Fuel Storage Feasibility Assessment

**Proposed Petrol Filling Station**
Land south of Broadland Gate, adj.to Postwick Interchange
Postwick
NR13 5NP

**Prepared for:**

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Land South of Broadland Gate, Postwick
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| Client:           | Euro Garages Ltd |
| Date:             | 5th April 2017 |

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<th>Authorised:</th>
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<tbody>
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<td>Giles Lock</td>
<td>Will Evans</td>
</tr>
<tr>
<td>Principal Consultant</td>
<td>Director</td>
<td>Director</td>
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1 INTRODUCTION

<table>
<thead>
<tr>
<th>Location:</th>
<th>Land south of Broadland Gate, adjacent to Postwick Interchange Postwick</th>
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</thead>
<tbody>
<tr>
<td>Post Code:</td>
<td>NR13 5NP</td>
</tr>
<tr>
<td>National Grid Ref:</td>
<td>629210, 308470</td>
</tr>
<tr>
<td>Development Proposal:</td>
<td>Proposals currently include the construction of a 7-pump petrol filling station (PFS) with a kiosk/amenity building together with 2 drive-thru restaurants, vehicle access, HGV parking and soft landscaping. It is proposed that there will be three 75,000l fuel storage tanks, containing both petrol and diesel.</td>
</tr>
<tr>
<td>Regulatory Ref:</td>
<td>20170095 (Planning) AE/2017/121301/01-L01 (Environment Agency)</td>
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<td>UK17.2609</td>
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Given the environmental context of the site, and Environment Agency objections associated with the current planning application, it has been confirmed that the installation of underground fuel storage tanks is potentially contrary to the requirements of The Environment Agency’s Approach to Groundwater Protection (‘GP 2017’, 2017 v1.0) position statements D2 and D3 and therefore the following Fuel Feasibility Assessment has been undertaken to outline site specific considerations with regard to the storage of hazardous substances at the proposed Petrol Filling Station (PFS).

The following sections present the environmental context of the site, outline the options for above / below ground fuel storage tanks and draw conclusions from an environmental risk perspective within the context of GP 2017.

A site location plan is included as Figure 1, a current site layout plan as Figure 2 and proposed development plans in Appendix A.
2 SITE LOCATION AND ENVIRONMENTAL CONTEXT

Information on the site’s geo-environmental setting has been obtained following a review of available records including a previous desk study undertaken in 2016, which has been made available to EPS as relevant background and the client is understood to have reliance. This report is as follows:

- **Phase 1 Land Quality Report - Land south of Broadland Gate, adjacent to Postwick Interchange, Norwich**
  – Roberts Environmental Limited ref 161102.R.002 (December 2016)

<table>
<thead>
<tr>
<th>Current Land Use</th>
<th>The site currently comprises an area of rough grassland with a gravelled area along its western extent which, until recently, formed a Balfour Beatty temporary construction compound associated with recent highway works. Within this compound area is a small building containing a flood warning siren. The site covers an approximate surface area of 2ha and lies at a topographic elevation of 16-20m Above Ordnance Datum (m AOD).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Surrounding Land Use</td>
<td>The site is bound by highways, with the A47 dual carriageway to the north and the A1042 to the south. The Balfour Beatty compound extends beyond the western site boundary while a limited wooded/overgrown area exists between the two highways to the east. The wider surrounding area is largely agricultural land with the exception of a new Anglian Water Treatment Works 150m to the south east. This works is understood to be a potable abstraction intended to supply Norwich with 7.5 million litres of drinking water per day.</td>
</tr>
<tr>
<td>Historical Land Use / Context</td>
<td>Throughout recorded history the site has remained largely undeveloped agricultural land.</td>
</tr>
<tr>
<td>Underlying Ground Conditions</td>
<td>Geological maps of the area indicate ground conditions to comprise largely bedrock of the Crag Group (sand &amp; gravel) to outcrop at surface, with White Chalk present at depth. Recorded superficial geology is limited to a section of the central southern part of the site whereby deposits of the Happisburgh Glacialic Formation and Lowestoft Formation (clay, sand and gravel) are identified. British Geological Survey (BGS) historical borehole logs positioned on and in the vicinity of the site indicate underlying geology comprises superficial deposits of sand, gravel and clay with Crag Sand at approximately 5m and Chalk at a depth of 10-20m. EPS carried out a site-specific ground investigation which encountered topsoil then gravelly sands or sands &amp; gravels to a depth of 12m, where the borehole was terminated. No made ground was recorded and the chalk was also not proven. The sands were noted to be clayey/silty between 7.40-8.20m but were otherwise consistently granular. The borehole log is included in Appendix B.</td>
</tr>
</tbody>
</table>
Aquifer Status

- Groundwater vulnerability maps for the area show that the bedrock is designated as a Principal Aquifer with soils of a high leaching potential, while the overlying superficial deposits identified as a Secondary (A) Aquifer, although as stated previously the superficial deposits are anticipated to be limited in extent across the site.

