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QUALITY ASSURANCE

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PROJECT NUMBER	11-542
IMS Template Reference: QR010-1	



EXECUTIVE SUMMARY		
Site Address	Land off Hinkshay Road, Telford, Shropshire, TF4 3PA	
Grid Reference	E369480, N307340	
Site Area	4.39Ha	
Current Site Use	<p>The comprises a former dry cell battery factory, a car park area, a former sewerage treatment works and sports field which also includes a backfilled quarry and J.B. Pugh landfill. It is understood that the factory buildings were demolished in the mid 1990's; including removal of quantities of buried battery wastes. The factory area was subsequently covered with demolition rubble and soil to a thickness of approximately 1.0m.</p> <p>Investigations have proven that factory floor slabs, foundations and other infrastructure still remain below the surface of this sector of the site.</p> <p>The site is bordered to the north by undeveloped land with some residential housing and the grounds of a rugby club, to the east and south by undeveloped park land, and to the west by an area of land known as Tarts Mound.</p>	
Proposed Development	Countryside Properties intends to construct a low rise residential development comprising 152 No. residential dwellings with associated gardens, estate roads and infrastructure.	
Environmental Setting	<i>Drift Geology</i>	None
	<i>Bedrock Geology</i>	Halesowen Formation - Sandstone
	<i>Hydrogeology</i>	Where drift deposits are present they are classified as a Secondary Undifferentiated (drift) overlying Secondary A aquifer (Solid). The nearest groundwater abstraction is located 694m away from the site.
	<i>Hydrology</i>	An on-site drainage ditch is present in the north of the site. The streams generally flow in a southerly direction towards Stirchey Pools to the south of the site.
	<i>Flood Risk</i>	Unaffected by flooding from rivers.
Site History	Historical maps indicate that the site historically comprised a battery works with associated tanks and storage sheds in the north east of the site, a sewage works and coal shafts in the centre of the site and soft standing in the west of the site, with a small former quarry on the south-western boundary.	
Previous Reports	<p>A previous Phase 1 & 2 report was completed by Wardell Armstrong in June 2013 (Reference LE0972-001 Rev A), which also references various ground investigations and remediation reports completed by Halcyon Environmental dated between September 1993 and April 2011, as well as a Contamination, Condition and Remediation Strategy report completed by Atkins in December 2003 and an Engineering report completed by Black Country Properties Ltd.</p> <p>An overview of the Wardell Armstrong and Atkins report is provided below:</p> <p>Wardell Armstrong – Phase 1 & 2 Geo-Environmental Report. Ref: Report No. LE0972-001 REV A dated June 2013.</p>	

