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Date: 02/12/2015

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Our Ref: MALT47072850
Your Ref: Wressle Surface Water Sampling

For the attention of: Martin Brooks

Dear Sir

Re: Wressle Surface Water Sampling Report

Please find this to be AECOM's report detailing the multiple rounds of surface water (SW) sampling undertaken at the Wressle exploration drill site during the well's testing phase, between 6th January 2015 and 30th October 2015.

Introduction

AECOM was commissioned (as URS Infrastructure and Environment UK Ltd) by Egdon Resources Plc (Egdon) to undertake sampling of the surface waters in the immediate vicinity of the Wressle exploration drill site prior to the commencement of well testing, during well testing, and following the ceasation of testing and demobilization. URS submitted the proposal[1] on 5th December 2014 and was subsequently authorized by Egdon on 8th December 2014.

Background

Egdon have undertaken the onshore exploration of potential oil resources at the Wressle site, which consisted of the drilling and installation of an operational well to date. The work was performed under a mining waste permit (MWP) as issued by the EA.

A requirement of this mining waste permit was the monitoring and sampling of the adjacent surface water feature (Ella Beck) for a number of predetermined parameters, to be collected from 3no. sampling points before, during and after the works.

URS undertook the surface water sampling on 9no. occasions (before, during and after drilling) from June to September 2014.

Further to the sampling undertaken during the drilling and installation of the well, the MWP requires that sampling continue during the testing of the well.

Site Details

Conventional exploratory onshore oil drilling has been undertaken at the site located approximately 450m east of Sadler's Lodge Farm. An area of woodland is located adjacent east whilst the agricultural

[1] P862902, Proposal for Wressle Drill Site SW Sampling, Dated 05 December 2014

land is located south. The site is bound to the north and west by Ella Brook which is not classified by the Environment Agency (EA) with regards to ecological and chemical quality.

Agricultural land exists in all directions beyond those land uses described above.

Objectives

In order to achieve the project objective, the following scope of works was undertaken:

- **Task 1 – Preliminary Works**: completion of a specific Safe Work Plan (SWP) including method statements and risk assessments for the proposed work.
- **Task 2 – Surface water monitoring**: seven monitoring visits between the 6th January 2015 and 30th October 2015. Monitoring included collection of water quality parameters and surface water samples from three sample locations (S1 to S3) for laboratory analysis.
- **Task 3 – Laboratory analysis:** all samples were transferred to the selected accredited laboratory, Jones Environmental, within secure packaging under chain of custody protocols on the day of sampling.
- **Task 4 – Reporting:** presentation of the results of the monitoring rounds, with conclusions and recommendations.

Surface Water Monitoring

Surface water monitoring was undertaken on seven (7No.) occasions between the 6th January 2015 and 30th October 2015 at three locations (S1 to S3) as follows:

ID	Location
S1	Adjacent to the site.
S2	Upstream of the site.
S3	Downstream of the site.

The sample locations are shown on Figure 1 and photographs are included as Appendix A.

Samples were collected using a bucket which was rinsed with surface water between samples. Water quality parameters, including temperature, dissolved oxygen, conductivity, pH and redox were recorded from water collected in the bucket.

Samples were collected into laboratory-supplied bottle ware and were submitted to Jones in pre-chilled cool-boxes under a chain of custody documentation. Surface water samples scheduled for heavy metals analyses were also filtered in the field using 0.45 micron medium capacity disposable filters to remove suspended sediments prior to storage in bottles containing preservative. All the surface water samples were analysed for the following laboratory suites:

- Metals – arsenic, water soluble boron, cadmium, calcium, chromium (total), copper, lead, mercury, nickel, selenium and zinc
- Inorganic compounds – chloride, ammoniacal nitrogen, carbonate alkalinity, pH and dissolved solids;
- PAH (Polycyclic Aromatic Hydrocarbons) – suite of 17 individual PAH compounds;
- MTBE/BTEX – Methyl tert butyl ether, benzene, toluene, ethylbenzene and xylenes;

- TPH CWG (6th January and 2nd June 2015 only) – Total Petroleum Hydrocarbons Criteria Working Group; and,
- EPH (all rounds with the exception of 30th June 2014) – Total Extractable Petroleum Hydrocarbons (C_8-C_{40}).

Fieldwork Findings

Surface Water Quality Parameters

Surface water quality parameters are presented in Table 1 and summarised below:

- Redox potential of surface water ranges from 90.2 (S3) to 462.7 (S3).
- Electrical conductivity of surface water ranges from 920mS/cm (S3) to 1018mS/cm (S1).
- Surface water pH ranges from 5.65 (S1) to 7.95 (S3).
- Surface water temperature ranges from 4.9 º C to 15.8 ºC (both S3) which indicate normal, seasonally linked variations.
- Dissolved oxygen concentrations range from 9.46mg/L (S3) to 17.78mg/L (S1) indicating well-oxygenated waters, the concentration of which varies naturally with temperature.

