SUSTAINABLE DEVELOPMENT AND DELIVERY

A specialist team within DLP Planning Ltd

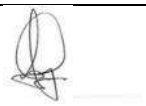
For and on behalf of
Anglo ES Levedale Ltd
c/o Anglo Renewables Ltd

Flood Risk Assessment / Drainage Strategy

Battery Storage Facility on Land at Levedale Road, Penkridge

Prepared by
Sustainable Development and Delivery
DLP Planning Ltd
Bristol

November 2023

Prepared by:	Andy Clay BSc MSc PhD Associate Director	
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SUSTAINABLE DEVELOPMENT AND DELIVERY

CONTENTS PAGE

SUSTAINABLE DEVELOPMENT AND DELIVERY

APPENDICES

1.0 INTRODUCTION

1.1 This Flood Risk Assessment (FRA) has been prepared by the Sustainable Development and Delivery Team (SDD) of DLP Planning Ltd, on behalf of Anglo Renewables Limited (the Applicant).

1.2 It has been provided to support a planning application for the construction and operation of a battery storage facility on land at Levedale Road, Penkridge.

1.3 The red line part of the site occupies an area of approximately 4.19Ha and is a part of a wider land ownership extent. It has a central OS grid reference of X: 390096, Y: 315653 and the nearest post code is ST18 9AH.

1.4 An indicative plan showing the site area (red outline) is included as **Figure 1.1** and a plan showing the site area and proposed layout is included as **Appendix A**.

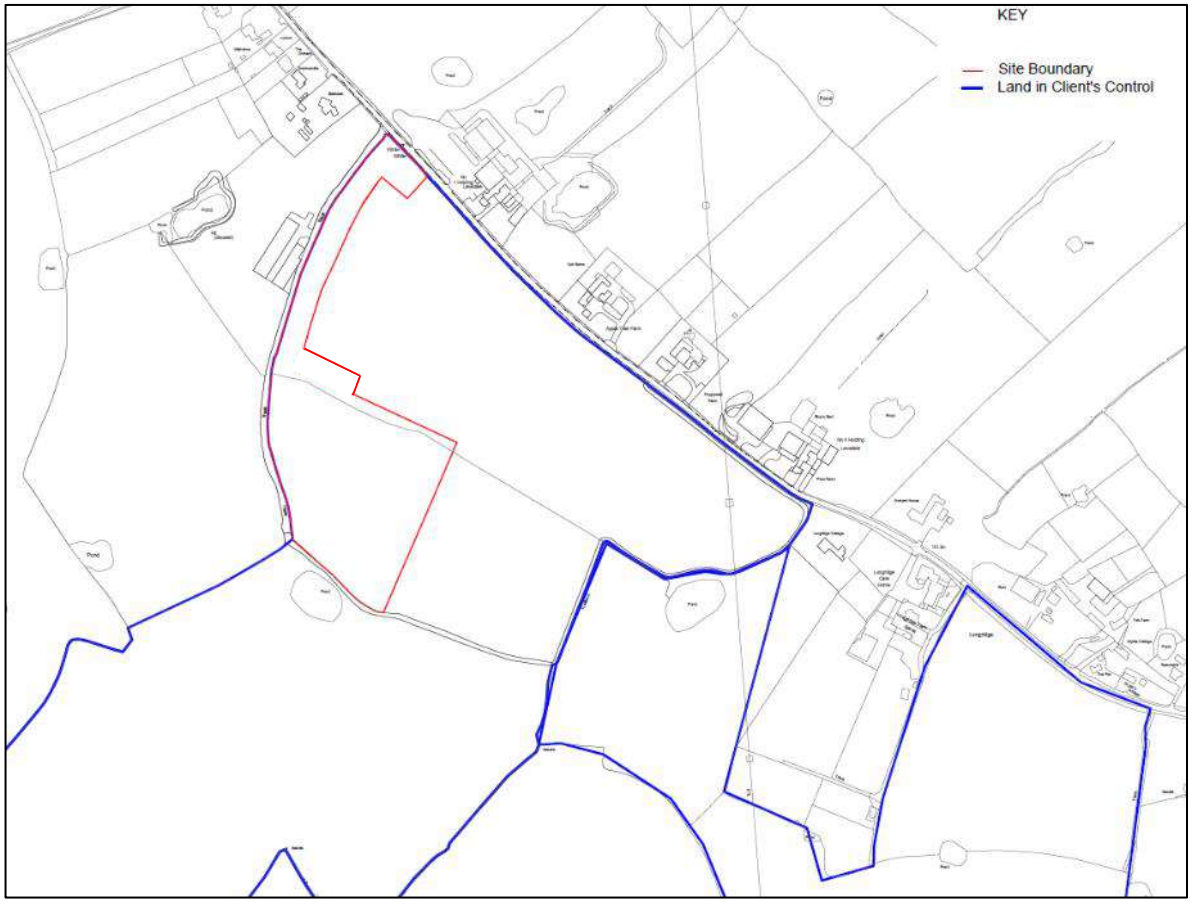

Figure 1.1: Site Location

1.5 This FRA considers the local sources of flood risk and assesses the potential implications both to and resulting from the proposed development.

1.6 It also considers the impact of the proposed development on the surface water runoff regime, and sets out a conceptual drainage strategy to manage these appropriately.

1.7 The Local Planning Authority (LPA) are South Staffordshire Council (SSC), the Lead Local Flood Authority (LLFA) is Staffordshire County Council (SCC) and the public sewerage authority is likely to be Severn Trent Water (STW).

1.8 A site walkover was completed in October 2022, to inform the baseline conditions and assessment, with a selection of photos from key locations included as **Appendix B**.

Proposed Development

1.9 The proposed development of the site is to provide a battery storage site, with the existing layout of the site and the proposed layout included as **Appendix A**.

1.10 The proposed development includes a number of containerised battery and power control system units. There is also a fenced area in the southern part of the site, which would house the main substation. There are some smaller containers next to this area for the control and welfare room, storage, DNO Room and other associated infrastructure. There is an access track that enters the site from the north and passing through the site to the main substation area.

2.0 BASELINE CONDITIONS

2.1 Levedale Road is located adjacent to the northern boundary of the site. There are agricultural fields located adjacent to the eastern, southern and western boundaries of the site.

2.2 The site walkover determined that the ground surface of the agricultural fields are generally slightly lower than the boundary bunds, typically between 0.15m and 0.30m. On the day of the site walkover, the fields were found to be damp and with standing water in places.

Topography

2.3 Based on information from OS mapping, ground levels are highest in the north-western and northern part of the land ownership extent. Ground levels are lowest in the southern and south-eastern part of the land ownership extent.

2.4 As noted above, the ground surface of the agricultural fields are generally slightly lower than the boundary bunds, typically between 0.15m and 0.30m.

2.5 A topographic survey of the site has been completed, with this included as **Appendix C**.

2.6 Ground levels are highest along the north-western boundary in the northern part of the land ownership extent with a highest level of 107.67m AOD recorded. Ground levels fall from here to the north-east towards Levedale Road and also to the south-east and south.

2.7 Ground levels are lowest in the southern part of the site with a lowest level of 102.02m AOD recorded in in the south-eastern part of the land ownership extent and 102.15m AOD adjacent to the southern boundary.

Geology

2.8 The 1 in 50,000 scale British Geological Survey (BGS) online mapping shows the land ownership extent to be underlain by bedrock geology of the Mercia Mudstone Group.

2.9 There is also a Glaciofluvial superficial deposit of sand and gravel in the northern, eastern and central parts of the land ownership extent.

Hydrogeology

2.10 The BGS and EA jointly provide a dataset that classifies the aquifer designations for England and Wales. The different designations reflect the importance of aquifers in terms of groundwater as a resource and also in supporting surface water flows. The data is useful for considering the sensitivity of groundwater from a proposed development and also the potential for groundwater to have an impact in terms of groundwater flooding.

2.11 The land ownership extent is classified as being upon a Secondary B Aquifer for the underlying bedrock. These aquifers are described as mainly lower permeability layers that may store and yield limited amounts of groundwater through characteristics like thin cracks (called fissures) and openings or eroded layers.

2.12 The BGS also provide a Groundwater Vulnerability Map, which shows the vulnerability of groundwater to a pollutant discharged at ground level. This is based on the local hydrological, geological, hydrogeological and soil properties to give a High, Medium or Low classification.

2.13 The groundwater vulnerability is Medium, with this used to classify areas that offer some groundwater protection and that are intermediate between high and low vulnerability. There is also a Soluble Rock risk in part of the land ownership extent adjacent to the northern boundary.

Soils

2.14 The Cranfield University Soilscapes website provides a simplified data-set at 1:250,000 scale. This gives a general understanding of the variations between different soil types across England and Wales, and how these affect the environment.

2.15 The soils across the northern, eastern and central parts of the land ownership extent are classified as slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils. Whereas the soils across the southern part of the land ownership extent are classified as slightly acid loamy and clayey soils with impeded drainage.

2.16 As noted above, on the day of the site walkover, the fields were found to be damp and with standing water in places.

Hydrology

2.17 The part of the land ownership extent adjacent to the northern boundary is located in the EA operational catchment of the River Penk and in the section from Whiston Brook to the River Sow.

2.18 The remainder of the land ownership extent is located in the EA operational catchment of the Whiston Brook, which is a Main River to the south, as illustrated in **Figure 2.1**.

2.19 The EA provide information on the overall water body and its chemical and ecological status derived from various sources of data, with the most recent classification in 2019.

2.20 The overall ecological status was classified as Poor and the overall chemical status was classified as a Fail, although in 2016 it had been classified as Good.

2.21 The reasons for not achieving Good status were attributed to a number of activities. This included diffuse source pollution from poor livestock management. It also included physical modification of the watercourse and impacts on flows by surface water abstraction with both of these associated with agriculture and rural management.

2.22 There are also Ordinary Watercourses in the area, notably adjacent to the eastern and a part of the south-eastern boundary of the land ownership extent. These adjoin and then drain away to the south, crossing Staffordshire Way and most likely into Whiston Brook.

2.23 The site walkover determined that the channels were moderately overgrown in some sections. The channel width is approximately 1.00m and the depth is between 0.80m and 0.50m typically with steep banks. Some sections of the channel contained water and others with damp channel bases, but water was not flowing at the time of the site walkover.

2.24 There are also some ponds within and adjacent to the land ownership extent, although outside of the site boundary. Based on information from the landowner, it is understood that the pond located directly south of the site has in the past been used for irrigation and that this soaks away into existing land drains. There is also a pipe that is understood to allow the southern pond to drain into the watercourse that is adjacent to the land ownership extent.

