

PRACTICAL IMPLEMENTATION OF A PPC SITE PROTECTION AND MONITORING PLAN

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Elementis Chromium operates a chromium chemical production installation under a Pollution Prevention and Control (PPC) Permit. A condition of the permit required submission of a Site Protection and Monitoring Programme (SPMP) to the Environment Agency within six months of the permit issue.

The SPMP requires the baseline soil and groundwater quality for the site to be established at the start of the permit life, along with the implementation of an ongoing programme to demonstrate the effectiveness of pollution prevention measures. The objective of the on-going SPMP is to ensure that there is no deterioration in land quality under the permit and generate evidence that can be used to confirm this at any would be site closure. This is achieved through an effective process of planned inspection, testing and maintenance of the site infrastructure, supported by periodic environmental monitoring to confirm the site condition.

This paper will discuss practical experiences gained from the perspective of the Permitted Installation, who had to implement the on-going SPMP requirements, and the Environmental Consultant, who carried out the baseline ground investigation.

INTRODUCTION

Elementis Chromium operates a unique production facility in the UK producing a range of chromium chemicals. The process required permitting under the Pollution Prevention and Control (PPC) Regulations in 2005, this was a natural extension of its existing IPC Permits held since 1994. Among the new requirements under PPC, this site, in common with other PPC controlled sites had to implement a "Site Protection and Monitoring Programme" (SPMP) to prevent pollution to land and groundwater while operating under a PPC permit.

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inspection, testing and maintenance of the site infrastructure, supported by periodic environmental monitoring to confirm the site condition.
The SPMP process involves the following steps:

- the collection of baseline "reference" data on existing land quality (including soil, groundwater and surface water),
- validation of protective infrastructure, e.g. bund and drain integrity,
- an on-going monitoring programme to ensure the continued functioning of protective infrastructure,
- an on-going environmental monitoring programme.

This paper will discuss practical experiences gained from the perspective of the Permitted Installation, who had to implement the on-going SPMP requirements, and the Environmental Consultant, who designed and carried out the baseline ground investigation.

SITE HISTORY

The Elementis Chromium site is located near the town of Eaglescliffe, Stockton-on-Tees in North East England and occupies an area of about 13.8 ha. A general location plan is shown as Figure 1.

The site was originally occupied by the Eaglescliffe Chemical Company Ltd. which was established in 1833 for the manufacture of sulphuric acid and fertilisers. Later production operations were added for animal foodstuffs, oleum, purple ore briquetting, copper extraction, zinc oxide, tin oxide and superphosphate production. Fertiliser production ceased in 1967 and a 1960 sulphuric acid plant was closed in 1984.

Production of chromium chemicals at the site started in 1927, with solid mineral process residues deposited in an above ground ("landhill") facility to the southwest of the current production site. The chromium operations were gradually expanded over the late 20th century to eventually occupy the majority of the site.

CLIENTS FACTORS FOR CONSIDERATION

With the long and complex history of the site as described above, there were concerns within Elementis Chromium that high concentrations of a variety of chromium and non-chromium pollutants might be encountered during the investigation. Contaminant mobility, potential risk to receptors both on and off site and liability implications facilitated the need for a thorough assessment of ground quality.

One of the main outcomes of the process, which will be discussed in greater depth throughout this paper, was that the concerns held prior to the investigation were unfounded. The client viewed the process as extremely positive, again views that will be discussed in detail throughout the paper.

Figure 1. Site location plan

ENVIRONMENTAL CONTEXT OF THE SITE

As can be seen in Figure 2, the Elementis site is roughly triangular in shape and lies on the upper slopes of a gentle valley. A small beck forms the northwest perimeter of the site which is more or less surrounded by arable farmland. There is an ecology wildlife area established by the company on land formerly occupied by the Royal Navy to the East of the site.

