ENVIRONMENTAL PERMITTING (ENGLAND AND WALES) REGULATIONS 2010 (AS AMENDED)

APPLICATION FOR THE SURRENDER OF

ENVIRONMENTAL PERMIT No: FP3737KL

SURRENDER SITE CONDITION REPORT

September 2014

Medina Processing Blaydon Limited

Blaydon Creamery

Chainbridge Road

Blaydon

Tyne and Wear

NE21 5SZ

Confidentiality Statement

This report is addressed to and may be relied upon by the following parties:

Medina Processing Blaydon Limited
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And

The Environment Agency
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Newcastle-upon-Tyne
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Introduction

Medina Processing Blaydon Limited (hereafter referred to as Medina) purchased the Dairy Farmers of Britain Limited (DFoB) site in Blaydon, Newcastle upon Tyne in January 2010. As part of this purchase Medina inherited the DFoB Environmental Permit (BT0286IR) which was transferred to Medina in February 2010 (Environmental Permit Ref. FP3737KL).

Medina ceased process operations at the Blaydon site in June 2011 and sold the site.

Under the Pollution Prevention and Control (England and Wales) Regulations 2000 (the PPC Regulations), the site undertook two prescribed activities, which were:

- Under Section 6.8, The Treatment of Animal and Vegetable Matter and Food Industries, A(1), (e) Treating and processing milk, the quantity of milk received being more than 200 tonnes per day (average value on an annual basis); and
- Under Section 5.3 Part A1(c)(i) – Disposal of non-hazardous waste in a facility with a capacity of more than 50 tonnes per day by biological treatment, not being treatment specified in any paragraph other than paragraph D8 of Annex II to Council Directive 75/442/EEC, which results in final compounds or mixtures which are discarded by means of any of the operations numbered D1 to D12 in that Annex (D8).

The original Permit (No. BT0286IR) was granted to DFoB on 13th December 2005 by The Environment Agency.

The installation, which was located on Chainbridge Road in Blaydon (See Appendix A1), undertook processing and pasteurisation of raw milk, cream processing and pasteurisation, packaging, chilled storage and distribution. The site also had an effluent treatment plant.

This application is for the surrender of the Permit following the closure of the site and therefore the cessation of the activities described above.

This document provides a description of the installation and processes previously employed, and an account of the steps taken during decommissioning to ensure that the site has been returned to a “satisfactory state” and that all relevant pollution risks have been removed. A summary of the reference site condition and the condition of the site at the time of application for Permit surrender is included to demonstrate that there has been no detrimental impact to the underlying ground / groundwater throughout the duration of the Permit, thus allowing the Environment Agency to determine surrender of the Permit.

Limitations

This report has been developed for the purpose of the surrender of an Environmental Permit held by the installation. The report should not be relied upon to provide site condition information outside the specific requirements of the Environmental Permitting Regime.

Non Technical Summary

Until June 2011, Medina operated as an installation under Sections 6.8 and 5.4 of the Environmental Permitting Regulations 2010 (EPR) for the processing and pasteurisation of milk and cream.

The EPR Permit was originally granted by The Environment Agency on 13th December 2005 to Dairy Farmers of Britain for the processing and pasteurisation of raw milk and cream, packaging, chilled storage and distribution. This permit was transferred to Medina in February 2010. A surrender application is being made for the full surrender of the Permit. The site layout is shown in Appendix A2.

Site Condition

Prior to, and since the issue of the EPR Permit, the installation used a range of management techniques to ensure that it met, as a minimum, the requirements of all relevant environmental legislation. This included the operation of an informal Environmental Management System (EMS).

The monitoring and reporting requirements established under the EMS and the EPR Permit, contributed to the successful environmental management of all site activities with the result that no significant incidents have occurred during site operations. This has been confirmed through interviews with long standing staff members.

As part of the decommissioning process, all significant pollution risks in the form of chemicals, oils and wastes associated with the activities covered in the Permit have been removed from site.

Decommissioning was undertaken by experienced site personnel. Process equipment and all above ground storage tanks were made safe, emptied and cleaned out and then sold to third parties through an auction. It has been confirmed that the underground diesel and gas oil tanks on site are empty and were cleaned out in October 2011. The tanks and associated delivery and dispensing connection points remain in-situ.

The on-site drainage system was decommissioned once production operations ceased, including a complete Clean in Place (CIP) and once all tanks had been emptied. The effluent treatment plant was decommissioned by MSA Environmental Ltd in June 2011 and the drains around the site were cleaned by Lanes for Drains.

Any unused raw materials were either transferred, for use, to the Medina Huddersfield site or returned to the supplier. All wastes generated during the decommissioning of the site were removed by licensed waste contractors.

As an assessment of the likelihood of pollution was undertaken at the permit application stage and identified that there was a reasonable likelihood of pollution from some of the activities undertaken on site. It was determined in the Site Protection and Monitoring Programme (SPMP) that an intrusive investigation should be undertaken to benchmark the site in the following two locations on the basis of their higher pollution potential:

- Underground diesel and gas oil storage tanks; and
- CIP cleaning chemicals storage area.

