BAL6/1

HATFIELD AERODROME

Town and Country Planning Act 1990, Section 78

Application for the establishment of a new quarry on land at the former Hatfield Aerodrome, including a new access onto the A1057, aggregate processing plant, concrete batching plant and other ancillary facilities, together with the importation of inert fill materials for the restoration of the minerals working

Application Ref. 5/0394-16

Section 78 Appeal against refusal of planning permission by Hertfordshire County Council.

Appeal Ref. APP/M1900/W/21/3278097

Proof of Evidence of Peter Rowland BSc. MSc.

Hydrogeology

SLR

SLR Ref: 403.09885.00024
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BASIS OF REPORT

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DOCUMENT REFERENCES

TABLES

ABBREVIATIONS

Agency	The Environment Agency
Affinity	Affinity Water plc
CSM	Conceptual Site Model
Brett	Brett Aggregates Limited
CQA	Construction Quality Assurance
CHPC	Colney Heath Parish Council
ESSE	Affinity Water, Essendon PWS
EARA	Ellenbrook Area Residents Association
GWMP	Groundwater and Water Management Plan
HATF	Affinity Water, Bishops Rise PWS
HCC	Hertfordshire County Council
IB	Interburden
LMH	Lower Mineral Horizon
LMA	Lower Mineral Aquifer
UMH	Upper Mineral Horizon
UMA	Upper Mineral Aquifer
UML	Upper Mineral Lagoon
LML	Lower Mineral Lagoon
mAOD	metres above ordnance datum
ROES	Affinity Water, Roestock PWS
PWS	Public Water Supply
SPZ	Source Protection Zone
SRA	Smallford Residents Association

1.0 Introduction

1.1 The following Inquiry Report has been prepared by Mr Peter Rowland. I hold the position of Technical Director (Land Quality and Remediation) at SLR Consulting Limited (SLR).

1.2 The documents that provided the evidential basis for this report are listed in the Core Documents List and are referenced in this report.

1.3 Regarding this proposed development, I was involved in initial discussions with the Environment Agency (the Agency) from 2010 onwards and subsequently with Affinity Water plc (Affinity) and Hertfordshire County Council (HCC). In 2010 The Agency stated that they could not support any application that compromised the ability of the Appropriate Person (AP) to remediate the bromate plume. These early and subsequent discussions with the Agency have guided the site design by adopting a conservative and precautionary approach. I, with the assistance of colleagues at SLR, have continued to plan and review all aspects of the groundwater environment at the application site on behalf of the Appellant, including hydrogeological inputs to Chapter 6 (Water Environment) of the Environmental Statement (ES) (CD1.2) which accompanied the Planning Application 5/0394-16 submitted in January 2016.

Professional Qualification and Experience Details.

1.4 I hold a Bachelor of Science degree in Geology and a Master of Science degree in Hydrogeology. I am a hydrogeologist with over 38 years of professional experience, 33 years in environmental consultancy in the USA (EMCON Associates), UK (ARCADIS, SLR), and UAE (SLR), preceded by 5 years in the Energy sector in the USA. While in the USA I was registered as a Professional Geologist (1990) in the State of Idaho which has reciprocity in many other States.

1.5 I have been employed by SLR as a Technical Director since 2006. I have worked across SLR's entire client base including Government, multinational firms, the professional and financial sector, and land development, where I apply my knowledge of land contamination and hydrogeology to assessing risk and liability and finding solutions for all stakeholders. I have been involved during regulatory authority negotiation, public meetings and take a senior role in site assessments, risk assessments, remedial feasibility studies, and remedial system design.

1.6 My Chalk aquifer experience include investigation, risk assessment and remediation of groundwater on behalf of the DIO (Defence Infrastructure Organisation) in Wiltshire, investigation, and risk assessment on behalf of a global pharmaceutical firm in the Home Counties, and the design and development of Chalk aquifer water supply boreholes in London. There have also been numerous other projects of different scales and complexity in unconsolidated mineral and dual porosity bedrock hydrogeological environments.

1.7 The evidence which I have prepared and provide for this appeal reference APP/BAL/6 (in this proof of evidence,) is true and has been prepared and is given in accordance with the guidance of my professional institution and I confirm that the opinions expressed are my true and professional opinions.

Background

1.8 Hertfordshire County Council (HCC) **(CD 1.8)** has objected to the establishment of a new quarry on land at the former Hatfield Aerodrome. At its meeting on 24th September 2020 members at the Development Control Committee resolved to refuse planning permission against officer's recommendation for approval. The Decision Notice was subsequently issued on 6th January 2021. Four reasons were put forward for refusing the planning permission. The fourth reason for refusal was stated as:

> *The lower aquifer to the north of the application site is contaminated by Bromate. The application proposes the extraction of sand and gravels from within the lower aquifer in close proximity to*

groundwater contaminated by Bromate. There is a high level of local concern that extracting mineral from within the lower aquifer could; extend the bromate contamination within the mineral workings; reduce the effectiveness of the measures in place to remediate the Bromate contamination; and potentially lead to contamination of boreholes used for the public drinking water supply at Essendon. It has not been demonstrated to the satisfaction of the Mineral Planning Authority that the risks to the water environment from the mineral working are acceptable; and, that all routes to possible contamination have been appropriately investigated; and, that all necessary mitigation against all risks has been included in the proposal; and, that the proposed mitigation will be effective. The proposal would thereby be contrary to the provisions of the Hertfordshire Minerals Local Plan (Policy 17(iv)) which does not permit mineral development resulting in negative quantitative and/or qualitative impact on the water environment, and to the provisions of the NPPF (Paragraph 170) for conserving and enhancing the natural environment, and to Policy R7 (Protection of Ground and Surface Water) of the Welwyn Hatfield District Plan (adopted 2005).

Report Structure

1.9 This report structure is set out in subsections as detailed below:

- Section 2: Provides a summary of statutory consultee responses to the application relevant to hydrogeology and the bromate plume
- Section 3: summarises the grounds of objection
- Section 4: outlines the scope of this Proof of Evidence report
- Section 5: provides a summary of the scope of the previous assessments
- Section 6: presents a discussion of the matters that formed the Grounds of Objection
- Section 7: presents conclusions.

2.0 Responses from Statutory Consultees

2.1 Of relevance to hydrogeology matters, responses to the application were received from the following statutory consultees:

- Environment Agency
- Affinity Water
- Hertfordshire County Council

2.2 As is outlined in detail below, the Agency and Affinity withdrew their objections to the 2016 Application on the basis of further detailed submissions by SLR on behalf of the applicant. Furthermore, the Planning Officers at HCC recommended approval of the application. Details of the submissions made by the consultees recommending approval are provided below.

Affinity Water

2.3 Affinity was consulted on the original planning application by HCC and initially objected to the proposed new quarry because the water they supplied (in their role as a statutory water undertaker) in this area is abstracted from groundwater sources and they had abstractions that could be affected by the proposed development. Affinity has since removed their objection following the submission of further information by SLR and the Appellant; details are provided below.

Affinity Letter to HCC dated 13th August 2018

2.4 Affinity objected to the application **(CD5.1)** following consultation on a draft Groundwater and Water Management Plan (GWMP), pending resolution of detailed controls necessary to ensure that the quarrying activities proposed by Brett did not affect the mobilisation of the existing plume of bromate contamination.

2.5 Affinity commented that they were seeking to enter into a private agreement with Brett. Pursuant to this they had a constructive meeting with Brett on 16 July 2018 with a view to the negotiation of an agreement prior to the grant of any planning permission. Affinity acknowledged that Brett was keen to avoid any mobilisation of the plume and was acting entirely responsibly in its discussions.

2.6 Affinity advised Brett that the draft GWMP needed to be updated to reflect the outcome of the additional pumping test SLR had carried out and that further work was required to understand the impact of the proposed quarrying activities on Affinity's management of groundwater through the existing Bishops Rise scavenging borehole (HATF). The assessment work needed to consider the impact of the proposed quarrying activities against maximum scavenging abstraction rates by Affinity and what the in-combination impacts of abstraction would be on local Chalk groundwater flow.

Affinity Letter to HCC dated 18th December 2018

2.7 In response to further consultation on a revised GWMP prepared by SLR dated November 2018, Affinity stated that they were satisfied with its content but did not consider the GWMP alone was sufficient to ensure that the proposed quarrying activities pursuant to the proposed permission would not affect the mobilisation of the existing plume of bromate contamination **(CD5.2)**. Affinity stated that meetings had been held with Brett in respect of a private agreement that would set out additional controls related to protection of their (groundwater) sources at Tyttenhanger (TYTT) and Roestock (ROES) but the agreement was not yet concluded.

Affinity Letter to HCC dated 20 May 2019

2.8 On 20th May 2019 Affinity wrote to HCC **(CD5.3)** confirming that it had received an undertaking from Brett that it would not commence extraction of mineral from the Lower Mineral Horizon (LMH) until it had entered into an operating agreement. Affinity noted that heads of terms relating to this operating agreement had been agreed.

