Written Scheme of Investigation

For a Geophysical Survey

of

Chidswell, Dewsbury

West Yorkshire

For

Cotswold Milton Keynes

Magnitude Surveys Ref: MSSE562

September 2019

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1. Introduction

1.1. This document details a Written Scheme of Investigation for a geophysical survey by Magnitude Surveys Ltd (MS) for Cotswold Milton Keynes. The survey comprises a c.119 ha area of land at Chidswell, Dewsbury, West Yorkshire (SE 27262 23492).

1.2. The geophysical survey will comprise hand-pulled/quad-towed, cart-mounted or hand-carried GNSS-positioned fluxgate gradiometer survey. Magnetic survey is the standard primary geophysical method for archaeological applications in the UK for its ability to detect a range of different features. The technique is particularly suited for detecting fired or magnetically enhanced features, such as ditches, pits, kilns, sunken earth houses, and industrial activity (David *et al*., 2008).

1.3. The survey will be conducted in line with the current best practice guidelines produced by Historic England (David et al., 2008), the Chartered Institute for Archaeologists (2014) and the European Archaeological Council (Schmidt et al., 2015).

2. Objective

2.1. The objective of this geophysical survey is to assess the subsurface archaeological potential of the survey area.

3. Quality Assurance

3.1. Project management, survey work, data processing and report production have been carried out by qualified and professional geophysicists to standards exceeding the current best practice (CIfA, 2014; David *et al*., 2008, Schmidt *et al*., 2015). All MS managers, field and office staff have relevant degree qualifications to archaeology or geophysics and/or field experience.

3.2. Magnitude Surveys is a Registered Organisation of the Chartered Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, and a corporate member of ISAP (International Society of Archaeological Prospection).

3.3. Director Dr. Chrys Harris is a Member of CIfA, has a PhD in archaeological geophysics from the University of Bradford and is the Vice-Chair of ISAP. Director Finnegan Pope-Carter is a Fellow of the London Geological Society, the chartered UK body for geophysicists and geologists, as well as a member of GeoSIG, the CIfA Geophysics Special Interest Group. Reporting Analyst Dr. Kayt Armstrong has a PhD in archaeological geophysics from Bournemouth University, is the Vice Conference Secretary and Editor of ISAP News for ISAP, and is the UK Management Committee representative for the COST Action SAGA.

3.4. MS has developed a bespoke geophysical system whereby data is live-streamed from the field back to the office while fieldwork is ongoing. This allows for data to be regularly monitored not only in the field, but by managers in a controlled office environment. Coverage gaps or small errors within the data can be quickly identified and rectified, improving quality control of field survey. The live data streaming allows MS to provide processed data to the client at regular intervals, allowing all parties to be informed of the field survey's progress. Should it become apparent that the survey is being compromised by local conditions, such as the spreading of green waste, this will be reported back to the client and a mitigation strategy can be devised if necessary.

4. Risk Assessment

4.1. MS' standard magnetic fieldwork risk assessment and site-specific risk assessment have been appended to the end of this document. Before geophysical survey will commence, a brief walkover will be undertaken to identify any additional hazards of an unusual or site-specific nature. If any additional hazards are identified, the site-specific risk assessment will be updated to include these hazards and all surveyors will be informed of the risk. If appropriate mitigation factors cannot be put in place, then the field or part thereof will not be surveyed.

4.2. Field staff will attend a site induction if required. Necessary PPE will be supplied and worn. Wet and cold/hot weather protection is also supplied.

4.3. All surveyors have been issued company mobile phones. Survey teams are expected to make regular contact with the office to keep all parties updated with survey progress. Any change in conditions that may affect the health and safety of the survey team must be reported immediately.

4.4. The survey van contains suitable welfare facilities. Antiseptic hand gel is provided, as is bottled drinking water. A first aid kit is stored in the cab of the van, with a second kit near personnel within the survey area.

4.5. The nearest NHS urgent care centre is at North Kirklees NHS Walk In Centre, Dewsbury & District Hospital , Halifax Road, Dewsbury, West Yorkshire, WF13 4HS. Should toilets be unavailable on site the nearest public accessible toilet is located at Tesco Extra, Bradford Road, Batley, WF17 5DR.

