Celtic enGlobe

The Royal Mint

**THE ROYAL MINT**

**ELECTROKINETIC FIELD TRIAL REPORT**

**TRIAL EXTENSION OCTOBER 2019 – MARCH 2020**

**R1722/20/5019**

**SEPTEMBER 2020**

| | |
|---|---|
| **Client:** | **The Royal Mint** |
| **Report Number:** | **R1722/19/4953** |
| **Report Title:** | **Electrokinetic Field Trial Report – Trial Extension October 2019 to March 2020** |
| **Report Status:** | **Draft** |
| **Author(s):** | **Kirsty Sweeny** |
| **(Signature & Date)** | 10.09.20 |
| **Project Manager:** | **Kirsty Sweeny** |
| **(Signature & Date)** | 10.09.20 |
| **QA Approved:** | **Martin Holmes** |
| **(Signature & Date)** | 17/9/20 |

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## 1.0 INTRODUCTION

Celtic EnGlobe (Celtic) was commissioned by The Royal Mint to carry out a field trial to assess the potential full-scale implementation of electrokinetic remediation. The aim of the trial was to remove dissolved-phase heavy metals, primarily nickel, from contaminated groundwater within the Nickel Plating area (NP1) located at the eastern site boundary of The Royal Mint. The Royal Mint commissioned a further extension of the field trial until September 2019, following the continued positive results as outlined in the progress report submitted in December 2018. The Royal Mint commissioned a further extension of the field trial from October 2019 until March 2020 following continued positive results and support from Natural Resources Wales (NRW).

This report follows on from the addendum report issued in January 2020 (R1722/19/4953 Addendum January 2020) which completed the data reporting for the previous trial. This report includes data and discussion of the analysis results and system performance from October 2019 to March 2020. The mild steel rods used for the last phase of the previous trial were replaced with solid stainless steel rods during this trial following expression of preference for these in National Resources Wales Compliance Assessment Report (Report ID CAR_NRW0035526 dated 08/08/2019).

### 1.1 Site Location

The manufacturing facility is located approximately 2 km north-west of Llantrisant, Mid Glamorgan, South Wales, CF72 8YT, at National Grid Reference 304000, 184900.

The site is located in Llantrisant Business Park, a mixed commercial and industrial area. The site location and boundaries are shown on Drawing D1722/5019/A1, Appendix A.

### 1.2 Electrokinetic Remediation Overview

Electrokinetic processes involve passing a low intensity electric current between a cathode and an anode, imbedded in the contaminated medium. Ions and small charged particles, in addition to water, are transported between the electrodes. Anions move towards the positive electrode (Anode) and cations travel towards the negative electrode (Cathode). An electric gradient initiates movement by electromigration, electro-osmosis and electrophoresis. The resultant migration of charged particles to their oppositely charged electrodes enables removal of ionic species and colloids through electroplating of the electrode, precipitation at the electrode, or pumping the waste out from the vicinity of the electrodes.

### 1.3 Previous Reports

Full results for previous field trial works are included within the previous reports, this report provides results for the period June to October 2019. Previous reports including the bench-scale trial reports and field trial reports are as follows;

- Celtic Englobe, Electrokinetic Bench-scale Trial Report, R1662-16-4654, dated February 2016;
- Celtic Englobe, Electrokinetic Bench-scale Trial 2 Report, R1662-16-7419, dated September 2016;
- Celtic Englobe, Electrokinetic Field Trial Report, R1722-18-4822, dated November 2017;
- The Royal Mint Electrokinetic Field Trial Report R1722/18/4935 December 2018;

- The Royal Mint Electrokinetic Field Trial Report R1722/19/4953 July 2019; and
- The Royal Mint, Electrokinetic Field Trial Report Addendum R1722/19/4953, January 2020.

### 1.4 Extended Trial Objectives

The main aims of the extended field trial were to strengthen the conclusions previously made from the initial field trials and to achieve longer term results, and to conduct the trial using solid stainless steel rods as recommended by Natural Resources Wales in their CAR Report (Report ID CAR_NRW0035526) in order to increase effective surface area, reduce the erosion of the rods over time, increase the longevity of the rods and therefore increase effectiveness of reduction of the nickel plume. This ultimately helps to determine if full-scale implementation is a viable and cost-effective technique and also continues to reduce the dissolved phase nickel concentrations in the trial area and reduce the size of the contamination plume. The data collected during the field trial will also be used to assist the design of any further site investigation and remediation required for regulatory close out of the site area once the updated DQRA (specific to the NP1 area) has been completed.

Additionally, the extended field trial is reducing nickel mass in the groundwater on the peripheries of the source of contamination within the NP1 building and is subsequently reducing Nickel contamination impact to the River Mychydd until such time that the full-scale remediation can be carried out.

## 2.0 PROGRAMME OF WORKS

### 2.1 Programme of Works

A summary of the programme and sequence of works carried out from October 2019 to March 2020 is presented in Table 1, below, to summarise:

- Approximately five further months of data was collated utilising solid stainless steel rods as the anode and cathode;
- Quarterly groundwater and surface water monitoring was undertaken throughout the extended trial at locations BHE1 – BHE6, BH26, SW0 – SW4 and SWA; and
- Monthly treatment system samples were taken at locations CBH17-1 – CBH17-6, and BH26.

**Table 1 – Extended Field Trials Programme of Works**

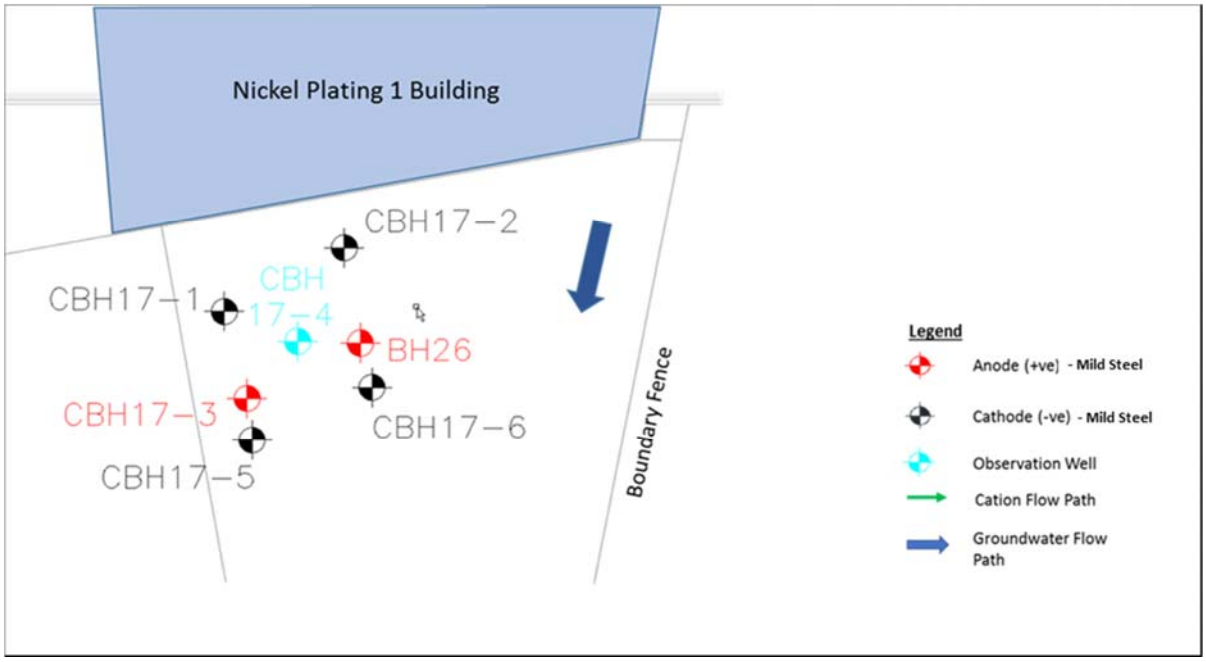
| Activities | Tasks | Date |
|---|---|---|
| **Treatment System Groundwater Sampling Rounds – October 2019** | • Groundwater monitoring at trial boreholes CBH17-1, CBH17-2, CBH17-3, CBH17-4, CBH17-5, CBH17-6 and BH26.<br>• Quarterly groundwater and surface water monitoring at trial at locations BHE1 – BHE6, BH26, SW0 – SW4 and SWA. | 1st October 2020*<br>7th October 2020<br>18th October 2020<br>25th October 2020<br>29th October 2020 |
| **Treatment System Groundwater Sampling Rounds – November 2019** | • Groundwater monitoring at trial boreholes CBH17-1, CBH17-2, CBH17-3, CBH17-4, CBH17-5, CBH17-6 and BH26. | 11th November 2020<br>18th November 2020 |
| **Treatment System Groundwater Sampling Rounds – December 2019** | • Groundwater monitoring at trial boreholes CBH17-1, CBH17-2, CBH17-3, CBH17-4, CBH17-5, CBH17-6 and BH26.<br>• Quarterly groundwater and surface water monitoring at trial at locations BHE1 – BHE6, BH26, SW0 – SW4 and SWA | 2nd December 2020<br>13th December 2020* |
| **Treatment System Groundwater Sampling Rounds – January 2020** | • Groundwater monitoring at trial boreholes CBH17-1, CBH17-2, CBH17-3, CBH17-4, CBH17-5, CBH17-6 and BH26. | 24th January 2020<br>31st January 2020 |
| **Treatment System Groundwater Sampling Rounds – February 2020** | • Quarterly groundwater and surface water monitoring at trial at locations BHE1 – BHE6, BH26, SW0 – SW4 and SWA.<br>• Groundwater monitoring at trial boreholes CBH17-1, CBH17-2, CBH17-3, CBH17-4, CBH17-5, CBH17-6 and BH26. | 14th February 2020<br>25th February 2020 |
| **Treatment System Groundwater Sampling Rounds – March 2020** | • Groundwater monitoring at trial boreholes CBH17-1, CBH17-2, CBH17-3, CBH17-4, CBH17-5, CBH17-6 and BH26.<br>• Quarterly groundwater and surface water monitoring at trial at locations BHE1 – BHE6, BH26, SW0 – SW4 and SWA. | 6th March 2020<br>13th March 2020<br>26th March 2020* |

Notes: * Quarterly round

## 2.2 Field Trial Set-Up

Previous extensions of the field trial ran firstly to March 2019 and subsequently to September 2019. In March 2019, additional electrodes were installed and the relative positions of anodes and cathodes were reconfigured. The configuration remains the same since March 2019, however, on October 25th 2019 the mild steel rods were replaced with solid stainless steel rods following the NRW Compliance Assessment Report comments. The configuration from March 2019 to the present is shown in Figure 1 overleaf.

**Figure 1 – Field Trial Electrodes Set-Up Configuration (March 2019 Onwards)**



## 3.0 FIELD TRIAL RESULTS

During the extended trial, samples were taken at least monthly from all treatment wells (CBH17-1 – CBH17-6 and BH26), and on a quarterly basis a full validation round was undertaken for all monitoring wells (BHE1 – BHE6 and BH26) and the surface water (River Mychydd) sample locations (SWA and SW0 – SW4).

All samples collected during the extended trial were sent to a UKAS and MCERTS accredited laboratory and all results are presented in Appendix B.

A summary of the extended trial results to date are provided in Table 2 overleaf;

- Extended Trial No. 6 – Stainless steel rods – 25th October 2019 – to 31st March 2020

A summary of the groundwater and surface water monitoring round results is provided in Table 3, overleaf.

