MORFA NON HAZARDOUS LANDFILL, PORT TALBOT

PERMIT BV7311IE

2014 Annual Review of Environmental Monitoring

Report Number 1392r1v1d0215

Commissioned by

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FILE REF: **Y:\Jobs\LiveJobs1351 - 1400\1392 MNHL 2014 Annual Report\Report\1392r1v1d0215.doc**

February 2015

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Executive Summary

Since December 2004, Tata Steel (UK) Limited (Tata) has operated the Morfa Non-Hazardous Landfill (MNHL) in accordance with an Environmental Permit. Each year, an annual review report is required by the Permit. This report covers the period to the end of December 2014 and evaluates the leachate, groundwater, surface water, gas and dust data collected since 2005. A recent topographic survey of the site is also presented.

The landfill is designed upon the containment principle. Pollutants are kept within the wastes by surrounding the wastes with barriers that are virtually impermeable to water, liquids and gases. The landfill is currently being constructed as a series of cells; one currently accepts wastes with a possibility of producing landfill gas and the other accepting wastes with a low gassing potential. Within each cell, leachate produced by the action of rainfall infiltrating and leaching the wastes is managed by extraction and then treatment in the main steelworks. This maintains the leachate at low levels within the landfill, which reduces the environmental risk by reducing the hydraulic pressure on the base of the landfill.

At the moment, leachate is characterised by an alkaline pH and elevated concentrations of chloride, considered to be due to the leaching of slag wastes and filter cake. Other parameters are at low concentrations.

Based on the current monitoring results there are no clear signs that the landfill is not behaving as predicted during the design stage. On this basis, the surrounding environment remains protected from the active landfill. Leachate from the unlined upgradient Morfa Closed Landfill does, however, continue to influence groundwater quality. As the closed landfill was finally fully restored in 2013 this influence should reduce in the long-term, as rainfall can no longer infiltrate and leach the unlined waste.

1 INTRODUCTION

Tata Steel (UK) Limited (Tata) operates the Morfa Non-Hazardous Landfill (MNHL) in accordance with Environmental Permit No. BV7311Ie dated 17 December 2004. Since this time the Permit has undergone Variation on two occasions. The latest Variation Notice number is GP3430MH.

The Permit applies to only part of the original Morfa Landfill waste management site, with approximately 40% being closed upon the commencement of MNHL and Morfa Hazardous Landfill (MHL). The closed part of the site is referred to as Morfa Closed Landfill (MCL). The location of MNHL and its position relative to key site features including MNHL and MCL is shown on Figure 1 and Figure 2.

Tata submit a report to Natural Resources Wales (NRW) on a three monthly basis which compares the monitoring results for landfill gas, leachate, surface and groundwater against the relevant emission limits, assessment limits, control levels and compliance limits specified in the permit. Permit Condition 4.2 requires that a further summary review of all monitoring data is produced on an annual basis. This report is the annual monitoring report for MNHL for the period January–December 2014 as required by Permit condition 4.2. This report also includes scale plans from the annual topographic survey, as required by the Permit.

The environmental monitoring commenced in 2005. This report has been compiled and completed by Geotechnology Ltd (Geotechnology) to provide an independent review of the monitoring data collected. Previous annual reports have also been prepared by Geotechnology and are listed below:

- 528.1/0/0307 Annual Review of Landfill Monitoring Results for Morfa Non-Hazardous and Hazardous Landfills. March 2007.
- 620.1/0/0108 Annual Review of Landfill Monitoring Results for Morfa Non-Hazardous Landfills. January 2008.
- 764r1v1d0209 2008 Annual Review of Landfill Monitoring Results for Morfa Non-Hazardous Landfills. February 2009.
- 907r1v1d0310 2009 Annual Review of Landfill Monitoring Results for Morfa Non-Hazardous Landfills
- 1045r1v1d0411 2010 Annual Review of Landfill Monitoring Results for Morfa Non-Hazardous Landfills
- 1130r1v1d0412 2011 Annual Review of Landfill Monitoring Results for Morfa Non-Hazardous Landfills
- 1211r1v1d0313 2012 Annual Review of Landfill Monitoring Results for Morfa Non-Hazardous Landfills
- 1291r1v1d0314 2013 Annual Review of Landfill Monitoring Results for Morfa Non-Hazardous Landfills

Separate annual monitoring reports describing the monitoring undertaken at MHL and MCL have also been compiled by Geotechnology.

The Permit was eight years old in December 2012 which prompted a review of the initial Hydrogeological Risk Assessment (HRA). The review is provided in Geotechnology report 1177r1v1d0712 and follows the first review in report 711r1v1d0908. Geotechnology understands that NRW require the next HRA review by 2018.

2 SITE DESCRIPTION AND ENVIRONMENTAL SETTING

The Morfa Site has been extensively investigated in support of landfill development. Since the issue of Environmental Permits (EPs) Tata Steel has maintained an extensive monitoring network that includes air quality monitoring, recording and investigating any visual or amenity issues, groundwater and surface water monitoring, landfill gas and landfill settlement. The information gathered to date is used in the following sections to describe the current site setting.

2.1 Location

The centre of the site is located at National Grid Reference SS781 838, as shown on Figure 1. The site currently comprises a mixture of casually over-tipped land, landfills constructed in accordance with the current Landfill Directive since 2004 (MNHL and MHL), the unlined but capped MCL, partially excavated sand dunes and pristine dune fields.

Aerial view west over site. Note recently restored areas on MCL

The site was granted planning consent for sand extraction and waste disposal in 1973 and has been used in part for these purposes since. The planning boundary covers a large area (as shown on Figure 2), though restrictions within the conditions required a stand-off to be observed between the landfill site and the River Kenfig to the south and Margam Sands to the west. Tata Steel also adopted a voluntary stand-off between the development of MNHL and MHL and Margam Moors, which was designated a SSSI in 1984, 11 years after planning consent for the landfill had been granted.

