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Date 26 May 2023

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Dear Jane,

Ref

Ref Royal Elm Park
TEC letter dated 19 March 2023, ref Lt.2302016.001.01

We have reviewed the above letter prepared by TEC which addressed our proposed strategy for discharge of pre-commencement conditions associated with groundwater and ground gases for Royal Elm Park, as presented during our meeting on the 22 February 2023.

Following our meeting in February, we have submitted further details for RBC review as part of a discharge of conditions application (RBC Ref. 230448) received on the 5th April 2023, in relation to planning conditions, 3, 4, 7, 68, 70, 71, 72 and 73. This included our report entitled 'Planning Enactment Works, Proposals for discharge of Planning Conditions relating to Contamination and Ground Gases', dated March 2023. Appendix 3 of that report contained our initial assessment of post planning groundwater and ground gases up to 2021, entitled 'Summary of Groundwater and Ground Gas Results' and dated March 2023. This latter report has been further updated to capture all monitoring results up to March 2023 and the following are appended to this letter:

1. Summary of Groundwater Quality & Ground Gas Results dated 31 May 2023
2. Ground Gas Assessment dated 31 May 2023.

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Our proposals for discharge of conditions related to groundwater and ground gases follow the Environmental Strategy detailed in the Arup report Environmental Strategy, Rev C dated 7 December 2017, which formed the basis of the consented planning application. The document is referenced as an approved technical document and is referenced by conditions 70, 71 and 73. The following responses are made to the comments raised in TEC's letter and refer to the approved Environmental Strategy and the above updated groundwater and ground gas assessments:

Groundwater

1. The location of borehole N is highlighted on the attached sketch SK 005 Monitoring Boreholes Location Plan.
2. The attached Ramboll report, dated 31 May 2023, provides detailed analysis of groundwater data from 2015 to March 2023.
3. Our report dated March 2023 provided trigger levels for the Ammoniacal Nitrate in the River Terrace ravel and the Chalk, in accordance with Appendix D of the Environmental Strategy, for monitoring data assessed up to August 2021 (ref Appendix3, Ramboll report 'Summary of Groundwater and Ground Gas Results', section 5). Since production of this report, we have assessed all further groundwater data up to and including March 2023 and have prepared revised trigger levels, in accordance with Condition 70. Please refer to revision 02 of the above report which is appended.
4. The trigger levels focus on Ammoniacal Nitrate, as agreed with the Environment Agency and as described in Appendix D of the Environmental Strategy.
5. We can confirm that the mitigation measures, in respect of groundwater and ground gases, as detailed in the Environmental Strategy will be implemented in the proposed works.
6. In accordance with the Environmental Strategy and Condition 72, cut off-wells will be brought into operation adjacent to each phase of the works. For the single pile to be constructed for the enactment, Line 4 will be brought into readiness. Should groundwater monitoring during or post piling identify levels of ammoniacal nitrate exceeding the agreed trigger levels the groundwater will be extracted until monitoring shows that contamination concentrations have fallen below the agreed trigger levels.
7. We assume that the term 'zones' refers to a plan division of the site into zones. The enactment works do not involve any proposed zoning of the site.
8. The planning permission relates to the risk assessment of groundwater as detailed in the Environmental Strategy. That strategy summarises in-depth detailed studies of the site since its first redevelopment and draws upon methods of construction tried and tested for the stadium construction and associated hotel and convention centre and received the approval of the Environment Agency. Our assessment of the groundwater are in the context, findings and recommendations of that assessment and the subsequent strategy for mitigation proposed for the works follow those in the Environmental Strategy. The strategy does not require:
 - a. Further research of groundwater levels across the site
 - b. Further assessment of groundwater flow directions
 - c. Further assessment of regional groundwater conditions
 - d. Development of a detailed conceptual model
 - e. Forward modelling to predict impact of the site redevelopment.

With respect to groundwater monitoring, item (b), monitoring of boreholes with the River Terrace Gravels (RTG) zones and the London Clay and Chalk zones, identified on SK005, will be carried out monthly post construction of the pile or a period of 4 months. The RTG zone has historically recorded the highest ammoniacal nitrate concentrations and are nearest to the base of the land-raise. It is reasonable to assume that any spike in groundwater contamination will first be noticed in the RTG zone. These boreholes are positioned around the complete perimeter of the site and so will intercept contamination via the most prevalent groundwater flow direction. Monitoring will revert to the agreed schedule of monitoring in accordance with RFC's Landfill Licence after the first 4 months of monitoring.

