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ARKENDALE, THE MAR

HYDROLOGICAL REPORT

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WSP | PARSONS BRINCKERHOFF

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HYDROLOGICAL REPORT

Arkendale, Coneythorpe and Clareton Parish Council

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1 EXECUTIVE SUMMARY

1.1 SCOPE OF WORK

1.1.1 Arkendale Coneythorpe and Clareton Parish Council is preparing grant applications to deliver an environmental programme of works to secure The Mar in Arkendale as an important environmental resource for the villages. To assist in the technical understanding of the site the council has appointed WSP to provide a hydrological assessment of the site that will be used to assist the council in preparing a scope of works in relation to its prospective grant application.

1.2 ASSESSMENTS UNDERTAKEN

1.2.1 Historic maps have been reviewed to assess the mapped historical presence of The Mar within the village. The review of these maps indicated that whilst the pond had been present since the 1850's, the drawn size of the pond had varied across the maps.

1.2.2 An assessment of geology of the area indicated that the site is likely to be comprised of a variety of impermeable and permeable strata that could affect whether groundwater inflow (or outflow) to the pond could occur under the right circumstances.

1.2.3 The topography of the site was reviewed to establish the likely catchment that could drain to the site. A field ditch was observed to drain into the pond from the east, and highway drainage was observed that could provide flow into The Mar, but the principal inflow to the site was assessed to be surface water run-off from the surrounding catchment.

1.3 RISKS AND THREATS

1.3.1 Risks and threats to the continued presence of significant body water on the site have been evaluated, with respect to the considered inflows and outflows to the pond.

1.3.2 A significant risk to the continued extended body of water was considered to be the level of vegetation within the pond, which was assessed to be a long term contributing factor to the drawing of water from the pond area.

1.3.3 Other threats to the site included the potential disturbance of ground in the vicinity of the pond that may lead to the existing water becoming in contact with a permeable ground strata through which it could discharge freely.

1.3.4 The collapse of the culvert, whilst not allowing flow to escape from site, could also prevent through flow of water through The Mar that would be a benefit to removing nutrients.

1.4 CONCLUSIONS

1.4.1 It has not been possible to qualify whether the pond on the site was created by purely natural circumstances, through man-made intervention or by a combination of both events.

1.4.2 The presence of a pond such of this within the village would have been of benefit to the village for a number of reasons including watering livestock, washing, etc. Anecdotal evidence and indications marked on historic maps indicate that the area of the pond and its surrounding land was an utilised space for the village. As such it is likely that over time man made intervention has taken place on the site to clear vegetation through either direct or indirect means.

1.4.3 Inflows into the pond have been identified as mostly provided by surface water run-off during storm events, from surrounding land that forms its natural catchment. It is also possible that groundwater inflow to the pond may occur during periods of elevated groundwater levels, but this is not deemed to be a significant factor.

1.4.4 The outflows from the pond have been assessed as caused through natural means, such as vegetation draw up, evaporation and leakage. The main form of structured outflow from the pond, the culvert, has collapsed and as such it would appear that there would be no high level flow control for the pond, which may present a flood risk to the area.

1.4.5 It is understood that the current intervention proposed for the site, is required to produce an asset for the village that can be maintained with minimal labour and funding. The exact disposition of the environment at the site is one that is understood to be open for debate within the local area and subject to the findings of the preliminary reports on hydrology and ecology for the site.

1.5 RECOMMENDATIONS

1.5.1 This report should be reviewed alongside the ecological report to be completed by Bernadette Lobo of Lobo Ecology.

1.5.2 It is not recommended to significantly increase the depth of the existing waterbody at The Mar, although careful localised works on the existing waterbody such as the creation of scrapes, or limited alterations to silt levels may be possible.

1.5.3 There is the potential to construct excavations within the dried/solid parts on The Mar, which may allow these areas to be utilised to store rainfall. Such operations as this are not expected to cause any significant changes to the existing waterbody on The Mar.

1.5.4 The outfall structure at the southern end of the site should be re-built to enable flow to once again access the culvert to the south.

1.5.5 The inflow from the fields to the west and north-west of the site should be investigated and steps taken to promote water flowing from these points to enter the main water body of The Mar.

1.5.6 Additional longer term principals have been recommended for the site to encourage water flow into The Mar and to collect additional information on the site for any future works.

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2 PROJECT BACKGROUND

2.1 INTRODUCTION

2.1.1 WSP | Parsons Brinckerhoff (WSP | PB) has been appointed to investigate a local pond referred to as 'The Mar' in the village of Arkendale. This location is understood to be defined as a Site of Importance for Nature Conservation (SINC) and the local parish councils of Arkendale, Coneythorpe and Clareton have expressed concern regarding the long term status and preservation of the pond.

2.1.2 As a result of this concern they have appointed specialist consultants to advise on matters relating to ecology, arboriculture and hydrology. WSP | PB have been appointed to provide an initial report relating to the hydrological factors affecting the pond and to liaise with the ecology and arboriculture specialists.

The investigations into the hydrology of the pond also referred to as the site, have been agreed to include the following actions:

- à A visit to assess the local environment of the site, topography of the site and any local watercourses or features.
- à Obtaining of available desk-top data relating to historical information, ground information and detailed mapping of the area of the site.
- à Develop a conceptual model of the hydrological aspects of the site, indicating inputs, outputs and any principal features regulating or controlling water levels.
- à Identify the risks and threats to the site (referencing the conceptual model)
- à Liaise with other disciplines over a co-ordinated evaluation of the site.