Groundwater / Surface Water Abstractions & SPZ status

- The site is designated to lie within a Source Protection Zone III (SPZ – Total Catchment) for groundwater abstraction.

  However, the Environment Agency correspondence included in Appendix C, which EPS followed up with verbal discussions, indicates that they consider the area to lie within an SPZ I (Inner Zone) and also within an EU Water Framework Directive Drinking Water Protected Area. The groundwater abstractions associated with the revised SPZ are understood to be the new Anglian Water abstractions, positioned 210m to the south east (permit ref 7/34/15/*G/0177). This abstraction licence is for a major public water supply.

Depth to Groundwater

- An intrusive investigation did not strike groundwater to a depth of 12m. A monitoring well was installed to this depth and a subsequent monitoring confirmed that the absence of groundwater.

Proximity of Surface Waters

- The nearest surface water feature is a balancing pond situated 20m to the south, anticipated to form part of an attenuation scheme associated with the adjacent Postwick Interchange. A second similar pond is located approximately 50m to the north. The nearest watercourse is the River Yare located roughly 650m to the south west.

Other Environmental Receptors

- The site is located within a Nitrate Vulnerable Zone where groundwater is vulnerable to nitrates from agricultural farming. In addition, ‘The Broads’ National Park is situated approximately 200m to the south west.
SITE SPECIFIC GROUND CONDITIONS

To support the proposed development, a full ground investigation will need to be carried out. However, it is recognised that the environmental sensitivity of the site is high as outlined by the Environment Agency’s correspondence (Appendix C) and presenting a Fuel Storage Feasibility Assessment based on only desk-based records would not be suitably precautionary. Therefore to ensure this assessment and subsequent conclusions were presented in accordance with the Environment Agency’s guidance (GP 2017), a single deep borehole was undertaken by EPS in the proposed tank farm location in March 2017 to gather information on ground conditions and groundwater levels. The borehole log and its location on site are included in Appendix B. The ground conditions encountered comprised topsoil then gravelly sands or sands & gravels proven to a depth of 12m, where the borehole was terminated.

This geology is consistent with BGS records for the area, which suggests that the majority of the soils encountered are representative of the Crag Group. The soils were consistently granular in nature with the exception of a clayey silty sand encountered between 7.40-8.20m bgl (below ground level). To further determine the grading and fines content of this material, a particle size distribution test was carried out and the results are available upon request.

Groundwater was not encountered through the investigation or during a return monitoring visit, carried out four days after the standpipe was installed (to the full depth of the borehole – 12m).
In March 2017, the Environment Agency revised its framework document for the approach to groundwater protection, which updates *Groundwater Protection: Principles and Practice* (known as GP3). GP 2017 constitutes a pragmatic risk based approach to the protection of groundwater resources in the UK, a key aspect being groundwater vulnerability, based on the concept that the risks of pollution from a given activity vary from place to place as they depend on the physical, chemical and biological properties of the underlying soil and rock, making groundwater in different areas more or less vulnerable to pollution.

4.1 GP 2017 Position Statements

GP 2017 sets out the EA’s position with respect to the storage of pollutants through a series of position statements, and specifically to below ground storage as discussed below; however it is extremely important that these position statements are considered and applied within the context of the wider aims and objectives of the guidance and not simply read or quoted in isolation.

They do differ slightly to the position statements presented within GP3, whereby site-specific considerations in terms of environmental sensitivity as well as issues such as health and safety appear to have been given greater weighting, as the EA acknowledges that considerable improvements to the standards of underground storage have been made, particularly in the area of fuel storage.

<table>
<thead>
<tr>
<th>D2 – Underground storage (and associated pipework)</th>
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<tbody>
<tr>
<td>The EA will normally object to new and increased underground storage of hazardous substances in SPZ1.</td>
</tr>
<tr>
<td>The EA will agree to such storage in principal and secondary aquifers outside SPZ1 only if there is evidence of overriding reasons why the:</td>
</tr>
<tr>
<td>• activity cannot take place within unproductive strata</td>
</tr>
<tr>
<td>• storage must be underground (for example public safety), in which case it is expected that the risks are appropriately mitigated</td>
</tr>
<tr>
<td>Where such storage already exists the EA will work with operators to assess and if necessary mitigate the risks, including an aim to change to above ground storage.</td>
</tr>
<tr>
<td>The EA will normally object to any redevelopment scheme involving retention of underground storage of hazardous substances in SPZ1 unless it can be demonstrated that risks to groundwater can be adequately mitigated.</td>
</tr>
<tr>
<td>For all storage of pollutants underground (hazardous substances and non-hazardous pollutants), the EA expects operators to adopt appropriate engineering standards and have effective management systems in place. These should take into account the nature and volume of the materials stored and the sensitivity of groundwater, including the location with respect to SPZs.</td>
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### D3 – Sub water table storage

