Conceptual Site Model and Contamination Alleviation Measures

RSK have carried out a Tier 1 and Tier 2 Risk Assessments. The Tier 2 Human Health Risk Assessment is based on the results of the laboratory tests on soils samples. These were evaluated using Generic Assessment Criteria (GACs) calculated using the final updated CLEA framework, comprising the new CLEA Software (version 1.06), and supporting documents.

Based on the above, RSK have prepared a Conceptual Site Model (CSM) so as to highlight the environmental risks. This is presented in table 5, below.

Substances present at source			Pathways	Receptors
Metals	Inorganic	Organic		
Arsenic,	Sulphate	PAHs		
X	×	Yes	ingestion of contaminated soil, dust, liquid	Human health
×	×	Yes	Inhalation of contaminated dust and vapours/gases	
x	×	Yes	Uptake into home grown produce	
×	×	Yes	Dermal contact with contaminated soil/water/liquid	
x	×	Yes	Migration of contaminated groundwater/leachate from site to underlying water resources	Groundwater
x	×	Yes	Migration of contaminated groundwater/leachate from site to surface water	Surface Water
x	×	×	Uptake into vegetation	Flora
Yes	Yes	x	Contact with contaminated ground/liquid/vapour	Building materials/ structures

Key:

* Based on the findings of the investigation, it is considered that these substances would **not** constitute a significant source of contamination.

Yes Based on the findings of the investigation, it is considered that these substances may constitute a source of contamination and a pollutant linkage.

Table 5: Conceptual Site Model prepared by RSK

Based on the above, RSK have proposed the following contamination alleviation measures:

To raise site levels where slightly elevated PAH concentrations were encountered (WS9 and WS11). RSK believe that these elevated concentrations are associated with dispersed charcoal and coal-type fragments. This will effectively encapsulate any material within this area, thus breaking any pathways towards human health.

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To carry out further assessment regarding the the marginal exceedance of benzo(a)pyrene occurs in an area of proposed gardens (WS9). If contamination is deemed to be present, the options comprise removal or encapsulation beneath an appropriate clean cover system.

To take additional samples for testing of Made Ground (WS9) and groundwater (WS11) to determine whether contamination is present and if so, what remediation is required.

The above strategy appears to be reasonable in terms of human health, however, the risks of potential contamination in the Ladies Bathing Pond and all the downstream ponds should be evaluated specifically in regard to the plant and aquatic life present.

The issue of contamination from demolition and during construction should be taken into account with regard to the proximity of the Ladies Bathing Pond.

Foundations

The geotechnical parameters suggested in Tables 7.2 and 7.3 appear to be reasonable. The geotechnical parameters given are typical for a clay with a high plasticity that is classified as stiff to very stiff.

The design parameters for the pile design, recommended by RSK, are appropriate for London Clay. These comprise the following:

- Adhesion Factor (a)
 0.6
- Bearing Capacity Factor (Nc) 9
- Undrained Shear Strength (cu) 72 + 4z kN/m2 where z = depth into clay
- Global Safety Factor 3.0
- Limiting Shaft Friction 140 kN/m2
- Limiting Concrete Stress 7.5N/mm2

The design parameters for the retaining wall design, recommended by RSK, are appropriate. These essentially comprise the drained cohesion and the drained angle of internal friction (c' (kN/m³) and f' (°)).

Balfour Beatty Ground Engineering were contacted as they are piling specialists and they confirmed that either steel sheet piling or contiguous bored piles would comprise suitable construction techniques, however contiguous bored piles would provide a stiffer wall (which may be preferable owing to the close proximity of the Bowling Club pavilion). The contiguous bored piling technique is watertight once constructed, whereas the clutches between each sheet pile would have to be welded in order to make the the sheet piling method watertight. However, the strategy within the CMP is to minimise muckaway from the site and vehicle movements into the site and therefore sheet piling is the most favourable solution.

The upper layer of the Weathered London Clay is significantly desiccated and therefore the proposed use of a compressible void former and a suspended slab will ensure that the potential swelling of the clay will not damage the foundations.

Hydrogeological Impacts of the Proposed Development

RSK have stated that the proposed development is unlikely to intrude significantly into the groundwater environment, for the following reasons:

1) The results of a month-long groundwater monitoring programme indicate that slow rates of water seepage are present within the weathered London Clay. The generally slow rates of seepage are compatible with the anticipated low permeability of the encountered materials, and it is considered unlikely that significant groundwater flows would be encountered from the London Clay Formation during excavation for the construction of the basement.

2) The sheet piling for the basement perimeter will seal the excavation.

3) It is proposed to provide new land drains around the sheet pilling to ease the flow of any water that is present. This measure should effectively mitigate against damming of flows up-gradient of the basement structure.