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	<p>Majority of the former factory area is underlain by layer of topsoil containing fragments of brick and colliery spoil to a depth of between 0.1m and 0.6m bgl. Underlying the topsoil are made ground soils consisting of either sandy clayey demolition brick and concrete rubble (with occasional metal and tarmac fragments) or gravelly clay colliery spoil. Within the Made Ground a reinforced concrete slab of varying thicknesses is encountered within the majority of holes between 0.46m and 1.05mbgl, with a thin layer of asphalt in some areas.</p> <p>Across the former sewage works area, a layer of topsoil of between 0.1m and 0.6m thickness is recorded at the surface. The Made Ground was generally recorded across the former sewage works and consisted of either clayey ash/ ashy clay with fragments of brick, concrete, clinker and plastic to a depth of between 1.00mbgl and 2.40mbgl.</p> <p>Across the former sports and social club area, a layer of topsoil containing brick, tiles, slate and ash is recorded between 0.1m and 0.6m bgl. The made ground within the former landfill was recorded to a maximum depth of at least 3.2mbgl and generally consisted of gravelly sandy ash with fragments of pottery, brick, leather shoe, clinker and glass and occasional pockets of clay.</p> <p>Rockhead was recorded within majority of trial pit and borehole positions across the site encountered as a weak to very weak sandstone at depths of between 1.00mbgl and 5.00mbgl.</p> <p>The Wardell Contamination risk assessment identified elevated inorganic heavy metals and non volatile PAH compounds within the made ground, however the risk to future site occupants could be mitigated through appropriate build phase measures. No risk to controlled waters or the wider environ was identified.</p> <p>Atkins – Contamination, Ground Conditions and Remediation Strategy Dated December 2003:</p> <p>Remediation was undertaken by Kenal Services Ltd of Chesterfield in April 1995. The works involved the removal of approximately 4500 tonnes of contaminated soil and battery cells.</p>
Utility Locations	<p>A review of online data held by Severn Trent shows the presence of mains sewers below Hinkshay Road. A former culvert like structure is also present below the south-eastern boundary of the site.</p>
Landfill Sites & Ground Gases	<p>The former quarry in the south west of the site is stated as being a J.B. Pugh landfill in the Wardell Armstrong report.</p> <p>There are 3No. historical landfills within 250m of the site. The closest of which is located 75m north west of the site which excepted unknown material.</p>
Radon	<p>Unaffected – no special precautions required.</p>
Coal Mining / Land Stability	<p>The site is underlain by deep mine workings that are unlikely to pose a subsidence risk to the site.</p> <p>However, there are 3No mine shafts within influencing distance of the site that will require a series of slit trenches to confirm their positions (or absence) within the proposed development site. In the event slit trenching does not locate the recorded shafts, a probe drilling exercise will be</p>



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Coal Mining / Land Stability	<p>required across the area of potential departure to confirm the absence of the mine entries.</p> <p>All future development must account for the appropriate 'no build' zone that will be determined as the maximum extent of mine shaft collapse influence.</p> <p>No treatment details for the on-site mine shafts have been given.</p>
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E3P Intrusive Ground Investigation

Ground Conditions	<p>E3P has undertaken 35 No. mechanically excavated trial pits, and 19 No. window sample probeholes as part of the supplementary intrusive Ground Investigation with ground conditions summarised below:</p> <p>Made Ground</p> <p><i>Former Factory Area and Car Park Area</i> Across the former factory area, a layer of topsoil containing gravels of brick is logged between 0.1m and 0.6m thickness is recorded at the surface.</p> <p>Underlying the topsoil in majority of locations a dark grey gravelly clay material that appears to be colliery spoil from 0.30m to 1.00m bgl. This is subsequently underlain by a thin band of a brown gravelly clay before concrete or asphalt is encountered at circa 0.70m to 1.20m bgl. The concrete and asphalt encountered was typically 200mm in thickness which represents the former building slab and hardstand.</p> <p>Underlying the concrete or asphalt is typically a dark brown sandy ashy gravel with rare cobbles of brick and concrete (historical level raising material). The gravel typically comprised brick, glass, slate, clinker and small amounts of slab to a maximum proven depth of 2.90m bgl.</p> <p><i>Former Sewage Works Area</i> Across the former sewage works area, a layer of topsoil with gravel of brick and glass between 0.1m and 0.6m thickness is recorded at the surface. Excluding TP128, Made Ground was recorded across the former sewage works and consisted of dark brown sandy ashy gravel with rare cobbles of brick and concrete. The gravel typically comprised brick, glass, slate, clinker to a maximum depth of 1.70mbgl. Trial pit TP115 was excavated</p>
Ground Conditions	<p>into the slope showing the use of the colliery spoil material to build up a level platform in the area of the former battery works. The colliery spoil material is not present beneath the former sewage works.</p> <p><i>Former Sports and Social Club Area</i> A layer of topsoil rarely containing brick is recorded across the south-western area of the site between 0.1m and 0.4m bgl. The Made Ground within the former landfill was recorded to a maximum depth of at least 5.00m bgl within WS102 (backfilled quarry) and generally consisted of gravelly sandy ash with fragments of pottery, brick, glass, clinker and glass.</p> <p>Drift</p> <p>Across the site drift deposits are fairly limited and in most cases a sandy gravel of mudstone is encountered, which is indicative of a weathered bedrock. Within a small number of holes a thin (300mm-600mm) layer of</p>

