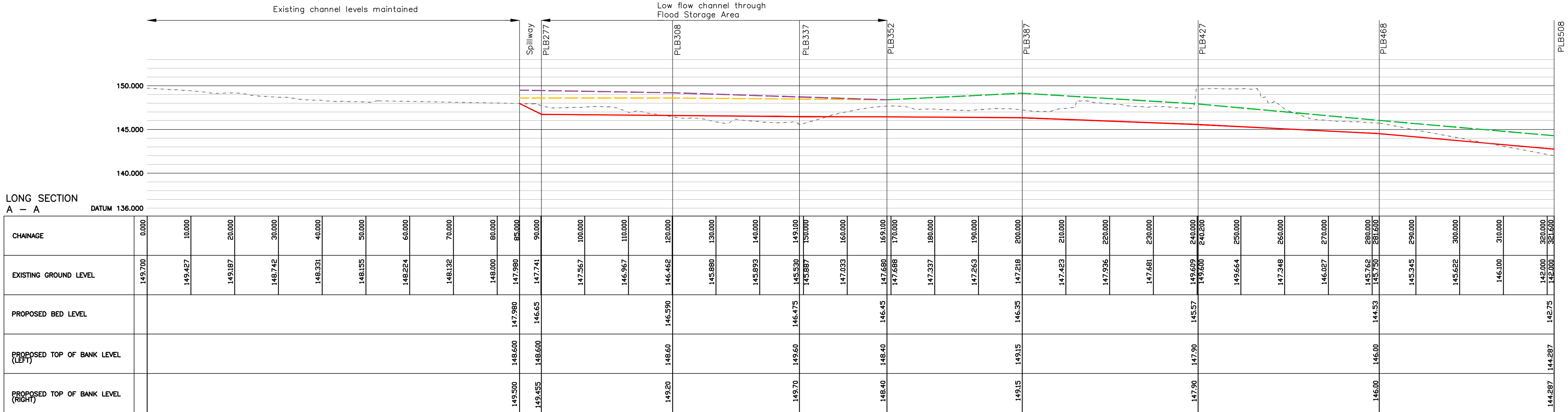
Job Title
Proposed Development
Tetrosyl Site
Walmersley Old Road
Bury

Drawing Title
Deculverted Watercourse
Proposed Cross-sections
Page 2 of 2

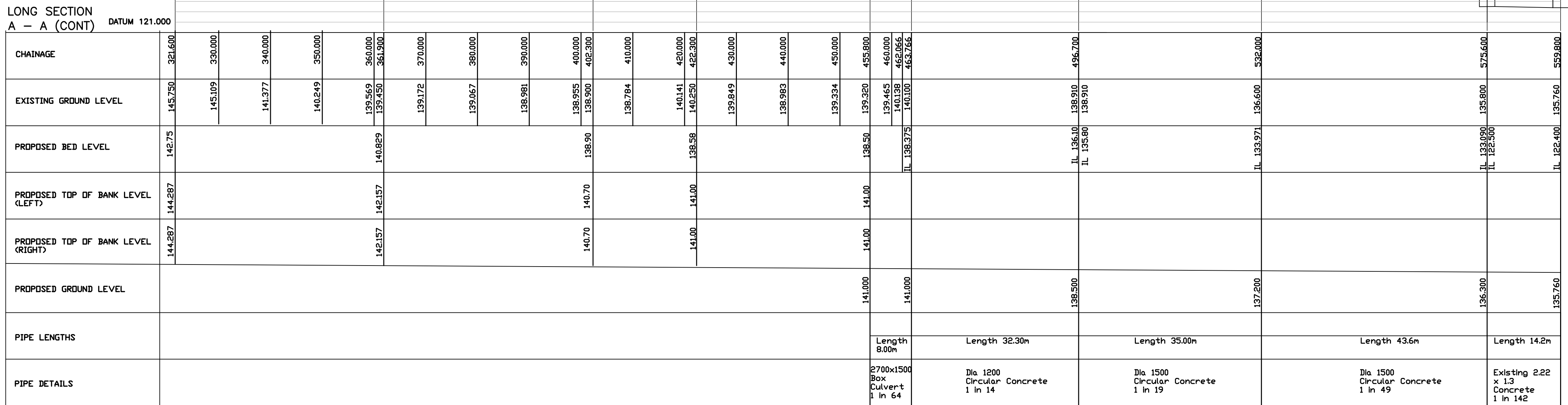
Drawing Status:
FOR COMMENT FOR PLANNING FOR TENDER FOR APPROVAL FOR CONSTRUCTION AS BUILT

Designated by: DF Date: April 2019 Drawn by: ZB Scale: 1:200@A1 Checked by: DF

Dwg. No.: 6155/507/02 Rev.: D



SECTION A - A LOCATION PLAN NTS



- KEY
- Existing ground profile
 - Proposed bed level
 - Proposed top of bank (left)
 - Proposed top of bank (right)
 - Proposed top of bank (left & right)
 - Proposed Ground Level
- NOTES
- All levels are in metres above Ordnance datum

B NJ 05.01.21 Long Section Updated

A SS 23.05.19 Pipe connection to existing culvert add

No. By Date Revision Details

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Client

Barratt Homes (Manchester)

Job Title

Proposed Residential Development
Former Tetrosyl Site
Walmersley Old Road
Bury

Drawing Title

Long Section Through Proposed
Flood Storage Area & Proposed
Watercourse Diversion

Drawing Status:

FOR COMMENT	FOR PLANNING	FOR TENDER	FOR APPROVAL	FOR CONSTRUCTION	AS BUILT

CONSTRUCTION AT CLIENT / CONTRACTOR RISK

Designed by: JP

Drawn by: SS

Checked by: DF

Date: May 2019

Scale: H:1:500, V:1:250

Dwg. No.: 6155/508

Rev.: B



Key	
—	Site boundary (10.88ha)
—	Existing watercourse
- - - -	Existing culverted watercourse
- - - -	Existing public foul sewer
- - - -	Existing public surface water sewer
- - - -	Existing public combined sewer
—	Proposed open watercourse
- - - -	Proposed surface water pipeline
- - - -	Existing reservoir to be removed
+148.20	Existing Level
+FL.149.20	Finished Level

- Notes:
1. All levels are in metres above ordnance datum
 2. All dimensions are in millimetres unless stated otherwise
 3. Sewer records provided by United Utilities, February 2014
 4. Topographical survey undertaken by Survey & Design Limited, March 2015.
 5. Proposed layout provided by Barratt Homes Manchester. Drawing Ref 456-P-PL02 Rev B
 6. Refer to the following drawings:
6155 - 508 - Watercourse Long Section
6155 - 507 - Watercourse Diversion Cross Sections

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Web Site www.ColeEasdon.com Email cec@ColeEasdon.com	
Client Barratt Homes (Manchester)	
Drawing Title Proposed Residential Development Former Tetrosyl Site Walmersey Old Road Bury	
Drawing Title Proposed Watercourse Diversion	
Drawing Date	
FOR COMMENT FOR PLANNING FOR TENDER FOR APPROVAL FOR CONSTRUCTION FOR BUILD	
"CONSTRUCTION AT CLIENT / CONTRACTOR RISK"	
Drawn by JP	Checked by JP
Drawn by DF	Checked by DF
Date November 2018	Scale 1:500@A0
Doc No 6155/510	Rev A

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Appendix 8



Coppull hedge mix
89nr Acer campestre 60-80cm
179nr Corylus avellana B 40-60cm
893nr Crataegus monogyna 60-80cm
89nr Ilex aquifolium 2L 60-80cm
179nr Prunus spinosa 60-80cm
89nr Rosa canina 60-80cm
89nr Sambucus nigra 60-80cm
89nr Viburnum opulus 60-80cm

Coppull native mix
127nr Acer campestre 60-80cm
130nr Alnus glutinosa 60-80cm
63nr Betula pubescens 60-80cm
127nr Corylus avellana B 40-60cm
127nr Prunus spinosa 60-80cm
63nr Quercus robur 60-80cm
127nr Salix caprea 60-80cm
127nr Salix fragilis 60-80cm
127nr Sorbus aucuparia 60-80cm
130nr Viburnum opulus 60-80cm

sketch layout\456 p sk100 sketch layout rev d.jpg

Low Planting Mix
136nr Corylus avellana B
883nr Hedera helix 2L
690nr Ruscus aculeatus 3L

Coppull native mix
61nr Acer campestre 60-80cm
91nr Alnus glutinosa 60-80cm
30nr Betula pubescens 60-80cm
61nr Corylus avellana B 40-60cm
61nr Prunus spinosa 60-80cm
30nr Quercus robur 60-80cm
61nr Salix caprea 60-80cm
61nr Salix fragilis 60-80cm
61nr Sorbus aucuparia 60-80cm
91nr Viburnum opulus 60-80cm

Full Planting Schedule

Shrub									
Name	Abb	Height	Form	Girth	Root	Chr	Cbs	Qty	
Corylus avellana	Cos ave	40-60cm			B		0.330	170	
Corylus avellana	Cos ave	40-60cm			B		1.500	389	
Corylus avellana	Cos ave	40-60cm			B		1.800	138	
Hedera helix	Hed hel	40-60cm			C	2L	1.000	883	
Ilex aquifolium	Iax	60-80cm			C	2L	0.330	89	
Prunus spinosa	Prun sp	60-80cm			B		0.330	170	
Prunus spinosa	Prun sp	60-80cm			B		1.500	188	
Rosa canina	Ros ca	60-80cm			B		0.330	89	
Ruscus aculeatus	Rus acu	20-30cm			C	2L	0.800	690	
Sambucus nigra	Smb ng	60-80cm			B		0.330	89	
Viburnum opulus	Vi op	60-80cm			B		0.330	89	
Viburnum opulus	Vi op	60-80cm			B		1.500	289	
								3080	
Tree									
Name	Abb	Height	Form	Girth	Root	Chr	Cbs	Qty	
Acer campestre	Ace cam	60-80cm	Whp		B		0.330	89	
Acer campestre	Ace cam	60-80cm	Whp		B		1.500	188	
Alnus glutinosa	Aln gl	60-80cm			B		1.500	289	
Betula pubescens	Be pb	60-80cm	Transplant - seed		B		1.500	93	
Crataegus monogyna	Crta m	60-80cm	Seedling		B		0.330	893	
Quercus robur	Qr ro	60-80cm	Transplant - seed		B		1.500	93	
Salix caprea	Sk cap	60-80cm	Seedling		B		1.500	188	
Salix fragilis	Sk fr	60-80cm	Transplant - seedling		B		1.500	188	
Sorbus aucuparia	Sor auc	60-80cm	Transplant - seed		B		1.500	127	
Sorbus aucuparia	Sor auc	60-80cm	Transplant - seed		B		1.500	61	
								2203	
								5281	

- Proposed native hedge planting in double-staggered rows, including 50mm depth no-fines bark mulch, tubular guards and stakes. Finished level to be 10mm below adjacent paving/hard (250mm length).
- Areas to be seeded with amenity grade seed mix, or existing grassed areas, mow good (500m²).
- Areas to be seeded with species-rich grass seed mix, such as Emongate Mix EMB, or similar and approved (4930m²).
- Areas to be seeded with species-rich wetland grass seed mix, such as Emongate Mix EGB (5530m²).
- Existing native planting, to be retained and enhanced in any gaps greater than 2m width.
- Areas of native woodland groundcover planting 1m centres on embankment (4220m²).
- Proposed new native buffer planting at 1.5m centres, including tubular guards and stakes (4220m²).
- Areas of existing unimproved grassland, to be retained.

Client
Barratt Homes Manchester/David Wilson Homes

Project
Former Tetrosyl Site, Walmersley

Drawing title
Outline Landscape Masterplan

Scale
1:500 @ A0

Drawn by
PDP

Date
Sept 2015

Drawing No.
c-1339-01 Revision B

Appendix 9

NOTE TO FILE

JBA Project Code	2020s0819
Contract	Bevis Green
Client	Barratt Homes
Day, Date and Time	27/11/2020
Author	Emma Wright
Reviewer / Sign-off	Matt Hemsworth
Subject	Technical Note

1 Introduction

JBA Consulting was commissioned by Barrett Homes in 2020 to undertake a hydromorphology assessment and conceptual design for the watercourse at the Former Tetrosyle site, Bevis Green, Bury.

1.1 Purpose and scope of study

1.2 Study area

Figure 1-1 displays the site location and the catchment area of the watercourse, which is unnamed and is a tributary of Pigs Lee Brook. The watercourse rises on the southern edge of Harden Moor near Nangreaves and flows primarily south towards the site. The outflow from the reservoir is controlled by a weir in which the channel is culverted and then flows into open channel before discharging into Pigs Lee Brook.



Figure 1-1: Site Location

NOTE TO FILE

JBA Project Code	2020s0819
Contract	Bevis Green
Client	Barratt Homes
Day, Date and Time	27/11/2020
Author	Emma Wright
Reviewer / Sign-off	Matt Hemsworth
Subject	Technical Note

2 Desk Based Assessment

2.1 Overview

A desk-based assessment has been undertaken for the catchment of the watercourse. This incorporates nearby main rivers and aims to provide understanding on catchment controls that influence hydromorphology on a local scale. The assessment has utilised available information including historic maps, aerial imagery, and LiDAR data.

2.2 Geology and land use

According to the British Geological Survey (BGS) mapping the watercourse and its upstream catchment is underlain by sandstone and are overlain by till superficial deposits, which are glaciogenic in origin.

The land surrounding to the south-west of the site is heavily urban with residential and commercial buildings. The land use to the north and within the watercourse's catchment is rural with localised areas of small woodland and agricultural land.

2.3 Flow regime

There are no flow gauges present on the watercourse, the closest gauge available is located approximately 3.0km downstream on the River Irwell. The difference in catchment characteristics, namely size, mean the flow gauge (69044 – Irwell at Bury ground) cannot be used to inform the flow regime of the unnamed watercourse.

The watercourse is not gauged; however, in the upper catchment it is characterised with steep topography, which is likely to produce rapid delivery of storm runoff to the watercourse. The urbanised nature of the catchment around the site will further contribute to this. During heavy rainfall events there is the potential for energy to be concentrated over a relatively short time frame, leading to elevated erosion rates in certain reaches.

2.4 Water Framework Directive Status and Water Quality

The unnamed watercourse falls within The Irwell (Rossendale STW to Roch) (ID GB112069064620) which is located within the Croal Irwell Operational Catchment. The waterbody is designated as 'heavily modified'. In the 2016 Cycle 2 assessment, the waterbody was classified as Moderate. There are several reasons why the waterbody is not achieving 'Good' status including both diffuse and point source pollution impacting upon phosphate in the watercourse and local ecology (macrophytes and phytobenthos (combined) and invertebrates).

2.5 Flood Risk

Figure 2-1 displays the Environment Agency Flood Zone Mapping across the site, illustrating that the site is located within Flood Zone 1. Downstream of the site where the watercourse converges with the River Irwell is in Flood Zone 3 which follows the route of the existing watercourse. To the north of the site the Cheesden Brook is within Flood Zone 2 and 3 which follows the route of the watercourse except to the north of the site the is flooding of the floodplain, however, this does not impact upon the unnamed watercourse of the site.

NOTE TO FILE

JBA Project Code 2020s0819
Contract Bevis Green
Client Barratt Homes
Day, Date and Time 27/11/2020
Author Emma Wright
Reviewer / Sign-off Matt Hemsworth
Subject Technical Note

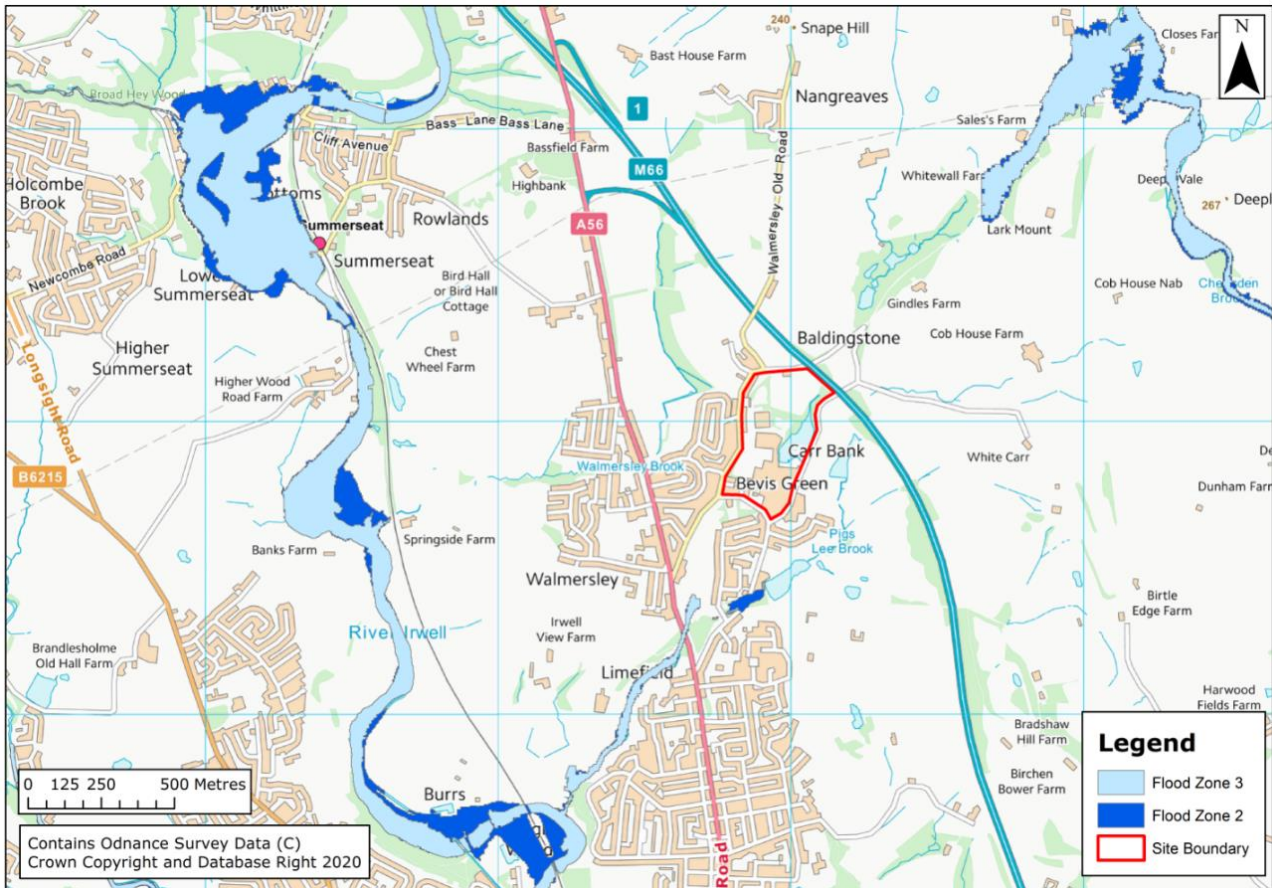


Figure 2-1: Current Flood Risk

2.6 Historic Trend Analysis

A desk-based review of historic maps has been undertaken to develop a historic chronology of the watercourse in response to channel modification over time. This information informs the current state of the channel through the identification of current and historic pressures influencing the watercourse. The assessment can therefore be utilised to predict how the riverine system will potentially develop under different scenarios in the future.

By reviewing the historic Ordnance Survey mapping it is apparent that the watercourse has been altered over time. The first mapping available from 1800, shows the reservoir and several weirs on the watercourse. It is thought the reservoir was originally constructed to supply water to the cotton mill.

Prior to the construction of the M66 the watercourse displayed some sinuosity upstream of the reservoir. The motorway in Bury was constructed between 1973 to 1978, during which the watercourse was straightened. The downstream extent of the watercourse connecting to Pig Lees Brook is entirely culverted, the exact date of which the culverting took place is unknown due to unclear mapping. Upstream of the site the watercourse was modified between 1930 and 1955 with the installation of three ponds controlled by weirs to maintain the water depth. These weirs are still present today.

NOTE TO FILE

JBA Project Code 2020s0819
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 Author Emma Wright
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3 Walkover Assessment

3.1 Introduction

A walkover assessment was completed on the 15th July 2020 by Rebecca Thrower (geomorphologist) and Emma Wright (geomorphologist) of the watercourse through the site and upstream of the site boundary. The purpose of surveying the watercourse upstream of the site was to identify analogue reaches to gain an understanding of the geomorphic conditions of the river when not confined to culverts.

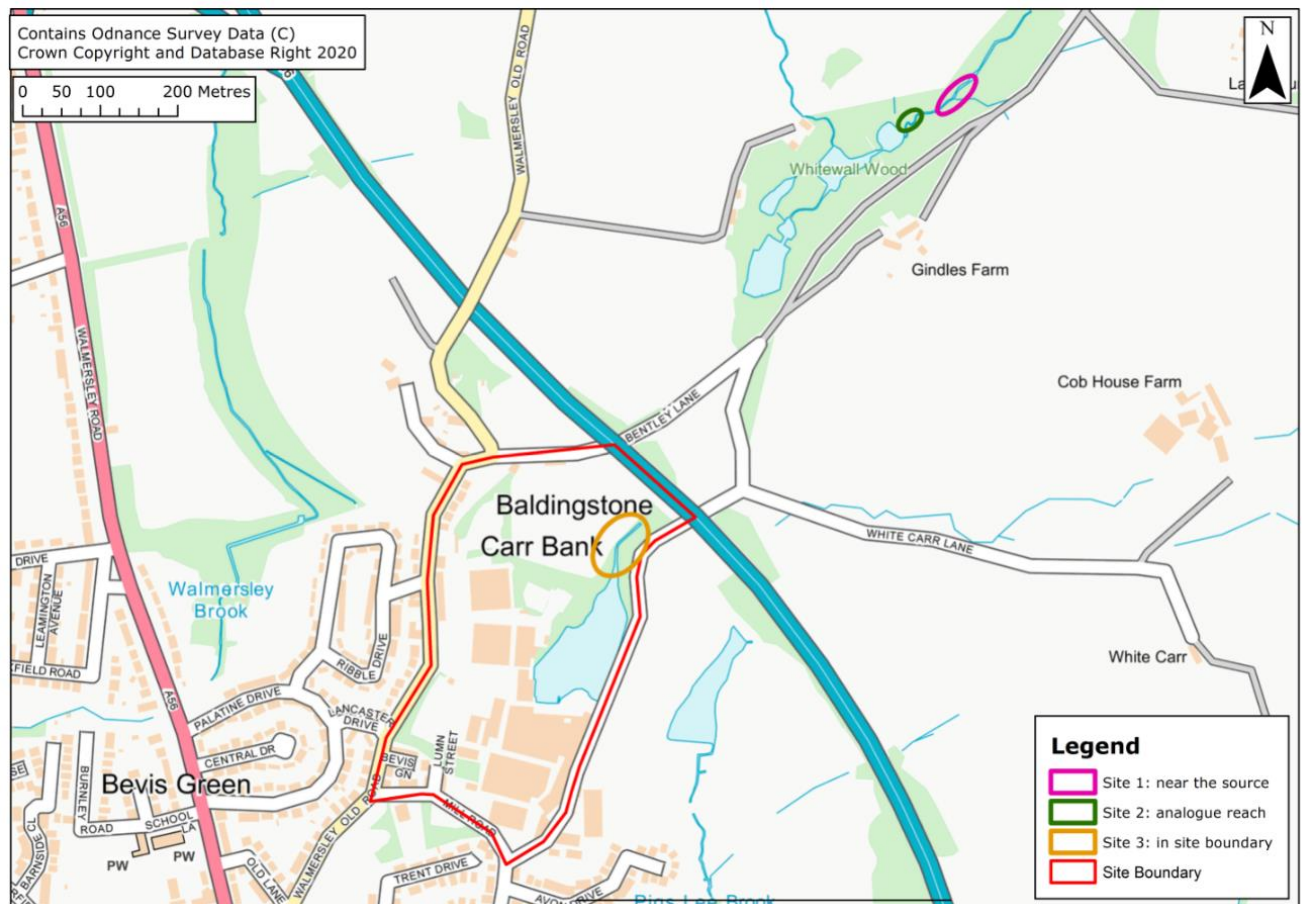


Figure 3-1: Survey Locations

NOTE TO FILE

JBA Project Code	2020s0819
Contract	Bevis Green
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Author	Emma Wright
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3.1.1 Upstream of the site: near the source

Upstream of the site (approximately 0.6km) the watercourse is a single thread river that flows through an alluvial channel. At this point in the catchment the watercourse is confined to a steep valley and displays both boulder cascade and cobble step pool morphologies (Figure 3-2). The channel is very narrow, approximately 0.5m wide, and steep with coarse bed material (gravels, cobbles, boulders) indicating an active supply of sediment to the reach. Some bank erosion was evident immediately downstream of the confluence between the two watercourses, where the channel gradient reduces and sediment has been deposited (Figure 3-4). The river is confined by the steep valley and therefore limited floodplain is evident; however, downstream the valley floor widens and this creates some floodplain. The confinement of the valley and lack of floodplain for flows to spill onto concentrates energy in channel and increases the size of the material that can be transported.