On-going groundwater monitoring undertaken during the lifetime of the permit indicated an apparent increase in the concentration of total petroleum hydrocarbons within the ground / groundwater. However, based on further monitoring and the assessment of the results obtained it is considered there has not been any adverse change in contamination status since the commencement of the SPMP. The site is therefore considered to be in a “satisfactory state”.

Surrender Site Condition Report

Activities at the Blaydon site were permitted under the PPC Regulations in December 2005; however, since then, the Environmental Permitting Regulations (EPR) have been implemented and the requirements for site surrender have changed.

At the time of the PPC application, the site was owned by Dairy Farmers of Britain (DFoB) who submitted an Application Site Report which established the history of the site and the nature of historical activities performed at the site, which may have resulted in contamination of the site. The report also identified environmentally sensitive areas and activities that may have affected the site and assessed the potential impact of these activities undertaken on site.

This Surrender Site Condition Report under EPR follows the Environment Agency's H5 SCR guidance. However, in the case of the information requested in Section 2: Condition of the Land at Permit Issue (required of new EPR applicants) in this guidance, it is considered that this is already available to the Environment Agency as part of the site's Application Site Report (ASR) and also the Site Protection and Monitoring Programme (SPMP).

1 Site Details

Name of the Applicant	Medina Processing Blaydon Limited
Activity Address	Blaydon Creamery Chainbridge Road Blaydon Tyne and Wear NE21 5SZ
National Grid Reference	NZ 194 636
Document Reference and Dates for Site Condition Report at Permit Application and Surrender	Application: IPPC Application Site Report (February 2005) Site Protection and Monitoring Programme (June 2006) First Phase Reporting of the Site Protection and Monitoring Programme Where Reference Data is Required (December 2006) Surrender: SSCR (September 2014)
Document references for Site Plans (including locations and boundaries)	Appendix A

2 Condition of the Land at Permit Issue

Information regarding the environmental setting and pollution history of the site has been submitted as part of the Application Site Report (ASR) when the original permit application was submitted to the Environment Agency.

The ASR identified that there was a reasonable likelihood of pollution associated with the following activities undertaken on site and recommended the collection of reference data to benchmark the site:

- Underground Diesel and Gas Oil Tank;
- Aboveground Diesel Tank;
- CIP Cleaning Chemicals;
- Waste Oil Tank; and
- Detergents and Hydrocarbons from Vehicles.

A Design Site Protection and Monitoring Programme (SPMP) was developed to determine the scope of the site investigation that was required to baseline the soil and groundwater conditions on the site. In the Design SPMP some of the potential sources of pollution identified in the ASR were not considered when designing the proposed site investigation, these sources included:

- Pasteurised milk and cream storage – these sources were not included as it was agreed with the Environment Agency that milk and cream are naturally occurring and do not persist in the environment. In addition there are no specific laboratory analytical methods available to test for these substances.
- Above ground diesel tank – not included as the fill point was upgraded so that it was fully contained.

Therefore the site investigation was designed to target the following areas:

- Underground diesel and gas oil storage tanks; and
- CIP cleaning chemicals storage area.

Soil and groundwater samples were collected from each monitoring well and chemical analysis was undertaken to determine the baseline conditions. The table below provides details of the analytical suite:

Exploratory Hole	Potential Sources of Contamination	Determinands
BH1	Underground diesel and gas oil storage tanks	TPH CWG
BH2		
WS1	CIP cleaning chemicals storage area	SVOC (tic*), VOC (tic*), pH, chloride, ammonium, nitrate, sodium, anionic surfactants
WS2		

* Tentatively Identified Compound

The ground investigation concluded that the majority of determinands tested for in the soil and groundwater were within typical background concentrations. However, both the Made Ground and the underlying superficial deposits (alluvium) had been significantly impacted by hydrocarbon contaminants within borehole BH2. Lower levels of contamination were noted within borehole BH1 and were largely confined to the Made Ground. This is consistent with observations made in the ASR, which noted that there was evidence of staining in the area around the diesel refuelling point. The SPMP concluded that the elevated concentrations of TPH recorded could be as a result of historical and / or current uses.

The SPMP recommended that groundwater monitoring should be undertaken for the duration of the permit and that samples should be collected at a frequency agreed with the Environment Agency. DFoB agreed with the Environment Agency that on-going monitoring was only required at two of these locations, BH1 and BH2, on a six-monthly basis.

Details of the on-going monitoring that was undertaken on site from boreholes BH1 and BH2 are provided in Section 7 of this report.

3 Permitted Activities

The table below shows the prescribed activities permitted under the Environmental Permitting Regulations.