5. Methodology

5.1. Data Collection

5.1.1. Geophysical survey will comprise the magnetic method as described in the following table.

5.1.2. Table of survey strategies:

Method	Instrument	Traverse Interval	Sample Interval
Magnetic	Bartington Instruments Grad-13 Digital Three-Axis Gradiometer	1 m	200 Hz reprojected to 0.125 m

5.1.3. Magnitude Surveys employs a modular cart system, which can easily be configured to be towed by quad, pulled by hand, or carried depending on what is most suitable for the site configuration and conditions. Consisting of a cart frame, and backpack system survey can be undertaken should conditions preclude survey with the wheels. The hand carried system retains all of the advantages of a cart system because it is still GNSS positioned and the sensors are maintained at a consistent height.

5.1.4. Magnetic data will be collected using MS' bespoke, hand-pulled/quad-towed cart system or hand-carried GNSS-positioned system. MS' cart or hand-carried system will be comprised of Bartington Instruments Grad 13 Digital Three-Axis Gradiometers. Positional referencing will be through a multi-channel, multi-constellation GNSS Smart Antenna RTK GPS outputting in NMEA mode to ensure high positional accuracy of collected measurements. The RTK GPS is accurate to 0.008m + 1ppm in the horizontal and 0.015m + 1ppm in the vertical.

5.1.5. Magnetic and GPS data will be stored on an SD card within MS' bespoke datalogger. The datalogger is continuously synced, via an in-field Wi-Fi unit, to servers within MS' offices. This allows data collection, processing and visualisation to be monitored in real-time as fieldwork is ongoing (see 3.6).

5.1.6. A navigation system will be integrated with the RTK GPS will be used to guide the surveyor. Data will be collected by traversing the survey area along the longest possible lines, ensuring efficient collection and processing.

5.2.Data Processing

5.2.1. Magnetic data will be processed in bespoke in-house software produced by MS. Processing steps conform to Historic England's standards for "raw or minimally processed data" (see sect 4.2 in David et al., 2008: 11). Data plots contained within the report conform to Historic England's standards for minimally processed data.

Sensor Calibration – The sensors will be calibrated using a bespoke in-house algorithm, which conforms to Olsen et al. (2003).

Zero Median Traverse – The median of each sensor traverse will be calculated within a specified range and subtracted from the collected data. This removes striping effects caused by small variations in sensor electronics.

Projection to a Regular Grid – Data collected using RTK GPS positioning requires a uniform grid projection to visualise data. Data will be rotated to best fit an orthogonal grid projection and are resampled onto the grid using an inverse distance-weighting algorithm.

Interpolation to Square Pixels – Data will be interpolated using a bicubic algorithm to increase the pixel density between sensor traverses. This produces images with square pixels for ease of visualisation.

5.3.Data Visualisation and Interpretation

5.3.1. The report will present the gradient of the sensors' total field data as greyscale images, as well as the total field data from the upper and/or lower sensors. The gradient of the sensors minimises external interferences and reduces the blown-out responses from ferrous and other high contrast material. However, the contrast of weak or ephemeral anomalies can be reduced through the process of calculating the gradient. Consequently, some features can be clearer in the respective gradient or total field datasets. Multiple greyscale images at different plotting ranges will be used for data interpretation.

5.3.2. Geophysical results will be interpreted using greyscale images and XY traces in a layered environment, overlaid against OS Open Data, satellite imagery, historic maps, LiDAR data, and soil and geology maps. Google Earth (2019) will be consulted as well, to compare the results with recent land usages.

5.3.3. Geodetic position of results - All vector and raster data will be projected into OSGB36 (ESPG27700) and provided upon request in ESRI Shapefile (.SHP) and Geotiff (.TIF) respectively. Figures will be provided with raster and vector data projected against OS Master Mapping.