2.1.3 This Hydrological Report summarises the main findings of the assessment undertaken and includes a summary of the data used to analyse the site. An annotated conceptual plan of the site has been produced for clarity and ease of reference, which summarises the hydrological characteristics of note and is included in this report in Appendix A.

2.2 LIMITATIONS

2.2.1 The assessments made in this report have been based on information collected from third parties on which WSP | PB has relied. This data has been used in the assessment and analysis of the hydrological matters within this report.

2.2.2 This report has been based on desktop investigations assisted with site visits. No intrusive ground investigation, drainage surveys or other surveys/investigations have been undertaken at this stage. The absence of such detailed site information consequently imposes limitations upon the conclusions drawn, and would be subject to review if such data was to be collected.

2.2.3 In making the recommendations for this site, consideration has been made to the limited level of funding that is understood to be available for any renovations to and long term management of this site at this time.

3 INVESTIGATIONS

3.1 ANECDOTAL EVIDENCE

3.1.1 Anecdotal evidence from residents adjacent to the pond have indicated that the pond has at times almost wholly disappeared, in what is understood to be a very rapid time (i.e. days). A local resident had reported that the total drying up of the pond had occurred approximately three times in their thirty years living near the site. This by inference would suggest that the pond also fills back up to an assessed 'normal' level at other times.

3.1.2 Other information from residents, include reference that previously a village green was located adjacent to The Mar, and that dredging of the pond was undertaken in approximately 1977. It was also reported that it was their belief that the pond was clay lined and previously used for washing cattle. An outfall to the pond that was previously located at the south eastern corner of the pond was reported to have previously had a sluice on it.

3.2 HISTORY OF THE SITE

3.2.1 The pond within the village of Arkendale (or Lower Arkendale) that is designated as 'The Mar', has been observed, through a review of available historic maps, to be present in its current location in all reviewed historic maps as far back as 1852[1]. Refer to Appendix B for a site location plan.

3.2.2 A review of available reference documents into the significance of the title of the site as 'The Mar', uncovered no clear reference attached to the meaning of this name/designation. One consideration may be from historic names of bodies of water, such as the Latin word 'Mare' (meaning sea), and the word Mere (meaning lake) and similar derivations of these words over the course of time may have resulted in the name/designation being attributed to this pond. If accurate, the application of this name would likely confer a more historic presence of the pond before the 1850's.

3.2.3 The ground conditions within the site may be a factor that could provide both a historic origin for the pond's assigned name 'The Mar' and also a factor in the creation of the pond as it is today. The area could have been a site where marl was present close to the surface. There is historic documented evidence that marl soil was used as a dressing or fertiliser. A recorded agricultural book published in 1758[2] includes references to the use of 'marle' to improve the soil. Other similar documented references to marl's use to improve land also refer to the locations of a marl pit through which marl is excavated.

3.2.4 It has been suggested that the site may have been created as a 'dew pond'. Such 'dew ponds' were typically created to collect water in an area without ready access to water to assist with husbandry of grazing livestock. It is possible that this pond was created to collect water for grazing livestock, but it is considered that this would be a less likely cause, given the relative close location of waterlogged ground to the south west that could have provided a source of water.

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[1] OS Six Inch England and Wales 1852 (National Library of Scotland) http://maps.nls.uk/view/102344665 (Yorkshire 138)
[2] A Compleat (sic) Body of Husbandry, Thomas Hale, Volume 1, Second Edition, 1758

3.2.5 A review of historical maps for the region that included maps from the years 1850, 1890, 1892,1903,1910,1938,1956,1966,1970 and 1973 was completed. In all maps the location of the pond is visible and marked on the drawings, although the extents of the pond vary shown on the maps between maps/years. It has been assumed that the shape at the site indicated the extents of the water in the pond measured at that time.

3.2.6 The 1850 map shows the southern third of the site to be covered by the pond but in the 1890 and 1892 maps the pond is shown to occupy approximately three quarters of the area of the site.

3.2.7 In the 1903 map however the pond is shown to only occupy a small central part of the site approximately one tenth of the overall site, this extent is observed through the maps of 1910, 1938, 1956 and 1966. Only in the map of 1970 is the pond size shown to increase again, to occupy approximately one third of the site, with this size appearing to be retained in the rough size and location to present day.

3.2.8 Historical mapping also shows the presence of a village pump located to the south of the site, at the junction of Marhead Balk and Reins (road).

3.2.9 Early historic mapping also indicates that at the northern end of the site there was a pinfold (a pound used for stray animals).

3.3 GEOLOGICAL

3.3.1 The Soilscapes map[3] for this area, lists the predominant soil within the village of Arkendale and to the west of the village as a free draining loamy soil. To the north of the site there are located large areas of loamy and clayey soil with slightly impeded drainage, and to the east it records a similar soil with an impeded drainage. Areas to the south west of village are recorded as naturally wet with a high water table.

3.3.2 The British Geological Society (BGS) online mapping[4], indicates that there is a range of superficial and bedrock geological areas in the vicinity of the site. The bedrock that is indicated to run beneath the village and extends to the south is the Roxby formation, a mudstone/siltstone bedrock. There are indications of a specific change in the location of the site in the combined bedrock/superficial mapping in the region, however there is no available key to indicate what this may represent.