Laboratory Results

The results were screened against Environmental Quality Standards (EQS) for rivers and freshwater lakes provided in the Water Framework Directive (WFD), England and Wales, 2010 in order to assess potential risks to Ella Brook. Where concentrations exceed the EQS, this indicates that the brook would not be classified as 'Good' under the WFD. The surface water results indicate that the concentration of calcium carbonate was generally not reported above the method reporting limit (MRL) and therefore the EQS used in this assessment is taken from the lowest CaCO3 range (0-50mg/l).

Where EQS values were not available, concentrations were compared against criteria provided in SEPA - Supporting Guidance (WAT-SG-53) Environmental Standards for Discharges to Surface Waters. v4.0. Apr 2013.

Laboratory results are presented against screening criteria in Tables 2 to 3 and laboratory certificates are presented in Appendix B.

Metals and Inorganics

In general, concentrations of metals and inorganics did not exceed the EQS. Concentrations of ammoniacal nitrogen exceeded the EQS of 300µg/l (Good) on one occasion (07/08/15) at all three sampling locations. This concentration would classify the quality of Ella Brook as moderate. However, given the location of the site in an agricultural area, the ammoniacal nitrogen is likely to be the result of the addition of fertilisers to the soil, potentially exacerbated by the weather at the time of sampling.

The pH varied between 5.65 and 7.95 throughout the sampling events. This is considered to be within the normal range for a surface water course.

PAHs

There were no reported concentrations of PAHs in excess of the respective screening criteria for any surface water samples recovered during the sampling events.

TPH CWG / MTBE / EPH
Concentrations of TPH fractions, MTBE and total EPH were reported below the method detection limit in all the samples analysed.

Conclusion

A total of seven (7No.) surface water monitoring rounds were undertaken between January 2015 and end of October 2015 during the well testing phase of the works. Recorded concentrations of the majority of analytes at the sample locations S 1 did not exceed the EQS. Where the concentration of ammoniacal nitrogen did exceed the EQS at all sample locations on one occasion, this is considered to be an isolated occurrence and is not likely to be caused by works currently being undertaken at the site.

Therefore, the well testing works are unlikely to have had an adverse effect on the surface water quality of Ella Beck.

Table 1
Water Quality Parameters in the Surface Water Samples

Sample Location	Temp (°C) 06/01/2015	Temp (°C) 11/02/2015	Temp (°C) 12/03/2015	Temp (°C) 02/06/2015	Temp (°C) 16/07/2015	Temp (°C) 07/08/2015	Temp (°C) 30/10/2015	Max	Min
Sample point 1	7.4	5	8.4	10.1	15.4	13.3	12.6	15.4	5
Sample point 2 (upstream)	7.4	5.1	8.4	9.8	15.5	13.3	12.7	15.5	5.1
Sample point 3 (downstream)	7.4	4.9	8.6	10.4	15.8	13	12.8	15.8	4.9

Sample Location	DO (mg/L) 06/01/2015	DO (mg/L) 11/02/2015	DO (mg/L) 12/03/2015	DO (mg/L) 02/06/2015	DO (mg/L) 16/07/2015	DO (mg/L) 07/08/2015	DO (mg/L) 30/10/2015	Max	Min
Sample point 1	13.67	11.54	17.78	13.65	10.75	11.53	13.29	17.78	10.75
Sample point 2 (upstream)	13.69	11.36	16.94	13.22	10.04	11.01	11.94	16.94	10.04
Sample point 3 (downstream)	14.85	11.58	17.22	14	11.54	9.46	11.11	17.22	9.46

Sample Location	SPC (µs/cm) 06/01/2015	SPC (µs/cm) 11/02/2015	SPC (µs/cm) 12/03/2015	SPC (µs/cm) 02/06/2015	SPC (µs/cm) 16/07/2015	SPC (µs/cm) 07/08/2015	SPC (µs/cm) 30/10/2015	Max	Min
Sample point 1	988	954	955	989	931	1018	744	1018	931
Sample point 2 (upstream)	984	953	954	974	933	1013	656	1013	933
Sample point 3 (downstream)	987	955	975	985	920	1015	858	1015	920