Permitted Activities	6.8 A(1)(e) Treating and processing milk, the quantity of milk received being more than 200 tonnes per day (average value on an annual basis). 5.3 A1(c)(i) Disposal of non-hazardous waste in a facility with a capacity of more than 50 tonnes per day by biological treatment, not being treatment specified in any paragraph other than paragraph D8 of Annex II to Council Directive 75/442/EEC, which results in final compounds or mixtures which are discarded by means of any of the operations numbered D1 to D12 in that Annex (D8).
Non-permitted activities undertaken	Directly associated activities: - Steam generation. - Packaging of finished product. - Waste storage and disposal.
Document references for: ■ **Plan showing activity layout; and** ■ **Environmental risk assessment**	See Appendix A2 See original Application Site Report for assessment of likelihood of pollution

4 Changes to the Activities

The nature of the operations on site have not been varied throughout the life of the permit. The only variations to the permit have been changes to the operator of the installation.

Medina confirmed that during their period of operating the site, only one of the three underground storage tanks was used for the storage of gas oil. Medina ceased using this tank by September 2010 and moved the gas oil to a bunded above ground tank. The fuel oil was stored in the above ground tank throughout the time that Medina operated the site.

No new substances of a potentially polluting nature have been used, in addition to those identified in the original IPPC Application.

5 Measures taken to Protect Land

5.1 MANAGEMENT SYSTEMS

5.1.1 Environmental Management System

DFoB operated an Environmental Management System (EMS) which was accredited to ISO14001. It is understood that the EMS and maintenance systems implemented on site included the inspection and maintenance of pollution prevention infrastructure such as surface finishes, secondary containment, tanks and pipework.

Medina operated an informal Environmental Management System with numerous systems and procedures in place to ensure that the likelihood of spills and leaks associated with the operation of the site were minimised and appropriate remedial measures implemented should such an incident take place. It is understood from interviews with staff and the review of documentation that the following measures were in place to protect the ground and groundwater beneath the site:

- Regular visual inspections of storage areas;
- All drums were lidded when not in use;
- The levels in the underground tanks were checked prior to accepting a delivery to ensure that there was sufficient capacity;
- All deliveries were supervised;
- Regular maintenance schedules for all equipment / infrastructure; and
- A spill response procedure was in place.

5.2 PHYSICAL ENVIRONMENTAL INFRASTRUCTURE IN PLACE

Surfaces

All of the process operations were undertaken within buildings. Material storage areas were either within buildings or within an external area. The external areas were surfaced with either concrete or tarmac of generally good integrity.

Material Delivery and Storage

The delivery of raw materials took place in an area of concrete hardstanding and all deliveries were supervised. Only trained and experienced personnel were permitted to work with tanker drivers when accepting deliveries. In order to prevent spillages, the levels in the underground tanks were verified prior to the tanker off-loading to ensure that the storage tanks could accept the tankers load.

Three bulk storage tanks for diesel (2 x 14,000 litres) and gas oil (1 x 14,000 litres) were situated below ground. It is understood that these tanks passed a pressure test in 2004 and Medina commissioned a visual inspection of the tanks in October 2011 which identified that there was light rusting around the tanks but no visible defects. Therefore they were considered not to be leaking. Records were kept of the amount of diesel / fuel oil delivered to the tanks and the removal of diesel / fuel oil was metered so that any leaks would be detected.

All other bulk storage tanks, apart from the milk silos, pasteurised milk and cream tanks and the raw effluent tanks, were located above ground and were provided with secondary containment. Raw materials which were delivered in mobile containers were stored in a bunded area.

Regular visual inspections of the storage areas were undertaken to ensure adequate containment.

Waste Storage

Arrangements were in place for the appropriate storage of wastes generated on site, with incompatible wastes segregated. All effluent produced at the installation was directed into the effluent treatment plant before being discharged into the River Tyne. All other wastes were stored in skips and waste storage containers prior to disposal off site by a licensed waste contractor.

Waste disposal was carried out throughout the decommissioning activity in accordance with site waste disposal procedures to ensure that the site's Duty of Care responsibilities were met. Registered waste carriers were used, and waste disposal sites were appropriately licensed.

Spillage Retention

A spill response procedure for major and minor spillages was in place. In the event of a spillage there were a number of spill kits located at various points around the site and staff were trained in the use of these.

Drain covers were available to cover the drains to prevent spills and leaks entering the surface water drainage system.

Drainage System

All drainage within the site was routed to a holding tank prior to treatment in the on-site effluent treatment plant, before discharge of site.

Environmental Accidents / Incidents

Throughout the life of the permit, there were no relevant environmental incidents or events that required notification to the Environment Agency.

Complaints associated with odour from the effluent treatment plant were received during the life of the permit however, these were resolved.

As a result of discussions with site personnel it has been confirmed that no incidents have occurred during the operation of the facility or during decommissioning that could have caused ongoing ground / groundwater pollution.

The management systems and physical infrastructure in place at the site have provided an effective means to protect the condition of the ground and groundwater beneath the site during the lifetime of the permit.

6 Pollution Incidents that may have had an Impact on Land, and their Remediation

It is understood following interviews with staff members that during the life of the permit no environmental incidents occurred with pollution potential that required reporting to the Environment Agency.