3.4 BOREHOLES

3.4.1 A review of the BGS Borehole records, indicate that there are three boreholes recorded in close vicinity to the site. Refer to drawing 70023730-S02 (Appendix E) for locations of boreholes

Borehole SE31 - Ground Conditions

3.4.2 The borehole, was recorded to a depth of 15m, with a note of sandy/clayey ground to a depth of 2.9m below ground level (bgl), underlain by glacial till (clay) to a depth of 12.9m with a layer of Marl (clayey/sandy/weak) being recorded beneath this up to the borehole depth of 15m.

Borehole SE31 - Groundwater

3.4.3 There was no recorded strike of groundwater within this borehole.

[3] Soils Data © Cranfield University (NSRI) and for the Controller of HMSO [2017]
[4] British Geological Survey- Geology of Britain Viewer (January 2017)

Borehole SE110 – Ground Conditions

3.4.4 The borehole indicated initial layers of topsoil, silt and clayey gravel up to a depth of 1.2m bgl. Beneath these layers to a depth of 3.5m bgl was recorded a layer of very clayey sand, which was underlain with dense brown gravel to the depth of the borehole.

Borehole SE110 – Groundwater

3.4.5 The borehole recorded a groundwater strike at 3.5m, which rose by 0.6m over 20 minutes and the final standing level of the water was at 1.3m bgl.

Borehole SE111 – Ground Conditions

3.4.6 The initial layer of topsoil in the borehole of 0.2m bgl was underlain by a clay layer that was reported as sandy to a depth of 3.9m. Beneath this were three layers of sand, which were defined as clayey, silty and dense respectively to a depth of 7.95m bgl. The borehole recorded a final layer of clay (reportedly silty) to the depth of the borehole at 8.5m bgl.

Borehole SE111 – Ground Conditions

3.4.7 Groundwater within the borehole was recorded at a depth of 5.95m bgl and rose by 0.35m over 20 minutes, however the final level was recorded at a depth of 6.3m bgl.

3.5 SITE VISIT

3.5.1 A visit to review the site was undertaken on the 29th of November 2016, accompanied by two of the local residents with knowledge of the site. The visit was undertaken on a dry clear day and a water body (The Mar) was observed to be present, although it was clear that the current depth/extent of the pond was at a reduced level, due to the presence of more established border plants at elevated positions, and damp waterlogged ground adjacent to the current water level.

3.5.2 It was discussed that during the preceding months the pond had completely dried up, and during the course of the year the pond had also been at a much deeper level than currently exhibited.

3.5.3 At the south eastern extent of the pond, there is observed to be a channel that appears to run from the main body of the water in a south eastern direction towards the grassed bank near Marhead Balk. At the south easternmost end of this channel the local ground is observed to have collapsed, and this was informed to previously have been the start of a culvert. Bricks and stones were observed within the ground at this location, which would seem to support the presence of a culvert at this location. It is not known how long the culvert has been in this condition for, although the observed settled ground would seem to indicate that it may have been not a recent change.

3.5.4 The pond was observed to be located at the base of sloping land from the west, north and east with the land to the south on the pond at a similar level with the surrounds to the pond with a minor perceivable fall away from the site further towards the south.

3.5.5 From observations made whilst onsite, the land to the north and east principally fall towards the pond at a significant gradient adjacent to the pond with a slighter grade away this steeper bank. A drainage ditch for agricultural land to the east was observed to drain toward the pond, but no other apparent man-made discharges/ditches were observed to drain towards the pond.

3.5.6 West Field Lane, to the north of the site, is an undulating road, with several low spots on the road which are drained by road gullies. The observed gullies on the road in the vicinity of the site are located on the southern edge of the road. The road of West Field Lane cuts through what has been perceived as the natural hydrological catchment that would drain towards The Mar, based on a review of local contour maps. However this road is recorded as a route on historic plans dating back to 1850, suggesting that this such circumstances and effects will have been settled and is not likely to be a factor causing any recent changes.

3.6 SURFACE WATER

3.6.1 A review of the Environment Agency information for consented Water Abstractions in the region of Arkendale[5], indicated no abstractions within at least a kilometre radius of Arkendale.

3.6.2 The Environment Agency risk of surface water flooding maps[6] support the topographical assessments of the land surrounding the pond, indicating a risk of surface water flowing from the north and west towards the pond and consequently away from the pond in a southerly direction.

3.6.3 The Environment Agency doesn't predict any flood risk to the site from rivers or sea, or reservoirs.

3.6.4 The historical siting of a village pump to the south of the site, which can be traced back through historical maps to at least 1850, would indicate that groundwater at a point close to the site is likely to be relatively near the surface.

3.6.5 A review of Yorkshire Water's (YW) records for the area, indicate only the presence of a foul water sewer system serving the properties in the village. This would indicate that the surface water from the properties and roads in the region is discharged through a different means such as soak-away/other non-YW drainage system.

3.6.6 It is unclear whether the culvert at the southern end of The Mar, may have discharged water into/or away from the pond location, and the local topography would suggest that both are possible, however only a small amount of land would likely be high enough to drain directly into the pond. As such it is considered more likely that the culvert was an outflow from the site.

3.6.7 The connectivity of the drainage from West Field Lane is assumed to route away from the road towards the site. Enquiries were raised with North Yorkshire County Council to obtain any information in relation to the drainage for the site, but no drainage records were located by North Yorkshire County Council.