4) Perched water appears to be locally present in the Made Ground across the site, overlying the low permeability weathered London Clay. This perched water may potentially be a significant source of water with regard to site drainage. In general, the Made Ground/London Clay boundary was encountered at depths between 0.3m and 0.9m bgl, and at these levels the proposed foundations and basement are likely to have no more effect on the perched water regime that the foundations to the existing property on site. Disturbance of the shallow perched water regime during construction is likely to be limited to the effects of severing existing land drainage networks. These should be identified before the start of construction, using ground penetrating radar or similar, so that mitigation arrangements can be put in place before decommissioning the existing system and to avoid unexpected severance of drainage lines.

5) The surface watercourse to the immediate north-west of the site appears to be underlain by a larger subsurface alluvial tract which contains water-bearing alluvium in the north-west of the site and is likely to be a significant source of recharge for the Highgate Ladies Bathing Pond into which it drains. No redevelopment works are planned for this area of the site that would intrude into the groundwater environment.

6) Surface run-off from the site may potentially be disturbed during construction by the removal of vegetation and changes to hard-standing, and run-off from stockpiles of excavated soils. However, any potential impacts may be effectively mitigated by on-site bunding of stockpiled materials and/or creation of retention basins to attenuate surface run-off.

RSK have concluded that: " the impact of the proposed development on the local hydrogeological regime will be minimal and is considered unlikely to have any effect on the water supply to the Highgate Ponds. Any potential disturbances to drainage from the site may be effectively mitigated by the measures outlined above".

We concur with the above points and as previously stated, if the surface water run-off is managed so that rainwater from the buildings is collected and in-directly discharged into the nearby watercourse, then it is unlikely that this development will adversely affect the groundwater regime.

If the above could not be done, then consideration should be given to altering the proposed design by installing a geosynthetic drainage barrier below and around the reinforced concrete box structure of the basement and to remove the sheet piles on completion of the basement construction. However, the above may not be warranted as the property lies between two watercourses and groundwater in the associated watercourse alluvium, so the construction impact on the overall groundwater flow is likely to be minimal.

Conclusions and Recommendations

RSK have concluded that the Ladies Bathing Pond is recharged by:

- water flowing from the ponds connected upstream
- · the watercourse adjacent to the Fitzroy Farm boundary
- surface water run-off

• groundwater within the Made Ground and within sand lenses/sandy seams in the London Clay Formation.

RSK have recommended that groundwater monitoring is continued and that rainfall records are obtained for the monitoring period.

RSK plan to carry out a Radar survey to locate any existing land drainage in the basement construction area so as to construct diversions if necessary.

RSK have concluded that the "impact of the proposed development on the local hydrogeological regime will be minimal and is considered unlikely to have any effect on the water supply to the Highgate Ponds. Any potential disturbances to drainage from the site may be effectively mitigated by the measures outlined above".

We generally concur with the above points and make further recommendations below.

Hydrogeological Key Points and Recommendations

The majority of the site is underlain by London Clay which has a low permeability (3 x 10⁻⁹ m/s for clay with sand partings).

The alluvial tract in the north-western zone of the site is critical zone and needs to be protected from the proposed works.

The groundwater flows within the Made Ground must be maintained.

Surface run-off should be routed to ponds/below ground chambers so that rainwater can seep out into the north-western boundary watercourse (SUDs).

Water quality issues regarding the demolition and construction should be assessed.

The proposed underpinning works to the boundary wall should not put the Made Ground hydrogeology at risk.

A cross section of the site, the proposed works and adjacent features including the structure of the Bowling Club should be prepared so as to understand how much ground the boundary walls are retaining and the implications this will have on the proposed excavations. This should be used to aid the design of the proposed underpinning and evaluate the Made Ground Hydrology.

It is recommended that at least four water samples are taken for testing, two from the upper part of the site and two from the lower part of the site. In addition a sample of the water from the Ladies Bathing Pond should be taken to provide benchmark data to compare the site water samples against.

The strategy proposed for dealing with contamination appears to be reasonable in terms of human health, however, the risks of potential contamination in the Ladies Bathing Pond and all the downstream ponds due to the proposed construction should be evaluated specifically in regard to the plant and aquatic life present.

Rainfall records could be obtained from the Hampstead Heath Scientific Society Met Station at Kenwood in order to determine the reaction rates of the groundwater to rainfall events.

Further ground investigation should be carried out by Trial Pits excavated with a JCB in the zone of the pond shown on the 1953 Historical Map (this is within the footprint of the proposed building) so as to determine what material has been used to fill the pond and to locate the source of the water filling the pond. Proposals should then be put forward to preserve the water source if it is located.

Geotechnical and General Recommendations

A condition survey/investigation of all the boundary retaining walls should be carried out.

Further ground investigation is recommended within the basement zone to reduce the risks of unforeseen ground conditions.

Consideration should be given to carrying out Consolidation testing to define coefficient of consolidation (Cv) and coefficient of compressibility (Mv) values as this would enable settlement/heave to be estimated.

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References

Risk Group Plc (GCL Associates Ltd), Fitzroy Farm, Fitzroy Park, Highgate, North West London, Geotechnical, Hydrogeological and Geoenvironmental Site Investigation Report Project no.241529, May 2010

M.Carter and S.P.Bentley, Correlations of Soil Properties, 1991.