7 Soil Gas and Water Quality Monitoring

7.1 INTRODUCTION

The 'First Phase Reporting of the Site Protection and Monitoring Programme Where Reference Data is Required' prepared for DFoB in December 2006 recommended that on-going groundwater monitoring from the monitoring wells should be undertaken for the duration of the permit. DFoB agreed with the Environment Agency that on-going monitoring would be undertaken from boreholes BH1 and BH2 on a six monthly basis. These monitoring wells were installed at strategic locations to identify any pollution arising from the underground diesel and gas oil storage tanks.

Groundwater monitoring was undertaken by DFoB on the following occasions:

- April 2008;
- September 2008; and
- March 2009.

Medina undertook further groundwater monitoring in July 2011.

The results of the groundwater monitoring are presented in the following reports which were submitted to the Environment Agency and have been summarised in this SSCR:

- SPMP Monitoring Report April 2008; prepared by WSP Environmental Ltd dated, 24th April 2008;
- SPMP Monitoring Report September 2008, prepared by WSP Environmental Ltd, dated 30th October 2008;
- SPMP Monitoring Report March 2009, prepared by WSP Environmental Ltd, dated 25th March 2009; and
- Groundwater Monitoring Report July 2011, prepared by WSP Environmental Ltd, dated 12th August 2011.

A table providing a summary of all of the groundwater monitoring undertaken during the lifetime of the permit is presented in Appendix B.

7.2 GROUNDWATER MONITORING RESULTS: APRIL 2008

Monitoring of boreholes BH1 and BH2 was undertaken on the 1st April 2008 to assess the concentration of TPH in the groundwater against baseline conditions, however there was insufficient groundwater present within borehole BH2 for a sample to be recovered for laboratory analysis.

The results of the groundwater analysis for borehole BH1 indicated a decrease in dissolved phase TPH concentrations (Total TPH of 0.14 mg/l compared to a 2006 baseline concentration of 0.2 mg/l).

7.3 GROUNDWATER MONITORING RESULTS: SEPTEMBER 2008

Groundwater monitoring of boreholes BH1 and BH2 was undertaken on the 30th September 2008 to enable DFoB to establish whether the concentrations of TPH had varied since the first round of monitoring undertaken in April 2008 and since the collection of baseline data in 2006. Sufficient water was present within borehole BH2 to enable recovery of a sample for laboratory analysis (it had not been possible to sample this borehole in April 2008).

The results of the September 2008 groundwater monitoring demonstrated that:

- There was a slight increase in total TPH concentrations in borehole BH1 compared to the 2006 baseline and 2008 monitoring data (0.49 mg/l compared to 0.2 mg/l in 2006 and 0.14 mg/l in April 2008); and,
- Elevated concentrations of total TPH were present within groundwater recovered from borehole BH2 (78 mg/l), which is consistent with olfactory observations and soil analytical results made during the 2006 baseline assessment.

It should be noted that, due to poor recharge of the monitoring wells, 'bailed' samples of water had to be recovered from the wells without prior purging, therefore the sample may not have been representative of the groundwater conditions beneath the site, as only the standing water within the monitoring well itself was tested.

7.4 GROUNDWATER MONITORING RESULTS: JANUARY 2009

Groundwater monitoring of boreholes BH1 and BH2 was undertaken on the 26th January 2009. Groundwater samples were collected from borehole BH1, however, the recharge following purging of borehole BH2 was poor and sufficient sample could not be obtained for laboratory analysis.

The results of the groundwater analysis from borehole BH1 indicated a decrease in the concentration of hydrocarbons in the groundwater beneath the site in comparison to the groundwater monitoring in both April and September 2008, with all hydrocarbon species analysed for below laboratory limit of detection. The results were also in the same range as those recorded in the baseline assessment in 2006.

7.5 GROUNDWATER MONITORING RESULTS: JULY 2011

Groundwater monitoring of boreholes was undertaken on the 26th July 2011 with groundwater samples collected from both boreholes BH1 and BH2.

The results of the groundwater monitoring demonstrated that:

- Total TPH concentrations in borehole BH1 were below laboratory limit of detection and had therefore decreased since the 2006 baseline assessment: and,
- Concentrations of both speciated and Total TPH within borehole BH2 showed an increase since the September 2008 monitoring, however the sampling methodology varied to that adopted in 2008 (borehole purged prior to sampling, unlike 2008 where the sample was recovered from standing water within the monitoring well via a bailer).

The results of the 2011 monitoring are not considered to be representative of true dissolved phase TPH contamination due to the presence of free phase hydrocarbons in the vicinity of borehole BH2, as noted during the baseline site assessment. This can result in elevated and highly variable concentrations, as discussed in greater detail in Section 9.

8 Decommissioning and Removal of Pollution Risk

8.1 DECOMMISSIONING

Decommissioning was undertaken by experienced site personnel in accordance with the principles outlined in the Site Closure Plan which was submitted to and approved by the Environment Agency in October 2010.