3.7 TOPOGRAPHY

3.7.1 Detailed ground level information was obtained in close proximity to the site to better understand existing levels surrounding the site. This data has been overlaid upon a simplified background map for the site to enable a profile of the topography of the site to be developed, which is recorded in the LIDAR Ground Level Plan (Drawing 70023730-GIS-001A Appendix C)[7].

[5] Environment Agency –Water Abstraction Licences (data recorded January 2017)
[6] Environment Agency – Risk of Surface Water Flooding (Accessed January 2017)
[7] The LIDAR data obtain is from a surface level survey, which will record the level of significant buildings, large trees or other large structures (i.e. the top surface level of these). In addition the data only records the surface level of any water bodies and not the depth of the base of water bodies.

3.7.2 The LIDAR ground plan indicates that the current position of the water body within the pond site area occupies the principle lowest point on the site, which is to be expected. The small variance in ground levels within the site indicates that deeper water levels would likely extend the footprint of the pond considerably providing the appearance of a larger pond albeit at shallow depths.

4 HYDROLOGICAL ASSESSMENT

4.1 POND INFLOWS

4.1.1 There were no natural watercourses, streams or other water sources observed that may provide a consistent supply of water to the pond. Based on the evidence discussed in this report the main inflow entering the pond is therefore believed to be rainfall on the pond itself and run-off from the fields that naturally fall towards the site of the pond (it's natural catchment), although the influence of groundwater levels may also impact on the ponds water level.

4.1.2 A review of the likely drainage catchment for the pond based on wide scale topography has been completed, a copy of which can be seen in Appendix D. This assessment, considered that approximately 24 hectares of area could drain to the pond, which when assessed using industry standard run-off calculations would generate surface water run-off in a storm of a one year return period, towards the pond of approximately 91 l/s at its peak.

4.1.3 The pond may also take some run-off from buildings in the vicinity of the pond and the local roads, as the review of Yorkshire Water records did not indicate any surface or combined public sewers. There were no obvious discharge pipes or outfalls observed to connect from these areas, except a small trench to the southernmost part of the pond that appears to drain the local highway, although other flow from these area may discharge to the pond through overland or un-discovered features.

4.1.4 Based on the assessment of the reported collapsed culvert entrance and the review of ground levels, it has been deemed likely that the culvert is not a source of inflow into the pond.

4.1.5 The historic presence of the village pump to the south of the site, would suggest that groundwater levels in that region are reasonably near to the surface. Further evidence from local boreholes gives an indication that groundwater levels in the region are likely to be linked to water carrying strata (layers) that appear to occur at varying depths around the site. The water level recorded in the borehole ref SE110 to the south of the site, indicated a groundwater source that was pressurised, and rose to a level approximately 1.3m below ground level. The consistency and dispersion of such water carrying layers in the region is unknown and water levels within these layers would likely vary due to ground or climate conditions.

4.1.6 The location of groundwater at a depth near to the surface, close to the site of the pond, does provide evidence that groundwater could be a contributing inflow into the pond through water bearing strata within the surrounding ground. During periods of prolonged rainfall, groundwater levels may rise, with the potential to emerge from the water bearing strata, if such is located at high elevations around the site.

4.2 POND OUTFLOWS

4.2.1 The collapsed culvert is expected to have been the location where excess water could be drained away from the site and is believed to follow the topographical route away from the site to the south-west. The invert (bottom) level and the flow carrying capacity of this culvert will be one of the limiting factors that would control flood water levels within the pond (i.e. its maximum water capacity).

4.2.2 The presence of the culvert at this location (and the reported sluice gate) would indicate a previous/historic requirement to control the water level within the pond. This would seem to indicate that in the past there may have been additional water that was able to either enter or be stored at the site, such that these control measures would be needed.

4.2.3 The pond is likely to also lose water through water seepage into the ground beneath the water surface. It is assumed that this rate of leakage from pond would have settled to a constant level over time. However the variation that is observed in the ground strata around the pond, including layers that will restrict and allow the flow of water within them, would indicate that it may be possible for water to also escape, if a flow path was created/available into a permeable strata.

4.2.4 The pond will also lose water through evaporation and wind-blown water loss. This water loss is dependent upon the weather and the extent of the pond (i.e. smaller or larger surface water extent) and will very likely vary considerably throughout the year.

4.2.5 Other factors in the loss of open water in a pond could be the take up of water through larger vegetation/trees within the site of the pond. As areas of the pond accumulate further sediment and debris from vegetation, it can allow the bed of the pond to become more firm land and as such will increasingly provide a suitable habitat for a wider range of species.

4.2.6 Changes in the size of natural ponds are not an unusual factor, especially in situations where the principal inflow mechanism for the pond is through rainfall/groundwater. Depending upon the preceding weather patterns, the pond size could be expected to increase or decrease based on the patterns of rainfall and catchment wetness.

4.3 HYDROLOGICAL RISKS TO THE SITE

4.3.1 The natural progressions of most ponds if left alone in the natural environment is to become more vegetated and to lead ultimately to turn the site of the pond to dry land through the gradual encroachment of larger vegetation. The length of time that this process takes varies considerably and can occur across a period of decades or centuries[8].

4.3.2 An increase in nutrients and sediment within the pond environment would likely lead to the gradual expansion and colonisation of the environment of the pond by further vegetation.