The site occupies a coastal location, adjacent to the dune system behind Margam Sands. The ground is generally flat with only 2 metres of relief between 6m and 8m AOD, though the western edge of the development encroaches into the dune system, where elevation rises to 14m AOD. The western edge of the site is the coastal dune field over its entire length and is roughly parallel to the beach which lies 75 metres further to the west. The southern edge of the site is occupied by MCL with the eastern edge following the fence line at the western edge of Margam Moors. The central part of the site is occupied by the

current MNHL while the northwestern corner is occupied by MHL. The northern edge of the site is defined by a disused access track crossing from the coast road to the edge of the moors. These key features are illustrated in Figure 3.

The site is remote and located at the southern end of the Port Talbot steel plant. It is surrounded by land entirely owned by the company. The adjacent Margam Moors as far as the railway line to the east is owned by Tata Steel (UK) Ltd as is the site as far south as the River Kenfig. KNNR is located to the south of the River Kenfig and is bound by the southern bank of the River Kenfig.

There are no inhabited buildings within 1.9km and the nearest industrial buildings are close to 1km from the site. There are no public roads within 1km of the site and the adjacent beach is also under the private ownership of Tata Steel (UK) Ltd. There are no services crossing the site. One public footpath crosses the moors close to the site.

The site lies in an area of great ecological interest. Some 40m to the south of MCL, on the opposite side of the River Kenfig is the Kenfig National Nature Reserve, a SAC. The site shares a common boundary to the east with the Margam Moors which has also been granted statutory protection by its SSSI designation.

The principal watercourse in the area is the River Kenfig, which drains a catchment to the east of the site. The water quality of the river is routinely monitored by the Environment Agency. Both chemical and biological indicators are used to classify the quality of the river water and the water course. The Kenfig flows to the south of the site, where it breaks the confines of its river valley to spread into a coastal wetland that gives rise in part to the ecological interest of the area. The wetland extends across the entire southern boundary of the closed landfill site, until the river discharges over a pebble bank onto Margam Sands. The pebble bank represents the highest point to which normal tides flow.

Margam moors is a flat, poorly drained moorland which has been artificially managed over many centuries with a ditch or reen system. Precipitation is slow to run-off and the poor vegetation cover supports a small livestock rearing effort. The moors are characterised by the deep man made reed filled ditches which allow the moors to drain water northwards where it is collected and pumped into the steel plant to be used as process water.

2.2 Geology

Much of the site is underlain by an irregular sheet of wind-blown sand which extends from the ground surface down to an organic/alluvial clay layer. The sand deposit is typically several metres thick, though this locally increases due to sand dune topography. Being wind-blown, the dune sand is poorly graded, with a very uniform grain size throughout. The sand has blown inland from Margam Beach which lies to the west. Locally, the wind-blown sand is overlain by made ground comprising steel making wastes. The small woodland patches along the base of the northeastern flank of the site appear to be dune migration barriers and mark the extent of the blown sand.

Underlying the wind-blown sand at every trial pit and borehole, except those along the southern boundary, is an organic and alluvial clay layer of up to 2.8m thickness. The alluvial clay layer is continuous with the clays found at the surface on the adjacent Margam Moors and therefore this layer represents the moorland surface prior to the deposition of the wind-blown sands.

An examination of the reduced elevation of the clay layer has revealed that it is not completely flat, as it falls from 4.1m AOD at Borehole 14 to 3.2m in Borehole 2, adjacent to Margam Moors. Further, the upper surface of the clay aquitard has been found to have a broad shallow valley or trough running centrally through the site from south to north. Sufficient density of ground investigation data has allowed this feature to be identified and it explains the occurrence of contaminated groundwater emanating from MCL as a springline in the vicinity of SW3/SW2.

Ground investigation works in the southern part of the site has revealed that the clay layer is absent alongside the River Kenfig. The precise line along which it terminates is not known, though this line is considered to lie between Boreholes 14 and 10 and 9 and 16 (see Figure 3 and Figure 4). It is considered most likely that the River Kenfig, in its meandering past has eroded the clay layer, resulting in the sequence of strata seen in Boreholes 16, 15 and 10, where wind-blown sand directly overlies estuarine alluvium.

Throughout the area, the clay layer overlies an estuarine alluvium sequence, comprising principally dirty sands with shell fragments. Locally, finer lenses are seen and on occasions the upper surface of the estuarine fines layer supports a thin organic layer. In the extreme north of the site the estuarine fines dominate the sequence, with the upper 10m of the stratum comprising sandy silt and clays. Locally, within the estuarine deposits, gravels and even cobbles are noted occurring in bands, with one of these traceable between Boreholes 14 and 15.

The estuarine sands overlie glacial gravels at depth, which have been encountered in nearby deep boreholes. None of the investigation boreholes drilled at the site have continued sufficiently deep to intersect these strata. The glacial gravels, which also crop out beneath the seaward edge of the coastal barrier dunes extend inland for some distance. Coal Measures Bedrock underlies the glacial gravels at a depth of approximately 26m at the nearby Newlands Colliery.

2.3 Meteorology

Meteorological data is recorded by two site weather stations. One is located on top of the weighbridge office and the other is located in the sub-contractors yard. Information is also routinely obtained from Natural Resources Wales stations located at Margam and at the Tata Steel Works site. The site typically receives approximately 1000mm rainfall per annum and the prevailing wind direction is southwesterly.

2.4 Air Quality

Meteorological data is recorded by two site weather stations. One is located on top of the weighbridge office and the other is located in the sub-contractors yard. Information is also routinely obtained from Natural Resources Wales stations located at Margam and at the Tata Steel Works site. The site typically receives approximately 1000mm rainfall per annum and the prevailing wind direction is southwesterly.

Air quality at the site is routinely monitored by the Tata Steel Environment Department. Monitoring currently comprises:

- Deposition gauges which collect dust (and rainfall) via a bowl which drains into a bottle at four locations. These instruments record the total amount of dust fallen.

- Flexible poles fitted with 'sticky pads' at 5 sites. As the pads collect airborne dust from 360 degrees dust deposition direction can be evaluated. These were installed November 2005.

Independent quarterly asbestos fibre monitoring is also undertaken at four positions around MHL.

The site is not in an Air Quality Management Area.

