



**Buckie Harbour
BPEO – Sediment Risk Assessment**

June 2020

Buckie Harbour

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1 INTRODUCTION

1.1 Scope of Report

Following the submission of the Best Practicable Environmental Options (BPEO) report to Marine Scotland in support of their dredge license application for two harbour sites in Moray, Marine Scotland requested additional information and assessment in support of the application. This report details the further assessment and additional information requested for both Buckie Harbour.

This report is to be read in conjunction with the BPEO report undertaken by Moray Council.

1.2 Report Usage

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1.3 Chemical Data

5 grab samples were collected from Buckie Harbour and submitted for analysis at Socotec Laboratories. The data can be reviewed in the Pre-Dredge Sample forms submitted as part of the licence application. The results are summarised below with summary tables presented in Appendix A.

Please note that both sites have been screened as a single data set.

1.3.1 Metals

The majority of metals were below their respective revised Action Level 1 (RAL 1) with the following notable exceptions:

- Cadmium - 1 of 5 samples recorded cadmium levels above RAL1. The maximum concentration recorded of 1.14 mg/kg was in sample B1.

- Chromium - 1 of 5 samples recorded chromium levels above RAL1. The maximum concentration recorded of 158 mg/kg was in sample B1.
- Copper –4 of 5 samples recorded copper levels above RAL1. The maximum concentration recorded was 151 mg/kg recorded was in sample B5.
- Zinc –2 of 5 samples recorded copper levels above RAL1. The maximum concentration recorded was 151 mg/kg recorded was in sample B5.

1.3.2 Tributyl Tin (TBT)

Buckie Harbour

No samples recorded an exceedance of TBT with the maximum concentration recorded as 0.01mg/kg in sample B3.

1.3.3 Polyaromatic Hydrocarbons (PAHs)

Buckie Harbour

4 of 5 samples recorded one or more PAH species in excess of the RAL1. The maximum concentration recorded was 0.423 mg/kg for pyrene recorded in sample B5.

1.3.4 Polychlorinated Biphenyls

Buckie Harbour

All samples recorded individual PCB congeners and ICES 7 PCBs below the RAL with the maximum concentration recorded in sample B4 recording 0.006 mg/kg for ICES 7.

1.3.5 Total Hydrocarbons (THC)

Buckie Harbour

5 of 5 samples recorded hydrocarbons above Rev AL1. The maximum concentration was 1,760 mg/kg in sample B3.

1.4 Summary

RAL1 were exceeded for several metals, PAHs in several samples. RAL 2 levels were not exceeded in any of the samples tested. These exceedances will be considered further in Section 2 - Further Assessment.

2 FURTHER ASSESSMENT

As detailed in Section 1, on the basis of the exceedances recorded for Action Level 1 further assessment to determine the suitability of the material for sea disposal is deemed a requirement as requested by Marine Scotland. All summary tables are presented in Appendix A.

The approach for this further assessment is outlined as follows:

- Provide an overview of the proposed dredge works and the identified disposal site including existing chemical monitoring data for the site where available; and
- Compare existing chemical data with other recognised sediment assessment criteria including those listed below. Summary tables are provided in Appendix A.

Background Assessment Concentration (BAC) - BACs were developed by the OSPAR Commission (OSPAR) for testing whether concentrations are near background levels. Mean concentrations significantly below the BAC are said to be near background. However, it should be noted that river catchments have their own unique geochemical fingerprints and are also governed by the geology within the catchment, so in theory one set of background level values is not applicable to all situations;

Effects Range Low (ERL) - ERLs were developed by the United States Environmental Protection Agency (USEPA) for assessing the ecological significance of sediment concentrations. Concentrations below the ERL rarely cause adverse effects in marine organisms. Concentrations above the ERL will often cause adverse effects in some marine organisms;

Probable Effects Level (PEL) – PELs (Marine) have been adopted from the Canadian Environmental Quality Guidelines (http://www.ccme.ca/en/resources/canadian_environmental_quality_guidelines/) If a concentration is recorded above the PEL this is the probable effect range within which adverse effects frequently occur. The Threshold Effect levels (TELs) have been included in the summary table in Appendix B, but have not been used as part of the further assessment as they typically fall below the RAL1

Review of potential risks to the list of receptors identified in “Water Framework Directive Assessment: estuarine and coastal waters (<https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters>) to draw conclusions from available information and provide recommendation for proposed disposal routes.