2.25 The ponds typically have a dense vegetated boundary, which limited observations during the site walkover. The water level in the ponds appeared to be quite depleted from the potential maximum volume that they could hold, and with the ponds in the southern part of the land ownership extent found to be completely dry.

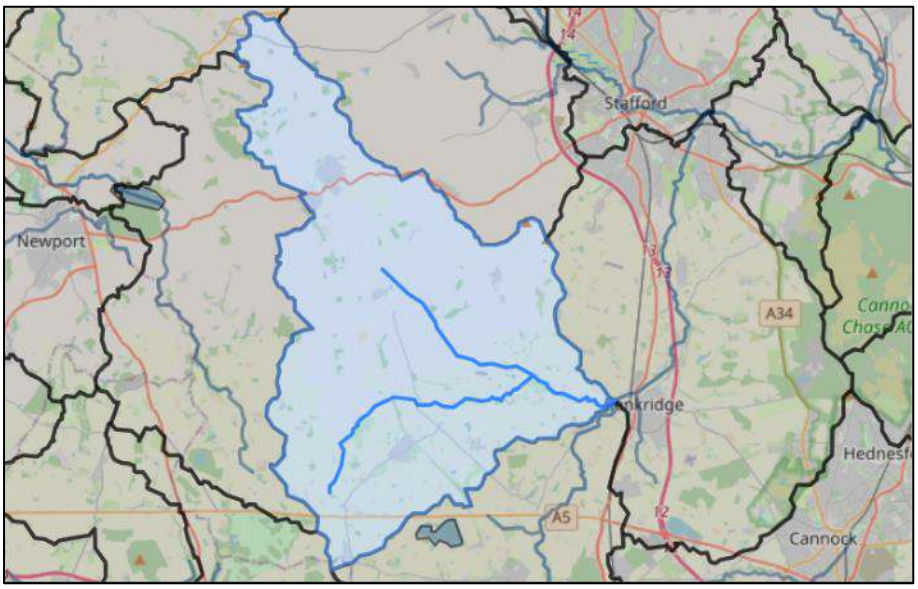

Figure 2.1: EA Operational Catchment of Whiston Brook

3.0 STATUTORY PLANNING POLICY

3.1 The revised NPPF was published in July 2018 and the latest update was published in July 2021. This sets out the Government's national policies for flood risk management in a land use planning context within England.

3.2 The Planning Practice Guidance (PPG) then sets out how to apply the NPPF.

3.3 The LPA has a statutory obligation to consult the EA on all applications in flood risk zones. The EA will then consider the effects of flood risk in accordance with the NPPF.

3.4 In terms of the flood risk classification, the NPPF categorises this into Flood Zones:

- Flood Zone 1 – Low probability (< 1 in 1000 years);
- Flood Zone 2 – Medium probability (1 in 1000 to 1 in 100 years);
- Flood Zone 3a – High probability (> 1 in 100 years) and;
- Flood Zone 3b – Functional floodplain (typically >1 in 20 years).

3.5 Sites that are located in Flood Zones 2 and 3 require a site-specific FRA to be provided, to assess the flood risks to and resulting from the proposed development and to provide appropriate measures to mitigate and manage these.

3.6 The NPPF classifies different types of land use and development in accordance with their vulnerability to flooding. This uses a classification of Highly Vulnerable, More Vulnerable and Low Vulnerable also Essential Infrastructure and Water Compatible Development.

3.7 The NPPF then sets out a matrix based on the results of the Flood Zones and the Flood Risk Vulnerability Classification to indicate whether the proposed land use or development would normally be considered appropriate for location in that particular area.

3.8 The NPPF classifies utility infrastructure as Essential Infrastructure. This is considered to be appropriate for locating in Flood Zones 1 and 2. If required, Essential Infrastructure can also be located in Flood Zone 3a and 3b, subject to passing the Exception Test.

3.9 In addition, sites with an area >1 ha also require an FRA to be provided. This is due to the potential for the development of such a land area to impact upon the surface water runoff regime and, as a consequence, to change the flooding over the site and surrounding area.

Sequential Test and Exception Test

3.10 The NPPF states that development should be located in flood zones with the lowest probability of flooding. This should be achieved by application of the Sequential Test, which aims to steer new development to areas with the lowest probability of flooding.

3.11 Where new development is proposed in areas of higher risk, the policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall.

3.12 In flood-affected areas, the Exception Test is a method to demonstrate that the flood risk to

people and property will be managed satisfactorily. This can allow necessary development to go ahead in situations where suitable sites at a lower level of risk are not available.

3.13 The Exception Test requires a proposed development to demonstrate that it will:

1. Provide wider sustainability benefits to the community that outweigh flood risk, and;
2. That it will be safe for its lifetime, without increasing flood risk elsewhere and, where possible, to reduce flood risk overall.

Local Planning Policy and Guidance

3.14 The SSC Local Plan (2012) includes a number of core policies of relevance to the assessment of flood risk and drainage.

3.15 Core Policy 3 (Sustainable Development and Climate Change requires development to be designed to cater for the effects of climate change, making prudent use of natural resources, enabling opportunities for renewable energy and energy efficiency and helping to minimise any environmental impacts. This will be achieved by a number of factors, including of relevant to this assessment by:

- Guiding development away from known areas of flood risk as identified in the Strategic Flood Risk Assessment, Surface Water Management Plan and consistent with NPPF;
- Ensuring the use of sustainable drainage (Sustainable Drainage Systems) in all new development and promoting the retrofitting of SUDs where possible;
- Ensuring that all development includes pollution prevention measures where appropriate to prevent risk of pollution to controlled waters.

3.16 Core Policy 4 (Promoting High Quality Design) requires all development proposals to achieve a high quality of design of buildings and their landscape setting, in order to achieve the vision of a high quality environment for South Staffordshire. Support will be given to proposals that are consistent with the detailed design policy set out in Policy EQ11 and the guidance in the adopted Village Design Guide Supplementary Planning Document (or subsequent revisions), and be informed by any other local design statements, and meet the following requirements of relevance to this assessment:

- To incorporate measures to reduce the risk of flooding and prepare for the predicted effects of climate change.

3.17 SSC, in conjunction with Cannock Chase Council, Lichfield District Council, Stafford Borough Council and Tamworth Borough Council, has published a Strategic Flood Risk Assessment (SFRA) for 2019.

3.18 The SFRA provides an understanding of the risk from all types of flooding across Southern Staffordshire and presents clear and robust evidence. It also provides useful information to inform future Infrastructure Planning and Neighbourhood Plans.

4.0 FLOOD RISK

4.1 An assessment of flood risk sources to the site and surrounding areas and resulting from the proposed development has been completed.

4.2 This has determined the requirement for any mitigation measures to make the development safe from flooding and/or to manage adverse flood risks that may result elsewhere.

Fluvial and Tidal Flooding

4.3 Information from the EA Flood Map for Planning (FMfP) is included as **Appendix D**, with an extract of the FMfP for where the site is located included as **Figure 4.1**.

4.4 The dark blue areas on the FMfP are classified as Flood Zone 3, light blue areas are classified as Flood Zone 2 and areas with no colour are classified as Flood Zone 1.

4.5 The site and the wider land ownership extent is shown to be located wholly in Flood Zone 1. This is an area defined as having a less than 1 in 1000-year probability of fluvial or tidal flooding and considered to be at a low risk of flooding from these sources.

4.6 These flood extents do not account for the impact of climate change over the development design life. They also do not usually take account of the benefits resulting from formal or anecdotal flood defences.

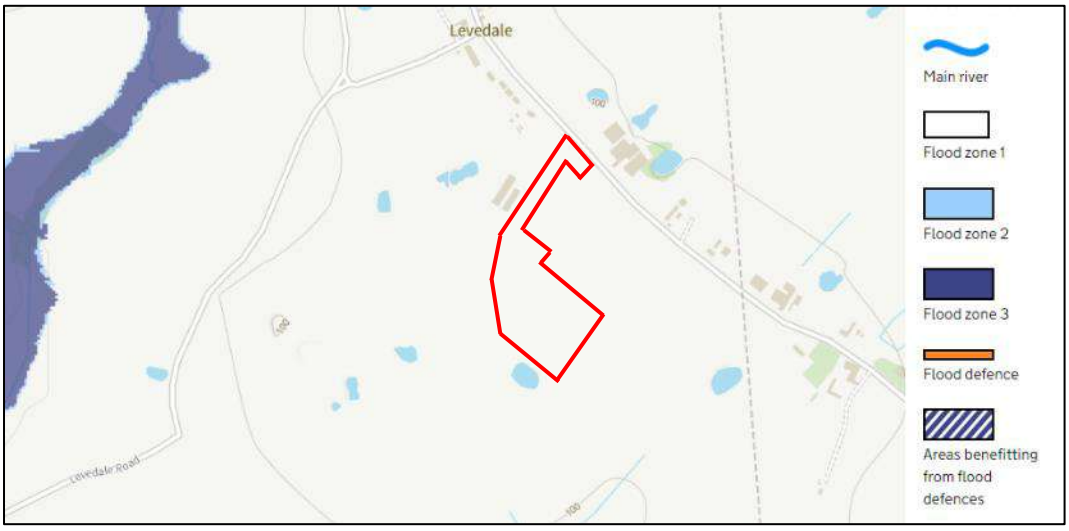

Figure 4.1: EA Flood Map for Planning

Surface Water Flooding

4.7 Surface water flooding is a result of overland flow that can follow a rainfall event, before the runoff enters a watercourse or sewer. This form of flooding is usually associated with high intensity rainfall events but can also occur with lower intensity rainfall or from melting snow where the ground is saturated, frozen, developed or otherwise has a low permeability.

4.8 An extract of the Long Term Flood Map (LTFM) showing the flow paths and ponding resulting from surface water flooding in the vicinity of the site is shown as **Figure 4.2**.

4.9 Dark blue areas on the LTFM indicate surface water flooding with a 1 in 30-year chance of occurrence and classified as a high risk; blue areas with a 1 in 100-year chance of flood occurrence and classified as a medium risk; and light blue areas with a 1 in 1000-year chance of flood occurrence and classified as a low risk. Areas with no shading have a greater than 1 in 1000-year chance of flood occurrence and classified as a very low risk.