The riparian zone consists of a broadleaf woodland providing a large supply woody debris and leaf litter into the channel (Figure 3-4).



Figure 3-2: Upstream steep morphology

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Client	Barratt Homes
Day, Date and Time	27/11/2020
Author	Emma Wright
Reviewer / Sign-off	Matt Hemsworth
Subject	Technical Note

This reach could be used to define characteristics of the new channel if the gradient is to be of similar steepness. Figure 3-3 depicts the long section throughout the site but specifically the step-pool sequences that occur within the steeper gradient. This can be used as an analogue to determine the in-channel features within an area of steeper gradient.

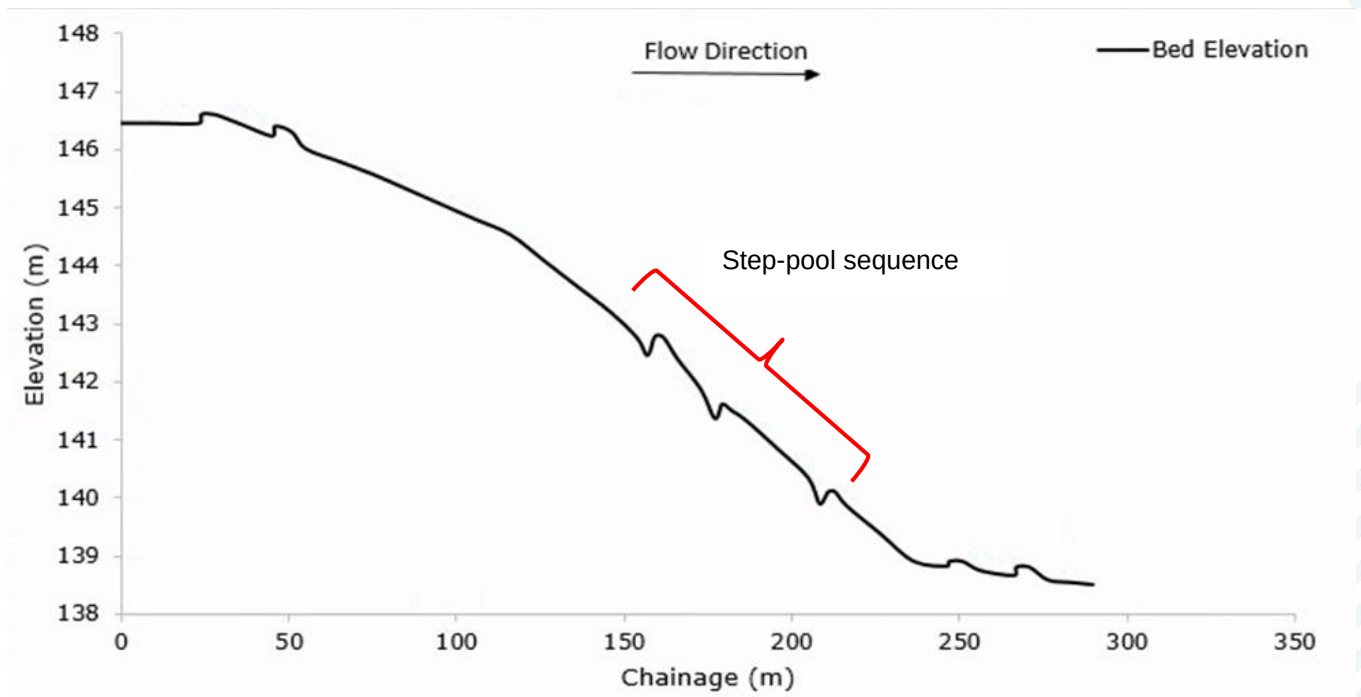


Figure 3-3: Long section to demonstrate the step-pool (step-pool) sequence

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Client	Barratt Homes
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Subject	Technical Note



Figure 3-4: Large woody debris supplied into the channel with bank erosion

3.1.2 Upstream of site: Reduced channel gradient

This reach displayed a distinct change in the morphology from the previous reach due to a notable change in gradient and slight widening of the valley floor. The reduced gradient has allowed for a meandering pool riffle morphology. In-channel velocities have reduced as a result of a shallower gradient and enabled greater sediment deposition. Smaller sized coarse sediment is seen throughout with the presence of fine gravels and small cobbles. Small gravels and cobbles are stored in short exposed gravel bars on alternative sides of the channel. These features are typically 0.5m wide and range in length from 1m to 8m. Immediately downstream of the bars, riffles have formed over the submerged part of the bar. Riffles are associated with shallower water depths, locally steeper gradient and increased in-channel velocities due to increased turbulence. These contrast to the deeper areas of channel that are characterised by slower moving pools, which during low flow conditions are typically low energy areas of the channel. Within this reach the river is well connected to its floodplain with shallow bank gradients and heights, which were typically 0.3-0.5m above bed level and at the time of the walkover 0.2-0.25m above the water level (Table 3-2).

Figure 3-5 shows a basic site sketch with the key hydromorphic processes of the reach illustrated. It was determined that this reach and the upstream reach would be used as analogue sites to inform the key hydromorphic features within the new channel construction at the site, therefore incorporating both the higher and lower gradient channel morphologies.

NOTE TO FILE

JBA Project Code 2020s0819
 Contract Bevis Green
 Client Barratt Homes
 Day, Date and Time 27/11/2020
 Author Emma Wright
 Reviewer / Sign-off Matt Hemsworth
 Subject Technical Note

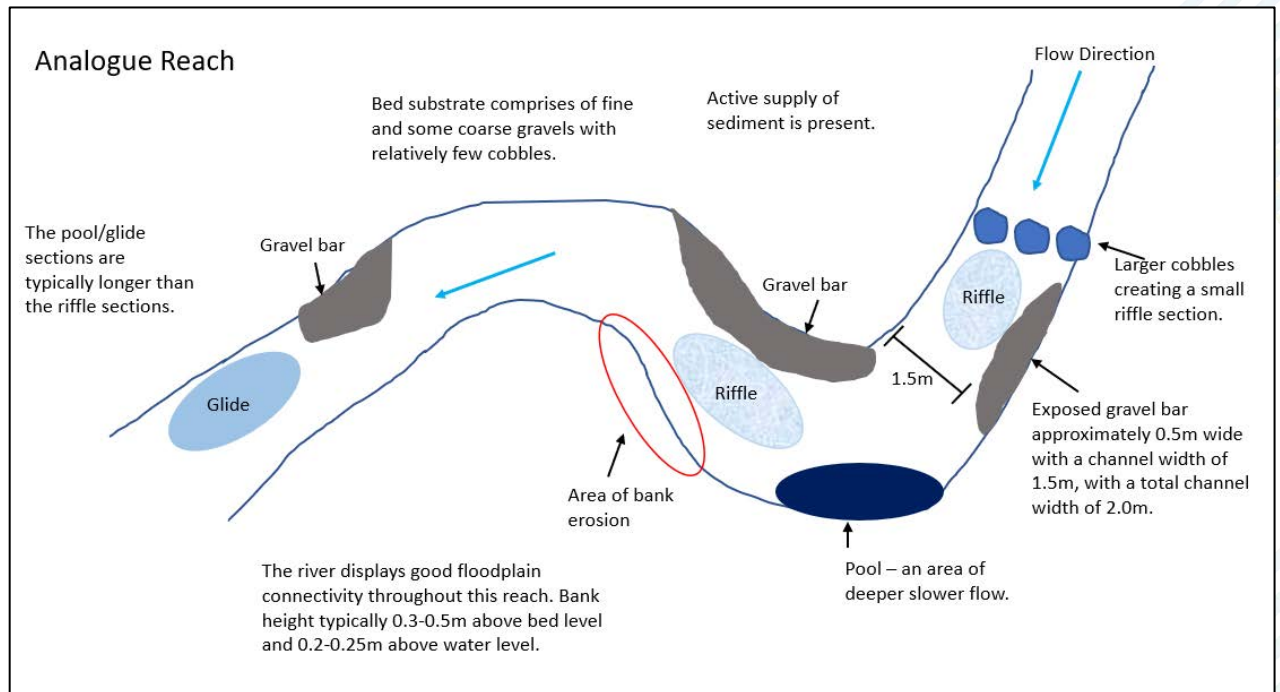


Figure 3-5: Site sketch of the reach to be used as the analogue reach (for lower gradient reaches)

Table 3-1 shows the approximate channel widths, widths and lengths of bar features estimated from the analogue reach, based upon site photographs from Table 3-2 below.

Site Photo	Channel Width (m)	Channel Width (m)	Bar width (m)	Bar length (m)	Riffle length (m)	Bank height from bed (cm)	Height of Bar feature	Connected to floodplain
1	2	0.5	1.5	5	2	0.4	0.2	Yes, particularly on the left-hand bank
2	1	0.5	0.5	1.5	1.5	0.4	0.2	Yes
3	3	0.5	2.5	8	2	0.5	0.3	Yes
4	1	0.5	0.5	1	-	0.7	0.3	No
5	2	0.5	1.5	2	0.75	0.5	0.2	Yes

NOTE TO FILE

JBA Project Code 2020s0819
 Contract Bevis Green
 Client Barratt Homes
 Day, Date and Time 27/11/2020
 Author Emma Wright
 Reviewer / Sign-off Matt Hemsworth
 Subject Technical Note

Table 3-2: Site photographs to be used as an analogue reach (for the lower gradient reaches)

Photograph 1



Photograph 2



Photograph 3



Photograph 4



NOTE TO FILE

JBA Project Code	2020s0819
Contract	Bevis Green
Client	Barratt Homes
Day, Date and Time	27/11/2020
Author	Emma Wright
Reviewer / Sign-off	Matt Hemsworth
Subject	Technical Note

Photograph 5



3.2 Indicative bar features

A series of indicative cross sections were developed from using the channel measurements from the site visit. These sections provide a guide to the development of the cross sections.

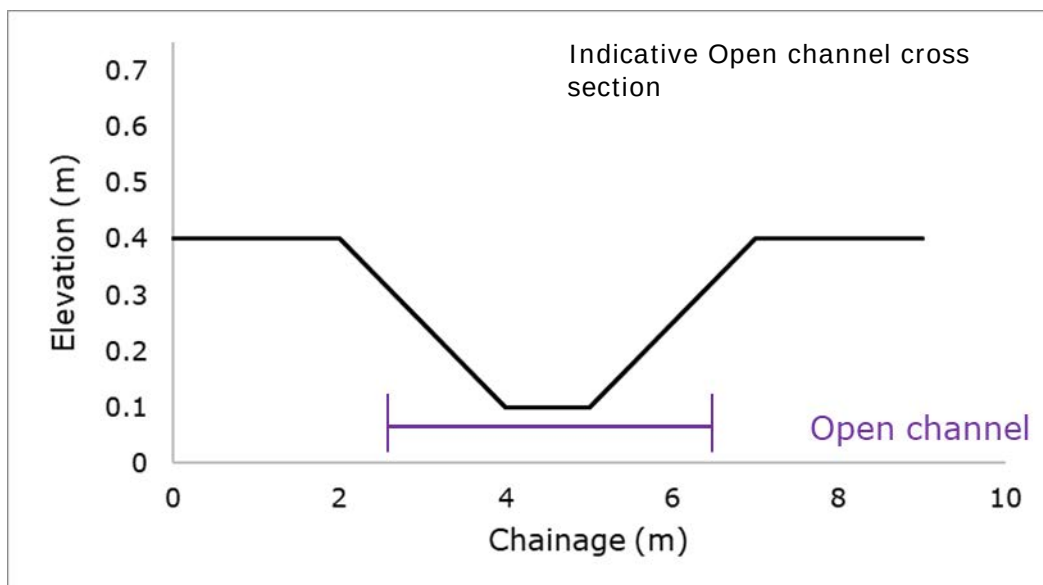


Figure 3-6: Indicative open channel section

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Table 3-3: Indicative open channel section			
Open channel - Option 1		Open channel - Option 2	
Chainage (m)	Elevation (m)	Chainage (m)	Elevation (m)
0	0.4	0	0.4
2	0.4	3	0.4
4	0.1	4.25	0.1
5	0.1	5	0.1
7	0.4	6.25	0.4
9	0.4	9.25	0.4

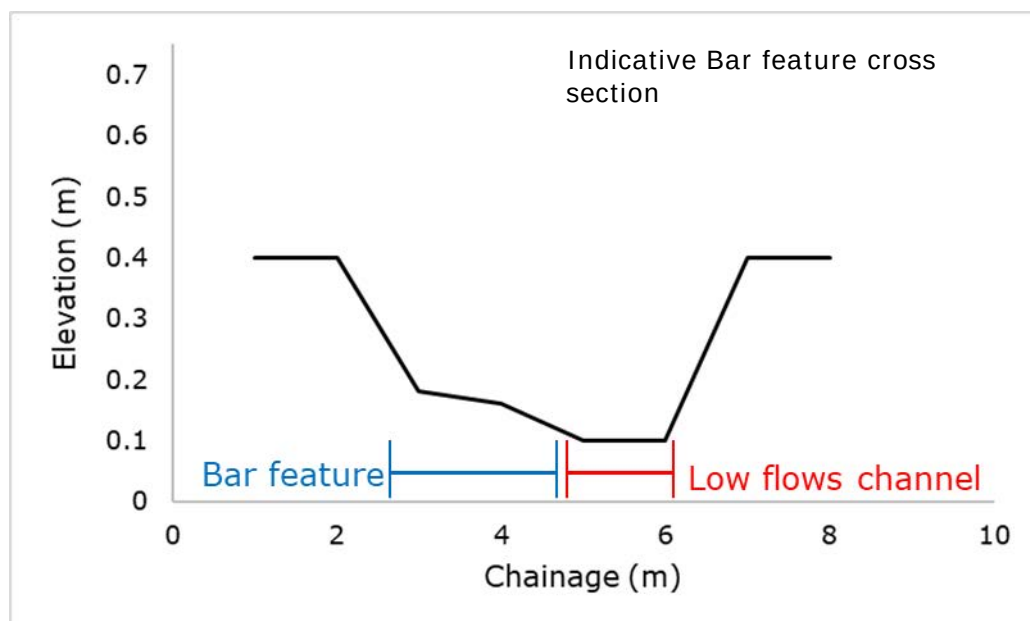


Figure 3-7: Indicative low flows channel section

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Table 3-4: Indicative open channel section			
Bar feature - Option 1		Bar feature - Option 2	
Chainage (m)	Elevation (m)	Chainage (m)	Elevation (m)
0	0.4	0	0.4
2	0.4	2	0.4
3	0.18	3	0.2
4.5	0.16	5.5	0.15
5.5	0.1	6	0.1
6	0.1	6.75	0.1
7	0.4	7.75	0.4
10	0.4	9.75	0.4

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4 Low Flows Modelling

4.1 Introduction

This section of the report describes the modelling approach that was undertaken to represent the in-channel features for the new open channel watercourse. The purpose of this modelling was to determine the function of the morphological features and to understand what influence they will have on sediment transport processes, to inform the concept design for the new channel.

4.2 Methodology

4.2.1 Flow Duration Curve

A catchment for the unnamed watercourse has been delineated from the FEH CD-ROM and run through LowFlows 2 software, developed by Wallingford HydroSolutions (WHS). This software estimated the natural flow regime at the location based on a database of hydrologically similar catchments. A Flow Duration Curve (FDC) was developed and used to determine the low flows for the model, key exceedances are shown in Table 4-1.

Table 4-1: Summary of Flow Duration Curve	
Exceedance	Discharge (m ³ /s)
Q10	0.104
Q20	0.065
Q50	0.027
Q70	0.017
Q95	0.007

4.2.2 Baseline Scenario

An existing hydraulic model, supplied by Cole Easdon, was used to develop the concept design for the new channel. The supplied hydraulic model consists of one of the existing configurations with the watercourse culverted underneath the buildings and a post development model with proposed ideas for an open channel.

4.2.3 Post Development Scenario

The low flows model was developed through using the Cole Easdon post development model. To adapt the model for us, several cross sections were modified to incorporate bar and step-pool sequence to represent similar widths and attributes as observed within the analogue reach.

4.3 Model representation

Table 4-2 below depicts how the features were represented in the model, including bar and step-pool sequences.

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Table 4-2: Model Representation	
Feature	Representation
Bar feature	The channel geometry was altered to incorporate bar features into the channel. The length of the bars was determined using similar lengths as observed in the 2nd, pool riffle, analogue reach. The height of the bar features was determined by the water levels, allowing the majority of the bar to be exposed at Q70 whilst submerged at higher flow exceedances, for example Q10.
Step -Pool feature	The channel geometry was altered to incorporate a deeper channel to act as a pool. The depth of the section was increased from the original however the banks remained the same. Whilst immediately downstream of the pool the channel geometry was altered to incorporate a cross section to represent a step, in order to represent some of the features observed in the 1st analogue reach where the gradient is steep. The bed level was raised within this section to provide increased velocities through this section.

4.4 Assumptions and limitations

The hydraulic modelling undertaken for this study is accompanied by some assumptions and limitations, which are discussed below:

- The in-channel roughness values were all set at 0.05, which was considered appropriate to hydraulic conditions observed in the analogue reaches.
- The model was truncated at the weir at Mill Road downstream of the site, as it was anticipated that this structure would not instigate any backflow (due to an 8m drop in bed levels either side of the structure) which may influence on upstream water levels. This was therefore seen as an appropriate location to truncate the model. The model was additionally truncated upstream of the attenuation pond as it was anticipated that this would control the flows downstream into the new channel.

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5 Results

5.1 Introduction

Within this section of the report the results outputted from the post developed hydraulic model are discussed. Table 5-1 reports the model node name and whether it is classified as an open channel section or a bar feature (the difference of which are shown in the next section). These node names are used in the sections below to discuss the velocity, entrainment and shear stress.

Table 5-1: Model node labels	
Cross section type	Mode Node Label
PLB352	Open channel
PLB387	Bar feature
PLB427	Open channel
PLB468	Open channel
PLB508	Open channel
PLB508_PO1	Pool (lowered bed level)
PLB508_PO2	Open channel
PLB508_R1	Step (raised bed level)
PLB508_R2	Open channel
PLB548	Open channel
PLB588	Open channel
PLB628	Open channel
PLB641	Open channel

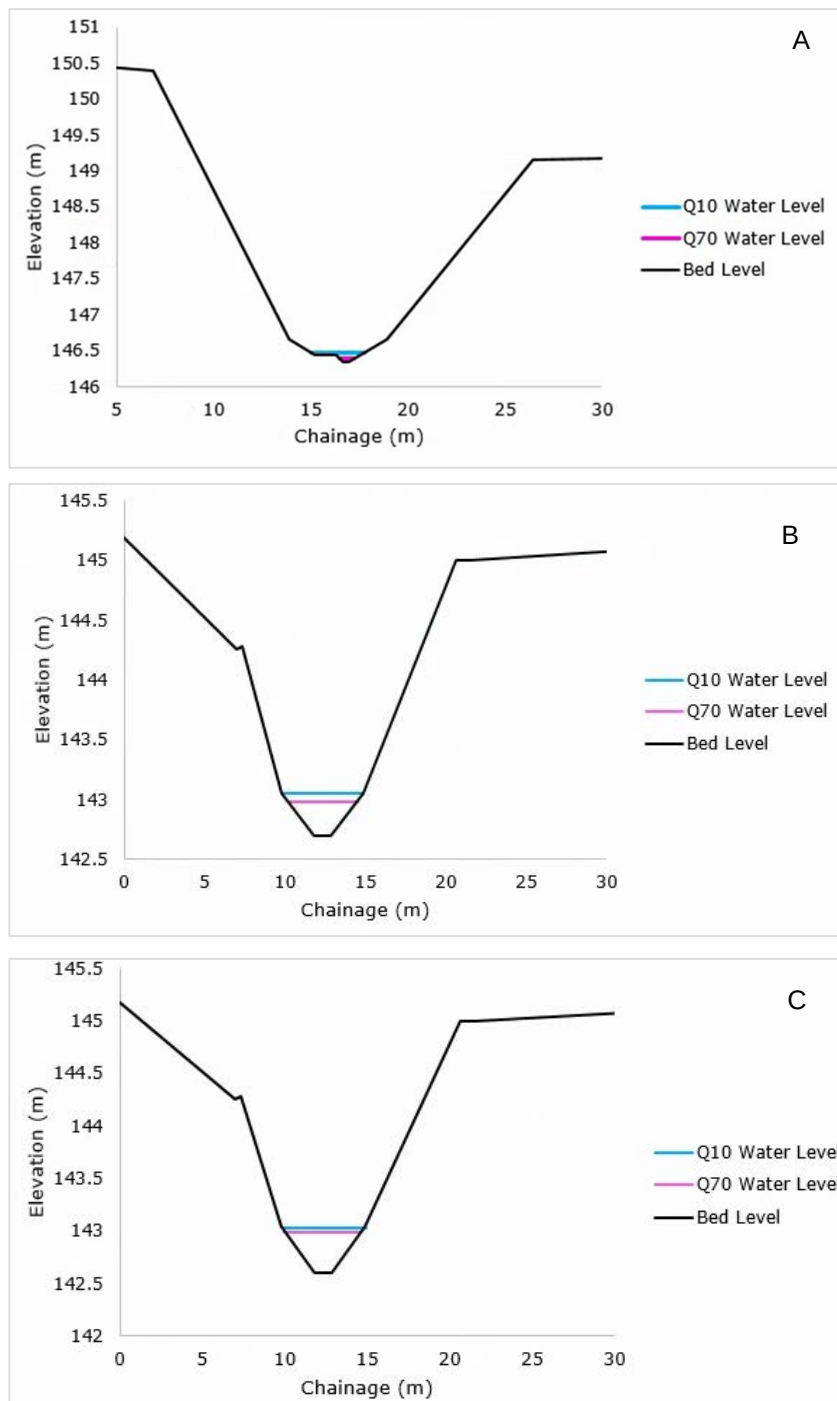
5.2 Water Levels

Table 5-2 depicts a cross sections within the model including both the open channel, with the bar features and in areas of step-pool sequences. The water levels within the bar cross section (A) shows that within a higher flow exceedance (Q10) the bar features are fully submerged, whilst at a lower exceedance they are exposed as per the design criteria. The cross section that contains a pool (B) shows the water levels are greater because the channel is narrower. Cross section (C) depicts the step has raised water levels compared to the open channel sections.

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Table 5-2: Model water levels



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5.3 Channel Velocities

Velocities throughout the site have been extracted from the hydraulic model. Figure 5-1 shows the channel velocities with the open river channel sections without the presence of any in-channel features. The data shows that the gradient steepens, as shown in the long section in Figure 5-2, there is a correlated increase in the in-channel velocities. As the bed gradient become shallower these velocities reduce. It is anticipated to observe erosional process occurring in the steeper sections where the velocities are high, whilst where the gradient becomes shallower it is anticipated to observe a more depositional environment. The Hjulström curve depicts the relationship between the size of the sediment and the velocity that is required to either transport it, erode or deposit it. Within the Q10 flows the velocities range from 0.3-0.7m/s. The calculated entrainment values for the same event would be capable of entraining, transporting and deposition of small gravels between 6-38mm.