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	<p>very stiff brown sandy CLAY was encountered overlying the weathered bedrock.</p> <p>Bedrock</p> <p>Rockhead was recorded in majority of trial pit and borehole positions across the site. Within the former factory area, car park area and former sewage works area rockhead was recorded to be relatively shallow and was encountered as a weak to very weak sandstone at depths of between 1.50mbgl and 3.00mbgl.</p> <p>Within the former sports and social club area rockhead was also recorded to be relatively shallow and comprise weak to very weak sandstone at depths of between 1.00mbgl and 5.00mbgl.</p> <p>Groundwater</p> <p>Perched groundwater was only encountered within very small number of holes between 3.00m and 4.00m bgl. Standing water was encountered in TP125, however this seemed to be a pooling of water within the Made Ground.</p>
<p>Human Health Contamination Risk Assessment</p>	<p>A Tier I Human Health Risk Assessment has been undertaken using the chemical analysis results of the soils and comparing to the relevant Tier I criteria. This assessment has identified the presence of elevated lead, arsenic, cadmium, zinc, benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(a,h)anthracene, asbestos and TPH bands C16-C35.</p> <p>All of the identified elevated concentrations have primary exposure pathways related to dermal contact and ingestion of soils, inhalation of particulate and consumption of home-grown vegetables. The chronic risk to human health associated with the elevated concentrations on inorganic heavy metals and non-volatile PAH compounds can be mitigated through the installation of a suitable cover system in all proposed private gardens, landscaping and Public Open Space to remove any potential for direct exposure to impacted soils.</p> <p>Asbestos in the form of chrysotile and amosite has also been identified within localised areas in shallow Made Ground deposits. Asbestos quantification should be undertaken to further assess where these soils</p>
<p>Human Health Contamination Risk Assessment</p>	<p>may be placed. No visual signs of ACM has been encountered during the Ground Investigation, therefore it is likely only trace fibres and small fragments are present within these localised soils and a process of hotspot excavation with placement of impacted soils at depth beneath proposed plots (to be vibro piled) may be undertaken to ensure they pose no unacceptable risk to the future site users.</p> <p>Chemical analysis of the natural sand and clay deposits have identified these soils to be acceptable for use as subsoil within the proposed garden areas, however further chemical validation samples will be required to confirm this. There are no suitable sources of topsoil available on the site.</p>










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Controlled Waters	<p>Elevated levels of Lead, Zinc and Nickel have been identified are of low solubility and the nearest abstraction well or watercourse is at a significant distance from the site.</p> <p>Due to the limited amount of viable receptors there is considered to be no significant level of risk to the controlled water receptors.</p>
Ground Gas	<p>Ground gas monitoring thus far has indicated the site would be classed as Characteristic Situation 2 / Amber 1, suggesting no gas protection measures will be required. However, the final ground gas regime will be confirmed following the completion of the ground gas monitoring programme.</p>
Potable Water Infrastructure	<p>A well designed, managed and validated programme of enabling works should render the site suitable for PE Potable Supply Infrastructure.</p>