On the later point (e), the proposed permanent works are designed to eliminate the ingress of rainwater which would otherwise add to the current volume of leachate in the landraise. The landraise is currently capped with a clay layer designed in coordination with land-drains to prevent rainwater infiltration. The proposed development will be completely impermeable. By limiting the ingress of water, the volume of leachate currently migrating from the landraise is expected to reduce.

Ground Gas

1. Ground gas data from 2017 to March 2023 has been collated and compared to pre-2017 levels to identify general changes in concentration trends. We have updated the assessment to BS8485:2019 using the same assessment and reasoning presented in the Environmental Strategy and agreed in the granted planning application.
2. Our updated assessment of the gas results identifies the changing trends in concentrations, which generally show a slight downward trend in key boreholes R, S and T. The Environmental Strategy did not address or propose future assessment of changing conditions. However, in general degradation of organic matter within the landraise is influenced by water. We expect that as leachate levels gradually reduce and the landraise dries out, biodegradation will increase. The impact on gas concentrations and flow rates is difficult to assess accurately and will be influenced by several variable factors such as the volume and degree at which degradation has already occurred, the rate of reducing leachate levels and the relative period of time over which the gas is generated. Continual monitoring and assessment of the gas is designed to provide evidence of the gas situation on site at the point of development so that appropriate mitigation measures may be implemented.

In summary, we have carried out a full assessment of the groundwater contamination and ground gases as required by the agreed Environmental strategy. It shows that the site conditions are comparatively stable, with a slight improvement in ground gases. Therefore, for the enactment works, we do not propose to change the mitigation measures agreed at planning and as detailed in the Environmental Strategy.

We would emphasise that the monitoring and the proposed mitigation measures are not frozen in time at the point of enactment. The Environmental Strategy provides an agreed framework for ongoing monitoring and assessment of groundwater and ground gases before each phase of construction, so that the form of mitigation can be adjusted to suit as and where appropriate.

Monthly monitoring of groundwater and ground gases will continue as required by RFC's landfill management license, thus providing a wealth of data for future further assessment. In addition, we would recommend that monitoring of ground gases in boreholes GW04, GW05, GW06, GW07, GW08 and GW09, installed in 2016, are monitored monthly over a period of 12 months prior to construction. These would be assessed and any changes to the mitigation measures, in respect of

groundwater monitoring, the cut-off wells or mitigation against changes in the ground gases would then be submitted for review and agreement prior to construction.

Whilst we note that conditions 3, 4, 7 (a), and 72 do not specify a partial/phased approach, this does not preclude the Council issuing a partial discharge to reflect and enforce the intent of the Environmental Strategy. The Council may wish to accept the information provided as sufficient to allow enactment but seek to retain control over the remaining construction of phase 1 and other phases of the Full permission. This would enable contemporaneous information to be provided when the remainder of the development comes forward. Planning conditions 7 (b) and (c), 68, 70, 71, and 73 specifically state phase or part of phase so that the mitigation measures may be changed and adapted as appropriate.

We hope the above, and the attached show that we are implementing the recommendations of the strategy agreed with the EA and with RBC following extensive negotiation in 2016 and 2017. We hope we have addressed your comments as completely as possible at this stage and are sufficient for the purpose of enacting the planning application through construction of a single pile.

Yours sincerely



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Structures

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Our Ref: lt.2302016.001.01
Your Ref:

19 March 2023

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RUK Comments:

Please refer to Ramboll letter dated 31 May 2023 for responses, each coordinated with the numbered tags highlighted below.

Dear Catherine

ROYAL ELM PARK, READING – 160199/HYB

Further to our recent discussions and following the information presented by Damien Friel on behalf of the Applicant (RFC Prop Co Ltd) on 22 February 2023, we have reviewed the Environmental Strategy prepared for the site by Arup, reference E002 Rev C, dated December 2017 and note the following:

The proposed development is reported to comprise the construction of a number of new buildings, containing residential, leisure and commercial spaces. It is understood that phased development of the site is proposed, with Phase I comprising construction of a Convention Centre, Block 7 of the private residential units and the multi-storey car park. Phase II of the development is reported to comprise further residential units.