2.9 Affinity was satisfied that the arrangements in the operating agreement would provide it (as the appointed water undertaker) with a direct ability to ensure that sources of water that were used for public water supply were protected during quarrying activity. Affinity therefore withdrew its objection to the application. In conclusion Affinity stated that "In our view, the GWMP condition proposed by and agreed with the Agency is appropriate and adequate in accordance with the relevant Government guidance".

Rule 6 Statement to this Planning Appeal

2.10 In their Rule 6 statement to this Appeal **(CD5.4)**, Affinity noted that the private agreement was to initiate actions if groundwater levels were to reach historic lows levels or bromate concentrations in monitoring wells were to exceed defined prescribed values. The private agreement was primarily aiming for protection of:

- the scavenging operation at the HATF source,
- Affinity groundwater abstraction sources at TYTT and ROES in order to maintain water supply resilience and to ensure the bromate plume does not change its position and spatial extent from their abstraction sources due to quarrying activities; and,
- limiting any future cost exposure to Affinity's customers in the event of any negative impact on the local water sources due to Brett's activities.

2.11 Affinity noted that whilst Heads of Terms for the private agreement had been agreed, the full agreement affording all protections is not in place, because the Application had been refused.

2.12 Affinity wanted to emphasise to the Planning Inspector the significance of a suitable monitoring arrangement being in place should the development be approved and progress. The monitoring requirements should be linked to triggers on:

- the lowest recorded Chalk and Lower Mineral Horizon (LMH) groundwater levels in the existing boreholes around the proposed quarry; and,
- historic bromate concentrations at several observation boreholes around the proposed quarry.

2.13 The triggers would reference the need for further technical meetings with further actions to be decided upon at the time.

Environment Agency

2.14 The Agency has been consulted extensively by Brett and SLR through pre-application and post-application meetings and submissions in relation to the 2016 Application. The matters included not only the potential for quarrying activities to impact the existing bromate plume, but also the applications for the groundwater abstraction licence(s) and an Environmental Permit to facilitate the mineral extraction and restoration of the mineral workings with inert waste. Upon being consulted on the original application the Agency lodged several objections which have since been removed. Details are provided below.

2.15 A clear summary of the extent and status of this consultation is outlined in the Agency Statement of Case **(EA SoC dated September 2021):**

- The Agency first entered pre application discussions with SLR acting on behalf of Brett regarding the proposed quarrying activities in 2012.
- In 2012, there was uncertainty regarding the location of the southern boundary of the bromate plume and concerns that the quarrying activities could interact and potentially exacerbate the effect of the bromate plume on groundwater quality. To address these concerns, SLR on behalf of Brett undertook several phases of site investigation, including groundwater quality monitoring to allow for a better understanding of the bromate plume local to the Site.
- The Agency stated that these works were completed in a logical manner by a competent environmental consultancy and the Agency was consulted throughout the process. They also stated that quarterly monitoring data, commenced in 2013 and, importantly, included representative groundwater level changes and different pumping regimes at HATF1.
- In addition to groundwater quality monitoring, pumping tests were undertaken by SLR in discussion with Affinity, in support of an application for dewatering and mineral washing licences. The results were used to demonstrate that the bromate plume was not present beneath the proposed working areas of the quarry and that the quarrying activity, including dewatering, could be managed without risk of exacerbating the bromate contamination.
- The Agency granted Brett an Environmental Permit on 15 January 2018 for Inert landfill (including waste treatment & mining waste operations) for restoration of the land to a country park including lakes. (EA Environmental Permit Regulations licence application number: EA/EPR/EB3808HD/v002. EA Waste Management Licence number: 403832) **(EA SoC Document 4**). This permit was modified on 2 January 2020 to amend the waste types that the site can accept within the Inert Category.
- The Agency granted Brett groundwater abstraction licences for UMA dewatering and minerals processing on 2 November 2018. (Agency Abstraction Licence numbers: TH/039/0028/054 for mineral washing **(EA SoC Document 5)**, and TH/039/0028/051 for dewatering) (**EA SoC Document 6)**.
- The requirements of each of these permits/licences were developed in consultation with Agency hydrogeologists familiar with the issues associated with the bromate contamination in groundwater, the local hydrogeology and setting of this site in the vicinity of other existing mineral and landfill operations.

2.16 Based on the information provided by SLR (on behalf of Brett) and the Agency's own understanding of the hydrogeological conditions in the vicinity of the site, the Agency recommended that planning permission be granted subject to the inclusion of conditions which required the provision of a GWMP for each phase of the quarry. The Agency recommended 3 Conditions be imposed if planning permission is granted **(EA SoC Section 6).**

Hertfordshire County Council

January 2017 Officers Report to Development Control Committee Agenda Item 1

2.17 Planning Officers submitted a report on the planning application to the meeting of Hertfordshire's Development Control Committee on 25th January 2017 (HCC DCC January 2017 Report' **(CD1.4)**. The

[1] HATF are the groundwater boreholes (also known as Bishops Rise) that Affinity use to scavenge the bromatebromate plume in the Hatfield area.

application was recommended for approval, with a summary of the reasons for the recommendation set out in paragraphs 2.1 to 2.8, stating that "… the Chief Executive and Director of Environment be authorised to grant planning permission subject to a series of planning conditions that included the Environment Agency recommended conditions in relation to the groundwater environment".

2.18 The application was also reported to the 18th December 2019 meeting of the Development Control Committee, but the Committee resolved to defer the consideration of the application to a future meeting of the Committee subject to further advice from the Environment Agency and Affinity Water regarding the risk of contamination to the water supply from the bromate plume.

2.19 In the period following the 18th December 2019 committee meeting and leading up to the September 2020 committee meeting the following reports were submitted to HCC and were placed on the planning portal:

- Groundwater and Water Management Plan (V5) (January 2020) **(CD1.6).**
- Borehole Monitoring Data 2013 – 2019. **(CD5.5)**

September 2020 Officers Report to Development Control Committee Agenda Item 2

2.20 HCC planning officers submitted a report on the 2016 application to the Development Control Committee at their meeting of 24th September 2020 **(CD1.7)**, with the officer recommendation for approval, subject to planning conditions. In arriving at the recommendation for approval, the Planning Officer identified 12 key issues to be considered in determining whether the application was acceptable, including environmental effects in relation to groundwater pollution.

2.21 The following paragraphs (to end of 2.25) are direct quotations from the Planning Officer's report to the Development Control Committee:

Paragraphs 8.25 & 8.26 in respect of Conformity with site brief

2.22 The existing pollution of groundwater has been considered as part of the Environmental Statement and there have been detailed discussions with the Environment Agency and Affinity Water with regards to mitigation of the risks of mineral working in close proximity to the bromate plume. It has been demonstrated through the Groundwater Management Plan that these risks will be mitigated throughout the mineral workings.

Paragraphs 8.45 to 8.48 in respect of Water Environment

2.23 With regards to the parts of the site falling within groundwater protection zones II wherein the brief states 'the Environment Agency would normally object to the use of landfill for restoration unless it can be demonstrated that the waste used will be non-polluting matter such as inert naturally excavated material', an Environmental Permit has already been granted for infilling of the mineral void using imported inert wastes. The groundwater environment will be protected via the construction methods set out in the Groundwater Management Plan and the conditions attached to the Environmental Permit.

2.24 The Environment Agency has been consulted on the planning application (and the future Minerals Local Plan) and has raised no objections either to the mineral working proposed in the planning application or the potential inclusion of the site as a Preferred Area for mineral working in the future Hertfordshire Local Plan, subject to three criteria being met: i.e.

- no mineral extraction will take place from within the existing bromate/bromide plume;
- any activities close to the plume must not change the existing hydrogeological flow regime; and
- any activities close to the plume must not interfere with the remediation of the bromate and bromide pollution.

2.25 In response to consultation on the planning application the Environment Agency requested that the applicant should submit a Groundwater Management Plan (GMP) prior to the commencement of mineral working. The applicant submitted the GMP in January 2019 together with borehole monitoring data for 2013 – 2019. Following further consultation, the Agency has confirmed that the GMP considers the site in the context of wider information on groundwater pollution and activities on neighbouring sites, the GMP covers the site as a whole, and it recommends refining the Plan for each phase of the development. Furthermore, the GMP demonstrates that the three criteria stipulated by the Environment Agency in their earlier consultation responses on the planning application and Minerals Plan are met. Accordingly, the Environment Agency accepts that the GMP provides adequate mitigation for the potential risks associated with the mineral working.