Geotechnical Assessment

Underground Obstructions	<p>Within the area of the former battery works reinforced concrete floor slabs and asphalt were encountered across the former footprint. Brick walls and former man holes were also encountered.</p> <p>The former building slab, hardstand and foundations remain in-situ with extensive relict foundations and infrastructure. Large scale process of substructure demolition and subsequent enabling works will be required across all areas of previously developed land.</p>
Allowable Bearing Pressure	<p>The underlying natural CLAY drift deposits have been assessed as being very stiff high strength with a net ABP in the order of 155-246kN/m² at circa 1.00m – 3.00m bgl however a firm CLAY with an ABP of 68kN/m² was encountered within BH101 at 1.50m bgl.</p> <p>The majority of the site is underlain by medium dense to dense gravelly SAND with an ABP of 118 to >400kN/m² between 0.75m and 5.00m bgl. In localised areas of the site, the underlying SAND are loose in a few area of the site with an ABP of 66-77kN/m² between 1.50m and 4.50m bgl. The weathered bedrock is likely to have an ABP of >400kN/m².</p> <p>Drift deposits beneath the infilled quarry on the western boundary and sewage works were assessed as having a net ABP of 100kN/m² in the silty CLAY at circa 5.00m bgl.</p>
Foundation Options	<p>Given the significant topographical variances on the site, prior to the detailed design of suitable foundations solutions, a programme of remediation and enabling works will be required to remove the extensive buried obstructions and cut / fill the site to provide suitable development platform levels.</p> <p>Therefore, upon completion of these enabling works, it is likely that the most cost effective option for the majority of the site would be re-engineer the Made Ground using Vibro Stone Columns (VSC) to support a shallow strip or spread foundation.</p> <p>The exception to this would be in the location of the former infilled quarry area and area of infill on the very western boundary where Made Ground was identified to be deep and underlain by bedrock. Dependent on development levels, plots in this area may require a driven pile foundation.</p> <p>Foundation depths should take account of the presence of existing and proposed trees with foundations deepened locally, to mitigate the potential</p>

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Foundation Options	for volumetric instability attributed to fluctuations in moisture content, in accordance with the requirements of NHBC standards. It is recommended that at working drawing stage a foundation schedule is prepared for the development taking account of the physical change of natural clay soils and the current / proposed locations of trees.
Building Floor Slabs	Ground bearing floor slabs are unlikely to be viable given the anticipate depths or re-worked Made Ground >600mm and shallow cohesive soils.
Heave Precautions	Limited cohesive deposits were encountered in the south west of the site, therefore heave precautions may be required.
Soakaway Drainage	The Sand and sandstone bedrock stratum beneath the site is likely to have a moderate to high effective permeability, which may be suitable for soakaway drainage, though its application will depend on finished floor levels and the specific requirements of the development. All soakaways should be designed in accordance with BRE Special Digest 365 – Soakaway Design.
Sulphate Assessment	Concrete classification will be DS1 AC1s.
CBR Design %	Granular soils can be re-engineered to ensure 5% within the sub-grade during favourable climatic conditions. Natural CLAY soils will provide a CBR in the order of 3-5% during drier climatic periods. However, if water is allowed to shed onto the formation, the CBR will reduce to <2% which will require specialist engineering of the sub-grade.
Infrastructure	Consideration should be given to the presence of shallow rock which will impede excavation for drainage infrastructure within certain areas of the site.
Cut / Fill	Development levels unknown at this time, however significant cut fill works will be required to prepare the development platform.
Waste Characterisation	Stable Non-Reactive (hazardous / inert).
Recommendations	Based on the findings of the intrusive site investigation, the following additional works are recommended to be completed in due course: <ul style="list-style-type: none">  Supplementary intrusive investigations within the areas of potential departure (misposition) of the mine entries recorded on or immediately adjacent to the site by a process of slit trenching to expose bedrock. In the event slit trenching is inconclusive, probe drilling will be required in accordance with the Coal Authority Permission process;  Completion of slope stability assessments;  Upon completion of the supplementary intrusive investigations to locate the mine entries, the appropriate 'no build' stand-off zone will be defined to inform the final development layout;  Plot Specific Foundation Schedule (upon receipt of the final development levels);  Production of Contamination Piling Risk assessment to demonstrate that any driven piles bearing within the underlying bedrock will create no preferential pathway for contaminant migration;  Geotechnical Earthworks Strategy (Infrastructure); and,  Detailed Remediation & Enabling Works strategy.