4.10 The LTFM shows the majority of the site and the wider land ownership extent to have a very low level of risk from surface water flooding. There are some areas of surface water ponding, with these associated with the ponds in the area. There is also a surface water flow path along the eastern and part of the south-eastern boundary of the land ownership extent, associated with the watercourses in this area. This flows to the south, most likely then adjoining towards Whiston Brook.

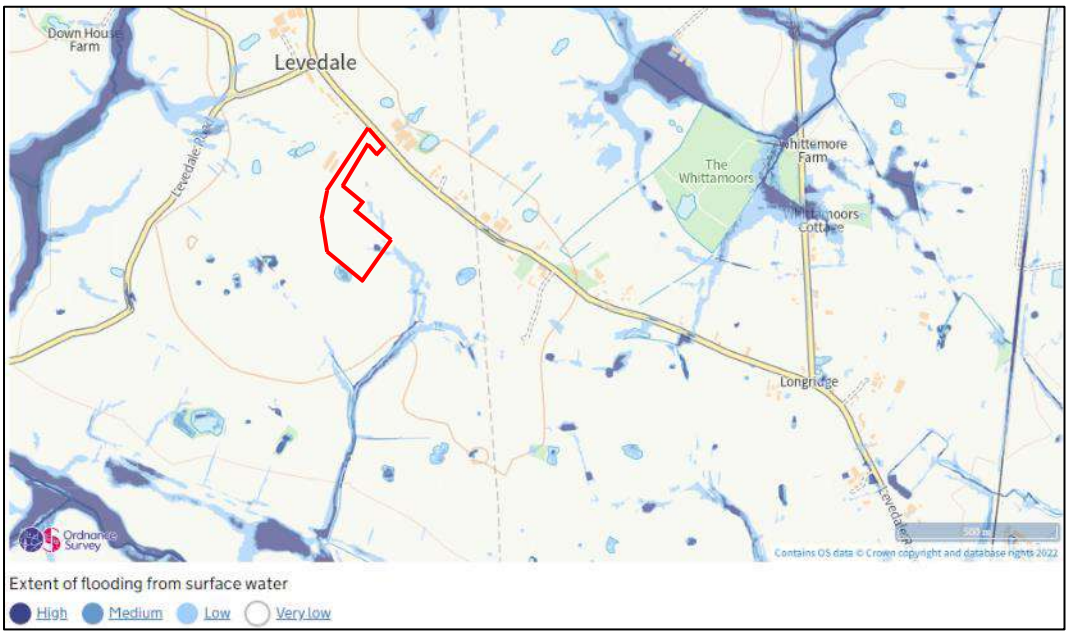

Figure 4.2: Long Term Flood Map – Surface Water Flooding

Infrastructural Flooding

4.11 Infrastructural flooding occurs when sewerage systems are overwhelmed, resulting in them surcharging. This may occur alone or be combined with other sources of flooding.

4.12 The public sewerage authority for the area is Severn Trent Water (STW) and the Highway Authority is SCC.

4.13 However, the nearest drainage infrastructure is expected to be to the north-east of the land ownership extent, along Levedale Road and associated with the village of Longridge.

4.14 Given the topography in this area and the distance from the land ownership extent, if any sewers were to surcharge, they are unlikely to pose a flood risk.

4.15 The risk of infrastructure flooding is therefore considered to be low.

Groundwater Flooding

4.16 The SFRA for SSC advises that the Areas Susceptible to Groundwater Flooding Map shows that in general, the majority of the area has a low risk of groundwater flooding.

4.17 The SFRA goes on to advise that parts of the area including along the River Trent, the River Tame, Tamworth and Stafford have a higher risk of groundwater flooding.

4.18 The Local Flood Risk Management Strategy states that historically, information on groundwater flooding has been sparse and there is currently no evidence to suggest that this is a major problem within Southern Staffordshire.

4.19 Based on this, it is anticipated that groundwater flooding issues are likely to be localised in their nature, affecting only a small number of properties.

4.20 The risk of groundwater flooding affecting the site is therefore considered to be low.

Artificial Sources of Flooding

4.21 Artificial sources of flooding can include non-natural or other sources of flooding, such as reservoirs, lakes and canals. The proximity of such features should therefore be assessed.

4.22 The LTFM shows areas that could be affected should there be a reservoir breach or failure. The site and wider land ownership extent are not shown to be within an affected area, as shown in **Figure 4.3**. The nearest area to the land ownership extent that is shown to be affected should there be a reservoir flood is associated with Whiston Brook to the south.

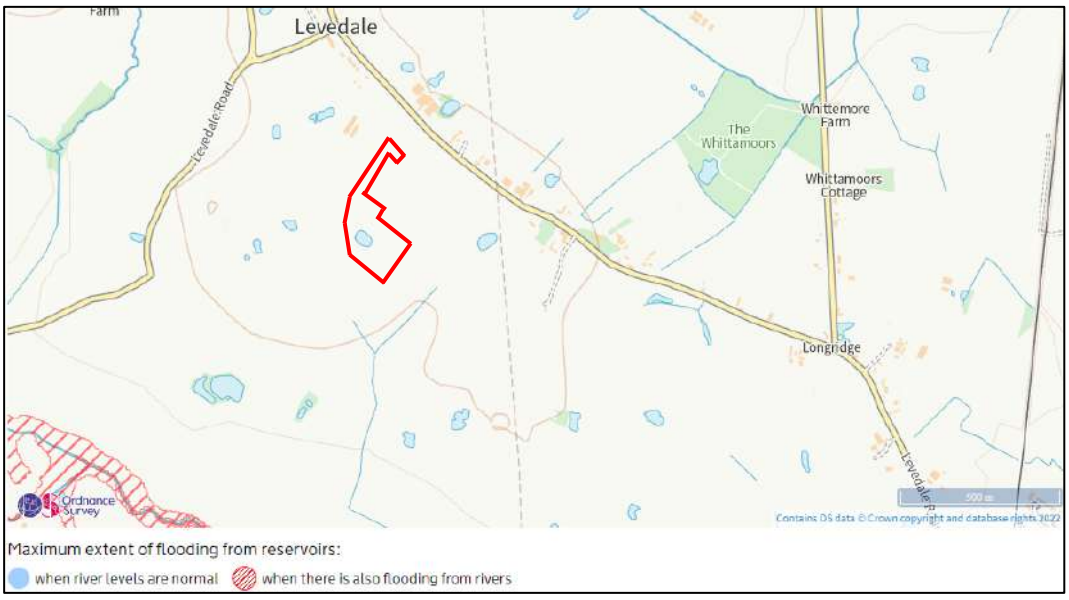

Figure 4.3: Long Term Flood Map – Reservoir Flooding

4.23 There are also some ponds in the area, including within and adjacent to the land ownership extent. Consideration should therefore be given to these features, with development maintaining a suitable distance from the top of bank in case these were to flood.

4.24 The risk from artificial sources of flooding is therefore considered to be low.

Mitigation and Management Measures

4.25 Based on the assessment of flood risk sources, the following mitigation and management measures are suggested.

4.26 The platform levels of contained areas that could be occupied during the operation of the facility should be slightly elevated above surrounding ground levels. This is suggested to protect against the possibility of shallow ponding which can sometimes occur after heavy or prolonged rainfall. This is a mitigation measure typically required for new buildings; however it is considered to be an appropriate suggestion here.

4.27 A surface water drainage strategy has also been incorporated into the proposed layout, which includes measures for managing surface water runoff from impermeable areas. The surface water drainage strategy is described in Section 5 of this FRA.

5.0 SURFACE WATER DRAINAGE STRATEGY

5.1 It is well understood that one of the effects of development is typically to reduce the permeability of the site and consequently to change its response to rainfall.

5.2 A drainage strategy is required to ensure that surface water is appropriately managed so that the development would not increase flood risk on the site and to surrounding areas.

5.3 The key components of a surface water drainage strategy are to:

- Consider the potential for infiltration of water into the ground;
- Determine an appropriate and available discharge receptor, selected in accordance with the sustainable discharge hierarchy;
- The conveyance routes across and from the site, taking into consideration the topography, layout and levels of drainage features and infrastructure; and
- Assess the impact of the development on the surface water runoff regime, and the mitigation measures to be used to manage these to an acceptable level.

Sustainable Discharge Hierarchy

5.4 The guidance on the use of SuDS in development proposals refers to what is described as the sustainable discharge hierarchy. This is defined in the NPPF and shown in **Figure 5.1**.

5.5 The aim should be to discharge surface water runoff as high up the hierarchy as reasonably practicable, and to demonstrate the reasoning behind the decision-making process.

> Generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable:
>
> 1. into the ground (infiltration);
> 2. to a surface water body;
> 3. to a surface water sewer, highway drain, or another drainage system;
> 4. to a combined sewer.
>
> Particular types of sustainable drainage systems may not be practicable in all locations. It could be helpful therefore for local planning authorities to set out those local situations where they anticipate particular sustainable drainage systems not being appropriate.

Figure 5.1: Sustainable Discharge Hierarchy

Into the ground (infiltration):

5.6 Although soakaway testing was not completed, the bedrock geology is classified to be of the Mercia Mudstone Group. It is considered unlikely that the local substrate will be suitable for an infiltration-led drainage solution.

5.7 The local soils are described as loamy and clayey. Chapter 25 of the CIRIA SuDS Manual (C753) provides typical infiltration rates for different types of substrate, with silty clay loam soils typically in the range 1 x 10^{-08} to 1 x 10^{-06} m/sec and clay soils typically less than 3 x 10^{-08} m/sec. These types of soil are classified as very poor infiltration media.

5.8 Whilst some natural drainage into the underlying substrate would occur such as for source control, the use of an infiltration-led drainage solution is not anticipated to be viable.

To a surface water body:

5.9 The nearest surface watercourse is adjacent to the eastern and a part of the south-eastern boundary of the land ownership extent. This watercourse drains away to the south, crossing Staffordshire Way and most likely then adjoining Whiston Brook.

5.10 There are also some ponds within and adjacent to the land ownership extent, although it is not known if these drain anywhere.

To a surface water sewer, highway drain, or another drainage system:

5.11 It is not known whether there is sewerage or highway drainage infrastructure across or adjacent to the land ownership extent. However, the nearest drainage infrastructure is expected to be to the north-east. Ground levels to the north-east are more elevated than those across the site, limiting the potential for a gravity drainage connection from the site.

To a combined sewer:

5.12 Combined sewerage systems convey both foul and surface water. It is not known if there is sewerage infrastructure across or adjacent to the land ownership extent. However, given the ground levels in the area where the nearest drainage infrastructure is expected, a connection to a combined sewer is not considered to be appropriate or required.