2.5 Hydrogeology

Ground investigation boreholes and trial pits excavated around the site have been used to obtain basic groundwater data, including groundwater levels and strata permeabilities. During the investigation works it was apparent that the site is underlain by two water bodies. The first has been encountered throughout the site at shallow depth and lies within the wind-blown sand. This shallow water body sits above the alluvial clay sequence and drilling into the clay has been seen repeatedly to seal off water inflows from this "shallow aquifer".

When the clay layer is breached by drilling works and the underlying estuarine sand sequence is struck, groundwater rises in the drill casing to a different (and normally lower), height than the shallow aquifer. Continued drilling into the estuarine sand sequence maintains a uniform water level, indicating that there is no stratification within the "deep aquifer". The sequence of upper and lower aquifer observed in drilling works has been confirmed to be consistent across the site, with the exception of a strip adjacent to the River Kenfig, where the clay layer separating the aquifer is absent. However, even in this area, shallow piezometers and boreholes reveal a head differential with the wells placed into the lower aquifer indicating stratification of the water body here too.

2.5.1 Shallow Aquifer

The shallow aquifer is the wind-blown sand deposit with vertical downward percolation eliminated or restricted by the presence of the underlying clay. Permeability tests have been undertaken (rising head tests) and these reveal a variation in permeability ranging from 2 x $10^{-3}ms^{-1}$ to 5 x $10^{-5}ms^{-1}$, with an average permeability of 2.3 x $10^{-4}ms^{-1}$. Due to the sand deposits limited thickness the aquifer is thin, with perched water depths typically around 2 to 3 metres, extending from close to ground surface down to the underlying clay layer.

The position of each monitoring point has been established with a differential GPS instrument so that the spatial location of the data can be mapped. This has allowed groundwater surfaces to be constructed onto a base plan of the site.

An examination of the shallow groundwater surface shows that it is typically domed, with a concentric series of groundwater elevation contours centred on the highest elevation close to the centre of the site (see Figure 5). Groundwater flows in response to head loss and accordingly flow lines will be normal to the contours, radiating outward from the central dome. This radial flow pattern is considered to be a response to groundwater recharge in the shallow aquifer, which has very limited extent, following almost exactly the footprint of the site. Clearly, shallow groundwater flow from beneath the Morfa site would be expected toward Margam Moors, Margam Beach, the River Kenfig and the railway sidings.

In Section 2.2, the dune sand was noted to have limited extent, petering out along the site's boundary with Margam Moors. The moorland, which lies directly on the clay layer, is

continuous with the clay underlying the dune sand and therefore the presence of a spring-line where the groundwater surface meets the edge of the sand deposit is not unexpected. A significant spring-line 40m from the northeast edge of the boundary along Margam Moors can be seen on the ground and this strip of wet ground supports a fen habitat which has been protected by SSSI status.

To the west of the site, the shallow aquifer discharges into Margam Beach in the inter-tidal zone. It is difficult to see the spring-line under conditions other than dry periods with spring tides but a linear seepage line at an elevation of 2.5m is present.

The shallow aquifer may or may not have localised areas where it is in continuity with the underlying deep aquifer. At every point where an investigation borehole has been drilled sufficiently deep, the presence of the underlying clay layer has been confirmed. It is likely therefore that the clay aquitard is either complete or near complete.

Ground investigation data has revealed that the ground alongside the Kenfig and along the southern part of the existing site comprises wind-blown sand over estuarine sands. The clay layer, characteristic of a large part of the existing site and the entire PPC permit boundary, is absent. This absence, most likely due to river erosion as described earlier, has prevented the clear separation between the upper and lower aquifers. However, there is a permeability contrast between the wind-blown sand aquifer and the underlying estuarine sands and this causes stratification within the groundwater. Greater heads in the shallow groundwater indicates that recharge from the shallow aquifer is active, explaining the difference in chemistry between shallow and deep groundwater along this edge.

Water quality in the shallow aquifer is variably impacted due to seepage from the unlined MCL. Shallow groundwater quality is poorest in the northeast (Margam Moors) downgradient flow zone of MCL where List I substances and elevated levels of List II substances have been found historically e.g. BH18–20 on Figure 3. When this shallow groundwater eventually discharges along the fringe with the Margam Moors as a springline (SW3 and SW2) it has had an observable ecological impact due to its alkaline mineralised load. Capping of MCL is intended to improve groundwater quality along this fringeline by recharging the system with clean surface water runoff.

2.5.2 Deep Aquifer

Beneath the alluvial clay layer the estuarine sands are saturated and piezometric levels are higher than the base of the clay. The water in the lower aquifer is therefore confined by the clay layer. Using data from the monitoring boreholes it has been possible to produce a map of the piezometric surface in the area surrounding the site. The piezometric surface plan of the deep aquifer is included in Figure 6.

Rising head permeability tests have been undertaken in many of the boreholes and these reveal that the lower aquifer is of lower permeability than the upper aquifer, with permeabilities ranging from $5.2 \times 10^{-4} ms^{-1}$ to $1.5 \times 10^{-7} ms^{-1}$. This is consistent with descriptions of the lower aquifer stratum as being silty sand.

Locally, thicker deposits of estuarine fines are found interbedded with the sands, with one principal fines stratum shown on the geological sections. At the northern edge of MHL, Boreholes 26 and 27 intersected a sequence dominated by silts and clays, with sand occurring as a minor constituent. Permeabilities here are expected to be accordingly smaller.

Typical deep groundwater piezometric levels are indicated on Figure 6 and the plan shows a pattern of decreasing head towards the north and west. There is no element of a radial pattern to the contours as seen in the overlying shallow groundwater, but rather a uniform loss of head from the east towards the west. Recharge to the deep aquifer takes place at some distance to the east of the site, where the sand and gravel deposits form undulating farmland in the Cornelly/Pyle/Margam district. Groundwater migrating seaward from this higher ground passes beneath the industrial areas (where it has been utilised for water resources), beneath the railway and then beneath the site.

An examination of Figure 6 shows that the deep groundwater surface is at the same level as the River Kenfig at the southern boundary of the site, strongly indicating a degree of interaction with the surface water. In this area drilling has also revealed that the clay aquitard is absent, with the wind-blown sand aquifer directly overlying the estuarine sequence.