**Table 2 – Extended Trial No. 6 – Stainless Steel Rods Summary of Results (Nickel ug/L)**

| Borehole | Date and Trial Time (days) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 | 6 | 17 | 24 | 28 | 41 | 48 | 62 |
| | 01/10/2019 | 07/10/2019 | 18/10/2019 | 25/10/2019 | 29/10/2019 | 11/11/2019 | 18/11/2019 | 02/12/2019 |
| CBH17-1 (Cathode) | 160 | 130 | 150 | 140 | 170 | 140 | 23 | 50 |
| CBH17-3 (Anode) | 310 | 5000 | 2100 | 1100 | 7000 | 850 | 120 | 11000 |
| Percentage Reduction (anode - cathode) | 48.39 | 97.40 | 92.86 | 87.27 | 98 | 83.53 | 80.83 | 99.55 |
| | | | | | | | | |
| CBH17-5 (Cathode) | 1100 | 410 | 270 | 470 | 710 | 630 | 63 | 1000 |
| CBH17-3 (Anode) | 310 | 5000 | 2100 | 1100 | 7000 | 850 | 120 | 11000 |
| Percentage Reduction (anode - cathode) | -254.84 | 91.80 | 87.14 | 57.27 | 90 | 25.88 | 47.50 | 90.91 |
| | | | | | | | | |
| CBH17-2 (Cathode) | 410 | 8.9 | 31 | 18 | 150 | 89 | 91 | 130 |
| BH26 (Anode) | 1100 | 1600 | 4300 | 15000 | 69000 | 9600 | 920 | 82000 |
| Percentage Reduction (anode - cathode) | 62.73 | 99.44 | 99.28 | 99.88 | 100 | 99.07 | 90.11 | 99.84 |
| | | | | | | | | |
| CBH17-6 (Cathode) | 140 | 30 | 44 | 58 | 280 | 210 | 73 | 440 |
| BH26 (Anode) | 1100 | 1600 | 4300 | 15000 | 69000 | 9600 | 920 | 82000 |
| Percentage Reduction (anode - cathode) | 87.27 | 98.13 | 98.98 | 99.61 | 100 | 97.81 | 92.07 | 99.46 |
| | | | | | | | | |
| CBH17-4 (Mid- Monitoring Well) | 9100 | 6100 | 8700 | 31000 | 16000 | 30000 | 40000 | 2500 |

Reported in last Field Trial Report, pre-change from mild steel to stainless steel, included for completeness to show completed extended trial #6

| Borehole | Date and Trial Time (days) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 73 | 115 | 122 | 136 | 147 | 157 | 164 | 177 |
| | 13/12/2019 | 24/01/2020 | 31/01/2020 | 14/02/2020 | 25/02/2020 | 06/03/2020 | 13/03/2020 | 26/03/2020 |
| CBH17-1 (Cathode) | 130 | 1.0 | 240 | 120 | 170 | 47 | 1 | 320 |
| CBH17-3 (Anode) | 22000 | 12000 | 1900 | 10000 | 210 | 3500 | 9700 | 9100 |
| Percentage Reduction (anode - cathode) | 99.41 | 99.99 | 87.37 | 98.80 | 19.05 | 98.66 | 99.99 | 96.48 |
| | | | | | | | | |
| CBH17-5 (Cathode) | 680 | 470 | 100 | 470 | 25 | 84 | 63 | 5 |
| CBH17-3 (Anode) | 22000 | 12000 | 1900 | 10000 | 210 | 3500 | 9700 | 9100 |
| Percentage Reduction (anode - cathode) | 96.91 | 96.08 | 94.74 | 95.30 | 88.10 | 97.60 | 99.35 | 99.95 |
| | | | | | | | | |
| CBH17-2 (Cathode) | 28 | 23 | 39 | 9.1 | 23.0 | 28.0 | 20.0 | 62.0 |
| BH26 (Anode) | 8400 | 37000 | 14000 | 5400 | 38 | 9 | 20000 | 24000 |
| Percentage Reduction (anode - cathode) | 99.67 | 99.94 | 99.72 | 99.83 | 39.47 | -221.84 | 99.90 | 99.74 |
| | | | | | | | | |
| CBH17-6 (Cathode) | 66 | 37 | 67 | 160 | 26 | 24 | 12 | 8 |
| BH26 (Anode) | 8400 | 37000 | 14000 | 5400 | 38 | 9 | 20000 | 24000 |
| Percentage Reduction (anode - cathode) | 99.21 | 99.90 | 99.52 | 97.04 | 31.58 | -175.86 | 99.94 | 99.97 |
| | | | | | | | | |
| CBH17-4 (Mid- Monitoring Well) | 18000 | 26000 | 27000 | 48000 | 860 | 280 | 37000 | 20 |

Reported in last Field Trial Report, pre-change from mild steel to stainless steel, included for completeness to show completed extended trial #6

**Table 3 – Groundwater and Surface Water Summary of Results (Nickel µg/L)**

| Date | BHE1 | BHE2 | BHE3 | BHE4 | BHE5 | BHE6 | BH26 | SWO | SW1 | SW2 | SW3 | SW4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **01/10/2019** | 2,200 | 28,000 | 1,400 | 150 | 41 | 7.6 | 1,100 | 2 | 2.2 | < 1.0 | 1.4 | < 1.0 |
| **13/12/2019** | 890 | 13,000 | 150 | 21 | < 1.0 | 5.1 | 8,400 | 47 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| **26/03/2020** | 5200 | 11,000 | 850 | 20 | 1.1 | 1.1 | 24,000 | 23 | < 1.0 | 5.2 | < 1.0 | < 1.0 |

Reported in last Field Trial Report, pre-change from mild steel to stainless steel, included for completeness.

### 3.1 Discussion of Field Trial Results

Dissolved phase nickel concentrations in groundwater have been maintained at levels below the derived NRW agreed remedial target (160mg/l) and at levels significantly below the baseline reading for extended periods of time over the field trial programme. The electrokinetic cell that has been set-up generally maintains in excess of 95% reduction across the anode – cathode (39 of the 64 results of this most recent trial extension exceeded 95% reduction, and 36 out of 52 results exceeded 95% reduction since the change to stainless steel rods).

Following the installation of additional electrodes (in total, 4 no. cathodes and 2 no. anodes) in the wells in March 2019, as indicated in Figure 1, an overall reduction in nickel concentrations in the trial area has continued to occur, as shown in Table 2 and further illustrated in Figure 2, overleaf.

The field trial was extended for a further year in March 2020, to run April 2020 to March 2021. An updated DQRA specific to the NP1 area has been commissioned by the Royal Mint to include a wider groundwater model, actual mass flux and impact of the nickel to the River utilising the past 10 years' worth of data, which is currently being undertaken by Celtic. The current electrode configuration will be maintained for the duration of Extended Field Trial no. 7 (April 2020 to March 2021).

### 3.2 Degradation of the electrodes

Following issue of National Resources Wales Compliance Assessment Report in August which discussed their preference for the use of stainless steel rods, the mild steel rods were replaced with solid stainless steel on 25$^{th}$ October 2019, details of any degradation of the solid steel rods will be included within the next full field trial report, however during the trial extension from October 2019 to March 2020 no significant degradation of the stainless steel rods has been observed and therefore their use continues into the next trial extension (April 2020 to March 2021).

### 3.3 Long-term Monitoring of NP1 Area

The latest dissolved phase nickel concentrations in groundwater within the field trial area are shown in the Surfer plots in Figure 2 to 5.

Figure 6, overleaf, shows the long-term trend of the contamination plume across the NP1 area along with the affect it is having on the River Mychydd. This data shows that, from the beginning of the Celtic works, the overall mass of nickel has reduced from the main part of the plume that is currently accessible (BHE1, BH2 and BH26). This area has reduced from an average of approximately 111,000 µg/L at the start of the trial to an average of approximately 8,297 µg/L in the past year (93% reduction over 9 years).

Figure 7, overleaf, shows the average nickel concentration (BHE1, BHE2 and BH26) over time showing the overall effect the work has been having on the contamination plume. The long- term data does still show some peaks in the data over time. This is due to seasonal variation and the mass flux of nickel coming from the source zone under the NP1 building and over time replenishing the outer plume that is being treated.

The peaks within the data are seen throughout the pumping works and throughout the electrokinetic trial. It is the seasonal variation and mass flux of nickel that means the electrokinetic trial cannot show a smooth reduction in concentration over time. However, the short-term results are still positive and indicate the suitability of this technique in the field, along with the long-term results that show the cathode can be maintained at a very low level.

**Figure 2 – Dissolved Phase Nickel Concentrations in the Field Trial Cell – June 2019 to October 2019 Surfer Plots**

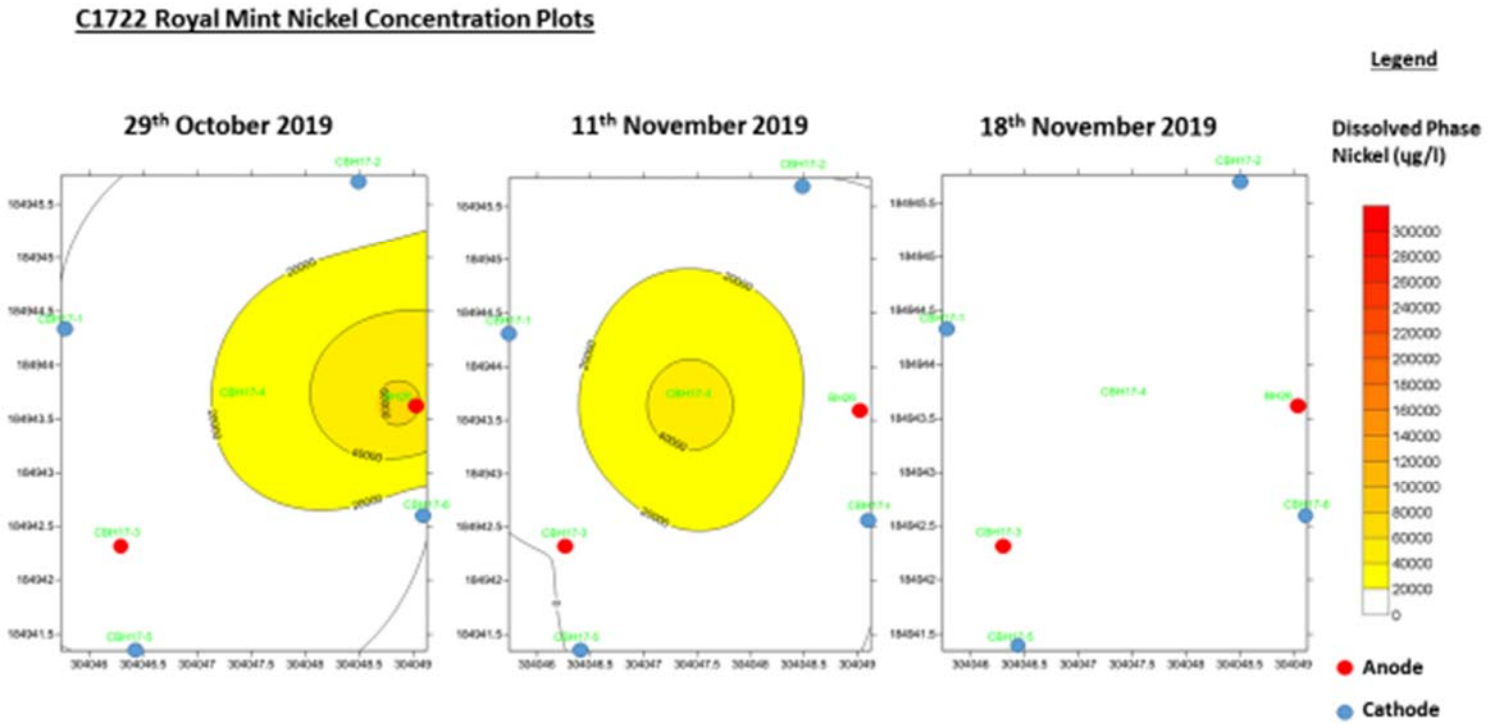


**Figure 3 – Dissolved Phase Nickel Concentrations in the Field Trial Cell – June 2019 to October 2019 Surfer Plots- continued**

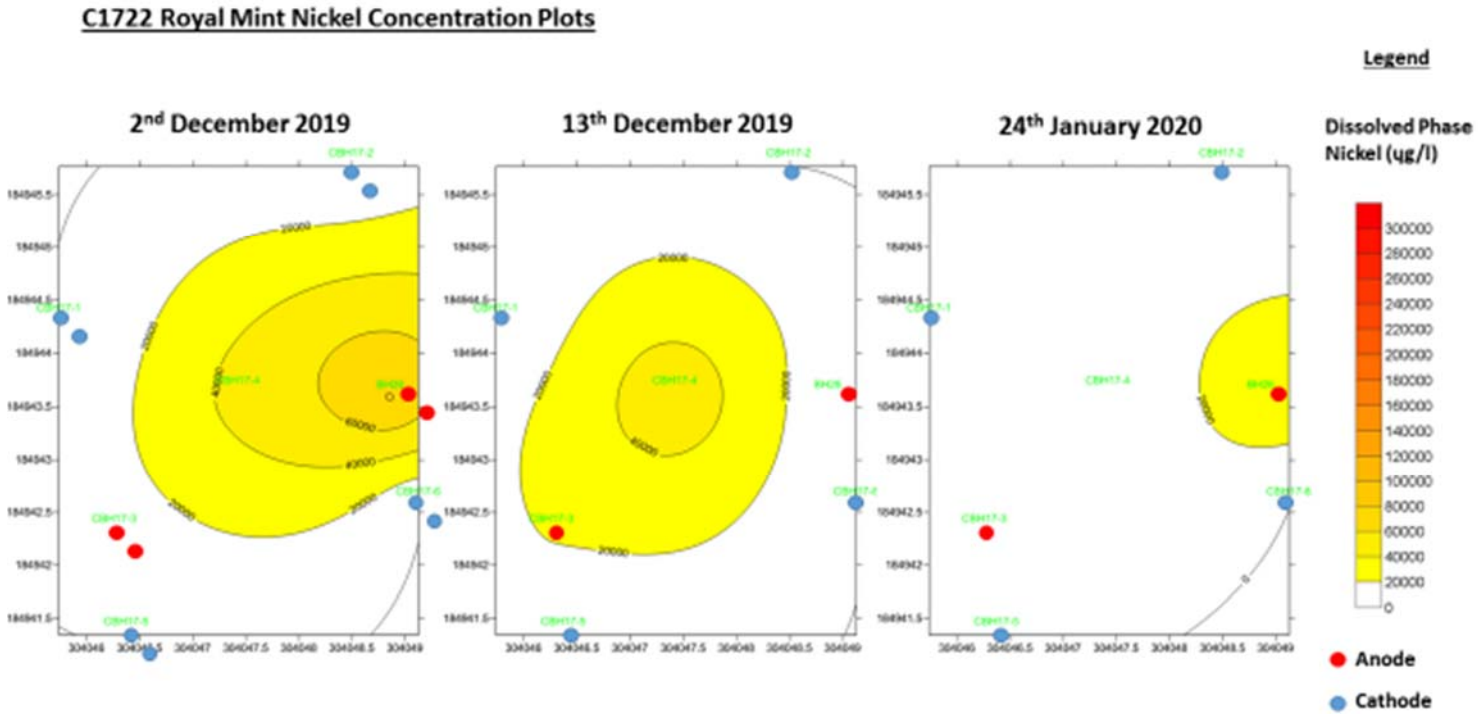


**Figure 4 – Dissolved Phase Nickel Concentrations in the Field Trial Cell – June 2019 to October 2019 Surfer Plots- continued**