Summary:

5.13 In summary, an infiltration-led drainage strategy is not considered to be a viable option for the surface water drainage strategy. However, some natural drainage into the underlying substrate would still occur such as for source control.

5.14 The use of sustainable drainage features and permeable materials would allow the site to drain naturally through limited infiltration and evapotranspiration. A discharge from the site would also be possible, with a controlled drainage connection to the southern pond, which has an existing connection to the watercourse adjacent to the land ownership extent.

Surface Water Drainage Design

5.15 The greenfield runoff rates for the site were calculated in MicroDrainage for a 1ha area of the site. These calculations are included as **Appendix E**, and summarised in **Table 5.1**.

5.16 The surface water drainage strategy would be designed to achieve the Q_{BAR} greenfield runoff rate of 4.40 l/sec per ha from the impermeable surfaces. The design rainfall event would be the 1 in 100-year event with a 40% allowance for future climate change.

5.17 This surface water runoff rate would be achieved through incorporation of the required volume of attenuation within the surface water drainage strategy.

5.18 This was calculated in MicroDrainage to be between 628m^3 and 847m^3 for each 1ha of impermeable surface area, with the upper end of the attenuation range used for conceptual design purposes (i.e. 847m^3 per 1 ha of impermeable surface). As explained below, the site will incorporate a number of permeable surfaces, reducing this mitigation requirement.

Return Period	Runoff Rate (1 ha Area)
1 in 1-year (Q1)	3.60 l/sec
1 in 30 year (Q30)	8.60 l/sec
1 in 100-year (Q100)	11.30 l/sec
Mean Annual Flow (Q_{BAR})	4.40 l/sec

Table 5.1: Greenfield Runoff Rates (MicroDrainage)

Developmental Drainage Impacts

5.19 Given the nature of the proposed development with the use of gravel surfaced areas and reinforced amenity grass and the limited extent of significant impermeable surfaces, there is considered to be a low level of impact on the surface water runoff regime. This reduces the need for mitigation measures for the management of surface water runoff, because the attenuation volume is more of a requirement for impermeable surface areas.

5.20 The proposed development includes a number of containerised battery and inverter/transformer units. There is also a fenced area in the southern part of the site, which would house the main substation. There are also some smaller containers next to this area for the control and welfare room, storage, DNO Room and other associated infrastructure.

5.21 It is proposed for these parts of the site to be surfaced using gravel areas, with the void spaces in the gravel offering a storage volume for the surface water runoff from the containers and also during normal rainfall events to drain into the underlying substrate.

5.22 The proposals include internal access tracks through the battery storage part of site and an access from the northern part of this area to Levedale Road. These internal access tracks would be formed and surfaced with gravel.

5.23 Gravel filled trenches fitted with a perforated pipe would be located adjacent to parts of the internal access tracks. These would capture and convey surface water runoff from the site and from more extreme events, and drain it towards the eastern and southern boundaries of the site, as shown in the conceptual drainage strategy included as **Figure 5.2**.

Figure 5.2: Conceptual Drainage Strategy

5.24 Swales are proposed adjacent to the eastern and southern boundaries of the site. The surface water runoff from the site would drain into these swales from the perforated pipes and also as natural runoff from the surface of the site.

5.25 The swales would capture and convey surface water towards a detention basin included in the south-eastern part of the site. The detention basin would then drain via a piped connection with an appropriate flow control to the pond to the south, which has an existing connection to the watercourse adjacent to the land ownership extent. The southern pond is located outside of the site boundary, but as illustrated in **Figure 1.1**, within the land ownership extent.

Conceptual Drainage Design

5.26 The swales would be designed in accordance with the guidance in the CIRIA SuDS Manual, with a plan of a typical swale included below as **Figure 5.3**.

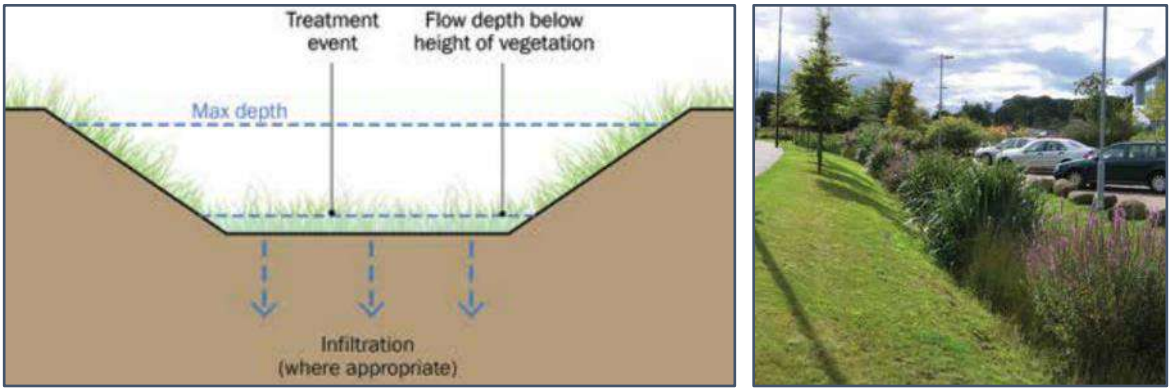

Figure 5.3: Section and Image of a Typical Swale (SuDS Manual)

5.27 It is anticipated that the swales would be included within a 3m to 5m strip of land, with the base width of the swale typically to be at least 0.5m, the swale depth 0.5m and with at least one side having a 1 in 3 side slope.

5.28 The swales would be planted with vegetation that is tolerant to occasional inundation allowing it to be a bioretention system, adding additional value.

5.29 Steeper sections of the swales would include check dams, perhaps formed from a coarse aggregate piled within the channel or with structures associated with walkways. These would help to manage the flow, and also create a series of flat channel base areas that are terraced down the length of the swale.

5.30 In addition to the conveyance of surface water runoff towards the detention basin, the swales would provide some attenuation and drainage into the substrate and other benefits (e.g. water quality and biodiversity).

5.31 The detention basin would be designed in accordance with the guidance in the CIRIA SuDS Manual, with a plan of a typical detention basin included below as **Figure 5.4**.

5.32 Detention basins are landscaped depressions that are normally dry except during and immediately following storm events. They can be designed with a small permanent pool at the outlet to help prevent resuspension of sediment particles and to provide enhanced water quality treatment.

5.33 The basin bank side slopes should not exceed 1 in 3 and basin depth should be less than 2m. The bottom of a detention basin should be fairly flat with a gentle slope towards the outlet.

5.34 The upper level of the detention basin would provide an attenuation volume to manage the surface water runoff, whereas a lower level of the detention basin could be over-deepened to create a permanent pool.

5.35 In addition to the management of surface water runoff, detention basins provide other environmental and community benefits (e.g. water quality, landscape and biodiversity).

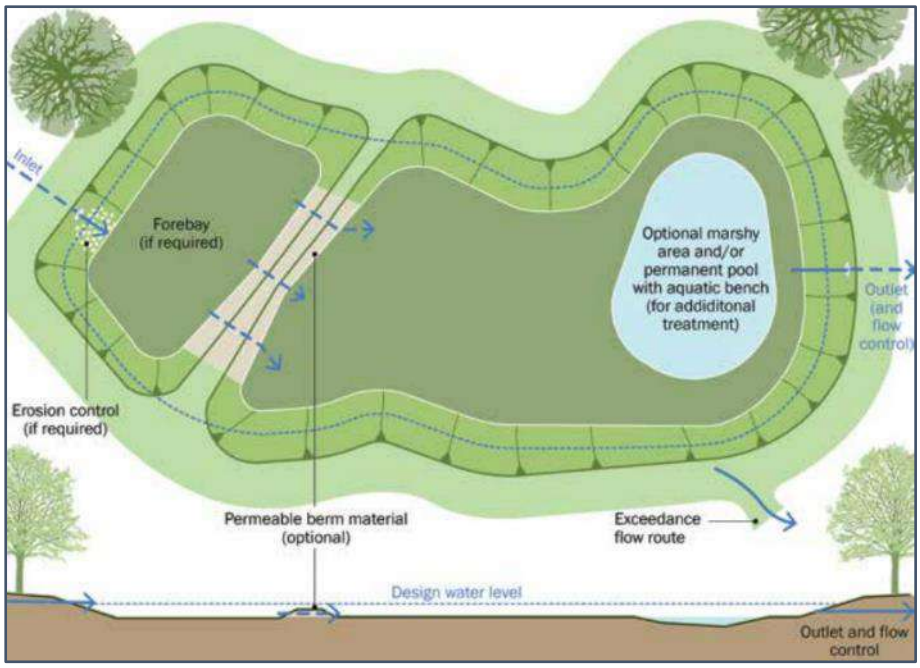

Figure 5.4: Plan and Section of a Typical Detention Basin (SuDS Manual)

Exceedance Events

5.36 The NPPF advises that exceedance flows from the surface water drainage strategy must be managed in conveyance routes that minimise the risk to people and property.

5.37 The various drainage features would be designed to manage the rainfall received from the 1 in 100-year rainfall event with a 40% allowance for climate change, and therefore provide surplus storage to manage current day events. The detention basin would also have a freeboard, which would provide an additional storage volume if required.

5.38 Swales are proposed adjacent to the eastern and southern boundaries of the site and the battery storage part of the site is to be gravel surfaced and drained using gravel filled trenches fitted with a perforated pipe. These features would capture and convey surface water runoff from an exceedance event and then drain in accordance with topography along the swale to the detention basin.

Water Quality

5.39 Water quality has been considered in accordance with the CIRIA SuDS Manual (C753). This advises that a drainage scheme must demonstrate that the hazard index for the particular

land use is less than the mitigation index of the proposed SuDS features.

5.40 The pollution hazard indices for the scheme are summarised in **Table 5.2**, with the land use having been assessed as "Other Roofs". This is based on the water quality management section of the CIRIA SuDS Manual (C753) which provides guidance on pollution hazard indices for different land uses.

Land Use	Pollution Hazard Indices		
	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Other Roofs	0.30	0.20	0.05
Total	**0.30**	**0.20**	**0.05**

Table 5.2: Pollution Hazard Indices for the Proposed Development (SuDS Manual)

5.41 The proposed development would have gravel surfaced areas, also with gravel filled trenches next to parts of the internal access tracks. These gravel areas would operate as a filter drain to enable drainage of surface water into the underlying substrate and conveyance to the east and south. Swales are proposed adjacent to the eastern and southern boundaries of the site with these draining to a detention basin.