Process equipment and all above ground storage tanks were made safe, emptied and cleaned out and then sold to third parties through an auction. Where equipment was sold to third parties, these organisations came to the site to remove the equipment. Operations undertaken by these organisations were supervised by Medina personnel to ensure that the equipment was dismantled safely.

It has been confirmed that the underground diesel and gas oil tanks on site are empty and were cleaned out in October 2011. The tanks and associated delivery and dispensing connection points remain in-situ.

Any unused raw materials were appropriately packaged and either transferred, for use, to the Medina Huddersfield site or returned to the supplier.

All wastes generated during the decommissioning of the site were removed by licensed waste contractors.

The on-site drainage system was decommissioned once production operations ceased, including a complete CIP and once all potentially polluting materials had been removed from site. The effluent treatment plant was decommissioned by MSA Environmental Ltd in June 2011 and the drains around the site were cleaned by Lanes for Drains.

It is understood that the last site inspection was undertaken by the Environment Agency in August 2011 and that the report from this inspection states that they were satisfied with the approach taken to decommissioning.

8.2 SECURITY

Access to the site was controlled by the use of fencing and controlled gates, CCTV was also employed. An induction process was undertaken for all contractors and visitors.

8.3 INCIDENTS AND EMERGENCIES

A capability to respond to unplanned events was maintained throughout the operational and decommissioning phases of the permitted period. The site maintained procedures for minor and major spillages with sufficient human resources and emergency equipment to effectively respond to an incident during all phases of the permitted period including decommissioning.

It is understood from interviews with staff members that since the issue of the permit no environmental incidents occurred with pollution potential that required reporting to the Environment Agency, this applied to both operational and decommissioning periods.

9 Reference Data and Remediation

9.1 INTRODUCTION

Elevated concentrations of TPH were identified in soil samples from borehole BH2 and lower concentrations in soil and groundwater samples from borehole BH1 when the site conditions were benchmarked in 2006. The SPMP concluded that the concentrations of TPH recorded could be as a result of historical and / or current uses and therefore groundwater monitoring was undertaken during the life of the permit.

The groundwater monitoring undertaken between April 2008 and July 2011 indicated that the concentration of TPH in borehole BH1 had decreased to concentrations lower than those recorded in 2006. However, the concentrations of TPH in groundwater from borehole BH2 (which was not sampled as part of the 2006 baseline assessment) are elevated and show an upward trend. Therefore further groundwater monitoring was undertaken.

9.2 GROUNDWATER MONITORING

A further round of groundwater monitoring of boreholes BH1, BH2 and WS1 was undertaken on the 23rd April 2014. Groundwater samples were collected from borehole BH2 both prior to and post purging of the well.

The results of the groundwater monitoring demonstrated that the concentration of TPH in the vicinity of the underground diesel and gas oil storage tanks had decreased in borehole BH1 since 2006. Borehole WS1 was also sampled on this occasion to establish if there was evidence of wider hydrocarbon contamination. No significantly elevated hydrocarbon concentrations were recorded in WS1, with most of the results below the laboratory limit of detection. The results from the monitoring in borehole BH2 are summarised in Table 9.1 alongside previous monitoring results for this borehole.

Table 9.1: Summary of Borehole BH2 Monitoring Results (mg/l)

Sampling Date	November 2006	April 2008	September 2008	January 2009	July 2011	April 2014	
Monitoring Well Purged?	N/A	N/A	No	N/A	Yes	No	Yes
Total Aliphatic & Aromatic Hydrocarbons (mg/l)	-	-	78	-	1,570	2,020	587

Two samples were collected from borehole BH2, an initial grab sample (BH2/1) and a second sample was collected following purging three well volumes (BH2/2). The laboratory test certificates for these samples are provided in Appendix C. The results for the initial grab sample indicate an increase in TPH concentrations compared to the 2008 and 2011 results, whereas the purged sample indicates a decrease compared to the 2011 results These highly variable results are considered to be indicative of the influence of a residual non-aqueous phase liquid (NAPL) source, rather than representing true dissolved phase concentrations, and are consistent with both olfactory observations made during the advancement of borehole BH2 and subsequent soil analyses. This is discussed in greater detail in the following Section.

9.3 ASSESSMENT OF CONTAMINATION STATUS

Introduction

The results of the groundwater quality monitoring undertaken since 2006 indicate that there has been an deterioration in groundwater quality within borehole BH2 since the Site's original baseline survey. However, there are no records of any spills or leaks during the operation of the Site which would have led to deterioration in ground conditions. This section of the SSCR presents a discussion on why it is considered that the results of

the groundwater monitoring programme may be providing a misleading picture of groundwater quality trends beneath the Site.

2006 Baseline Assessment

The site investigation undertaken by WSPE in November 2006 as part of the original ASR aimed to provide a baseline assessment of the Site against which its condition at the time of Permit surrender could be compared. This would enable determination of what, if any, deterioration had taken place throughout the life of the Permit and therefore whether any remediation would be required to return the Site to its original condition, in accordance with the requirements of the EPR.