The chemistry of the deep aquifer is generally far less contaminated with slag source pollutants than the upper aquifer. Most monitoring results show lower pH, lower alkalinity and lower calcium levels. Generally, water quality in the lower aquifer is similar to or better than the overlying shallow aquifer. However, the lower aquifer is contaminated with other pollutants, with ammoniacal nitrogen and nitrate in greater concentration than the shallow aquifer. The chemical profiles are evidence of pollution from different sources, MCL is the source of pollutants for the shallow aquifer, whilst industrial and farm land to the east is the source for the deep aquifer. Where water quality of the upper aquifer is considered to be good (i.e. little contamination with Ca, pH and alkalinity) the lower aquifer beneath is also low in these pollutants. Where the upper aquifer can be seen to be affected, the lower aquifer remains less so. This supports the observation that the clay aquitard provides effective separation of the two water bodies over much of the site.

2.5.3 Conceptual Hydrogeological Models

As the intrusive investigation programme has evolved and further monitoring data gathered, Geotechnology has developed and refined a conceptual hydrogeological model of the site that summarises the current level of understanding of the geology beneath the site and groundwater flow. The flow of water through the ground is a direct result of the geometry of the strata beneath and around the site and the physical properties of each stratum.

Due to the shallow trough in the clay aquitard between MCL and MHL, two conceptual models have been developed. One describes the shallow aquifer on the southern side of the trough around MCL and MNHL and one for the northern side of the trough around MHL. In both models the deep groundwater generally moves to the north and west, being recharged off-site in the surrounding industrial and agricultural areas.

In both conceptual models there is a degree of radial flow within the shallow aquifer. In the northern conceptual model shallow groundwater moves towards Margam Moors and Margam beach. In the southern conceptual model the radial component results in the majority of flow in the shallow aquifer moving toward the Margam Moors with a small contribution flowing towards the Kenfig, although the hydraulic gradient in this area is shallow and subject to sporadic reversal.

Flow to both the Moors and Kenfig is contaminated due to the leaching of wastes from MCL. As the dominant flow path is towards the Margam Moors this results in a concentration of pollution along the springline where the shallow aquifer discharges. This area is typically characterised by alkaline groundwater and precipitates can be found in topographically low

areas. Leaching and dispersion of precipitates from this area is also impacting on surface water in Margam Moors.

Along the fringe with the River Kenfig, groundwater is found to be mineralised in close proximity to MCL. However, the River Kenfig shows no evidence of any impact related to MCL. This is primarily considered to be due to the flat gradients along this fringe limiting advective transport from MCL to the Kenfig and dilution within the Kenfig. Waterlevels in the River Kenfig are higher than those in Margam Moors.

The monitoring conducted to date shows that there is no impact related to either MHL or MNHL. Shallow groundwater is currently polluted due to leaching of wastes deposited at MCL, whilst deep groundwater is polluted due largely to off-site recharge with a small contribution from MCL.

2.6 Hydrology

The site is surrounded by a sand dune field and there are no surface water courses within the site, or at its immediate perimeter. Surface water features in the vicinity of the site comprise the River Kenfig to the south, the Margam Moors ditch system to the north and the Bristol Channel to the west. A small number of isolated ponds are found on the low lying area to the north of MCL in an area that will be developed as part of MNHL.

The flat lying moors have been managed for centuries for agricultural production by draining the clay soils using a deep network of ditches. The configuration of ditches has been developed to address local ground conditions. The ditches are at their densest along the southern and western edge of the moors where there is a need to drain surface water originating from the pronounced springline. All the ditches feed into the Mother Ditch which flows northward to a single gauged collection point. From here the entire flow of water is abstracted into the works for use as process water. The pumping is carried out after the water discharges over a weir and therefore pumping cannot affect water levels in the ditches.

The River Kenfig drains a small catchment to the east of the site to the sea at Margam Beach. This is the principal watercourse in the area and separates the site from Kenfig National Nature Reserve which is bound by the southern bank of the Kenfig. The river has a 95 percentile low flow of 950 litres/sec. The river is monitored routinely by Natural Resources Wales. Based on 36 measurements made in 2007, the upstream and downstream river stretches were chemically classified by the Agency as Grade B, with low levels of phosphorous but moderately elevated nitrates. The biology of the river stretches is classified as Grade E. The chemical and biological scale used by the Agency runs from A to F (very good to bad). The lack of deterioration in the quality of the River Kenfig demonstrated by the Agency is backed up by the routine monitoring of the River Kenfig undertaken by Tata Steel.

2.7 Ecological Setting

Two sites of ecological importance lie in close proximity to the site:

- Kenfig National Nature Reserve (KNNR)
- Margam Moors SSSI

2.7.1 Kenfig National Nature Reserve

The northern boundary of Kenfig National Nature Reserve (KNNR) follows the southern bank of Kenfig River which flows to within 40m of the southern edge of MCL, as shown on Figure 3.

KNNR is a Special Area of Conservation (SAC), designated because of the following features:

Habitats of community interest whose conservation requires the designation of Special Areas of Conservation; these are included on Annex I of the European Communities Council Directive on the Conservation of Natural Habitats and Wild Fauna and Flora:

1. Fixed dunes with herbaceous vegetation (grey dunes).
2. Dunes with *Salix repens* subsp. *argentea* (*Salicion arenarae*).
3. Humid dune slacks.
4. Atlantic salt meadows (*Glauco-puccinellietalia maritimae*).
5. Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.

Animal and plant species of community interest whose conservation requires the designation of Special Areas of Conservation; these are included on Annex II of the European Communities Council Directive on the Conservation of Natural Habitats and Wild Fauna and Flora:

1. Fen orchid Liparis loeselii
2. Petalwort Petalophyllum ralfsii

KNNR is also included under the following United Kingdom designations:

- Sites of Special Scientific Interest (United Kingdom)
- National Nature Reserves (United Kingdom).