**New sites**
The EA will normally object to any proposed new storage and transmission of hazardous substances below the water table* in groundwater SPZ1. For all other proposed locations, a risk assessment must be conducted based on the nature and quantity of the hazardous substances and the physical nature of the location. Where this assessment demonstrates that there is a high risk of groundwater pollution, the EA will normally object to storage below the water table:

- in any strata where the groundwater provides an important contribution to drinking water supply, river flow or other sensitive surface waters or wetlands
- within SPZ2 or 3
- in a principal aquifer

**Existing sites**
For existing sites that store or transmit hazardous substances or non-hazardous pollutants below the water table, or where the water level subsequently rises, the EA will work with operators to mitigate the risks. The aim is eventually to change to above ground storage (notwithstanding other position statements and in particular D2).

The EA will normally object to any redevelopment scheme involving retention of sub water table storage of hazardous substances unless it can be demonstrated that risks to groundwater can be adequately mitigated.

* For the purposes of this position statement this should include any laterally continuous groundwater in these aquifers including ‘perched’ groundwater. Operators should consider the lifetime of the storage in their assessment of the depth to groundwater.

### 4.2 Site Relevance Under GP 2017

With respect to the underlying ground conditions and site setting, the proposed PFS tank farm is anticipated to be underlain by a significant thickness of unsaturated gravelly sands and sands & gravels, considered representative of the Crag Group which extend to a depth of at least 12m bgl. White Chalk is anticipated at depths of 15-20m. Both the Crag Group and the Upper Chalk are Principal Aquifers.

With respect to D2 – Underground storage, GP 2017 states that in principal and secondary aquifers the EA prefers storage of hazardous substances to be placed above ground in tanks with suitable secondary containment, but it is recognised that this may not always be reasonable when other risks are taken into account such as health & safety issues. Therefore the position statement allows for underground storage of hazardous substances outside of SPZ1 providing risks are fully considered and where necessary, appropriately mitigated against. Position Statement D2 is clearly relevant to this site.

Any below ground storage tanks which are submerged or partially submerged, below groundwater is considered in GP 2017 as being more problematic as any leak would contravene legislation. By implementing the position statement D3, GP 2017 is trying as far as possible to minimise the perpetuation of below water table storage facilities.
For D3, any underground storage tanks to be installed at the site would not be submerged below groundwater, so Position Statement D3 is not considered relevant. Groundwater was not encountered in the investigation or during a return monitoring visit. Although only a single monitoring visit was undertaken, which is not sufficient to account for seasonal fluctuation, no evidence of significant fluctuation (of say up to 10m) was noted in the soils recovered during the investigation.

GP 2017, makes a clear statement when introducing the Position Statements and the role of the EA that SPZs and the use of aquifer designation should not be taken as a substitute for site-specific risk assessment, the EA states that it uses them as generic indicators of risk. Therefore where available, site specific data must be reviewed to accurately assess the risks to groundwater resources, determine whether those resources are of high value and are physically representative of the aquifer status which has been attributed by the Environment Agency.

4.3 Aquifer Status

GP 2017 does not appear to present any updated aquifer definitions to GP3, which defined a Principal Aquifer as ‘Geological strata that exhibit high permeability and usually provide a high level of water storage. They are capable of supporting water supply on a strategic scale and are often of major importance to river base flow’

The European Water Framework Directive (2000/60/EC) defines an aquifer as ‘A subsurface layer or layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater’.

In the case of the site at Broadland Gate, the site is underlain by granular deposits of the Crag Group which in turn are underlain by White Chalk, both of which are classified as Principal Aquifers and groundwater. Although groundwater depth is not specifically known, it is anticipated to rest at levels towards the base of the Crag Group or within the upper sections of the chalk. Consideration has to be given as to the physical properties of the geology as well as any groundwater present within it, in relation to how the aquifer unit as a whole will perform. The granular soils will be permeable, but a limited band of silty/clayey sand was recorded at around 7.5m, which could offer some limited protection to downward migration of mobile contaminant. It is also possible that deposits of low permeability material are present below 12m depth which could offer further protection to groundwater but drilling work could not be extended below 12m depth in the time available so this remains unproven. The Chalk aquifer is however clearly capable of supporting regional potable water supplies as evidenced by Anglian Water public abstractions within the vicinity.