2.1 Background Data – Dredge and Disposal Site

Moray Council are looking at disposing Buckie Harbour sediment arisings at Buckie CR040 (57.70330023400 , -2.95330000049).

Results of samples collected by Marine Scotland are compared against the ERL and PEL in Table C in Appendix A. Only benzo(a)pyrene was reviewed for the PAHs.

A limited data set for the Buckie disposal site (one sample for metals and PAHs) was provided by Marine Scotland for review. All concentrations were recorded below the ERL and PEL for corresponding contaminants of concern where available for review with the exception of PAHs which recorded a marginal exceedance of the PEL for benzo(a)pyrene.

Marine Scotland noted that in Scotland the preference for disposal site selection is those which are dispersive, and as such it is assumed that both disposal ground sites are dispersive.

2.2 Analytical Data Review

Existing analytical data for the proposed dredge sites is provided in Summary Tables A1 and A2 in Appendix A. This data has been summarised against RAL 1 & 2, the BAC, ERL and PEL. As detailed previously, the data has not been reviewed against the Canadian TEL as these numbers are typically lower than RAL1. A summary of the findings is detailed below and summarised in Appendix A.

2.2.1 Action Level 1

The majority of contaminants were below their respective RAL 1 with the following exceptions:

- Cadmium - 1 of 5 samples recorded cadmium levels above RAL1.
- Chromium - 1 of 5 samples recorded chromium levels above RAL1.
- Copper –4 of 5 samples recorded copper levels above RAL1.
- Zinc –2 of 5 samples recorded copper levels above RAL1. 4 of
- PAHs – 4 of 5 samples recorded one or more PAH species above RAL
- THC – 4 of 5 samples recorded THC content above RAL1.

2.2.2 ERL & PEL Review

The ERL, where one is available, was exceeded for the following contaminants of concern:

Buckie Harbour

- Copper – 4 of 5 samples recorded levels above the ERL
- Mercury – 1 of 5 samples recorded levels above the ERL
- Zinc – 1 of 5 samples recorded levels above the ERL.
- PAHs – 2 of 5 samples recorded levels above the ERL for benzo(ghi)perylene.

The PEL was not exceeded for any of the contaminants of concern in Buckie Harbour.

2.3 Averages

Review of the averaged data as detailed in Appendix A Tables B1 and B2 for all the data has been undertaken i.e. considering the material as a single volume for disposal. The concentrations of the various contaminants of concern are quite variable, the review of average data against the available adopted assessment criteria are as follows:

Buckie Harbour

- Averaged concentrations exceeded RAL1 for cadmium, chromium and copper plus several PAH species.
- Averaged concentrations exceeded the ERL for copper.
- No exceedances of the PEL were recorded for any contaminant of concern where one is available for review.

2.3.1 Disposal Ground Data Review

Buckie Disposal Site

The single sample indicates elevated PAH in exceedance of the PEL for benzo(a)pyrene. All other contaminants of concern were recorded below the PEL where one is available for review.

2.4 Chemical Assessment Conclusions

A number of samples record exceedances of RAL1 including metals, PAHs and THC. No samples recorded contaminant levels in exceedance of RAL 2.

While a number of ERL exceedances have been recorded no exceedances of PEL were recorded for Buckie Harbour.

Very limited background data for the disposal site is available for review and consideration, although the data provided would suggest that most contaminants are present at low levels with the exception of PAHs which have been noted as being above the PEL for at least one PAH species benzo(a)pyrene.

Further consideration of the potential risks associated with the proposed disposal is considered in the following sections.

3 WATER FRAMEWORK DIRECTIVE ASSESSMENT

As outlined in the Water Framework Directive Assessment: estuarine and coastal waters, there are several key receptors which can be impacted upon including the following:

- Hydromorphology
- Biology – habitats
- Biology – fish
- Water quality
- Protected areas

Each of these points are considered in Table 2.1 below:

Table 3.1: Receptor Risk Assessment

Key Receptor	Brief Summary of Potential Effects on Receptor	Further Consideration Required?	Comment
Hydromorphology (Source Area and Disposal Site)	Morphological conditions, for example depth variation, the seabed and intertidal zone structure tidal patterns, for example dominant currents, freshwater flow and wave exposure	No	The areas proposed to be dredged are already subject to dredging and the disposal site(s) in the Moray Firth is already licensed and designated for this purpose. The coastal morphology is classified as High potential/status according to its WFD classification.
Biology - habitats	Included to assess potential impacts to sensitive/high value habitats.	No	Not considered to be a significant risk considering the dredge areas are part of the existing harbour area(s) and require dredging to maintain its use.
Biology – fish	Consideration of fish both within the estuary and also potential effects on migratory fish in transit through the estuary.	No	The disposal site is a sacrificial disposal site which has been used for the deposition of sediments. Key contaminants of concern within the dredge material are recorded below the PEL in all instances where data is available, so risks to marine life area considered to be low.

Water Quality	Consideration must be given to water quality when contaminants are present in exceedance of CEFAS RAL1.	Yes	<p>Contaminants noted to exceed CEFAS RAL1 within sediment samples for some metal and PAH species.</p> <p>The WFD water quality status for “Whitenesshead to Burghead” and “Burghead to Lossiemouth” is classified as “good” with medium confidence (2017).</p>
Protected Areas	<p>If your activity is within 2km of any WFD protected area, include each identified area in your impact assessment.</p> <ul style="list-style-type: none"> • special areas of conservation (SAC) • special protection areas (SPA) • shellfish waters • bathing waters • nutrient sensitive areas 	Yes	<p>Buckie Harbour, and the associated disposal ground Buckie are not located within the Moray Firth SAC or within 2km of a SAC, SPA.</p> <p>Buckie Harbour is are over 8km away from the closest designated bathing water site at Cullen bay.</p> <p>The dredge and disposal sites are not designated as shellfish water or within 2km of any designated shellfish water protected areas.</p> <p>On this basis there is not considered to be potential for significant impact to the designated sites from the dredge activity.</p>

Source: Taken from <https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters>

3.1 Potential Risk to Water Quality and Marine Life

The potential risks to water quality at both the dredge sites and disposal sites are further considered as all other receptors have been screened out of the assessment.

The coastal classification of this area of water “Whitenesshead to Burghead” and “Burghead to Lossiemouth” is classified as “good” with medium confidence (2017).reported as “Good” in 2016 (SEPA) as detailed on Marine Scotland’s NMPI Viewer (<https://marinescotland.atkinsgeospatial.com/nmpi/>).

Although there are contaminants of concern above the RAL1 for various metals and PAHs it is considered that these levels will not contribute to an overall degradation of water quality as the potential for dilution in the Moray Firth is very considerable.

When the sediment results are reviewed on average to assess the sediment mass as a single unit for disposal from Buckie Harbour then all results are below the ERL for most contaminants of concern

excluding a number of PAH species. No average concentrations were recorded in excess of the PEL where one is available for the Buckie Harbour Sediments. On this basis the risks from the sediment as a dredge mass are considered to be low, with the associated dilution potential providing further mitigation to potential risks.

The key contaminants for impacting water quality are considered to be metals as these have the potential to dissolve/desorb from sorption sites, whereas the organic contaminants (e.g. PAHs and PCBs) have a greater affinity for the organic materials which they are bound to, and are more likely to remain strongly bound to the sediment, or if they become dissolved, quickly adsorbed onto organic matter within the water column or sediments. Saline water environments tend to help facilitate flocculation of suspended material which ultimately settles on the seabed and helps control dissolved contaminant concentrations further.

The key risk is considered to be an increase in turbidity/suspended solids during the disposal activity, although this is likely to cause localised degradation in water quality, it is considered that this will be a short-term event and has been factored into the selection and location of the agreed disposal ground.

The sediment material comprises a mix of sand and silt at Buckie Harbour with 61% sand, 38% silt and 3% clay on average.

Clay and silt have the potential to suspend for longer within the water column due to their smaller size and density than sand. Suspension and dispersion can be minimised depending on dredging technique to maximise the benefits of the cohesive nature of the silts and clays, so that it could fall as large clumps rather than a slurry through the water column. All associated effects, where they exist, are considered to be both localised and temporary.

On this basis, the associated risk with degradation of water quality directly associated with the proposed disposal is considered to be Low i.e. unlikely to cause a significant adverse effect on the overall water quality or have an adverse effect upon marine life.

The water classification for the local area is “Good”.