2.26 Affinity Water has entered into a formal agreement with Brett Aggregates, confirming 'We are satisfied that these arrangements will provide us as the appointed water undertaker with a direct ability to ensure that sources of water that we use for public water supply are protected during quarrying activity. We have considered the question of planning conditions and confirm that any new or amended condition is unnecessary. In our view, the Groundwater Management Plan condition proposed by and agreed with the Environment Agency is appropriate and adequate in accordance with the relevant Government guidance'.

2.27 Having taken into account the environmental information submitted with the application together with the submitted monitoring data from 2013 to 2019, and the contents of the submitted Groundwater Management Plan, it is considered the proposed development will meet the requirements of the NPPF in preventing the new and existing development from contributing to, being put at unacceptable risk to, or being adversely affected by unacceptable levels of pollution in relation to the water environment."

3.0 Summary of the Grounds for Objection

3.1 Objections, regarding hydrogeology and the bromate plume in relation to the ES and supporting documents (principally the GWMP) include:

- HCC Statement of Case Reason 4 (August 2021)
- Ellenbrook Area Residents Association (EARA) and Smallford Residents Association (SRA) Statement of Case (September 2021) **(EARA SoC)**.
- Colney Heath Parish Council Statement of Case (Section 5).

3.2 A summary of the objections is given below, which are considered in further detail in Sections 4, 6 and 7 of this report.

HCC

3.3 HCC's position is that the lower aquifer to the north of the application site is contaminated by bromate. There is a high level of local concern that extracting mineral from within the lower aquifer could:

1. *extend the bromate contamination within the mineral workings,*
2. *reduce the effectiveness of the measures in place to remediate the Bromate contamination; and*
3. *potentially lead to contamination of boreholes used for the public drinking water supply at Essendon.*

3.4 Further, it has not been demonstrated to the satisfaction of the Mineral Planning Authority that the risks to the water environment from the mineral working are acceptable; and,

4. *that all routes to possible contamination have been appropriately investigated; and*
5. *that all necessary mitigation against all risks has been included in the proposal; and*
6. *that the proposed mitigation will be effective.*

3.5 In its amplified reasoning, HCC says that it will argue that the application has not satisfactorily demonstrated the risks to the water environment from the mineral working are acceptable, in particular,

7. *that the risks of intercepting Bromate within the LMH will be appropriately managed,*
8. *the risk that mineral working could affect the direction and rate of flow of the Bromate plume*
9. *risks of causing contamination to surface water sources as a result of de-watering groundwater from within the LMH,*
10. *risk of causing adverse quantitative/qualitative impacts upon the public water resource; and*
11. *have not demonstrated proposed mitigation measures will be effective."*

Ellenbrook Area Residents Association and Smallford Residents Association (September 2021)

3.6 EARA and SRA submitted a Statement of Case in September 2021. The areas of concern cited by them that are relevant to water environment comprise

- 4.1 Groundwater Management Plan
- 4.4 Pollution and Bromate
- 4.5 Public Water Resources

Colney Heath Parish Council

3.7 The Proof of Evidence Response to the HCC reasons for refusal and EARA/SRA areas of concern address some of the questions raised by CHPC, but CHPC also raise matters of strategic water supply constraints that the application site does not impact upon.

4.0 Scope of this Proof of Evidence Report

4.1 My proof of evidence presents a summary of the submitted assessment for the site and relevant surrounding area, in relation to bromate and groundwater followed by an evaluation of the objections raised by HCC and the two community groups, supported by quantitative and qualitative evidence. I have approached my evidence on the basis of the further environmental information supplied to PINS in October 2021, particularly that there will be no dewatering or pumping of the LMA.

4.2 Reasons and amplified reasons have been grouped in the table below. To avoid repetition, I have grouped the reasons as set out in the table below.

Table 4-1:
Analysis of HCC Statement of Case

HCC Statement of Case Reasons (R) and Amplified Reasons (A)		Expert Response
The lower aquifer to the north of the application site is contaminated by bromate. There is a high level of local concern that extracting mineral from within the lower aquifer could		
R1	**extend the bromate contamination within the mineral workings**	Matter A
R2 & A8	**reduce the effectiveness of the measures in place to remediate the bromate contamination**	Matter B
	risk of causing adverse quantitative/qualitative impacts upon the public water resource	
R3 & A10	**potentially lead to contamination of boreholes used for the public drinking water supply at Essendon**	Matter C
	The risk that mineral working could affect the direction and rate of flow of the bromate plume	
It has not been demonstrated to the satisfaction of the Mineral Planning Authority that the risks to the water environment from the mineral working are acceptable; and		
R4 & A9	**that all routes to possible contamination have been appropriately investigated**	Matter D
	risks of causing contamination to surface water sources as a result of de-watering groundwater from within the LMH,	
R5 & A7	**that all necessary mitigation against all risks has been included in the proposal**	Matter E
	that the risks of intercepting bromate within the LMH will be appropriately managed	
R6 & A11	**that the proposed mitigation will be effective**	Matter F
	have not demonstrated proposed mitigation measures will be effective	

Key
R = Reasons
A = Amplified reasoning

4.3 With respect to the questions or commentary provided by EARA and SRA in their Statement of Case (CD5.14) it is considered that this Proof of Evidence response to the HCC reasons for refusal addresses many of the areas of concern that EARA and SRA raise. However, there are exceptions, so these have been addressed in Section 6.0, Matter G, where I address the following questions (with EARA paragraph

numbering):

- 4.1.8 - Due to the proximity of the bromate just outside the site, there is a high risk that the plume will be drawn into the LML construction area
- 4.1.10 – The GWMP for the Application site is silent on its impact to the surrounding area (CEMEX)
- 4.4.3.2 - Comments relating to the absence of data on the mineral dig site
- 4.4.3.10 – The presence of bromide on the site
- 4.4.3.12 – Brett's ability to comply with the 3 Agency Conditions.

4.4 The HCC and EARA /SRA reasons and questions are considered in Section 6.0.

4.5 Considering the reasons for objection raised above, the following work has been completed to inform this Proof of Evidence:

- Review of Chapter 6 (Water Environment) of the Environmental Statement 2016, supporting Figures and Technical Appendices (**CD1.2).**
- Review of Report of Dr Rivett for Hatfield Town Council: Expert Opinion on: Groundwater contamination aspects of the proposed quarrying activity at Hatfield Aerodrome, specifically: Response to the Hertfordshire CC consultation on the Groundwater Management Plan (GWMP) (Final v5) and SLR borehole data. (**CD5.6**).
- Review of SLR Response to Dr Rivett Report June 2020 (**CD5.7**).
- Review of Chapter 6 (Water Environment) of the Environmental Statement 2021, supporting Figures and Technical Appendices **(CD2.2)**.
- Review of the Relevant Consultation Responses, including the Statement of Cases prepared by Environment Agency, Affinity Water, HCC and EARA and SRA.
- Preparation of supplementary Figures and Tables to support this Proof of Evidence.

5.0 Summary of the Site Setting and Proven Hydrogeology

Introduction

5.1 The Appellant, Brett, and I undertook early pre-investigation discussions with the Agency in 2010 at which time the key issue discussed was to understand the nature and extent of the known bromate plume that was present to the northeast side of the application site in the Lower Mineral Aquifer (LMA) and Chalk Aquifer.

5.2 I, with support of my colleagues, undertook a desk-based literature review of the local and regional geology, hydrology, and hydrogeology. This was then verified by a programme of site investigation, groundwater level monitoring, groundwater quality monitoring, pumping tests and data evaluation. The results of all investigations and assessments have been summarised and are presented in Chapter 6 and associated Appendices of the Environmental Statements (ES – 2016 and 2021). Data obtained across the site includes continuous records of groundwater level changes in 8 wells over 8 years during which time different pumping regimes have been deployed by Affinity as well as natural seasonal highs and lows. Data and the results of site investigations have shared data with the Environment Agency, Affinity and HCC throughout this period.

5.3 The substantial and detailed programme of site investigation, monitoring, and assessment that I and my colleagues have undertaken has enabled me to establish a thorough and complete understanding of the site so that potential impacted and effects could be appropriately considered and assessed. As noted by the Agency in their Statement of Case they consider that: “These works were completed in a logical manner by a competent environmental consultant and the Agency was consulted throughout the process”.

5.4 Summary details of the sites hydrogeological setting is presented below.

Regional Geology

5.5 The solid geology beneath the application site comprises undifferentiated Lewes Nodular Chalk Formation and Seaford Chalk Formation that dips to the south-east.

5.6 The superficial geology is the Lowestoft Formation comprising a sequence of glacial deposits including boulder clays and sands and gravels (the mineral deposits targeted by this application) deposited in a paleo-valley cut into the Chalk. **Figure PR-PE1** depicts the location of mineral deposits in the valley and the Chalk at the surface to the north-west and south-east.