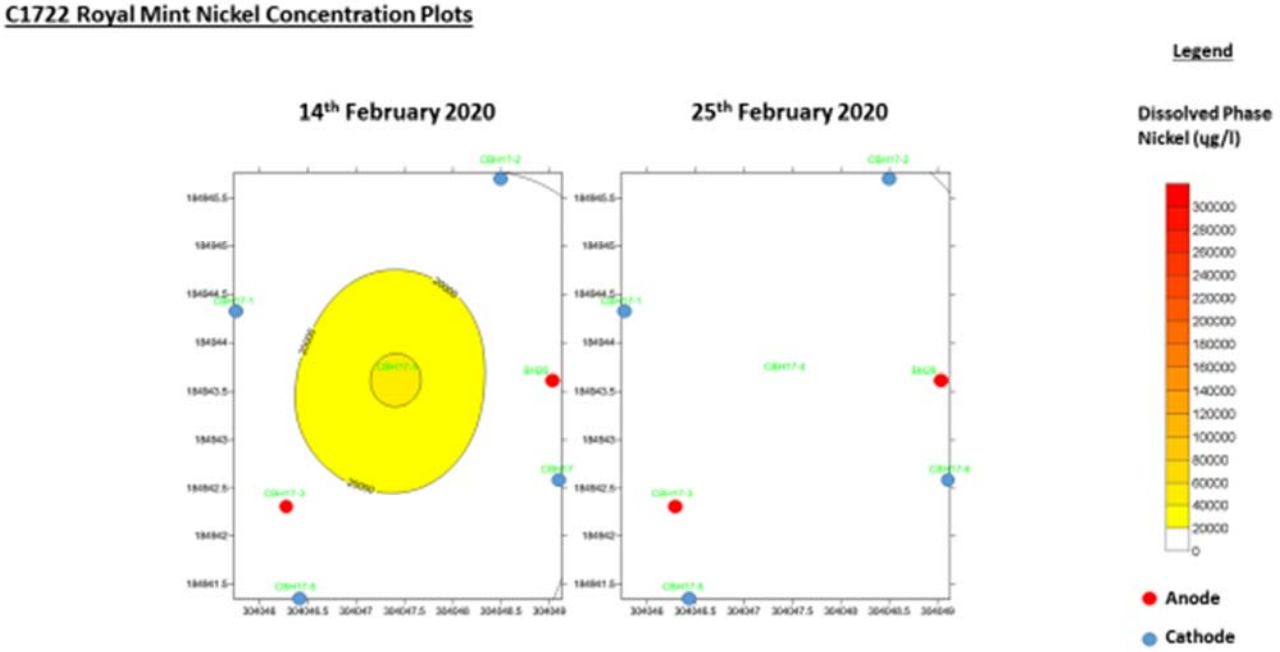


**Figure 5 – Dissolved Phase Nickel Concentrations in the Field Trial Cell – June 2019 to October 2019 Surfer Plots- continued**

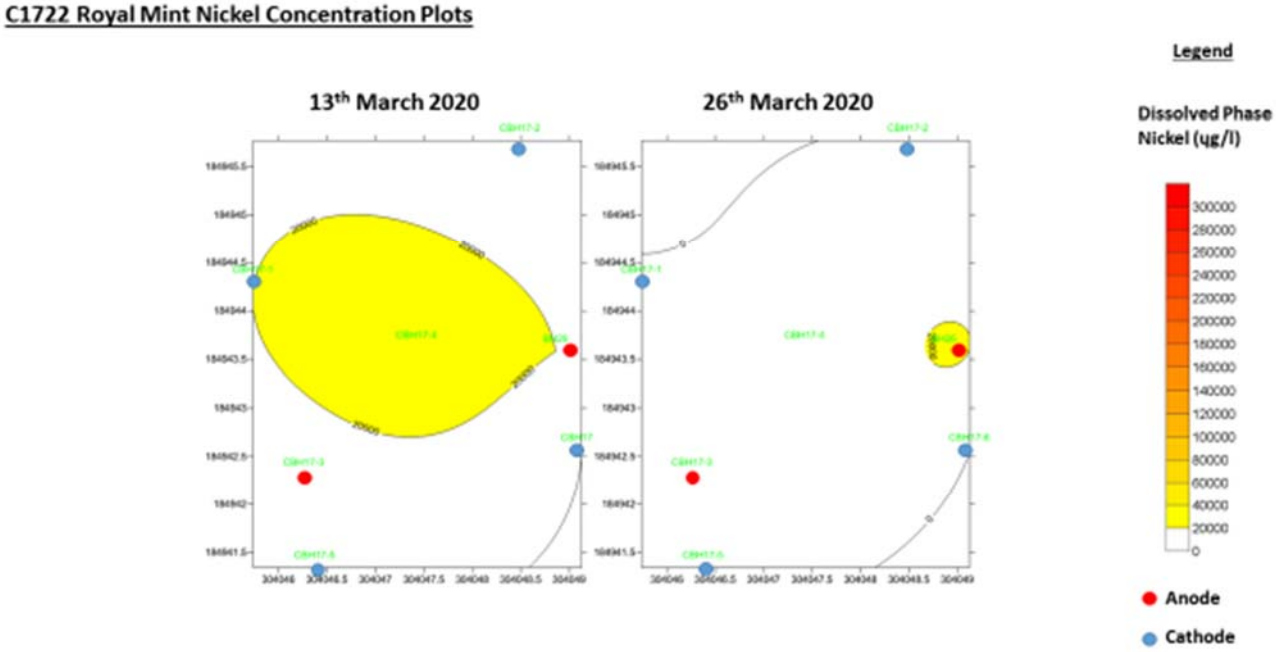


**Figure 6 – Nickel Concentration over time – March 2010 – March 2020**

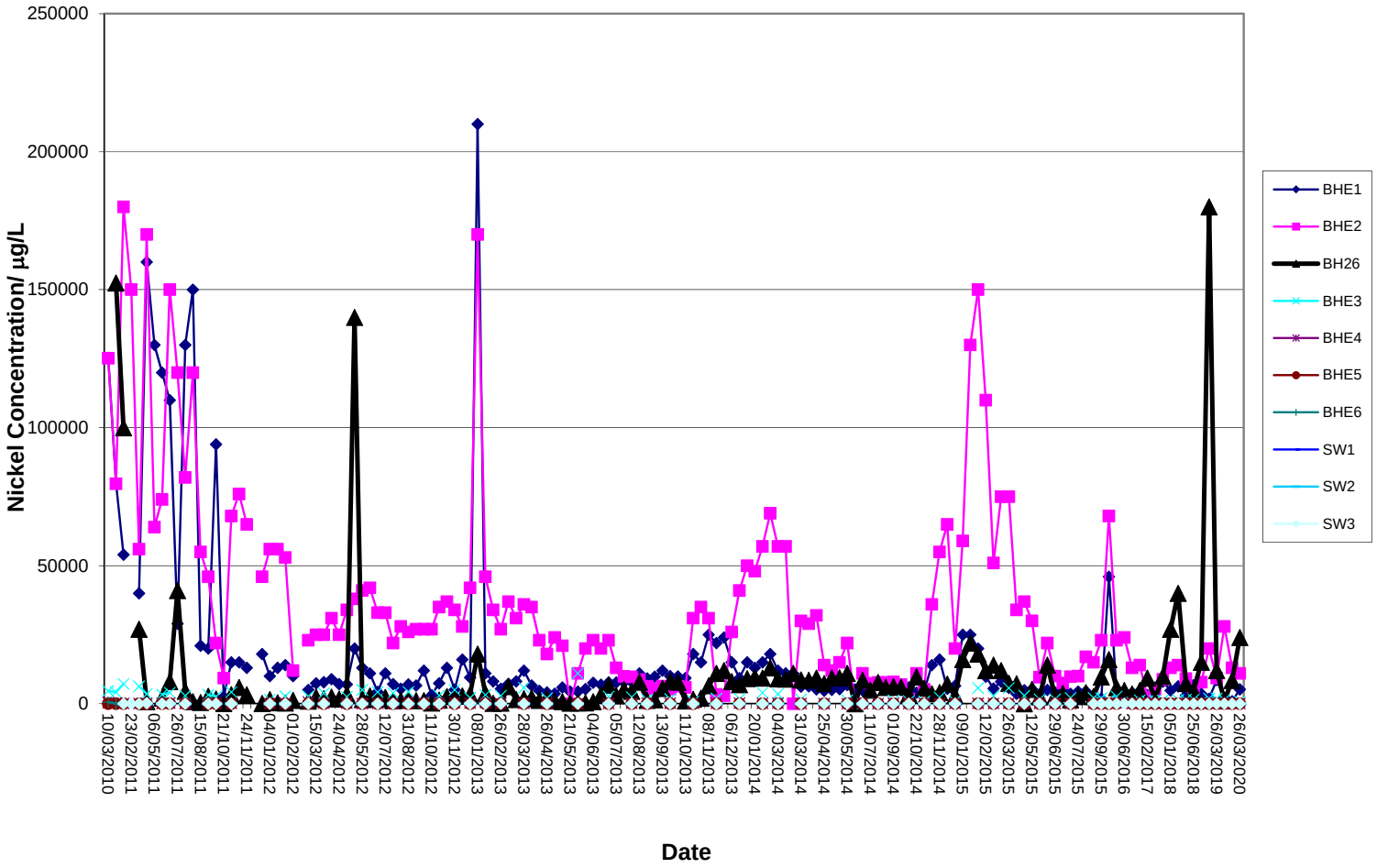
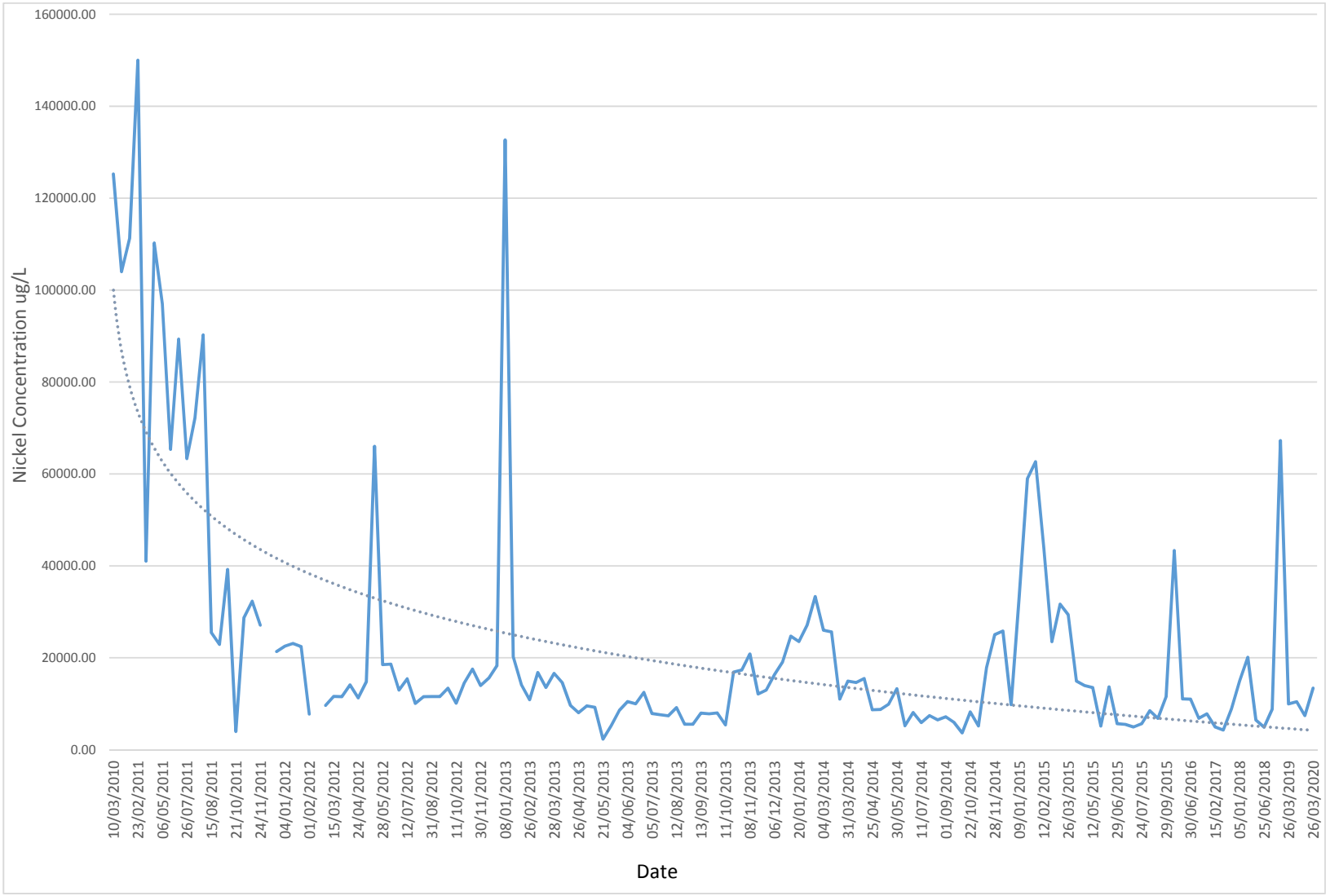


**Figure 7 – NP1 Contamination Plume – Average Nickel Concentration over time – March 2010 – March 2020**



## 4.0 CONCLUSIONS

- The electrokinetic extended field trials have been successful to date and are to continue at present until March 2021. This report follows on from the 2019 addendum report which included data up until October 2019.