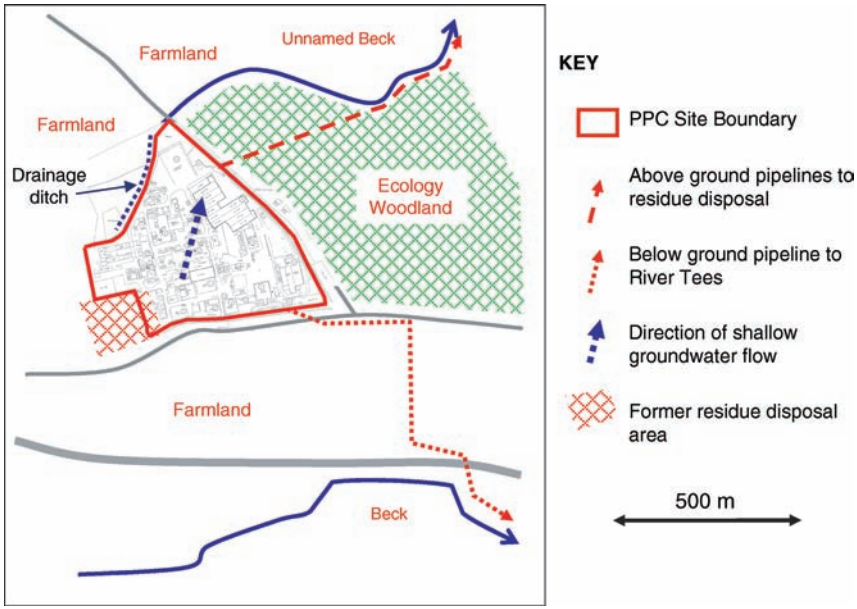

Figure 2. Environmental context of the site

Adjacent to the site to the southwest is a former above ground mineral residue disposal area operated by the company until 1949.

The Cenargo World Depot (a former COMAH site) is located about 600 m to the east and residential housing is located at Eaglescliffe about 1 km to the east.

GEOLOGY

The geological sequence beneath the site comprises made ground up to 2.0 m thick overlying Flandrian Alluvial Deposits consisting of alternating laminated clay and sands and Devensian Glacial Till of sufficient combined thickness to provide protection to the underlying Triassic Sherwood Sandstone.

Groundwater Vulnerability Map (Sheet 8) for the area indicates that the soils are classified as negligibly permeable over non-aquifer.

BASELINE INVESTIGATION OF LAND QUALITY

OBJECTIVES

The objectives of an SPMP baseline investigation of land quality are: to obtain information to allow the refinement of the conceptual model of the site and its surroundings; as well as

to obtain baseline data in areas that are vulnerable to existing and future potential contamination. These data will serve as a reference against which the site condition will be assessed at closure.

DESIGNING THE INVESTIGATION

Sampling points which are shown on Figure 3 were selected on the basis of the pollution potential of the on-going PPC activities, together with historical information derived from site incident logs and previous ground investigations. Areas where historic contaminants are expected to be present are defined using this information and are shown in the shaded areas on Figure 3.

A technique that is frequently used when designing SPMP baseline investigations and one that was used at Elementis Chromium was to divide the site into zones depending on current site processes. The zones are also shown on Figure 3. The sample locations within each zone can then be selected based on this process information and the historical information. The cost benefit associated with the number of samples is also considered at this stage bearing in mind that the process is an iterative one and further sampling locations can be added in the future if necessary.

While historical site information combined with the findings of previous ground investigations affords a certain level of confidence in selecting the sampling locations, the uncertain nature of ground investigations means that the designer of the investigation must be prepared to modify any assumptions whenever further information becomes available. This also emphasises the need for the requisite time to be taken in order to compile a pre-investigation conceptual site model with the aim of attempting to understand as much as is possible about the environmental context of the site.

Locations where high concentrations of contaminants are encountered should be investigated further to identify the source and delineate the affected area. Under PPC, operators will be required to remove any contamination that was not identified at the start of the permit, therefore identifying areas of previous impact is important to limit future liability. Beyond the PPC requirements, the operator should be keen to identify cases of existing pollution as it allows them to evaluate the associated risks to the environment and to plan remediation strategies if required. This is one of the areas where Elementis Chromium welcomed the findings of the SPMP as it confirmed to them that the action they were taking, and continued to take, was protecting the local environment. Additionally, from a commercial point of view, it allowed the operator to identify and reduce any potential liability that may exist in relation to ground contamination.