It supports populations of Nationally Rare and Nationally Scarce non-vascular plants including Petalwort, *Amblystegium serpens* var. *satinum, Campylium polygamum, Drepanocladus lycopodioides, D. sendtneri, Moerckia hibernica* and *Chara aspera*. Populations of Nationally Rare vascular plants include Fen Orchid, Sea Stock *Matthiola sinuata*, Long-stalked Orache *Atriplex longipes,* Maiden Pink *Dianthus deltoides,* Green-flowered Helleborine *Epipactis phyllanthes,* Variegated Horsetail, Portland Spurge *Euphorbia portlandica,* Sea Spurge *E. paralias, Euphrasia rostkoviana* and Hutchinsia *Hornungia petraea*. Several Nationally Scarce species of vascular plant have also been recorded. In addition the site also supports a rich assemblage of Nationally Rare and Nationally Scarce invertebrate species. The exceptional wetness of the Kenfig dune system is of national significance and the hydrological regime appears perfectly natural. Although the KNNR groundwater system is thought to be mainly rain-fed, there is the possibility that groundwater inflow from underlying/neighbouring carbonate aquifers also plays a role.

Relevant factors which are known to influence the features at Kenfig and which are likely to influence dunes elsewhere locally include over-stabilisation, with the extent of bare sand having declined from c. 40% in 1946 to c. 2% at Kenfig at the present time (Jones, in prep.); the virtual cessation of grazing by rabbits (through myxomatosis) and a decline in livestock grazing. Shoreline retreat, preventing the formation of strandline and fore dune communities, has long been a problem at Kenfig with only a small section of the shoreline up to 300m south of the mouth of the River Kenfig showing localised signs of accretion.

2.7.2 Margam Moors SSSI Description

The western part of Margam Moors lies within 40m of the active MNHL and is shown on Figure 3. Margam Moors is a Site of Special Scientific Interest (SSSI) designated because of the following features:

The mosaic of drainage ditches provides the main interest of the moors and it is principally for this feature that the site was designated as a Site of Special Scientific Interest (SSSI). In a Welsh context only the extensive Wentlooge Levels support a similar assemblage of habitats and species.

Important bird species that have been lost through habitat loss and possibly changes in management include White-fronted Goose *Anser albifrons* (a winter visitor) and Yellow Wagtail *Motacilla flava* (a summer visitor).

The site does still support numerous species of high conservation value including aquatic plants such as Frogbit *Hydrocharis morsus-ranae*, Flowering Rush *Butomus umbellatus*, Cyperus Sedge *Carex pseudocyperus*, Brown Sedge *C. disticha*, Unbranched Bur-reed *Sparganium emersum* and Arrowhead *Sagittaria sagittifolia*. All except the latter were recorded during this survey and were found to be thriving. In addition to the plants a rich assemblage of scarce aquatic invertebrates are known from the moors and a selection of previously recorded and additional species of high conservation value were noted during this survey. Continuous management is required to prevent Common Reed *Phragmites australis* from shading out some of the more sensitive species and many ditches were found to be in need of some management.
Marginal habitats of significance include areas of species-rich mesotrophic marsh. These result from seepage of water from the base of the dunes and support a characteristic suite of species, often with substantial quantities of Yellow Flag *Iris pseudaTata Steel*, Meadowsweet *Filipendula ulmaria*, Water Mint *Mentha aquatica*, Ragged Robin *Lychnis flos-cuculi* and Lesser Spearwort *Ranunculus flammula*.

Areas of semi-improved grassland were found to be in a less favourable condition and uncommon species known to have been recorded in the past, e.g. Green-winged Orchid *Orchis morio*, Common Twayblade *Listera ovata* and Cowslip *Primula veris*, were either not recorded at all or were very scarce. An area of dense birch/sallow scrub occurs in the very south of the site. Biodiversity Action Plan species associated with the pastures and ditches include Shrill Carder Bee *Bombus sylvarum*, Brown-banded Carder Bee *B. humilis*, Brown Hare *Lepus europaeus*, Skylark *Alauda arvensis* and Reed Bunting *Emberiza schoeniclus*. The Kingfisher, a schedule 1 species protected under the Wildlife and Countryside Act has also been recorded in the past (Gillham, 1976).

3 REGULATORY FRAMEWORK

3.1 Background

The Permit defines the regulatory emission limits that must be met at MNHL. These include leachate limit levels, emission limits to air for particulates and landfill gas, emission limits for surface water and Compliance Limits for emissions into groundwater. Since the issue of the Permit these have changed on several occasions. To ensure these changes can be traced they are summarised below:

- Subsequent to the issue of the Permit, Geotechnology presented a revised set of Assessment Criteria for groundwater, surface water and leachate in accordance with the Permit Improvement Conditions. These revised Assessment Criteria were initially presented by Geotechnology following a review of the Hydrogeological Risk Assessment (HRA) (see Geotechnology report 403.1/1/1006 Review of Hydrogeological Risk Assessment) after commencement of landfilling. These criteria were further updated following feedback from the NRW in Geotechnology letter 403/reviewHRA/lt1/BR/kp (dated 17 January 2007) to the Agency and also in the 2006 annual monitoring report (see Geotechnology report 528.1/0/0307).
- During 2007, the NRW commented upon the revised criteria presented in the 2006 annual report and after slight modification, a revised set of Assessment Criteria for groundwater and surface water were agreed (see Geotechnology correspondence 244Permit_lt1/BR/kp and NRW correspondence dated 30 April 2007 and 7 June 2007 (ref: BV7311IE)).
- The 2006 annual monitoring report also indicated that dust levels regularly exceeded the Permit limit of 100 mg/m^2/day and that the generation of dust was not solely related to landfilling activities according to Tata. On 28 September 2007, Tata submitted a request to the NRW that suggested apportioning 50% of the measured dust to the landfill with a limit value of 200 mg/m^2/day and the other 50% allocated to other activities at the works and natural deposition.
- Further minor operational changes to the Permit were requested by Tata on 13 June 2008 (Tata reference LANDFILLPPC_017). The request related to leachate control levels, surface water assessment levels, dust levels and Compliance Limits at external gas well GA16. These changes were prompted by the 2007 annual monitoring report (see Geotechnology report 620.1/0/0108), a meeting with the NRW on 10 June 2008 and NRW Compliance Assessment Reports 01718 and 01770. In response, the NRW agreed the minor changes to the Permit in a letter dated 30 July 2008. For clarity, this letter summarised the changes and the applicable assessment criteria.
- The most recent Permit Variation Notice (Variation Notice No. GP3430MH) included an Improvement Programme which required Tata to undertake a review of copper trigger levels. Geotechnology undertook this assessment at the request of Tata (see Geotechnology report 990r1v1d0610 dated June 2010) and the NRW has reviewed and accepted the new groundwater copper trigger levels. The NRW review and acceptance is set out in Compliance Assessment Report 03451 issued 25 November 2010.
- As part of the 2011 annual review (Geotechnology report 1130r1v1d0412) new assessment levels for carbon monoxide and compliance levels for methane were derived in accordance with The Industry Code of Practice (ICOP) guidance.