6. Reporting

6.1. A detailed report of the survey will be produced after data collection is completed. The Planning Archaeologist will be provided with a draft report for approval, and the approved report will be submitted to the HER. The final report will include as standard:

- Abstract
- Introduction – Details site location and client details.
- Quality Assurance – Details the expertise of Magnitude Surveys and Magnitude Surveys employees undertaking the work.
- Objectives—Details survey objectives.
- Geographic Background – Details the soils and geology of the survey area, as well as providing a general summary of site conditions at time of survey.
- Archaeological Background – Details a brief summary of the archaeological and historical background of the site and its immediate environs. While this will not be an exhaustive assessment of the known sites, it will draw on elements relevant to the results obtained during survey.
- Methodology—Details survey strategy employed, instruments used, data collection strategy, data processing and visualisation methods.
- Survey Considerations – Details specific points of note for each survey area, including topography, upstanding obstructions or neighbouring objects.
- Results—Details the results and interpretation of the geophysical survey, both in a general context and discusses specific anomalies of archaeological interest. Geophysical reports will be discussed in consideration with satellite imagery, historic mapping and LiDAR data—if freely available—as supporting interpretative evidence.
- Conclusions
- Archiving
- Copyright
- References

- Figures—The site location and individual survey areas will be presented. Georeferenced greyscale images of the minimally processed data, XY traces and corresponding interpretations will be displayed at appropriate scales. Interpretations will also be displayed over satellite imagery, historic mapping and LiDAR—as applicable—to provide further context to the interpretations. All figures will include a detailed scale bar, north arrow and key.

7. Archiving

7.1. MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013). This archive stores the collected measurements, minimally processed data, georeferenced and un-georeferenced images, XY traces and a copy of the final report. A copy of this archive will be included in a disk with the final printed report.

7.2. MS contributes reports to the ADS Grey Literature Library upon permission from the client, subject to the any dictated time embargoes.

7.3. An OASIS form will be filled in on completion of the survey, providing permission from the client.

8. Copyright

8.1. Copyright and the intellectual property pertaining to all reports, figures, and datasets produced by Magnitude Services Ltd. is retained by MS. The client is given full licence to use such material for their own purposes. Permission must be sought by any third party wishing to use or reproduce any IP owned by MS.

9. References

Chartered Institute for Archaeologists, 2014. Standards and guidance for archaeological geophysical survey. CIfA.