4.3.3 Excess nutrients could be sourced from fertilisers or human/pet waste, but given the limited amount of fields surrounding the site and the small population of the village, it is unlikely that either of these factors are the principal cause of change, although the reduction of such nutrients entering the pond could be considered beneficial.

[8] Pond Ecology – Penn State University , Thomas McCarty (year unknown)

4.3.4 The sedimentation in the pond may well be increasing due to decaying of plant matter, from plants growing on the fringes and within the pond environment. Sediment may also be entering the pond through surface water flow from the surrounding land during heavy rainstorms. Such increases in sediment can lead to more nutrients and growing media for plants and wooded species to establish and thrive in the environment. This has the potential to become a continuing cycle that would eventually, if left unchecked, cause the site to become mostly vegetated even if it still collected water during heavy storms.

4.3.5 Any blockages or interceptions to overland surface water flow entering the pond will also be of detriment to the refresh/refilling of the pond. This could be as a result of building work to properties around the pond that may have introduced positive drainage (e.g. ditches, drains, etc.) that route flow away from draining into the pond.

4.3.6 A further risk associated with the site, is the potential loss of the site as an interception and storage basin for surface water run-off and water in the region. The current site enables the storage of such flow from rainfall in the local area that would prevent it discharging over land to another location, potentially causing overloading of drainage or flooding in other areas.

5 CONCLUSIONS

5.1 WATER RESOURCE IN THE MAR

5.1.1 The Mar has been present in this location from at least 1850, and quite possibly pre-dates that period. It may have been formed through a number of methods; a historic excavation on the site that created the pond as a by-product, or a natural depression in the local topography that naturally formed the pond, or by man-made intervention to enhance a suitable open area to collect water to form a pond. There is anecdotal evidence that the human intervention has occurred on the site, with reports of a village green adjacent at one point in history being adjacent to the pond (that is assumed to have been from flat, cleared ground), reports of dredging in the 1970's and the use of the pond for cattle (assuming that vegetation would have been cleared to support this).

5.1.2 A review of surrounding boreholes on the site, illustrated that the local area contains layers of permeable and impermeable ground at varying depths and the exact configuration and distribution of these layers within the site could have a significant influence on the pond. The undertaking of excavations in the pond, without knowledge of the location of such layers could pose a risk by provide accessibility for the pond water to permeable ground strata that may result in more rapid changes in water level. It is not recommended to significantly increase the depth of the existing waterbody at The Mar, although careful localised works on the existing waterbody such as the creation of scrapes, or limited alterations to silt levels may be possible.

5.1.3 From the review of available information, it would appear that the water within The Mar is primarily fed from direct rainfall into the pond and surface water run-off from the surrounding fields draining via the local topography into the pond. A secondary source of water in the pond may be from local groundwater in connected permeable strata on the site, but this could equally be a path through which water may escape from the site.

5.1.4 The pond is likely also to be affected by a gradual increase in sediment/debris, which will provide the ability for vegetation to find locations to grow. Such natural changes in a pond such as this are a long term process, which would over the course of a long time eventually lead to a permanent change to a dry habitat. This process is likely to have been happening over centuries, with only human interactions such as clearance or dredging temporarily halting this process. The small changes to the vegetation and debris in the pond could have resulted in shallower areas of water occurring that may make the water more susceptible to environmental conditions such as evaporation.

5.1.5 There appears to be evidence of a previous overflow into a nearby culvert that could take excess flow from the pond to drain in a southerly direction. However this culvert seems to have collapsed at its entrance and no outflow from the pond into this culvert is currently happening. The outflow from the pond into this culvert may have allowed a movement of water, which may have discharged some nutrient rich water away from the site.

5.1.6 From anecdotal evidence the water levels within The Mar have changed significantly over the preceding months/year to a point that has raised concerns locally over its long term retention. There is evidence based on historic maps that the size of the water body has not been consistent over preceding centuries, with reductions and increases of the indicated footprint of the pond. This is backed up by anecdotal evidence that rapid reductions in pond size have occurred previously, albeit at a very infrequent rate (three times in 30 years).

5.1.7 Ponds that have their water level/quantity maintained by rainfall/rainfall run-off and the influence of the surrounding ground will be by their very nature, vary in line with recently occurring weather patterns and more long term trends in ground conditions. It is not uncommon for some ponds and even rivers to dry up in summer months under certain conditions. As such it is not unexpected that the water level within The Mar will fluctuate throughout any year. If however, rapid decreases or increases in water over a short period of days occur (outside conditions such as a very heavy storm), then this would be unusual and benefit from further investigation.

5.2 RECOMMENDATIONS FOR THE FUTURE HYDROLOGICAL MANAGEMENT OF THE MAR

5.2.1 Based on the information gathered as part of this project, several potential sources have been identified in the areas that have the ability to contribute flow into The Mar. There is no one source of water flow likely to be solely responsible for maintaining water within this site, but several factors including the ground conditions beneath the pond, the debris within the pond itself and the surrounding land could influence the water level.

5.2.2 In making the recommendations for this site, consideration has been made to the limited level of funding that is understood to be available for any renovations to and long term management of this site at this time. Should additional funding be made available and a desire for a more significant body of water to be restored on the site, then it is recommended that further investigations are undertaken into establishing the ground conditions throughout the site to inform the design parameters required to create a stable water body.