A final action within the design of the investigation should be to assess the impact of the investigation itself and any potential impact to the environment that it may have.

RESULTS AND ISSUES ARISING FROM FIRST PHASE OF INVESTIGATION

Following the intrusive ground investigation and sampling collection process, selected samples were analysed for a range of determinants by a suitably accredited analytical laboratory.

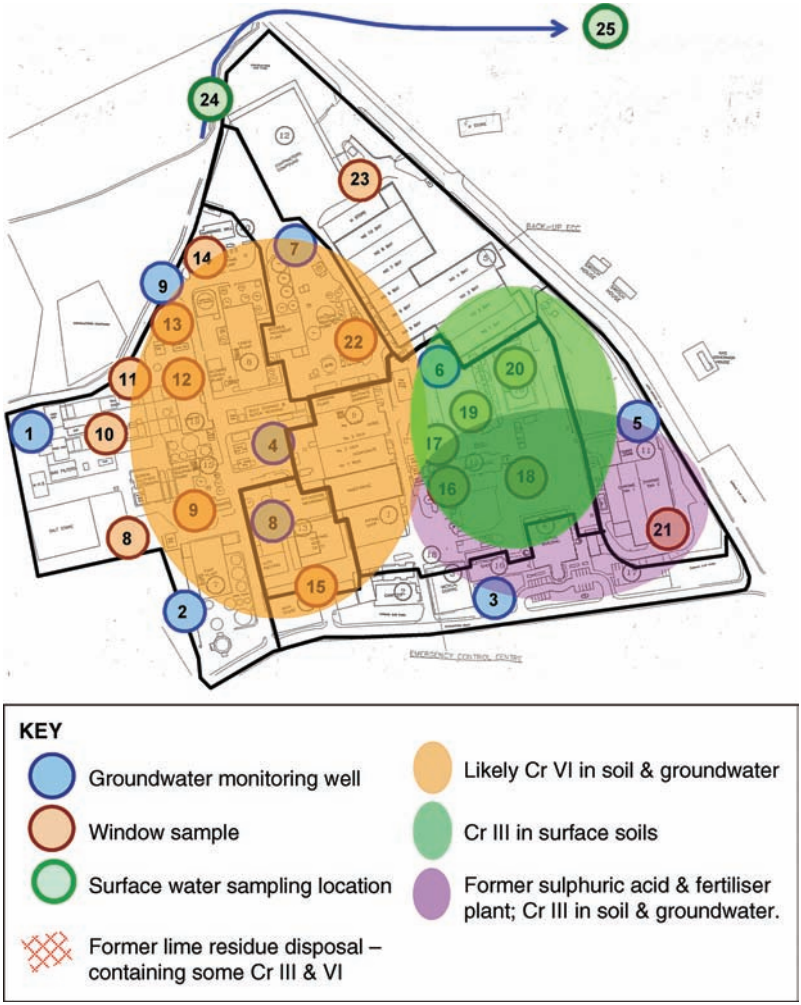

Figure 3. Sampling locations and areas of expected contamination

Data sets containing the analytical results from each zone were compiled enabling an accurate and robust baseline of land quality for each zone to be established. A conceptual site model, in plan and section view, was constructed based on the findings of the initial investigation and historical site data. The plan and section views of the initial conceptual site model are shown in Figures 4 and 5 respectively.

