CASE STUDY

Permeable Reactive Barrier Installation

Remediation of Site Impacted by Chromium (III & VI)

Client

East Renfrewshire Council

Regulator

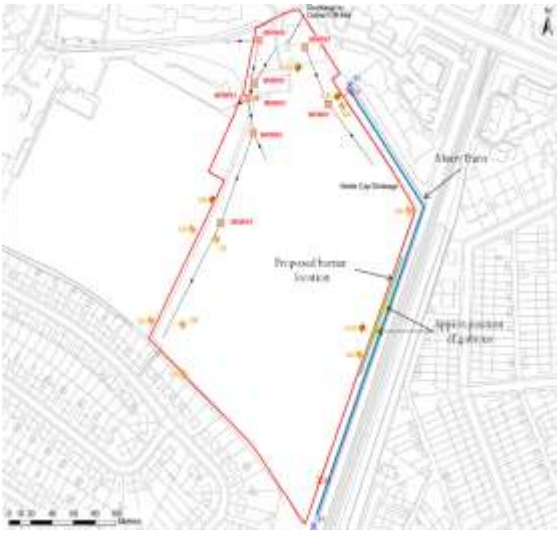
SEPA Scottish Environment Protection Agency

Site Background & History

The site is located at Muirend Playing Fields, Giffnock, Southwest Glasgow.

The Merry Burn bounds the eastern and part of the northern perimeter of the site before becoming culverted, see Figure 1 below.

Figure 1 – Site Plan



The site is currently used as sports and recreation purposes - see Figure 2 below.

Figure 2 – Overview of the Site Today

In the 1950s the site was used for the disposal of waste (particularly chromium bearing wastes), prior to development as playing fields.

Along the eastern boundary of the site the Merry Burn has historically been affected by the chromium contamination leaching from the waste situated beneath the playing fields. In 2003 extensive remediation work was carried out on the site including capping of the waste, installation of a new drainage system isolated from the contaminated waste, construction of an up-gradient slurry cut-off wall along the northern, southern and western site boundaries and dredging of the burn.

At the time, it was anticipated that while the remediation works would lead to a significant improvement in the quality of the surrounding surface waters - it was acknowledged that some ingress of chromium-contaminated leachate would continue to occur which it was envisaged would diminish over time. In practice the chromium levels in the Merry Burn have not decreased as much as was anticipated and there continues to be some visible discolouration of the burn.

Further site investigation indicated chromium waste breaking through into the burn at several locations.

Further works were commissioned with the construction of gabion baskets and peat barriers at key locations to prevent the chromium waste entering the burn. These works proved ineffective as can be seen in Figure 3 below.

Figure 3 – Chromium Waste Breaking Through Gabion Baskets

The pH analysis of the resulting leachate was 11.8 indicating the strong possibility that the waste was highly alkaline chromite ore processing waste. Analysis undertaken by Envirotreat indicated total chromium of 26,000µg/l of which 20,000µg/l was hexavalent entering the burn (the EQS values being 4.7ug/l and 3.4ug/l respectively).

Following an options appraisal for the site, Envirotreat were approached in 2014 to provide a permeable reactive barrier [PRB] remediation solution to further reduce the ongoing contamination issues of the Merry Burn.

Methodology

The PRB was installed along a 100-metre section on the east of the site – this was in the vicinity of the gabions where the contamination ingress was considered to be the worst.

The treatment medium within the PRB was a site-specific E-Clay (ChromeSorb) formulation designed to address the identified / reported contaminants of concern (primarily hexavalent and trivalent chromium with the additional capability to treat lead and nickel).

The barrier was installed in relatively short sections (up to 2m) in order to reduce the risk of collapse and to minimise the quantity of excavated stockpiled soils at any one time.

Each section was excavated to the required depth (determined by the depth of underlying impermeable clay layer). The relatively uncontaminated surface soils were initially removed and placed to one side of the trench (behind suitable bunding to prevent them falling into the burn and to maximise their potential for reuse / reinstatement as a suitable capping layer). The more contaminated soils were placed on an engineered containment system on the opposite side of the barrier trench to minimise the risk of cross contamination.

An appropriate volume of ChromeSorb was added to the excavated trench followed by the addition of small quantities of the previously excavated (and set aside) soils – the ChromeSorb and soils were carefully mixed *in-situ* using the excavator bucket until the mix was homogenous.

Further soils additions were made and similarly mixed. The barrier sections were finally capped by carefully placing uncontaminated material on top of the barrier installation.

This operation was repeated along the complete length of the barrier.

The barrier installation is shown in Figure 4 below.