3.2 Conclusions and Recommendations

Review of available information has highlighted that although several chemical contaminants exceed RAL1, assessment of key receptors concluded that there is a low risk to these receptors which includes both marine life and water quality.

The chemical levels in the sediments are not considered likely to have a significant adverse impact on the sediment quality already located within the disposal grounds and it is recognised that this part of the sea floor is licensed for the disposal of dredge material within agreed parameters.

Overall, based on the multiple lines of evidence approach adopted to further assess the exceedances identified in the sediment assessment, recommendation for sea disposal is considered to be the preferred option.

The Best Practicable Environmental Option for disposal of the dredging for both Buckie Harbour has therefore been assessed as sea disposal. This option is considered to have no significant long-term impact on the marine environment; the disposal site is readily accessible from all the dredging areas and is the most cost-effective option as detailed in the accompanying BPEO report provided by Moray Council.

REFERENCES

- Marine Scotland (2017). *Pre-Dredge Sampling Guidance Version 2*. Scottish Government.
Marine Scotland (2015). *Guidance for Marine Licence Applicants Version 2*. Scottish Government.

APPENDICES

A SUMMARY TABLES

Summary Table A1 Buckie Harbour

Sampling Results Assessment Summary

Source	AL1 (mg/kg)	AL2 (mg/kg)	BAC (mg/kg)	ERL (mg/kg)	PEL (mg/kg)	Buckie Harbour					AVERAGE	No. Exceed RAL 1	No. Exceed RAL 2	No.Exceed BAC?	No. Exceed ERL	No. Exceed PEL?
						B1	B2	B3	B4	B5						
			CSEMP	CSEMP	Canada											
Arsenic	20	70	25	-	41.6	6.5	5	6.5	7.3	8	6.66	0	0	0	-	0
Cadmium	0.4	4	0.31	1.2	4.2	1.14	0.14	0.25	0.31	0.32	0.43	1	0	2	0	0
Chromium	50	370	81	81	160	158	35.1	46.4	43.8	31.8	63.02	1	0	1	1	0
Copper	30	300	27	34	108	80	16.7	34.6	54.3	87.8	54.68	4	0	4	4	0
Mercury	0.25	1.5	0.07	0.15	0.7	0.04	0.03	0.06	0.1	0.16	0.08	0	0	2	1	0
Nickel	30	150	36	-	-	11.9	6.9	9.6	9.7	9.8	9.58	0	0	0	N/A	N/A
Lead	50	400	38	47	112	15.8	11.3	20.4	27	29	20.70	0	0	0	0	0
Zinc	130	600	122	150	271	102.0	49.4	124.0	137.0	151.0	112.68	2	0	3	1	0
Napthalene	0.1	-	0.08	0.16	0.391	0.0151	0.0227	0.0218	0.0221	0.0276	0.02	0	-	0	0	0
Acenaphthylene	0.1	-	-	-	0.128	0.011	0.0212	0.00751	0.0163	0.0286	0.02	0	-	N/A	N/A	0
Acenaphthene	0.1	-	-	-	0.0889	0.0101	0.0163	0.0051	0.0109	0.018	0.01	0	-	N/A	N/A	0
Fluorene	0.1	-	-	-	0.144	0.0166	0.0425	0.0108	0.0174	0.0274	0.02	0	-	N/A	N/A	0
Phenanthrene	0.1	-	0.032	0.24	0.544	0.0956	0.218	0.0459	0.108	0.168	0.13	3	-	5	0	0
Anthracene	0.1	-	0.05	0.085	0.245	0.0213	0.0688	0.0195	0.0452	0.0632	0.04	0	-	2	0	0
Fluoranthene	0.1	-	0.039	0.6	1.494	0.0919	0.243	0.105	0.238	0.34	0.20	4	-	5	0	0
Pyrene	0.1	-	0.024	0.665	1.398	0.0874	0.272	0.156	0.304	0.423	0.25	4	-	5	0	0
Benzo(a)anthracene	0.1	-	0.016	0.261	0.693	0.0385	0.113	0.056	0.118	0.175	0.10	3	-	5	0	0
Chrysene	0.1	-	0.02	0.384	0.846	0.0403	0.111	0.0604	0.127	0.188	0.11	3	-	5	0	0
Benzo(b)fluoranthene	0.1	-	-	-	-	0.0341	0.0935	0.0559	0.141	0.206	0.11	2	-	N/A	N/A	N/A
Benzo(k)fluoranthene	0.1	-	-	-	-	0.0171	0.0421	0.0255	0.063	0.104	0.05	1	-	N/A	N/A	N/A
Benzo(a)pyrene	0.1	-	0.03	0.384	0.763	0.0391	0.11	0.0614	0.139	0.21	0.11	3	-	5	0	0
Indeno(1,2,3cd)pyrene	0.1	-	0.103	0.24	-	0.0321	0.067	0.0459	0.102	0.146	0.08	2	-	1	0	N/A
Benzo(ghi)perylene	0.1	-	0.08	0.085	-	0.0238	0.0666	0.0446	0.099	0.152	0.08	1	-	2	2	N/A
Dibenzo(a,h)anthracene	0.01	-	-	-	0.135	0.00544	0.0139	0.00977	0.0217	0.027	0.02	0	-	N/A	N/A	0
TPH	100	-	-	-	-	205	294	1760	677	852	757.6	5	-	N/A	N/A	N/A
PCBs	0.02	0.18	-	-	0.189	0.001	0.002	0.002	0.006	0.005	0.0032	0	0	N/A	N/A	0
TBT	0.1	0.5	-	-	-	0.005	0.005	0.010	0.05	0.07	0.0278	0	0	N/A	N/A	N/A