Local Geology

5.7 The Lowestoft Formation comprises four broad superficial drift units above the Chalk. These comprise an upper and lower granular formation (sands, gravels referred to as the Upper Mineral Horizon (UMH) and the Lower Mineral Horizon (LMH) respectively), separated by boulder clay, referred to as Interburden (IB). The geological sequence is summarised in **Table 5-1**.

Table 5-1 - Geology and Groundwater Occurrence

Geological Unit	Description	Thickness	Groundwater
Overburden	Clayey, silty sand and gravels	0m – 2m	Variable and seasonally saturated by the **UMA**
Upper Mineral Horizon (UMH)	Silty sands and gravels	1.7m – 6.7m	**Upper Mineral Aquifer (UMA)** (perched on aquitard below)
Interburden (IB)	Boulder Clay (Stiff glacial clay)	3m – 4m	**Aquitard** (Barrier to groundwater flow)
Lower Mineral Horizon (LMH)	Sands and gravels	5m – 7m	**Lower Mineral Aquifer (LMA)** (hydraulically connected with the underlying Chalk aquifer)
Chalk Bedrock (Lewes Nodular Chalk)	Weathered at its surface increasing competency with depth	Unproven thickness on site	**Chalk Aquifer**

5.8 A detailed west to east orientated regional geological cross section is shown on **Figure PR-PE2**.

Hydrogeology

5.9 This section of the statement focusses on the hydrogeology of the Chalk and LMH as they form the aquifer that is the focus of the Grounds for Objection.

5.10 The Chalk is classified by the Agency as a Principal Aquifer; it contains a laterally continuous water body and is an important regional supply of potable water as well as supporting base flow in rivers.

5.11 The Chalk has a high matrix porosity but low matrix permeability. This means that groundwater flow mainly takes place through fractures and fissures. In this part of Hertfordshire groundwater flow in the Chalk is influenced[2] by karstic features aligned west to east that direct groundwater flow towards the Lea Valley.

5.12 Locally, the Chalk is overlain by permeable (LMH) deposits within and surrounding the site. The piezometric surface of the groundwater in the Chalk aquifer is above the top of the Chalk rock so the groundwater flows into the overlying LMH deposits, forming a single continuous ground water body. The effective thickness of this aquifer (Chalk + LMH) is approximately 60 to 70m and the average thickness of the LMH is between 5.8m and therefore represents 8% to 9.6% of the combined aquifer.

5.13 Site investigation has demonstrated that the Interburden (IB) above the LMH is laterally continuous across the application site and acts as a barrier to groundwater flow such that there is no hydraulic connection between the LMH and the Upper Mineral Horizon (UMH). Groundwater is present in the UMH as a perched aquifer, resting on the IB.

5.14 The application site is located within the Total Catchment Zone (SPZ3) and Outer Source Protection Zone (SPZ2) of two Public Water Supply (PWS) well fields, Bishops Rise in Hatfield – (HATF), and Roestock (ROES) located 1,500m south-east and 2,200m south south-east from the application site, respectively (**Figure PR-PE3).**

5.15 The Bishops Rise HATF PWS well is currently being used for capture of a regional bromate plume and

[2] Cook, S. J. (2010), The hydrogeology of bromate contamination in the Hertfordshire Chalk: Incorporating Karst in Predictive Models., EngD, University College London.

abstracted water is not used for public water supply.

Groundwater Levels

5.16 Groundwater levels within the UMA, LMA and Chalk aquifer are routinely recorded from a network of monitoring wells advanced to inform the ES and develop the Conceptual Site Model (CSM) on and adjacent to the application site by manual water level dipping during sampling events and using automatic level recording instruments installed in selected wells.

5.17 Hydrographs of representative wells are included in **Figure PR-PE4**. Full details of groundwater monitoring data across the site are presented in the 2021 ES and associated Appendices

5.18 Groundwater levels in the LMH and the Chalk are monitored in adjacent (nested wells) and closely correlate indicating that the LMH and Chalk are in hydraulic continuity as depicted on the hydrographs across the entire monitoring period.

5.19 The highest recorded groundwater levels in all aquifers during the monitoring period occurred in March 2014 and April 2021 when they reached similar elevations. Lowest groundwater levels were recorded in November 2017 and November 2019.

Bromate Plume

5.20 The Chalk aquifer to the northwest, north and east of the Site is impacted by a bromate and bromide groundwater plume. The plume was discovered in 2000 when bromate was added to the UK drinking water standard and water quality testing discovered its presence in public water abstraction boreholes to the south east and east of the Site.

5.21 The plume source was traced back to the former Steetley chemical works in Sandridge (now known as St Leonard's Court) approximately 2.6km northwest of northern application boundary (**Figure PR-PE5**).

5.22 The dissolved plume extent is largely controlled by the groundwater flow direction which can be determined from the piezometric surface (the groundwater elevation at each monitoring point) as illustrated on **Figure PR-PE5**. In this Figure (data from 2019), the bromate plume is shown migrating southeast from Sandridge to Nashes Farm Lane before veering east towards the River Lea valley c.5.8km east of Nashes Farm.

5.23 The plume core is located approximately 800m north-east of the eastern application boundary (**Figure PR-PE5**). The southwest edge of the bromate plume in the Chalk approximates to the site's northeast boundary (**Figures PR-PE5, and PR-PE6**), although this varies in accordance with a variety of physical conditions (See **Section 5.6** below).

5.24 Remedial action has been implemented since mid-2005 by Affinity Water acting on behalf of the identified AP in accordance with EPA (1990) Part IIA legislation (from Environment Agency Rule 6(6) Statement Attachment 3. St Leonards Court Decision Document Part 1). Affinity has been operating a plume scavenging (pumping) system at its Bishops Rise (HATF) borehole location (shown on **Figure PR-PE5)** located c.1,600m southeast of the application site.

5.25 The objective of plume scavenging is to capture the bromate plume and reduce its impact on other downgradient PWS locations along the River Lea, in particular the Essendon PWS (ESSE) (location indicated on PR-PE3), which in 2005 recorded an average bromate concentration of 40 ug/l (from Environment Agency Rule 6(6) Statement Attachment 1. Planning Inspectors Report para 257.) The second remedial objective is to reduce bromate mass from groundwater.

5.26 In their letter of 18th December 2019 **(CD 5.8**), regarding Land at Hatfield Aerodrome, the Environment Agency stated that "For the purpose of practicable regulation of the existing CEMEX Hatfield Quarry we have taken the position that bromate concentrations of concern in groundwater are ≥2 ug/l (0.002mg/l)

and that it was consistent to apply this definition to neighbouring planning and permit applications for mineral extraction and landfill". Therefore, I have adopted this concentration to illustrate the outer edge or extent of the bromate plume.

Bromate Plume Location Relative to the Application Site

5.27 The plume location has been stable in its location north east of the Application site in both seasonally low and seasonally high groundwater conditions. This is illustrated by **Figures PR-PE5** and **PR-PE6** representing a relatively high and low natural groundwater level for the Chalk.

5.28 The southern perimeter of the bromate plume in groundwater in the LMH sits further northeast than in the Chalk, and again, the plume location has remained stable as illustrated on **Figures PR-PE7 and PR-PE8** during the same periods of seasonally low and high groundwater conditions. The HATF pumping rate was the same for both periods.

Factors Influencing Bromate Plume Location and Capture by HATF

5.29 This section explains the factors that affect the Bishops Rise HATF plume scavenging operation that have been considered in the design of the proposed mineral workings and the method of working on the site.

- Groundwater flow is a response to aquifer recharge to the northwest and discharge towards the River Lea valley to the east. The location of the bromate plume is controlled by the natural groundwater flow direction.
- Geological boundaries along the flow line.
- Higher seasonal groundwater levels tend to cause the plume location to shift slightly to the east and lower groundwater levels tend to result in small movements in the plume location to the west.
- High seasonal water levels are a response to winter recharge which will have a dilution effect on plume concentrations.
- Existing PWS wells (ESSE, ROES, TYTT PWS) simultaneously exert a demand on the groundwater resource across the region.
- HATF plume scavenging operation locally alters the natural groundwater flow conditions to capture the plume and achieve its primary objectives of protecting ESSE and bromate mass removal.
- The HATF groundwater abstraction rate and physical properties of the aquifer control the plume capture radius. However, logistical factors such as:
    - (1) water treatment and discharge capacity at HATF, and
    - (2) minimising the drawdown caused by HATF near to the ROES catchment, influence the maximum HATF pumping rate.

5.30 All these factors must be considered and balanced to ensure the desired outcome is optimised, i.e., maximum sustainable plume capture to protect ESSE and reduce bromate mass, without expanding the capture radius into the ROES catchment, while safely treating and discharging the effluent.