Surface water courses in the immediate vicinity are limited to drainage features so the resource value of the aquifer, as oppose to base-flow contributions to watercourses, is the primary concern.
5 DESIGN AND PLANNING

The following comments are provided in relation to the advantages and disadvantages of above ground, and below ground fuel storage tanks and their associated control measures.

5.1 General Notes On Above Ground Tanks

The design and specification of petroleum rated above ground storage tanks have improved significantly over the last few years and they have been successfully installed at a number of sites in the UK. They do not yet have any appreciable track record in terms of longer term safety and integrity, however, there is an assumption that potential leakage from the tanks themselves is less likely, or the impacts less severe given the ability for physical / visual checks.

There are sustainability benefits in relation to the installation, redevelopment and decommissioning of above ground storage facilities which do not require extensive excavation and disposal of generated soil wastes for installation, or further breakout and excavation for physical removal and backfilling at the end of their operational lifespan.

Above ground tank farms create increased health and safety risks from an on-going operational and maintenance perspective, the two key areas being working at height and the increased area of ‘hazardous zones’. These are areas in which petroleum vapour may be present on occasion. With below ground tanks the hazardous zones are restricted to the immediate area around the tank manhole lids; with above ground tanks the hazardous zone extends to the entire area surrounding the tanks.

Above ground storage tanks are often of smaller capacity to below ground storage tanks requiring increased frequency of deliveries and associated risks. Fuel lines supplying dispensers from above ground tanks will be under pressure due to being gravity fed and will as a result require enhanced leak prevention and detection. All above ground pipework will require a suitable level of fire protection.

Above ground tanks may be a target for vandalism and / or malicious attack which in turn would give rise to potentially dangerous occurrences. They are also generally considered to be visually unattractive and may be objected to by any local residents unless appropriate screening can be agreed. Above ground fuel storage tanks and their associated increased hazardous zones can also prove problematic in terms of space which can cause issues with tanker routes, location of public thoroughfare and safe distances with which buildings and structures must be placed from AST’s.

All dispensers from above ground storage tanks are inherently pressurised due to siphonic action, which poses an additional risk to the environment in the event of a pipe leak. Unlike an underground system, fuel delivery pipes from above ground tanks remain pressurized with fuel at all times, which poses risks of spillage and fire in the event of accidental pump damage or vandalism e.g. a fuel pump being driven into and knocked off. While it is understood that cut off arrangements do exist in this instance, some amount of fuel would still be released. If the same incident were to occur at an underground tank facility, fuel within the delivery pipes would lose suction and drain back to the tanks. Petrol station installations based on suction dispensing principles are generally considered much safer than pressurised systems, which are inherent with above ground fuel storage. The delivery of fuel from a road tanker to an AST is also considered to be associated with increased spill risks due to the fuel having to be pumped under pressure as opposed to a gravity filled with a UST.
5.2 General Notes on Below Ground Tanks

The practice of storing flammable fuels below ground benefits from well-established technologies for protecting the environment from potential pollution. High specification double skinned tanks are now an industry standard and all have interstitial monitoring linked to an alarm. In the event of a breach of either the external or internal skin, an inert non-toxic liquid in the interstitial space will leak out causing the alarm to activate. It is also noted that double skin below ground solutions have been used in the UK for some 25 years without the fire service being aware of a single incidence of fuel being leaked into the ground.

Currently the vast majority of new PFS sites have plastic pipework installed, (these are the pipes taking fuel from the tanks to the pumps). When below ground there is greater opportunity for the pipework to be installed as a continuous single run so that the only joints are at the tank end and the pump end. When coming from an above ground tank several joints are required to run fuel from the tank, over the bund wall (if present) and below ground and then on to the pumps.

Although it is recognised that above ground tanks have the advantage of being easily inspected, underground tanks would have a monitor well installed which can be used for frequent physical monitoring or continuous vapour monitoring with an alarm linked back to the kiosk.

The risk of spillages during a pumped delivery process for above ground tanks is considered by an Energy Institute Risk Assessment as being much higher than for underground tanks which use a gravity delivery system.

5.3 A Comparison of Risks Related to Above Ground and Underground Tanks

Guidance has been issued by the EA and the Energy Institute entitled ‘A Comparison of Risks Related to the Storage of Hydrocarbons in Above-Ground and Underground Tanks at Petrol Filling Stations’ (July 2014) which offers solutions to the challenges associated with the location of areas of fuel storage under GP 2017.