5.42 The filter drain and detention basin have been assessed to see if they offer sufficient water quality mitigation for the proposed land use. This has been informed by the CIRIA SuDS Manual on the indicative SuDS mitigation indices for drainage into the underlying substrate.

5.43 The water quality management section of the SuDS Manual provides guidance on the indicative SuDS mitigation indices for discharges to a surface water body. The mitigation measures for the SuDS features in the surface water drainage strategy are summarised in **Table 5.3**.

Mitigation Measure	Pollution Mitigation Indices		
	Total Suspended Solids	Metals	Hydrocarbons
Filter Drain	0.40	0.40	0.40
Swale	0.5 * 0.50 = 0.25	0.5 x 0.60 = 0.30	0.5 x 0.60 = 0.30
Detention Basin	0.5 x 0.50 = 0.25	0.5 x 0.50 = 0.25	0.5 x 0.60 = 0.30
Total	**0.90**	**0.95**	**1.00**

Table 5.3: Pollution Mitigation Indices for the Proposed Development (SuDS Manual)

5.44 A factor of 0.5 has been applied to the pollution mitigation values for the swale and the detention basin. This is to account for the reduced performance that is anticipated to be possible with secondary and tertiary components when associated with the already reduced inflow concentrations resulting from the primary component, as advised by the CIRIA SuDS Manual guidance.

5.45 The assessment of water quality demonstrates that an adequate level of mitigation would be provided from the mitigation measures for the potential polluting effect from the proposed development.

5.46 As described earlier, the overall ecological status of Whiston Brook was classified as Poor and the overall chemical status was classified as a Fail, although in 2016 it had been classified as Good. This demonstrates therefore that the proposed development would not have an adverse impact on this water body.

Operation and Maintenance

5.47 Operation and maintenance would be undertaken in accordance with the recommendations as outlined in the SuDS Manual (C753).

5.48 The gravel surfaced site area and access tracks and gravel filled trenches most closely match the description for filter drains. The extract for the operation and maintenance of filter drains is provided in **Figure 5.4**, swales in **Figure 5.5** and detention basins in **Figure 5.6**.

5.49 It is anticipated that these operation and maintenance measures would be completed by the site operator, as part of the routine operational requirements for running the site.

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

Figure 5.4: Filter Drain Operation and Maintenance Requirements (SuDS Manual)

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Figure 5.5: Swale Operation and Maintenance Requirements (SuDS Manual)

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

Figure 5.6: Detention Basin Operation and Maintenance Requirements (SuDS Manual)

6.0 CONCLUSION

6.1 This Flood Risk Assessment has been prepared by the Sustainable Development and Delivery Team of DLP Planning Ltd.

6.2 It has been provided to support a planning application to SSC for a battery storage facility on land at Levedale Road, Penkridge.

6.3 The red line boundary occupies an area of approximately 4.19Ha and is a part of a wider land ownership extent.

6.4 This FRA has considered the local sources of flood risk and assessed the potential implications both to and resulting from the development proposals.

6.5 The FRA has also considered the impact of the development proposals on surface water runoff, and set out a conceptual drainage strategy for these to be managed appropriately.

6.6 A background understanding of the local topography, geology, hydrogeology, soils and hydrology was provided. A summary of relevant national and local planning policy was provided.

6.7 There is a fall in ground levels from the north-western boundary of the land ownership extent, towards the south-west, south and south-east. Ground levels are lowest in the southern corner of the land ownership extent.

6.8 The bedrock geology is mudstone and with the northern, eastern and central parts of the land ownership extent also having a superficial deposit of sand and gravel.

6.9 The soils in the northern, eastern and central parts of the land ownership extent are loamy and clayey, and typically would have impeded drainage. Whereas the soils across the southern part are loamy and clayey and typically with impeded drainage.

6.10 The nearest surface watercourses are adjacent to the eastern and a part of the south-eastern boundary of the land ownership extent. These adjoin and then drain away to the south, most likely into Whiston Brook.

6.11 There are also some ponds within and adjacent to the land ownership extent, although outside of the site boundary. Based on information from the landowner, it is understood that the pond to the south of the site has in the past been used for irrigation and that this soaks away into existing land drains. There is also a pipe that is understood to allow the southern pond to drain into the watercourse that is adjacent to the land ownership extent.

6.12 The proposed development is Essential Infrastructure and wholly located within Flood Zone 1. The NPPF advises that this is an appropriate use of land. However, an FRA would still be required given that the site has an area that is greater than 1 ha.

6.13 An assessment of flood risk sources concluded that these represent a low or very low risk to the site.

6.14 The FRA suggests for the platform levels of contained areas to be slightly elevated above surrounding ground levels, to protect against the possibility of shallow ponding. A surface water drainage strategy would also be incorporated with measures for managing surface water runoff.

6.15 Based on the desk based assessment, an infiltration-led drainage strategy was not considered to be a viable option for the surface water drainage strategy. However, some natural drainage into the underlying substrate would still occur such as for source control.

6.16 Given the nature of the proposed development with the use of gravel surfaced areas and reinforced amenity grass and the limited extent of significant impermeable surfaces, there is considered to be a low level of impact on the surface water runoff regime. This reduces the need for mitigation and management measures.

6.17 The proposals include internal access tracks, with these formed and surfaced with gravel. Gravel filled trenches fitted with a perforated pipe would be located adjacent to parts of the internal access tracks to capture and convey surface water runoff and also resulting from more extreme events, and drain it towards the eastern and southern boundaries of the site.

6.18 Swales are proposed adjacent to the eastern and southern boundaries of the site. The surface water runoff from the site would drain into these swales from the perforated pipes and also as natural runoff from the surface of the site.

6.19 The swales would capture and convey surface water towards a detention basin included in the south-eastern part of the site.

6.20 A pipe could be used to provide a controlled drainage connection from the detention basin to the southern pond, with this located within land that the client controls and which has an existing drainage connection to the watercourse adjacent to the eastern boundary of the land ownership extent.

6.21 The concepts for the drainage design were set out, making reference to the design guidance provided in the CIRIA SuDS Manual. The use of sustainable drainage features would provide additional environmental and community benefits.

6.22 Sustainable drainage features and permeable materials would allow the site to drain naturally through limited infiltration and evapotranspiration. A controlled drainage connection from the detention basin to the southern pond could also be used, and which has an existing drainage connection to the watercourse adjacent to the eastern boundary of the land ownership extent.

6.23 The management of exceedance events was also considered, with the proposed drainage features capturing and conveying surface water runoff and providing additional storage for future climate change and also a freeboard in the design.

6.24 Water quality was considered in accordance with the CIRIA SuDS Manual. For each of the assessed water quality parameters, the mitigation provided by the measures in the drainage strategy would be higher than the pollution hazard indices from the land use.

6.25 Operation and maintenance would be undertaken in accordance with the recommendations as outlined in the SuDS Manual (C753). This would be completed by the site operator, as part of the routine requirements for running the site.

6.26 This FRA has concluded that with incorporation of the suggested mitigation and management measures, that the proposed development of the site is considered to be appropriate in terms of flood risk and drainage.

6.27 The proposed development is considered to be in accordance with the national flood risk and drainage guidance provided in the NPPF and also the relevant local polices set out in the Local Plan. A surface water drainage strategy would be provided for the proposed development and that incorporates SuDS features. It is suggested that a detailed design of this strategy is provided at a later stage as part of an appropriate planning condition.

Appendix A Proposed Development Layout

REVISION	CLIENT	Date 06.06.2023	OS Ref. -	Drawn by MRK
	Anglo Renewables Ltd	Scale 1:1000 @ A1	Drawing no. SK01	Checked
		Job no. ST5050P	-	
	PROJECT Land on the South West Side of Levedale Road, Penkridge, Staffordshire, ST19	DRAWING TITLE Proposed Layout		

DLP PLANNING LIMITED
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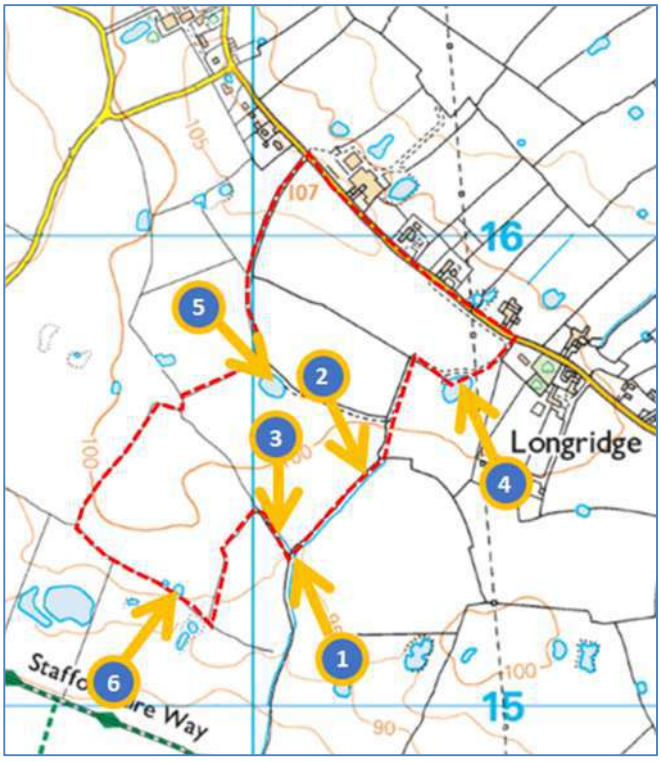
SUSTAINABLE DEVELOPMENT AND DELIVERY

