CELSA MANUFACTURING LTD

Cardiff Groundwater Investigation Consent – operational testing

21/03/2014 10652/r1

1. INTRODUCTION

1.1 Background

Zenith International Limited (Zenith) has previously been approached by Michael Sylvester of EAME with a request for assistance with guiding a client (CELSA Manufacturing (UK) Limited) through the Natural Resources Wales' process to obtain a variation to their existing abstraction licence, namely an increased abstraction rate. The client uses water for process cooling and dust suppression as part of a steel works operation.

The borehole is located at GR ST 2104 7602 at the CELSA Manufacturing site located near to Cardiff docks. The current abstraction licence is for 50,000 m^3/yr.

Natural Resources Wales (NRW) issued a consent to drill and test pump the existing borehole on 14th January 2014. Zenith's previous report, 10652r1 details the work carried out in order to obtain this consent. This included the completion of a Water Features Survey where no groundwater dependent features were identified in the specified 500 m radius.

1.2 Scope of work

The aim of this work is to complete all necessary steps, as required by the consent to enable the client to apply for an abstraction licence variation. The scope of work for the phase of the project were therefore to:

- Provide specification for alterations to borehole headworks to allow monitoring equipment to be installed
- Liaise with on-site engineer to modify headworks
- Site visit to install temporary monitoring equipment (water level logger, provided by Zenith) prior to 7 day monitoring period
- Operational support and written instructions for carrying out operational pumping test
- Site visit to download water level logger and retrieve equipment at the end of the pumping test
- Analysis of pumping test data
- Complete pumping test impact assessment report, for submission to the NRW

2. MONITORING

2.1 Groundwater investigation consent

Following the acceptance of the submitted Water Features Survey, the NRW issued a Section 32 Consent to investigate a groundwater source on 14/01/2014. The consent specified the following:

- The consent holder shall carry out test pumping and measurement of water levels on the works using a Constant Rate test (CRT) . During the test, pumping rates shall not exceed a maximum of 614 m^3/d
- Water level monitoring equipment should be installed into the borehole capable of recorded at an interval of 15 minutes of less. The monitoring equipment should be installed 3 days prior to pumping commencement to obtain baseline data prior to the CRT
- There is no requirement to undertake additional monitoring of water levels at another location during the pumping test
- All data must be supplied electronically

The Groundwater Investigation Consent (GIC) was later amended and agreed by the NRW on 27/01/2014 to accommodate the operational restrictions at the site. It was agreed that the pumping test and monitoring would comprise the following:

- 7 days of monitoring (at current operational levels) prior to the start of the test
- 4 days of required operational testing at a rate not exceeding 614 m^3/d
- Monitored recovery of groundwater levels

2.2 Operational test

The operational test consisted of 7 days of pre test monitoring and normal operational rate (up to the existing maximum abstraction licence rate of 192 m^3/d) followed by 4 days of operational testing up to the required licensed maximum of 614 m^3/d). It was agreed to monitor recovery, whilst operation activities continued until pre test water levels were observed.

2.3 Monitoring equipment

Zenith coordinated all modifications to the existing borehole headworks, including the specification of the installation of a 50mm PVC dip tube. This was to allow for the accurate measurement of the groundwater head throughout the testing schedule.

A water level data logger was installed into the borehole at 10:30 am on 18/02/2014 and programmed to log the hydrostatic pressure at a 1-minute sampling frequency. A barometric logger was also programmed to log the barometric pressure at surface at the same time interval to accurately compensate groundwater level changes.

Periodic groundwater dip measurements were taken to corroborate the automatic water level data obtained from the loggers.

A cumulative flow meter was used to gauge the daily flow from the borehole during the test. Daily readings were obtained each morning by the site supervisor prior to pump operation.

3. PUMPING TEST DATA

3.1 Pumping controls

A submersible pump is installed in the borehole. The pump is automatically controlled by pressure transducers in the reservoir tank which trigger pumping when the water level reduces below the trigger level.

During production hours between the hours of 07:00 – 13:00, the pump is triggered on average every 5 minutes. Once triggered, water will be pumped at a fixed rate for a period of 5 – 10 minutes on average, or until the water level in the reservoir tank has reached the required capacity.

It is also possible to over-ride this automatic control and manually control the pump's operation. During the 4 day pre-test monitoring the operation of the pump was maintained via the manual over-ride switch mechanism.