Sample Location	pH 06/01/2015	pH 11/02/2015	pH 12/03/2015	pH 02/06/2015	pH 16/07/2015	pH 07/08/2015	pH 30/10/2015	Max	Min
Sample point 1	6.39	6.77	6.56	7.01	5.65	5.77	6.17	7.01	5.65
Sample point 2 (upstream)	7.39	7.49	7.36	7.31	6.4	6.38	6.71	7.49	6.38
Sample point 3 (downstream)	7.79	7.95	7.76	7.52	6.95	6.86	7.15	7.95	6.86

Sample Location	ORP 06/01/2015	ORP 11/02/2015	ORP 12/03/2015	ORP 02/06/2015	ORP 16/07/2015	ORP 07/08/2015	ORP 30/10/2015	Max	Min
Sample point 1	377.1	284	462.1	388.2	126.1	121.4	167.1	462.1	121.4
Sample point 2 (upstream)	361.4	221.36	455.4	399	104.2	104.8	131.2	455.4	104.2
Sample point 3 (downstream)	337.4	272.9	462.7	407.1	92.5	90.2	107.3	462.7	90.2

DO = dissolved oxygen
SPC = specific conductivity
ORP = oxygen reducing potential
ORP values corrected with SHE (Standard Hydrogen Electrode)
values for the corresponding temperature

Analyte	Controlled Waters		Sample ID	S1							S2							S3						
	GAC	Source	LOD	06/01/2015	11/02/2015	12/03/2015	02/06/2015	16/07/2015	07/08/2015	30/10/2015	06/01/2015	11/02/2015	12/03/2015	02/06/2015	16/07/2015	07/08/2015	30/10/2015	06/01/2015	11/02/2015	12/03/2015	02/06/2015	16/07/2015	07/08/2015	30/10/2015
Arsenic	50	WFD EQS 2010 Fresh (Eng/Wal)	<2.5	5.5	-	-	-	-	-	-	2.7	-	-	-	-	-	-	6.4	-	-	-	-	-	-
Boron	2000	SEPA WAT-SG-53 Fresh EQS - AA - 2013	<12	65	59	61	32	91	85	67	63	58	59	31	88	85	63	60	58	60	33	86	84	71
Cadmium	0.08	WFD EQS 2010 Fresh (Eng/Wal)	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calcium			<0.2	156100	163600	157300	N/A	144000	148800	109700	157100	159500	159100	N/A	144800	149100	99800	157900	170300	165000	N/A	147200	148100	129600
Total Chromium	3.4	WFD EQS 2010 Fresh (Eng/Wal)	<1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	1	WFD EQS 2010 Fresh (Eng/Wal)	<7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead	7.2	WFD EQS 2010 Fresh (Eng/Wal)	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury	0.05	WFD EQS 2010 Fresh (Eng/Wal)	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel	20	WFD EQS 2010 Fresh (Eng/Wal)	<2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Selenium			<3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	8	WFD EQS 2010 Fresh (Eng/Wal)	<3	6	-	4	-	4	3	4	4	-	-	-	3	3	5	4	-	4	4	-	-	3
Chloride	250000	SEPA WAT-SG-53 Fresh EQS - AA - 2013	<300	50800	58100	58400	46800	72900	69700	50400	50600	58300	58300	46100	73400	70600	47200	50800	58500	58500	44000	72700	70200	60100
Ammoniacal Nitrogen as N	300	WFD EQS 2010 Fresh (Eng/Wal)	<30	50	50	40	30	70	320	40	50	50	50	30	80	320	50	50	60	50	-	50	470	50
Carbonate Alkalinity as CaCO3			<1000	-	-	-	212000	12000	32000	-	-	-	-	214000	-	-	-	-	-	-	198000	-	-	-
pH			<0.01	8.15	8.13	7.41	7.93	8.47	8.33	8.03	8.08	8.09	7.34	7.97	8.18	8.13	7.87	8.10	8.12	7.41	7.97	8.23	8.04	8.04
Total Dissolved Solids			<10000	587000	611000	522000	443000	616000	647000	430000	594000	574000	590000	462000	678000	611000	488000	596000	606000	572000	461000	692000	627000	616000

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LOD = Limit of detection
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xx Indicates a GAC exceedance