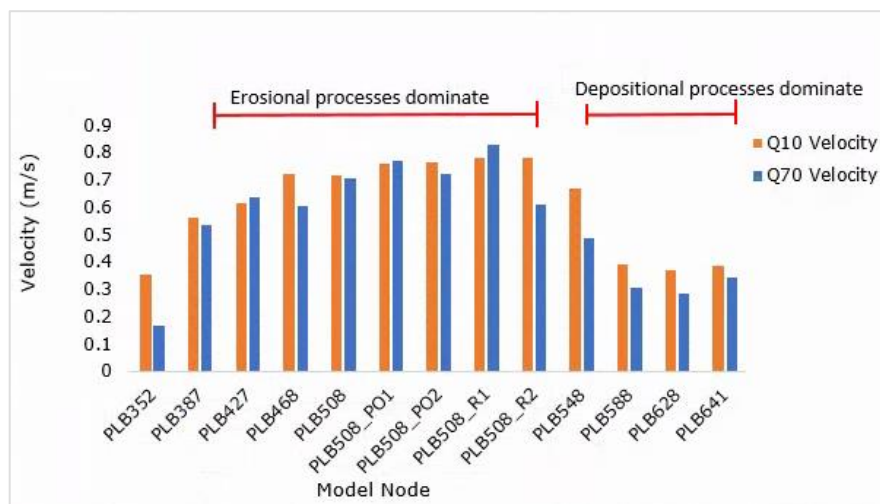
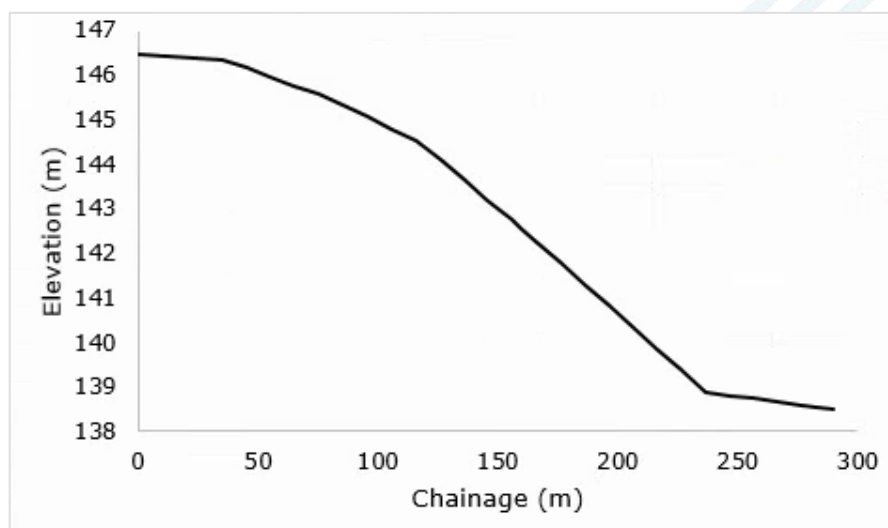


Figure 5-1: Velocities across the site (Baseline) sequence*

* *Note not to scale, total model length is 289m and the distance between the model nodes vary.



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Figure 5-2: Long section

5.3.1 In channel features present

The hydraulic model was developed to include the addition of a step-pool sequence within the stepper sections of the long profile to represent the bed conditions observed upstream from the site. These features have also been introduced to manage the high velocities shown in Figure 5-1, which could lead to a highly erosive channel if left designed as a uniform channel. In the shallower gradient areas at the start and end of the reach, a bar feature has been included to determine the influence this would have on the in-channel velocities.

Figure 5-3 shows the results of this scenario in terms of modelled velocities.

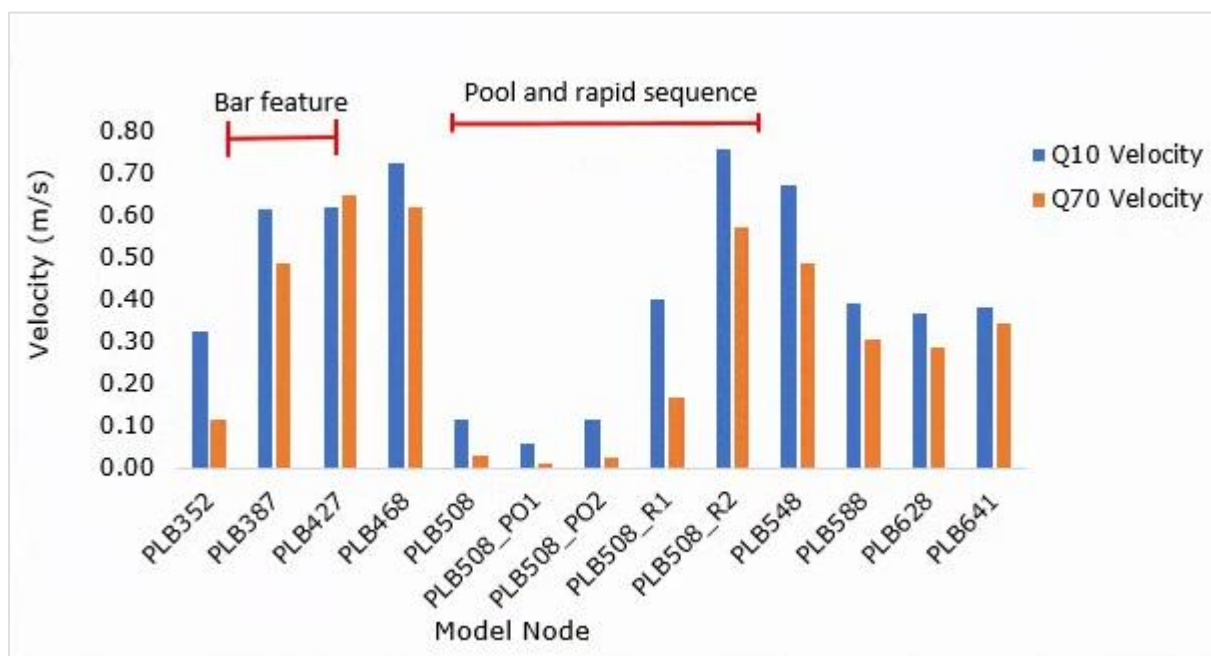


Figure 5-3: Velocities across the site (post development) sequence *

*Note not to scale, total model length is 289m and the distance between the model nodes vary.

Table 5-3: Comparison of velocity's		
	Q10 Velocity	
Model Node	Baseline	Post Development
PLB352	0.35	0.32
PLB387	0.56	0.61
PLB427	0.62	0.62
PLB468	0.72	0.72
PLB508	0.72	0.11
PLB508_PO1	0.76	0.06

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PLB508_PO2	0.76	0.11
PLB508_R1	0.78	0.4
PLB508_R2	0.78	0.75
PLB548	0.67	0.67
PLB588	0.39	0.39
PLB628	0.37	0.37
PLB641	0.38	0.38

Velocities throughout the site have been extracted from the hydraulic model. Table 5-3 (red text highlights an in-channel feature) shows a comparison of velocities between the baseline and the post development results during Q10 flows. It shows within the steeper gradient where the pool has been modelled there is a decrease in the in-channel velocities as a result of deeper water, with a substantial increase in velocities through the step-pool due to the steeper gradient associated with these features. For the Q10 flow results around the bar feature in the lower gradient area, the velocities are higher which can be attributed to the way the model calculates an average velocity for the cross section and in bar features, the flow depths over the bar are shallower than then open channel. In addition, there is a narrower flow channel which increases water depth attributing to higher velocities.

The variation in velocity between sections and between different flow events will help to maintain and provide diverse geomorphic conditions, significantly improving upon the existing culverted watercourse.

5.4 Sediment transport

The shear stress and entrainment values were determined for the modelled cross sections for the site, using the Shields equation. Entrainment is the value in which the maximum size of sediment can be transported during a particular flood or low flow event. Figure 5-4 depicts the entrainment values at both Q10 and Q70 flow exceedances for the post development. The graph shows that the typical grain size that is mobilised and entrained during Q10 flows ranges from 6-38mm, which represent flows that are exceeded only 10% of the time and are therefore relatively high flows (compared to other low flows), suggests the new channel would be capable of sustaining bedform development. This is regarded as a positive outcome as bedform development leads to diverse morphology and creates in-channel habitat, such as those observed in the analogue reaches upstream.

Velocity is used in the calculation of shear stress and so the results share similar trends. Figure 5-4 shows that typically there is a greater size of sediment which is entrained within the open channel compared to those with a bar feature present. This indicates that at Q10 flows, larger sediment would be entrained and transported through the open channel sections, which are deeper and slightly narrower than the overall channel with the bar features. Whereas at bar feature cross-section, the slight reduction in maximum grain size entrainment would mean coarser sediment is deposited. This enables bars to form as they are created through depositional processes. Immediately downstream of the bar features there is the potential for riffles to form as an extension of the bar and which would provide flow diversity within the channel.

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Immediately upstream of the modelled step-pool on the steeper section, there is a drop in the shear stress and entrainment associated with the pool feature, as a result in the reduced flow velocity. The modelled step-pool sequence is shown to reduce velocities overall when compared to the results without them in. This will help manage velocities in the reach which is seeking to mimic the high gradient slope observed in the headwater streams.

The recorded entrainment values outputted from the hydraulic model, is comparable to observations made on the walkover assessment of the analogue reach. Small gravels were observed typically within the open channel, with larger, coarser gravels identified on the exposed bar features. Whilst, further upstream in areas of steeper gradients step-pool sequences dominated observing very coarse bed material (gravels, cobbles, boulders) indicating an active sediment supply.

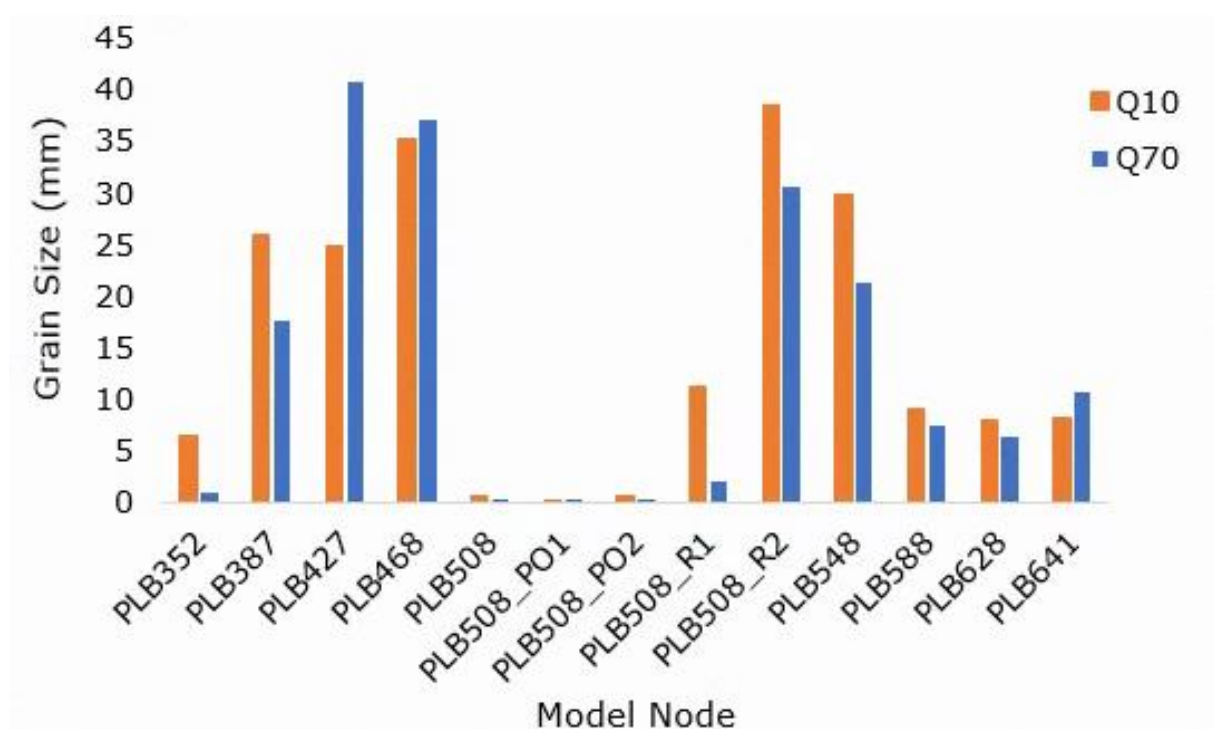


Figure 5-4: Entrainment values across the site*

*Note not to scale, total model length is 289m and the distance between the model nodes vary.

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5.5 Design risks

When designing a new channel or when considering modifications to an existing channel, there are a number of risks that need to be considered to develop an appropriate design. The following risks have been identified:

- Inappropriate sizing of the channel which could lead to a degraded system that does not support hydromorphic processes: To mitigate this risk analogue sites have been identified and used to inform the shape of the new channel. Hydraulic modelling has been used to test the appropriateness of the channel shape and size under low flow conditions.
- Uncontrolled or excessive erosion that could impact infrastructure or destabilise the bed: The steeper channel profile required by the client has the potential to generate high energy that could lead to instability in the reach, particularly if sediment supply to the reach is limited by the reservoir and modifications upstream. To mitigate this, features are recommended in the concept design to control erosion and mimic morphological units found in steep channels (i.e. rapid and step pools).
- Uncontrolled or excessive erosion that could impact infrastructure through bank erosion: Bank erosion is a residual risk that will need to be considered in future design work. The conceptual design has involved working with natural processes to produce a functioning channel, within the constraints of the site. Some bank erosion may therefore occur on the outside of small bends within the channel; monitoring will be required to ensure bank erosion is not excessive and does not threaten the stability of infrastructure within the development.

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6 Indicative Drawings

6.1 Introduction

Following on from the hydraulic modelling a series of indicative drawings were developed to demonstrate the in-channel bar features geometry, which met the design criteria of the bars being fully submerged at Q10 and exposed during lower flows for example at Q70, and developing slower in-channel velocities through the pool, but increased velocities over the step-pool sections.

The indicative cross sections are provided within DRV-JBAU-XX-00-DR-EN-0001-S3-P02-Indicative_Cross_Sections. Within the indicative drawings it outlines the long section marked with the locations for the different in-channel features, such as step-pool sequences and bar features. The step-pool sequences are located within areas of steeper bed gradient as these processes are anticipated to be dominated by erosional processes. Whilst in shallower bed gradients it is anticipated to have more depositional environments allowing the formation of bars. River sections where the bar is present the channel is typically wider which encourages deposition during higher flows and develops a varied channel morphology. It additionally displays how the cross sections developed for the hydraulic modelling compare to the original cross sections within the model provided.

6.2 CDM Regulation 2015

This report provides conceptual design parameters and information for the new channel associated with the Bevis Green site. If these are taken forward to detailed design and implementation all work will need to follow the framework and fulfil the obligations outline in the Construction (Design and Management) Regulation 2015 (CDM Regulations). At this early stage, JBA Consulting has not been designated as the Principal Designer but have acted as a designer. When progressing the designs further, the client should assess where the nature and scale of the works are likely to be notifiable under CDM regulations (the criteria for it being notifiable is that the construction phase will last more than 30 working days or shifts and gas more than 20 persons on site, or will involve more than 500 person days or shifts).

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7 Conclusions

A hydraulic model has been developed to include in-channel features to improve the geomorphic conditions of the watercourse from its existing culvert. A geomorphology assessment was undertaken to understand hydromorphic processes operating in the watercourse and an analogue site was identified upstream. The concept design for the new channel has been based on this analogue site.

Bar features were hydraulically modelled to narrow the channel width and create an area of deeper flow during low flow conditions. Water levels were shown to submerge the bar feature during a Q10 event whilst at a lower flow extent, such as Q70, the bars were exposed with all the flow contained within the low flows channel. The calculated entrainment values showed a Q10 event would be capable of entraining and transporting small gravels (6-38mm), whilst smaller sediment sizes could be transported during a Q70 event.

This sediment mobilisation is similar to observations made during the site walkover. Velocities and shear stress were found to be lower in areas where bar features were present in the model, indicating higher rates of deposition in these parts of the channel. Immediately downstream of the bars, an increase in velocities and entrainment was shown, indicating the potential for riffle features to develop which would encourage greater geomorphic diversity within the channel.

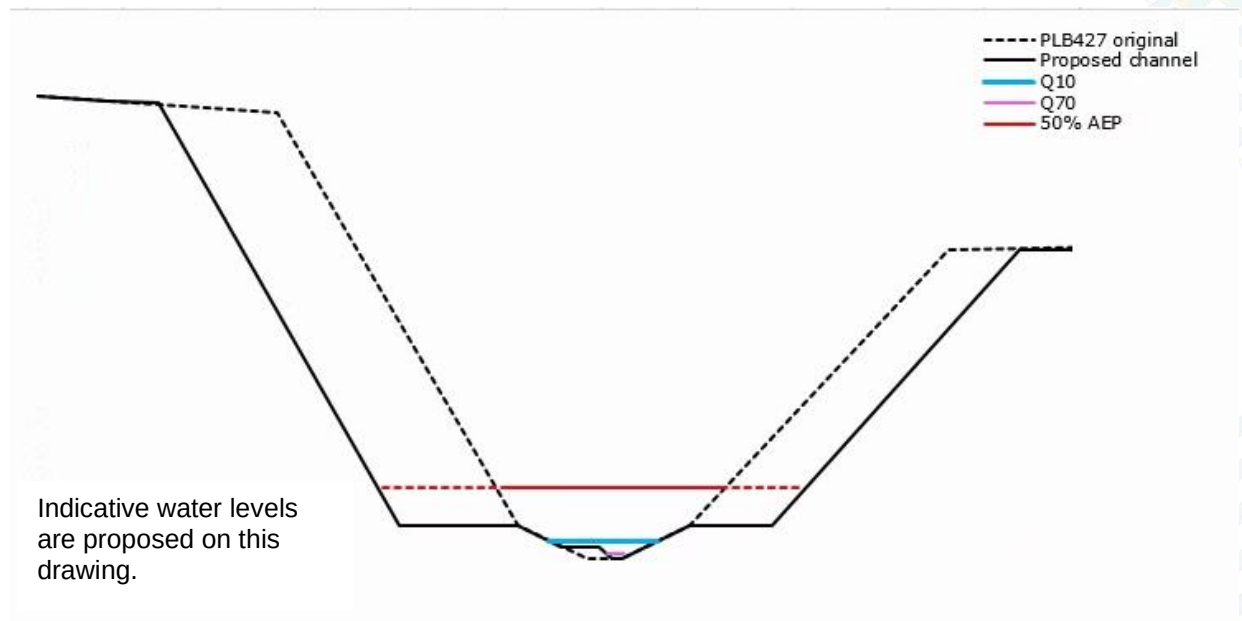
8 Recommendations

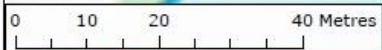
It is recommended that the following should be completed at the next stage:

- Advancement of the concept proposals during the detailed design stage - it is assumed this will be undertaken by Barratt Homes.
- It may be required to conduct further flood risk modelling of the new design to ensure the proposed channel does not increase flood risk to adjacent properties.
- A Water Framework Directive assessment would be required to obtain the relevant permits.
- Larger flows (such as the 50% AEP) should not be contained within the channel as this disconnects the channel from its floodplain and concentrates high energy within the channel, which can lead to exacerbated erosion. It is understood that space is limited; however, by designing the channel so that the upper bank profiles are set back and larger flows are able to spill onto a second stage of the channel, would allow for some riparian connectivity within the limited river corridor. This would also provide additional flood storage capacity during flood flows without impacting upon the gradient of slopes on both banks, as the figure below demonstrates.

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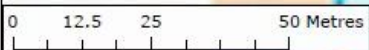
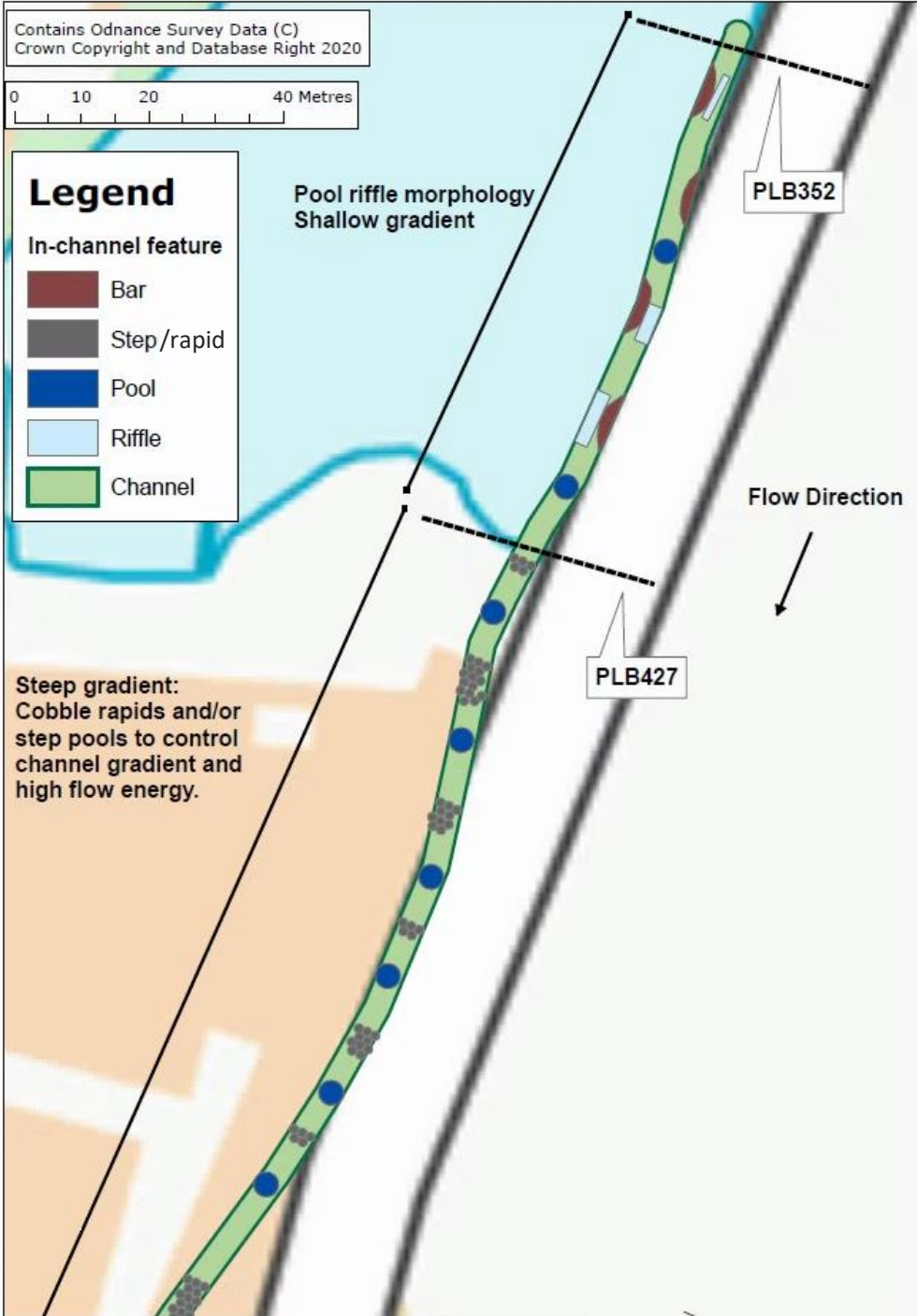




Legend

In-channel feature

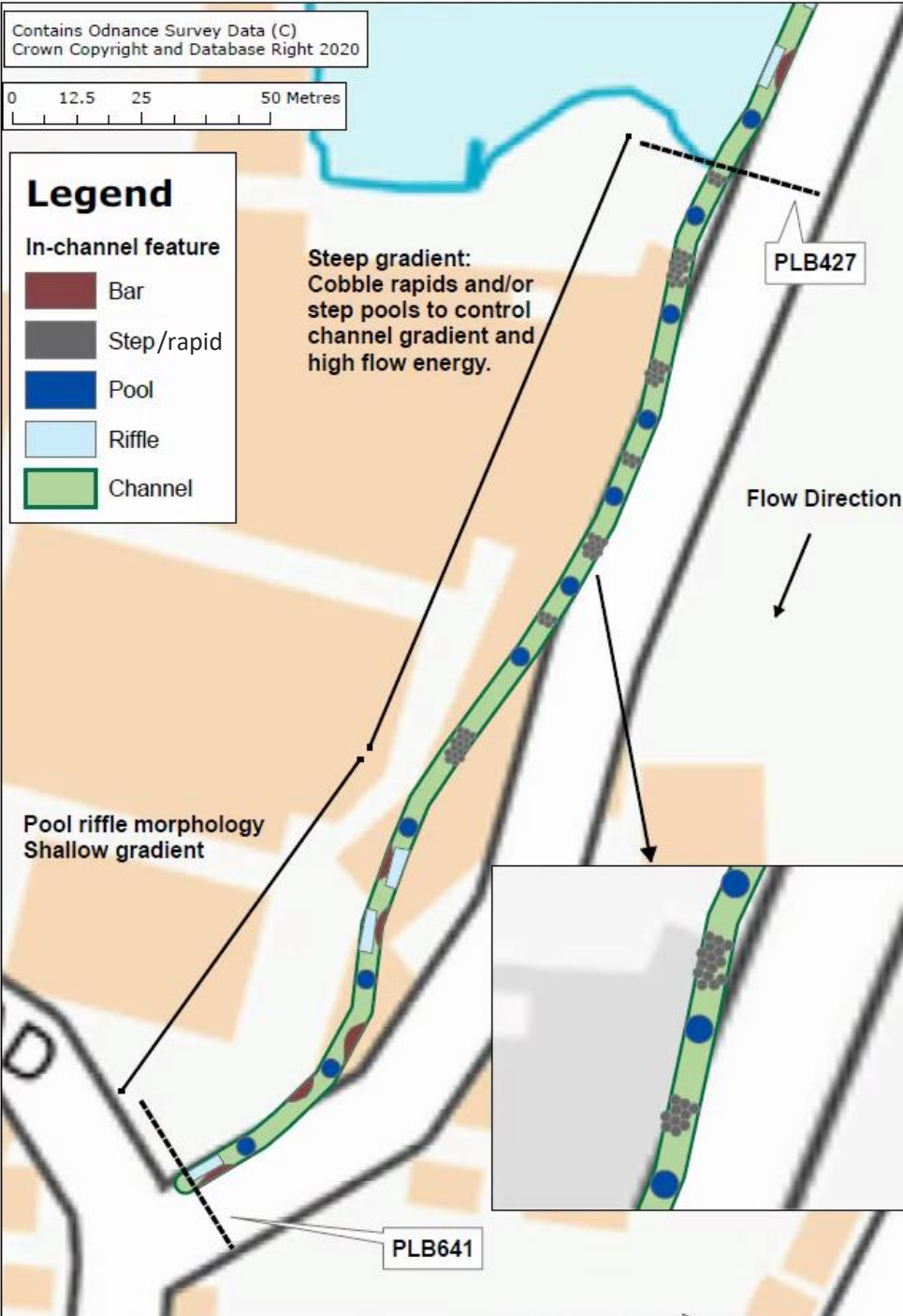
- Bar
- Step/rapid
- Pool
- Riffle
- Channel



Legend

In-channel feature

- Bar
- Step/rapid
- Pool
- Riffle
- Channel



Bevis Green – Conceptual Plan view

This document presents a concept design comprising of an indicative plan for the new channel with example placement of morphological features. Further hydraulic modelling and analysis will be needed as part of a detailed design stage to determine the placement and size of in-channel features (including size of sediment) to progress the design for implementation.