3.2 Pumping details

The pump was operated during the *Pre-test monitoring* primarily in the morning between 07:30 – 12:00 below the licenced abstraction volume. During the *Operational testing* the intended increase in abstraction to the desired 614 m^3/d wasn't reached. The increase wasn't feasible due to low Melt Shop production between the Thursday and Saturday *(pers comm.. Craig Bennett, General Manager, Celsa Operations, 04/03/2014)*. Table 1 below summarises the testing periods.

Table 1 Pumping test schedule

Test	Period
Pre-test monitoring	18/02/2014 - 24/02/2014
Operational testing	25/02/2014 - 28/02/2014
Recovery test	28/02/2014 - 01/03/2014

3.3 Data analysis

As specified above in section 2.2, the monitoring incorporated a number of pumping operations; pre-test monitoring, operational test and recovery. The data analysis and interpretation has therefore been separated to adequately describe the impacts that were apparent during the different phases of testing. The data is presented below in Figure 1.

Pre-test monitoring (18/02/2014 – 24/02/2014)

During the 7 days of pre test monitoring, pumping was restricted to the daily licensed rate of 192 m^3/d. During the 7 days, the borehole was operated at an average daily rate of approximately 100 m^3/d. During each pumping event, groundwater drawdown was recorded at approximately 0.32 m on average. Following pump cessation, groundwater levels recovered to steady state within 40 minutes on average with an estimated 85% of the total recovery recorded in the first 2 minutes following pump cessation.

Operational testing (25/02/2014 – 28/02/2014)

The operational testing immediately followed the 7 days of pre-test monitoring where abstraction was increased above the current licenced volume to determine the effect of increased abstraction on groundwater drawdown and recovery.

Groundwater drawdown during each pumping period over the operational test resulted in a total groundwater drawdown of between 0.31 – 0.33m. Higher abstraction on the 26th of February between 06:30 – 11:30 at a rate of approximately 400 m^3/d resulted in a cumulative drawdown of 0.33 m. Groundwater recovery following pump cessation took approximately 2 hours to recover to steady state conditions, however 75% of the total recovery was recorded in the first 2 minutes following pump cessation.

The difference in groundwater drawdown for variable daily abstraction volumes is negligible. This can be seen below in Table 2 and shown visually on Figure 1. It is not expected that an increase in daily groundwater abstraction to the desired rate of 614 m^3/d would result in a significantly larger drawdown.

Table 2 Groundwater drawdown and daily abstraction

Date	Total daily abstraction (m^3)	Total daily groundwater drawdown (m)
18/02/2014	124	0.35
19/02/2014	109	0.34
20/02/2014	0	0
21/02/2014	170	0.28
22/02/2014	69	0.32
23/02/2014	87	0.32
24/02/2014	119	0.31
25/02/2014	93	0.32
26/02/2014	391	0.33
27/02/2014	196	0.31

Recovery (28/02/2014 - 01/03/2014)

Following the operational testing, groundwater levels were monitored without pumping for a period of 24 hours. Groundwater levels did not continue to recover over this period and actually decreased due to reduced regional rainfall falling across the South West & Wales over this period.

General observations

It is clear from the pumping test that groundwater levels across the site respond extremely quickly to pumping operations, recovering almost immediately to steady state conditions following pumping cessation. Groundwater drawdown is not significant during pumping and when abstraction is increased, drawdown does not drastically increase.