- During the extended trials long term data has been collected to assess the comparison of stainless steel and mild steel as electrodes.

- Stainless steel electrodes have been proven to not show degradation for extended periods of time compared with mild steel electrodes which have been shown to have approximately a 4-month timeframe prior to degradation.

- NRW indicated their preference for stainless steel rods, due to their longer lifespan and efficiency, in their Compliance Assessment Report (dated 8th August 2019) and in recent discussions; as previously discussed in this report the rods were changed to solid stainless steel at the end of October 2019. The stainless steel rods have continued maintain the nickel concentration at the cathode monitoring well at a significantly reduced level, below the derived NRW agreed remedial target, and compared to the baseline reading for extended periods of time. Up until the end of this extended trial (March 2019), they have not shown any significant degradation, indicating the stainless steel rods have a lifespan in excess of the mild steel electrodes.

- The electrokinetic cell generally maintains a 95% reduction in nickel concentrations across the anode – cathode.

- The addition of two electrodes in the treatment cell during March 2019 has further decreased the dissolved phase nickel concentrations within the cell. This configuration will continue until March 2020.

- Throughout the works to the periphery of the plume (pumping works and electrokinetic trials), the overall outer plume has reduced by 93% over 9 years, despite seasonal fluctuations and continual mass flux of nickel from the source zone.

- The electrokinetic trial has been extended until March 2021.

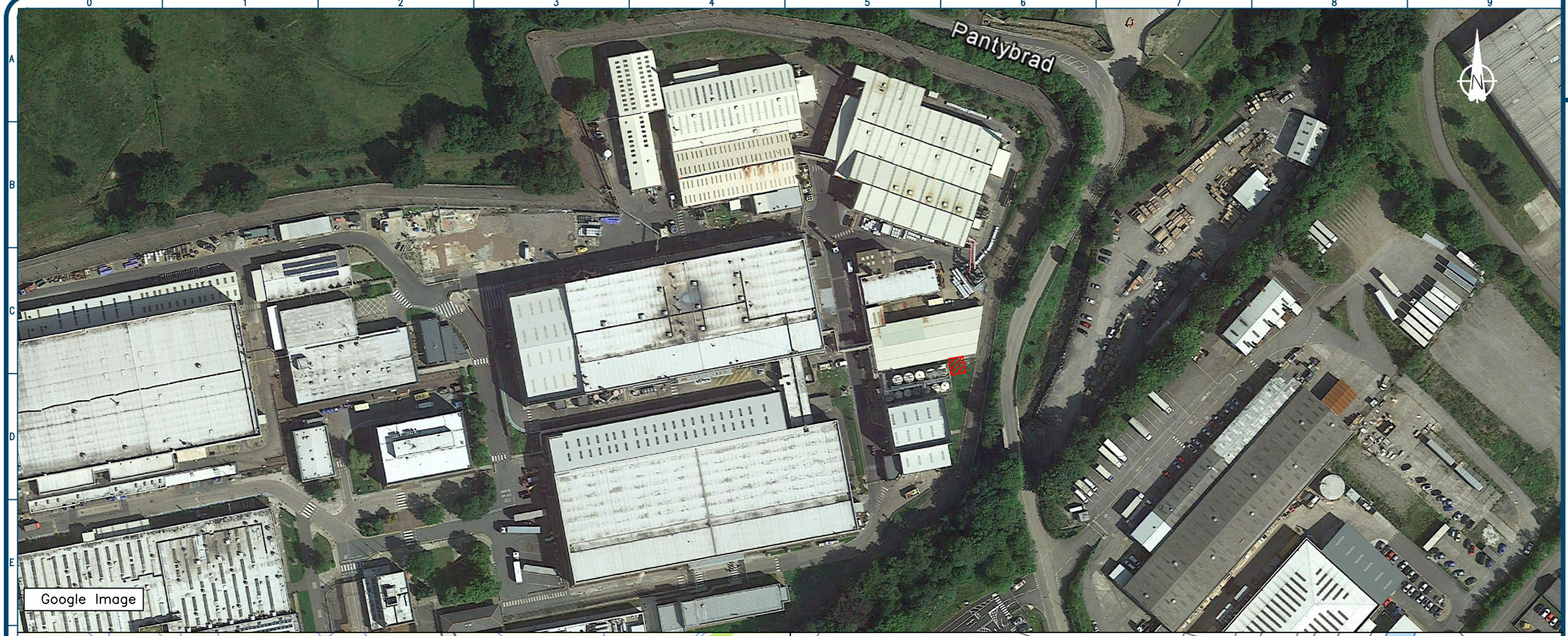
- An updated DQRA is currently being undertaken to be specific to the NP1 area (the previous DQRA carried out in 2010 (R1430-10-3943-Remedial Strategy Implementation Plan – Appendix B) was for the whole site prior to the remediation of the PMU area in 2011). The updated DQRA will also include more detailed groundwater modelling. This will then inform the proposed close out options for the site.

- If the Royal Mint Effluent Treatment Plant can accept the groundwater, Celtic have proposed pumping from the monitoring wells and from the anodes to enhance the mass removal of Nickel over time, or implementing an additional water treatment system if this is not possible, as recommended by NRW. The Abstraction License for pumping groundwater from the boreholes remains in place until March 2021. Celtic are currently discussing this and other potential treatment options with the Royal Mint.

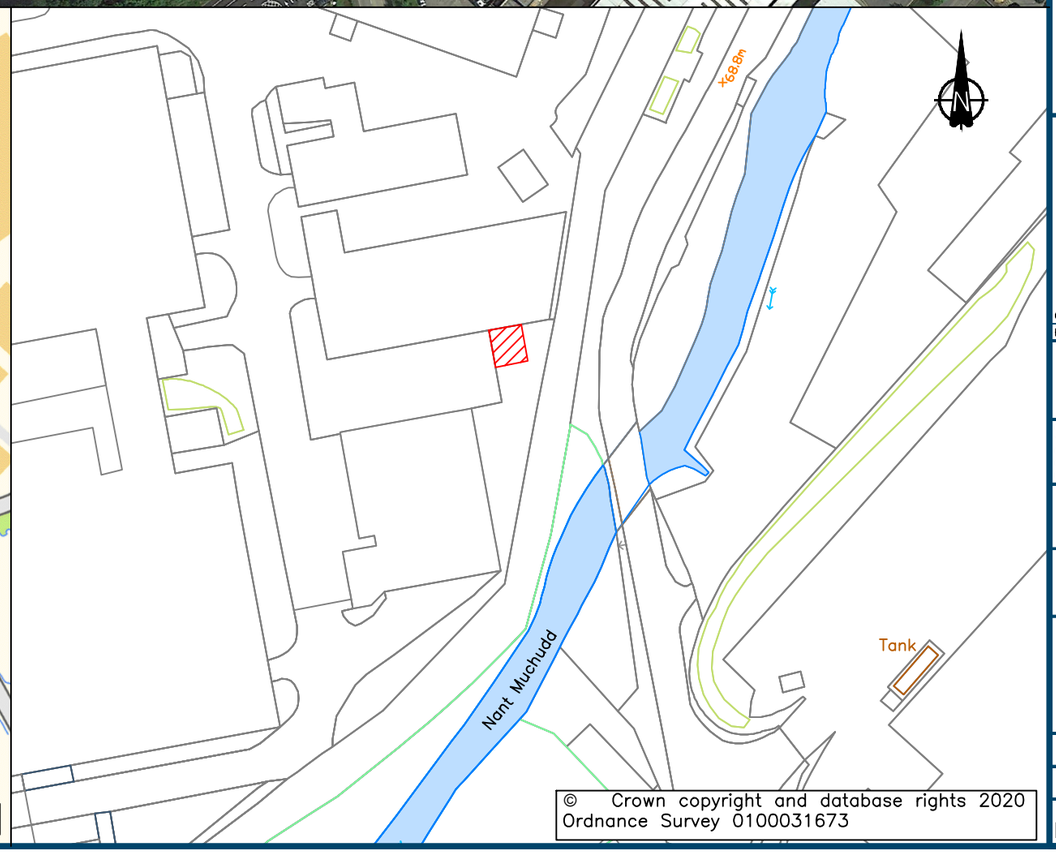
**APPENDICES**

**Appendix A**

**Drawings**








Legend

Site Co-ords:
304048.45,184943.14

Field Trial Area

| REV | COMMENT | DATE |
|---|---|---|
| 0 | ISSUED FOR COMMENT | 11/08/20 |

Celtic enGlobe
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Client
The Royal Mint

Project
Royal Mint,Pontyclun

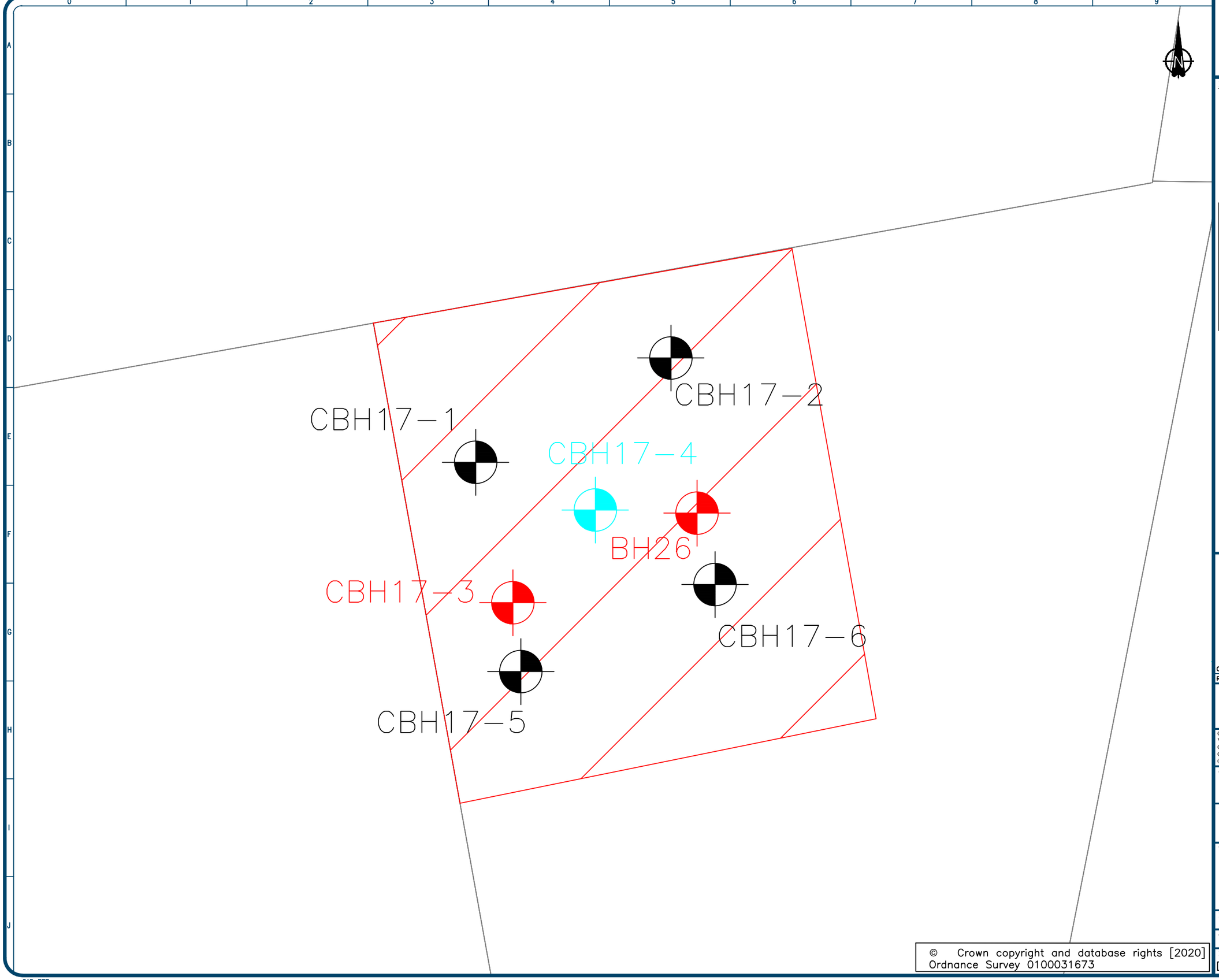
Title
Site Location Plan

| Drawn by | Checked Date | Authorised Date |
|---|---|---|
| GEP | KS 11/08/20 | KS 11/08/20 |

| Original Scale | Date | Rev | Paper |
|---|---|---|---|
| N.T.S | 11/08/20 | 0 | A3 |