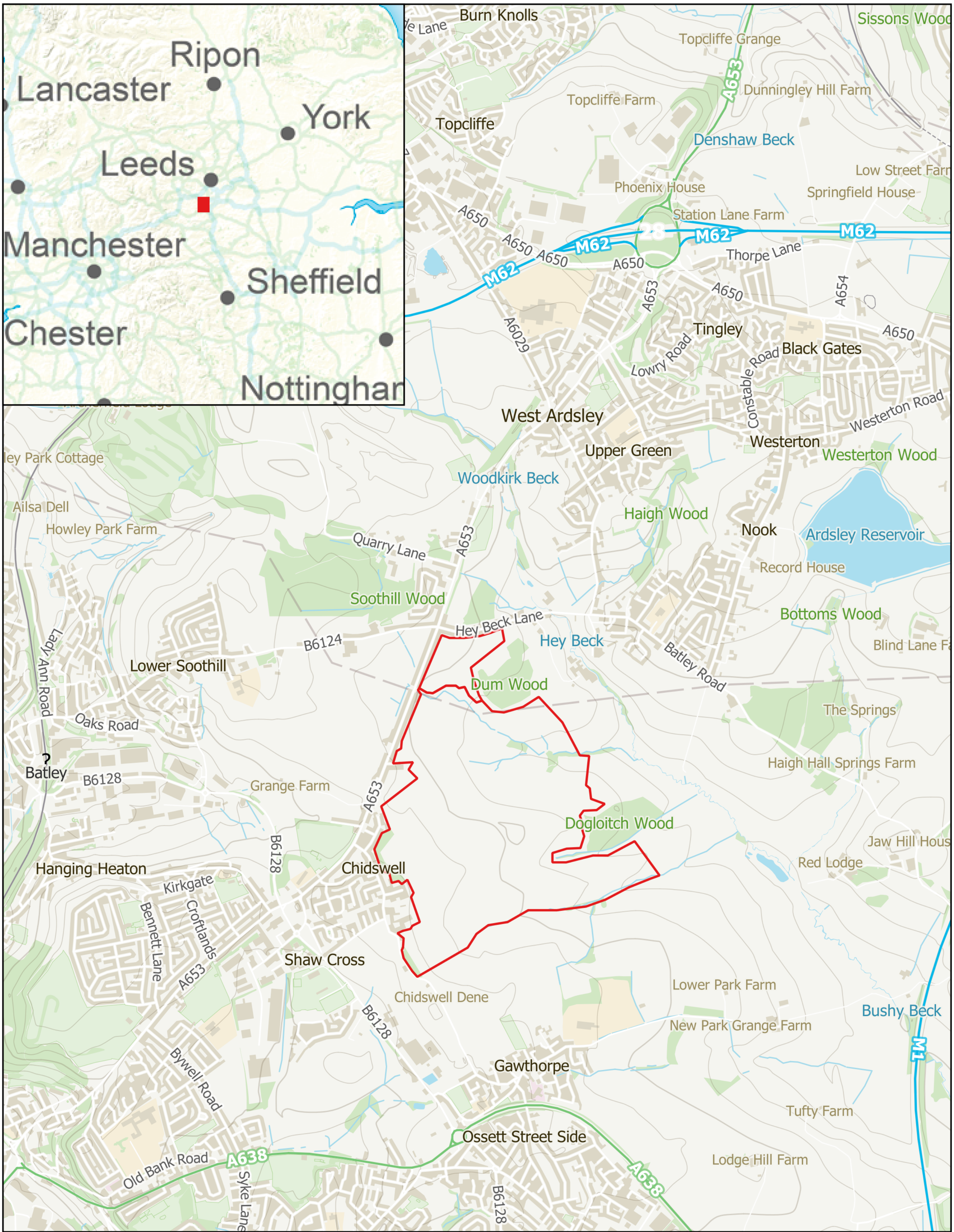
David, A., Linford, N., Linford, P. and Martin, L., 2008. Geophysical survey in archaeological field evaluation: research and professional services guidelines (2nd edition). Historic England.

Google Earth, 2019. Google Earth Pro V 7.1.7.2606.

Olsen, N., Toffner-Clausen, L., Sabaka, T.J., Brauer, P., Merayo, J.M.G., Jorgensen, J.L., Leger, J.M., Nielsen, O.V., Primdahl, F., and Risbo, T., 2003. Calibration of the Orsted vector magnetometer. *Earth Planets Space* 55: 11-18.

Schmidt, A. and Ernenwein, E., 2013. Guide to Good Practice: Geophysical Data in Archaeology. 2nd ed., Oxbow Books, Oxford.

Schmidt, A., Linford, P., Linford, N., David, A., Gaffney, C., Sarris, A. and Fassbinder, J., 2015. Guidelines for the use of geophysics in archaeology: questions to ask and points to consider. EAC Guidelines 2.