Appendix B Photos from Site Walkover

October 2022 Site Walkover – Photos



Location 2 – Watercourse

Location 2 – Watercourse

Location 1 – Watercourse

Location 3 – Watercourse

Location 1 – Agricultural Field

Location 3 – Agricultural Field

Location 4 – Pond

Location 6 – Dry Pond

Location 4 – Pond

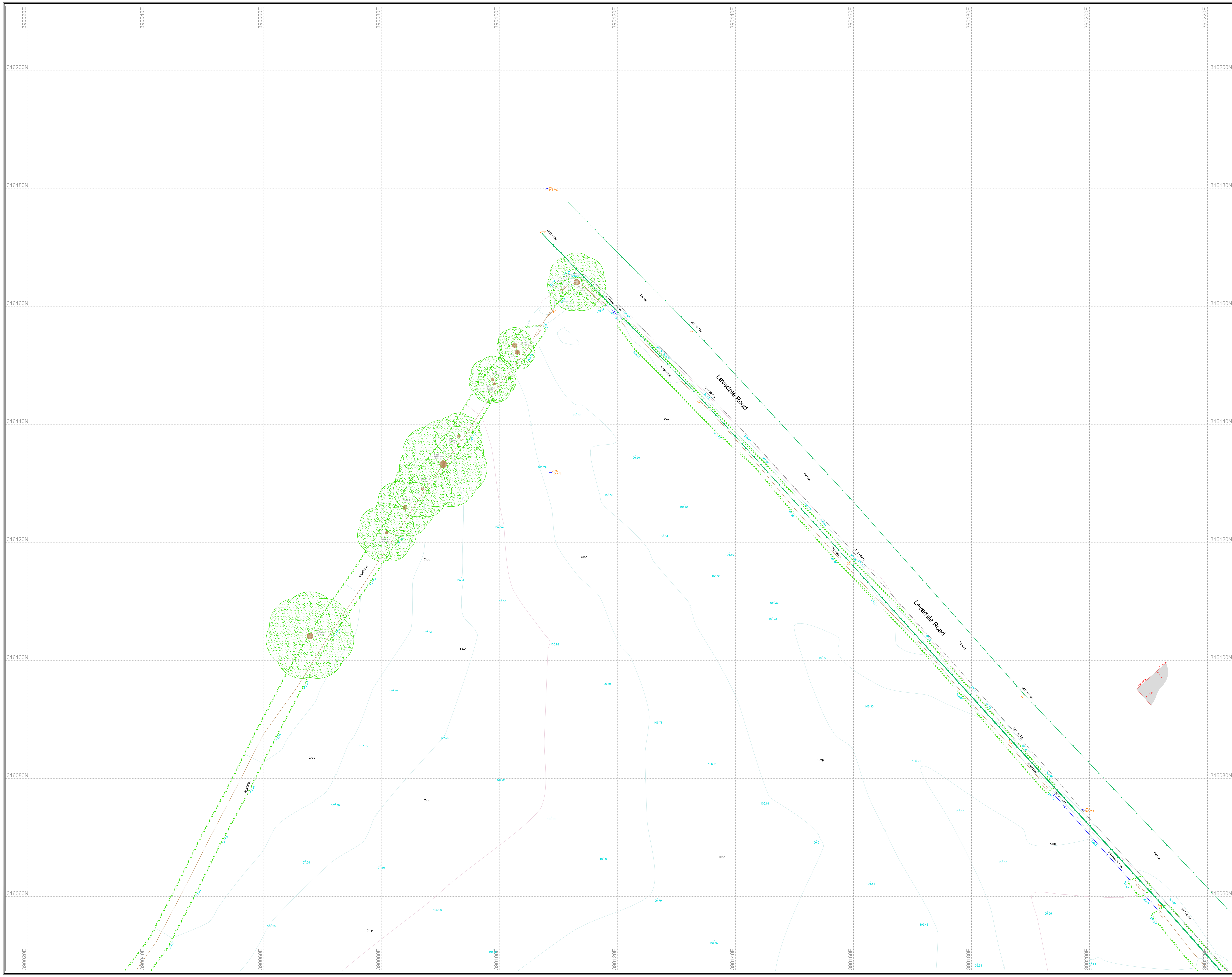
Location 6 – Dry Pond

Location 5 – Pond

Location 5 – Pond

SUSTAINABLE DEVELOPMENT AND DELIVERY

Appendix C Topographic Site Survey



Station	Easting (m)	Northing (m)	Level (m)
JH01	390108.061	316179.870	105.260
JH02	390108.687	316131.873	106.875
JH03	390049.326	316029.255	107.116
JH04	390198.919	316074.645	105.559

Survey Coordinates and Grid
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- ☐ *Arbitrary but approx. related to North*
- ☐ *Best fit to an Ordnance Survey Digital Sheet*
- ■ *Related to the Ordnance Survey National GPS Network*

Levels
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Client: Anglo ES Levedale Ltd
Project: Levedale Road, Penkridge ST18 9AH
Title: Topographical Survey - 2D

Surveyed: JH/JN Checked: NS Date: 09/06/2022
Sheet No: 1 of 6 Scale: 1:200@A0
Job No. 5468 Rev. -

NOTES:
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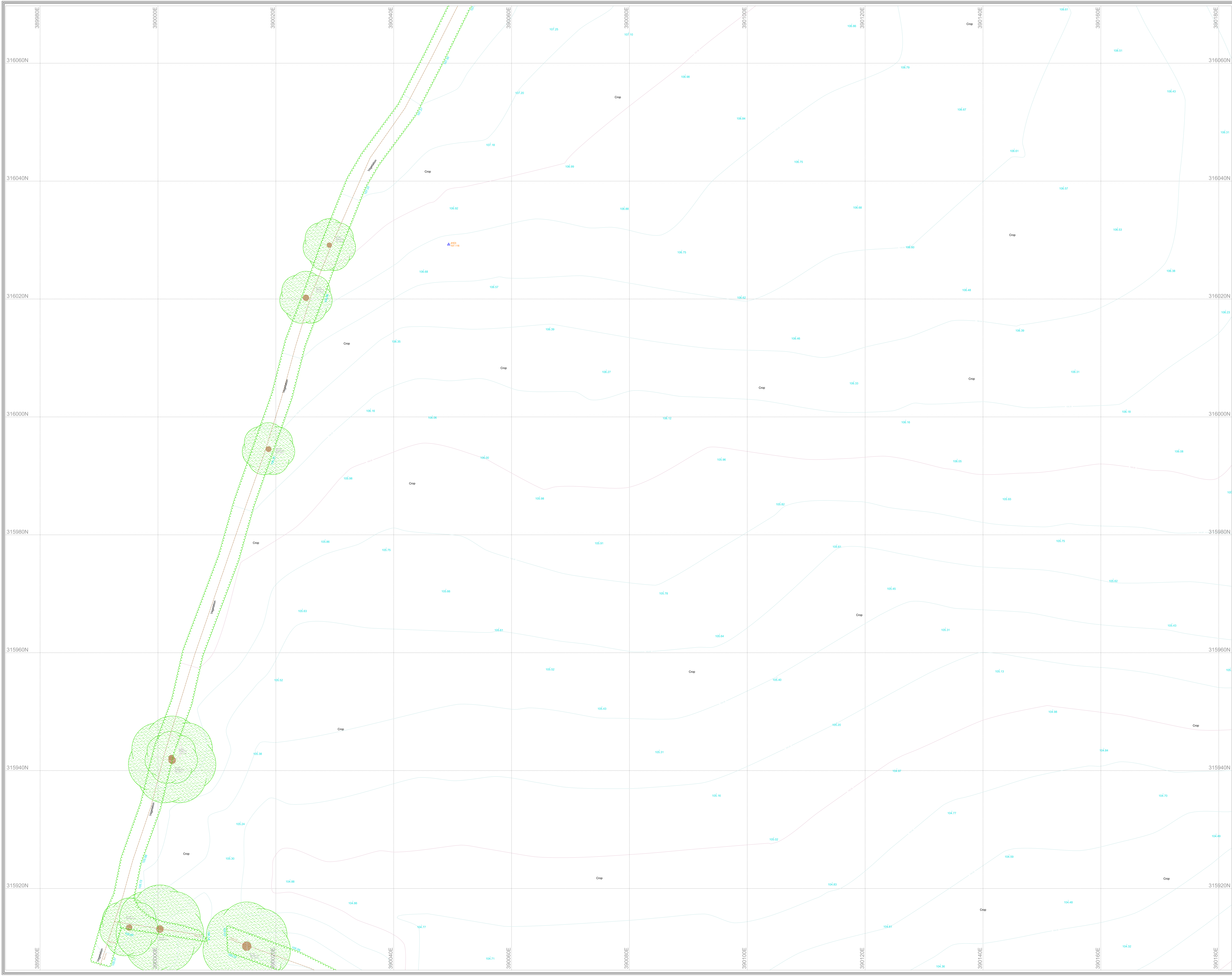

Building
Building Canopy
Edge of Scrub
Edge of Vegetation
Embankment Bottom
Embankment Top
Kerb
Kerb - Drop
Kerb - Top
Steps
Trackway
Tree Canopy
Verge
Verge Concrete
Verge Grass
Verge Tarmac
Wall
Water Edge

Suffixes
(D) - Dilapidated (L) - Illuminated (R) - Retractable (RF) - Reflective

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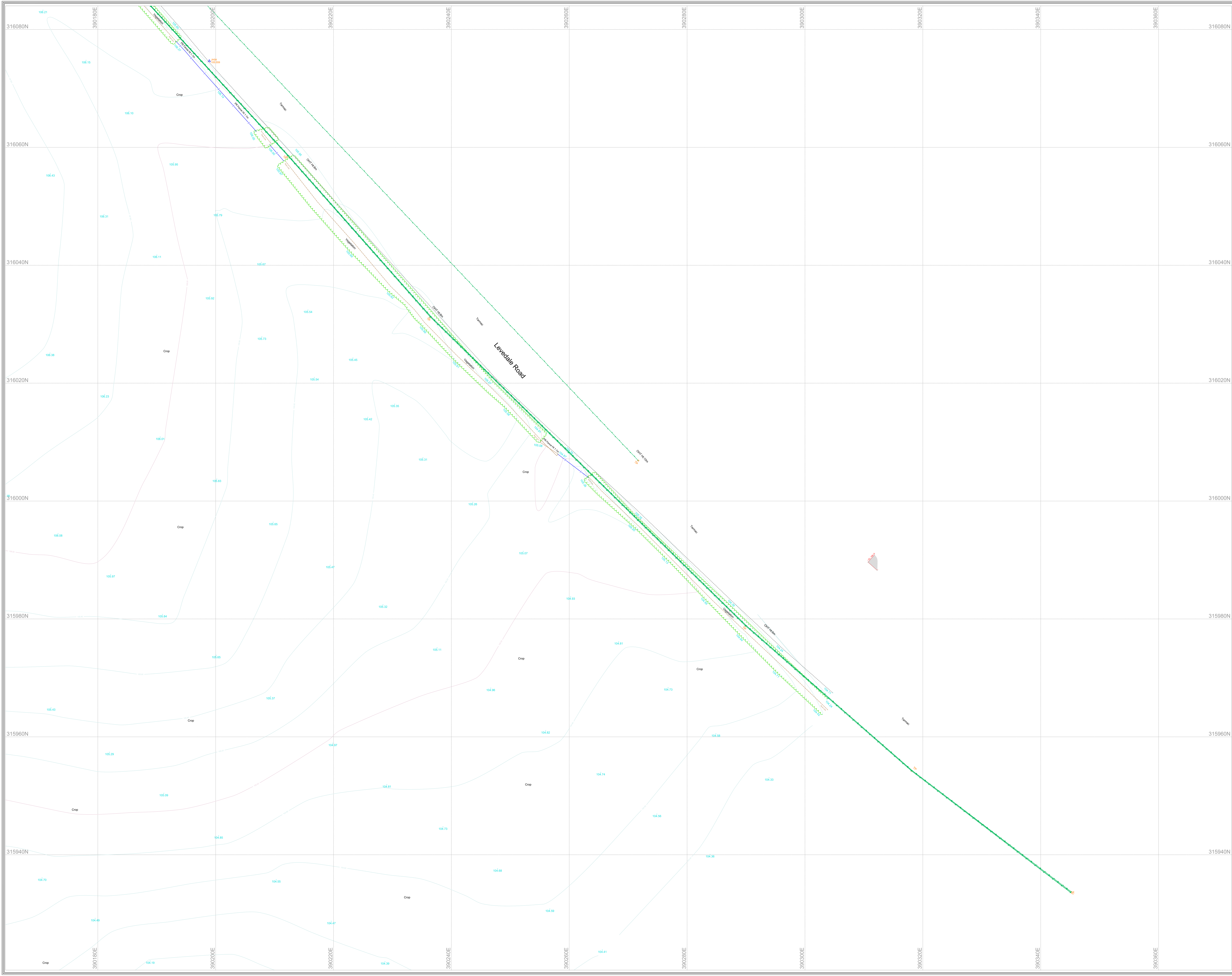