Table 1
Water Quality Parameters in the Surface Water Samples

Analyte	Controlled Waters		Sample ID	S1							S2							S3						
	GAC	Source	LOD	06/01/2015	11/02/2015	12/03/2015	02/06/2015	16/07/2015	07/08/2015	30/10/2015	06/01/2015	11/02/2015	12/03/2015	02/06/2015	16/07/2015	07/08/2015	30/10/2015	06/01/2015	11/02/2015	12/03/2015	02/06/2015	16/07/2015	07/08/2015	30/10/2015
Acenaphthene			<0.013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene			<0.013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	0.1	WFD EQS 2010 Fresh (Eng/Wal)	<0.013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene			<0.015	-	-	-	-	0.020	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-
Benzo(a)pyrene	0.05	WFD EQS 2010 Fresh (Eng/Wal)	<0.016	-	0.02	-	-	0.030	-	-	0.02	-	-	-	0.020	-	-	0.03	0.02	-	-	-	-	-
Benzo(b)fluoranthene			<0.01	-	-	-	-	0.04	-	-	-	-	0.01	-	0.02	-	-	0.03	-	0.01	-	-	-	-
Benzo(bk)fluoranthene			<0.018	-	-	-	-	0.050	-	-	-	-	0.02	-	0.030	-	-	0.04	-	0.02	-	-	-	-
Benzo(ghi)perylene			<0.011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene			<0.01	-	-	-	-	0.01	-	-	-	-	-	-	-	-	-	0.01	-	-	-	-	-	-
Chrysene			<0.011	-	-	-	-	0.030	-	-	-	-	-	-	0.020	-	-	0.02	0.020	-	-	-	-	-
Dibenzo(ah)anthracene			<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	0.1	WFD EQS 2010 Fresh (Eng/Wal)	<0.012	0.02	0.030	0.020	-	0.050	0.02	-	0.02	0.020	0.020	-	0.040	-	-	0.03	0.050	0.020	0.030	-	-	0.02
Fluorene			<0.014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(123cd)pyrene			<0.011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	2.4	WFD EQS 2010 Fresh (Eng/Wal)	<0.014	0.07	-	-	-	0.050	0.03	-	0.17	-	0.030	-	0.050	-	-	0.28	-	-	-	0.180	-	-
PAH 16 Total			<0.195	-	-	-	-	0.290	-	-	0.26	-	-	-	0.210	-	-	0.49	-	-	-	-	-	-
Phenanthrene			<0.011	0.02	0.020	0.020	-	0.020	-	-	0.03	-	0.020	-	0.020	-	-	0.03	0.030	0.020	-	-	-	-
Pyrene			<0.013	0.02	0.030	0.020	-	0.040	0.02	-	0.02	0.020	0.020	-	0.030	-	-	0.04	0.040	0.020	-	-	-	0.02

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	GAC	Source	LOD	06/01/2015	11/02/2015	12/03/2015	02/06/2015	16/07/2015	07/08/2015	30/10/2015	06/01/2015	11/02/2015	12/03/2015	02/06/2015	16/07/2015	07/08/2015	30/10/2015	06/01/2015	11/02/2015	12/03/2015	02/06/2015	16/07/2015	07/08/2015	30/10/2015
Methyl Tertiary Butyl Ether	2600	PNEC	<0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	10	WFD EQS 2010 Fresh (Eng/Wal)	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	50	WFD EQS 2010 Fresh (Eng/Wal)	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	20	SEPA WAT-SG-53 Fresh EQS - AA - 2013	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
p/m-Xylene			<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
o-Xylene	30	WFD EQS 2010 Fresh (Eng/Wal)	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aliphatics																								
>C5-C6			<5	-	EPH<10	EPH<10	-	EPH<10	EPH<10	EPH<10	-	EPH<10	EPH<10	-	EPH<10	EPH<10	EPH<10	-	EPH<10	EPH<10	-	EPH<10	EPH<10	EPH<10
>C6-C8			<5	-			-				-			-				-			-			
>C8-C10			<5	-			-				-			-				-			-			
>C10-C12			<5	-			-				-			-				-			-			
>C12-C16			<10	-			-				-			-				-			-			
>C16-C21			<10	-			-				-			-				-			-			
>C21-C35			<10	-			-				-			-				-			-			
Total aliphatics C5-35			<10	-			-				-			-				-			-			
Aromatics																								
>C5-EC7	10	WFD EQS 2010 Fresh (Eng/Wal)	<5	-			-				-			-				-			-			
>EC7-EC8	50	WFD EQS 2010 Fresh (Eng/Wal)	<5	-			-				-			-				-			-			
>EC8-EC10			<5	-			-				-			-				-			-			
>EC10-EC12			<5	-			-				-			-				-			-			
>EC12-EC16			<10	-			-				-			-				-			-			
>EC16-EC21			<10	-			-				-			-				-			-			
>EC21-EC35			<10	-			-				-			-				-			-			
Total aromatics C5-35			<10	-			-				-			-				-			-			
Total aliphatics and aromatics(C5-35)			<10	-			-				-			-				-			-			

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