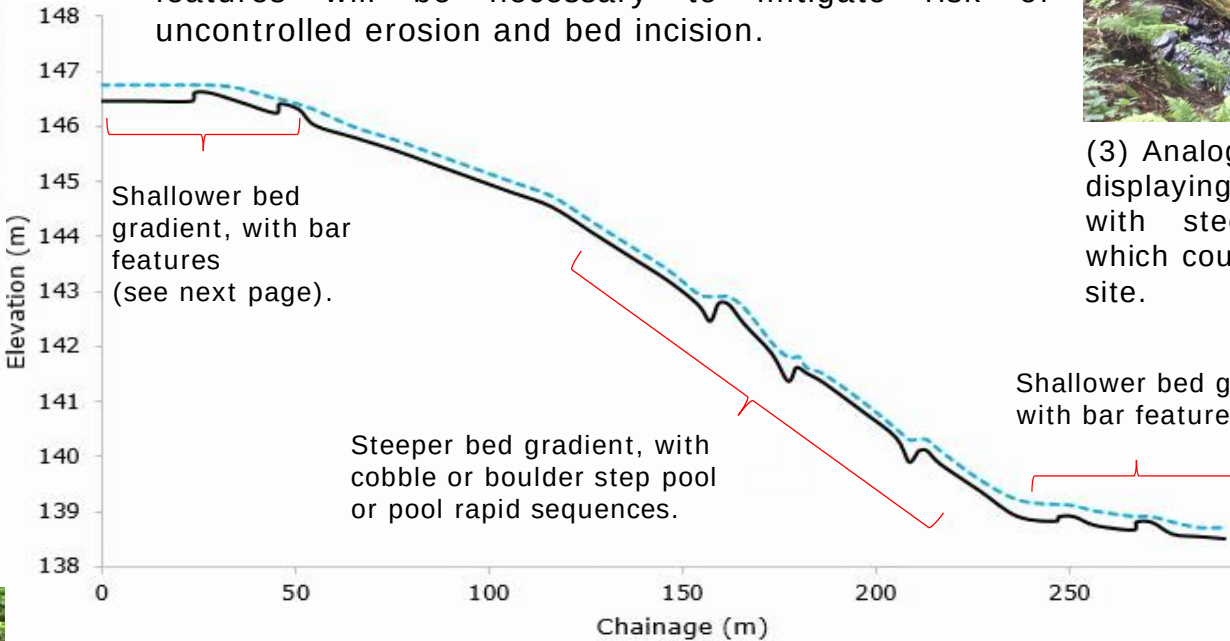
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Checked: R Thrower 02/12/2020	
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(1) Analogue reach displaying a step-pool morphology with steeper bed gradient. A similar concept could be achieved at the site, but with a wider channel as required.



The shallower bed gradient at either end of the new channel will reduce in-channel velocities and allow for depositional processes to dominate. It is anticipated that bar features will form (2), reducing the channel width and introducing morphological diversity.



Within areas of steeper bed gradient, features mimicking either step pool or cascade morphology should be created along this reach. Coarser bed material will form the step or rapid (areas of raised bed level) whilst material upstream of the rapid will be scoured out to form a pool, with increased water depths and reduced in-channel velocities. It is expected to see sediment deposition within the pool as a result. Erosional processes will dominate throughout this reach. Appropriate placement and sizing of features will be necessary to mitigate risk of uncontrolled erosion and bed incision.



(3) Analogue reach photograph displaying a cascade channel with steeper bed gradient, which could be achieved at the site.



(4) Typical sediment identified downstream of the step pool/ cascade reaches, predominately consisting of coarse gravels.

Bevis Green – Long Section Plan

Indicative long-section plot with example placement of morphological features to control gradient and limit high velocities. To be developed further as part of a detailed design stage.

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Bevis Green – Indicative Plan of Pool Riffle sections

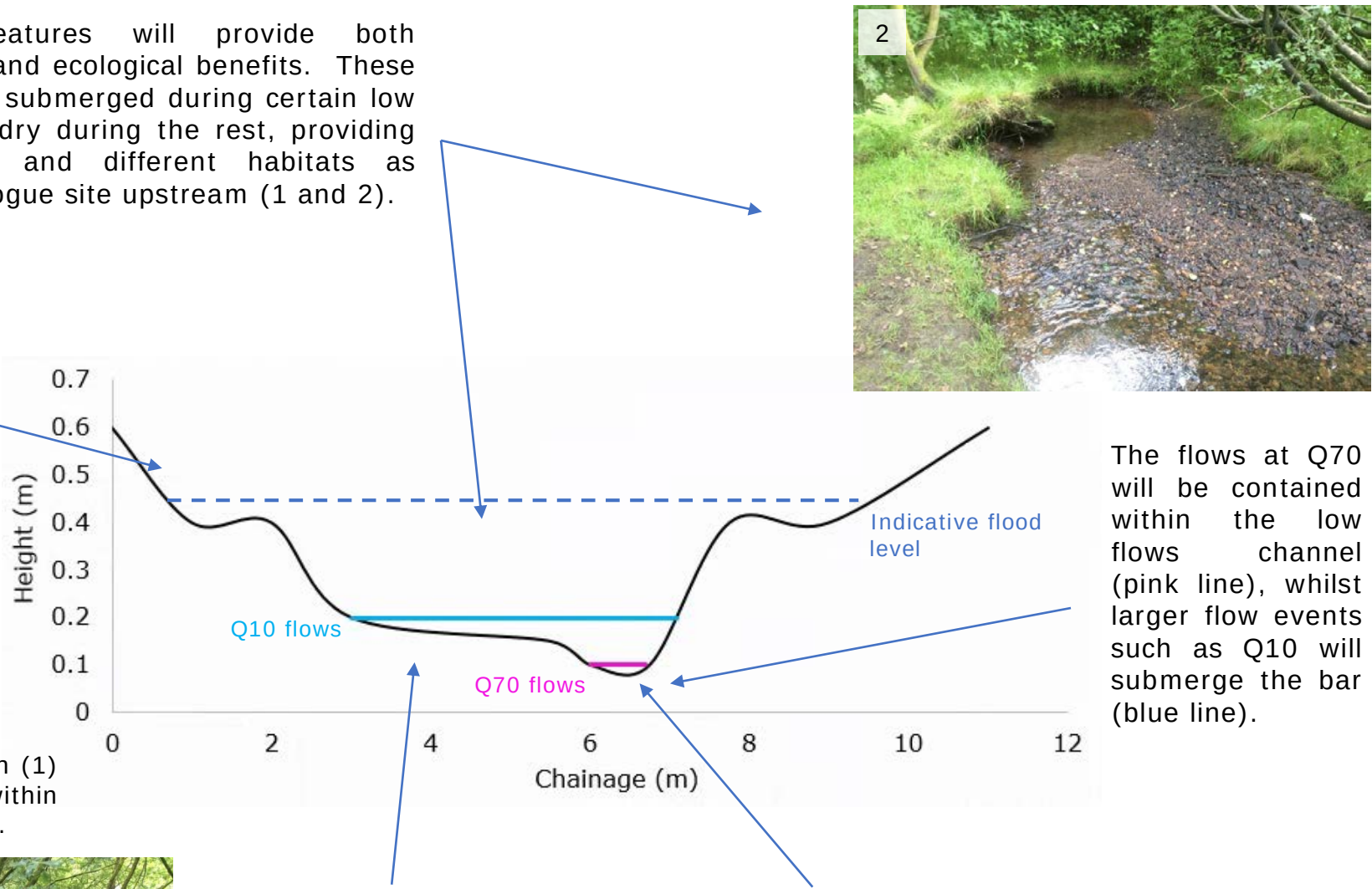
Indicative cross-section showing the typical channel shape within the shallower gradient sections of channel. To be developed further as part of a detailed design stage.

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In-channel bar features will provide both hydromorphological and ecological benefits. These features will only be submerged during certain low flow conditions and dry during the rest, providing channel complexity and different habitats as observed in the analogue site upstream (1 and 2).

The gradient of this slope will depend on the difference between the desired bed level and proposed site ground levels.



The flows at Q70 will be contained within the low flows channel (pink line), whilst larger flow events such as Q10 will submerge the bar (blue line).

Analogue reach photograph (1) displaying a bar feature within an area of gentler gradient.

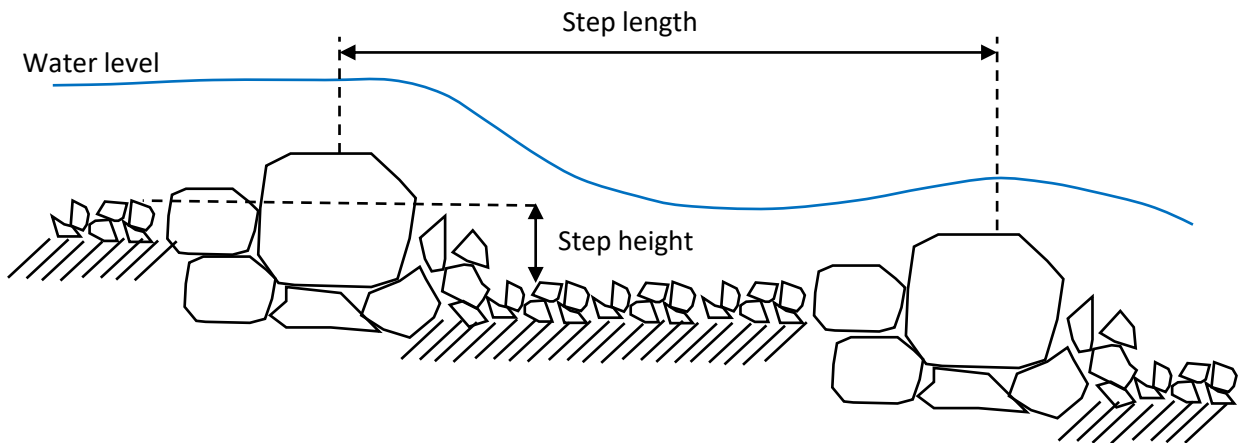


Bank heights are relatively shallow which is representative of the analogue reach and is important for maintaining a hydraulic connection to the riparian zone during larger flows.

Narrower low flows channel adjacent to the bar to encourage fine sediment to be transported downstream, as seen in the analogue reach. Generally, the channel is wider with bar features (compared with 'open channel' section) to encourage deposition during higher flows and varied channel morphology.

Bevis Green – Indicative Step Pool

This document presents a concept design comprising of an indicative plan for the new channel. Further hydraulic modelling and analysis will be needed as part of a detailed design stage to determine the placement and size of in channel features including size of sediment) to progress the design for implementation



The spacing and size of step pools should be variable, in order to maintain a natural sediment flux, particularly during flood flows. Designs should avoid uniform dimensions for the step pools.

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Appendix 10

Environmental Management System

Environmental management system for the realignment/diversion of the un-named tributary of Pigs Lee Brook and the treatment of associated silts.



**Former Tetrosyl Works,
Walmersley Old Road,
Bury.
BL9 6RG**

Author D J Woodrow	Position Project Manager	Signed	Date 29/05/20
Approved G Owen	Position Contract Manager	Signed	Date 29/05/20

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1.0 Introduction

Urban Regen Ltd. have been contracted, as Principal Contractor, by Barratt Homes (Manchester), to carry out the site preparatory works associated with the residential redevelopment of the former Tetrosyl Works, Bury. These preparatory works include the demolition of all above ground structures, site wide in-ground remediation, and the realignment/diversion of the un-named tributary of Pigs Lee Brook watercourse/culvert.

This '*Environmental Management System*' outlines the methods to be employed by Urban Regen Ltd. to systematically assess, reduce and prevent any environmental impact to the un-named tributary of Pigs Lee Brook, and the wider environment, during the '*flood risk activity*' to realign/divert the '*Main River*' watercourse. This '*Environmental Management System*' is a working document with the aim of ensuring that:

- The potential environmental impact caused by the '*flood risk activity*' and any associated contamination, is considered as part of the site inspection regime.
- Any potential environmental impact caused by the '*flood risk activity*' is controlled by considered operational practices, which include physical and management control measures.
- All appropriate measures are taken to prevent, or, where not reasonably practicable, reduce, any potential environmental impact to the un-named tributary of Pigs Lee Brook and the wider environment.

This '*Environmental Management System*' details the potential environmental impact of the '*flood risk activity*' and the control measures to be employed to mitigate the risk. This is supported through monitoring procedures and the review of documented complaints.

The methodologies detailed in this '*Environmental Management System*' have been prepared in accordance with the following documents:

- Environment Agency online guidance *‘Develop a management system: environmental permits for a flood risk activity’*

The information in this *‘Environmental Management System’* is to be supplement with the following site-specific documents:

- Dust Management Plan
- Noise and Vibration Management Plan
- Odour Management Plan
- Surface Water Management Plan

This *‘Environmental Management System’* is to be held on site within the relevant register of the *‘Construction Phase Health and Safety Plan’* at all times; being readily available for consultation by all parties.

2.0 Site background information

Located off Walmersley Old Road, the site covers an area of approximately 10.8 ha (26.7 acres) which falls generally north to south. Formerly known as the Tetrosyl Works, the site comprises of a mixture of buildings which include a 19th century cotton mill together with more recent warehouses and offices. Hardstanding surrounds many of the buildings to the south and west with undeveloped open land present in the north.

The former mill lodge is present to the centre east of the site; constructed on the alignment of the un-named tributary of the Pigs Lee Brook (which passes through site in a generally north south direction). To the north, the waters flow into the mill lodge through an open watercourse, to the south they pass through a weir/spillway structure and through a culverted section of watercourse, exiting into an open channel circa 175m beyond the southern site boundary.

The site occupies the valley of the un-named tributary of Pigs Lee Brook. Historically, this valley was backfilled to form the main mill lodge which previously discharged to two other lodges on site, and the culvert which allowed the watercourse to discharged off-site to the south. In addition to the mills, coal mining was present on-site, with adits located to the south east corner to access the Sand Rock coal seam. A rock quarry is also identified.

Latterly, the site was occupied by Tetrosyl Ltd. for the manufacture, packaging, storage, and distribution of car care products inc' antifreeze, waxes and paints. A solvent recovery process was also carried out on the site under an Industrial Pollution Control (IPC) permit.

Residential properties bound the site to the south and east, with open fields and the M66 being present to the north and east.

The existing layout of the site and the new alignment/diversion of the un-named tributary of Pigs Lee Brook is detailed on drawing '*333-20-002 Site layout plan (including design)*' contained in Appendix A.

3.0 Realignment/diversion works to the un-named tributary of Pigs Lee Brook

Currently, the un-named tributary of the Pigs Lee Brook runs from north to south through the centre east of the site. To the north, the watercourse enters site as an open channel before it flows into the former mill lodge/reservoir. The lodge/reservoir is controlled by a weir/spillway structure located to the south west which discharges waters into a culverted section of the watercourse. This culverted watercourse flows predominantly in a south/southwest direction, under the buildings located to the south east of the site. Upon reaching the southern site boundary it turns west and gradually south before becoming an open channel again. To enable redevelopment for a residential end land use, it is necessary to remove the lodge/reservoir and realign the watercourse along the eastern boundary of the site, carrying out remediation of the underlying made ground, as necessary. These works are to include:

- Suspended solids control measures.
- Maintaining flows to the un-named tributary of Pigs Lee Brook at all times.
- De-watering of the existing lodge/reservoir.
- Removal of fish from the existing lodge reservoir.
- Installation of temporary impermeable barriers to protect the existing watercourse.
- Physical and chemical treatment of lodge/reservoir silts.
- Installation of silt traps to protect the existing watercourse.
- Excavation of a new watercourse channel along the eastern boundary.
- Excavation of a new flood attenuation pond along the new alignment of the watercourse.
- Installation of a new length of culvert and associated headwall to connect the new watercourse to the existing culvert (towards the southern boundary).
- Installation of a flow control structure to the southern end of the new flood attenuation pond.

To facilitate the realignment/diversion of the un-named tributary of Pigs Lee Brook enabling works are required. These works include:

- Ecological mitigation works.
- Asbestos removal.
- Demolition.
- Break out of hardstanding and relict foundations.
- Site wide remediation/ground preparation.

A comprehensive overview of all tasks associated with the realignment/diversion of the un-named tributary of Pigs Lee Brook is detailed in document '*Watercourse realignment overview – Overview of the watercourse realignment/diversion works to the un-named tributary of Pigs Lee Brook and the treatment of associated silts*' contained in Appendix B.

3.1 Programming

All works associated with the realignment of the un-named tributary of Pigs Lee Brook are to be scheduled to ensure that any impact on the local environment (including all flora and fauna) is minimised at all times taking into consideration likely weather conditions, breeding/nesting, and hibernating. The current programme of works is detailed in Appendix C

4.0 Environmental pollution/nuisance sources, receptors, and potential impacts

4.1 Environmental pollution/nuisance sources

Works directly/indirectly associated with the realignment/diversion of the un-named tributary of Pigs Lee Brook, have the potential to generate environmental pollution/nuisance which may impact on the watercourse or the wider environment.

4.1.1 Pollution/nuisance sources (direct)

- Excavation (of the new alignment/diversion watercourse/channel).
- De-watering (of the lodge/reservoir).
- Over pumping (of the un-named tributary of Pigs Lee Brook to maintain flows during the works and any other pumping required).
- Civils construction (of the new culvert and associated structures).
- Silt stabilisation (of the exposed silts from the de-watering of the lodge/reservoir inc' materials).
- Plant (used across site to carry out the works).
- Deliveries (of materials).

4.1.2 Pollution/nuisance sources (indirect)

- Demolition (of all buildings across the site).
- Remediation (of all on-site contamination).
- Earthworks (of all turnover of made ground and removal of hardstanding and relict foundation).
- Processing (of all hard materials generated on-site for re-use).
- Waste (recovery and disposal of all wastes on-site).
- Plant (used across site to carry out the works).
- Deliveries (of materials).

4.2 Environmental receptors

The site is located in Walmersley, being part of the northern extent of the Bury conurbation. The 'Landscape Classification' for this area is 'Built up areas'. The main receptors in and around the site are:

- The un-named tributary of Pigs Lee Brook (which runs generally north south through the east of the site).
- Priority habitat – Deciduous woodland (predominantly located to the north east of the site around the upstream un-named tributary of Pigs Lee Brook and the lodge/reservoir).
- Priority habitat – Broadleaved woodland (predominantly located to the north east of the site around the upstream un-named tributary of Pigs Lee Brook and the lodge/reservoir).
- Badgers (located on the site to the north west of the lodge/reservoir).
- Bats (located in and around the on-site buildings).
- Aquatic life (inc' fish, common toads and potentially amphibians).
- Upland breeding bird area (located off-site to the north and east of the adjacent M66 motorway).
- Flora (other plants/habitat in and around the site).
- Fauna (other wildlife in and around the site).
- Residential properties (located to the south and west).
- General public (around the site but predominantly to the south and west).

4.3 Potential environmental impacts

4.3.1 Dust

4.3.1.1 Demolition operations

Dust will be generated during the controlled demolition of buildings located on the site. This has the potential to cause a physical and/or chemical impact on environmental receptors across the site, including siltation of the un-named tributary of Pigs Lee Brook if not sufficiently suppressed.

4.3.1.2 Bulk earthworks

Dust will be generated during the excavation/deposition of materials necessary to carry out the remediation of the site and achieve the proposed developable landform. This has the potential to cause a physical and/or chemical impact on environmental receptors across the site, including siltation of the un-named tributary of Pigs Lee Brook if not sufficiently suppressed.

4.3.1.3 Silt stabilisation works

Stabilisation of the silts associated with the lodge/reservoir, will cause cement dust to become airborne during the mixing process. This has the potential to cause a physical and/or chemical impact on environmental receptors across the site, including effects to the pH of the un-named tributary of Pigs Lee Brook if not sufficiently suppressed.

4.3.1.4 Importation of materials

Dependent upon road conditions any bulk import (cement/civils materials) and export (scrap metal and general waste) operations have the potential to generate dust on and off-site. Any dust generation will only be during the movement of road vehicles. This has the potential to cause a physical and/or chemical impact on environmental receptors across the site, including siltation of the un-named tributary of Pigs Lee Brook if not sufficiently suppressed.

4.3.1.5 On-site vehicle/plant movements

All works on site are to be carried out by heavy plant. Due to the size of the site and scope of works there is potential for dust to be generated. This has the potential to cause a physical and/or chemical impact on environmental receptors across the site, including siltation of the un-named tributary of Pigs Lee Brook if not sufficiently suppressed.