MSSE562 - Chidswell, Dewsbury
Figure 1 - Site Location
1:25,000 @ A4

Site Boundary

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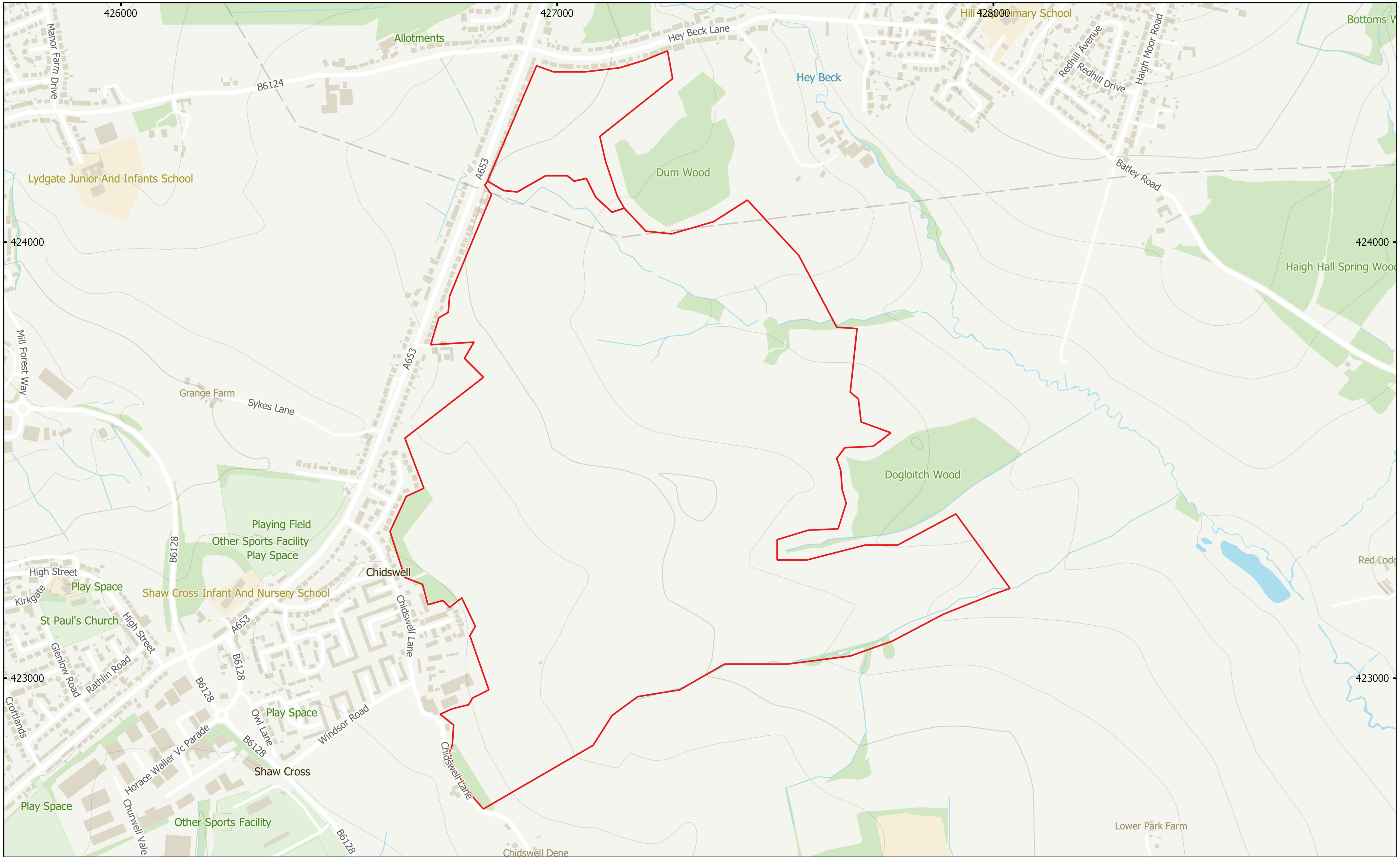

MSSE562 - Chidswell, Dewsbury
Figure 2 - Location of Survey Area
1:8,000 @ A3

Survey Extent
Survey Extent

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STANDARD MAGNETIC FIELDWORK RISK ASSESSMENT

Likelihood of Accident/Incident Occurring	Severity of Consequences
1. Highly improbable 2. Probable – annually 3. Infrequent – 2-3 times/year 4. Occasional – monthly 5. Frequent – weekly	1. Minor injury minor damage to plant/equipment/buildings 2. Injury (no time lost) damage repair costs are low 3. Injury (time lost) high damage repair costs 4. Major reportable injury very high damage repair costs 5. Fatality major damage and major costs