Drawing Number
D1722/5019/A1

CAD REF:-




Legend

- Monitoring Well
- Cathode Well
- Anode Well



| REV | COMMENT | DATE |
|---|---|---|
| 0 | ISSUED FOR COMMENT | 11/08/20 |

Celtic enGlobe
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Client: The Royal Mint

Project: Royal Mint,Pontyclun

Title: Current Electrode Arrangements

| Drawn by | Checked Date | Authorised Date |
|---|---|---|
| GEP | KS 11/08/17 | KS 11/08/20 |

| Original Scale | Date | Rev | Paper |
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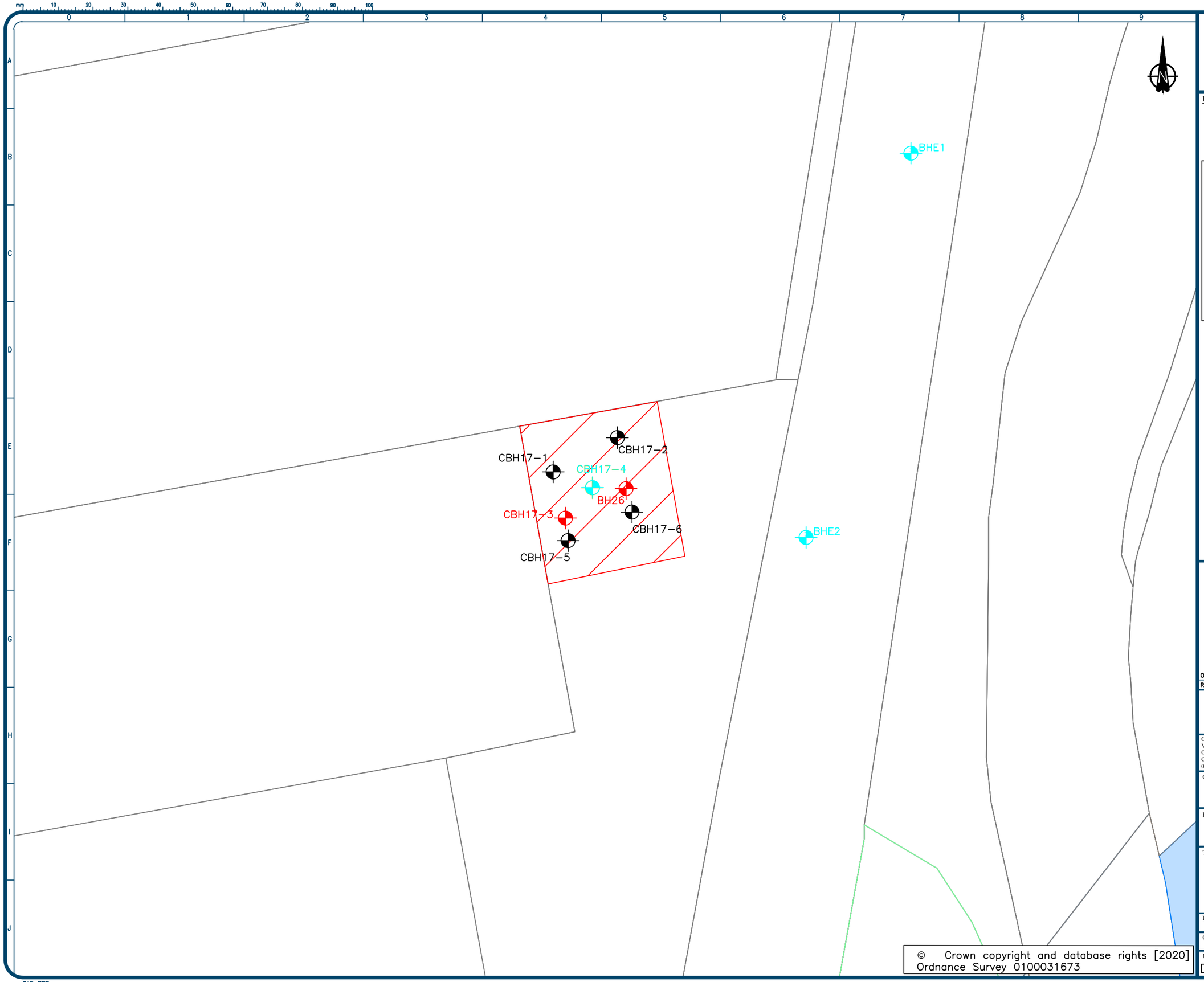
Drawing Number: D1722/5019/A2

CAD REF:–




Legend

- Pilot Trial Area
- Existing Monitoring Well
- Anode
- Cathode
- Monitoring Well

| REV | COMMENT | DATE |
|---|---|---|
| 0 | ISSUED FOR COMMENT | 11/08/20 |

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Client: The Royal Mint

Project: Royal Mint,Pontyclun

Title: Pilot Trial System Treatment Well Layout

| Drawn by | Checked Date | Authorised Date |
|---|---|---|
| GEP | KS 11/08/17 | KS 11/08/20 |

| Original Scale | Date | Rev | Paper |
|---|---|---|---|
| 1:150 | 11/08/20 | 0 | A3 |

Drawing Number: D1722/5019/A3



CAD REF:–

**Appendix B**

**Chemical Analysis Results**

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

UKAS TESTING
2183

# Final Report

| | |
|---|---|
| **Report No.:** | 19-36290-1 |
| **Initial Date of Issue:** | 07-Nov-2019 |
| **Client** | Celtic Ltd |
| **Client Address:** | Columbus House<br>Greenmeadow Springs<br>Tongwynlais<br>Cardiff<br>Glamorgan<br>CF15 7NE |
| **Contact(s):** | Katie Dennis<br>Katie Walker<br>Kirsty Sweeny<br>Paul Lambe<br>Stephen Kidley |
| **Project** | C1722 Royal Mint |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 30-Oct-2019 |
| **Order No.:** | 79981 | **Date Instructed:** | 30-Oct-2019 |
| **No. of Samples:** | 7 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 05-Nov-2019 |
| **Date Approved:** | 07-Nov-2019 | | |

**Approved By:**

**Details:** Glynn Harvey, Laboratory Manager

Chemtest
The right chemistry to deliver results

# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 19-36290 | 19-36290 | 19-36290 | 19-36290 | 19-36290 | 19-36290 | 19-36290 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 914857 | 914858 | 914859 | 914860 | 914861 | 914862 | 914863 |
| Order No.: 79981 | | Client Sample Ref.: | | | 17-1 | 17-2 | 17-3 | 17-4 | 17-5 | 17-6 | 26 |
| | | Sample Location: | | | CBH | CBH | CBH | CBH | CBH | CBH | BH |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Date Sampled ($): | | | 29-Oct-2019 | 29-Oct-2019 | 29-Oct-2019 | 29-Oct-2019 | 29-Oct-2019 | 29-Oct-2019 | 29-Oct-2019 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | |
| pH | U | 1010 | | N/A | 12.6 | 12.3 | 2.7 | 6.6 | 12.2 | 12.2 | 2.7 |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | 170 | 150 | 7000 | 25000 | 710 | 280 | 69000 |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1010 | pH Value of Waters | pH | pH Meter |
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |

## Report Information

### Key

| | |
|---|---|
| U | UKAS accredited |
| M | MCERTS and UKAS accredited |
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| SN | This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis |
| T | This analysis has been subcontracted to an unaccredited laboratory |
| I/S | Insufficient Sample |
| U/S | Unsuitable Sample |
| N/E | not evaluated |
| < | "less than" |
| > | "greater than" |
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For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

### Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

### Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

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Email: info@chemtest.com

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# Final Report

| | |
|---|---|
| **Report No.:** | 19-35948-1 |
| **Initial Date of Issue:** | 30-Oct-2019 |
| **Client** | Celtic Ltd |
| **Client Address:** | Columbus House<br>Greenmeadow Springs<br>Tongwynlais<br>Cardiff<br>Glamorgan<br>CF15 7NE |
| **Contact(s):** | Katie Walker<br>Kirsty Sweeny<br>Paul Lambe<br>Stephen Kidley |
| **Project** | C1722 Royal Mint |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 28-Oct-2019 |
| **Order No.:** | 79981 | **Date Instructed:** | 28-Oct-2019 |
| **No. of Samples:** | 7 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 01-Nov-2019 |
| **Date Approved:** | 30-Oct-2019 | | |

**Approved By:**

**Details:** Robert Monk, Technical Manager

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# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 19-35948 | 19-35948 | 19-35948 | 19-35948 | 19-35948 | 19-35948 | 19-35948 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 913431 | 913432 | 913433 | 913434 | 913435 | 913436 | 913437 |
| | | Sample Location: | | | CBH 17-1 | CBH 17-2 | CBH 17-3 | CBH 17-4 | CBH 17-5 | CBH 17-6 | BH 26 |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Date Sampled ($): | | | 25-Oct-2019 | 25-Oct-2019 | 25-Oct-2019 | 25-Oct-2019 | 25-Oct-2019 | 25-Oct-2019 | 25-Oct-2019 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | |
| pH | U | 1010 | | N/A | 12.2 | 11.4 | 11.4 | 7.9 | 11.7 | 11.7 | 8.4 |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | 140 | 18 | 1100 | 27000 | 470 | 58 | 15000 |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1010 | pH Value of Waters | pH | pH Meter |
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |

## Report Information

### Key

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| I/S | Insufficient Sample |
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D - Broken Container
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Email: info@chemtest.com

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# Final Report

| | |
|---|---|
| **Report No.:** | 19-35105-1 |
| **Initial Date of Issue:** | 28-Oct-2019 |
| **Client** | Celtic Ltd |
| **Client Address:** | Columbus House<br>Greenmeadow Springs<br>Tongwynlais<br>Cardiff<br>Glamorgan<br>CF15 7NE |
| **Contact(s):** | Katie Dennis<br>Katie Walker<br>Kirsty Sweeny<br>Paul Lambe<br>Stephen Kidley |
| **Project** | C1722 Royal Mint |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 21-Oct-2019 |
| **Order No.:** | 79981 | **Date Instructed:** | 21-Oct-2019 |
| **No. of Samples:** | 7 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 25-Oct-2019 |
| **Date Approved:** | 28-Oct-2019 | | |

**Approved By:**

**Details:** Glynn Harvey, Laboratory Manager

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# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 19-35105 | 19-35105 | 19-35105 | 19-35105 | 19-35105 | 19-35105 | 19-35105 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 909327 | 909328 | 909329 | 909330 | 909331 | 909332 | 909333 |
| | | Sample Location: | | | CBH 17-1 | CBH 17-2 | CBH 17-3 | CBH 17-4 | CBH 17-5 | CBH 17-6 | BH 26 |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Date Sampled ($): | | | 18-Oct-2019 | 18-Oct-2019 | 18-Oct-2019 | 18-Oct-2019 | 18-Oct-2019 | 18-Oct-2019 | 18-Oct-2019 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | |
| pH | U | 1010 | | N/A | 12.3 | 12.0 | 7.4 | 7.8 | 12.0 | 11.8 | 7.1 |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | 150 | 31 | 2100 | 26000 | 270 | 44 | 4300 |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1010 | pH Value of Waters | pH | pH Meter |
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |

## Report Information

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### Sample Retention and Disposal

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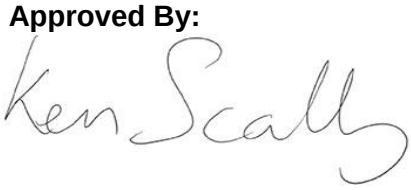
# Amended Report

| | | | |
|---|---|---|---|
| **Report No.:** | 19-33538-2 | | |
| **Initial Date of Issue:** | 14-Oct-2019 | **Date of Re-Issue:** | 28-Oct-2019 |
| **Client** | Celtic Ltd | | |
| **Client Address:** | Columbus House<br>Greenmeadow Springs<br>Tongwynlais<br>Cardiff<br>Glamorgan<br>CF15 7NE | | |
| **Contact(s):** | Katie Walker<br>Kirsty Sweeny<br>Paul Lambe<br>Stephen Kidley | | |
| **Project** | C1722 Royal Mint | | |
| **Quotation No.:** | | **Date Received:** | 08-Oct-2019 |
| **Order No.:** | 79981 | **Date Instructed:** | 08-Oct-2019 |
| **No. of Samples:** | 7 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 14-Oct-2019 |
| **Date Approved:** | 14-Oct-2019 | | |