The investigation focussed on an area of the Site deemed to pose a pollution potential due to the location of three underground and one above-ground storage tanks (USTs and ASTs) and three fuel pumps used for storage and dispensing of diesel and gas oil. The investigation comprised the advancement of four boreholes (WS1, WS2, BH1 & BH2) as detailed in Section 2. These utilised both cable percussion and window sampling drilling techniques (two boreholes [BH1 & BH2] installed by cable percussion drilling to 10m bgl and two boreholes [WS1 & WS2] installed by window sampling drilling to up to 7m bgl), the recovery of representative soil samples and the construction of four groundwater monitoring wells to facilitate a groundwater quality monitoring programme.

WSP Environmental was advised at the time of the investigation that the USTs had successfully passed integrity pressure testing. However, surface staining was apparent around the AST fill point and also around the nearby diesel fuel dispensers. Olfactory evidence of hydrocarbon contamination was noted within soil samples recovered from both cable percussion boreholes, most notably within borehole BH2 and, to a lesser extent, in borehole BH1.

Subsequent laboratory analysis of recovered soil samples indicated that both Made Ground and the underlying superficial deposits (alluvium) had been significantly impacted by hydrocarbon contaminants within borehole BH2, with a noticeable increase in contaminant concentrations with depth (Total TPH concentrations of 1,408 mg/kg at 2.0 metres below ground level [m bgl] and 5,145 mg/kg at 7.0m bgl). Lower levels of contamination were noted within borehole BH1, and were largely confined to the Made Ground.

The predominance of aliphatic hydrocarbon fractions in the carbon ranges identified is indicative of a diesel source, which was to be anticipated given the activities undertaken in that part of the Site. No contamination was evident in window sample boreholes WS1 and WS2, which were located to the west of the AST, USTs and fuel dispensers (see the borehole location plan presented as Figure A2). Borehole logs are presented in Appendix D.

Groundwater Monitoring Programme

A programme of groundwater quality monitoring commenced in November 2006, with further monitoring undertaken in April and September 2008, January 2009 and July 2011. No sample was recovered from borehole BH2 for analysis in 2006 due to insufficient volume being present within the borehole, although borehole BH2 has subsequently been sampled. Given evidence of hydrocarbon contamination within the Made Ground, the monitoring well construction included a response zone within this stratum and a bentonite seal installed within the underlying alluvium to avoid generating a migration pathway through the latter, in accordance with good practice for the investigation of brownfield sites. Given that the alluvium is characterised by clay, it is considered likely that borehole BH2 is monitoring perched water (i.e. delayed infiltration) within the overlying Made Ground, rather than a distinct groundwater body. It should be noted that the reach of the River Tyne approximately 300m to the north of the Site is tidal, and groundwater levels in the underlying alluvium (monitored by borehole BH1) may be influenced to a degree by tidal fluctuations.

The results of the monitoring programme were presented in a WSPE letter report dated 12th March 2013 (See Appendix E) and indicated that:

- Total TPH concentrations in samples recovered from borehole BH2 exhibited more than an order of magnitude increase between September 2008 and July 2011 (78 to 1,570 mg/l respectively); and,
- Groundwater samples recovered from borehole BH1 exhibited significantly lower TPH concentrations (<1 mg/l to below laboratory detection limit), which is broadly consistent with the soil analytical data from this borehole.

Assessment of Contamination Status over Duration of Environmental Permit

The WSPE 2013 letter report suggested that the apparent trend in groundwater TPH concentrations might be a possible consequence of differing sampling techniques rather than a deterioration in groundwater quality, with both 'grab' and purged samples recovered (possibly due to variations in perched water levels within the borehole). The 2013 report also highlighted the known presence of diesel-range contaminants at the time of the 2006 investigation.

A further review of the original (2006) soil and subsequent groundwater monitoring data, together with the construction of the monitoring wells, indicates that:

- The 2006 soil data for borehole BH2 indicates the presence of a residual NAPL source within a smear zone that appears contiguous between the Made Ground and underlying alluvium, with Total TPH concentrations of 1,408 mg/kg and 5,145 mg/kg for samples from 2.0m bgl (Mage Ground) and 7.0m bgl (alluvium) respectively;
- Borehole BH2 appears to be screened within the upper part of this smear zone; and,
- Recorded concentrations of both aliphatic and aromatic hydrocarbons in groundwater exceed both their pure phase and calculated effective solubilities i.e. they cannot represent true dissolved phase concentrations, but are likely to be driven by residual NAPL sheens/particles entrained within the recovered groundwater samples.