The main conclusions of this work can be summarised as follows:

- The key benefit of double skinned systems is the ability to perform leak detection in order to identify leaks before the second skin has failed.
- Double skinned systems (both USTs and ASTs) have lower risks to the environment than single skinned systems.
- Double skinned USTs with leak detection monitoring and bunded, double skinned ASTs which are regularly inspected have comparable spill and other risks.
- ASTs have higher safety risks than USTs due to the higher hydrostatic head of the fuel which has the potential to cause more problems in the event of a system failure, although this may or may not be material.
- It is preferential to see all underground pipework protected by active leak detection systems, which should especially be considered if the environment is considered to be vulnerable at a site.
5.4 Site Specific Design Considerations for the Proposed PFS, Broadland, Norwich

The proposed PFS with underground tank option would operate 7 pumps (14 filling positions) and has been laid out with optimum traffic flow in mind for both customers and tanker deliveries whilst also providing adequate space for customer parking, including HGV parking, as we well as ingress & egress required for the adjacent drive-thru restaurant area. Given the surrounding highway layout, the existing access from the A1042 will be used to ensure adequate safety whereby creating a new access to the A47 would not be viable.

While the site is quite large, it is generally relatively narrow, pinched between two major roads. If an above ground tank farm were to be accommodated into the proposed development, it would likely need to be located on the PFS site itself, close to the boundary with the A47. This would take up forecourt room and restrict tanker routes. Siting any AST to the east, reducing the lorry parking provision, would create the need for very long pressurised below ground pipework runs around, over (or beneath) the kiosk. Any AST would also need to provide appropriate safe distances from public thoroughfare, buildings and any other structures in line with the ‘Blue Book’.

Due to the location and proximity to the main ingress & egress for the site, the presence of ASTs are considered likely to increase risk to public safety should a fire / site incident arise. The Energy Institute guidance comparing risks related to the storage of hydrocarbons in ASTs and USTs notes that ASTs have higher spill risks for accidents and intentional acts. This is particularly appropriate given the site’s proposed development with associated access for multiple restaurant units and the increased risk of accidents associated with customer vehicles.

Reference is made with the Environment Agency response to hidden tanks, such as positioned between the pumps. These approaches have been utilised elsewhere but are generally suited to small-format sites, where lower capacity and less numerous tanks are installed. In addition to the increased capacity required at Broadland Gate, any appropriate above ground storage system would be larger than the equivalent below ground arrangement, requiring a form of secure compound.

5.5 Regulatory Liaison

Opinion on the proposed PFS, with regards to above and below ground tank solution, was sought from Mr Sonny Garrett who acts as Petroleum Officer for Norfolk Fire and Rescue. The following comments were sent to EPS on the 27th February 2017 and have been outlined within a formal consultation response to Broadland Council.

Mr Garrett stated a preference for below ground fuel storage tanks as oppose above ground, on the basis of safety. In previous correspondence, Mr Garrett noted that there has been no recorded product release from any double wall underground tank installed in the UK to the best of Norfolk Fire and Rescue’s knowledge.

Proposals for the installation of below ground tanks at the site were also submitted to the Environment Agency (EA) as a consultee to the planning process in 2016. The EA have objected to the application on the basis of a lack of risk assessment for controlled waters, with regards to the underground storage tanks.
The EA’s response, included in Appendix C, requested a review of fuel storage options in the context of the hydrogeological situation at the site, specifically, in relation to the Water Framework Directive as well as the EA’s own Groundwater Protection and Principles (GP3). The sensitivity of the site, primarily in relation to the imminent SPZ I re-classification was highlighted throughout their response.
6 SUMMARY OF MITIGATING FACTORS IN RELATION TO GP 2017

With respect to position statements D2 & D3 outlined in GP 2017, and the mitigating measures outlined above, the EA will take account of underground storage, provided evidence for the following can be provided:

<table>
<thead>
<tr>
<th>Evidence Required</th>
<th>Site Specific Evidence for Broadland Gate, Norwich</th>
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<tbody>
<tr>
<td>Effective management systems are or will be in place.</td>
<td>The new proposed fuel infrastructure will incorporate double skinned USTs with continuous remote wetstock monitoring. The new system will also include interstitial monitoring between tank skins with sensors which are linked to an alarm system.</td>
</tr>
<tr>
<td>Proposals reduce the risk of potentially combustible situations.</td>
<td>Evidence provided in previous sections relating to reduced risk of vandalism, reduced risk of fuel spill through siphoning and pumped delivery from tanker to ASTs, and reduced risk from collision from customer vehicles.</td>
</tr>
</tbody>
</table>

With respect to D2, the proposed development is not able to be undertaken on unproductive strata due to none being present within the site boundary. It could be stated that the proposed PFS and tank farm are located on the least sensitive part of the site, sitting within a limited area of superficial deposits but investigations found that soils to a depth of 12m beneath the site in this area do not offer significant protection to underlying deposits or groundwater. It is possible that lower permeability materials could be present at greater depth, above groundwater.