5.31 The HATF pumping rate has varied quite considerably across the period of monitoring on site:

- 2013 - Feb 2016 - rates vary from 3.8ML/d to 7ML/d with frequent periods of no pumping
- Feb 2016 – Dec 2017 – inconsistent, falling pumping rates from 3ML/d down to <1ML/d
- Dec 2017 – June 2018 – constant 1ML/d discharge (period of drain refurbishment)
- June 2018 – Feb 2019 – period of pumping tests at varying rates

- Feb 2019 – Current – Stable and constant abstraction (controlled by sewer discharge capacity) at 4 – 4.8ML/d.

5.32 Affinity's remediation works from 2018 onwards appear to have resulted in a relatively constant period of pumping and consistent discharge rate that looks to have achieved a balanced outcome as stated above (5.30). These data suggest that we have witnessed all possible effects of the various modes of operation of the Affinity remedial system on groundwater in the vicinity of the site and therefore that we have a sound conceptual site model on which to base this assessment.

6.0 Discussion of Matters

Matter A R1 Extend the bromate contamination within the mineral workings

Matter A1 – The bromate plume is not present on the mineral extraction site

6.1 **Figures PR-PE 5, PR-PE6 (Chalk)**, and **PR-PE7 and PR-PE8 (LMA)** are plume extent Figures for the Chalk and the LMA in Oct 2019 and April 2021. These dates coincide with the extremes of low and high regional groundwater levels (**refer to CD5.8 – 3, CD5.7 – 6 and CD5.13**) when Bishops Rise HATF was pumping at its optimal rate of c.4.8ML/d during both periods so extremes are comparable.

6.2 A comparison of the plume extents for the Chalk and the LMA indicates practically no difference in location. Bromate in the onsite well BH104 in the Chalk was 2.5ug/l (both 2019 and 2021) and in the LMA was 1.2ug/l and 0.7ug/l for Oct 2019 and April 2021, respectively. At such low concentrations these differences in analytical concentrations are at the limit of detection levels and are not considered significant when compared to the Agency position that bromate concentrations of concern are ≥ 2ug/l. (Note: Affinity Water's laboratory has been used for all bromate analysis – the minimum detection limit is 0.5ug/l).

6.3 Bromate was not detected in the LMA in BH301L in Oct 2019 and April 2021 during the low and high groundwater level periods.

6.4 **Figures PR-PE9 and PR-PE10** are bromate time-concentration graphs combined with Bishops Rise HATF pumping rate for BH301L&C and BH104L&C. Both graphs illustrate how concentrations have stabilised in recent years.

6.5 The plume extent evidence shows there is no bromate plume beneath the proposed LMH mineral excavation area in either high or low groundwater elevations. Time-concentration graphs indicate that that bromate concentrations are stable in the northeast corner of the site with an average concentration of <1ug/l in BH104L which is significantly below than the Agency's stated bromate concentration of concern of ≥2ug/l.

6.6 Further discussion outlining why the bromate plume is stable and will not extend across the site is provided in Appendix 6-11 of the Environment Statement 2021 **(CD2.2)** and in Response to the Dr Rivett Report "Response to the HCC Consultation on the Groundwater Management Plan" **(CD5.7)**. This data has been shared with the Agency and Affinity and both parties are satisfied that the available evidence indicates that the bromate plume is not present within the mineral workings. In their response to questions on 24/09/2020 the Agency stated, "we have no data at the moment that suggests that bromate is absolutely directly under the mineral working area within the proposed quarry site" **(EARA SoC Reference Document 18**)

Matter A2 – The offsite bromate plume will not be pulled on site during excavation works

6.7 Matter A1 explains that the bromate plume is not present on the mineral extraction site. This section explains the operational processes and methodology that will be implemented to ensure bromate is not 'pulled' onto the site during the excavation works, and the mechanisms for monitoring and demonstrating that the planned procedures are robust **(CD5.9 - 4C)**

6.8 The GWMP sets out an operational plan for mineral extraction and the management of water through all stages of the project. This plan complies with the requirements of the proposed Planning Conditions, the requirements of key stakeholders and the conditions associated with the Environmental Permit and

Abstraction Licences.

6.9 The site is divided into 7 operational phases, A to G (Drawing HQ 3/1 in CD2.2). Each phasing plan will be designed in a manner that takes advantage of seasonal conditions as excavation of the LMH will be undertaken on a campaign basis that comprises excavation and stockpiling of mineral when water level conditions are most favourable as described in the GWMP (**CD2.2 - Appendix 6-10 of the 2021 ES**). It is estimated that excavation within the LMH will be undertaken for c.100 days per year.

6.10 A significant 100m standoff from BH104 (<1ug/l Bromate) is included in the phasing layout for Phase B and C will further reduce any possibility of bromates presence on the mineral development site.

6.11 Two fundamental aspects of the operational plan are that there will be no pumping of groundwater from the LMH and that phase specific investigations will begin up to a year in advance to assess the geology, groundwater levels and groundwater quality to support the planning and development stage of the mineral extraction process.

6.12 Once data has been collected and assessed a phase specific operating plan will be prepared by the Applicant and subsequently presented, discussed, and considered by the stakeholders (Brett, Affinity, the Agency, and HCC). The decision to proceed will then be taken following stakeholder review.

6.13 The groundwater level criteria for proceeding are:

- LMA is Unconfined – piezometric surface is within the LMH – Interburden (IB) and LMH excavation and concurrent backfilling/reinstatement can proceed.
- LMA is Confined – piezometric surface rests within the IB - IB and LMH excavation concurrent backfilling/reinstatement can proceed.
- LMA is Confined – piezometric surface rests above the IB – no IB or LMH excavation will proceed.

6.14 Monitoring of groundwater levels and groundwater quality is a key task and fundamental to operations, permit compliance and ensuring bromate plume conditions are continuously understood. There are 56 existing and planned future permanent monitoring wells on the site and the GWMP describes a robust sampling and analysis plan to document changes and trends and inform the management and operational process. Infiltration lagoons and operation-critical monitoring wells will be equipped with telemetry links for real-time data analysis.

6.15 Performance reviews, progress meetings and stakeholder engagement has been incorporated into the management plan. Meetings with stakeholders will be held semi-annually when data trends, phasing plans, schedules and operations are discussed. Additional meetings will be held during periods of mineral extraction when recent monitoring data is shared. Time critical data will be provided to stakeholders upon receipt.

6.16 Note that the Agency considers that the water environment can be managed effectively through the proposed practices in the GWMP (**CD5.8 – 1**) and as stated by the Agency in EARA **(EARA SoC Reference Document 18**).

Matter B R2 Reduce the effectiveness of the measures in place to remediate the Bromate contamination

Matter B1 - Excavation of mineral and replacement with low permeability inert material

6.17 Data referred to in Matter A1 illustrates that there is no bromate plume beneath the proposed LMH mineral excavation area, and Matter A2 explains how the LMH planning, and excavation process will be implemented and monitored.

6.18 Matter B1 presents evidence that the entire mineral site is located within the zone of influence of the Bishops Rise HATF scavenging system in the Chalk and the LMA.

6.19 Piezometric surface contours and plume distribution shown on **Figures PR-PE7** and **PR-PE8** indicate a radial distribution of flow beneath the entire site towards the Bishops Rise HATF abstraction borehole. Given HATF results in complete capture across the site and that bromate is absent beneath and upgradient of the site it can be concluded that replacement of mineral with low permeability material will not reduce the effectiveness of HATF to capture bromate impacted groundwater in the Chalk or the LMA. The Agency expands on these points in its November 2020 statement to EARA **(EARA SoC Reference Document 24).**

Matter B2 – Excavation of mineral and replacement with site-won, low permeability inert material

6.20 Matter B2 supports the conclusion drawn for Matter B1. **Figure PR-PE11** illustrates the results of a signal test that records the water level drawdown from 16 Chalk and LMA monitoring wells on and off-site when Affinity was conducting commissioning tests following engineering works at the HATF borehole site (09/2018 – 01/2019).

6.21 The water level drawdown signal results support Matter B1 because it shows a water level response (drawdown and recovery) across the entire mineral extraction area (BH102 on the western boundary and BH301 and BH302 on the sites northern boundary), and east of the site and beyond BH105 (>500m from the mineral excavation area).

Matter B3 - Excavation of mineral and replacement with site-won low permeability inert material

6.22 Groundwater in the LMH is hydraulically connected with the underlying Chalk aquifer. The mineral workings will only remove mineral to within 1m of the top of the Chalk and replace it with inert low permeability material. This therefore represents the upper 4.8m (average) of the LMA and in turn this only represents a small percentage (c. 8 to 9%) of the effective Chalk/LMA aquifer thickness, also discussed in a response to Dr Rivett (**CD5.7 - 2**)

6.23 There will be no impact upon groundwater flow in the underlying Chalk aquifer, which is the target for bromate plume scavenging **(EARA SoC Reference Document 18).**

6.24 Groundwater flow occurs perpendicular to the piezometric surface contours. The inert clay fill placed in the LMA will form a limited thickness boundary to lateral groundwater flow approaching from the northwest. However, its orientation is angled such that flow in the upper c.4.8m of LMH (not the Chalk or the mineral left in place above the Chalk) will flow east until it reaches the area south of BH104 where flow will be directed southeast towards HATF – i.e., it will continue to be captured by HATF given its catchment is proven to exceed 500m east of the mineral boundary The Agency are satisfied that proposed works in the LMA are managed and they will not cause a diversion of the plume **(EARA SoC Reference Document 18**).