Note 1: All concentrations are recorded in mg/kg

Note 2: Underlined Values are <LOD

PEL Data Source: <http://ceqg-rcqe.ccm.ca/en/index.html#void>

Summary Table B1 - Buckie Harbour Samples

Buckie Harbour Sample Average Concentrations

All units in mg/kg

Source	AL1	AL2	BAC	<ERL	ISQG/TEL	PEL	Buckie					Dredge Average	Exceed AI1?	Exceed AI2?	Exceed BAC?	Exceed ERL ?	Exceed PEL?
			CSEMP	CSEMP	Canada		B1	B2	B3	B4	B5						
Arsenic	20	70	25	-	7.2	41.6	6.5	5	6.5	7.3	8	6.7	No	No	No	N/A	No
Cadmium	0.4	4	0.31	1.2	0.7	4.2	1.14	0.14	0.25	0.31	0.32	0.4	Yes	No	Yes	No	No
Chromium	50	370	81	81	52.3	160	158	35.1	46.4	43.8	31.8	63.0	Yes	No	No	No	No
Copper	30	300	27	34	18.7	108	80	16.7	34.6	54.3	87.8	54.7	Yes	No	Yes	Yes	No
Mercury	0.25	1.5	0.07	0.15	0.13	0.7	0.04	0.03	0.06	0.1	0.16	0.1	No	No	Yes	No	No
Nickel	30	150	36	-	-	-	11.9	6.9	9.6	9.7	9.8	9.6	No	No	No	N/A	N/A
Lead	50	400	38	47	30.2	112	15.8	11.3	20.4	27	29	20.7	No	No	No	No	No
Zinc	130	600	122	150	124	271	102.0	49.4	124.0	137.0	151.0	112.7	No	No	No	No	No
Napthalene	0.1	-	0.08	0.16	-	0.319	0.0151	0.0227	0.0218	0.0221	0.0276	0.022	No	N/A	No	No	No
Acenaphthylene	0.1	-	-	-	0.00587	0.128	0.011	0.0212	0.00751	0.0163	0.0286	0.017	No	N/A	N/A	N/A	No
Acenaphthene	0.1	-	-	-	0.00671	0.0889	0.0101	0.0163	0.0051	0.0109	0.018	0.012	No	N/A	N/A	N/A	No
Fluorene	0.1	-	-	-	0.0212	0.144	0.0166	0.0425	0.0108	0.0174	0.0274	0.023	No	N/A	N/A	N/A	No
Phenanthrene	0.1	-	0.032	0.24	0.0867	0.544	0.0956	0.218	0.0459	0.108	0.168	0.127	Yes	N/A	Yes	No	No
Anthracene	0.1	-	0.05	0.085	0.0469	0.245	0.0213	0.0688	0.0195	0.0452	0.0632	0.044	No	N/A	No	No	No
Fluoranthene	0.1	-	0.039	0.6	0.113	1.494	0.0919	0.243	0.105	0.238	0.34	0.204	Yes	N/A	Yes	No	No
Pyrene	0.1	-	0.024	0.665	0.153	1.398	0.0874	0.272	0.156	0.304	0.423	0.248	Yes	N/A	Yes	No	No
Benzo(a)anthracene	0.1	-	0.016	0.261	0.0748	0.693	0.0385	0.113	0.056	0.118	0.175	0.100	Yes	N/A	Yes	No	No
Chrysene	0.1	-	0.02	0.384	0.108	0.846	0.0403	0.111	0.0604	0.127	0.188	0.105	Yes	N/A	Yes	No	No
Benzo(b)fluoranthene	0.1	-	-	-	-	-	0.0341	0.0935	0.0559	0.141	0.206	0.106	Yes	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	0.1	-	-	-	-	-	0.0171	0.0421	0.0255	0.063	0.104	0.050	No	N/A	N/A	N/A	N/A
Benzo(a)pyrene	0.1	-	0.03	0.384	0.0888	0.763	0.0391	0.11	0.0614	0.139	0.21	0.112	Yes	N/A	Yes	No	No
Indeno(1,2,3cd)pyrene	0.1	-	0.103	0.24	-	-	0.0321	0.067	0.0459	0.102	0.146	0.079	No	N/A	No	No	N/A
Benzo(ghi)perylene	0.1	-	0.08	0.085	-	-	0.0238	0.0666	0.0446	0.099	0.152	0.077	No	N/A	No	No	N/A
Dibenzo(a,h)anthracene	0.01	-	-	-	0.00622	0.135	0.00544	0.0139	0.00977	0.0217	0.027	0.016	Yes	N/A	N/A	N/A	No
PCBs	0.02	0.18	-	-	0.0215	0.189	0.0009	0.00175	0.00213	0.0063	0.00509	0.002	No	No	N/A	N/A	No
TBT	0.1	0.5	-	-	-	-	0.005	0.005	0.010	0.053	0.066	0.0015	No	No	N/A	N/A	N/A