- Most recently, as part of the 2012 HRA review, new assessment levels were presented for leachate, groundwater and surface water (see Geotechnology report 1177r1v1d0712). These were also consolidated in a letter to NRW from Tata on 4 February 2013. Given the acceptance of these new levels towards the end of 2012, Tata only started implementing the use of these new control and compliance levels in January 2013.

The following sections summarise the applicable Assessment Criteria used since January 2013.

3.2 Applicable Assessment Criteria

3.2.1 Emissions to Air

The limits for emission to air are reproduced in Table 3-1.

Table 3-1 Particulate matter emission limits into air

Tata Landfill	Parameters and frequency of monitoring	Emission Limit	Designation of Monitoring Points	Note
Morfa Non-Hazardous Landfill	Gross dust depositional rate – Quarterly	200 mg/m^2/day*	D15, D16, D17, D18 and D19	*50% correction factor applied (as outlined by Tata letter (ref:Landfill_003) dated 28 September 2007)

The limit should only be applied to 50% of the total dust deposition. Therefore, the actual total dust deposition allowed before the emission limit is exceeded is 400 mg/m^2/day.

3.2.2 Surface Water Control Levels

The surface water control levels are set out in Table 3-2.

Table 3-2 Assessment Levels for Surface Water

	SW2 and SW4	
Parameter	**Assessment level 1 (AL1)**	**Assessment level 22 (AL2)**
Cadmium	0.1	
Copper	25	28
Mercury	0.1	
Chloride	200	250
Ammonia	2.75	3
Alkalinity	350	400
Cadmium, copper and mercury reported as µg/l. Alkalinity reported as mg/l $CaCO_3$. Ammonia reported as mg/l.		

3.2.3 Groundwater Compliance Limits

The groundwater Compliance Limits and Control Levels (CL) are summarised in Table 3-3.

Table 3-3 Groundwater Trigger and Control Levels

Parameter	BH3 (shallow aquifer)			BH4 (shallow aquifer)			BH6 (shallow aquifer)		
	CL1	CL2	Trigger Level	CL1	CL2	Trigger Level	CL1	CL2	Trigger Level
Cadmium	-	0.1		-	0.1		-	0.1	
Mercury	-	0.1		-	0.1		-	0.1	
Chloride		100	250		100	250		100	250
Ammonia	8	10	12	2	3	4	14	16	18
Alkalinity	2400	2700	3000	650	700	750	1200	1300	1400
	BH11 (shallow aquifer)			BH12 (shallow aquifer)			BH13 (shallow aquifer)		
	CL1	CL2	Trigger Level	CL1	CL2	Trigger Level	CL1	CL2	Trigger Level
Cadmium	-	0.1		-	0.1		-	0.1	
Mercury	-	0.1		-	0.1		-	0.1	
Chloride	100	200		100	200		100	200	
Ammonia	0.88	1.1		0.44	0.52		1.8	2.1	
Alkalinity	556	657		284	335		738	872	
	BH14 (shallow aquifer)			BH30 (shallow aquifer)					
	CL1	CL2	Trigger Level	CL1	CL2	Trigger Level			
Cadmium	-	0.1			0.1				
Mercury	-	0.1			0.1				
Chloride	100	200			100	250			
Ammonia	10.9	12.9		2	3	4			
Alkalinity	178	211		650	700	750			

Cadmium, copper and mercury reported as µg/l. Alkalinity reported as mg/l $CaCO_3$. Ammonia reported as mg/l.

These Assessment Criteria will also apply to future replacement boreholes for these positions although the situation will be reviewed at the time.

3.2.4 Leachate Control Levels

The leachate assessment levels are summarised in Table 3-4.

Table 3-4 Leachate Control Levels

Leachate Point	Ammoniacal nitrogen	Cl	As
Unit	**mg/l**	**mg/l**	**mg/l**
Control levels	70	70000	3

3.2.5 Leachate Level Limits

The head of leachate shall not be permitted to exceed 1 metre above the base of any leachate monitoring point at any time throughout the operational or aftercare phases.

3.2.6 External Gas Monitoring Compliance Limits

The Compliance Limits are summarised in Table 3-5.

Table 3-5 Perimeter Compliance Limits and Assessment Levels

Perimeter gas position	Methane Compliance Limit	Carbon Dioxide Assessment level
GA7	2	3.5
GA16	3.6	3.4

3.2.7 Internal Landfill Gas Compliance Limits

Compliance Limits are not established for the internal landfill gas monitoring wells during operation. Once a cell is capped, the average methane flux and total methane emission will need to be measured and compared to permissible emission rates stipulated in the Permit.

3.3 Assessment against Permit Criteria

The focus of this annual summary report is to evaluate the data collected against the applicable Assessment Criteria. To enable rapid and efficient data evaluation, time series graphs have been generated where applicable. These are presented in Appendices 1 to 7. Spatial summaries of key parameters are provided in Appendix 8.

Time series graphs have been plotted for the majority of parameters where Compliance Limit and Control levels apply and where sufficient data is available for graphical plotting. Any agreed changes to the relevant Assessment Criteria are included where applicable. Time series plots of other key parameters are also presented in the relevant appendices. Where possible, the scale of the y-axis has been standardised on each graph for the same parameter from different monitoring locations to facilitate rapid comparison of the data.

3.4 Hydrogeological Risk Assessment Criteria

One of the objectives of the HRA review is to ensure that the computer simulations used as part of the design of the landfill do not become detached from the reality of landfill construction and operation. Therefore, in addition to evaluating the data against the assessment criteria set out in the Permit, Geotechnology also uses the preparation of the annual report as an opportunity to compare the actual leachate chemistry with that modelled as part of the HRA. The model input parameters against which the leachate chemistry is compared are summarised in Table 3-6.