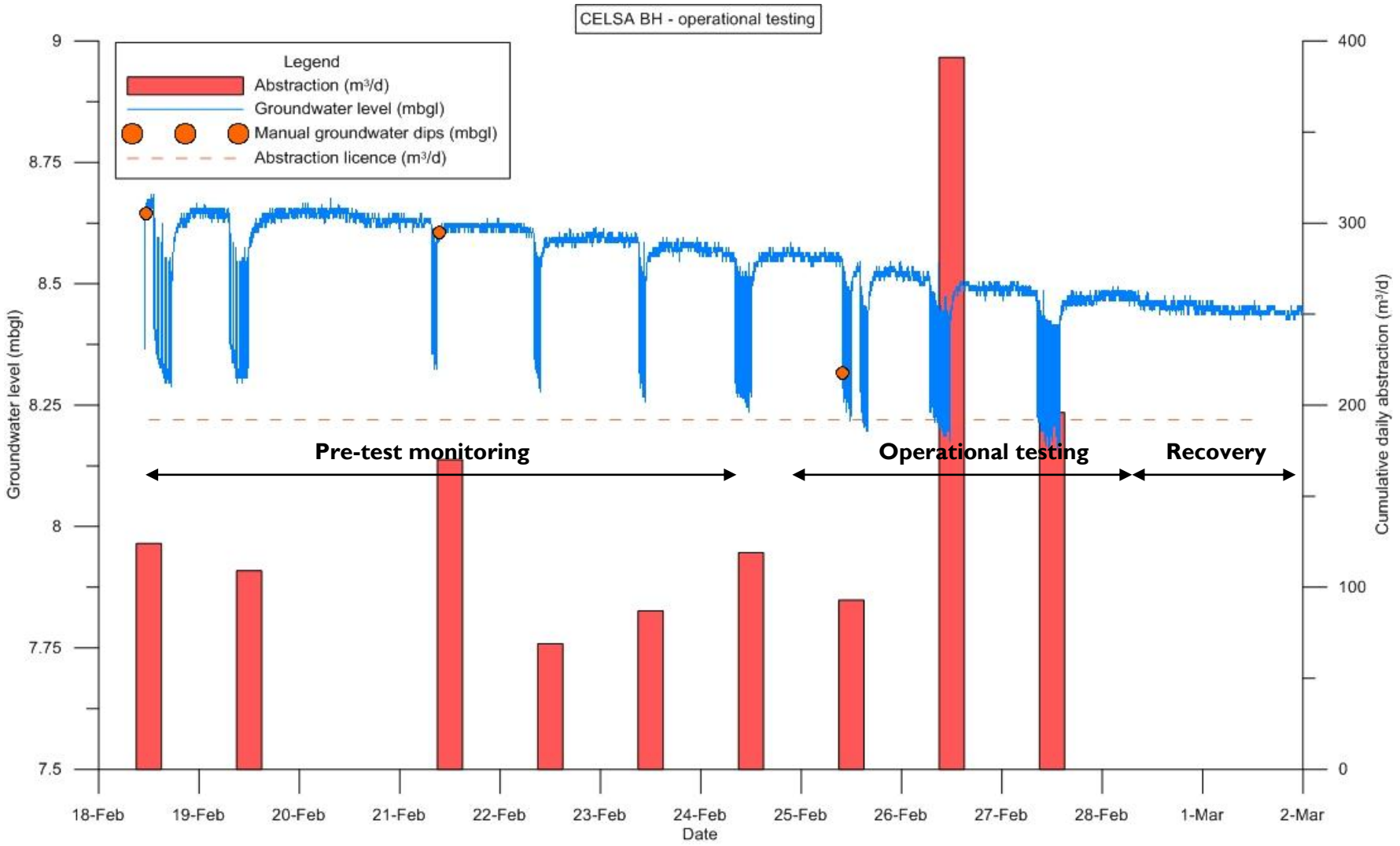

Figure 1 CELSA BH – operational testing

3.4 Environmental factors

There is an overall reduction in groundwater level throughout the monitoring period which is not related to pumping. The gradual reduction in the groundwater level of approximately 0.2 m over the full monitoring period is likely to be influenced by a combination of variables. These have been summarised below

Reduced rainfall

Rainfall data has not yet been obtained but the testing occurred following a period of heavy rainfall throughout the country. The reduction in groundwater level is therefore likely to be as a consequence of regionally elevated levels receding to normal following this period of high rainfall.

Tidal changes

The proximity of the borehole to the Severn Estuary and the nature of the brackish aquifer would suggest that groundwater levels at the location would be affected by tidal variations. These expected level variations have not been detected at the monitoring location.

4. SUMMARY

4.1 Conclusions

- Groundwater levels respond extremely quickly to pumping operations;
- Operational testing above the current groundwater abstraction licence confirmed that the borehole is capable of sustaining an increase in abstraction.
- Operating the pump for a 4.5 hour period resulted in a daily abstraction rate of approximately 400 m^3/d. The increased abstraction generated a total groundwater drawdown of 0.33 m over this period followed by a recovery to steady state conditions in less than 2 hours.
- The overall daily groundwater drawdown during operational testing compared with the daily groundwater drawdown noted over the pre-test monitoring is negligible, indicating that an overall increase in groundwater abstraction does not significantly impact groundwater levels.
- On average, 75-85% of the total recovery occurred in the first 2 minutes of pumping cessation during both the pre-test monitoring and the operational test
- It is likely that an increase in groundwater abstraction to the desired daily abstraction rate of 614 m^3/d would result in negligible additional groundwater drawdown.
- A gradual decrease in groundwater levels over the monitoring period of less than 0.2 m is likely to be attributed to a reduction in precipitation over this period, interpreted as water levels returning to normal levels following a period of unseasonably high rainfall.
- Tidal influences are not apparent from the monitoring data.

ISO 9001:2008 Quality Management System		
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