Information provided within the report indicates the site has been subject to a number of phases of landfilling / raising, with the first phase, known as the Smallmead Tip landfill, undertaken in the north eastern part of the site c. 1972. It is reported that records indicate the waste components associated with this landfill comprised predominantly municipal solid waste and building waste. Waste was reportedly deposited in the form of a land raise and was unlined to allow percolation of rainwater through the waste material. During 1997, it was reported that Smallmead Tip was re-located to allow for the construction of the retail parks to the east of the site. The tip material was reportedly re-deposited across the Site under a Waste Management Licence.

The underlying ground conditions are reported to comprise made ground and landfill waste underlain by superficial Alluvial and River Terrace Deposits. This in turn is reported to be underlain by the London Clay Formation, the London Basement Beds (Harwich Formation), Lambeth Group and Upper Chalk. Limited information is provided regarding the ground profile of the site within the report.

The report and information provided within the initial meeting with representatives of the Applicant on 22 February 2023 indicates the presence of a cohesive layer associated with the Alluvium deposits immediately below the waste materials within some areas of the site. Review of available borehole logs for monitoring wells installed in 2016, presented within the report appendices, indicates the presence of clay within monitoring location GW06 and GW09 in proximity to the proposed pile location but it is currently unclear as to whether any assessment has been made to determine the presence or otherwise of this material within the proposed pile location.

It is reported that 2No aquifers are present below the site, associated with the superficial River Terrace Deposits (designated as a Secondary A Aquifer) and the Upper Chalk (designated as a Principal Aquifer).

Perched water is reported between 37mAOD and 40.25mAOD, which is noted to be approximately 1m above the base of the original land raise.

Groundwater is reported within the River Terrace Deposits at depths of between 36.5mAOD and 37mAOD, which is understood to be approximately at the interface with the underlying London Clay Formation.



Groundwater within the chalk is reported between 33mAOD and 34mAOD. It is assumed this level is metres below ground level rather than metres above Ordnance Datum as this would place the chalk aquifer within the London Clay Formation of the ground model detailed within the report.

It is reported that groundwater flow directions in the chalk are difficult to determine and it is likely that there are groundwater divides across the site and that locally groundwater flow directions may vary.

The report highlights the presence of elevated ammoniacal nitrogen and potassium within the groundwater. The report indicates that potassium concentrations are likely due to high concentrations within the groundwater regionally but provides no evidence to confirm this is the case. Localised exceedances are also noted for arsenic, lead, nickel, nitrate and magnesium but no discussion regarding these Contaminants of Potential Concern (CoPC) has been provided within the report.

Ammoniacal nitrogen is reported to be at highest concentrations within the lower leachate wells and is reported to decrease in concentration within samples collected from the River Terrace Gravels and underlying Chalk. The report further indicates that data from 2011 – 2015 shows long-term stability or improvement of groundwater. However, it is also noted that concentrations are reported to increase within BHN from 2014. The location of this borehole in relation to the proposed pile location is unknown. ← Comment 1

A review of the available perched water and groundwater monitoring indicates sampling and analysis frequency within the different perched water and groundwater bodies differs significantly. In order to assess exceedances to different water bodies in context, we have assessed the exceedances as a percentage of samples taken, which is summarised within Table 1 below.

Table 1: Exceedances of Ammoniacal Nitrogen

Strata	Percentage of water samples with concentration of ammoniacal nitrogen above the DWS (2010)
Made ground / landfill	88%
River Terrace Gravels	55%
Lambeth Group	63%
Chalk	100%

As detailed within the table above, concentrations of ammoniacal nitrogen within the groundwater collected from the chalk have exceeded the DWS (2010) level within all samples analysed.

It is further noted that no data beyond 2015 has been discussed within the report and it is understood no further assessment utilising recent data has been undertaken to date. ← Comment 2 ← Comment 3

It is noted that there are proposals to provide Trigger Levels for ammoniacal nitrogen that are to be used for monitoring during and post construction. There is no proposal for potassium and it is therefore assumed that this has been agreed with the Environment Agency. It is further understood that these levels have yet to be agreed with the Environment Agency. ← Comment 4

The report details an initial Foundation Works Risk Assessment (FWRA). Scenario 1 of the assessment indicates there are two stages during the construction of the pile where a temporary migration pathway between the perched water in the leachate and the River Terrace Gravels is created. Proposed mitigation measures have been proposed to mitigate the risk and it is assumed these measures will be implemented during the construction of the proposed pile. ← Comment 5

It is stated within the report that previous phases of construction have shown some deterioration in water quality of the River Terrace Gravels following piling but that this has been reversed by abstraction from the groundwater abstraction system. It is assumed this will be implemented again during the construction of the proposed pile. ← Comment 6

There appears to be some discrepancy within the report regarding the Characteristic Situation (CS) of the site. Within the main report text, the site is reported to be CS4. However, the Geo-environmental Interpretive Report dated 17 February 2017 presented within the appendices indicates the adoption of CS5 would be considered appropriate for the development, which is again indicated within the Technical Note dated 21st March 2017.