Details of tasks to be carried out	Potential Hazard	A Likelihood	B Severity Rating	Overall Risk Rating A x B	Control Measures	Action	Revised Risk Rating
Driving company vehicle	Losing control of vehicle, sudden breaking or swerving. Hitting another road user, pedestrian or stationary object.	2 2	5 5	10 Moderate 10 Moderate	Do not drive vehicle if feeling unwell or tired. Take regular breaks on long journeys. Take turns driving when working in groups. Try to avoid driving in adverse weather	If weather is severe pull over. Stay in a hotel if work has been delayed or weather conditions are extreme.	1x5=5 Low 1x5=5 Low
Parking company vehicle	Parking in an unsafe location, such as a blind corner or hidden dip or on the side of a major highway. Pausing while farm gates are opened in order to exit highway.	3 4	5 4	15 High 16 High	Where possible park off-road in car parks, farm yards, fields or lay-bys. If it is not possible to access a survey area in a safe manner, stop and make new arrangements, such as obtaining keys or codes to locked gates. Use vehicle lights, such as dipped headlights, and hazards. Avoid packing or unpacking the vehicles in the dark. When performing reversing procedures while entering or exiting fields, position a colleague in a safe place where they can be seen and heard in order to direct and	Wear high visibility clothing when working around vehicles. Use the floodlight when necessary and safe to do so. Return early during winter months to prevent working in dusk conditions Only stop on highway if safe to do so. Use hazard lights.	1x5=5 Low 1x4=4 Low

STANDARD MAGNETIC FIELDWORK RISK ASSESSMENT

Likelihood of Accident/Incident Occurring	Severity of Consequences
1. Highly improbable 2. Probable – annually 3. Infrequent – 2-3 times/year 4. Occasional – monthly 5. Frequent – weekly	1. Minor injury minor damage to plant/equipment/buildings 2. Injury (no time lost) damage repair costs are low 3. Injury (time lost) high damage repair costs 4. Major reportable injury very high damage repair costs 5. Fatality major damage and major costs

					communicate information on the road traffic.		
Loading and unloading the cart	Muscle strain, dropping equipment, slips trips and falls.	4	2	8 Moderate	Work in a pair, never lift the cart in or out on your own. Move the cart to the edge of the van and then lower to the ground. Never step out the van while lowering to the floor. Follow manual handling training.	Clear both the interior and surrounding van area before attempting to lift the cart in or out the van.	2x1=2 Low
Entering and commencing work in a new survey area	Coming into contact with unknown hazards in a new survey area.	4	2	8 Moderate	Where possible, arrange for livestock to be removed from survey areas before work is begun. Liaise with farmer with regard to livestock. Complete a walkover survey and dynamic risk assessment of the survey area to identify any hidden or unusual hazards, remove or reduce the hazard as best as possible and inform all other staff members of both the hazard and the measures that are being implemented to minimise the risk.	Provide a project questionnaire a to be completed by the client before commencement of fieldwork to reduce or eliminate hazards before commencing fieldwork.	2x1=2 Low
Balancing the magnetic sensors	To complete the sensors' calibration requires the cart to be lifted and turned upside down.	4	3	12 Moderate	When the cart must be lifted, ensure it is set up by two people. Before the cart is lifted, a set of steps and commands should be agreed, who will perform each step and when. If either party feels uncomfortable with the procedure, they should immediately let their partner now and safely put the cart down together.		3x2=6 Low

STANDARD MAGNETIC FIELDWORK RISK ASSESSMENT

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1. Highly improbable 2. Probable – annually 3. Infrequent – 2-3 times/year 4. Occasional – monthly 5. Frequent – weekly	1. Minor injury minor damage to plant/equipment/buildings 2. Injury (no time lost) damage repair costs are low 3. Injury (time lost) high damage repair costs 4. Major reportable injury very high damage repair costs 5. Fatality major damage and major costs

					The cart should not be lifted in high winds or when the ground is slippery underfoot.		
Surveying with the cart	Slips, trips and falls while walking with instrument. Strains to muscles while pulling cart.	4	3	12 Moderate	Care taken when working in field. Work not to be undertaken where there are poor field conditions, such as heavy plough or thick vegetation - where a clear view of the underfoot condition is not possible.	Safety survey boots to be worn while walking. Warm up/ down in cold conditions.	**3x2=6 Low**
Working in all weather conditions.	Hypothermia and heat stroke.	3	3	9 Moderate	Stop survey and take shelter in heavy rain and strong wind to avoid accidents and illness. Take regular breaks in hot weather.	Appropriate PPE to be worn, full waterproofs and safety boots are provided. Make use of the provided, water, sun tan lotion and aftersun. Wear a hat.	**3x1=3 Low**