4.3.2 Noise

The majority of noise generation on-site will be from the movement/use of heavy plant, either directly or indirectly, the common impacts being:

4.3.2.1 General public

Dependent upon the proximity and exposure duration, excessive noise may have the following effects:

- Annoyance and irritation
- Concentration and efficiency
- Fatigue and likelihood of accident-proneness
- Mask out other sounds including instructions and warning sounds
- Temporary/permanent hearing loss

4.3.2.2 Fauna

Dependent upon the proximity and exposure duration, excessive noise may have the following consequences for both terrestrial and marine fauna:

- Interference with communication/hunting
- Auditory damage
- Physiological stress
- Anti-predator responses

4.3.3 Vibration

The majority of vibration generation on-site will be from the movement/use of heavy plant, either directly or indirectly, the common impacts being:

4.3.3.1 General public

Dependent upon the proximity and exposure duration, excessive vibration may have the following effects:

- Annoyance and irritation
- Concentration and efficiency
- Fatigue and likelihood of accident-proneness

4.3.3.2 Fauna

Dependent upon the proximity and exposure duration, excessive vibration may have the following consequences for both terrestrial and marine fauna:

- Interference with communication/hunting
- Physiological stress
- Anti-predator responses

4.3.3.3 Structures/landform

Dependent upon the proximity and exposure duration, excessive vibration may have the following effects:

- Cosmetic damage to structures
- Structural damage to structures potentially leading to failure
- Cause instability to landforms potentially leading to failure

4.3.4 Odour

4.3.4.1 Disturbance of lodge/reservoir silts

Although the lodge/reservoir is not a stagnant body of water, being continually charged/discharged by the un-named tributary of Pigs Lee Brook, general detritus may be

present in the base/silts causing an anaerobic environment. Post de-watering and during any disturbance a 'moderately offensive' odour as classified on the Hedonic Scale is anticipated to be present immediately adjacent to any works. However, low emission rates will mean that the odour will be rapidly dispersed and is not expected to cause nuisance beyond the site boundaries.

4.3.4.2 Contaminated soils

Several 'hotspots' of contaminated soils have been identified on site which are to be excavated/treated/disposed of during remediation works. Although an odour will be associated with these works is anticipated that it will be transitory at worst being diluted prior to any dispersal beyond the site boundary.

4.3.5 Surface water

4.3.5.1 General surface run-off

Due to the site being located in a valley (albeit modified to enable the former mill etc), surface run-off through site caused by rainfall occurs naturally. Generally, the waters flow in a southerly direction passing into the on-site drainage system the majority of which is assumed to drain into the culvert of the un-named tributary of Pigs Lee Brook.

4.3.5.2 Demolition

Dust and light-weight materials generated during demolition has the potential to be washed away by surface water run-off in the immediate area, leading to sedimentation of the un-named tributary of Pigs Lee Brook as well as littering from deleterious materials.

4.3.5.3 Bulk earthworks/remediation

Much of the developable area of the site requires earthworks to be carried out. These works necessitate the removal of hard standings and vegetation which will expose the underlying soils (which may be contaminated e.g. hydrocarbons/solvents etc) which will be susceptible to erosion

from surface run-off. Potentially this surface run-off will accumulate sediments which may cause sedimentation/pollution of the un-named tributary of Pigs Lee Brook

4.3.5.4 Silt stabilisation works

Any surface run-off passing through the area of silt stabilisation has the potential to cause a physical and/or chemical impact on the un-named tributary of Pigs Lee Brook.

4.3.5.5 Spillages

If exposed to surface run-off, spillages can be transported on site causing contamination to soils, as well as to the watercourses and possibly groundwater. Spillages are generally associated with leaks from heavy plant inc' diesel and hydraulic oil.

4.3.5.6 Flooding of the un-named tributary of Pigs Lee Brook

During prolonged periods of heavy rainfall there is the potential that a flood situation on-site may occur. The Environment Agency '*Flood Zone Map*' for the area identifies that the site is located within '*Flood Zone 1*' (low risk), with minor flooding of the site possible (mainly contained to the site roads) directly from the watercourse (and associated lodge/reservoir). In the event of a flood situation arising from the reservoirs to the north; there is the potential for the whole of the site to be flooded.

Any flooding on site has the potential to cause physical and/or chemical impact on environmental receptors across the site, including siltation of the un-named tributary of Pigs Lee Brook.

5.0 Environmental impact control measures

Management and physical control measures have been prepared to control any potential environmental impact which may be caused due to the works.

5.1 Site Management responsibilities

The Urban Regen Ltd. Project Manager will have the responsibility for ensuring that any potential sources of pollution/nuisance likely to be caused by site operations are prevented/minimised.

Robust procedures are to be implemented to carry out environmental monitoring with full and complete records held on-site within the relevant section of the '*Construction Phase Health and Safety Plan*'.

Regular 'Progress Meetings' will be carried out to discuss current and proposed site operations. These discussions will include the impact of works with regards to the environment.

5.2 Operational control measures

Operational control measures to mitigate against any potential environmental impact that the works may cause, are to be included within all '*task specific method statements*'.

5.2.1 Dust

Dust generation on site is anticipated, however, works will be planned and carried out in a manner to minimise any potential environmental impact/nuisance:

- Consideration is to be given to weather conditions which may cause dust to pass beyond the site boundary. If working methods and/or mitigation methods cannot control dust generation due to the weather i.e. windy conditions, works with the potential to cause dust are to cease until the weather is suitable/the generation of dust can be controlled.
- Works are to be planned and carried out to prevent/minimise dust passing beyond the site boundary e.g. demolition works to be carried out towards the prevailing wind to maximise the protection provided by the building being demolished.
- Soft strip to buildings is to be carried out as much as is practicable to reduce the volume of materials with the potential to become airborne.

- On-site dust suppression is to be carried out using a tractor/bowser as necessary (using the on-site water supply).
- Cement associated with the treatment of the lodge/reservoir silts is to be delivered to site in sealed 2t bags; being stored on a hardstanding (this area is to be bunded to protect the surrounding environment in the event that the bags become damaged and are subjected to surface run-off).
- Treatment works to the silts are to be carried out to minimise exposure to the wind and minimise the extent of any transitory dust.
- Cement to be used in the silt treatment process, is to be transferred to the work area in sealed 2t bags, immediately prior to being used.
- When mixing the cement, the bag is to be suspended just above the silt. A hole is to be cut in the base of the bag to allow the cement to drain out in a controlled manner over the top of the silt being treated (achieving the correct mixing ratio). Using a mixing bucket, the cement is to be carefully mixed through the silt as necessary ensuring that the generation of any dust is kept to a minimum.
- Treated silt is to be stockpiled in low windrows to minimise exposure to the wind and minimise the extent of any potential transitory dust (dust generation from treated materials that have cured is anticipated to be very low).
- Road vehicles delivering/removing potentially dusty materials to/from site are to be sheeted at all times.
- Road vehicles are to remain on hard standings at all times; being maintained/cleaned by a road sweeper as necessary to minimise dust/trafficking.
- A speed limit of 10mph is to be implemented across the whole of site.

- Site plant haul routes are to be segregated from road going vehicles to ensure that the access routes to/from site remain clean.
- The stockpiling of materials on site is to be minimised. Any stockpiles are to be located in relatively sheltered locations, the height of which are to remain >0.5m below the levels of any adjacent on-site buildings/structures/landforms.

5.2.2 Noise/vibration

Best Practical Means (BPM) of noise and vibration control is to be applied during the works to minimise any environmental impact/nuisance to the local environment. These include:

- Working hours are to be as detailed in the associated planning permission.
- Delivery/collection of plant/materials are to be made during established working hours.
- Vehicles/plant brought to site, are to comply with all statutory requirements; being maintained in a good and effective working order and operated in a manner to minimise noise and vibration emissions.
- Care is to be taken when unloading vehicles to avoid unnecessary noise.
- Plant maintenance operations are to be undertaken with consideration to local receptors i.e. located on hard standing away from the watercourse/culvert.
- The use of noisy plant is to be restricted i.e. not used early in the morning.
- Methods of work are to take into consideration noise and vibration nuisance mitigation techniques where possible.
- HGV's/plant are to be equipped with non-tonal reversing alarms where possible.
- HGV's attending site are not to access site in convoy.

- HGV's/plant movements are to be restricted to 10mph.
- HGV's/vehicles attending site are not to park off-site.
- HGV's/plant are not to wait with their engines running.
- Drop heights are to be minimised when loading.
- Compressor, generator, and engine compartments are to remain closed with plant turned off when not in use.
- Only silent pumps and generators are to be used on site.

5.2.3 Odour

Odour generation on-site is anticipated to be relatively low. However, works will proceed in a manner to minimise any potential environmental impact/nuisance:

- Silt excavation operations are to be carried out in a steady controlled manner causing minimal disturbance to the source material.
- The silts are to be treated with cement. This will stabilise the source material with regards to water and odour.
- If it becomes evident that odours are excessive; passing beyond the site boundary, works are to cease, and Smith Grant LLP (environmental consultants) contacted for advice.
- If necessary, an odour atomiser will be obtained to neutralise/break down any odours being generated.

5.2.4 Surface water

Surface run-off during site works is anticipated, however, works will be planned and carried out in a manner to minimise any potential environmental impact/nuisance:

- Where possible vegetation cover is to be maintained as much as is practicable to control surface run-off and allow natural percolation of waters across site.
- Consideration is to be given to weather conditions at all times. If working methods and/or mitigation methods cannot manage surface run-off on site all works with the potential to cause pollution are to cease until the weather is suitable/surface run-off can be controlled.
- Straw bales are to be placed down all surface gullies to act as localised silt traps whilst surface drainage is still live, mitigating suspended solids entering into the culvert of the un-named tributary of Pigs Lee Brook and the local drainage network.
- Works are to be planned and carried out to prevent pollution to the adjacent watercourse at all times. If the agreed working methods and/or mitigation methods cannot manage surface run-off on-site all works with the potential to cause pollution are to cease until the working and/or mitigation methods have been revised to enable the surface run-off to be controlled.
- Soft strip to buildings is to be carried out as much as is practicable to reduce the volume of deleterious materials with the potential to be washed away by surface run-off. Also, flows of surface run-off are to be directed away from immediate work areas.
- Prior to any treatment works to the silt, a temporary impermeable bund is to be constructed to prevent any bulk cement from being washed directly into the adjacent watercourse.
- Treated silts are to be temporarily stockpiled to cure in the immediate work area prior to being used in the treatment area as fills.
- The stockpiling of earthwork materials on site is to be minimised. Any stockpiles are to be located in relatively sheltered locations away from the adjacent water course.

- Where water flows/springs are encountered during the earthworks these are to be managed to direct them away from the works to mitigate against any potential siltation/contamination.
- Road vehicles are to remain on hard standings at all times; being maintained/cleaned by a road sweeper as necessary to prevent a build-up of fines with the potential to be washed away by surface water run-off and cause siltation/pollution to the un-named tributary of Pigs Lee Brook.
- The road sweeper is to discharge its contents at a suitable location where the swept arisings are not going to be impacted by surface waters or flow directly into any adjacent watercourses.
- Site plant haul routes are to be segregated from road going vehicles to ensure that the access routes to/from site remain clean. Preferably, during earthworks, site plant haul routes will be located off hard standings which form preferential routes for surface water run-off.
- Fuel/oil stores are to be located on elevated hard standings greater than 10m from any watercourse. They are also to be located away from any potential surface water run-off flows e.g. sloping roads. Any fuel tanks are to be bunded. Bunded areas are to be established around the re-fuelling facility and any oil storage areas to contain any potential spillages.
- Suitable spill kits are to be located around site and be readily available to clean up/contain any minor spillages.
- An emergency procedure to deal with spillages is to be implemented prior to works commencing.

- Prior to works commencing, sign up to the Environment Agency ‘Floodline’ flood warning system (see <https://www.fws.environment-agency.gov.uk/app/olr/register>). Also monitor the Environment Agency website for additional information on local water levels as recorded at specified monitoring points.
- In the event that a flood event is predicted, works are to cease and all potential sources of pollution, located in and/or around the impact area, are to be relocated out of any likely flow path as much as is practicable, to minimise any impact on the watercourse or adjacent environment. Also, if possible, a temporary route is to be formed e.g. by constructing a temporary bund, to direct any waters on-site to ensure that they do not flow into any potentially exposed contamination or recently cement stabilised silts.
- In the event that a flood is expected from the reservoirs located upstream of the unnamed tributary of Pigs Lee Brook, works are to cease, and all potential sources of pollution located in and/or around the site are to be relocated as much as is practicable, to a safe secure area, to minimise any impact on the watercourse or adjacent environment. The site is then to be evacuated until the flood event has passed.

6.0 Environmental monitoring/measurement

Prior to any works commencing the Urban Regen Ltd. Project Manager is to check and document the weather conditions on the '*Daily Site Diary*'. This enables potential weather associated issues to be predicted, with proactive remedial actions implemented prior to any issues arising. The assessing of the weather conditions should be an ongoing process with the information recorded at regular intervals.

All staff responsible for carrying out monitoring will receive appropriate training arranged by the Urban Regen Ltd. Project Manager.

All on site personnel are responsible for reporting any environmental issues to the Urban Regen Ltd. Project Manager immediately. This will be instructed during the site-specific site induction.

All inspection/monitoring information associated with the works are to be recorded on the designated forms and held on-site in the relevant register of the '*Construction Phase Health and Safety Plan*'.

6.1 Dust

The Urban Regen Ltd. Project Manager (or designated person – 'DP') will carry out visual dust monitoring a minimum of daily, with all information recorded on the '*Daily Dust Inspection Form*' (see Appendix E). If planned works are being carried out which may generate dust these inspections are to be increased, as necessary.

Dust monitoring is to be carried out in the following manner:

- An initial assessment of any dust is to be carried to visually determine any locations of dust generation.

- After the initial assessment has been carried out any suspect locations are to be visited to determine if dust is impacting on any environmental receptors and/or migrating beyond the site boundary.
- If dust is identified as impacting on environmental receptors and/or migrating beyond the site boundary, the source of the dust is to be identified and any corrective/remedial actions carried out to minimise any potential receptor impact.
- To supplement the daily visual dust monitoring, dust monitoring points (sticky pads) are to be established around the site boundary to record the presence of nuisance dust. These are to be analysed by a specialist consultant to provide a formal quantification on a fortnightly basis (see Appendix D).

Any dust issues reported to the Urban Regen Ltd. Project Manager are to be investigated immediately with the information recorded on the '*Dust Investigation Form*' (see Appendix E).

6.2 Noise and vibration

6.2.1 Noise measurement

The measurement of noise and exposure to noise is a specialist activity.

The unit of measurement for noise (unwanted sound) is a decibel (dB). This scale is logarithmic meaning that 90dB is ten times the intensity of 80dB and one hundred times the intensity of 70dB.

An increase of 3dB doubles the energy in the sound. This means that 87dB is actually twice as damaging as 84dB, even though the 3dB difference in sound level is difficult to perceive.

In construction there are various action levels to control exposure to noise. These are:

80dB(A) Employers must assess the risk to worker' health and provide them with relevant information.

85dB(A) Hearing protection must be provided.

87dB(A) Workers must not be exposed to noise levels that exceed this.

The various action levels are meaningless to anyone who does not have an accurate way of calculating noise levels, however, there are two rules of thumb which provide a rough indication of noise levels:

One metre rule If two people standing one metre apart, who are not wearing hearing protection, have to raise their voices to hear each other, the noise level is around or above 90dB.

Two metre rule If two people standing two metres apart have to raise their voices to hear each other, the noise level is around 85dB.

6.2.2 Vibration measurement

The measurement of vibration and exposure to vibration is a specialist activity.

In construction there are specific definitions associated with the measurement of vibration:

Daily exposure the extent of mechanical vibration a worker is exposed to during the working day which takes into account both the magnitude and duration of vibration.

Exposure Action Value (EAV) the level of daily exposure that, if exceeded, requires specific action to be taken to reduce risk.

Exposure Limit Value (ELV) the level of daily exposure for any worker that must not be exceeded.

Dependent upon the type of exposure to vibration being monitored there are different values. In this instance ‘*Whole-body vibration*’ has been considered; the relevant exposure limits being:

Daily exposure action value 0.5m/s² A(8)

Daily exposure limit value 1.15m/s² A(8)

(where A(8) represents a working day of 8 hours)

The impact of vibrations on structures is also to be considered.

6.2.3 Monitoring

Due to the location of the site, it is not anticipated that there should be any issues regarding noise and vibration with regards to the local environment, therefore, no formal monitoring is to be carried out unless it is deemed necessary. Instead, '*observational*' noise and vibration monitoring is to be carried out by Urban Regen Ltd. site personnel. In the event that formal noise and vibration is deemed necessary, a professional consultant is to be contracted to carry out the necessary monitoring.

Prior to any works commencing the Urban Regen Ltd. Project Manager is to carry out an external photographic record of the closest properties to the site to provide a baseline in the event of any reported damage.

The Urban Regen Ltd. Project Manager (or designated person – 'DP') will carry out '*observational*' noise and vibration monitoring a minimum of daily, along the site boundary, generally in line with the point source of noise and vibration and the nearest residential properties. All monitoring information is to be recorded on the '*Daily Noise and Vibration Inspection Form*' (See Appendix F). If planned works are being carried out which may generate potential excessive noise and vibration these inspections are to be increased, as necessary.

'*Observational*' noise and vibration monitoring is to be carried out in the following manner:

- The person carrying out the noise and vibration monitoring is to attend the designated monitoring location. Facing towards the noise and vibration point source, the person is to assess the general level of noise and vibration.
- If the noise is assessed as potentially excessive at this location the person carrying out the monitoring is to try and determine if the noise level is at the 85dB action level by carrying out the 'two metre test', with a site colleague. If the noise value is deemed to be in the region of 85dB works are to cease and any corrective/remedial actions carried out to reduce any potential receptor impact.
- If the vibration is assessed as potentially excessive at this location the source of the vibration is to be identified any corrective/remedial actions carried out to reduce any potential receptor impact.
- If deemed necessary, specialist consultants are to be employed to carry out the necessary tests to confirm noise and vibration levels and assist with modifications to the working methods as required.

Any noise and vibration issues reported to the Urban Regen Ltd. Project Manager are to be investigated immediately with the information recorded on the 'Noise and Vibration Investigation Form' (See Appendix F).

6.3 Odour

During works associated with silt stabilisation, the Urban Regen Ltd. Project Manager (or designated person – 'DP') will carry out odour monitoring a minimum of daily, along the site boundary, with all information recorded on the 'Daily Odour Inspection Form' (See Appendix G). If planned works are being carried out which may generate additional odour these inspections are to be increased, as necessary.

Odour monitoring is to be carried out in the following manner:

- The person carrying out the odour monitoring will walk slowly along the boundary breathing normally. If an odour cannot be detected in this way, the person is to periodically stand still, face upwind and inhale deeply.
- If an odour is identified at site boundary, the source of the odour is to be identified and any corrective/remedial actions carried out to minimise any potential receptor impact.

Wherever possible, odour inspection is to be carried out by a person unlikely to suffer from adaptation of odour.

People carrying out the odour inspections will be instructed to avoid strong food or drinks for at least 1 hour prior to inspection.

Personnel who have a cold, sore throat or sinusitis will not be allowed to carry out an odour assessment.

Any odour issues reported to the Urban Regen Ltd. Project Manager are to be investigated immediately with the information recorded on the '*Odour Investigation Form*' (See Appendix G).

6.4 Surface water

The Urban Regen Ltd. Project Manager (or designated person – 'DP') will carry out visual monitoring of surface waters a minimum of daily at the designated monitoring points (see Appendix D) with all information recorded on the '*Daily Surface Water Inspection Form*' (see Appendix H). If planned works are being carried out which may generate surface water issues these inspections are to be increased, with additional monitoring points established, as necessary.

Surface water monitoring is to be carried out in the following manner:

- Prior to any works commencing, the Urban Regen Ltd. Project Manager will carry out initial visual monitoring of the monitoring points, with a photographic record made to provide

a permanent record. This information is to be used to provide a baseline for all future monitoring. These monitoring points are:

- Un-named tributary of Pigs Lee Brook, upstream of the lodge/reservoir (SW1) – *for the duration of the works.*
 - Un-named tributary of Pigs Lee Brook, downstream of the culvert discharge point (SW2) – *for the duration of the works*
 - Un-named tributary of Pigs Lee Brook, lodge/reservoir spillway (SW3) – *for the duration of the lodge/reservoir de-watering works and until the Un-named tributary of Pigs Lee Brook is realigned/diverted.*
 - Additional temporary monitoring points established dependent upon works requirements.
- During the works all of the monitoring points are to be inspected a minimum of daily with images taken as a permanent record.
 - If necessary, Smith Grant LLP (environmental consultants) are to attend site and take samples for analysis at the monitoring points.

In addition to monitoring points detailed above, a graduated marker post is to be established within the upstream confines of the un-named tributary of pigs Lee Brook channel. This marker post is to be monitored regularly to identify the current water level and determine if it is rising – which may indicate that a flood event on site is imminent.

Any surface water issues reported to the Urban Regen Ltd. Project Manager are to be investigated immediately with the information recorded on the ‘*Surface Water Investigation Form*’ (See Appendix H).

7.0 Environmental mitigation procedure

Any environmental issues can be identified by either:

- On-site reporting of environmental issues by site personnel.
- Detection of environmental issues as part of the monitoring procedure.
- By receipt of an environmental complaint from a third party.

Any environmental issues are to be mitigated as follows:

- If surface water run-off is contaminating the un-named tributary of Pigs Lee Brook or the lodge/reservoir, it is to be diverted/stopped immediately and/or contained.
- Any chemical/pH impacted waters are to be tested to determine management/disposal requirements. It may also be necessary to sample the associated soils to determine contamination level and any methods of remediation that may be necessary.
- The Urban Regen Ltd. Project Manager will carry out an assessment of the works causing the environmental issue to ensure that they are being carried out as detailed in the relevant '*Method Statement*'.
- If works are found to be being carried out incorrectly all associated personnel are to be re-briefed on the associated '*Method Statement*' to ensure correct procedures are followed.
- If the works are identified as being carried out as detailed in the relevant '*Method Statement*', and environmental issues are still evident, works are to be modified to prevent the issue.

-
- If works cannot be modified sufficiently to prevent environmental issues, works are to cease until additional methods are implemented which can prevent the environmental issue.
 - Any outcome of the environmental mitigation is to be documented and discussed at the following '*Progress Meeting*'.
 - Operational procedures will be reviewed by the relevant Director to confirm compliance.

8.0 Complaints procedure

Any environmental complaint is to be reported to the Urban Regen Ltd. head office immediately.

Any environmental complaint is to be entered onto the relevant complaints form (see Appendix E/F/G and H) by the Urban Regen Ltd. Project Manager; being entered into the relevant section of the '*Construction Phase Health and Safety Plan*'.

The Urban Regen Ltd. Project Manager is to ensure that:

- The environmental complaint is investigated to identify the cause of the complaint.
- Any abnormal on-site activity is to be assessed, and if necessary, preventative action taken to prevent a reoccurrence of the same problem. Any actions are to be documented.
- The investigation is to be forwarded to the relevant Director for review/comment.
- The Complainant is to be contacted and updated on the investigation and the actions taken.
- The complaint is to be discussed at the following '*Progress Meeting*' identifying the cause and the measures implemented to prevent any reoccurrence.
- Any changes to site procedures to prevent reoccurrence are to be documented and conveyed to site personnel in a '*toolbox talk*'.
- If the investigation indicates that the complaint has not been justified this will also be recorded on the relevant complaint form.

9.0 Personnel, plant, and equipment

9.1 Site personnel

All personnel associated with the works are to be suitably trained, competent, and certificated.

These personnel include:

- Project Manager
- WAMITAB technically competent Manager (provided by Urban Soil Solutions Ltd)
- Site Engineer
- Qualified Plant Operators
- Labourers

All personnel are to be in possession of a valid and suitable CPCS/CCDO/CSCS/NPORS card or similar. Project Managers and Supervisors must also be possession of an SMSTS or SSSTS certificate, respectively. Copies of all certification are to be kept in the relevant section of the '*Construction Phase Health and Safety Plan*'; being recorded on the relevant register. Random certification checks are to be carried out, as necessary.

Site personnel are only to use plant and equipment that they are trained and authorised to use.

All site personnel are to receive a site specific '*Safety Induction*' and be briefed on task specific '*Risk Assessments*' and '*Method Statements*' prior to commencing any works on site. They are also to be briefed on the items held on the COSHH register which they are likely to encounter. These briefings are to be signed for and entered into the relevant register of the '*Construction Phase Health and Safety Plan*'.

Dependent upon the works to be carried out, site personnel will may also be briefed on various permits e.g. Permit to Work, Permit to Dig, Hot Works Permit etc. These briefing will also be signed for and entered into the relevant register of the '*Construction Phase Health and Safety Plan*'.

All personnel are to sign in and out of site daily using the relevant register of the '*Construction Phase Health and Safety Plan*'.

