10 sets of Data over 4 mths :

absolute loadings :

CAR#021 Proposal for additional monitoring work on the Haggs mine water treatment scheme design

Justification and objectives of work

The following represents a strategy for water quality and flow monitoring in the river catchment within which the Haggs mine water discharges. This is critical, for a number of reasons:

1. Reliable, synchronous flow and water quality data across the full range of hydrological conditions are ***the most important design criteria for a mine water treatment system*** (and reference to any respected national or international guidance documents on such matters will corroborate this). Haggs is no exception, and yet data available to date are not clearly reliable and there is no indication that they have been collected across a wide range of hydrological conditions.

2. The measurement of flow of the Haggs discharge has been methodologically poor to date, and the current flow from the adit is known not to represent the full flow that might emerge if minor changes occur in the subsurface; specifically re-routing of the Brownley Hill adit water. For that reason it is necessary to monitor the Brownley Hill discharge (flow and quality) as well as Haggs (and on the same occasions).

3. Without reliable flow and water quality data for the Haggs discharge, design of the treatment system will be based on assumptions about flow and water quality. Given that the construction cost of a passive treatment system at Haggs is likely to be in the region of £1.5 million, it is considered reasonable to invest approximately 2% of this total on gathering the very data that underpins the entire treatment system design.

4. Given the scale of investment in the treatment system, the benefits of the treatment system to the wider river catchment should be quantified. This can be achieved by monitoring flow and quality at key locations within the River Nent, also across hydrological conditions, and on the same days as monitoring of the Haggs and Brownley Hill discharges.

5. There are other point source mine water discharges to the River Nent. Reliably measuring flow and water quality of these (on the same days as monitoring of the Haggs and Brownley Hill discharges and River Nent), is important as there is a much wider issue of metal pollution of the Rivers South Tyne and Tyne, to which these discharges contribute. The Coal Authority is one of the organisations involved in addressing this issue. The importance of individual discharges to this problem, specifically in the context of total metal export from the River Nent under varying hydrological conditions, has not been accurately quantified to date

The scope of works outlined below will provide answers to the questions above, and in the most cost-effective way. Ideally this would have all been done over a year ago. However, the data will still be of great value to the design of the Haggs treatment system. This is because it will be possible to modify the detailed design as the new data become available, ultimately resulting in the best possible treatment system design. The information gathered will be of more value than just for the Haggs treatment system design, as detailed above.

This work would be an addition to the existing contract, but will likely be completed within the current timeframe of the current work (i.e. by April 2016) subject to a timely instruction to proceed.

Scope of Work

The work will entail the collection of water quality and flow-rate data from 8[1] locations within the catchment of the River Nent, Cumbria. The exact locations may change subject to preliminary results and access, but are likely to be as follows:

1. River Nent downstream of the Haggs mine water discharge [a]
2. River Nent upstream of the Haggs mine water discharge [a]
3. Haggs mine water discharge [b]
4. Croft mine water discharge
5. Rampgill mine water discharge
6. Capelcleugh mine water discharge
7. Discharge from Nenthead power station [c]
8. Brownley Hill mine water discharge (on Gudham Gill)

([a] Flow gauging subject to flow conditions; [b] The installation of a V-notch at the Haggs adit will make an inconsequential difference to project costs: a [redacted] reduction to be specific i.e. the cost of 5 kg of lab grade NaCl [c] Subject to change depending on access / flow-rate)

Ten sets of data will be collected, which will be as representative as possible (within the timeframe available) of the full range of flow conditions within the catchment. Ten rounds of monitoring is considered the minimum to complete a thorough characterization of the metal dynamics (loading and concentrations) in the River Nent and to properly understand the relative contributions of the various mine water discharges to the absolute metal loading of the river under varying hydrological conditions. Assuming the work is undertaken over 4 months, the ten sets of data will be collected within this timeframe. It is not possible to state exactly when each round of monitoring will occur, exactly because the monitoring is *reactive* to hydrological conditions. The [redacted] team has a track record of success in this type of reactive monitoring work, often on much more logistically challenging projects.