RECOMMENDED ACTIONS

5.2.3 It is recommended that the previous outflow structure from the pond that would have drained into the culvert to the south of The Mar should be rebuilt. It is recommended that an excavation is completed in this area to uncover the head of the culvert to enable an outflow structure to be created. North Yorkshire County Council have been approached as to whether this would be an asset that they may be responsible to maintain (and undertake such work on), however their initial response was that even if this were an asset that they should repair or maintain, the significance of it means that it would be very far down the priority list.

5.2.4 To enable the re-construction of the outfall structure, it is recommended that the landowner for the location of the outfall and culvert is contacted to get their permission to undertake the work. As a landowner with a culvert on/under their land, then they have certain rights and responsibilities that include maintaining flow through such structures and general maintenance.

5.2.5 The outflow structure should include a structural tie to the culvert, a transitional arrangement between the structure and the surrounding soft landscaping of the pond and a location in which additional weir boards or stop logs can be added upstream of the entrance to the culvert. The inclusion of locations to install weir boards/stop logs is to address a potential future need to be able to control flow from the pond.

5.2.6 In addition to the re-building of the pond outlet, it is recommended that some other minor works are considered that may influence the amount of water that is reaching the main water body in The Mar.

5.2.7 To the west there is a field ditch that terminates above the site, which is understood to take field drainage from the adjacent fields and a field to the north of West Field Lane. The drainage discharging from this ditch is believed to generally drain in the direction of The Mar, but some of this flow may be getting dispersed into surrounding areas. There is an opportunity to ensure the water from the ditch is directed into the main water body of The Mar, through either a lined drainage channel (clay or impermeable membrane), or the introduction of a pipe from the discharge to the water body.

5.2.8 There is purportedly another land drainage pipe that enters The Mar from the north west of the site, which drains one of the local fields. It is understood that this previously was a drainage ditch before being placed in a culvert. There is no obvious sign of a discharge structure within this area, however one of the local farmers believes that he can determine its position. There is an opportunity to expose this culvert and ensure that it is capable of draining into an area of designated water within The Mar.

RECOMMENDED LONGER TERM PROPOSALS

5.2.9 There is a number of longer term principles that are recommended for the continual management of water within the local area, which if implemented could have a positive impact upon the water level within The Mar. The implementation of these principles pre-supposes that the outfall from The Mar has been reconstructed and that it is capable of taking any excess water from the site.

5.2.10 A programme to inform local residents who own or manage land and buildings surrounding The Mar on any opportunities to re-direct roof drainage, or other drainage of rainfall within their property or land towards the site. If rainfall from sources other than roofs is being directed towards The Mar, then consideration of the water quality of such flows should be made prior to discharge being connected and they may require discharging through grass lined channels to aid water quality.

5.2.11 It is suggested that The Mar be promoted as a location that may be suitable for surface water discharge to be routed through from new development in the region. Should development within the catchment of The Mar be proposed, then discharges from these sources may provide additional surface water flows that can be collected at The Mar. The suitability of the site to receive such flows should be assessed as part of any development, including an assessment of the water quality of any such flows.

5.2.12 It is recommended that North Yorkshire County Council highways department is contacted to regarding the drainage from West Field Road. It is likely that this will discharge into the field drain that discharges into the western side of the site (although it may need maintaining) but if this is found not to be the case then consideration of making and maintaining such a connection could be discussed with the highways department.

5.2.13 There is the potential to construct excavations within the dried/solid parts on The Mar, which may allow these areas to be utilised to store rainfall. Such operations as this are not expected to cause any significant changes to the existing waterbody on The Mar and it is suggested that if any excavation or changes are made within the site, then some simple analysis of the type and distribution of soil is made during this process. This process should allow a better understanding of ground conditions around the site and could provide suitable evidence for future plans.

5.2.14 There may also be opportunities to record water levels within The Mar, through some form of installed measuring pole that would also provide more evidence to understand the changes in water levels within the pond over time.

Appendix A

CONCEPTUAL INFLOWS AND OUTFLOWS TO THE MAR

DO NOT SCALE

NORTH

WEST FIELD LANE

GENERAL OVERALL FALL
BUT MOSTLY FLAT

FALL

RUN-OFF FROM
ROAD/TRACK

MAR HEAD (BRACK)

SURFACE WATER
RUN-OFF

FALL

POTENTIAL FLOW FROM
HIGHWAY GULLIES

SURFACE WATER
RUN-OFF

(POTENTIAL) SURFACE WATER
FLOW FROM BUILDINGS

FALL

DRIER VEGETATED AREA

WOODED

(POTENTIAL)
GROUNDWATER
RE-CHARGE

DIRECT RAINFALL
RE-CHARGE

- EVAPORATION
- VEGETATION TAKE UP
- LEAKAGE/SEEPAGE

FALL

FIELD
DRAINAGE
DITCH

APPROX EXTENT
OF POND

DITCH/CHANNEL

HIGHWAY
RUN-OFF
ROUTE

OUTFLOW WOULD BE
THROUGH DRAIN/CULVERT

SLIGHT FALL

OUTFALL DRAIN/CULVERT
COLLAPSED

ARKENDALE MAIN VILLAGE

The Old Vicarage
Sow House
The Flat
Harrison House
Hazel Head
Farm
Low Arkendale
Mar
Lodge
Pond House Farm
Mar House
Silo
Sunnyside
Farm