NOTE: All works associated with the treatment of the silts in the lodge/reservoir are to be directly managed by the WAMITAB technically competent manager provided by Urban Soil Solutions Ltd.

9.1.1 Training records

Personnel training is on-going, being structured to provide continual development in general site health and safety as well as their chosen discipline. Training is carried out both internally and externally with obtained certification entered onto the Urban Regen Ltd. '*Training Matrix*' (at the head office), which is used to determine staff competency for specific tasks (see Appendix I).

9.2 Plant and equipment

All plant will be accompanied with the relevant certification in accordance with '*PUWER Regulations 1998*' and provided to the Principal Contractor for entry into the relevant register of the '*Construction Phase Health and Safety Plan*'.

All machines must allow the operator to have a minimum of 1m visibility around the full perimeter of the machine at all times.

All self-propelled mobile plant operated on site must have an amber warning beacon to alert pedestrians and other plant users of operational equipment in the immediate vicinity.

All plant (inc' attachments) must be inspected and maintained daily in accordance with the manufacturer's recommendations prior to use (or post re-configuration); a written report made weekly and provided to the Principal Contractor for entry into the relevant register of the '*Construction Phase Health and Safety Plan*'.

In the event that an item of plant is faulty/damaged, it is to be taken out of service until a suitable repair has been completed or it has been replaced.

Any maintenance of plant and equipment must only be carried out by suitably trained and authorised personnel.

When not in use, all plant and equipment are to be stored securely in the plant compound located to the south of the site adjacent to the welfare facilities.

10.0 Contingency plans

To minimise any environmental impact from unforeseen events, the following contingency plans are to be implemented (see also Appendix J):

10.1 Breakdowns

In the event that an item of plant is faulty/damaged, it is to be taken out of service until a suitable repair has been completed or it has been replaced.

In the event of a total breakdown, the plant operator is to inform the Urban Regen Ltd. Project Manager immediately. The item of plant is then to be made safe by turning it off, removing the keys, isolating it, and establishing an exclusion zone around it.

Dependent upon the type of breakdown e.g. oil/fuel leak, it may be necessary to use spill kits to clean up any small leaks. For larger spillages it may be necessary to bund the area to contain any oil/fuel within the immediate area, minimising the extent of any contamination. The area can then be remediated as necessary, with the contaminated materials disposed of at a suitably licensed facility.

Any maintenance of plant and equipment must only be carried out by suitably trained and authorised personnel.

10.2 Enforced shutdowns

In the event of an enforced shutdown, all work areas are to be made safe, and all plant and equipment relocated to the secure plant compound for storage until further notice.

If, during the enforced shutdown period, critical tasks are being carried out which are required to remain live for health and safety and/or environmental reasons, this is to be agreed with senior Urban Regen Ltd. Management. If agreed, only the specific operation is to be maintained.

10.3 Unexpected conditions

Urban Regen Ltd. are carrying out the site wide remediation and preparatory works as well as the realignment/diversion of the un-named tributary of Pigs Lee Brook watercourse/culvert to enable the area to be redeveloped. As such, extensive site investigation has been carried out to identify potential areas of contamination.

The majority of the site is covered with made ground which varies between 0.5m – 11m deep. This is impacted with inorganic heavy metals, asbestos fibres, and non-volatile PAH's. Initial monitoring has also identified the presence of marginally elevated methane (CH₄) and carbon dioxide (CO₂) within the deep made ground. Monitoring is to continue through the works.

Elevated volatile (aliphatic and aromatic) petroleum range (BTEX) compounds have been identified within the shallow soil and groundwater adjacent to the above ground storage tanks (AST's) used for the storage/recovery of bulk solvents and the underground storage tanks (UST's) used to store petrol, diesel, and white spirit. Upon decommissioning/demolition of the tanks, additional site investigation is to be carried out in this area to develop the 'Remediation Strategy' to the satisfaction of the Local Authority and the Environment Agency.

Further post demolition site investigation is also necessary to further characterise the nature of the deep fills associated with the former reservoirs on-site.

Soil concentrations for the identified contaminants have been compared against accepted limits and categorised as having no significant impact to human health or controlled waters.

If during the works any additional suspected contamination/pollution is encountered or site conditions suddenly change, all associated works are to cease, and the Urban Regen Ltd. Project Manager informed immediately. The work area is then to be reassessed (by Smith Grant LLP if necessary – environmental consultants), and documentation updated/revised as necessary prior to works recommencing.

If the work area is to remain '*quarantined*' for a prolonged period, it is to be made safe and a suitable exclusion zone established around it to prevent unauthorised access.

10.4 Changes in normal operations

In the event that a flood event is predicted, works are to cease and all potential sources of pollution, located in and/or around the impact area, are to be relocated out of any likely flow path as much as is practicable, to minimise any impact on the watercourse or adjacent environment. Also, if possible, a temporary route is to be formed e.g. by constructing a temporary bund, to direct any waters on-site to ensure that they do not flow into any potentially exposed contamination or recently cement stabilised silts.

In the event that a flood event is expected from the reservoirs located upstream of the un-named tributary of Pigs Lee Brook, works are to cease and all potential sources of pollution located in and/or around the site, are to be relocated as much as is practicable, to a safe secure area, to minimise any impact on the watercourse or adjacent environment. The site is then to be evacuated until the flood event has passed.

Upon return to the site, flood damage is to be assessed and all resultant waste removed off-site to a suitably licensed facility.

11.0 Emergency procedure

Should an emergency incident occur all works are to stop, the Urban Regen Ltd. Project Manager is to be informed immediately, and the '*Emergency Plan*' is to be implemented.

The '*Emergency Plan*' is prepared as part of the '*Construction Phase Health and Safety Plan*' and provides information/details the procedures to be followed, in the event of physical injuries, mechanical damage or environmental impact etc.

As a minimum the '*Emergency Plan*' identifies the following:

- Emergency contacts (e.g. emergency services/Environment Agency/Waste Management and Spill Management contractors/water companies etc.)
- Site contact details
- Site specific restrictions (e.g. working hours/noise restrictions/protected and restricted areas etc.)
- Site layout plan detailing the main site features, foul and surface water drainage, waste locations (skips/stockpiles), sensitive receptors (inc' residents), protected or restricted areas, spill response equipment, firefighting equipment, first aid equipment etc.
- Record of fuels/oils/chemicals on site detailing location, quantity/volume, hazard and means of use.
- A flow diagram detailing the procedure to follow in the event of an incident.

All site personnel are to be briefed on the '*Emergency Plan*' during the site induction.

The emergency procedure/plan is to be displayed on the site '*Notice Board*' at all times being updated as necessary as the works progress.

Accident/incident investigation is to be carried out by a Director/external health and safety consultant (or competent delegated person), in conjunction with the Relevant Urban Regen Ltd. Project Manager. If, the accident/incident is notifiable, it is to be reported to the HSE accordingly.

Recommendations following an accident/incident investigation are to be incorporated into the health and safety management process to prevent a re-occurrence of a similar incident.

A record of any accident/incidents and associated investigations, are to be retained on site; being held within the relevant register of the '*Construction Phase Health and Safety Plan*'.

12.0 Quality, compliance, and review (see also Appendix K)

This site specific '*Environmental Management System*' is to be managed in accordance with the Urban Regen Ltd. and Urban Soil Solutions Ltd. quality and environmental management system accreditation to ISO 9001 and 14001, respectively.

It will be the responsibility of the Urban Regen Ltd. Project Manager to ensure that this site specific '*Environmental Management System*' is adhered to.

It will be the responsibility of the relevant Director to carry out monitoring, auditing, and evaluation of site performance to ensure compliance with the ISO 9001 and 14001, standard.

This site specific '*Environmental Management System*' will be reviewed through internal audits as part of the '*Quality and Environmental Management Systems*'.

External audits will be carried out to ensure that the ISO 9001 and 14001 standards are retained.

13.0 Record keeping

All records associated with the site are to be held within the relevant register of the '*Construction Phase Health and Safety Plan*' for the duration of the contract, prior to being archived for a minimum of 7 years. These records include the following information:

- Pre-construction information
- Planning permission
- Regulatory correspondence (inc' notifications and permits)
- Remediation strategy
- Method statements
- Risk assessment
- COSHH assessments
- Environmental management plans
- Engineering drawings
- Certification (personnel/plant, etc)
- Permits
- Monitoring/inspections
- Chemical analysis/validation testing
- Materials management plan
- Material tracking records
- As built plans
- Accident book/incident reporting
- Emergency procedures

Appendix A Site layout plan (including design)

Appendix B Watercourse realignment overview

Appendix C Works programme

Appendix D Monitoring points location plan

Appendix E Dust inspection/investigation/ complaints form

Appendix F Noise and vibration inspection/ investigation/complaints form

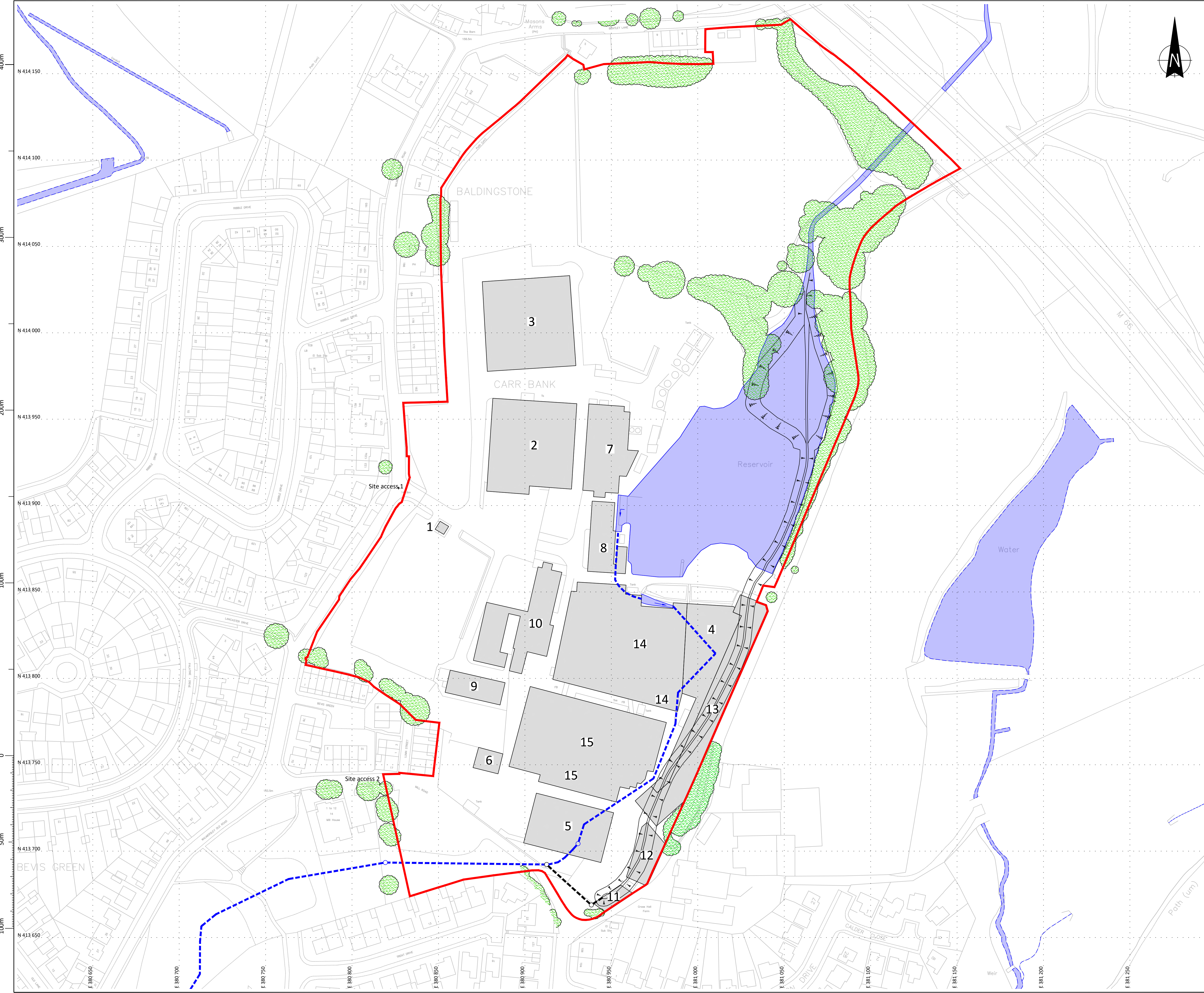
Appendix G Odour inspection/investigation/ complaints form

Appendix H Surface water inspection/ investigation/complaints form

Appendix I Urban Regen Ltd. training matrix

Appendix J Contingency Plan

Appendix K Policies, manuals, and certification



Legend:

- Site boundary
- Buildings to be demolished (see note 5)
- Un-named tributary of Pigs Lee Brook (see note 7)
- Other existing watercourses/water bodies
- Un-named tributary of Pigs Lee Brook realignment (see note 10)
- Un-named tributary of Pigs Lee Brook culvert - existing
- Un-named tributary of Pigs Lee Brook culvert - new section
- Trees/vegetation to be retained (see note 15)

Notes

1. This plan is to be read in conjunction with all other documentation associated with the re-alignment/diversion of the un-named tributary of Pigs Lee Brook watercourse/culvert.

Survey Information:			
Co-ord System:	Co-ord Type:	Primary Survey Control:	Secondary Survey Control:
OSGB36(15)	Grid	Leica SmartNet	Site

Rev	Date	Amendment	Drawn	Checked



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Client:

Barratt Homes (Manchester)

Project:

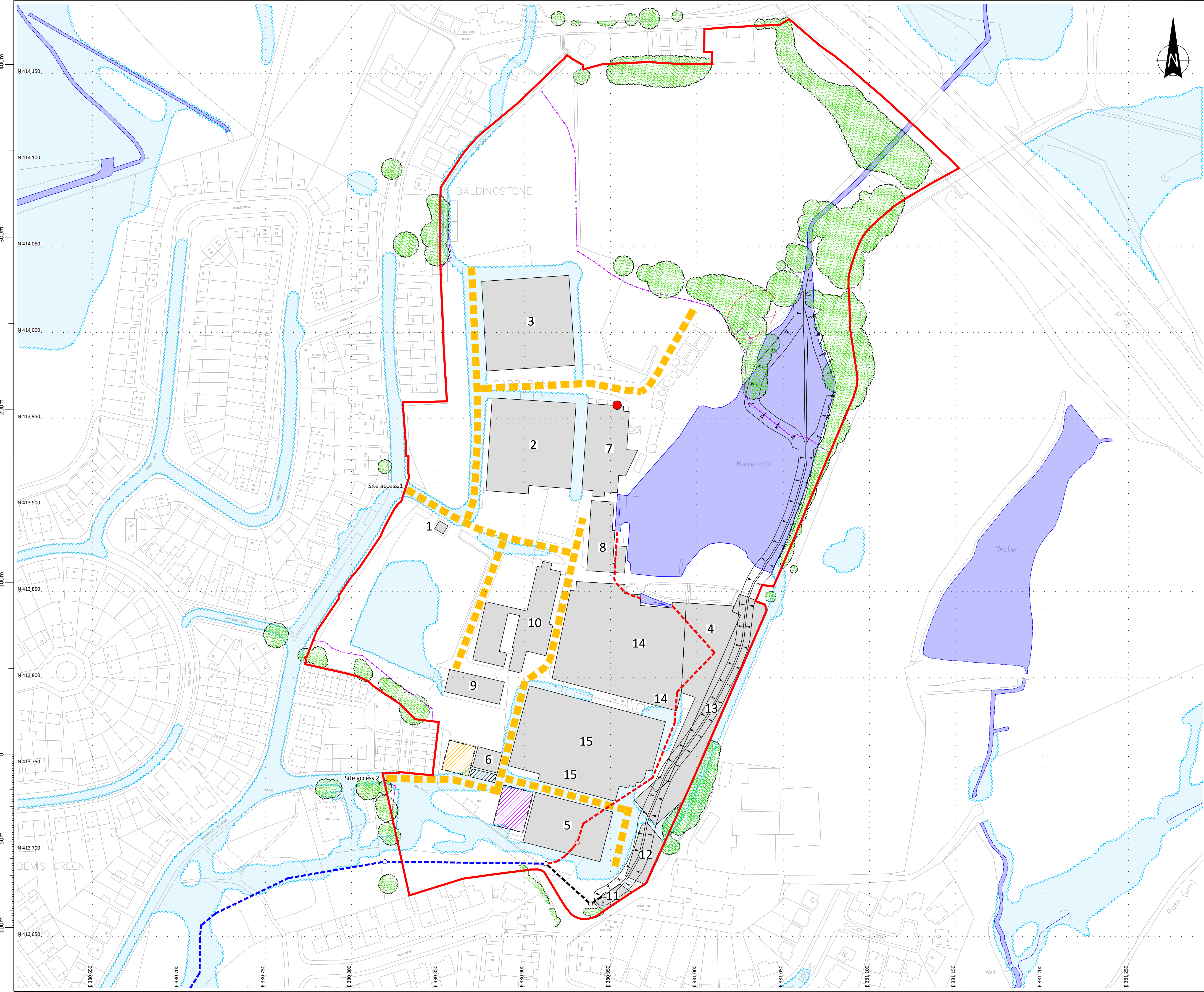
Tetrosyl, Bury

Title:

**Site layout plan
(including design)**

Scale:	First Issue:	Drawn:	Checked:
1:1000@A1	18th May 2020	D.J.Woodrow	G.Owen
Drawing No:			Revision:

333-20-002



- Legend:
- Site boundary
 - Urban Regen Ltd. welfare facilities (see note 2)
 - Urban Regen Ltd. carpark
 - Urban Regen Ltd. plant compound (see note 3)
 - Existing haul routes (see note 4)
 - Buildings to be demolished (see note 5)
 - Un-named tributary of Pigs Lee Brook (see note 7)
 - Other existing watercourses/water bodies
 - EA surface water flood zone (see note 8)
 - Un-named tributary of Pigs Lee Brook realignment (see note 10)
 - Un-named tributary of Pigs Lee Brook culvert - to be retained
 - Un-named tributary of Pigs Lee Brook culvert - to be abandoned
 - Un-named tributary of Pigs Lee Brook culvert - new section
 - Bat roost (see note 11)
 - Badger set (see note 13)
 - Trees/vegetation to be retained (see note 15)
 - Proposed alignment of tree protection fencing (see note 16)

- Notes
- This plan is to be read in conjunction with drawing '333-20-001-02 Site infrastructure plan (design installation stages)' and all other documentation associated with the re-alignment/diversion of the un-named tributary of Pigs Lee Brook watercourse/culvert.
 - Urban Regen Ltd. welfare facilities contain all necessary welfare provisions including fire fighting equipment and first aid.
 - Urban Regen Ltd. plant compound provides:
 - a secure location for all heavy plant to be stored.
 - a secure area for all fuels and oils to be stored.
 - suitable spill kits.
 - suitable waste disposal facilities.
 - Plant haul routes are to be established on hard-standings as much as is practicable being maintained to prevent/minimise trafficking on/off site.
 - All buildings on-site are to be demolished. HERAS fencing is to be established around demolition operations to form exclusion zones to contain the works and prevent unauthorised access.
 - All processing and storage of demolition arising's is to be carried out within the associated fenced exclusion zone.
 - The associated lodge/reservoir is to be de-watered and remediated whilst maintaining flows (as per design). As the lodge/reservoir is de-watered the associated required aquatic wildlife is to be removed and relocated by a suitably licensed ecologist.
 - The EA surface water flood zone detailed on this drawing is extracted from the 'Flood Risk Assessment' prepared by Cole Easedon Consultants Limited.
 - In addition to the surface water flood zone; in the event of a flood from Ashworth Moor Reservoir (located to the north east), the majority of the site would be flooded.
 - Post demolition and remediation, the un-named tributary of Pigs Lee Brook is to be realigned in accordance with the approved design.
 - Prior to demolition works being carried out, the relevant license is to be obtained from 'Natural England' to enable the approved bat mitigation works to be carried out to Building 7.
 - During the demolition works of the relevant buildings, a suitably licensed bat surveyor is to be in attendance in the event that additional bats are identified.
 - Prior to earth works commencing, the relevant license is to be obtained from 'Natural England' to enable the approved badger mitigation works to be carried out.
 - All ecological mitigation requirements are extracted from the ERAP 'Ecological survey and assessment' dated July 2019.
 - The trees/vegetation to be retained and the tree protection fencing detailed is extracted from the Ascerta 'Tree constraints and draft protection drawing' contained within the 'Arboricultural Impact Assessment' dated Oct 2018.
 - No works are to be carried out within the tree protection fencing unless all necessary permissions have been obtained from the Client.