**Approved By:**



**Details:** Ken Scally, Technical Director

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# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 19-33538 | 19-33538 | 19-33538 | 19-33538 | 19-33538 | 19-33538 | 19-33538 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 901548 | 901549 | 901550 | 901551 | 901552 | 901553 | 901554 |
| | | Sample Location: | | | CBH 17.1 | CBH 17.2 | CBH 17.3 | CBH 17.4 | CBH 17.5 | CBH 17.6 | BH 26 |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Date Sampled ($): | | | 07-Oct-2019 | 07-Oct-2019 | 07-Oct-2019 | 07-Oct-2019 | 07-Oct-2019 | 07-Oct-2019 | 07-Oct-2019 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | |
| pH | U | 1010 | | N/A | 12.5 | 12.5 | 5.3 | 6.7 | 12.4 | 12.4 | 6.5 |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | 130 | 8.9 | 5000 | 18000 | 410 | 30 | 1600 |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1010 | pH Value of Waters | pH | pH Meter |
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |

## Report Information

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| U/S | Unsuitable Sample |
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### Sample Deviation Codes

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### Sample Retention and Disposal

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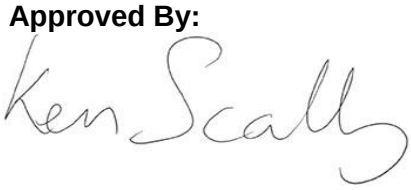
# Final Report

| | |
|---|---|
| **Report No.:** | 19-33142-1 |
| **Initial Date of Issue:** | 10-Oct-2019 |
| **Client** | Celtic Ltd |
| **Client Address:** | Columbus House<br>Greenmeadow Springs<br>Tongwynlais<br>Cardiff<br>Glamorgan<br>CF15 7NE |
| **Contact(s):** | Katie Dennis<br>Paul Lambe |
| **Project** | C1722 Royal Mint |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 03-Oct-2019 |
| **Order No.:** | 79981 | **Date Instructed:** | 03-Oct-2019 |
| **No. of Samples:** | 19 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 09-Oct-2019 |
| **Date Approved:** | 10-Oct-2019 | | |

**Approved By:**



**Details:** Ken Scally, Technical Director

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# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 19-33142 | 19-33142 | 19-33142 | 19-33142 | 19-33142 | 19-33142 | 19-33142 | 19-33142 | 19-33142 | 19-33142 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 899516 | 899517 | 899518 | 899519 | 899520 | 899521 | 899522 | 899524 | 899525 | 899526 |
| | | Sample Location: | | | BHE 1 | BHE 2 | BHE 3 | BHE 4 | BHE 5 | BHE 6 | BH26 | SW0 | SW1 | SW2 |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Date Sampled ($): | | | 01-Oct-2019 | 01-Oct-2019 | 01-Oct-2019 | 01-Oct-2019 | 01-Oct-2019 | 01-Oct-2019 | 01-Oct-2019 | 01-Oct-2019 | 01-Oct-2019 | 01-Oct-2019 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | | | | |
| Total Hardness as CaCO3 | U | 1270 | mg/l | 15 | 100 | 190 | 180 | 130 | 92 | 80 | 19 | | 40 | 40 |
| Arsenic (Dissolved) | U | 1450 | µg/l | 1.0 | 1.5 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | | < 1.0 | < 1.0 |
| Boron (Dissolved) | U | 1450 | µg/l | 20 | 160 | 1100 | 59 | 36 | < 20 | < 20 | 160 | | < 20 | < 20 |
| Cadmium (Dissolved) | U | 1450 | µg/l | 0.080 | < 0.080 | 0.32 | < 0.080 | < 0.080 | < 0.080 | < 0.080 | < 0.080 | | < 0.080 | < 0.080 |
| Chromium (Dissolved) | U | 1450 | µg/l | 1.0 | 5.5 | < 1.0 | < 1.0 | < 1.0 | 14 | < 1.0 | < 1.0 | | < 1.0 | < 1.0 |
| Copper (Dissolved) | U | 1450 | µg/l | 1.0 | 110 | 34 | 8.8 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | | 1.2 | < 1.0 |
| Mercury (Dissolved) | U | 1450 | µg/l | 0.50 | < 0.50 | < 0.50 | < 0.50 | < 0.50 | < 0.50 | < 0.50 | < 0.50 | | < 0.50 | < 0.50 |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | 2200 | 28000 | 1400 | 150 | 41 | 7.6 | 1100 | 2.0 | 2.2 | < 1.0 |
| Lead (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | | < 1.0 | < 1.0 |
| Selenium (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | 1.8 | 1.7 | 1.0 | < 1.0 | < 1.0 | 3.4 | | < 1.0 | < 1.0 |
| Zinc (Dissolved) | U | 1450 | µg/l | 1.0 | 20 | 380 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | 11 | | < 1.0 | < 1.0 |

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# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 19-33142 | 19-33142 | 19-33142 | 19-33142 | 19-33142 | 19-33142 | 19-33142 | 19-33142 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 899527 | 899528 | 899529 | 899530 | 899531 | 899532 | 899533 | 899534 |
| | | Sample Location: | | | SW3 | SW4 | CBH17-1 | CBH17-2 | CBH17-3 | CBH17-4 | CBH17-5 | CBH17-6 |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Date Sampled ($): | | | 01-Oct-2019 | 01-Oct-2019 | 01-Oct-2019 | 01-Oct-2019 | 01-Oct-2019 | 01-Oct-2019 | 01-Oct-2019 | 01-Oct-2019 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | | |
| Total Hardness as CaCO3 | U | 1270 | mg/l | 15 | 41 | | | | | | | |
| Arsenic (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | | | | | | | |
| Boron (Dissolved) | U | 1450 | µg/l | 20 | < 20 | | | | | | | |
| Cadmium (Dissolved) | U | 1450 | µg/l | 0.080 | < 0.080 | | | | | | | |
| Chromium (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | | | | | | | |
| Copper (Dissolved) | U | 1450 | µg/l | 1.0 | 2.2 | | | | | | | |
| Mercury (Dissolved) | U | 1450 | µg/l | 0.50 | < 0.50 | | | | | | | |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | 1.4 | < 1.0 | 160 | 410 | 310 | 2500 | 1100 | 140 |
| Lead (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | | | | | | | |
| Selenium (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | | | | | | | |
| Zinc (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | | | | | | | |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1270 | Total Hardness of Waters | Total hardness | Calculation applied to calcium and magnesium results, expressed as mg l-1 CaCO3 equivalent. |
| 1415 | Cations in Waters by ICP-MS | Sodium; Potassium; Calcium; Magnesium | Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS). |
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |

## Report Information

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Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

### Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

### Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

# Amended Report

| | | | |
|---|---|---|---|
| **Report No.:** | 19-38632-2 | | |
| **Initial Date of Issue:** | 25-Nov-2019 | **Date of Re-Issue:** | 04-Sep-2020 |
| **Client** | Celtic Ltd | | |
| **Client Address:** | Columbus House<br>Greenmeadow Springs<br>Tongwynlais<br>Cardiff<br>Glamorgan<br>CF15 7NE | | |
| **Contact(s):** | Katie Dennis<br>Katie Walker<br>Kirsty Sweeny<br>Paul Lambe<br>Stephen Kidley | | |
| **Project** | C1722 Royal Mint | | |
| **Quotation No.:** | | **Date Received:** | 19-Nov-2019 |
| **Order No.:** | 79981 | **Date Instructed:** | 19-Nov-2019 |
| **No. of Samples:** | 7 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 25-Nov-2019 |
| **Date Approved:** | 25-Nov-2019 | | |
| **Approved By:** | | | |
| **Details:** | Amy Parekh-Pross, Technical Projects Manager | | |

# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 19-38632 | 19-38632 | 19-38632 | 19-38632 | 19-38632 | 19-38632 | 19-38632 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 927464 | 927465 | 927466 | 927467 | 927468 | 927469 | 927470 |
| | | Sample Location: | | | CBH 17-3 | CBH 17-2 | CBH 17-1 | CBH 17-4 | CBH 17-5 | CBH 17-6 | BH 26 |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Date Sampled: | | | 18-Nov-2019 | 18-Nov-2019 | 18-Nov-2019 | 18-Nov-2019 | 18-Nov-2019 | 18-Nov-2019 | 18-Nov-2019 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | |
| pH | U | 1010 | | N/A | 12.7 | 12.7 | 2.7 | 6.4 | 12.1 | 12.2 | 2.3 |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | 120 | 91 | 23 | 260 | 63 | 73 | 920 |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1010 | pH Value of Waters | pH | pH Meter |
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |

## Report Information

**Key**

| | |
|---|---|
| U | UKAS accredited |
| M | MCERTS and UKAS accredited |
| N | Unaccredited |
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| SN | This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis |
| T | This analysis has been subcontracted to an unaccredited laboratory |
| I/S | Insufficient Sample |
| U/S | Unsuitable Sample |
| N/E | not evaluated |
| < | "less than" |
| > | "greater than" |

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

**Sample Deviation Codes**

A - Date of sampling not supplied

B - Sample age exceeds stability time (sampling to extraction)

C - Sample not received in appropriate containers

D - Broken Container

E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

**Sample Retention and Disposal**

All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

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customerservices@chemtest.com

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Email: info@chemtest.com

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# Final Report

| | |
|---|---|
| **Report No.:** | 19-37779-1 |
| **Initial Date of Issue:** | 15-Nov-2019 |
| **Client** | Celtic Ltd |
| **Client Address:** | Columbus House<br>Greenmeadow Springs<br>Tongwynlais<br>Cardiff<br>Glamorgan<br>CF15 7NE |
| **Contact(s):** | Katie Dennis<br>Katie Walker<br>Kirsty Sweeny<br>Paul Lambe<br>Stephen Kidley |
| **Project** | C1722 Royal Mint |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 12-Nov-2019 |
| **Order No.:** | 79981 | **Date Instructed:** | 12-Nov-2019 |
| **No. of Samples:** | 7 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 18-Nov-2019 |
| **Date Approved:** | 15-Nov-2019 | | |

**Approved By:**

**Details:** Glynn Harvey, Laboratory Manager

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# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 19-37779 | 19-37779 | 19-37779 | 19-37779 | 19-37779 | 19-37779 | 19-37779 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 922993 | 922994 | 922995 | 922996 | 922997 | 922998 | 922999 |
| | | Sample Location: | | | CBH17-1 | CBH17-2 | CBH17-3 | CBH17-4 | CBH17-5 | CBH17-6 | BH26 |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Date Sampled ($): | | | 11-Nov-2019 | 11-Nov-2019 | 11-Nov-2019 | 11-Nov-2019 | 11-Nov-2019 | 11-Nov-2019 | 11-Nov-2019 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | |
| pH | U | 1010 | | N/A | 12.3 | 12.3 | 3.1 | 6.0 | 12.0 | 12.1 | 3.6 |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | 140 | 89 | 850 | 54000 | 630 | 210 | 9600 |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1010 | pH Value of Waters | pH | pH Meter |
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |

## Report Information

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| SN | This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis |
| T | This analysis has been subcontracted to an unaccredited laboratory |
| I/S | Insufficient Sample |
| U/S | Unsuitable Sample |
| N/E | not evaluated |
| < | "less than" |
| > | "greater than" |
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### Sample Deviation Codes

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B - Sample age exceeds stability time (sampling to extraction)
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D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

### Sample Retention and Disposal

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# Final Report

| | |
|---|---|
| **Report No.:** | 19-42069-1 |
| **Initial Date of Issue:** | 19-Dec-2019 |
| **Client** | Celtic Ltd |
| **Client Address:** | Columbus House<br>Greenmeadow Springs<br>Tongwynlais<br>Cardiff<br>Glamorgan<br>CF15 7NE |
| **Contact(s):** | Katie Dennis<br>Katie Walker<br>Kirsty Sweeny<br>Paul Lambe<br>Stephen Kidley |
| **Project** | C1722 Royal Mint |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 16-Dec-2019 |
| **Order No.:** | 79981 | **Date Instructed:** | 17-Dec-2019 |
| **No. of Samples:** | 6 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 23-Dec-2019 |
| **Date Approved:** | 19-Dec-2019 | | |

**Approved By:**

**Details:** Glynn Harvey, Laboratory Manager

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# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | | | | **Chemtest Job No.:** | 19-42069 | 19-42069 | 19-42069 | 19-42069 | 19-42069 |
|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | | | | **Chemtest Sample ID.:** | 944455 | 944456 | 944457 | 944458 | 944459 | 944460 |
| | | | | | Sample Location: | CBH 17-1 | CBH 17-2 | CBH 17-3 | CBH 17-4 | CBH 17-5 | CBH 17-6 |
| | | | | | Sample Type: | WATER | WATER | WATER | WATER | WATER | WATER |
| | | | | | Date Sampled ($): | 13-Dec-2019 | 13-Dec-2019 | 13-Dec-2019 | 13-Dec-2019 | 13-Dec-2019 | 13-Dec-2019 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | | 130 | 28 | 22000 | 56000 | 680 | 66 |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |

## Report Information

### Key

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| T | This analysis has been subcontracted to an unaccredited laboratory |
| I/S | Insufficient Sample |
| U/S | Unsuitable Sample |
| N/E | not evaluated |
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All Asbestos testing is performed at the indicated laboratory
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### Sample Deviation Codes

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D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

### Sample Retention and Disposal

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Email: info@chemtest.com

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# Final Report

| | |
|---|---|
| **Report No.:** | 19-42039-1 |
| **Initial Date of Issue:** | 19-Dec-2019 |
| **Client** | Celtic Ltd |
| **Client Address:** | Columbus House<br>Greenmeadow Springs<br>Tongwynlais<br>Cardiff<br>Glamorgan<br>CF15 7NE |
| **Contact(s):** | Katie Dennis<br>Katie Walker<br>Kirsty Sweeny<br>Paul Lambe<br>Stephen Kidley |
| **Project** | C1722 Royal Mint |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 16-Dec-2019 |
| **Order No.:** | 79981 | **Date Instructed:** | 17-Dec-2019 |
| **No. of Samples:** | 13 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 23-Dec-2019 |
| **Date Approved:** | 19-Dec-2019 | | |

**Approved By:**

**Details:** Glynn Harvey, Laboratory Manager

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# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 19-42039 | 19-42039 | 19-42039 | 19-42039 | 19-42039 | 19-42039 | 19-42039 | 19-42039 | 19-42039 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 944442 | 944443 | 944444 | 944445 | 944446 | 944447 | 944448 | 944449 | 944450 |
| | | Sample Location: | | | BHE 1 | BHE 2 | BHE 3 | BHE 4 | BHE 5 | BHE 6 | BH 26 | SW A | SW 0 |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Date Sampled ($): | | | 13-Dec-2019 | 13-Dec-2019 | 13-Dec-2019 | 13-Dec-2019 | 13-Dec-2019 | 13-Dec-2019 | 13-Dec-2019 | 13-Dec-2019 | 13-Dec-2019 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | | | |
| Total Hardness as CaCO3 | U | 1270 | mg/l | 15 | 71 | 150 | 190 | 130 | 56 | 52 | 60 | | |
| Arsenic (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | 1.0 | < 1.0 | < 1.0 | | |
| Boron (Dissolved) | U | 1450 | µg/l | 20 | 21 | 260 | < 20 | < 20 | < 20 | < 20 | 270 | | |
| Cadmium (Dissolved) | U | 1450 | µg/l | 0.080 | < 0.080 | 0.13 | < 0.080 | < 0.080 | < 0.080 | < 0.080 | 0.095 | | |
| Chromium (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | 3.3 | 1100 | | |
| Copper (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | 1.7 | < 1.0 | 22 | | |
| Mercury (Dissolved) | U | 1450 | µg/l | 0.50 | 0.88 | 0.66 | 0.73 | 2.2 | 2.1 | 1.7 | 4.8 | | |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | 890 | 13000 | 150 | 21 | < 1.0 | 5.1 | 8400 | 47 | < 1.0 |
| Lead (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | | |
| Selenium (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | 2.2 | < 1.0 | 1.5 | < 1.0 | < 1.0 | 2.5 | | |
| Zinc (Dissolved) | U | 1450 | µg/l | 1.0 | 4.4 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | | |

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# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 19-42039 | 19-42039 | 19-42039 | 19-42039 |
|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 944451 | 944452 | 944453 | 944454 |
| | | | Sample Location: | | SW 1 | SW 2 | SW 3 | SW 4 |
| | | | Sample Type: | | WATER | WATER | WATER | WATER |
| | | | Date Sampled ($): | | 13-Dec-2019 | 13-Dec-2019 | 13-Dec-2019 | 13-Dec-2019 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | |
| Total Hardness as CaCO3 | U | 1270 | mg/l | 15 | 30 | 36 | 36 | |
| Arsenic (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | < 1.0 | |
| Boron (Dissolved) | U | 1450 | µg/l | 20 | < 20 | < 20 | < 20 | |
| Cadmium (Dissolved) | U | 1450 | µg/l | 0.080 | < 0.080 | < 0.080 | < 0.080 | |
| Chromium (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | < 1.0 | |
| Copper (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | < 1.0 | |
| Mercury (Dissolved) | U | 1450 | µg/l | 0.50 | 1.2 | 1.5 | 1.0 | |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Lead (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | < 1.0 | |
| Selenium (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | < 1.0 | |
| Zinc (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | 1.2 | 1.8 | |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1270 | Total Hardness of Waters | Total hardness | Calculation applied to calcium and magnesium results, expressed as mg l-1 CaCO3 equivalent. |
| 1415 | Cations in Waters by ICP-MS | Sodium; Potassium; Calcium; Magnesium | Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS). |
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |

## Report Information

### Key

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# Final Report

| | |
|---|---|
| **Report No.:** | 19-40546-1 |
| **Initial Date of Issue:** | 09-Dec-2019 |
| **Client** | Celtic Ltd |
| **Client Address:** | Columbus House<br>Greenmeadow Springs<br>Tongwynlais<br>Cardiff<br>Glamorgan<br>CF15 7NE |
| **Contact(s):** | Katie Dennis<br>Katie Walker<br>Kirsty Sweeny<br>Paul Lambe<br>Stephen Kidley |
| **Project** | C1722 Royal Mint |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 04-Dec-2019 |
| **Order No.:** | 79981 | **Date Instructed:** | 04-Dec-2019 |
| **No. of Samples:** | 7 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 10-Dec-2019 |
| **Date Approved:** | 09-Dec-2019 | | |

**Approved By:**

**Details:** Amy Parekh-Pross, Technical Projects Manager

Chemtest
The right chemistry to deliver results

# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 19-40546 | 19-40546 | 19-40546 | 19-40546 | 19-40546 | 19-40546 | 19-40546 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 937074 | 937075 | 937076 | 937077 | 937078 | 937079 | 937080 |
| | | Sample Location: | | | CBH 17-1 | CBH 17-2 | CBH 17-3 | CBH 17-4 | CBH 17-5 | CBH 17-6 | BH 26 |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Date Sampled ($): | | | 02-Dec-2019 | 02-Dec-2019 | 02-Dec-2019 | 02-Dec-2019 | 02-Dec-2019 | 02-Dec-2019 | 02-Dec-2019 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | |
| pH | U | 1010 | | N/A | 12.4 | 12.3 | 3.1 | 7.9 | 10.6 | 10.9 | 3.0 |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | 50 | 130 | 11000 | 47000 | 1000 | 440 | 82000 |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1010 | pH Value of Waters | pH | pH Meter |
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |

## Report Information

### Key

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### Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

### Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

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Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

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# Final Report

| | |
|---|---|
| **Report No.:** | 20-03304-1 |
| **Initial Date of Issue:** | 10-Feb-2020 |
| **Client** | Celtic Ltd |
| **Client Address:** | Columbus House<br>Greenmeadow Springs<br>Tongwynlais<br>Cardiff<br>Glamorgan<br>CF15 7NE |
| **Contact(s):** | Katie Walker<br>Kirsty Sweeny<br>Paul Lambe<br>Stephen Kidley |
| **Project** | C1722 Royal Mint |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 03-Feb-2020 |
| **Order No.:** | 79981 | **Date Instructed:** | 04-Feb-2020 |
| **No. of Samples:** | 7 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 10-Feb-2020 |
| **Date Approved:** | 10-Feb-2020 | | |

**Approved By:**

**Details:** Glynn Harvey, Laboratory Manager

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# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 20-03304 | 20-03304 | 20-03304 | 20-03304 | 20-03304 | 20-03304 | 20-03304 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 963095 | 963096 | 963097 | 963098 | 963099 | 963100 | 963101 |
| | | Sample Location: | | | CBH 17-1 | CBH 17-2 | CBH 17-3 | CBH 17-4 | CBH 17-5 | CBH 17-6 | BH 26 |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Date Sampled: | | | 31-Jan-2020 | 31-Jan-2020 | 31-Jan-2020 | 31-Jan-2020 | 31-Jan-2020 | 31-Jan-2020 | 31-Jan-2020 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | |
| pH | U | 1010 | | N/A | 12.4 | 12.3 | 2.6 | 7.3 | 11.9 | 12.1 | 3.4 |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | 240 | 39 | 1900 | 11000 | 100 | 67 | 14000 |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1010 | pH Value of Waters | pH | pH Meter |
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |

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# Report Information

## Key

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| N | Unaccredited |
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| SN | This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis |
| T | This analysis has been subcontracted to an unaccredited laboratory |
| I/S | Insufficient Sample |
| U/S | Unsuitable Sample |
| N/E | not evaluated |
| < | "less than" |
| > | "greater than" |

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For all other tests the samples were dried at < 37°C prior to analysis
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A - Date of sampling not supplied
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**CB8 0AL**
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# Final Report

| | |
|---|---|
| **Report No.:** | 20-02557-1 |
| **Initial Date of Issue:** | 31-Jan-2020 |
| **Client** | Celtic Ltd |
| **Client Address:** | Columbus House<br>Greenmeadow Springs<br>Tongwynlais<br>Cardiff<br>Glamorgan<br>CF15 7NE |
| **Contact(s):** | Kirsty Sweeny<br>Paul Lambe<br>Katie Walker<br>Stephen Kidley |
| **Project** | C1722 ROYAL MINT |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 27-Jan-2020 |
| **Order No.:** | 79981 | **Date Instructed:** | 28-Jan-2020 |
| **No. of Samples:** | 7 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 03-Feb-2020 |
| **Date Approved:** | 31-Jan-2020 | | |

**Approved By:**

**Details:** Glynn Harvey, Laboratory Manager

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# Results - Water

**Project: C1722 ROYAL MINT**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 20-02557 | 20-02557 | 20-02557 | 20-02557 | 20-02557 | 20-02557 | 20-02557 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 959729 | 959730 | 959731 | 959732 | 959733 | 959734 | 959735 |
| | | Sample Location: | | | CBH 17.1 | CBH 17.2 | CBH 17.3 | CBH 17.4 | CBH 17.5 | CBH 17.6 | BH 26 |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Date Sampled: | | | 24-Jan-2020 | 24-Jan-2020 | 24-Jan-2020 | 24-Jan-2020 | 24-Jan-2020 | 24-Jan-2020 | 24-Jan-2020 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | |
| pH | U | 1010 | | N/A | 12.2 | 12.6 | 3.5 | 5.6 | 11.9 | 12.1 | 3.2 |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | 23 | 12000 | 56 | 470 | 37 | 37000 |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1010 | pH Value of Waters | pH | pH Meter |
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |

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# Report Information

## Key

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|---|---|
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| M | MCERTS and UKAS accredited |
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| T | This analysis has been subcontracted to an unaccredited laboratory |
| I/S | Insufficient Sample |
| U/S | Unsuitable Sample |
| N/E | not evaluated |
| < | "less than" |
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Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

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D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

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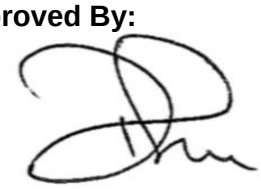
# Final Report

| | |
|---|---|
| **Report No.:** | 20-09574-1 |
| **Initial Date of Issue:** | 02-Apr-2020 |
| **Client** | Celtic Ltd |
| **Client Address:** | Columbus House<br>Greenmeadow Springs<br>Tongwynlais<br>Cardiff<br>Glamorgan<br>CF15 7NE |
| **Contact(s):** | Kirsty Sweeny<br>Katie Walker<br>Paul Lambe<br>Stephen Kidley |
| **Project** | C1722 Royal Mint |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 27-Mar-2020 |
| **Order No.:** | 79981 | **Date Instructed:** | 27-Mar-2020 |
| **No. of Samples:** | 19 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 02-Apr-2020 |
| **Date Approved:** | 02-Apr-2020 | | |