To demonstrate the influence of a residual NAPL source on true dissolved phase groundwater concentrations, the effective solubility (i.e. maximum potential true dissolved concentration) of each aliphatic and aromatic fraction within the residual NAPL has been calculated using Raoult's Law, which states that:

$$Cw = x * S$$

where:

Cw	=	concentration of chemical in water (mg/l)
x	=	mole fraction in organic (NAPL) phase (mole chemical/mole oil)
S	=	solubility of pure chemical in water (mg/l)

The Raoult's Law calculations, using mole fractions for each aliphatic and aromatic banding calculated from the 2006 soil TPH-CWG data, are presented in Appendix F. For those CWG fractions that would exist as solids in their pure phase at Standard Temperature and Pressure (STP), super-cooled aqueous solubility values for surrogate compounds have been used (octadecane and octacosane for aliphatic EC16-21 and EC21-35 respectively, and average PAH values for aromatic EC10-12, EC12-16, EC16-21 and EC21-35 fractions). In all cases the super cooled aqueous solubilities are higher than the respective pure phase aqueous solubilities.

A comparison of the calculated effective solubility with recorded groundwater concentrations for each of the aliphatic and aromatic fractions for borehole BH2 is presented in Table 9.2 below. The higher recorded groundwater concentrations are typically several orders of magnitude above the calculated effective solubilities, indicating that contaminant concentrations in groundwater appear to be driven by a residual NAPL source rather than soil leaching.

Table 9.2: Comparison of Effective Solubilities and Recorded Groundwater Concentrations

Contaminant	Effective Solubility based upon BH2 soil data @ 2.0m bgl (mg/l)	Effective Solubility based upon BH2 soil data @ 7.0m bgl (mg/l)	BH2 Recorded groundwater concentrations 2008 - 2011 (mg/l)
TPH Aliphatic EC5-6	-	-	<0.01
TPH Aliphatic EC6-8	0.0025	0.0008	<0.01 - 0.2
TPH Aliphatic EC8-10	0.0005	0.0008	0.052 - 2.93
TPH Aliphatic EC10-12	0.0018	0.0006	0.27 - 8.04
TPH Aliphatic EC12-16	4.4E-5	0.0002	18 - 454
TPH Aliphatic EC16-21	2.5E-7	1.2E-6	25 - 624
TPH Aliphatic EC21-35	6.2E-6	3.4E-6	12 - 309
TPH Aromatic EC6-8	0.0135	0.0041	<0.01
TPH Aromatic EC8-10	0.0038	0.0012	0.079 - 1.95
TPH Aromatic EC10-12	4.4844	1.3638	0.40 - 5.36
TPH Aromatic EC12-16	6.7515	2.0533	4.1 - 19.6
TPH Aromatic EC16-21	1.4609	0.7597	8.5 - 67.5
TPH Aromatic EC21-35	0.1303	0.0125	8.6 - 78.1

To determine whether a particular petroleum hydrocarbon mixture could be present within soils at sufficient concentrations as to occur as a NAPL, WSP has developed an Excel-based tool for calculating the soil saturation limit (C_{Sat}) of both individual organic compounds and TPH NAPL mixtures. The TPH Saturation Calculator tool adopts the methodology presented in the American Petroleum Institute (API) guidance paper *'Non Aqueous Phase Liquid (NAPL) Mobility Limits in Soil'* (API Soil & Groundwater Research Bulletin No. 9, June 2000).

Using the TPH Saturation Calculator tool, values for C_{Sat} for individual aliphatic and aromatic fractions can be calculated for a given soil type. The tool also allows $C_{Sat\ T}$ to be calculated for any given TPHCWG mixture *T*. Based on the outputs from the Excel tool, it is possible to quantitatively assess whether a soil contains NAPL or not. If the analysed TPH concentration for a given soil is less than the calculated value for $C_{Sat\ T}$ then it is considered that the observed concentrations will be fully partitioned to soil air, water or organic carbon and NAPL particles will not be present within the soil matrix. Where analysed TPH concentrations are above the calculated $C_{Sat\ T}$ values, it is anticipated that residual NAPL particles will be present within the soil matrix. This approach has gained regulatory approval following its use by WSP personnel on a number of projects, most notably for assessing NAPL mobility limits within soil adjacent to a water course as part of the redevelopment of a former tar works site within the Nar Ouse Millennium Development, King's Lynn, Norfolk.

The TPH Saturation Calculator is presented in Appendix G. The calculations assume a Fraction of Organic Carbon (foc) value of 0.006 (equivalent to a Soil Organic Matter of 1%), which is considered to be a reasonable assumption for the Made Ground at the Blaydon site.

Values for $C_{Sat\ T}$ from 149 mg/kg to 184 mg/kg have been calculated using the 2006 TPHCWG soil data for samples from 2.0 and 7.0m bgl respectively within borehole BH2. These values are significantly lower than the actual original soil data (Total TPH values of 1,408 mg/kg and 5,145 mg/kg respectively), and indicate that a residual NAPL source was present at the time of the baseline site investigation conducted in 2006. This is also consistent with observations made at the time of the intrusive investigation.