Summary Table C

Buckie CR040 and Burghead CR030 - Pre-Dredge Contaminant Summary - Source: Marine Scotland

Sample Name	Site Name	Year	Oslo Code	Date	Latitude	Longitude	As mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg	ICES7 ug/kg	TBT+ mg/kg	B(a)P (mg/kg)	
7BKE0	Buckie	2000	CR040	18-May-00	57.7080	-2.9531	12.30	<0.186	4.54	1.59	<0.048	5.86	5.89	13.00	-	-	0.8	
1BGD91	Burghead	1991	CR030	19-Jan-91	-	-	2.90	<0.2	6.20	5.73	0.013	7.50	11.03	27.59	-	-	-	
2BGD91	Burghead	1991	CR030	19-Jan-91	-	-	2.19	<0.2	4.81	4.71	<0.004	4.75	6.95	20.63	-	-	-	
3BGD91	Burghead	1991	CR030	19-Jan-91	-	-	2.28	<0.2	3.65	2.86	<0.004	2.50	3.68	10.86	-	-	-	
4BGD91	Burghead	1991	CR030	19-Jan-91	-	-	2.11	<0.2	3.67	2.84	<0.004	1.57	2.71	9.56	-	-	-	
5BGD91	Burghead	1991	CR030	19-Jan-91	-	-	2.01	<0.2	3.33	1.88	0.004	2.06	2.48	9.63	-	-	-	
6BGD91	Burghead	1991	CR030	19-Jan-91	-	-	1.97	<0.2	2.54	1.92	0.046	3.11	3.41	9.44	-	-	-	
7BGD91	Burghead	1991	CR030	19-Jan-91	-	-	1.33	<0.2	2.18	1.92	0.019	2.64	2.19	7.19	-	<4	-	
8BGD91	Burghead	1991	CR030	19-Jan-91	-	-	2.34	<0.2	6.20	5.73	0.034	5.16	5.64	24.43	-	<4	-	
9BGD91	Burghead	1991	CR030	19-Jan-91	-	-	2.41	<0.2	6.80	2.92	0.007	4.14	3.36	18.63	-	-	-	
10BGD91	Burghead	1991	CR030	19-Jan-91	-	-	2.31	<0.2	4.41	2.84	0.004	2.05	2.71	10.02	-	-	-	
11BGD91	Burghead	1991	CR030	19-Jan-91	-	-	2.04	<0.2	2.96	2.83	0.010	2.38	2.98	9.17	-	<4	-	
12BGD91	Burghead	1991	CR030	19-Jan-91	-	-	2.04	<0.2	2.96	3.77	0.004	2.85	2.23	8.25	-	<4	-	
13BGD91	Burghead	1991	CR030	19-Jan-91	-	-	1.64	<0.2	1.84	2.84	0.013	2.83	1.48	8.20	-	-	-	
9BGD00	Burghead	2000	CR030	17-May-00	57.7168	-3.5175	2.22	<0.186	2.90	0.89	<0.048	2.06	1.72	7.84	-	-	-	
8BGD00	Burghead	2000	CR030	17-May-00	57.7206	-3.5166	1.77	<0.186	2.26	0.70	<0.048	1.62	1.49	7.39	-	-	-	
7BGD00	Burghead	2000	CR030	17-May-00	57.7293	-3.5174	2.62	<0.186	6.24	1.49	<0.048	3.36	3.02	13.10	-	-	-	