6.25 Upon restoration, unimpacted groundwater in the upper c.4.8m of LMA approaching the site from the west will also follow the piezometric contours flowing south parallel to the clay fill but upon reaching the south west corner of the site (**PR-PE7 and PR-PE8**) the flow will continue contours towards HATF.

6.26 The low permeability clay fill placed in the LMA may result in the HATF scavenging system being marginally more efficient at plume capture because for any given pumping rate it will extend and widen its 'reach' in the LMA to the north and east of HATF towards the core of the bromate plume.

6.27 Further discussion of this matter is provided in Response to Dr Rivett Report "Response to the HCC Consultation on the Groundwater Management Plan **(CD5.7 – 3)**.

Matter B4 – Operation of water infiltration lagoons

6.28 Details of the location of the Upper (UML) and Lower Mineral Lagoon (LML) is presented in Appendix 01 of the GWMP **(CD2.2).** Discharge into the Upper Mineral Lagoon (UML) is the primary route for reinfiltrating groundwater from the UMA so will have no impact upon the LMA.

6.29 There is no pumping of groundwater from the LMA so there is no LMA groundwater disposal requirement.

6.30 The Lower Mineral Lagoon (LML) is a contingency lagoon for use during short term extreme circumstance. The default overflow from the UML is into the LML. Should there be a discharge of UMA water into the LML then the infiltration direction will be directed towards the southeast **(PR-PE7 and PR-PE8)**.

6.31 Runoff spilling into the LML is considered a low risk as it only manifests itself over a relative short period of time as quarrying is nearing completion and the restoration is well advanced **(CD2.2).**

6.32 The assumptions adopted to assess the potential volumes and duration spilling into the LML include:

- the lower bound estimates of the infiltration capacity of the UML of 2,000m^{3}d-1 and 1,200m^{3}d-1 for low and high groundwater scenarios respectively; and
- a very conservative estimate of the percentage runoff from the restored phases of 60%.

6.33 Under 'normal' circumstances, i.e., assuming a mean recorded ground water level in the UMA in the vicinity of the UML of 72.63mAOD, it is only the runoff in response to a 1 in 100-year storm that would exceed the capacity of the UML when the final cell has been restored. In these circumstances, a volume of circa 4,000m^3 could be expected to spill in to the LML over a period of approximately 20 hours at a maximum rate of 0.15m^{3}s^{-1}.

6.34 Therefore, under the 'normal' circumstances described above, there is only a 1% annual probability of a spillage to the LML occurring in the short period between the restoration of the final phase and the decommissioning and infilling of the LML. Even in the unlikely event of a significant storm occurring during this period, the volume and duration of the spill is unlikely to have any significant impact on the bromate plume given its duration.

6.35 In accordance with the GWMP, discharge to the LML would only occur following discussions and approval by the stakeholders, the Agency, Affinity and HCC and authorised by the Brett Managing Director.

Matter C R3 Potentially lead to contamination of boreholes used for public drinking water supply at Essendon

Matter C1 – Possible impact to boreholes at Essendon

6.36 As stated in Matter B3, changes to groundwater flow because of the replacement of c.4.8m of mineral will not impact upon the Chalk aquifer, the primary remedial target for the HATF abstraction. Equally, the impact on the hydraulically connected overlying LMA is not expected to materially alter the plume location east of the site given the southeast flow direction towards Bishops Rise, HATF.

6.37 **Figure PR-PE3** is a borehole catchment plan for the region depicting the location of Bishops Rise HATF, ROES, TYYT and ESSE. It is my opinion that there is an extremely low potential for any impact upon ESSE catchment from the site location. The reason for this is that:

- The area northeast east of the site is entirely contained within the Bishops Rise HATF Source Protection Zone 2 (SPZ2) and groundwater flow is southeast towards the HATF borehole,
- The distance to the Bishops Rise HATF/ESSE catchment boundary is c. 2.3km,

- The ESSE catchment is across the hydraulic gradient to the site, unlike HATF which is down the hydraulic gradient to the site.

Matter C2 – Possible impact to boreholes at Roestock

6.38 **Figure PR-PE6** is a catchment plan illustrating the location of the site and surrounding PWS abstraction wells. Roestock PWS (ROES) is located 2.2km south of the proposed mineral site and has not recorded bromate in the past.

6.39 The ROES PWS is an important groundwater abstraction site to safeguard so a groundwater elevation trigger level has been agreed with Affinity for BH102 using the lowest recorded groundwater elevation (67.0mAOD +0.2m) at this monitoring well. The GWMP calls for water levels in this well to be always visible by telemetry but regardless, should this level be reached it will result in stakeholder notification, plotting of hydrographs and frequent groundwater sampling. As Brett will not be undertaking any LMA pumping any active response to the trigger will be implemented by Affinity. Comment 3 in Response to Dr Rivett Report "Response to the HCC Consultation on the Groundwater Management Plan" **(CD5.7 – 3)** provides a response to this question and a quote from Affinity.

6.40 The statement above highlights that the Bishops Rise HATF abstraction rate is limited in part by the groundwater elevation between the HATF and ROES catchments, which for the last 3 years has been safely held with an optimum abstraction rate of c.4.8ML/d, especially during naturally low groundwater elevation periods.

6.41 It is my opinion, this line of evidence illustrates that Brett has considered all outcomes, has liaised with stakeholders, and has adopted a no-risk approach to the mineral development and is pleased to cooperate and support Affinity in its implementation of the current remedial action.

Matter D R4 That all routes to possible contamination have been appropriately investigated

6.42 An assessment of the potential impacts of the proposed development on hydrogeological environments and groundwater quality is presented in Chapter 6, paragraphs 6.130 – 6.145 of the 2021 ES (**CD2.2**).

6.43 It was recognised prior to the 2016 application by Brett that a GWMP would be required to enable the operation of the quarrying activities in a manner that did not intercept the bromate plume or cause an adverse effect upon the scavenge pumping of the bromate plume. This was proposed as a mitigation measure in the 2016 ES Chapter 6 paragraph 6.134 **(CD1.2).**

6.44 Since 2016 following extensive collaborative discussions with both the Agency and Affinity the Groundwater Management plan has evolved and been refined.

6.45 The proposed mitigation of potential impacts on the hydrogeological environment is presented in the 2021 ES Chapter 6, paragraphs 6.160 – 6.183 together with an updated version of the GWMP (v.6) in Appendix 6-10 of the 2021 ES. (**CD2.2**).

6.46 The conclusions of the 2021 ES, in particular the mitigation of the revised method of quarrying and the groundwater management plan are presented in ES paragraphs 6.190 to 6.197 **(CD2.2)**

Matter E R5 That all necessary mitigation against all risks has been included in the proposal

6.47 I have assessed the following four scenarios (A to D) and associated mitigation measures. The topics selected are those considered already but they are the most important

- A - Bromate impacted water will be pulled on site

- B - Replacement of mineral with site derived lower permeability fill will reduce effectiveness of scavenger pumping and could cause bromate impact to ESSE PWS
- C – Roestock PWS could be is at risk of impact
- D – Evidence that the risk of intercepting bromate is being effectively managed

Scenario A Bromate impacted groundwater will be pulled on site in the LMH excavation area.

6.48 Evidence for the absence of bromate in the LMH within the mineral excavation area is described in Matter A1 (paragraph 6.1 – 6.6).

6.49 The operational plan to be applied to each phase as described in the 2021 GWMP **(CD2.2)** which is set out in Matter 2. The key points of the operational plan that mitigate plume movement are:

- There will be no LMA groundwater abstraction
- There will be a 100m standoff from BH104 with no LMH excavation
- Phase specific investigations will be undertaken up to a year in advance of implementation to gather phase specific data that will inform the design of the LMH extraction process, programme of works and schedule. Works will include an addition of 3 triple well installation locations, one of which is to assist Affinity on the western side of the site and two are located to monitor the lagoons.
- The operational plan and supporting data will be presented to a 3rd-party stakeholder group (the Agency, Affinity, HCC) for review, discussion, and modification, if required. A decision to proceed will then be taken.
- An extensive programme of monitoring and reporting will support the validation process and will be used to monitor changes and trends and support the operational process.
- Time critical data will be circulated to stakeholders upon receipt and critical monitoring wells will be linked directly to the stakeholders using a telemetry link.
- Semi-annual and monthly performance reviews during LMH excavation are built into the operational plan.