KEY:

Building Roof Line		OS Detail	
Building		Steps	
Building Canopy		Trackway	
Edge of Scrub		Tree Canopy	
Edge of Vegetation		Verge	
Embankment Bottom		Verge Concrete	
Embankment Top		Verge Grass	
Kerb		Verge Tarmac	
Kerb - Drop		Wall	
Kerb - Top		Water Edge	

Suffixes
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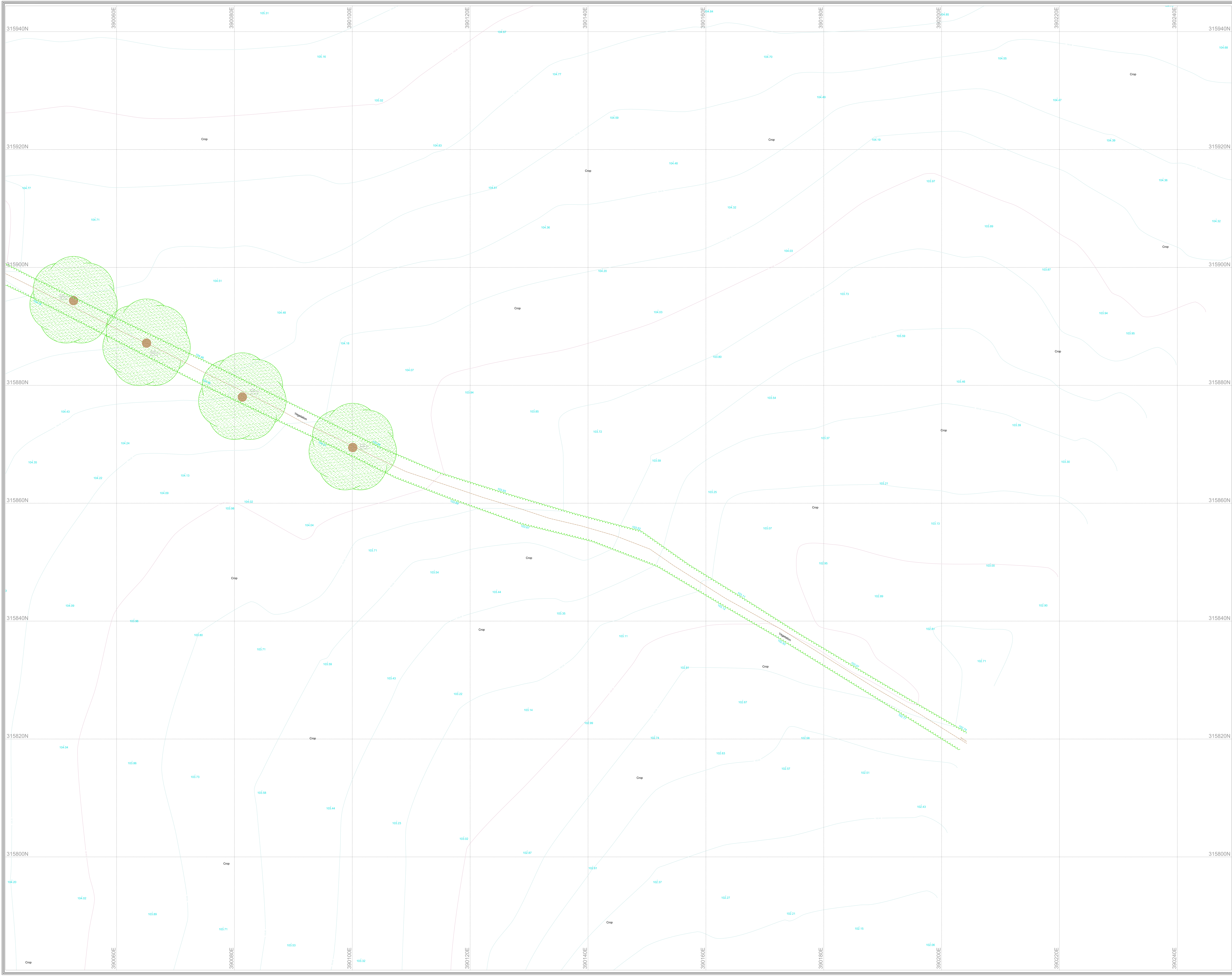

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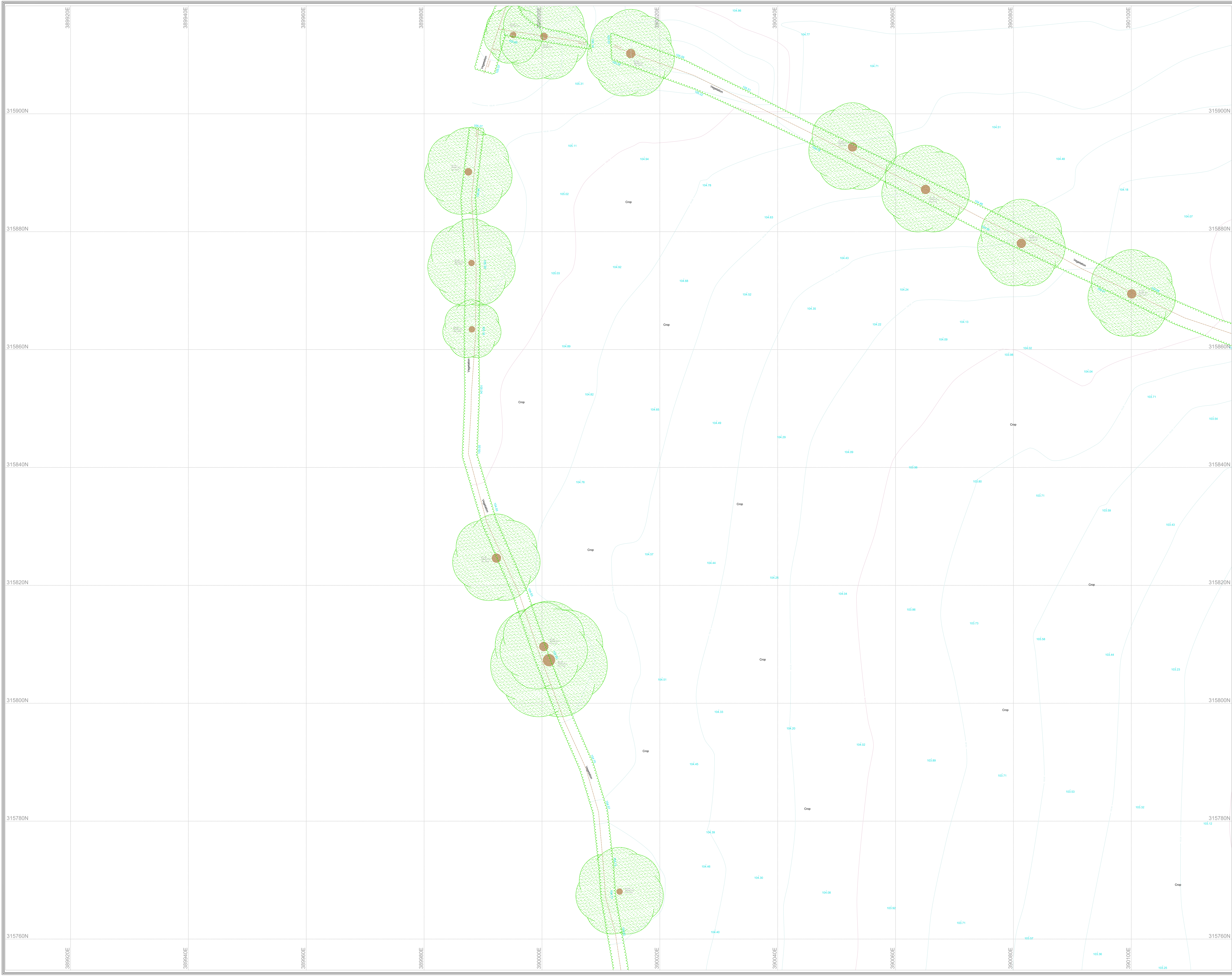