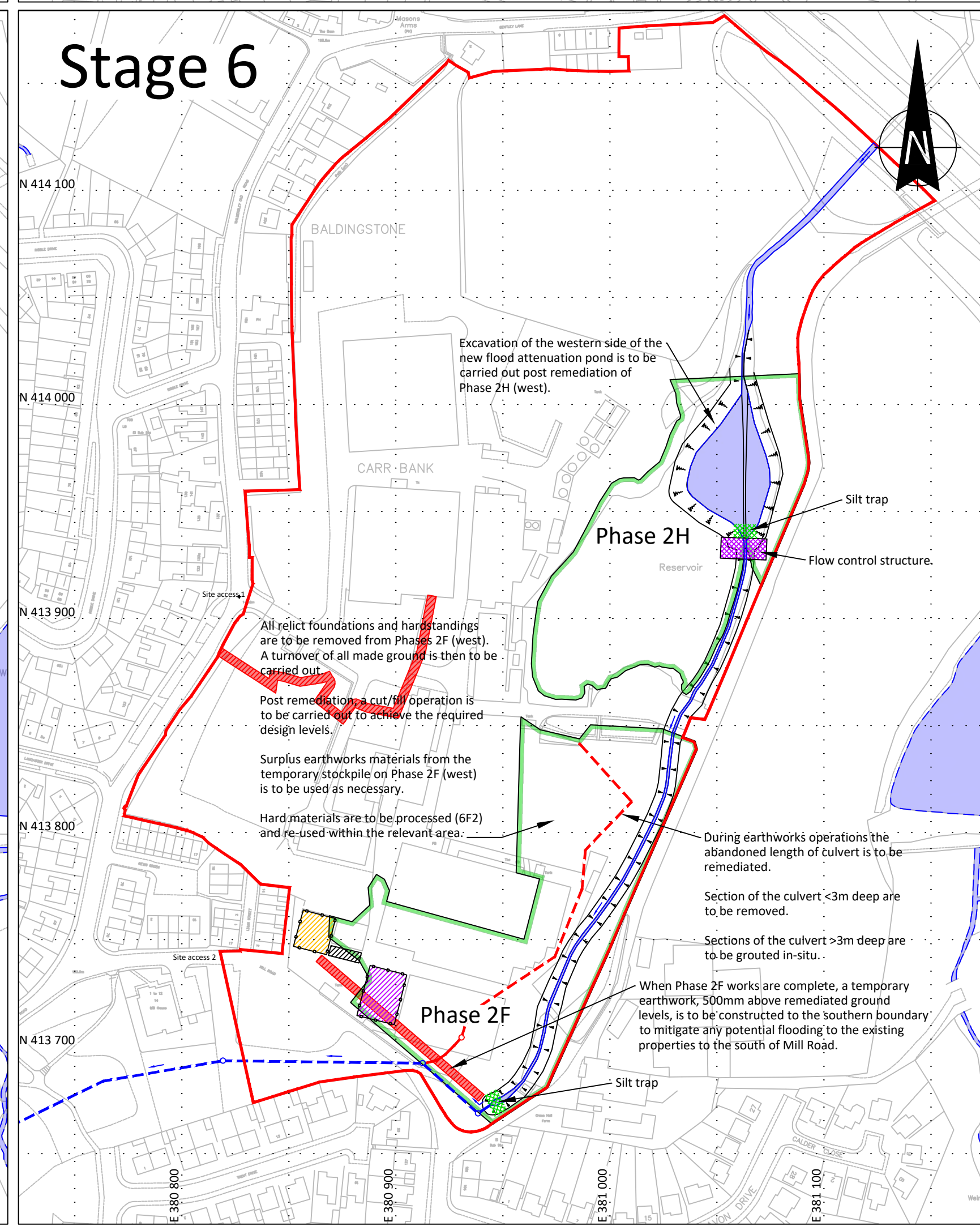
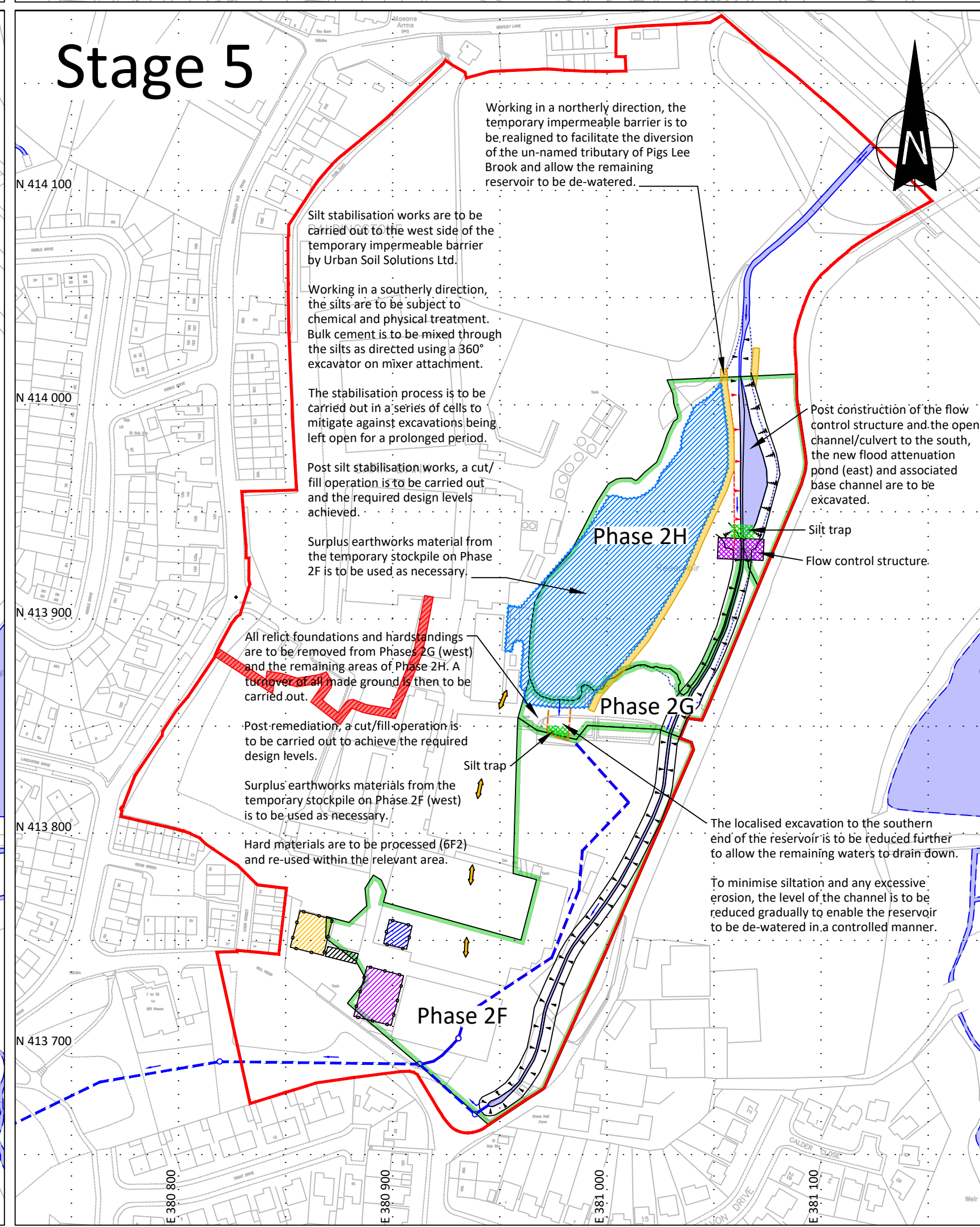
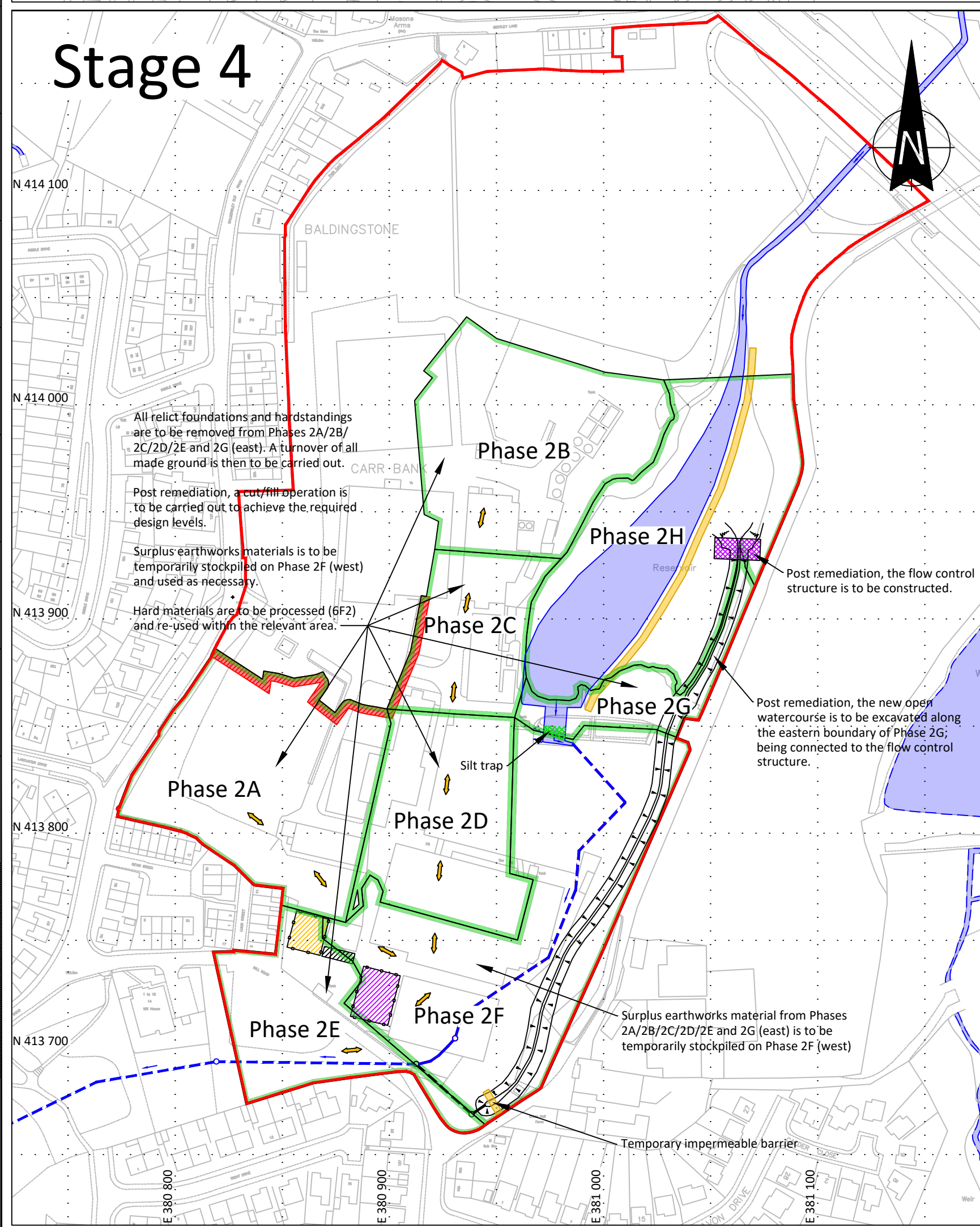
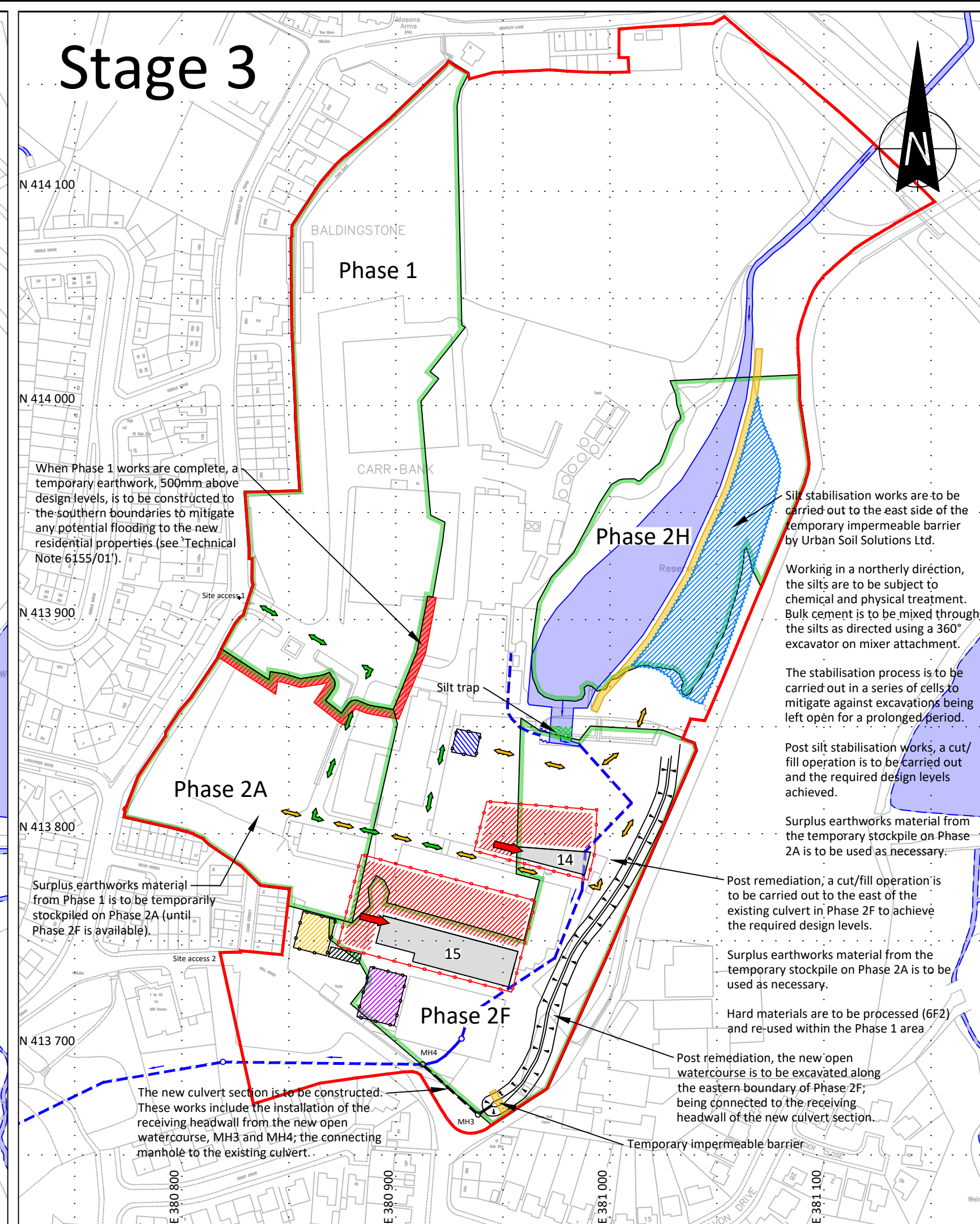
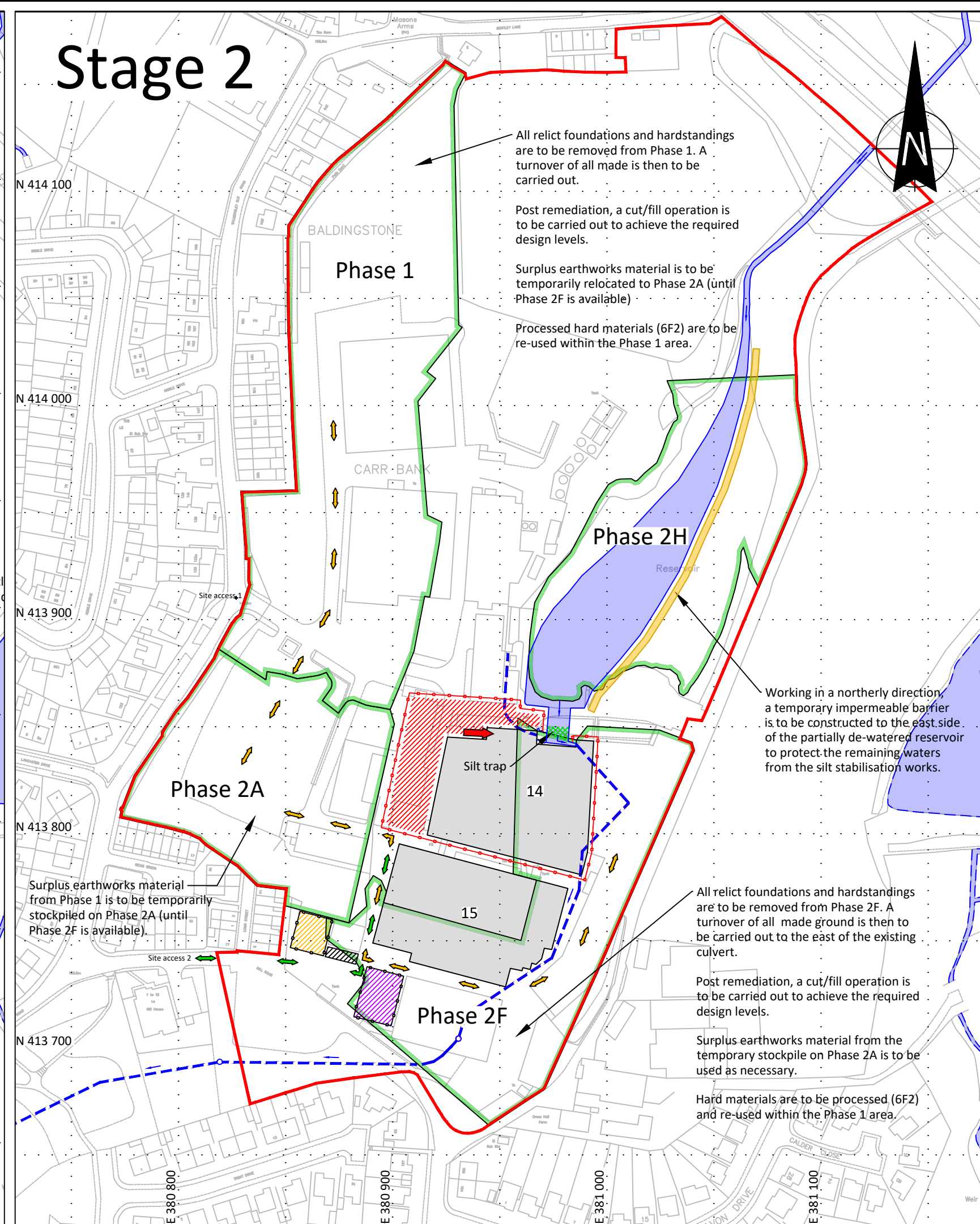
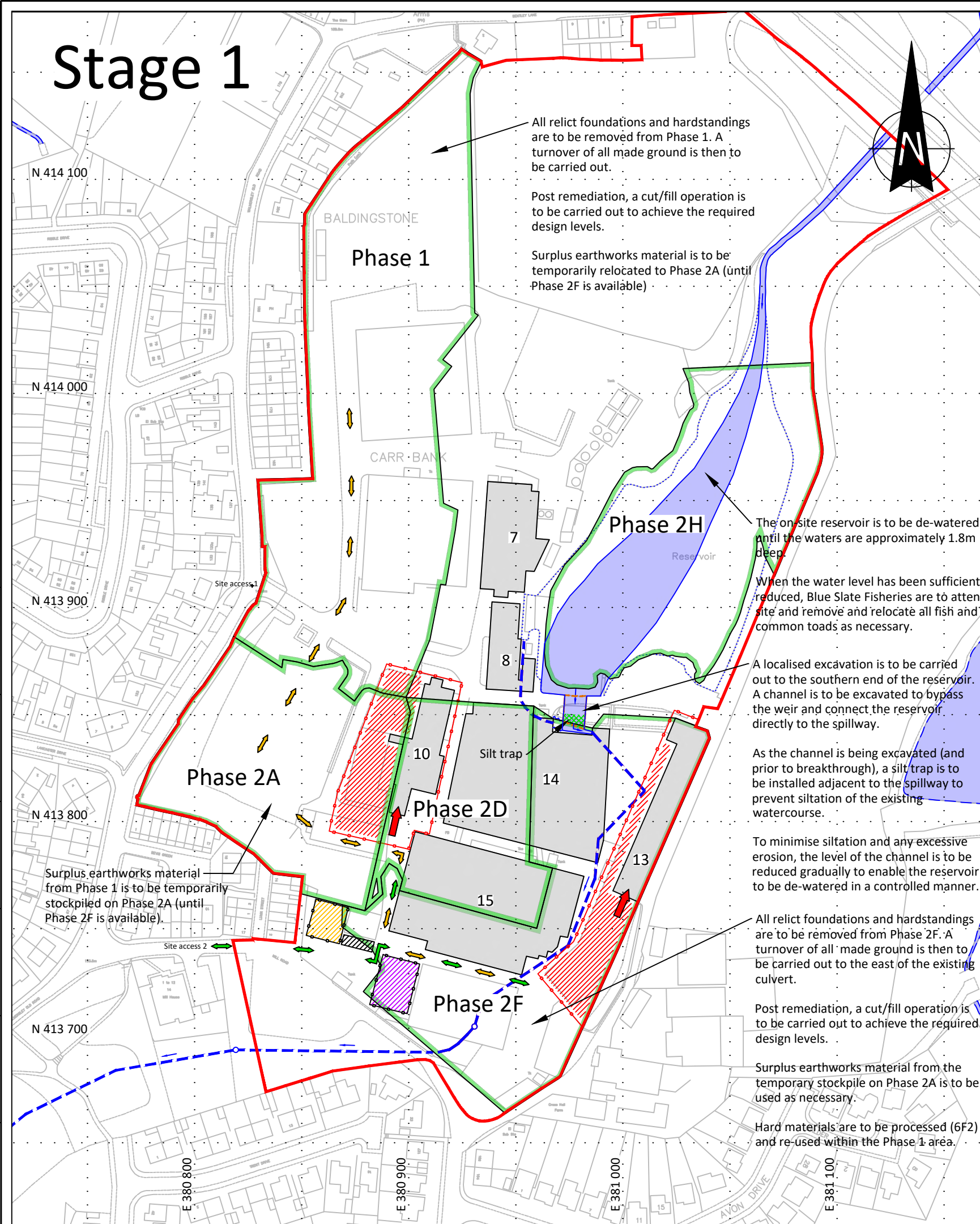
Survey Information:			
Co-ord System:	Co-ord Type:	Primary Survey Control:	Secondary Survey Control:
OSGB36(15)	Grid	Leica SmartNet	Site

Rev	Date	Amendment	Drawn	Checked



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Client:	Barratt Homes (Manchester)		
Project:	Tetrosyl, Bury		
Title:	Site infrastructure plan (existing layout and design)		
Scale:	First Issue:	Drawn:	Checked:
1:1000@A1	18th May 2020	D.J.Woodrow	G.Owen
Drawing No:	333-20-001-01		Revision:



Legend:

- Site boundary
- Phase boundaries
- Urban Regen Ltd. welfare facilities (see notes 3 and 5)
- Urban Regen Ltd. carpark
- Urban Regen Ltd. plant compound (see notes 4 and 5)
- Haul route - road vehicles (see note 6)
- Haul route - plant (see note 6)
- Buildings to be demolished (see note 7)
- Direction of demolition
- Exclusion zone fencing (see notes 7 and 8)
- Processing area (see note 8)
- Pigs Lee Brook reservoir/watercourse - live (see note 9)
- Other existing watercourses/waterbodies
- Pigs Lee Brook culvert - live
- Direction of flow
- Former extent of reservoir
- Localised excavation
- Silt trap
- Temporary impermeable barrier
- Bulk cement storage
- Silt stabilisation works
- Temporary 500mm flood barrier (see note 10)
- Pigs Lee Brook culvert - to be abandoned
- Pigs Lee Brook realignment/diversion
- Pigs Lee Brook culvert realignment/diversion
- Flow control structure
- Temporary channel

Notes

- This plan is to be read in conjunction with drawing '333-20-001-01 Site infrastructure plan (existing layout and design)', and all other documentation associated with the re-alignment/diversion of the un-named tributary of Pigs Lee Brook watercourse/culvert.
- To aid drawing clarity, the following information has been omitted:
 - Surface water flood zones.
 - Trees/vegetation to be retained.
 - Identified ecology.
- Urban Regen Ltd. welfare facilities contain all necessary welfare provisions including fire fighting equipment and first aid.
- Urban Regen Ltd. plant compound provides:
 - a secure location for all heavy plant to be stored.
 - a secure area for all fuels and oils to be stored (plus spill kits).
 - suitable waste disposal facilities.
- Post demolition, the Urban Regen Ltd. welfare facilities and plant compound are to be relocated to a convenient location to accommodate the necessary earthworks.
- Plant haul routes are to be established on hardstandings as much as is practicable to prevent/minimise trafficking on/off site.
- All buildings on-site are to be demolished. HERAS fencing is to be established around demolition operations to form exclusion zones to contain the works and prevent unauthorised access.
- All processing and storage of demolition arising's is to be carried out within the associated fenced exclusion zone.
- When carrying out works on or adjacent to the 'live' un-named tributary of Pigs Lee Brook watercourse/culvert, any environmental impact is to be prevented/minimised. If direct environmental impact cannot be prevented, suitable mitigation measures are to be implemented to restrict the effects of any works on the wider Pigs Lee Brook watercourse.
- To prevent potential flooding to properties, earthworks (500mm above finished design levels) are to be established to control flood waters for the duration of the residential development works.

Survey information:

Co-ord System:	Co-ord Type:	Primary Survey Control:	Secondary Survey Control:
OSGB36(15)	Grid	Leica SmartNet	Site

A	29/05/20	500mm flood bund detail added.	D.J.W	G.O
Rev	Date	Amendment	Drawn	Checked

Client:

Barratt Homes (Manchester)

Project:

Tetrosyl, Bury

Title:

Site infrastructure plan
(design installation stages)

Scale:	First Issue:	Drawn:	Checked:
1:2000@A1	18th May 2020	D.J.Woodrow	G.Owen

Drawing No:

333-20-001-02

A

Appendix 11

Tetrosyl, Mill Lane, Bury, BL9 6RE

REASONABLE AVOIDANCE MEASURES METHOD STATEMENT FOR AMPHIBIANS

March 2020

[ERAP (Consultant Ecologists) Ltd ref: 2019-159b]
[Bury Council ref: 63533 Condition 17]

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Document Control

Reporting	Personnel	Date
Author	Victoria Burrows B.Sc. (Hons) M.Sc. CEnv MCIEEM Principal Ecologist	28 th February 2020
Signature(s)		
Checked by	Catie Haworth B.Sc. (Hons) M.Sc.	2 nd March 2020
Reviewed and Issued	Victoria Burrows	2 nd March 2020
Version	1	
Report issued to	Barratt Manchester	

1.0 INTRODUCTION

1.1 Background

1.1.1 Planning consent for 'residential development comprising 268 no. dwellings (Class C3) with associated access, car parking, landscaping and open space' [Bury Council reference: 63533] at the former Tetrosyl site, Bevis Green Works, Mill Lane, Bury BL9 6RE (hereafter referred to as the 'site') was granted in February 2020.

1.1.2 Condition 17 of the planning consent states:

"Prior to the commencement of any earthworks, draw down and infilling of the mill lodge, a reasonable avoidance method statement for amphibians, written by a suitably experienced ecologist shall be submitted to and approved in writing by the Local Planning Authority. The method statement will include full details of:

- *The consultant name and contact details and experience;*
- *Detail of how contractors will be briefed;*
- *Procedures on how to deal with common toad if found on site;*
- *Timing of draw down and site clearance;*
- *Procedures for checking the site prior to work commencing; and*
- *Procedures for management of the site during construction.*

Only the approved method statement shall be adhered to and implemented in full prior to works commencing.