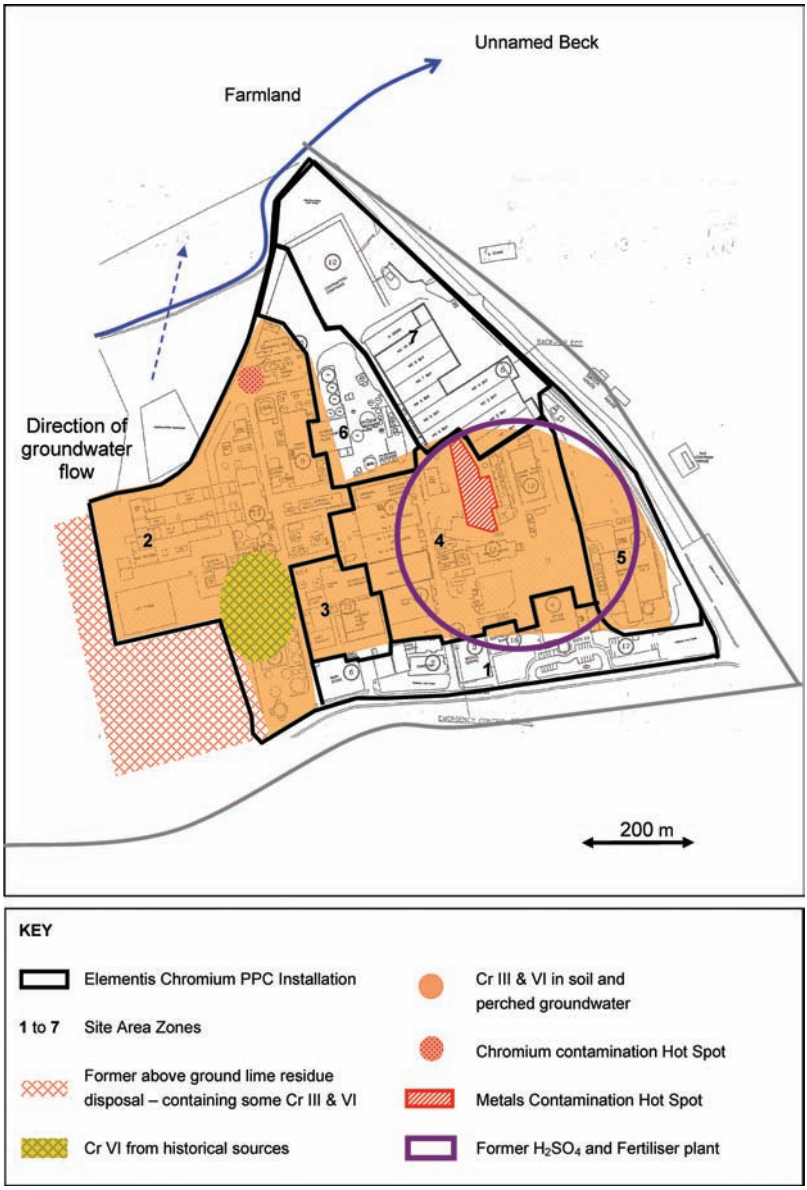

Figure 4. Plan view of initial conceptual site model

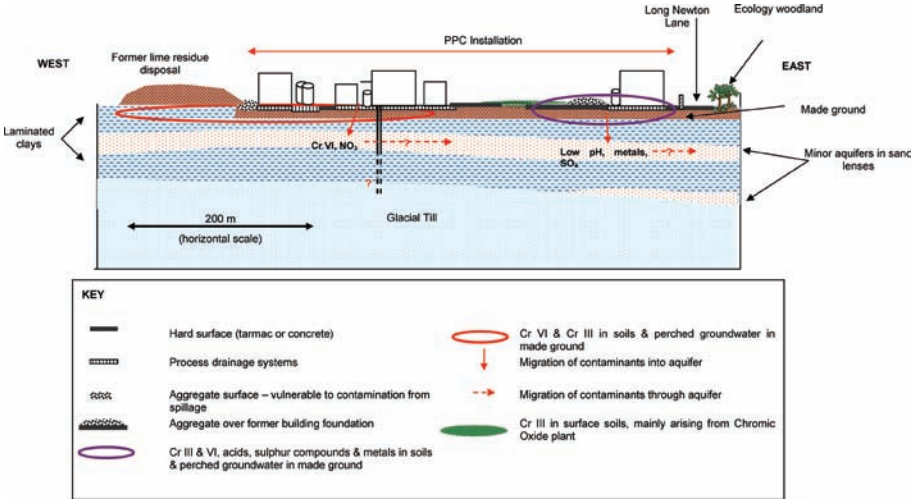

Figure 5. Section view of initial conceptual site model

Where data gained from the initial investigation were either of insufficient quality to compile a robust defendable baseline or left unanswered, questions relating to the potential risk to the environment, further intrusive investigation was required.