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QUAD RISK ASSESSMENT

A: Likelihood of Accident/Incident Occurring	B: Severity of Consequences
1. Highly improbable 2. Probable – annually 3. Infrequent – 2-3 times/year 4. Occasional – monthly 5. Frequent – weekly	1. Minor injury / minor damage to plant/equipment/buildings 2. Injury (no time lost) / damage repair costs are low 3. Injury (time lost) / high damage repair costs 4. Major reportable injury / very high damage repair costs 5. Fatality / major damage and major costs

Details of tasks to be carried out	Potential Hazard	A Likelihood	B Severity Rating	Overall Risk Rating A x B	Control Measures	Action	Revised Risk Rating
Loading and unloading the quad into / out of the van	Slipping and tripping when quad is loaded / unloaded	3	4	12 Moderate	Work in a pair, never drive the quad in on your own. Roll the quad out making sure you have a firm grip of the breaks. Align the quad on the ramps before moving on to them. Fully empty van prior to loading. Correctly secure ramps using ratchet straps.	Check conditions of the ground where the quad is to be unloaded. Remove any obstacles that might be in the way. Check the ramp is stable to be driven over.	1x4=4 Low
	Quad moving around when the van is driven	2	3	6 Moderate	Roll the quad to the front of the van. Properly secure quad at four points to van using ratchets provided.	Check the ratchets are properly secured before setting off. Make sure the quad is in park mode before moving van.	1x3=3 Low
Refuelling tank	Fuel spillage	3	4	12 Moderate	All refueling to be carried out using a funnel or a container with the appropriate spout. Have spill kit and fire extinguisher to hand. Wear gloves to protect skin.	To be done in a ventilated area. Keep away from any source of ignition	1x2=2 Low

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QUAD RISK ASSESSMENT

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1. Highly improbable 2. Probable – annually 3. Infrequent – 2-3 times/year 4. Occasional – monthly 5. Frequent – weekly	1. Minor injury / minor damage to plant/equipment/buildings 2. Injury (no time lost) / damage repair costs are low 3. Injury (time lost) / high damage repair costs 4. Major reportable injury / very high damage repair costs 5. Fatality / major damage and major costs

Attaching cart to the quad	Cart detaching from quad / Damaging of survey equipment.	3	3	9 Moderate	Properly secure cart to the hitch point of the quad. When driving, regularly check the condition of the cart. Do not collect data on poor ground conditions	Follow manufacturer advice.	1x3=3 Low
Driving quad on site	Being thrown off due to quad tipping or a collision into an obstacle.	3	5	15 High	Always wear the provided helmet and PPE. Only those who have passed the Lantra Training to use the quad. Don’t overload racks.	Drive with care and attention at all times. Follow correct procedures taught during training. Maintain low speed. Maintain correct posture when driving quad. Do not carry passengers	1x5=5 Low
	Quad failure.	3	3	9 Moderate	Drive quad according to manufacturer’s directions. Check level of liquids (fuel, oil, brakes) and tyre pressure.	Do daily maintenance checks. Immediately report any observed damage on the quad.	2x3=6 Low

SITE SPECIFIC RISK ASSESSMENT

Project Name:
Project No:
Client:
Assessor:
Date of Survey:
Signature:

Description:

Hazard	Who could be harmed?	Mitigation strategies?	Any further action required?	Who should take action? When?	Has the hazard been resolved?

COSHH FORM

Task **Refuelling of Quad Bike**	
Location of activity: On Site	**Assessment Reference: MAGCOSHH - 3**
Who is at Risk:	Staff undertaking task, nearby contractors and/ or public.
Material	**Hazard**
Petrol	Risk of combustion. The vapours and liquid are hazardous to health. Skin contact with liquid fuel can lead to soreness and itching rashes or blistering (dermatitis).