Where soil saturation limits are exceeded within a soil, there is the potential for the NAPL to become mobile. The API paper also presents a methodology for calculating $C_{Res\ T}$, which represents the concentration above which a NAPL source can migrate due to gravity or convection. The calculation of $C_{Res\ T}$ requires an assumed value for the fraction of voids within the soil that are occupied by NAPL (Sr, units of cm^3/cm^3). The API paper presents a range of Sr values for differing NAPL and soil types derived from laboratory experiments. These vary from 0.002 to 0.92 (an Sr value of 1 indicates that all available void space is occupied by NAPL). An adopted Sr value of 0.15 cm^3/cm^3 is considered to be reasonable based upon the known diesel source and the nature of the soils.

Values for $C_{Res\ T}$ of 25,100 mg/kg to 27,700 mg/kg have been calculated based upon the 2006 soil data (Appendix G). By comparing these values to known soil concentrations, it can be seen that the NAPL source identified during the original baseline investigation is likely to be relatively immobile due to gravity or convection. Although the AST and USTs were decommissioned during Medina's tenure of the site, this residual and largely immobile NAPL source has the potential to provide an ongoing source of dissolved phase TPH concentrations and, directly within the vicinity of this source, recovered water samples are likely to become impacted with entrained NAPL sheens, despite no measurable NAPL having been encountered.

Conclusions

Olfactory observations and soil analytical data from the 2006 investigation indicate the presence of a NAPL source in the vicinity of borehole BH2. Effective solubilities for each aliphatic and aromatic fraction have been calculated using Raoult's Law and are typically several orders of magnitude lower than recorded groundwater concentrations. This is consistent with a NAPL source influencing apparent groundwater quality (i.e. the reported groundwater concentrations are not representative of true dissolved phase contamination).

To establish whether such a NAPL source was present at the time of the original baseline assessment the original investigation data has been used in conjunction with the methodology presented by the API through the TPH Saturation Calculator tool to determine the soil saturation limit ($C_{Sat\ T}$) for the TPHCWG mixture encountered. The $C_{Sat\ T}$ values calculated indicate that a residual NAPL source was present at the time of the baseline site investigation. Based on soil type and the likely NAPL profile, this residual NAPL source is considered likely to be largely immobile through gravity or convection based on the API findings (i.e. the 2006 soil concentrations are lower than calculated $C_{Res\ T}$ values).

Despite the lack of groundwater laboratory data for borehole BH2 during the 2006 baseline survey, a well with a response zone within a known residual NAPL smear zone is considered likely to exhibit elevated and highly variable concentrations similar to those gathered in more recent monitoring visits and caused by entrained NAPL particles within the recovered groundwater samples. Based on this evidence it is considered there has not been any adverse change in contamination status since the commencement of the SPMP (i.e. there is sufficient evidence to suggest that groundwater quality in this part of the site had already been significantly impacted by diesel-range contaminants at the time of the Permit's issue).

9.4 REMEDIATION

As the localised groundwater impact in borehole BH2 is considered to be a NAPL source within surrounding soil that was present at the time of the 2006 baseline assessment and there is no evidence to suggest that there has been any incremental contamination throughout the lifetime of the permit, remediation is not deemed necessary.

10 Statement of Site Condition

The permitted activities have now stopped and the site has been decommissioned and sold. It is believed that the condition of the site following decommissioning and removal of pollution risks satisfies the EPR requirements of a “satisfactory state”.

Glossary

BH – Borehole

DFoB – Dairy Farmers of Britain

EMS – Environmental Management System

EPR – Environmental Permitting Regulations

SVOC (tic) – Semi Volatile Organic Compounds (Tentatively Identified Compounds)

TPH CWG – Total Petroleum Hydrocarbon Criteria Working Group

VOC (tic) – Volatile Organic Compounds (Tentatively Identified Compounds)

WS – Window Sample

References

1. Dairy Farmers of Britain, Blaydon Dairy IPPC Application Site Report, February 2005
2. IPPC Permit Blaydon Dairy, Dairy Farmers of Britain (Permit Number: BT0286IR), issued 13th December 2005
3. Dairy Farmers of Britain, Blaydon Dairy Site Protection and Monitoring Programme, June 2006
4. Dairy Farmers of Britain, Blaydon Dairy First Phase Reporting of the Site Protection and Monitoring Programme Where Reference Data is Required, December 2006
5. Dairy Farmers of Britain SPMP Groundwater Monitoring at Blaydon Dairy, 24th April 2008
6. Dairy Farmers of Britain SPMP Groundwater Monitoring at Blaydon Dairy, 30th October 2008
7. Dairy Farmers of Britain SPMP Groundwater Monitoring at Blaydon Dairy, 25th March 2009
7. Medina Foods SPMP Groundwater Monitoring at Blaydon Dairy, 12th August 2011
8. Environmental Permit Variation, Medina Processing Blaydon Ltd (Permit Number: FP3737KL), issued 3rd December 2013

Appendix A: Figures and Plans

Appendix A1 – Site Location Plan

Appendix A2 – Site Layout Plan and Borehole Locations