PLANNING AND EXECUTION OF FURTHER INVESTIGATION

To complete the PPC baseline evaluation, a further investigation of the following was required:

POINT 1

An area of elevated hexavalent chromium in surface soils which was not recognised as having a high pollution potential from the initial study

Second study action:

Locations were sited radiating out from is area "A" which was identified as the likely source of the elevated levels of hexavalent chromium, with samples taken at various depths at each location. The aim of this was to accurately map the horizontal and vertical extent of the contamination.

Outcome and Findings from further investigation:

The elevated chromium levels that were detected in the vicinity of Area "A" were confirmed to cover an area of approximately 700m^2. No particular distribution pattern was revealed

by the further investigation however the limit of the vertical extent of the contamination was confirmed by a lack of contamination detected in groundwater monitoring wells.

POINT 2
High levels of chromium detected in the vicinity of the former Plant "B" and potentially penetrating into an unconfined aquifer within the superficial deposits

Second study action:
A new groundwater monitoring well was sunk within the plant "B" in the most likely source area for the contamination, where the highest concentrations of ground and groundwater contamination was likely to exist.

Outcome and Findings from further investigation:
The concentrations of chromium detected in the borehole within the former plant "B" were confirmed to represent the highest to be found anywhere on the site. As chromium production is no longer undertaken in the plant and the building has been decommissioned, there is no potential for additional chromium to be released in this area under the currently permitted PPC activities.

POINT 3
Groundwater flow regime for the site and surrounding area needed to be fully understood.

Second study action:
Groundwater was monitored for a further period of two months at each of the existing monitoring wells and two new wells including the new well in the plant "B".

Outcome and Findings from further investigation:
Additional rounds of groundwater monitoring led to the conclusion that there is no significant flow within the aquifer; the aquifer was not under pressure and groundwater height did not vary significantly across the site. The groundwater flow direction arrow from the initial conceptual site model has therefore been removed.

While this location represents the highest concentrations of contamination on the site, the fact that groundwater in the confined aquifer is not moving means that the risk to the environment from the contamination migrating off site is minimal. This inference can be made as the contamination that exists does not contain all three facets, i.e. source, pathway and receptor, required to represent a significant risk to the environment. In this case the source and receptors both exist but as there is no pathway connecting the two, the risk is perceived as minimal. This hypothesis was confirmed by the monitoring wells around the boundary of the site, where groundwater quality was found to be good.

Revised versions of the conceptual site models in plan and section view can be viewed in Figures 6 and 7 respectively.