Reason. In order to ensure that no harm is caused to a Protected Species pursuant to policies EN6 – Conservation of the Natural Environment and EN6/3 – Features of Ecological Value of the Bury Unitary Development Plan and Section 11 of the National Planning Policy Framework."

1.1.3 This report / Reasonable Avoidance Measures Method Statement (RAMMS) has been prepared to satisfy the requirements of Condition 17 of the planning consent.

1.2 Rationale and Supporting Documents

1.2.1 The need for a RAMMS was identified in the *Ecological Survey and Assessment* report (ERAP (Consultant Ecologists) Ltd, July 2019), hereafter the '2019 ecology report', prepared to inform the planning application.

1.2.2 The 2019 ecology report identified that breeding common toad (*Bufo bufo*), a Priority Species, use the mill lodge (Pond 1) and records of breeding common toad are known for habitats in the wider area (particularly at Gorse Quarry Site of Biological Importance (SBI), Baldingstone SBI and Gindles Farm Biological Heritage Site (BHS)), which all support large bodies of open water within a radius of 500 metres from the Tetrosyl site.

1.2.3 Owing to the presence of breeding common toad, Pond 1 is recognised as Priority Habitat. The 2019 ecology report identified that mitigation measures in the form of a RAMMS were necessary to protect common toad during the construction period (particularly works at the mill lodge), to provide opportunities for breeding common toad in the long-term and to ensure that the redevelopment proposals comply with the requirements of national and local planning policy and best practice.

- 1.2.4 The timings referred to in this report are in accordance with the programme of works provided by Urban Regen (principal contractor) on 21st February 2020; the preparation of which was informed by ecological guidance.

2.0 REASONABLE AVOIDANCE MEASURES METHOD STATEMENT FOR THE PROTECTION OF AMPHIBIANS

2.1 Ecologist's Details

Lead / Principal Ecologist: Victoria Burrows B.Sc. (Hons) M.Sc. CEnv MCIEEM

- 2.1.1 Victoria has over 20 years experience working as a consultant ecologist. This work has included the preparation and implementation of RAMMS and licensed mitigation works for a range of amphibian species including common toad and great crested newt (*Triturus cristatus*). Victoria is experienced in the identification and handling of all British amphibian species. Victoria has held over 30 Natural England European Protected Species Mitigation (EPSM) licences for great crested newt and is a registered consultant under the great crested newt low impact class licence which is awarded by Natural England through earned recognition whilst working with amphibians.

Ecologist: Amy Sharples B.Sc. (Hons) M.Sc. GradCIEEM

- 2.1.2 Amy Sharples has worked with Victoria at ERAP (Consultant Ecologists) Ltd since 2012. Amy has experience of the completion of great crested newt and amphibian surveys and the implementation of mitigation strategies. Amy has prepared and implemented common toad RAMMS including the draining down and search of breeding ponds and the rescue and translocation of amphibians.

Ecologist Team

- 2.1.3 The ecologists will be assisted by other members of our qualified and experienced ecologist team, as needed.

Contact Details

- 2.1.4 ERAP (Consultant Ecologists) Ltd. 49a Manor Lane, Penwortham, Preston PR1 0TA

Tel: 01772 750502

Email: victoria.burrows@erap.co.uk

Website: www.erap.co.uk

2.2 Scope of Toolbox Talk

- 2.2.1 Prior to the commencement of works at the lodge, the Toolbox Talk to be delivered by the licensed ecologist will cover:
- A brief summary of common toad ecology;
 - The wildlife legislation and protection and conservation status afforded to common toad;
 - The presence of the Reasonable Avoidance Measures Method Statement (RAMMS) and the need to abide by the content (i.e. measures that will be used to protect common toad and other ecological considerations);
 - Good working practices;

- e. Protocol to be followed if a common toad is discovered (particularly when the ecologist is not on site); and
- f. Identification of common toad and other amphibians, refer to Amphibian Identification Guide (**Appendix 3**).

2.2.2 All contractors / site personnel to confirm they have understood the Toolbox Talk by signing the Toolbox Talk record sheet, appended (**Appendix 2**).

2.2.3 A copy of the Toolbox Talk will be available at the site office for reference as needed.

2.2.4 Confirmation that the Toolbox Talk exists and its content will be included within the site manager's induction process / meeting for new site personnel, as needed.

2.3 Timing of Works

2.3.1 Following ecological input into the programme of works and taking into consideration other constraints, the current (21.02.2020) version of the programme of works confirms the following relevant timings:

- | | | |
|--------------|---|----------------------|
| a. Item 12. | Common Toad breeding season restrictions (spawn stage) | 02.03.20 to 30.04.20 |
| b. Item 13. | Fish removal from lodge (under licence) | 11.05.20 to 28.05.20 |
| c. Item 14. | Commence draining of lodge
(under consented permit to discharge) | 01.05.20 to 28.05.20 |
| d. Item 104. | Open the de-culverted diversion along the eastern boundary* | 04.12.20 to 17.12.20 |

*At this time the retained pool at the northern end of the site will be completed and available for breeding common toad in the 2021 breeding season.

2.3.2 This programme of works has been arranged to ensure impacts on common toad are avoided / minimised in the following ways:

- a. Minimising the risk of common toad spawn (typically laid in March) becoming stranded and at risk of drying out / predation on the margins of the lodge as the water levels are scheduled to be lowered after the tadpoles will have hatched; and
- b. Ensuring that common toad on site are not left without a breeding pond (i.e. breeding will be permitted in 2020 and the new pond area at the northern end of the site will be available prior to the 2021 breeding season).

2.4 Biosecurity

Pollution Prevention

2.4.1 The pollution prevention measures and environmental considerations detailed in the *Construction Environment Management Plan (CEMP)*, or similar, will be adhered to.

Biosecurity and Invasive Plant Species

2.4.2 To ensure no invasive or undesirable plant species are introduced to the site and retained habitats / areas of habitat creation it is essential that plant and machinery to be brought to the site is clean and

clear of plant material and excessive mud and other materials. Contractors must not accept any hired plant or machinery onto the site that contains plant material or excessive mud / earth cover.

Amphibian Disease Precautions

- 2.4.3 Prior to the commencement of works all ecologists working on the site will familiarise themselves with the guidance provided by ARG UK entitled *Amphibian Disease Precautions: A Guide for UK Fieldworkers* (ARG UK, March 2017).
- 2.4.4 All equipment and containers used will be clean. The appropriate disinfects (Virkon) will be used prior to entering the pond areas and after works.
- 2.4.5 To avoid the risk of spread of Chytridiomycosis and Ranavirus in accordance with best practice and the *Amphibian Disease Precautions: A Guide for UK Fieldworkers* (ARG UK, March 2017) advice note, amphibians will not be actively transferred off site.

2.5 Actions to be Applied Prior to / During Draining Down of Lodge

- 2.5.1 The draining down of the lodge is expected to occur slowly over a number of days. This approach permits adult amphibians the chance to escape and the tadpoles to move with the retreating water level.
- 2.5.2 Prior to the commencement of draining down an ecologist will search the margins of the lodge for toad spawn. If spawn is present the works will be postponed.
- 2.5.3 The draining down will permit the following actions to be carried out by the ecologists:
 - a. Netting of the lodge margins with the use a long-handled pond net. Any netted amphibians (all life stages) will be deposited in a lidded bucket that contains wet moss;
 - b. The search of the terrestrial vegetation and other debris on the pond margins for amphibians. Any amphibians will be picked up and deposited into the lidded bucket;
 - c. Once draining down commences netting will be carried out periodically. As the pond levels decrease, where it is safe to do so, the shallow water will be netted and the bed and margins of the lodge will be searched for amphibians by the ecologists. Any netted amphibians will be deposited in a lidded bucket which contains rainwater and wet moss;
 - d. Once all reasonable effort has been carried out to rescue any amphibians the ecologists will cease the netting;
 - e. All captured amphibians will be recorded; and
 - f. All captured amphibians will either be deposited beneath suitable debris (log piles and mossy habitats) in the grassland and woodland to be retained in the northern and eastern margins of the site or, particularly in the case of tadpoles, in the retained pool of water at the northern end of the site.

2.6 Discovery of a Common Toad and Other Amphibians

- 2.6.1 Refer to the Amphibian Identification Guide at **Appendix 3**.
- 2.6.2 If a common toad (or other amphibian species) is discovered during the works it is recommended that the animal is carefully picked up and placed in a bucket or other suitable container. The amphibian should then be moved (by hand (not in a machine)) to the grassland and woodland habitats at the

northern and eastern margins of the site. This position has been selected as these habitats are scheduled for retention, they have connectivity to the proposed new pond area and the off-site ponds in the wider area and are away from sources of potential harm such as busy roads.

2.7 Best Practice Actions / Site Management to be Implemented During Construction

During Construction

2.7.1 To avoid the active construction working area becoming suitable for the attraction of sheltering amphibians the following best practice actions are necessary:

- a. Ensure areas of standing water / pools are not permitted to accumulate (as much as possible);
- b. Avoid the accumulation of construction waste and debris in piles (which can create suitable shelters for amphibians) by ensuring skips are available to receive waste;
- c. Store construction materials off the ground as much as is possible (i.e. on pallets);
- d. Avoid leaving trenches / holes open overnight (either complete the works in one day or ensure the holes are suitably covered or fitted with a means of escape (sloping edge or plank) to permit wildlife to escape; and
- e. Piles of crushed demolition rubble and construction materials will not be deposited within 30 metres of the new pond basin. The pond basin will be demarcated with temporary fencing and treated as a 'no-go' area for construction operations.

During Habitat Creation

2.7.2 The ecologist will attend site when the final profile of the new pond area is created. This will enable direction to be provided in relation to the shape of the banks and consideration of amphibian access in future years.

3.0 CONCLUSION

3.1 It is considered that this RAMMS provides all relevant information to inform the commencement of works and to satisfy the requirements of Condition 17 of the planning consent.

4.0 REFERENCES

ARG UK, March 2017. *Amphibian Disease Precautions: A Guide for UK Fieldworkers.*, UK: Amphibian and Reptile Groups of the United Kingdom.

Bury Council , August 1997. *Bury Unitary Development Plan (UDP)* , Bury: Bury Council .

ERAP (Consultant Ecologists) Ltd, December 2018. *Tetrosyl, Walmersley Old Road, Walmersley, Bury BL9 6RG. Confidential Addendum: Badger Survey and Assessment*, Preston: ERAP (Consultant Ecologists) Ltd.

ERAP (Consultant Ecologists) Ltd, July 2019. *Tetrosyl, Walmersley Old Road, Bury. Ecological Survey and Assessment (including a Licensed Bat Survey and Assessment and Mitigation Strategy)*, Preston: ERAP (Consultant Ecologists) Ltd.

Great Britain, 1981. *Wildlife and Countryside Act*. London: H.M.S.O.

Great Britain, 2006. *Natural Environment and Rural Communities Act*. London: H.M.S.O.

5.0 APPENDIX 1: FIGURE

Figure 5.2: Phase 1 Habitat Survey to Show Location of Lodge



6.0 APPENDIX 2: TOOLBOX TALK DECLARATION

DECLARATION:

It is confirmed that the Ecologist provided the Toolbox Talk. I and all relevant contractors understand the Toolbox Talk and will abide by the content and guidance provided:

Signed:				
Print Name:				
Position:				
Date:				

Signed:				
Print Name:				
Position:				
Date:				

7.0 APPENDIX 3: AMPHIBIAN IDENTIFICATION GUIDE

Amphibian Identification

Common frog

Adults 6-7 cm.
Smooth skin, which appears moist.

Coloration variable, includes brown, yellow and orange. Some females have red markings on lower body.

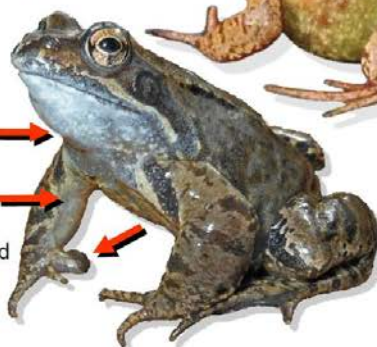
Usually has a dark 'mask' marking behind the eye.

Breeding male

Grey/pale blue throat.

Thick front legs.

Dark (nuptial) pad on inner toes of the front feet.



Markings also variable, including varying amounts of black spots and stripes.



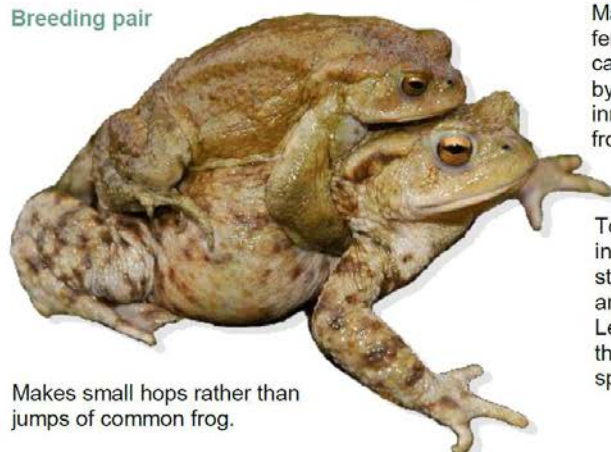
Young froglets look like smaller versions of the adults.

Spawn is laid in gelatinous clumps.

Common toad

Adults 5-9 cm. Rough skin. Brown with darker markings. Less commonly, some individuals are very dark, almost black, others are brick-red.

Breeding pair

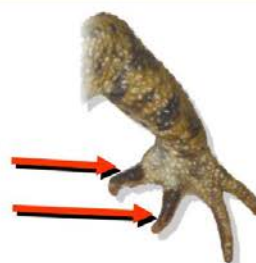


Makes small hops rather than jumps of common frog.

Toadlets transforming from the tadpole stage are often very dark in colour.



Males smaller than females. Breeding males can also be distinguished by dark (nuptial) pads on innermost two toes of the front feet.



Toad spawn is laid in gelatinous strings, wrapped around vegetation. Less conspicuous than common frog spawn.



Juveniles are similar colours to adults, including brick-red.



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Great crested newt

Grows to 16 cm, but usually smaller. Crest in male has break at base of tail. Silvery-white stripe towards rear of tail conspicuous.

Both sexes have rough, granular skins and yellow/orange bellies with irregular black spots.

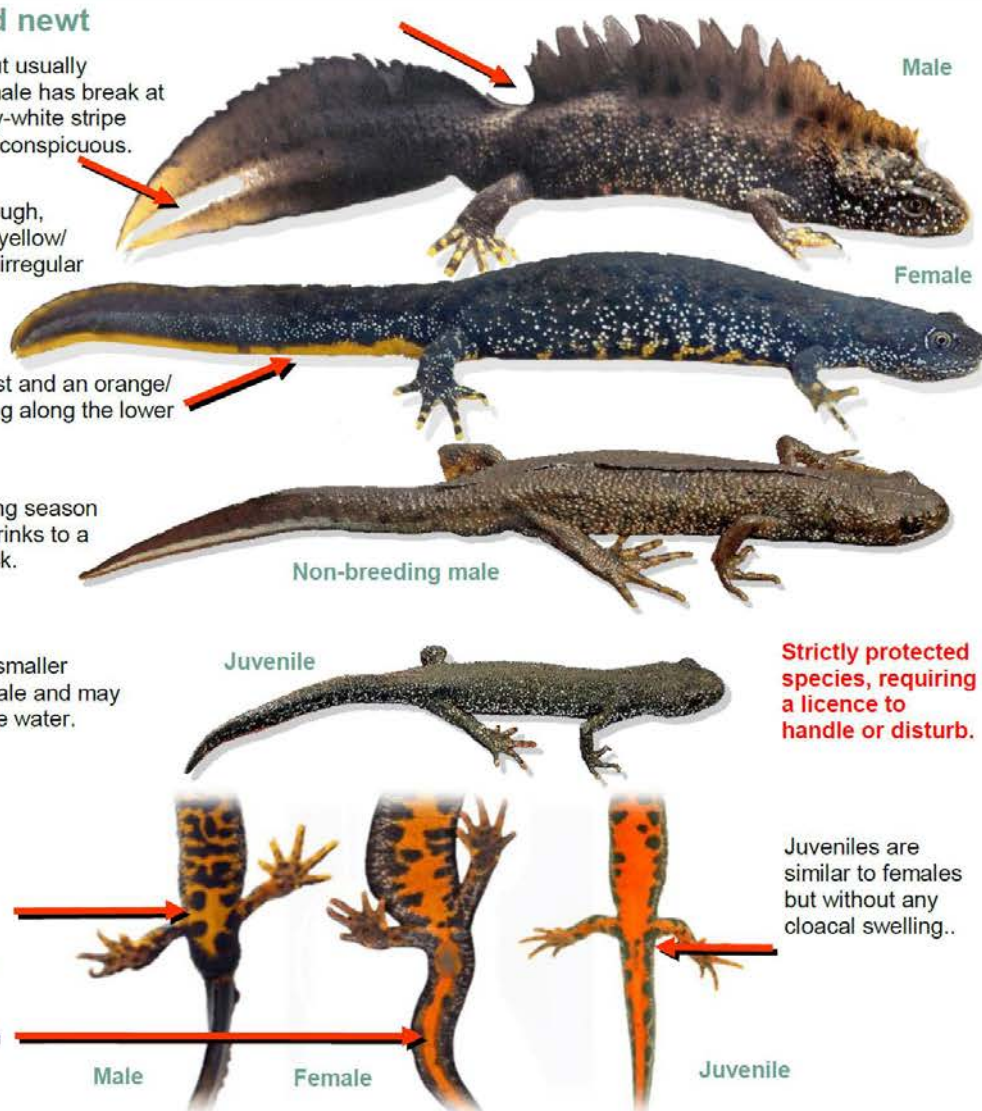
Female has no crest and an orange/yellow stripe running along the lower edge of the tail.

Outside the breeding season the male's crest shrinks to a ridge along the back.

Juveniles look like smaller versions of the female and may live on land or in the water.

Orange/yellow coloration on underside extends to flanks (not confined to central stripe). This continues along lower edge of tail in females.

Strictly protected species, requiring a licence to handle or disturb.



Alpine newt



Adults 8-11 cm, females often much larger than males. A non-native species restricted to few sites, but becoming increasingly common. Most likely to be found in garden ponds, or ponds near to gardens.

Females have a marbled pattern on the back.

Underside is bright orange, without spots (although there may be black spots on the throat in some cases).



Smooth newt

A widespread species which breeds in a variety of water bodies. Often found in garden ponds.



Male

Female

Both sexes have an orange or yellow belly stripe and rounded spots, which are larger in the male.



Male



Female

Grows to about 10 cm. Breeding male has an undulating crest running from head to tail tip.



Non-breeding male

Non-breeding adults live mostly on land. Juveniles live entirely on land.



Juvenile (eft)

Palmate newt

Grows to 9 cm. Breeding male has a ridge running along the back, rather than a crest. Dark, webbed hind feet, and tail ends in filament.



Non-breeding male



There are two pale coloured nodules on the underside of the hind feet of the female.

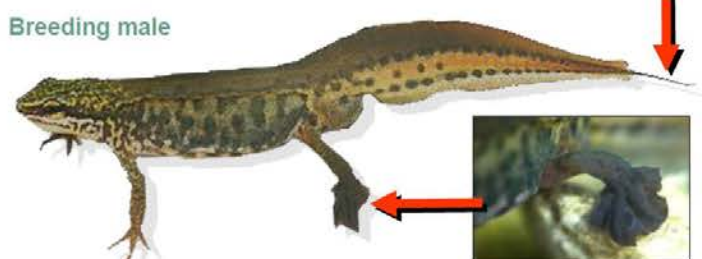


Palmate



Smooth

Throat of palmate newt has no pigment (looks pink). Throat of smooth newt is off-white and usually spotted.



Breeding male

Female



Female looks similar to smooth newt.



Underside (male)

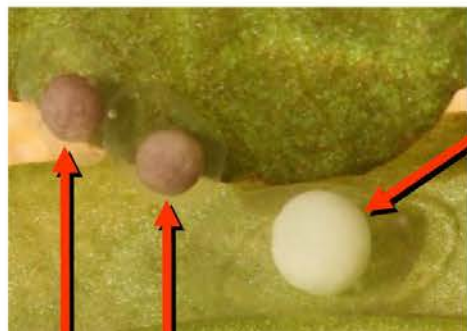
Juveniles live on land.



Juvenile (eft)

Newt eggs

Newt eggs are usually wrapped, singly, in vegetation. Leaves folded around great crested newt eggs are particularly conspicuous. To identify, unfold the leaf. Identification of undeveloped eggs is easiest.



Eggs of smooth and palmate newts cannot be distinguished by eye, but they are smaller (jelly capsule 3 mm) than great crested newt eggs and are grey or beige when newly laid.

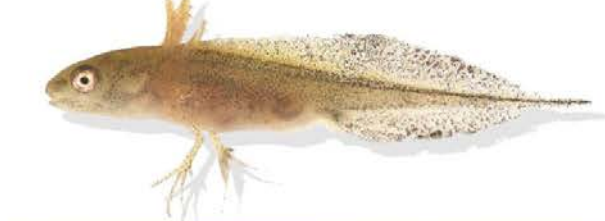
Great crested newt eggs are white, sometimes with a tint of green or orange (jelly capsule 5 mm).



Several great crested newt eggs folded into a single blade of flote grass, giving a 'concertina' effect.

Newt larvae

Examine well-developed larvae (late May to July, or to August for great crested newts).



Great crested newt larvae (above) have long toes and blotches of dark pigmentation on tail fins. Grow to approximately 5 cm.



Palmate and smooth newt larvae (above) are indistinguishable in the field—but do not have the long toes or spotted tail fins of great crested newt larvae. Grow to approximately 3 cm.

Overwintering and neoteny



Young newts usually leave the water in late summer or autumn, although sometimes they remain as larvae over the winter (e.g. smooth newt, right).

Neotenuous smooth newt



Exceptionally newt larvae grow to adult size, able to breed, but retaining their gills.

Further information Howard Inns (2009, reprinted 2011). *Britain's Reptiles and Amphibians*. WILDGuides.

Amphibian and Reptile Conservation & Fred Holmes (2014)

Additional photographs courtesy of Jon Cranfield, Ray Cranfield, Chris Gleed-Owen, Howard Inns, Mark Jones, Phyl King, Liam Russell, Duncan Sweeting and Rose Tichner.

Revised with financial assistance from Natural England.

Amphibian and Reptile Conservation www.arc-trust.org

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8.0 APPENDIX 4: RECORD OF AMPHIBIANS FOUND / ADVICE GIVEN

To be completed by the Ecologist, as needed.

Authorisation to fish using instruments (other than rod and line) under section 27A Salmon and Freshwater Fisheries Act 1975.

Permit Reference EP/EW081-S-814/17907/01 Date of Issue 03 March 2020

1. Authorisation Holder

Name Mr Craig Burns
Enterprise Blue Slate Fishery
Position Owner
Address Greystones,
Broadfield,
Oswaldtwistle,
ACCRINGTON,
Lancashire
Post code BB5 3RY

2. Fishing Instruments

Authorisation has been granted to the above named authorisation holder to use the following fishing instruments:

Instrument	Number	Additional Notes
Seine Net		
Electrofishing		

3. Species for Removal

It is a condition of this authorisation that only the following fish species may be removed:

- Coarse Fish > 1 Spp.

At: Tetrosyl Plant Reservoir (EW081-S-814); BURY; SD81001390

From: 04 March 2020

To: 04 September 2020

4. Conditions

Subject to the following condition(s):

- Check, Clean, Dry. All traps, nets and ancillary equipment must be disinfected with an appropriate disinfectant, then air dried, before being used on a different body of water.
- If any non-native species are caught the Environment Agency must be notified
- If the operation does not go ahead the Environment Agency should be notified.

5. Contact Details

If you wish to discuss your authorisation please contact the Environment Agency Fish Movements Team on 02084 745243.

6. Authorising Officer

Signed:

Paul Siddle Fisheries, Biodiversity and Geomorphology Team Leader

7. Guidance Notes

Being granted this authorisation does not give you the right or authority to remove fish from private waters; only to use the named instruments in those waters. You should obtain separate permission from the fishery owner and any relevant controlling angling club. Failure to obtain the relevant permissions could leave you liable to legal action.