All of the [redacted] laboratory analysis work adheres to the methods detailed in the internationally-recognised American Public Health Association (APHA) publication (2005) *Standard Methods for the Examination of Water and Wastewater* (21st Edition). Where methods are not available in APHA (2005) we use methods published elsewhere in international literature.

Analysis of total and dissolved cations will be undertaken using a Varian Vista-MPX ICP-OES or Agilent 770 Series ICP-MS, as appropriate for the metal concentration. Blanks and standards are used throughout and triplicate samples analysed periodically. Anion analysis is conducted using a Dionex DX320 ion chromatograph.

A complete listing of all substances that will be determined during the project is given in Table 1, alongside the detection limit for each determinant (where applicable), and the relevant Environmental Quality Standard (EQS) for the metals Zn, Cd, Pb, Ni, Cu.

Table 1. Variables that will be determined in water samples over the duration of the project, and detection limits (detection limits for both ICP-MS and ICP-OES, and EQS values, provided only for Zn, Cd, Ni, Cu and Pb (low hardness assumed))

Determinant (Units)	Detection limit	Determinant (Units)	Detection limit
Temperature (°C)	n/a	Na (mg/L)	0.1 mg/L
pH (-)	n/a	K (mg/L)	1 mg/L
Eh (mV)	n/a	SO_4 (mg/L)	0.5 mg/L
Conductivity (µS/cm)	n/a	Cl (mg/L)	0.2 mg/L
Alkalinity (mg/L as $CaCO_3$)	1 mg/L as $CaCO_3$	Al (mg/L)	0.05 mg/L
Suspended solids (mg/L)	2 mg/L	Mn (mg/L)	0.01 mg/L
Ca (mg/L)	0.02 mg/L	Fe (mg/L)	0.01 mg/L
Mg (mg/L)	0.02 mg/L	Si (mg/L)	0.1 mg/L
	Detection limit		
	ICP-OES	ICP-MS	EQS
Cd (µg/L)	10 µg/L	0.1 µg/L	0.08 µg/L
Pb (mg/L)	50 µg/L	1.0 µg/L	7.2 µg/L
Cu (mg/L)	10 µg/L	1.0 µg/L	1.0 µg/L
Ni (mg/L)	10 µg/L	1.0 µg/L	20 µg/L
Zn (mg/L)	10 µg/L	2.0 µg/L	8.0 µg/L

[1] Additional locations could be added at small additional cost as per the email from [redacted] to the Coal Authority and Environment Agency dated Mon 09/11/2015 08:48 which AECOM understand is awaiting response.

An interpretive report will be provided, giving full results of the exercise and outlining the relevance of the results to the design and benefits of the Haggs mine water treatment scheme. Interim updates to the project team will be provided as and when required by telephone or e-mail. If written interim reports are required this will incur additional costs.

Deliverables

- Full water quality and flow data set, including metal mass loadings
- Attendance at meetings and telecons as appropriate
- Interpretive report

Costs

The work will require the input of the following staff, with day-rates as indicated:

- [redacted]

The subcontractor costs for Newcastle University are outlined below and are inclusive of the [redacted] administration which AECOM are eligible to apply under the terms of the Framework Agreement. The total Newcastle University costs for the work are indicated in the table below. All costs are exclusive of VAT.

Item	Cost
Staff time: sampling and analysis JD: 22 days; PO: 15 days; CG: 4 days	[redacted]
Travel & subsistence 90 miles per trip @ [redacted] person/visit subsistence	
Analysis costs Complete analysis of 160 samples (as Table 1), plus salt gauging analysis	
Equipment / consumables costs Syringes, filters, field alkalinity consumables, EC probe, salt	
Staff time: interpretation and reporting CG: 2 days; AJ: 2 days	
TOTAL	**£31,300.50**

Additional input required during the establishment and modification of the monitoring regime and input to the interpretive report both technically and for quality assurance and control is itemized below. It is assumed that the award shall be granted under an existing project and not as a new commission and therefore there are no additional costs for administration (i.e. invoicing).

[redacted]

AECOM subtotal – £1,980

Total tender price £33,280.50 ex VAT.