60
62
58
56
54
52
50
48

KEY

50 HEIGHT ABOVE DATUM CONTOUR LINES

TEXT = INFORMATION NOTES

TEXT = INFLOWS TO THE MAR

TEXT = OUTFLOWS FROM THE MAR

REV	DATE	BY	DESCRIPTION	CHK	APD
A	15/02/17	GW	INITIAL ISSUE	MWW	MWW

SCALE @ A3: 1:1250
CHECKED: MWW
APPROVED: MWW

DRAWING STATUS: FOR INFORMATION ONLY

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PROJECT: THE MAR, ARKENDALE

TITLE: CONCEPTUAL INFLOWS AND OUTFLOWS AT THE MAR

CLIENT: ARKENDALE CONEYTHORPE & CLARETON PARISH COUNCIL

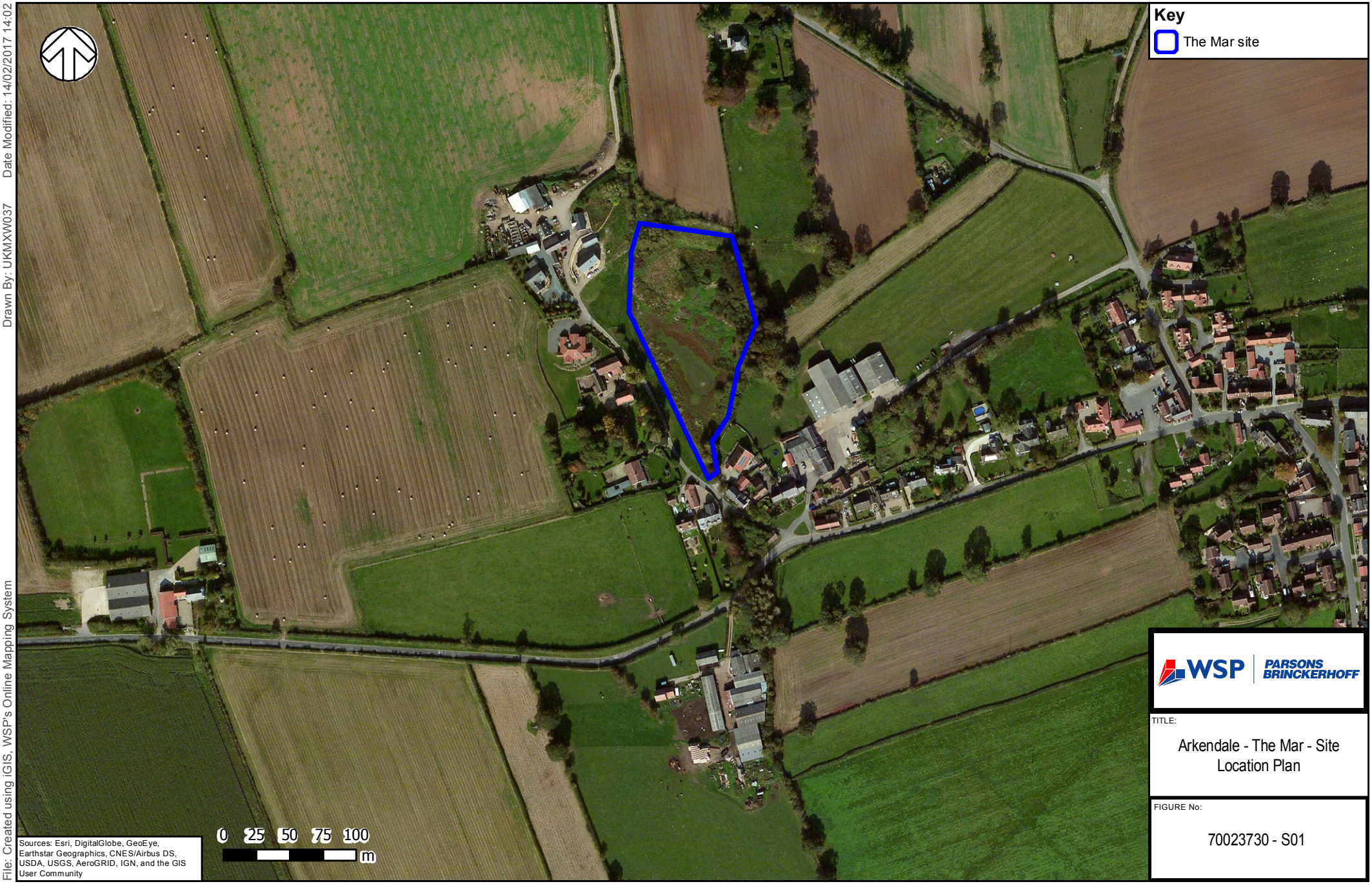
CAD FILE: 70023730-HY01.DWG
DESIGN-DRAWN: GW
DATE: February 17

ARCHITECT: N/A

PROJECT No: 70023730
DRAWING No: 70023730-HY01
REV: A

Appendix B

SITE LOCATION PLAN


Key
The Mar site
0 25 50 75 100
m
Sources: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
WSP
PARSONS BRINCKERHOFF
TITLE:
Arkendale - The Mar - Site Location Plan
FIGURE No:
70023730 - S01
File: Created using iGIS, WSP's Online Mapping System
Drawn By: UKMXW037
Date Modified: 14/02/2017 14:02

Appendix C

LIDAR GROUND LEVEL PLAN

Date Modified: 16/01/2017

Drawn By: uklxg002

Legend

Contours at 1m intervals

Level (m AOD)