Table 3-6 Modelled leachate inventory

LandSim Parameter	Ammonia	Arsenic	Chloride
	mg/l	mg/l	mg/l
Minimum Value	0.05	0.005	1000
Most Likely Value	10	0.3	10000
Maximum Value	50	3	61000
PDF Used	Triangular	Triangular	Log Triangular

4 MONITORING NETWORK

4.1 Monitoring Programme

4.1.1 Monitoring Completed

The full monitoring network available to Tata for all of the landfills is shown in Figure 3. From this network the infrastructure used for the assessment of MNHL is summarised in Table 4-1. The table also summarises the main features of the current monitoring programme.

Table 4-1 Monitoring Schedule

	Lab analysis	Surface water samples	Quarterly Groundwater samples	Annual Groundwater Samples	Monthly water levels	Leachate chemistry	Gas
Q1 (Jan-Mar)	Indicator suite	SW1 – SW15	BH3S, BH4S, BH6S, BH17S, BH18S, BH19S, BH20S, BH30, GWT3A		SW gauges 1,2,4,5,6 Piezometers BH3S, BH4S, BH6S, BH17S, BH18S, BH19S, BH20S, BH30, GWT3A	L1, L6, L7, L8,	GA1, GA2, GA7 – GA16 W1 – W16
Q2 (Apr-Jun)	Indicator suite/ Characterisation suite alternated every year	SW1 – SW15	BH1, BH2, BH10S, BH11S, BH12S, BH13S, BH14S, BH3S, BH4S, BH6S, BH17S, BH18S, BH19S, BH20S, BH30, GWT3A,		SW gauges 1,2,4,5,6 Piezometers BH3S, BH4S, BH6S, BH17S, BH18S, BH19S, BH20S, BH30, GWT3A Sampled groundwater wells	L1, L6, L7, L8,	GA1, GA2, GA7 – GA16 W1 – W16
Q3 (Jul-Sep)	Indicator suite	SW1 – SW15	BH3S, BH4S, BH6S, BH17S, BH18S, BH19S, BH20S, BH30, GWT3A		SW gauges 1,2,4,5,6 Piezometers BH3S, BH4S, BH6S, BH17S, BH18S,90 BH19S, BH20S, BH30, GWT3A	L1, L6, L7, L8,	GA1, GA2, GA7 – GA16 W1 – W16
Q4 (Oct-Dec)	Indicator suite/ Characterisation suite alternated every year	SW1 – SW15	BH1, BH2S, BH10S, BH11S, BH12S, BH13S, BH14S, BH3S, BH4S, BH6S, BH17S, BH18S, BH19S, BH20S, BH30, GWT3A,	BH2D, BH10D, BH11D, BH12D, BH13D, BH14D BH3D, BH4D, BH6D, BH17D, BH18D, BH19D, BH20D,	SW gauges 1,2,4,5,6 Piezometers BH3S, BH4S, BH6S, BH17S, BH18S, BH19S, BH20S, BH30, GWT3A Sampled groundwater wells	L1, L6, L7, L8,	GA1, GA2, GA7 – GA16 W1 – W16

4.2 Integrity of Monitoring Infrastructure

Each time samples are collected by Geotechnology, the monitoring infrastructure is inspected. The landfill operator also inspects parts of the monitoring infrastructure during more routine site checks.

4.2.1 Landfill Leachate Monitoring Infrastructure

The landfill leachate infrastructure is performing well. Dedicated pumps are provided for the purging and sampling of each sump to prevent cross contamination.

4.2.2 Groundwater Monitoring Infrastructure

The integrity of the groundwater monitoring network is inspected monthly. The monitoring infrastructure continues to perform well although vandalism is sometimes a problem. Routine maintenance and repairs are rapidly undertaken by Darlow Lloyd. The continued routine clearance of vegetation will ensure safe access.

4.2.3 Shallow Piezometer Monitoring Infrastructure

A series of shallow piezometers have been manually installed into the shallow aquifer along the boundary with Margam Moors, as shown on Figure 3. These have been routinely monitored since 2006. This aspect of the monitoring network is currently performing well although monitoring positions TPG and TPV have been lost due to the construction of Cell 2 MHL. The piezometers located in Margam Moors are also susceptible to damage by either grazing cattle or farm vehicles.

4.2.4 Surface Water Monitoring Infrastructure

The integrity, access and safety of each of the surface monitoring locations are inspected monthly. In August 2006, four surface water level gauge boards (SW Gauge 1-4) were installed at the positions shown on Figure 3, two on the River Kenfig and two on the Mother Ditch in Margam Moors. These have been monitored monthly by Geotechnology.

During 2010, detailed consideration was given to the safety of the approach to SW Gauge 3. The gauge is located on an outside of a meander and can only be approached down a steep bank, which when wet can be very slippery. To improve the safety of the monitoring, Geotechnology installed a new gauge (referred to as SW Gauge 6) at a more accessible upstream location. The position of this new monitoring position is shown on Figure 3.

Many of the surface water sample positions in the Margam Moors are difficult to access due to dense vegetation. Several sample positions are also stagnant with significant accumulation of plant matter and ochre precipitates.

No additional aspect of the surface water monitoring network requires change or improvement. The continued routine clearance of vegetation will ensure safe access.

4.2.5 External Gas Monitoring Infrastructure

The integrity of the external gas monitoring wells is inspected monthly.

Several minor repairs are required to the headworks which have rusted and broken at several positions.

4.2.6 Internal Gas Monitoring Infrastructure

The integrity of the external gas monitoring wells is inspected monthly. There are no problems with this aspect of the monitoring network.

4.2.7 Dust Monitoring Infrastructure

Dust monitoring is undertaken by Tata Environment Department. Up until 2011, dust monitoring comprised two types of monitoring:

- Deposition gauges which collect dust (and rainfall) via a bowl which drains into a bottle at four locations. These instruments record the total amount of dust fallen.
- Flexible poles fitted with 'sticky pads' at 5 sites. As the pads collect airborne dust from 360 degrees, the direction from which dust has deposited can be determined. These were installed November 2005.