The site does lie within a Source Protection Zone for groundwater abstraction. While the classification is currently only an SPZ III, it is understood to be imminently upgraded to SPZ I due to the presence of nearby major potable abstractions. As such, the underlying geology is clearly capable of supporting regional abstraction.

Surface waters within the vicinity of the site are limited drainage ponds. So although the geology would be capable of supporting base flow to rivers, the presence of groundwater abstractions is considered an overriding concern. As such, Position Statement D2 is considered applicable in accordance with the principles of GP 2017.

With respect to D3, the groundwater has been proven to rest at depth of at least 12m. The base of the proposed tanks will sit at around 3.5m, so even accounting for significant regional fluctuation, Position Statement D3 is not deemed relevant.
However, consideration must be given to the space available for the PFS and the minimum separation distances stipulated within the Blue Book, including ingress and egress, tank layouts and the necessary parking provisions for the neighbouring proposed retail units when considering an AST installation.

The mitigation measures outlined above include the monitoring of wet stock, monitoring of interstitial space within double skinned tanks and associated alarm systems. These factors, combined with the general reduction in risk to public safety compared to an above ground facility particularly in an area close to major roads within a mixed-use development, indicate that the proposed underground fuel storage is appropriate in the context of GP 2017.
7 CONCLUSIONS

On the basis of the information provided in previous sections, it is concluded that an above ground tank option at the site would not be feasible, primarily due to the increase in risk to public safety, which is pertinent given the close proximity of major highways and public thoroughfare to the proposed drive-thru restaurant units associated with the PFS.

Consideration should therefore be given to the degree of engineering control measures that could be included in the context of environmental cost benefit and the vulnerability of the groundwater resource, i.e. what more can reasonably be expected to be achieved through the implementation of additional layers of protective control measures beyond what has been proposed?

The proposed scheme at Broadland Gate represents a modern facility which crucially includes double skin tanks with an interstitial monitoring system representing a robust degree of protection to the groundwater resource. Given the Environment Agency’s concern with regard to the vulnerability of water resources in this area and their precautionary approach to the resource protection within the context of GP 2017 (as outlined in their correspondence), additional control measures will be required beyond those that would be adopted as standard for Euro Garages design in line with relevant engineering control measures, the objectives of which should be to aim to deliver increased protection to the groundwater resource within the underlying aquifer and ultimately, the Anglian Water potable abstractions. These are outlined in the following section.
8 PROPOSED ADDITIONAL ENGINEERED CONTROL MEASURES TO MITIGATE RISKS FOR UNDERGROUND TANK OPTION

In addition to the industry standard control measures required to prevent leakage from below ground tanks, which include double skin tanks with interstitial monitoring systems and constant wetstock monitoring, the following additional measures are proposed for this site.

a) All EPS installed boreholes will be professionally decommissioned prior to the commencement of the proposed works.

b) Secondary containment on the suction and off-set fills would be integrated with double skinned pipework on both delivery and dispensing lines.

c) The tank farm will be housed within an underground vault or equivalent modular vault, which will include both hydrocarbon and waterproofing barriers to act as tertiary containment, physically separating the storage tanks from the surrounding aquifer and groundwater.

d) It is also proposed to install standpipes within the inside of the vault to provide robust pre-release monitoring of the tertiary containment. These wells would be installed within granular backfill to ensure its integrity, in order to provide the potential for future monitoring should a site incident arise or should there be any discrepancies with regard to wetstock monitoring records.

Final design of any tertiary vault containment system would need to be agreed with the EA, relevant authorities and the PFS designers prior to installation on site and should achieve the objectives outlined above.
FIGURES
Site Location Plan

Project: Broadland Gate, Norwich, NR13 5NP
Fig No: 1

Scale: NTS
Drawn By: TP
Approved By: GL
Job No: UK17.3669
Dwg No: Norwich/0417/01
Date: April 2017

Crown Copyright. All rights reserved, Licence Number: 100054115
Approximate Site Boundary

Crown Copyright. All rights reserved. Licence Number: 100054115

Title: Current Site Layout Plan

Project: Broadland Gate, Norwich, NR13 5NP

Fig No: 2

Scale: NTS

Drawn By: TP
Approved By: GL

Job No: UK17/0269
Dwg No: Norwich 0417/02
Date: April 2017

Site Area
7.76 acres (gross) / 3.14 Ha
Red Line 5.20 acres / 2.105 Ha
Blue Line 2.56 acres / 1.033 Ha
APPENDICES
APPENDIX A

Proposed Development Plans
APPENDIX B

Borehole Location Plan & Site Specific Borehole Log
### Borehole Log

**Project Name:** Broadland Gate, Norwich  
**Location:** Norwich  
**Client:** Eurogarages  
**Dates:** -  
**Logged By:** -  
**Well No.:** BH1  
**Sheet 1 of 2**