**Approved By:**



**Details:** Darrell Hall, Director

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# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 20-09574 | 20-09574 | 20-09574 | 20-09574 | 20-09574 | 20-09574 | 20-09574 | 20-09574 | 20-09574 | 20-09574 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 992959 | 992960 | 992961 | 992962 | 992963 | 992964 | 992965 | 992966 | 992967 | 992968 |
| | | Client Sample ID.: | | | 1 | 2 | 3 | 4 | 5 | 6 | 26 | A | 0 | 1 |
| | | Sample Location: | | | BHE | BHE | BHE | BHE | BHE | BHE | BH | SW | SW | SW |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Date Sampled: | | | 26-Mar-2020 | 26-Mar-2020 | 26-Mar-2020 | 26-Mar-2020 | 26-Mar-2020 | 26-Mar-2020 | 26-Mar-2020 | 26-Mar-2020 | 26-Mar-2020 | 26-Mar-2020 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | | | | |
| pH | U | 1010 | | N/A | 8.4 | 7.8 | 8.1 | 8.2 | 8.3 | 8.1 | 2.4 | 7.4 | 7.5 | 8.3 |
| Total Hardness as CaCO3 | U | 1270 | mg/l | 15 | 150 | 93 | 170 | 69 | 81 | 74 | 59 | | | 45 |
| Arsenic (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | | | < 1.0 |
| Boron (Dissolved) | U | 1450 | µg/l | 20 | 180 | 330 | 73 | 30 | < 20 | < 20 | 1200 | | | < 20 |
| Cadmium (Dissolved) | U | 1450 | µg/l | 0.080 | < 0.080 | 0.15 | < 0.080 | < 0.080 | < 0.080 | < 0.080 | 0.83 | | | < 0.080 |
| Chromium (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | 3800 | | | < 1.0 |
| Copper (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | 96 | | | < 1.0 |
| Mercury (Dissolved) | U | 1450 | µg/l | 0.50 | 0.72 | 0.62 | 0.68 | < 0.50 | < 0.50 | < 0.50 | 2.4 | | | < 0.50 |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | 5200 | 11000 | 850 | 20 | 1.1 | 1.1 | 24000 | 23 | < 1.0 | 5.2 |
| Lead (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | | | < 1.0 |
| Selenium (Dissolved) | U | 1450 | µg/l | 1.0 | 3.0 | 2.2 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | 3.1 | | | < 1.0 |
| Zinc (Dissolved) | U | 1450 | µg/l | 1.0 | 21 | 48 | 5.7 | 3.9 | < 1.0 | 16 | 120 | | | 1.4 |

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# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 20-09574 | 20-09574 | 20-09574 | 20-09574 | 20-09574 | 20-09574 | 20-09574 | 20-09574 | 20-09574 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 992969 | 992970 | 992971 | 992972 | 992973 | 992974 | 992975 | 992976 | 992977 |
| | | Client Sample ID.: | | | 2 | 3 | 4 | 171 | 172 | 173 | 174 | 175 | 176 |
| | | Sample Location: | | | SW | SW | SW | CBH | CBH | CBH | CBH | CBH | CBH |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Date Sampled: | | | 26-Mar-2020 | 26-Mar-2020 | 26-Mar-2020 | 26-Mar-2020 | 26-Mar-2020 | 26-Mar-2020 | 26-Mar-2020 | 26-Mar-2020 | 26-Mar-2020 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | | | |
| pH | U | 1010 | | N/A | 8.2 | 8.1 | 8.1 | 13.3 | 12.5 | 2.1 | 12.4 | 12.3 | 12.4 |
| Total Hardness as CaCO3 | U | 1270 | mg/l | 15 | 42 | 42 | | | | | | | |
| Arsenic (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | | | | | | | |
| Boron (Dissolved) | U | 1450 | µg/l | 20 | < 20 | < 20 | | | | | | | |
| Cadmium (Dissolved) | U | 1450 | µg/l | 0.080 | < 0.080 | < 0.080 | | | | | | | |
| Chromium (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | | | | | | | |
| Copper (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | | | | | | | |
| Mercury (Dissolved) | U | 1450 | µg/l | 0.50 | < 0.50 | < 0.50 | | | | | | | |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | < 1.0 | 320 | 62 | 9100 | 43 | 5.0 | 7.9 |
| Lead (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | | | | | | | |
| Selenium (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | < 1.0 | | | | | | | |
| Zinc (Dissolved) | U | 1450 | µg/l | 1.0 | 1.7 | 1.6 | | | | | | | |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1010 | pH Value of Waters | pH | pH Meter |
| 1270 | Total Hardness of Waters | Total hardness | Calculation applied to calcium and magnesium results, expressed as mg l-1 CaCO3 equivalent. |
| 1415 | Cations in Waters by ICP-MS | Sodium; Potassium; Calcium; Magnesium | Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS). |
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |

## Report Information

### Key

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Email: info@chemtest.com

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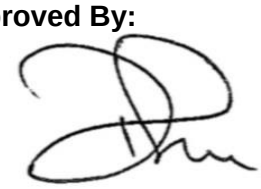
# Final Report

| | |
|---|---|
| **Report No.:** | 20-08340-1 |
| **Initial Date of Issue:** | 24-Mar-2020 |
| **Client** | Celtic Ltd |
| **Client Address:** | Columbus House<br>Greenmeadow Springs<br>Tongwynlais<br>Cardiff<br>Glamorgan<br>CF15 7NE |
| **Contact(s):** | Kirsty Sweeny<br>Paul Lambe<br>Katie Walker<br>Stephen Kidley |
| **Project** | C1722 Royal Mint |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 17-Mar-2020 |
| **Order No.:** | 79981 | **Date Instructed:** | 17-Mar-2020 |
| **No. of Samples:** | 7 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 23-Mar-2020 |
| **Date Approved:** | 24-Mar-2020 | | |

**Approved By:**



**Details:** Darrell Hall, Director

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# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 20-08340 | 20-08340 | 20-08340 | 20-08340 | 20-08340 | 20-08340 | 20-08340 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 986693 | 986694 | 986695 | 986696 | 986697 | 986698 | 986699 |
| | | Sample Location: | | | CBH | CBH | CBH | CBH | CBH | CBH | BH |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Top Depth (m): | | | 17.10 | 17.20 | 17.30 | 17.40 | 17.50 | 17.60 | 26.00 |
| | | Date Sampled: | | | 13-Mar-2020 | 13-Mar-2020 | 13-Mar-2020 | 13-Mar-2020 | 13-Mar-2020 | 13-Mar-2020 | 13-Mar-2020 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | |
| pH | U | 1010 | | N/A | 12.8 | 12.5 | 2.9 | 7.3 | 10.5 | 10.8 | 3.0 |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | < 1.0 | 20 | 9700 | 37000 | 63 | 12 | 20000 |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1010 | pH Value of Waters | pH | pH Meter |
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |

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The right chemistry to deliver results

# Report Information

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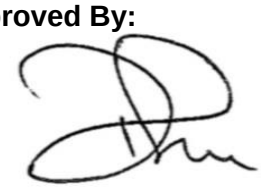
# Amended Report

| | | | |
|---|---|---|---|
| **Report No.:** | 20-07475-2 | | |
| **Initial Date of Issue:** | 11-Mar-2020 | **Date of Re-Issue:** | 04-Sep-2020 |
| **Client** | Celtic Ltd | | |
| **Client Address:** | Columbus House<br>Greenmeadow Springs<br>Tongwynlais<br>Cardiff<br>Glamorgan<br>CF15 7NE | | |
| **Contact(s):** | Katie Walker<br>Kirsty Sweeny<br>Paul Lambe<br>Stephen Kidley | | |
| **Project** | C1722 Royal Mint | | |
| **Quotation No.:** | | **Date Received:** | 09-Mar-2020 |
| **Order No.:** | 79981 | **Date Instructed:** | 09-Mar-2020 |
| **No. of Samples:** | 7 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 13-Mar-2020 |
| **Date Approved:** | 11-Mar-2020 | | |

**Approved By:**



**Details:** Darrell Hall, Director

# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 20-07475 | 20-07475 | 20-07475 | 20-07475 | 20-07475 | 20-07475 | 20-07475 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 982510 | 982511 | 982512 | 982513 | 982514 | 982515 | 982516 |
| | | Sample Location: | | | CBH 17-3 | CBH 17-2 | CBH 17-1 | CBH 17-4 | CBH 17-5 | CBH 17-6 | BH 26 |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Date Sampled: | | | 06-Mar-2020 | 06-Mar-2020 | 06-Mar-2020 | 06-Mar-2020 | 06-Mar-2020 | 06-Mar-2020 | 06-Mar-2020 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | |
| pH | U | 1010 | | N/A | 12.7 | 12.6 | 2.8 | 7.2 | 11.9 | 12.0 | 2.9 |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | 3500 | 28 | 47 | 280 | 84 | 24 | 8.7 |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1010 | pH Value of Waters | pH | pH Meter |
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |

## Report Information

**Key**

| | |
|---|---|
| U | UKAS accredited |
| M | MCERTS and UKAS accredited |
| N | Unaccredited |
| S | This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis |
| SN | This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis |
| T | This analysis has been subcontracted to an unaccredited laboratory |
| I/S | Insufficient Sample |
| U/S | Unsuitable Sample |
| N/E | not evaluated |
| < | "less than" |
| > | "greater than" |

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

**Sample Deviation Codes**

A - Date of sampling not supplied

B - Sample age exceeds stability time (sampling to extraction)

C - Sample not received in appropriate containers

D - Broken Container

E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

**Sample Retention and Disposal**

All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

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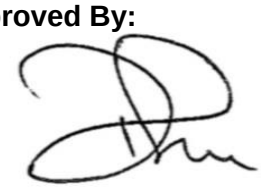
# Final Report

| | |
|---|---|
| **Report No.:** | 20-06082-1 |
| **Initial Date of Issue:** | 03-Mar-2020 |
| **Client** | Celtic Ltd |
| **Client Address:** | Columbus House<br>Greenmeadow Springs<br>Tongwynlais<br>Cardiff<br>Glamorgan<br>CF15 7NE |
| **Contact(s):** | Katie Walker<br>Kirsty Sweeny<br>Paul Lambe<br>Stephen Kidley |
| **Project** | C1722 Royal Mint |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 26-Feb-2020 |
| **Order No.:** | 79981 | **Date Instructed:** | 26-Feb-2020 |
| **No. of Samples:** | 7 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 03-Mar-2020 |
| **Date Approved:** | 02-Mar-2020 | | |

**Approved By:**



**Details:** Darrell Hall, Director

Chemtest
The right chemistry to deliver results

# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 20-06082 | 20-06082 | 20-06082 | 20-06082 | 20-06082 | 20-06082 | 20-06082 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 976201 | 976202 | 976203 | 976204 | 976205 | 976206 | 976207 |
| | | Sample Location: | | | CBH 17-1 | CBH 17-2 | CBH 17-3 | CBH 17-4 | CBH 17-5 | CBH 17-6 | BH 26 |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Date Sampled: | | | 25-Feb-2020 | 25-Feb-2020 | 25-Feb-2020 | 25-Feb-2020 | 25-Feb-2020 | 25-Feb-2020 | 25-Feb-2020 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | |
| pH | U | 1010 | | N/A | 12.7 | 12.5 | 3.8 | 6.7 | 12.3 | 12.3 | 8.0 |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | 170 | 23 | 210 | 860 | 25 | 26 | 38 |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1010 | pH Value of Waters | pH | pH Meter |
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |

Chemtest
The right chemistry to deliver results

# Report Information

## Key

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The results relate only to the items tested
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None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
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## Sample Deviation Codes

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B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

## Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

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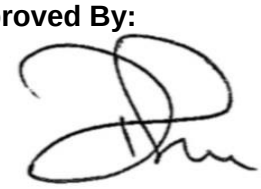
# Amended Report

| | | | |
|---|---|---|---|
| **Report No.:** | 20-04999-2 | | |
| **Initial Date of Issue:** | 20-Feb-2020 | **Date of Re-Issue:** | 04-Sep-2020 |
| **Client** | Celtic Ltd | | |
| **Client Address:** | Columbus House<br>Greenmeadow Springs<br>Tongwynlais<br>Cardiff<br>Glamorgan<br>CF15 7NE | | |
| **Contact(s):** | Katie Walker<br>Kirsty Sweeny<br>Paul Lambe<br>Stephen Kidley | | |
| **Project** | C1722 Royal Mint | | |
| **Quotation No.:** | | **Date Received:** | 17-Feb-2020 |
| **Order No.:** | 79981 | **Date Instructed:** | 17-Feb-2020 |
| **No. of Samples:** | 7 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 21-Feb-2020 |
| **Date Approved:** | 20-Feb-2020 | | |

**Approved By:**



**Details:** Darrell Hall, Director

# Results - Water

**Project: C1722 Royal Mint**

| **Client: Celtic Ltd** | | **Chemtest Job No.:** | | | 20-04999 | 20-04999 | 20-04999 | 20-04999 | 20-04999 | 20-04999 | 20-04999 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | **Chemtest Sample ID.:** | | | 970941 | 970942 | 970943 | 970944 | 970945 | 970946 | 970947 |
| | | Sample Location: | | | CBH 17.3 | CBH 17.2 | CBH 17.1 | CBH 17.4 | CBH 17.5 | CBH 17.6 | BH 26 |
| | | Sample Type: | | | WATER | WATER | WATER | WATER | WATER | WATER | WATER |
| | | Date Sampled: | | | 14-Feb-2020 | 14-Feb-2020 | 14-Feb-2020 | 14-Feb-2020 | 14-Feb-2020 | 14-Feb-2020 | 14-Feb-2020 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | |
| pH | U | 1010 | | N/A | 12.9 | 12.9 | 2.5 | 6.6 | 12.5 | 12.8 | 6.4 |
| Nickel (Dissolved) | U | 1450 | µg/l | 1.0 | 10000 | 9.1 | 120 | 48000 | 470 | 160 | 5400 |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1010 | pH Value of Waters | pH | pH Meter |
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |

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