Proposed Residential Development at Fitzroy Farm, Pre- Application Construction Management Plan, May 2010.

HRW Comments on Haycock Review 2nd July 2010

Conclusions and Recommendations (Pages 12 and 13);

- We confirm that all the recommendations for further work included in the RSK report have been instructed and that
 most of the field works have already been undertaken, we await the laboratory results and report, which should be
 available in the near future.
- A radar survey of existing land drainage will be undertaken but this may not be part of RSK's work. We are at present looking at appointing a specialist land drainage sub-contractor whom will advise on land drainage issues and may undertake the survey.

One of the main items we discussed in detail was the capping layer to the tennis court area as noted in both reports and the CMP. As discussed following a detailed cut and fill analysis of the excavations on the site, the volume of clay fill we need to accommodate is greater than originally anticipated. In order to keep lorry movements to a minimum we are re-using the natural inert London Clay to landscape areas of the site, the two main areas being the lawn in front of the house and the tennis court area.

The lawn area is fixed to the level of the house, we therefore propose to increase the clay capping on the tennis court area from the original 700mm to 1300mm, this will be carefully designed and detailed to ensure that no changes are made to the water regime on site. Firstly the existing tarmac finish will be carefully removed and taken of site, then a full survey of any existing land drainage will be undertaken, particularly any drainage from the retaining wall to the bowling green. Existing drainage is to be made good before the capping layer is put down by a specialist sub-contractor. A second layer of land drainage will then be installed with sinks to the lower level, before the final finish to the tennis court is laid. Materials used for the tennis court will be carefully selected and tested to ensure that these are also inert.

As discussed we will be instructing RSK to undertake an impact assessment on this item to ensure there are no unforeseen problems but in general you are satisfied with this approach and we will be forwarding the above assessment to you for final comment.

Haycock Comments on the above. Further to discussions with HRW on the 2nd July 2010 and receipt of sketch drawings of the proposed increased land areas and associated drainage, we are content that due consideration is being given to the protection of the alluvial aquifer in this section of the plot. The RSK impact assessment will be important to review and sediment control of this construction will be important to the protections of Ladies Bathing Pond.

Hydrology Key Points and Recommendations;

Alluvial Tract; As noted the alluvial tract to the north of the site will need to be carefully protected and we confirm this will be undertaken.

Water Flows; Ground water and surface water flows will be maintained by maintaining the existing land drains and providing new land drainage to the re-landscaped areas.

Water quality; Water quality issues during demolition / construction will be ensured by carefully detailed facilities noted in the CMP and WMP and further enhanced by monitoring noted below.

Underpinning; Underpinning to the bowling club wall, this will be carefully detailed to ensure no detriment to the made ground hydrology by providing large diameter weep holes / land drainage through the pins. As part of our detailed design on the project levels and retained heights will be carefully assessed.

Water Samples; As discussed, we are taking water samples from the site to investigate the minor charcoal contamination and any implications this may have, although waterbourn contamination from this existing source is very unlikely. We would

also be happy to take further on site samples to benchmark the site ground water. While we are also happy to undertake a test sample of water from the ladies pond, we would note that this will not provide bench mark data for the site as the catchment area for the pond is obviously much greater than the Fitzroy Farm site. The information would however be useful in determining the current state of the pond water but it is possible that potential contamination could enter the pond from anywhere in the catchment area.

Water Samples; As noted above the water sampling and further testing will indicate the extent and solubility of the charcoal and we would propose to await the results of the testing to determine the way forward. It is worth noting that the small amounts of charcoal are historic material probably dating from the site's use as a farm and therefore have been part of the ground regime for a significant time.

Rainfall Data; We confirm rainfall data is being collated.

1953 Pond; As noted in the historical section of the assessment, this appears to be an ornamental pond, which first appeared when the existing house was built on the 1934 map, the pond is not shown on any of the previous OS maps. The ground level in this area was reduced by the previous contractor, whom we assume removed the pond but there is no evidence of out flow from this area. We would therefore propose to investigate this when we get to site as we are fairly sure that this was an ornamental pond.

Haycock Comments on the above. Further to discussions with HRW on the 2nd July 2010 we are content that the above issues are being considered in the design of the scheme and protection of the groundwater movement from the Bowling Green is being considered in the design of the retaining wall for the site.

Geotechnical and General Recommendations;

Boundary Retaining Walls; An initial survey of the boundary walls has already been undertaken and this will be progressed as part of our detailed design.

Further Basement Zone Investigations; We understand your recommendation but the basement zone is below the existing house footprint and is not accessible at this time. We do also have five boreholes surrounding the basement area range from 5 to 20m and a close correlation of ground strata between them. We therefore believe we have sufficient information at present.

Consolidation / Compressibility Tests; The pile design and anti-heave measures below the slab make these tests unnecessary.

Haycock Comments on the above. Further to discussions with HRW on the 2nd July 2010 we are content with the comments and appreciate the difficult of securing this date.