Details regarding proposed ground gas protection measures have been detailed within the report. However, it is noted that the recommendations assume a CS2 or CS3 characterisation. In addition, the point score system utilised to determine protection measures have been based upon the guidance outlined with BS8485:2015. This document was updated in 2019 and includes refinement of the scores associated with each protection measure for the different characteristic situations.

It is noted that during the installation of a number of new boreholes for ground gas monitoring purposes in 2016, gas was reported to be visibly venting from locations GW04, GW06 and GW09 during the advancement of these locations. This was also reported to be the case in GW02, although the date of this installation is not clear.

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Methane concentrations within these boreholes appear to be consistently high (up to ~80%v/v). It is noted within the presentation notes provided by representative of the Applicant that flow rates in 'key borehole' (i.e. R, S & T) have a maximum flow rate of 1.0l/hr. However, information presented within the appendices indicates locations GW02/08? And GW09 located in closer proximity to the proposed pile location have had consistently higher flow rate (>5%, with >30% reported on occasion). Elevated flow rates have also been reported in GW03, GW04 and GW05 on occasion.

Information presented within the appendices also highlights the presence of elevated VOC's within a number of the boreholes during monitoring and subsequent laboratory analysis.

From a review of the Environmental Statement (reference E002 rev C, dated December 2017), as summarised above, it is considered that a current assessment of the nature and extent of contamination (including groundwater and ground gas covered in more detail below) is required in associated with Condition 3, to inform decision making regarding the partial or phased discharge of Planning Conditions 4, 7, 68, 70, 71, 72, 73, 74, 79 and 80 detailed within the Planning Performance Agreement (PPA) for the site, dated February 2023. This should include confirmation of any proposed 'zones' within the site in relation to the current development layout and a plan indicating the location of the proposed single pile in relation to the wider site and any defined zones. Comment 7

1. An updated groundwater risk assessment for the site, which includes an assessment of all monitoring data collected from the site to date, including more recent monitoring data from 2015 to the present, prepared in accordance with current guidance. This should include the following information: Comment 8

- Clarification on the groundwater levels recorded across the site (for consistency this should be in AOD);
- A detailed assessment of the groundwater flow direction (s) acting upon the site;
- Full assessment of the regional groundwater conditions, with supporting evidence (from up gradient monitoring locations) of contamination of the regional groundwater with potassium and any other contaminants of potential concern which are believed to be from an off-site source;
- A detailed conceptual site model;
- Forward modelling to provide an indication as to how the proposed development will affect the current groundwater regime both in terms of the introduction of a pile in the short term and the development as a whole in the long term. This should include an assessment of how the following will potentially impact on the groundwater regime at the site; changes to the surface permeability across the site by introduction of hardstanding, soakaway drainage, capping materials, construction of buildings etc.

2. An updated ground gas and hydrocarbon vapour risk assessment for the site, which includes an assessment of all monitoring data collected from the site to date, including more recent data between 2015 and the present, prepared in accordance with current guidance. This should include the following information (and any other information which is critical to present a line of evidence-based assessment of the potential gas risks at the site):

- Detailed assessment of the gases of concern recorded at the site (including VOCs) and discussion as to how the gas regime is likely to be affected in the future (short, medium and long term) by factors such as continued degradation of landfilled materials, remediation and construction works on site and the introduction of the proposed development, which will affect factors such as leachate and groundwater levels in and around the site (which potentially change the degradation rates of organic matter within the waste, and the gas generation rates associated with this).
- If zonation of the site is proposed, a detailed assessment as to how each zone has been defined will be required.
- Full details of the ground gas classification for the site, including any classification for individual zones.

In summary, from a review of the report and further to recent discussions, an updated assessment, in accordance with current guidance should be undertaken, in order to provide a better understanding of current conditions present across the site and to inform appropriate measures which may be necessary to ensure no further detriment to the underlying groundwater during the construction of the proposed pile and to mitigate risks against human health receptors and structures from ground gas present within the site.