6.50 Like the Environment Agency, I am satisfied that the proposed works will not result in diversion of the plume **(EARA SoC Reference Document 18 and 24).**

Scenario B: Replacement of mineral with clay will reduce the effectiveness of the measures in place to remediate the Bromate contamination and will reduce effectiveness of scavenger pumping and could cause bromate impact to ESSE PWS

6.51 Matter A1 explains that the Chalk and LMA does not contain bromate.

6.52 Matter B1 and B2 explains that the evidence for the entire site falling within the capture radius of Bishops Rise HATF.

6.53 Matter B3 presents evidence that the Agency consider the Chalk aquifer to be the main target zone for Bishops Rise HATF, which is known to be the same opinion of Affinity and that backfilling with clay will have no impact on remedial efficiency in the Chalk.

6.54 Matter B3 states that there will be a change in the direction of flow in the c.4.8m of LMH replaced with clay but that the flow will be directed east and then southeast towards Bishops Rise HATF. The Agency **(EARA SoC Reference Document 18 and 24)** is satisfied that the proposed works will not result in diversion of the plume.

6.55 It is suggested that the low permeability fill may increase efficiency of Bishops Rise HATF by forming a very shallow flow boundary.

6.56 Matter C1 discusses the potential for the plume to be directed east towards the ESSE catchment, which is already impacted by bromate and is the main objective for Bishops Rise HATF capturing the bromate plume.

6.57 The argument that applies is that the mineral site sits within the catchment of Bishops Rise HATF (so the main flow direction is southeast), that the ESSE catchment is over 2km east of the site, and hydraulically side gradient to the mineral site, which are all points that would suggest there is an extremely low risk of impact from plume diversion along the eastern side of the mineral extraction site.

Scenario C: Quarrying activity provides a pathway or mechanism for bromate impacted groundwater to enter the catchment of the ROES Abstraction

6.58 Matter A1 explains that the Chalk and LMA does not contain bromate.

6.59 Matter B1 and B2 explains that the evidence for the entire site falling within the capture radius of Bishops Rise HATF.

6.60 The ROES PWS has not detected bromate in the past and is an important groundwater abstraction site for Affinity to safeguard.

6.61 Affinity has applied a trigger water level for the LMA at BH102 on the western side of the mineral development site. The trigger level is set as a precautionary level just above the lowest groundwater level recorded for this location.

6.62 Should the trigger be reached, the stakeholders will be alerted, and a meeting held to discuss the situation and an action plan put in place. This is likely to involve the plotting of hydrographs, data review, and additional groundwater sampling, but since Brett is not pumping groundwater any active intervention is likely to be initiated by Affinity at ROES and HATF. Comment 3 in Response to Dr Rivett Report "Response to the HCC Consultation on the Groundwater Management Plan" **(CD5.7 – 3)** provides a response to this question and a quote from Affinity.

6.63 Brett is pleased to play a role in assisting Affinity and the Agency in their management of the current remedial action.

Scenario D: Evidence that "the risks of intercepting Bromate within the LMH will be appropriately managed"

6.64 The GWMP is a live document built around a detailed understanding of the site and the procedures in place are robust and extensive with significant groundwater quality monitoring requirement to record demonstrate that the site is being effectively managed.

6.65 Version 6 of the GWMP is the current working plan (2021) developed to reflect the revised method of working the mineral proposed in the second Application. The 2021 GWMP reflects the 2021 baseline hydrogeological conditions including the influence of nearby CEMEX operations. It builds upon the plans and principle of the previous versions of the GWMP that have been developed as part of extensive consultation between the stakeholders: Brett, Affinity, and the Agency. Whilst the details of Version 6 may continue to be refined, the principle that the GWMP protects against quarrying exacerbating the impact of the bromate plume is a matter of agreement between the parties.

6.66 The 2021 phase layout has been amended to include a 100m buffer from BH104 on the eastern boundary of the site, that is the only monitoring well on site that records bromate, albeit at extremely low concentrations. This precautionary approach has been applied to mitigate against bromate migration.

6.67 It has always been proposed to excavate the UMH using a 'dry' method and the LMH by a 'wet' method. The change to the method of working means that extraction of the LMH will be undertaken on a 'wet' campaign basis during periods of the year when groundwater in the LMH is at its seasonal low and in accordance with an approach described in the GWMP in Appendix 6-10 of the ES **(CD2.2)**. The approach defines a pre-excavation preparation stage to determine which of three hydrogeological scenarios applies within the phase, each with a clear operational procedure:

(1) **LMA is Unconfined – piezometric surface is within the LMH –** Interburden (IB) and LMH excavation and concurrent backfilling/reinstatement can proceed

(2) **LMA is Confined – piezometric surface rests within the IB -** IB and LMH excavation concurrent backfilling/reinstatement can proceed

(3) **LMA is Confined – piezometric surface rests above the IB** – no IB or LMH excavation will proceed

6.68 As stated in paragraphs 6.11 and 6.49 the existing data set will be supplemented by additional phase specific investigation boreholes to support the planning and development of each phase. These will be specifically targeted to gather data to support the planning and decision process for implementing LMH excavation in a safe and planned manner.

6.69 Two new monitoring wells will be located adjacent to the lagoons (in all 3 aquifers) and one on the west side of the site to provide Affinity with additional water level and bromate testing control adjacent to the ROES catchment.

6.70 There is a total of 56 monitoring wells on the site (25 groundwater monitoring wells installed in the UMA, 18 in the LMA and 13 in the Chalk aquifer). These are shown **on Drawings 01 to 04** in the 2021 GWMP **(CD2.2**).

6.71 Five laboratory testing suites have been devised and include a range of organic and inorganic compounds.

6.72 It is proposed to increase the number of automatic water level loggers to at least 19, several of which will be linked by telemetry to Affinity and Brett.

6.73 The sampling and analysis regime is robust and substantial with a mixture of onsite and offsite wells being sampled monthly and quarterly which will be added to a shared data base and will be used for compliance and to detect and monitor any changes in the bromate plume from its current location.

6.74 Furthermore, an additional benefit of the information that would be generated as a requirement of the GWMP in terms of groundwater elevation and quality (bromate concentration) being shared with Affinity and the Agency is that it will provide them with invaluable information on the location and extent of the southern edge of the bromate plume in a location of strategic importance[3] to enhance their management and optimisation of scavenging operation at Bishops Rise.

Matter F R6 That the proposed mitigation will be effective and can be demonstrated to be so.

6.75 Careful management of the groundwater and surface water environment is fundamental to the successful operation of the site and will require the understanding and integration of many environmental and operational factors as listed in the 2021 GWMP **(CD2.2)**. Examples include:

- Developing a seasonally controlled operating plan that minimises as far as reasonably possible, the need to pump and discharge water

[3] The location of the application site is strategic because the southwest side is close to the groundwater divide between Hatfield and Roestock.

- Seasonal changes in groundwater levels and its impact on water discharge volumes from back drain flow and UMA dewatering requirements
- Third party influences such as Affinity pumping rates
- Lagoon performance with water level changes
- Operational factors such as siltation of lagoons and maintenance
- Water discharge changes due to product demand changes, and
- The results of monitoring for Bromate and Bromide

6.76 The GWMP is not static, and for these reasons, it may be reviewed and amended.

6.77 There will be 6 monthly review meetings for the duration of the development to:

- Review phase specific development plans and proposed LMH excavation
- Share operational statistics about the guiding principles listed above, and to
- Monitor system performance:
  - water level changes
  - volumes pumped and discharged
  - lagoon performance
  - flow in the Nast
  - flow from back drains
  - water quality data; and
  - any local concerns or other environmental issues

6.78 It is proposed that these meetings are attended by Brett, the Agency, HCC, and Affinity. The frequency of these meetings will not be reduced unless all parties agree and additional meetings or sharing of data will occur as and when required to discuss any issues that arise, significant changes in monitoring results, or proposed significant changes to operational practice.

6.79 Although the GWMP is robust, its application will be supported by a Private Operating Agreement (POA) between Affinity and Brett. The POA ensures that groundwater, monitoring, and any associated operational decisions associated with the groundwater management plan is robust, effective and in the case of any dispute, promptly legally enforced.

Matter G EARA and SRA Statement of Case Questions.

Due to the proximity of the bromate just outside the site, there is a high risk that the plume will be drawn into the LML construction area.

6.80 Construction of the LML will require the excavation of the UMH and the IB. It shall not penetrate below the base of the IB into the LMH and will be lined on all sides down to the top of the IB. There is no risk that the plume will be drawn into the LML construction area as no groundwater or mineral will be removed from below the groundwater level during lagoon construction.

The GWMP for the Application site is silent on its impact to the surrounding area (CEMEX)

6.81 The baseline groundwater conditions on which the GWMP is based have been fully described in Chapter 6 (Water Environment of the Environmental Statements prepared in 2016 (CD1.2) and 2021 (CD2.2).