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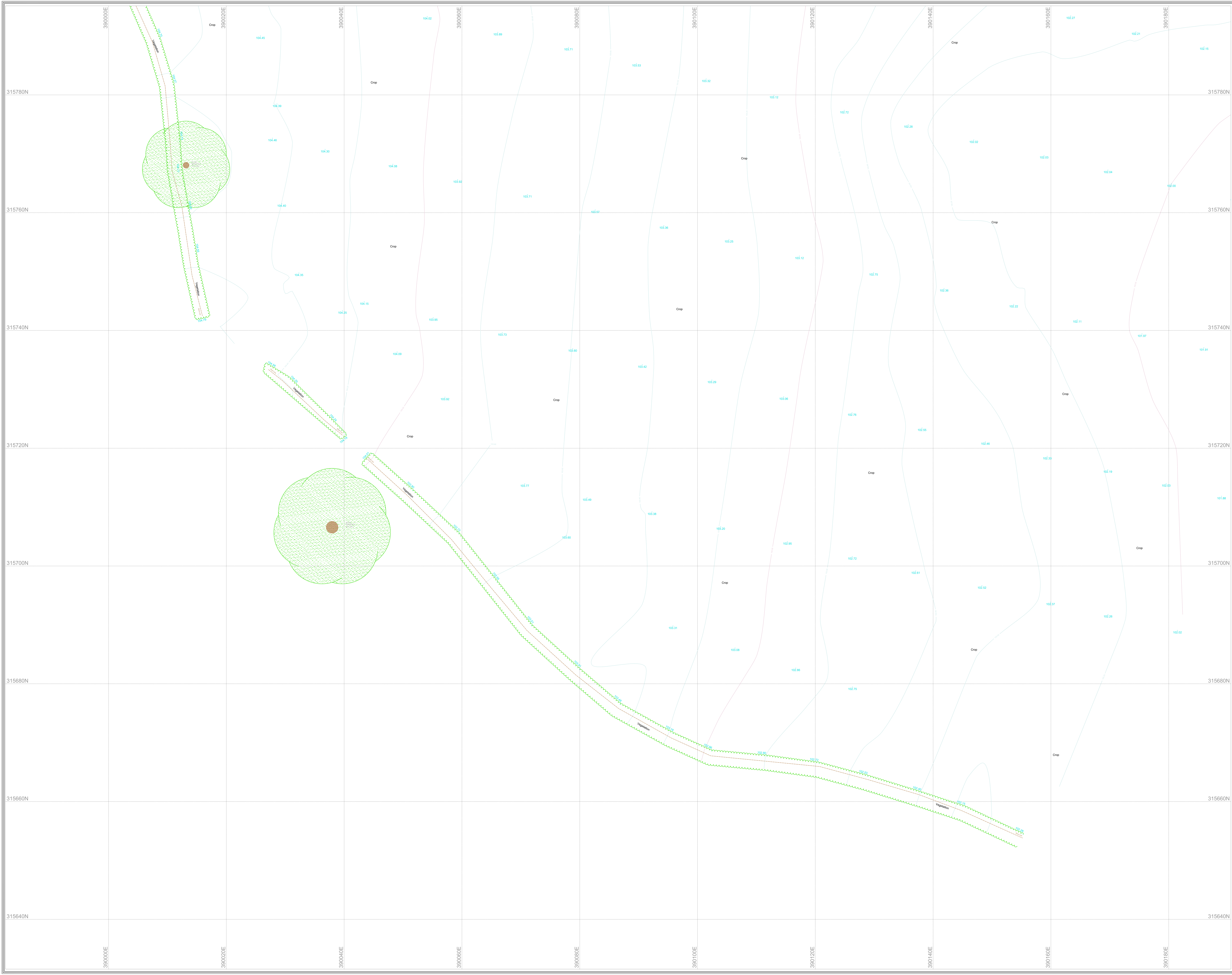
PLEASE REFER TO SURVEY STATION TABLE TO ENABLE ESTABLISHMENT OF THE ON-SITE GRID.



SafeContractor APPROVED

THE SURVEY ASSOCIATION FULL MEMBER

Station	Easting (m)	Northing (m)	Level (m)
JH01	390108.061	316179.870	105.260
JH02	390108.687	316131.873	106.875
JH03	390049.326	316029.255	107.116
JH04	390198.919	316074.645	105.559

Survey Coordinates and Grid

Please note that the grid shown on this drawing is as follows;

- ☐ *Arbitrary*
- ☐ *Arbitrary but approx. related to North*
- ☐ *Best fit to an Ordnance Survey Digital Sheet*
- ■ *Related to the Ordnance Survey National GPS Network*

Levels

Please note that the levels shown on this drawing are as follows;

- ☐ *Arbitrary*
- ☐ *Related to an Ordnance Survey Bench Mark*
- ■ *Related to the Ordnance Survey National GPS Network*

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Client Anglo ES Levedale Ltd

Project Levedale Road, Penkridge ST18 9AH

Title Topographical Survey - 2D

Surveyed JH/JN Checked NS Date 09/06/2022

Sheet No 6 of 6 Scale 1:200@A0

Job No. 5468 Rev. -

NOTES:

All critical measurements should be checked on site prior to design.
No liability will be taken for this plan if passed on to 3rd parties.
Some services/data may be omitted in areas of parked vehicles and vegetation.

THIS SURVEY HAS BEEN ORIENTATED TO THE ORDNANCE SURVEY (O.S) NATIONAL GRID (OSGB36) VIA A GLOBAL POSITION SYSTEM (GPS) AND THE O.S. ACTIVE NETWORK (OS NET).
A TRUE OSGB36 COORDINATE HAS BEEN ESTABLISHED NEAR TO THE SITE CENTRE VIA A TRANSFORMATION USING THE OSTN15 & OSGM15 TRANSFORMATION MODELS.
THE SURVEY HAS BEEN CORRELATED TO THIS POINT AND A FURTHER ONE OR MORE OSGB36 POINTS ESTABLISHED TO CREATE A TRUE O.S. BEARING FOR ANGLE ORIENTATION.
NO SCALE FACTOR HAS BEEN APPLIED TO THE SURVEY THEREFORE THE COORDINATES SHOWN ARE LOCAL PLANE GRID
PLEASE REFER TO SURVEY STATION TABLE TO ENABLE ESTABLISHMENT OF THE ON-SITE GRID.

SUSTAINABLE DEVELOPMENT AND DELIVERY

Appendix D EA Flood Map for Planning

Flood map for planning

Your reference	Location (easting/northing)	Created
Levedale Road	**390175/315575**	**17 Oct 2022 17:17**

Your selected location is in flood zone 1, an area with a low probability of flooding.

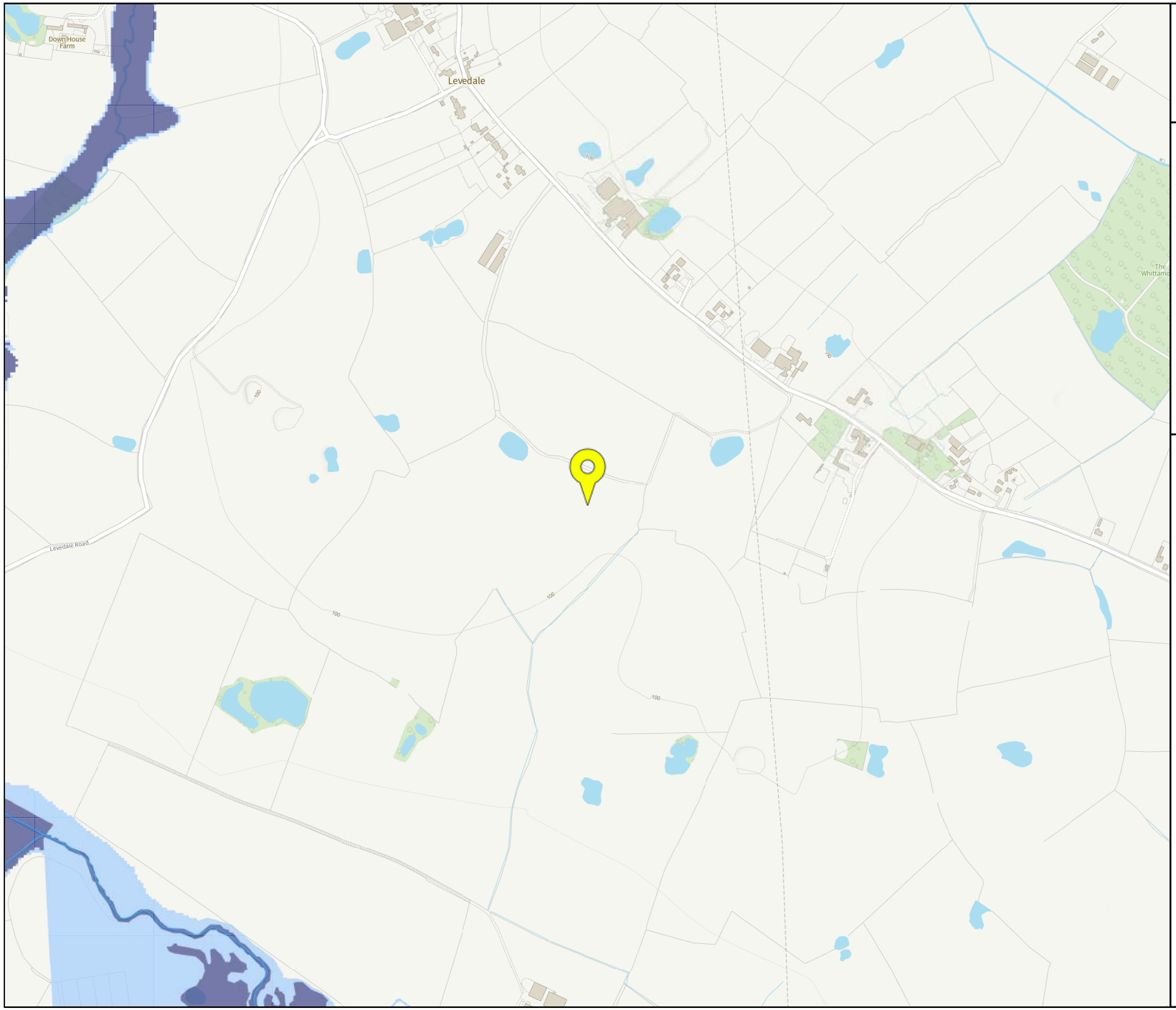
You will need to do a flood risk assessment if your site is **any of the following:**

- bigger that 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.



Environment Agency

Flood map for planning

Your reference
Levedale Road

Location (easting/northing)
390175/315575

Scale
1:10000

Created
17 Oct 2022 17:17

- Selected point
- Flood zone 3
- Flood zone 3: areas benefitting from flood defences
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 100 200 300m

SUSTAINABLE DEVELOPMENT AND DELIVERY

Appendix E Drainage Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years) 1 SAAR (mm) 700 Urban 0.000
Area (ha) 1.000 Soil 0.450 Region Number Region 4

Results l/s

QBAR Rural 4.4
QBAR Urban 4.4

Q1 year 3.6

Q1 year 3.6
Q30 years 8.6
Q100 years 11.3

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