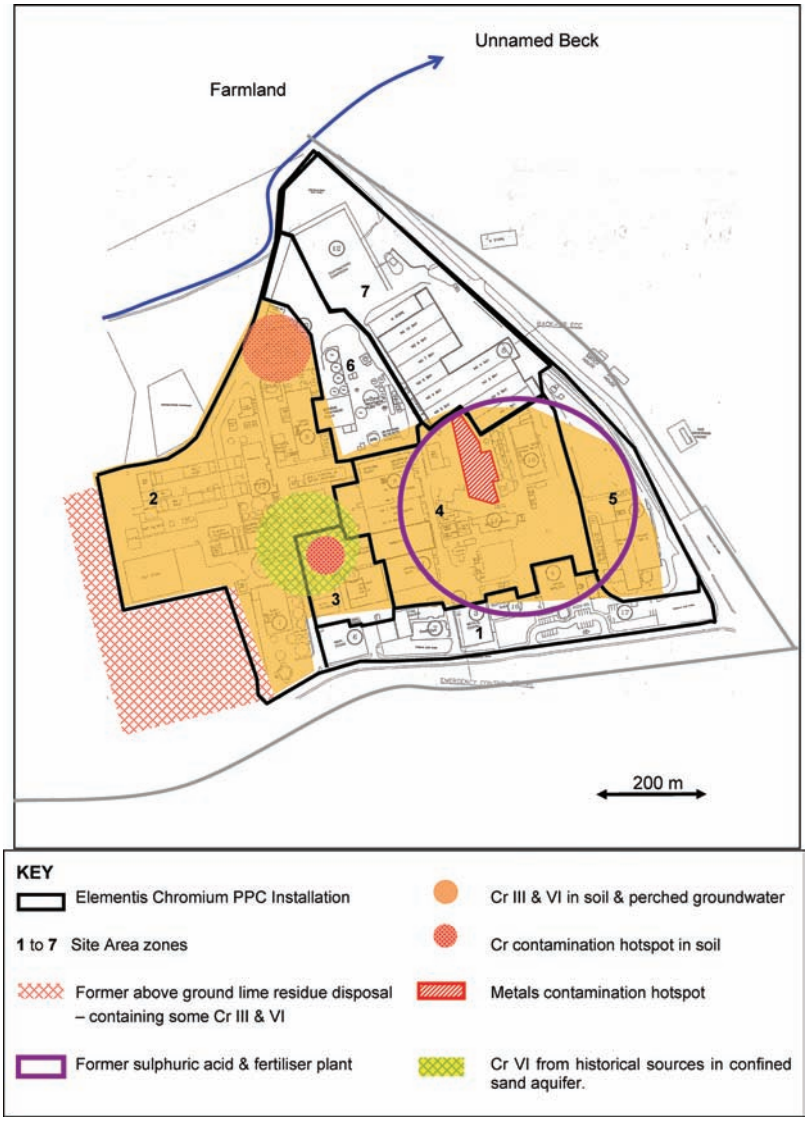

Figure 6. Revised conceptual site model plan view

CONCLUSION/LESSONS LEARNED

For Elementis Chromium, the PPC permit improvement condition to carry out a SPMP baseline investigation held some uncertainty in relation to the potential impact that the site was having on the environment. This links to the potential liability to which the company may be exposed, both within and beyond the PPC regulatory regime. The view the company takes is a positive one in terms of the impact the investigation has had to the business as can be described by the following examples:

- The investigation led to the identification of an area "A" that required action to ensure that it did not migrate into the environment. The area has subsequently been addressed; this potential source of pollution into the subsurface has been removed.
- The investigation demonstrated that contamination impacts are confined within the site boundaries, and indeed to specific areas within that boundary. It also demonstrated that the risk of off-site migration is minimal.
- Existing ground contamination impacts have been quantified and a good conceptual model developed for the site, underpinned by a robust set of data. This information will be beneficial for the maintenance of a fair valuation and assessment of risk in the event of a potential change of ownership of the company or the land in the future.
- An ongoing environmental monitoring programme has been developed and the existing site incident reporting procedure expanded to incorporate more detail of any potential environmental incidents. As a consequence of these developments Elementis Chromium can both protect the environment and mitigate potential liability to which that they would be exposed.
- All site personnel have attended training on the SPMP process, the reasons behind the programme and their individual role in the continuing monitoring programme. This has given the entire workforce continuing ownership of the new system of reporting incidents as well as responsibility for environmental protection, mitigating risk to the environment and reducing any exposure to potential risk and liability that may exist. By involving all site personnel in this way their proactive involvement in environmental matters has been secured.
- The bund inspection regime has been aligned to existing tank inspections. By simplifying the process of inspection and not enforcing a duel inspection regime we have ensured that the inspections fall into an existing, planned, preventative maintenance programme where actions are tracked through to completion.

REFERENCES

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