6BGD00	Burghead	2000	CR030	17-May-00	57.7334	-3.5169	3.30	<0.186	9.25	2.30	<0.048	5.81	4.27	20.40	-	-	-	
5BGD00	Burghead	2000	CR030	17-May-00	57.7251	-3.4979	2.39	<0.186	3.37	0.96	<0.048	2.14	2.04	8.12	-	-	0.5	
5ABGD00	Burghead	2000	CR030	17-May-00	57.7251	-3.4991	3.45	<0.186	6.92	3.15	<0.048	4.29	4.65	15.90	-	-	0.7	
4BGD00	Burghead	2000	CR030	17-May-00	57.7252	-3.5067	2.68	<0.186	3.81	1.03	<0.048	2.62	2.43	9.26	-	-	-	
3BGD00	Burghead	2000	CR030	17-May-00	57.7250	-3.5165	2.73	<0.186	4.26	1.01	<0.048	2.21	2.65	8.86	-	-	-	
2BGD00	Burghead	2000	CR030	17-May-00	57.7250	-3.5253	2.55	<0.186	4.46	0.94	<0.048	2.18	2.53	8.06	-	-	1.3	
1BGD00	Burghead	2000	CR030	17-May-00	57.7257	-3.5321	2.76	<0.186	6.43	1.07	<0.048	2.82	2.66	13.50	-	-	2.1	
8/BGD/2006	Burghead	2006	CR030	18-Apr-06	57.7208	-3.5168	2.10		2.77	0.79		1.61	2.58	18.81				
7/BGD/2006	Burghead	2006	CR030	18-Apr-06	57.7293	-3.5164	2.64		6.20	1.29		2.85	3.40	10.83				
3/BGD/2006	Burghead	2006	CR030	18-Apr-06	57.7249	-3.5169	2.89	BDL	4.05	0.94	BDL	2.15	3.29	8.15				
2/BGD/2006	Burghead	2006	CR030	18-Apr-06	57.7251	-3.5248	2.42	BDL	4.46	0.90	BDL	2.13	3.09	7.71				
09/BGD/12	Burghead	0712A	CR030	11-May-12	57.7265	-3.5135	3.78	0.017	6.09	2.06	0.059	3.29	4.99	12.20		0.0	1.3	
04/BGD/12	Burghead	0712A	CR030	11-May-12	-	-	-	-	-	-	-	-	-	-	ND	0.0	1.2	
01/BGD/12	Burghead	0712A	CR030	11-May-12	-	-	-	-	-	-	-	-	-	-	TR	0.0	0.5	
06/BGD/12	Burghead	0712A	CR030	11-May-12	-	-	-	-	-	-	-	-	-	-	0.04	0.0	0.7	
ERL	Burghead	-	-	-	-	-	-	1.2	81	34	0.15	-	47	150	-	-	0.384	
PEL		-	-	-	-	-	41.6	4.2	160	108	0.7	-	112	271	189	-	0.763	
Min								1.33	0.02	1.84	0.70	0.00	1.57	1.48	7.19	0.04	0.00	0.50
Average								2.76	0.02	4.47	2.20	0.02	3.12	3.50	12.30	0.04	0.00	1.00
Max								12.30	0.02	9.25	5.73	0.06	7.50	11.03	27.59	0.04	0.00	2.10