6.82 The baseline groundwater conditions are influenced by recent and ongoing operations at the CEMEX site

as noted in paragraphs 6.58 and 6.59 of the 2021 Water Environment ES (**CD2.2**). It is the baseline conditions that have been assessed and incorporated into the design and operation of the proposed 2021 GWMP.

The absence of bromate data on the mineral dig site

6.83 Permanent monitoring wells were not installed within the mineral excavation area as they would be destroyed during mineral working. In my opinion. the monitoring network has defined the edge of the bromate plume and this has been accepted by the Agency as being sufficient (**CD5.8** and **CD5.12**).

6.84 Further details of planned installation of additional monitoring wells during operational phases are given in the GWMP and in Section 2.7 of Response to Dr Rivett (**CD 5.7**) designed to confirm groundwater condition including analysis for bromate/bromide.

6.85 Paragraph 6.9 – 6.14 explains how the phase-specific operating plans will be produced in advance of each phase being developed. This will require many more monitoring wells and piezometers designed to fulfil the design requirements for the project, including the presence or absence of bromate.

The presence of bromide on the site

6.86 Bromide has been detected in groundwater on the application site and bromate and bromide do occur together in the main bromate plume.

6.87 Bromide is a naturally occurring anion that is readily soluble in water and is derived from a variety of sources, particularly rock salt. Site data on bromide has been shared with the Agency and Affinity Water.

6.88 The Environment Agency have regional monitoring data for bromate and bromide within the regional bromate plume and outside it and thus are in the best position to consider the relevance of bromide detection at the site. As they state in their letter of 18 December 2019, 'there are many sources of bromide including its natural occurrence in the environment'.

6.89 With respect to the bromate plume, the Agency stated in their letters of 28 August 2019 **(CD5.9)** and amplified on 30th August 2019 **(CD5.10)** that locations of concern are those within the combined bromide and bromate plume.

Brett's ability to comply with the 3 Agency Points

6.90 The Agency state on multiple occasions that the three points referred to above were submitted to HCC in response to the 2019 Hertfordshire County Council Local Minerals Plan Consultation. The points are:

6.91 No mineral is extracted from within the existing plume of bromate and bromide groundwater pollution.

6.92 Any activities close to the plume must not change the existing hydrogeological flow regime.

6.93 Any activities close to the plume must not interfere with the remediation of the bromate and bromide pollution.

6.94 In my response to the HCC Statement of Case and previously in my response to Dr Rivett **(CD5.7)** I have explained how the operation and development of the quarry will create small changes to hydrogeological regime in the immediate vicinity of the application site but will have an insignificant effect to the wider regional groundwater flow and effectiveness of the remediation of the bromate and bromide pollution.

6.95 The Agency has stated that they consider the Appellant will be able to comply with their three points in their letter of 10 October 2019 **(CD 5.11)**, and again on 3 July 2020 **(CD5.12)** that the three points can be met by virtue of the Appellant providing a significant body of site-specific information and the points were met by the application of a robust GWMP.

7.0 Conclusions

7.1 I confirm that the assessments of Hydrogeology completed and presented in Chapter 6 (Water Environment) of the ES Report **(CD1.2 & 2.2)** has been completed in accordance with industry standard best practice.

7.2 It has included a desk-based literature review of the local and regional geology, hydrology, and hydrogeology. This was then verified by a substantial programme of site investigations to characterise the ground conditions, develop a Conceptual Site Model (CSM) and prove the southwest edge of the bromate plume.

7.3 Assessment work has comprised constructing 41 boreholes, installed with 54 monitoring wells, 9 years of water quality analysis and water level monitoring across 3 aquifer units and surface water; continuous water level monitoring in 9 monitoring wells and two groundwater pumping tests to quantify hydraulic properties of the aquifers and infiltration data to inform lagoon design.

7.4 Meetings have been held, technical data has been shared and 5 update presentations have been held with Affinity and the Agency between 2014 and 2021 which has helped develop a common understanding of the CSM. It is my understanding that sharing of data with Affinity and the Agency has assisted them in their task of managing the bromate plume scavenging system.

7.5 The Chalk aquifer to the northwest, north and east of the Site and in places the overlying LMA is impacted by a bromate and bromide groundwater plume. The plume was discovered in 2000 when water quality testing discovered bromate in PWS boreholes to the southeast and east of the Site. The plume source was traced back to the former Steetley chemical works in Sandridge approximately 2.6km northwest of northern boundary of the application site.

7.6 Regionally, the dissolved bromate plume extent is controlled by the groundwater flow direction in the Chalk. In this part of Hertfordshire groundwater flow is influenced by Chalk karstic features running east to west. Under these influences, the bromate plume is migrating southeast from Sandridge to Nashes Farm Lane and then east towards the River Lea valley.

7.7 Locally, the southwest edge of the bromate plume in the Chalk approximates to the northeast boundary of the Application site and is interpreted to be outside of the mineral excavation area.

7.8 Remedial action has been implemented since mid-2005 by Affinity acting on behalf of the identified AP in accordance with EPA (1990) Part IIA legislation.

7.9 The plume location has remained stable during periods of extreme seasonal low and high groundwater levels between mid-2018 and 2021. This period of plume stability has occurred while the Bishops Rise pumping rates have been held in their optimum abstraction range of 4.5-5ML/d.

7.10 There are ground water monitoring wells within and adjacent to the application site. The hydrograph data (the signal test) from these monitoring wells show that the entire site and the bromate plume east of the site is captured by remediation pumping at the Bishops Rise pumping station.

7.11 The LMH at the Application Site is in hydraulic continuity with the underlying Chalk and forms a small percentage of the total Chalk aquifer thickness. Evidence gathered shows there is no bromate plume in the LMH within the mineral excavation area during extreme high or low groundwater elevations, with stable bromate concentrations in the northeast corner of the site. The average concentration of <1ug/l bromate in the LMH in this area is considered insignificant when compared to the Environment Agency's stated bromate concentration of concern, of greater than or equal to 2ug/l.

7.12 Quarrying activity in the LMH at the Application site will have no discernible impact on the hydrogeological environment of the underlying Chalk aquifer or the nature and extent of the bromate plume within it.

7.13 My main Proof of Evidence and the documents to which I refer have assessed the Reasons for Refusal cited by HCC, and the objections of the EARA, SRA and CHPC. I have concluded that the proposed development will not extend the bromate contamination within the mineral workings; it will not reduce the overall effectiveness of the measures in place to remediate the bromate contamination and will not lead to contamination of the Essendon Public Water Supply boreholes.

7.14 The GWMP sets out an operational plan for mineral extraction and the management of water through all stages of the project. This plan complies with the requirements of the proposed Planning Conditions, the requirements of key stakeholders and the conditions associated with the Environmental Permit and Abstraction Licences.

7.15 The site is divided into 7 operational phases (A to G) and each phase will be designed in a manner that takes advantage of seasonal conditions as excavation of the LMH will be undertaken on a campaign basis that comprises excavation and stockpiling of mineral when water level conditions are most favourable.

7.16 Two fundamental aspects of the operational plan are that there will be no pumping of groundwater from the LMH and that phase specific investigations will be undertaken up to a year in advance to assess the geology, groundwater levels and groundwater quality to support the planning and development stage of the mineral extraction process. Once data has been collected and assessed a phase specific operating plan will be prepared by Brett and subsequently presented and considered by the stakeholders (Brett, Affinity, the Agency, and HCC). The decision to proceed will then be taken following stakeholder review.

7.17 Monitoring of groundwater levels and groundwater quality is a key task and fundamental to operations and permit compliance. There are 56 existing and planned future monitoring wells on the site and there is a robust sampling and analysis plan included in the GWMP to document changes and trends and inform the management and operational process. Infiltration lagoons and operation-critical monitoring wells will be equipped with telemetry links for real-time data analysis.

7.18 Performance reviews, progress meetings and stakeholder engagement has been incorporated into the management plan. Meetings with stakeholders will be held semi-annually and more frequently during periods of mineral extraction when monitoring data is shared, and phasing plans and schedules are discussed. Time critical data will be provided to stakeholders upon receipt.

7.19 As statutory consultees, the Agency and Affinity were engaged both before and after the 2016 Application regarding the impact of the development on the water environment and risks presented by the bromate plume. Based on the information gathered and provided by SLR in combination with a draft GWMP and a POA between the Applicant and Affinity, the consultees have recommended approval of the planning application subject to 3 Conditions, all of which are addressed by the GWMP.

7.20 The HCC Planning Officer recommended approval, with a summary of the reasons for the recommendation stating that "… the Chief Executive and Director of Environment be authorised to grant planning permission subject to a series of planning conditions that included the Environment Agency's recommended conditions in relation to the groundwater environment".

7.21 In my opinion, there is no reason related to groundwater why the proposed development should not be permitted.

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