Control Measures

Store only the minimum amount of fuel required in the appropriate container, never over fill the container. Make sure the container is on firm level ground when filling. Regularly inspect the container to make sure it is in full working order and free from damage. Should you have any concern regarding the container report it immediately and do not use it.

Only refuel the quad bike where it is safe to do so, in a well-ventilated area, away from any source of heat, spark, flame or other source of ignition. Only undertake refueling when the area is free from other contractors and / or visitors, members of the public. Refuel the quad bike well away from watercourses or drainage systems to reduce risk of harm to wildlife. Use the appropriate funnel and spouts when refuelling to reduce the chance of spillage. Make sure the vehicle is switched off during the refuelling. Immediately secure both the container and the fuel tank on completion of refuelling. Make sure both the spill kit, fire extinguisher and fire blanket are to hand during the procedure.

Clean up any spillage immediately, using the spill kit.

Flammables and explosives

Is there a substance used or formed that might give rise to a fire? Yes

Petroleum is extremely flammable. Store away from heat, sparks, open flame and combustible materials. Store only in the appropriate container.

Foam, dry powder and carbon dioxide extinguishers can be used.

Personal Protective Equipment [*gloves, safety glasses*]

Wear safety glasses and single use gloves at all times while refuelling. Keep skin covered. Dispose of single use gloves after use.

Monitoring

Not required.

Health surveillance required Check skin for dryness and soreness every six months. Report any problems to Finnegan Pope-Carter.
Storage Keep away from heat, sparks, open flame and combustible materials. Store only in the provided container. Store used spill kit granules and absorbents in the waste bags provided in the spill kit
Waste disposal [general waste, recyclable] Arrange for hazardous waste collection through Bradford City Council
First Aid In the event of petrol coming into contact with skin or eyes rinse immediately with plenty of water or eyewash. Change clothes immediately. Attend the nearest A&E.

Assessment Summary The risk posed from refuelling the quad bike is medium. Using the appropriate control measures and PPE this risk is reduced to medium low.

Assessor: Ed Burton

Signed: Edward Burton

Date: 07/3/19

Review date: 31/3/20

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COSHH FORM

Task **Use of Lithium Polymer Batteries**	
Location of activity: On Site	**Assessment Reference: MAGCOSHH - 4**
Who is at Risk:	Staff undertaking task survey.
Material	**Hazard**
Lithium Polymer Batteries	Electrolyte may irritate skin or eyes. Fire Hazard if battery is damaged, incorrectly charged or exposed to excessive heat.

Control Measures and storage procedures

Batteries are designed to be recharged, use only charging equipment provided.

Use Lipo fire proof bags provided when charging. Do not leave unattended when charging.

Place charging equipment and batteries on a level, non-flammable surface.

Inspect cables in advance of use and charging, do not use or charge batteries **if a fault is found, quarantine the item and report to management.**

Never disassemble a battery, do not puncture or crush.

Do not store above 60® C

Protect terminals when storing

Flammables and explosives

Is there a substance used or formed that might give rise to a fire? Yes

Damaged cells may leak flammable vapours.

Foam, dry powder and carbon dioxide extinguishers can be used.

Personal Protective Equipment [*gloves, safety glasses*]
No PPE is required for the handling and use of batteries which have not been damaged.
The handling of damaged batteries should be avoided, if it is necessary to move a damaged battery chemical resistant gloves should be used, and safety glasses worn. No skin should be exposed.

Monitoring

Not required.

Health surveillance required

None.
Storage Keep away from heat, sparks, open flame and combustible materials. Store only in the provided containers, within lipo fire proof bags.
Waste disposal [general waste, recyclable] Arrange for hazardous waste collection through Bradford City Council
First Aid If cell becomes ruptured or damaged and material from within the cell comes in to contact with skin, flush immediately with water. If contact with eyes occurs, then flush with copious amounts of water for 15 minutes. Seek medical advice.

Assessment Summary The risk posed from the use of Lithium Polymer baterries is medium. Using the appropriate control measures and PPE this risk is reduced from medium to low.

Assessor: Ed Burton

Signed: Edward Burton

Date: 7/3/19
Review date: 31/3/20

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