#### Borehole Details
- **Borehole No.:** BH1  
- **Project No.:** UK17.2609  
- **Location:** Norwich  
- **Level:** 0.00  
- **Scale:** 1:50

#### Stratum Description
- **Dark Brown & Brown, Silty Sandy TOPSOIL with Occasional Rock Fragments and recently active roots**
- **Loose Brown Silty Medium SAND with Rare Fine to Medium Subrounded Subangular Gravel. Gravel is Predominantly Flint & Quartzite**
- **Medium Dense, Orange-Brown Gravely SAND**
- **Presence of Ironstone**
- **Medium Dense, Orange-Brown Medium SAND**
- **Medium Dense, Orange-Brown Grey Interbedded Clayey Silty SAND**
- **Medium Dense, Orange-Brown Yellow Gravely SAND. Gravel is Fine to Medium Subrounded Subangular Gravel. Gravel is Flint & Quartzite**

### Depth and Level

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**Remarks**

Continued on next sheet
**Borehole Log**

**Borehole No.**
BH1

**Sheet 2 of 2**

**Project Name:** Broadland Gate, Norwich  
**Project No.** UK17.2609  
**Co-ords:** -  
**Hole Type** CP

**Location:** Norwich  
**Level:** 0.00  
**Scale** 1:50

**Client:** Eurogarages  
**Dates:** -  
**Logged By**

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**Remarks**
APPENDIX C

Environment Agency Correspondence dated 20th February 2017
Dear Mr Rickman

FULL PLANNING APPLICATION FOR THE PROPOSED DEVELOPMENT OF 1 NO. PETROL FILLING STATION, 2 NO. DRIVE THROUGH RESTAURANTS & 24 SPACE HGV PARKING, TOGETHER WITH VARIOUS INFRASTRUCTURE AND LANDSCAPING WORKS, LAND SOUTH OF BROADLAND GATE, ADJACENT TO POSTWICK INTERCHANGE, POSTWICK, NR13 5NP

Thank you for your consultation received on 31 January 2017. We have inspected the application, as submitted, and are raising a holding objection on pollution prevention grounds.

Pollution Prevention

The site is underlain by a Secondary A aquifer (Happisburgh Glacigenic Formation And Lowestoft Formation (Undifferentiated)) followed by a Principal aquifer (Crag Group) then chalk (also a principal aquifer). The site is close to licenced potable groundwater abstractions for a public water supply. Consequently, we consider the site to be in Source Protection Zone 1. The site is also in an EU Water Framework Directive Drinking Water Protected Area. The depth of groundwater from nearby BGS boreholes may vary seasonally to be shallow. The environmental sensitivity at the site is therefore considered to be very high.

We are raising a holding objection to the proposed development as submitted because there is insufficient information to demonstrate that the risk of pollution to the water environment is acceptable:

1. We consider the level of risk posed by this proposal to be unacceptable.
2. The application fails to address the risks of pollution to our satisfaction.

Reason

To protect and prevent the pollution of the water environment from potential pollutants associated with current and previous land uses in line with National Planning Policy

Overcoming Our Objection

In order to overcome our objection the applicant should provide:

1. A comprehensive and balanced options appraisal, fairly comparing above and below ground storage, with appropriate mitigation measures to demonstrate best available technique, including above the normal practice measures described in the Association for Petroleum and Explosives Administration document: Guidance for Design, Construction, Modification, Maintenance and Decommissioning of Filling Stations (Revised June 2011) where necessary. The requirements of our GP3 position statements D1 to D4 need to be met. Due to the Source Protection Zone 1 location, it is considered that the only way forward we would possibly accept is that above ground fuel tanks are proposed, with appropriate pollution prevention measures. This is because position statement D2 prohibits below ground storage of hazardous substances in a Source Protection Zone 1.

2. An in-depth surface water drainage strategy which considers the risk to groundwater, particularly if infiltration devices are proposed, and provides appropriate pollution prevention measures give the sources of contamination and the water receptors. Recommended additional information to support any assessment include:
   - An in-depth assessment of the peak seasonal depth to groundwater and groundwater flow direction
   - More detailed intrusive investigation of the ground conditions at the location of the proposed underground tanks, to include permeability testing

Underground Storage in Source Protection Zone 1

We have reviewed the documents submitted with the application (including preliminary risk assessment and site layout drawings) as part of our response and have the associated comments detailed below.