Yours sincerely



Claire Hooley

Director

For and on behalf of

TEC

Refer to comments
1 & 2 under the sub
heading 'Ground
Gases'

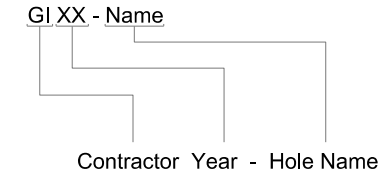
Monitoring Boreholes Location Plan

Notes:

- 1. Topo survey dated 2015-02 by Midland Survey LTD.
- 2. Borehole status pre-planning application (2015):

GIXX-Name	Location Currently Monitored
GIXX-Name	Monitoring Location Lost
GIXX-Name	Historical Location / Not Monitored
-----	Location of Drain

GI Name Description:



- BH response zone in the RTG
- BH response zone in the Lambeth Group, London Clay and Chalk
- BH's R, S, T & U: Ongoing gas monitoring from the land-raise
- SW BH's to be re-monitored for 12 months prior to planned construction.



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Monitoring Boreholes Location Plan

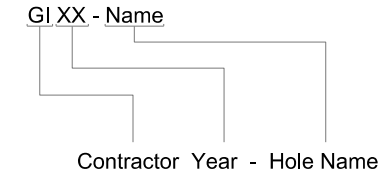


Notes:

- 1. Topo survey dated 2015-02 by Midland Survey LTD.
- 2. Borehole status pre-planning application (2015):

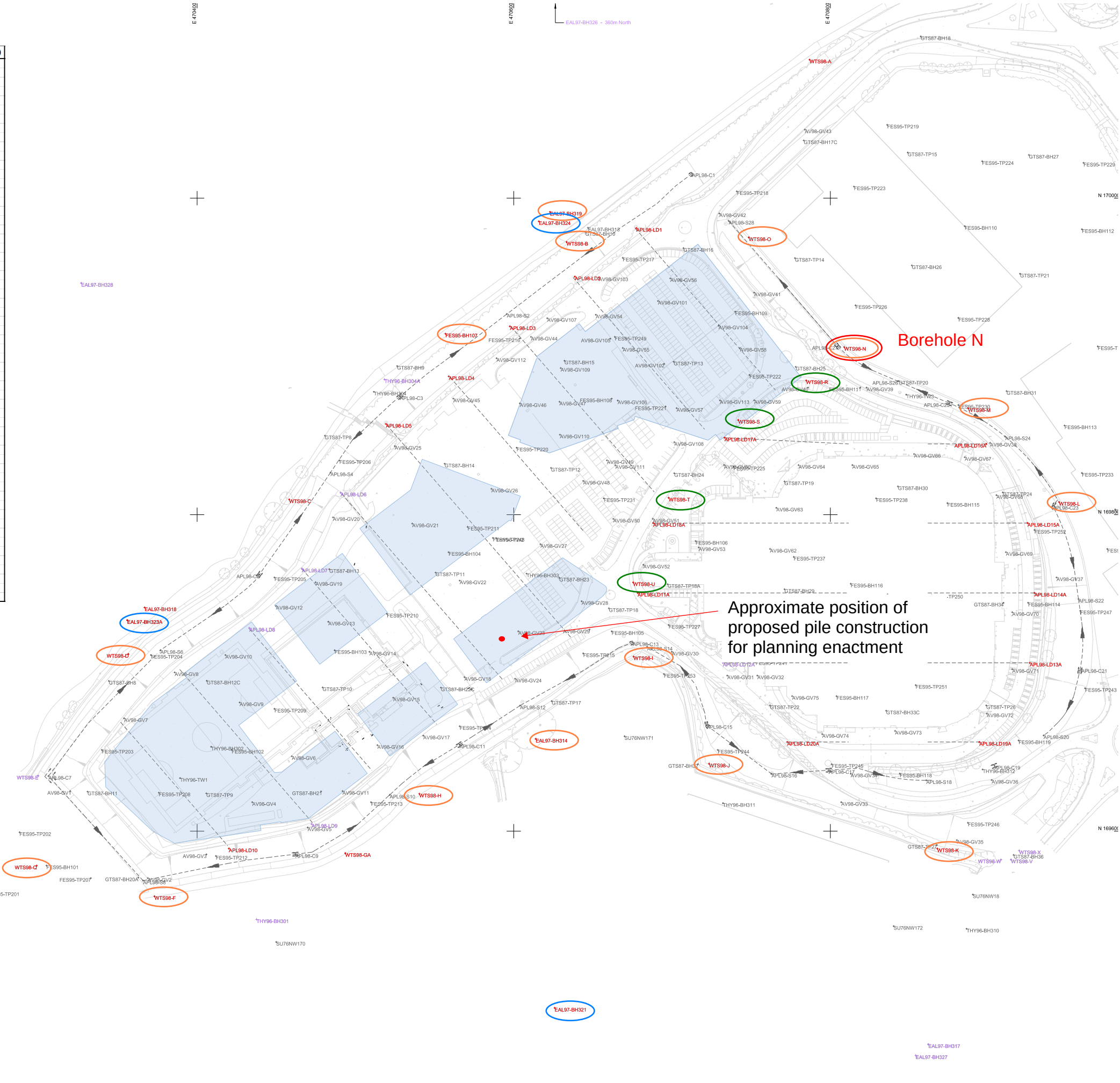
- GIXX-Name Location Currently Monitored
- GIXX-Name Monitoring Location Lost
- GIXX-Name Historical Location / Not Monitored
- Location of Drain