- < 46
- 46 - 47
- 47 - 48
- 48 - 49
- 49 - 50
- 50 - 51
- 51 - 52
- 52 - 53
- 53 - 54
- 54 - 55
- 55 - 56
- 56 - 57
- > 57

0 0.0125 0.025 0.05 0.075 0.1 Kilometres

WSP | PARSONS BRINCKERHOFF

TITLE:

THE MAR, ARKENDALE

FIGURE No:

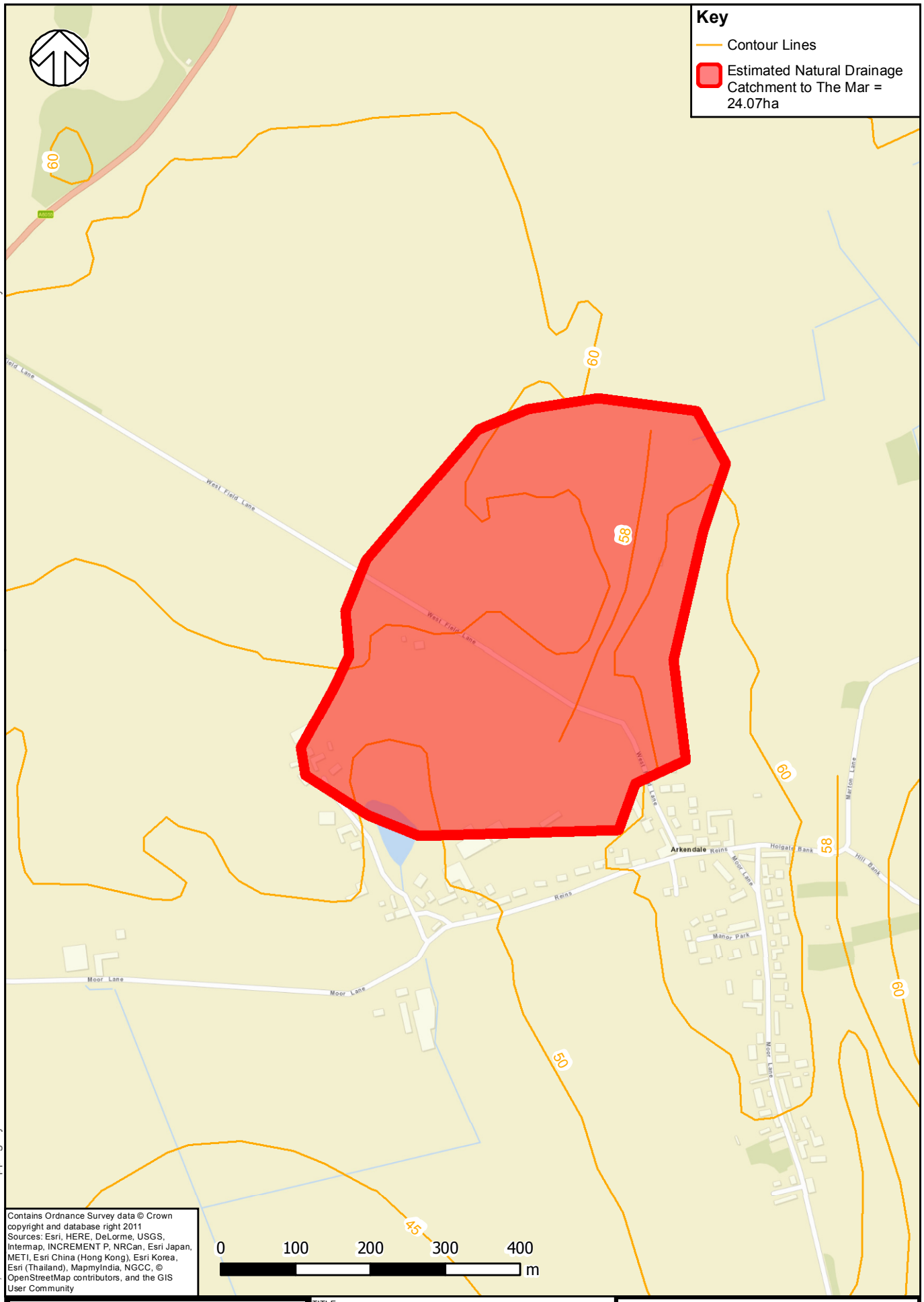
LIDAR GROUND LEVEL PLAN

70023730-GIS-001 A

File: \\uk.wspgroup.com\central data\Projects\700237xx\70023730 - Arkendale Hydrological Study 2\E Models and Drawings\Development\GIS\70023730-GIS-001.mxd

Appendix D

ESTIMATED HYDROLOGICAL CATCHMENT OF THE MAR



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Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

WSP | PARSONS BRINCKERHOFF

TITLE: Arkendale - The Mar

FIGURE No: 70023730 -SK2

Drawn By: UKMXW037 Date Modified: 06/01/2017 08:53

File: Created using iGIS, WSP's Online Mapping System

Appendix E

BOREHOLE LOCATIONS

Sources: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

WSP | PARSONS BRINCKERHOFF

TITLE:

Arkendale The Mar - Borehole Locations

FIGURE No:

70023730 - S02

File: Created using iGIS, WSP's Online Mapping System

Drawn By: UKMXW037

Date Modified: 14/02/2017 14:11