Figure 4 – Barrier Installation (Soil Mixing)

Environmental Monitoring

A comprehensive environmental monitoring programme was implemented due to the close proximity of several sensitive receptors. Dust, odours, noise and VOCs were monitored around the site during the remediation works.

Additionally, as part of the environmental monitoring agreed with SEPA in our working plan, frequent sampling and on-site analysis of the burn was undertaken during the works to demonstrate that works undertaken were not having a negative impact on water quality. This was further validated by MCERT laboratory analysis.

Validation

The barrier was installed in accordance with the design requirements. This was verified through Quality Control checks during installation and by Quality Assurance procedures as specified in the Site-Specific Quality Plan.

It is our understanding that ERC would continue to monitor the Merry Burn quality post installation.

Conclusions

During the works Envirotreat undertook further investigation into the causes of the contamination and were able to conclude that, although the site was capped, the quantity of leachate entering the burn through the gabion baskets significantly increased following significant rainfall and decreased following periods of relative dryness.

Envirotreat undertook a survey of the burn to record the extent and location of the chromium contamination. During the barrier installation Envirotreat monitored and recorded the soil quality in terms of visual evidence of chromium contamination. When the two were compared there was a high correlation between areas of high soil contamination and associated visual contamination within the burn. This was especially the case behind the gabion baskets where the excavated soils were considered to be grossly contaminated - see Figures 5 and 6 below.

Figure 5 – Typical Soil Excavated During Barrier Installation (behind Gabion Baskets)

Figure 6 - Contaminated Groundwater in Barrier Trench (behind Gabion Baskets)

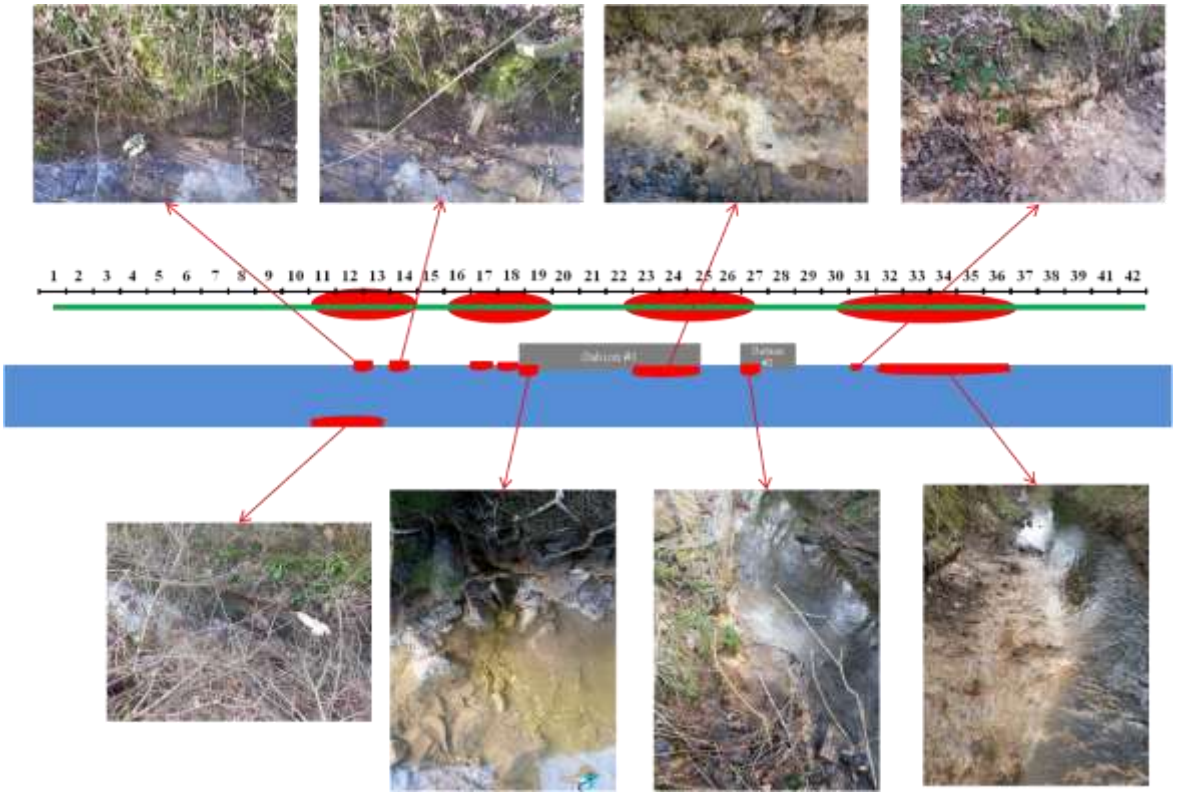



Figure 7 – Correlation between Soil Contamination and Associated Contamination of the Merry Burn Contamination