GI Name Description:



- BH response zone in the RTG
- BH response zone in the Lambeth Group, London Clay and Chalk
- BH's R, S, T & U: Ongoing gas monitoring from the land-raise

Name	X	Y	Elevation (mOD)
THY96-BH301	470437.54	169544.23	38.34
THY96-BH304A	470518.32	169885.50	39.08
EAL97-BH317	470861.88	169465.33	37.78
EAL97-BH320	470169.88	169459.33	38.37
EAL97-BH326	470627.88	170486.33	37.99
EAL97-BH327	470853.88	169458.33	37.60
EAL97-BH328	470326.88	169946.33	37.90
WTS98-E	470299.60	169635.00	39.16
WTS98-V	470914.12	169582.05	39.60
WTS98-W	470907.75	169582.05	0.00
WTS98-X	470919.26	169587.71	39.65
APL98-LD6	470490.70	169813.90	46.60
APL98-LD7	470466.20	169765.80	49.90
APL98-LD8	470433.00	169728.40	49.41
APL98-LD9	470472.40	169604.50	51.54
APL98-LD12A	470732.12	169706.39	0.00
FES95-BH107	470556.88	169914.33	39.00
EAL97-BH314	470613.88	169658.33	38.64
EAL97-BH315	470166.88	169455.33	38.45
EAL97-BH316	470366.88	169741.33	38.43
EAL97-BH319	470622.88	169991.33	38.76
EAL97-BH321	470625.88	169488.33	37.97
EAL97-BH323A	470355.88	169733.33	38.38
EAL97-BH324	470615.88	169985.33	38.66
EAL97-BH325	470161.88	169449.33	38.40
WTS98-A	470786.90	170087.50	39.58
WTS98-B	470633.40	169972.30	39.63
WTS98-C	470458.20	169809.60	39.33
WTS98-D	470356.60	169711.90	39.46
WTS98-F	470373.10	169558.90	39.30
WTS98-GA	470493.60	169586.10	39.22
WTS98-H	470540.40	169623.60	39.21
WTS98-I	470675.70	169710.40	39.56
WTS98-J	470723.40	169642.60	38.94
WTS98-K	470867.50	169589.00	38.85
WTS98-L	470944.40	169808.00	39.80
WTS98-M	470887.00	169867.20	39.49
WTS98-N	470808.70	169905.90	39.69
WTS98-O	470748.50	169975.20	39.67
WTS98-Q	470298.70	169578.20	38.67
WTS98-R	470784.72	169884.82	47.40
WTS98-S	470741.82	169859.82	47.51
WTS98-T	470697.92	169810.62	47.49
WTS98-U	470675.42	169757.22	47.57
APL98-LD1	470677.40	169981.10	44.31
APL98-LD2	470638.60	169950.40	44.69
APL98-LD3	470597.60	169919.00	44.07
APL98-LD4	470559.00	169887.40	44.63
APL98-LD5	470519.30	169857.30	44.84
APL98-LD10	470420.10	169589.00	48.76
APL98-LD11A	470678.26	169750.55	0.00
APL98-LD13A	470925.98	169706.39	0.00
APL98-LD14A	470928.87	169750.55	0.00
APL98-LD15A	470924.54	169794.71	0.00
APL98-LD16A	470898.49	169844.71	0.00
APL98-LD17A	470733.13	169848.62	0.00
APL98-LD18A	470688.09	169794.71	0.00
APL98-LD19A	470894.10	169656.39	0.00
APL98-LD20A	470772.75	169656.39	0.00



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