The Roberts Environmental Phase 1 Land Quality Report of December 2016 (referenced 161102.R.002) is acceptable with respect to land contamination issues at the site. Section 8 of the report discusses the source protection 3 underlying the site, but the authors were presumably not aware of the new source protections in development or the significance of the public water supply boreholes close to the site. We object to any proposal in a Source Protection Zone 1 or sub water table. Below we quote GP3 position statement D2:

“We will object to the new and increased underground storage of hazardous substances in SPZ1.
We will agree to such storage on principal and secondary aquifers outside SPZ only if there is evidence of overriding reasons why:
(a) the activity cannot take place on unproductive strata, and
(b) the storage must be underground (for example public safety), in which case we expect the risks to be appropriately mitigated, as noted below”

The supporting documentation does not outline why the activity cannot take place on unproductive strata (for example, a different site entirely), and there has been no above
versus below ground options appraisal. We have many examples of where underground storage was originally proposed with above ground tanks later considered, accepted and implemented.

Above ground tanks, whilst they take up more space and have other disadvantages, are usually a better option with respect to pollution prevention when correctly designed than underground tanks. An underground leak is extremely difficult to stop and remediate before impacting on groundwater when containment fails. The site is underlain by granular deposits followed by chalk strata. Groundwater may be present at around 5-10m and investigation could be carried out to determine peak seasonal groundwater levels.

As the site overlies sand and gravels (Happisburgh Glacigenic Formation And Lowestoft Formation (Undifferentiated) secondary A aquifer), followed by more sand and gravel (Crag principal aquifer) and then chalk (also a principal aquifer), all of which are highly transmissive, any pollution could rapidly reach groundwater. Any pollution that enters groundwater within an SPZ1 is calculated to take less than 50 days before impacting the associated public water supply. Pollution from hydrocarbons would render the public water supply unusable, with very high compensation costs being paid by the polluter.

Any installed site investigation holes (that were proposed in the Phase 1 report) will ultimately (after all of their usefulness is exhausted) need to be professionally decommissioned in line with best practice to avoid creating preferential pathways for contamination, and any holes not installed should be backfilled with hydrated bentonite.

Please refer to our guidance Groundwater Protection: Principles and Practice (GP3: v1.1, 2012), specifically position statement D2 and D3. The site is a new development and does not appear to be tight on space. Please consider novel tank options such as above ground tanks in the space between the pumps – we can provide examples of this in use, or permanently wholly visible but partially underground tanks with vaulted storage. Please also consider utilising more of the car parking spaces if the minimum number has not already been met.

Further Advice

This site is located above Principal and Secondary A aquifers, Source Protection Zone 1 WFD groundwater body, nearby groundwater abstractions, River Stour and WFD drinking water protected area. Groundwater beneath the site is potentially relatively shallow. The site is considered to be of high sensitivity and the proposed fuel storage and distribution presents potential pollutant linkages to the water environment. In addition, the proposed land uses pose a potential surface water runoff contamination risk if infiltration drainage is proposed. The application form indicates that SuDS and soakaways are proposed to dispose of surface water from the development. We require an in-depth surface water drainage strategy that considers the risk to the water environment from the various sources of pollution on site, and the mitigation measures that are proposed to mitigate against this risk, particularly given the very high environmental sensitivity of the location.

Further guidance is provided in the Technical Appendix to this letter.

It should be noted that if this objection is removed by satisfying the aforementioned points, planning conditions would be recommended, specifically relating to contaminated land, tank design, piling and surface water drainage.
We trust this advice is useful.

Yours sincerely

Miss Eleanor Stewart  
Sustainable Places - Planning Advisor

Direct dial 020 8474 8097  
Email planning.ipswich@environment-agency.gov.uk

cc PWA Planning
Appendix – Advice to Applicant

We recommend that developers should:

1) Refer to our ‘Groundwater Protection: Principles and Practice (GP3)’ document;

2) Follow the risk management framework provided in CLR11, ‘Model Procedures for the Management of Land Contamination’, when dealing with land affected by contamination;

3) Refer to our ‘Guiding Principles for Land Contamination’ for the type of information that we require in order to assess risks to the water environment from the site. The Local Authority can advise on risk to other receptors, for example human health;

4) Refer to our Land Contamination Technical Guidance;

5) Refer to the CL:AIRE ‘Definition of Waste: Development Industry Code of Practice’ (version 2) and our related ‘Position Statement on the Definition of Waste: Development Industry Code of Practice’;


7) Refer to our ‘Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination’ National Groundwater & Contaminated Land Centre Project NC/99/73. The selected method, including environmental mitigation measures, should be presented in a ‘Foundation Works Risk Assessment Report’, guidance on producing this can be found in Table 3 of ‘Piling Into Contaminated Sites’;

8) Refer to our ‘Good Practice for Decommissioning Boreholes and Wells’.

9) Refer to our ‘Temporary water discharges from excavations’ guidance when temporary dewatering is proposed.