Since 2011, only the deposition gauges have been used. The five dust monitoring positions (D15 – D19) are indicated on Figure 3. The 'sticky pad' poles were not used in 2011 as this aspect of the monitoring is not a Permit requirement and is now only considered by Tata during the implementation of contingency actions, documented in the Dust Management Plan for the site.

4.3 Actions required

Based on recent observations of the available monitoring network, the following items require address to ensure that high quality data continues to be collected:

- Many of the borehole headworks require repair due to corrosion to enable them to be closed. Specifically, BH1, BH2, BH3, BH4, BH6, BH9, BH10, BH12, BH15, BH16, BH17, BH18 and BH19 require improvement.
- Losses from and damage to the piezometer monitoring network need to be addressed. Specifically, P1, P3, P4, P16, TPG and TPV need repair/replacement and re-surveying.
- Vegetation in the vicinity of several sampling points requires routine clearance to enable continual safe access.
- Site weather stations should be routinely maintained to ensure they continue to operate satisfactorily

5 ANALYTICAL TESTWORK

5.1 Laboratory Selection

All aspects of the analytical and monitoring programme are directly managed by Tata Environment Department. Under the direction of the Environment Department, Geotechnology and Testing Solutions Wales (the analytical laboratory) undertake several aspects of the sampling and analysis. These include surface water, groundwater and leachate samples for laboratory analysis, measurement of groundwater and surface water levels and the on-site monitoring of landfill and ground gas. The landfill operator (Darlow Lloyd and Sons Ltd) undertake the leachate level monitoring. Tata Environmental Department undertakes all other monitoring aspects.

Severn Trent Laboratories (STL) was the laboratory used at the start of the landfill monitoring programme in February 2005. In July 2006, STL was replaced by Testing Solutions Wales for all water analysis by Tata. TSW was based at the Engineering Centre for Manufacturing and Materials (ECM) in Margam, adjacent to the former works entrance. During 2013 however, TSW (now known as TDC) moved to new facilities outside of the works at Harbourside Road, Port Talbot. Prior to the final move, during 2012, TSW moved to temporary facilities due to construction of the PDR (Port Talbot Peripheral Distribution Road). Geotechnology understands that since April 2012 the laboratory has not been officially UKAS accredited for all parameters. At the moment, the laboratory is accredited for anions, pH, EC, COD, Alkalinity, ammonia, TDS, SS and metals by ICP. The laboratory has informed Geotechnology that they hope to get accreditation back for metals via ICP-MS by mid-2015.

5.2 Overview of Testing Parameters

Monitoring at the Morfa site has occurred since 2005. During this time a large monitoring dataset has been compiled.

During 2012, Tata completed the second fourth year review of the HRA in accordance with the Permit. As part of the review, the properties of the waste stream and the contaminants of concern were evaluated. This review is summarised in Table 5-1. The aim of the evaluation was to ensure that the on-going monitoring programme is focussed on analysing key contaminants to ensure the efficient allocation of resources. Within this context, the current analytical schedule, summarised in Table 5-2, was developed.

Table 5-1 Review of Analytical Programme

Parameter	Units	Assessment Level (AL)	Evaluation of all MNHL data to date			Dilution Factor	Continue routine monitoring	Justification
			Max	Average	Std. deviation	(Av. Conc /EAL)		
Lab pH	pH units	6 - 9	13.2	11.5	1.1		Y	Bulk indicators of leachate quality
Lab Conductivity	microS/cm		108800.0	15490.3	23925.4		Y	
Lab Alkalinity	mg/l CaCO3		1965.0	803.3	570.3		Y	
Calcium	mg/l		34700.0	5035.9	7308.7		Y	
Sodium	mg/l	200	531.0	194.5	140.2	1	N	Not significantly elevated in leachate
Potassium	mg/l		757.0	160.3	218.5		N	
Magnesium	mg/l		12.9	4.0	4.7		N	
Sulphate	mg/l	400	265.0	109.8	88.6	0	N	
Fluoride	mg/l	1 (AA) / 3 (MAC)	16.9	7.0	7.2	6	N	Not required as Chloride is to be monitored
Chloride	mg/l	250	60808.0	9287.2	14233.8	37	Y	Key indicator of leachate
Chemical Oxygen Demand	mg/l	30	10080.0	879.9	1767.5	29	Y	Useful bulk indicator of leachate quality
Biochemical Oxygen Demand	mg/l	4 - 9	110.0	20.1	28.9	5	N	Not significantly elevated.
Total Organic Carbon	mg/l		54.0	18.7	14.2		Y	Bulk measure of dissolved organic carbon compounds
Ammoniacal Nitrogen as N	mg/l	0.3 - 2.5	36.8	10.9	10.0	36	Y	Indicator of non-hazardous pollutants.
Total Oxidised Nitrogen	mg/l		168.5	30.7	44.1		Y	Not explicitly required but easily measured by laboratory during analysis of other anions.
Nitrate	mg/l	25 (AA) / 50 (MAC)	197.0	35.9	52.9	1	Y	
Nitrite	mg/l	0.01	93.6	10.3	20.3	1025	Y	
Phosphorous	mg/l	0.05 reactive phosphorous	327.1	68.6	71.1	1372	Y	
Phosphate	mg/l		11.2	3.7	3.6		Y	
Arsenic	microg/l	50	2007.0	277.9	416.7	5	Y	Only non-hazardous pollutant detected at elevated concentrations.
Aluminium	microg/l	200	3637.7	429.8	777.4	2	N	Not detected at elevated concentration in current leachate
Antimony	microg/l	5	4.4	3.1	1.8	1	N	
Boron	microg/l	1000	3348.6	700.0	821.1	1	N	
Chromium (total)	microg/l	4.7 AA / 32 (MAC)	32.1	8.4	6.9	2	N	
Chromium (VI)	microg/l	3.4	2.3	1.9	0.6	1	N	
Cobalt	microg/l	3 (AA) / 100 (MAC)	11.9	8.0	3.5	3	N	
Copper	microg/l	10	297.5	23.2	57.9	2	N	
Iron	microg/l	300	2334.0	319.5	739.5	1	N	
Lead	microg/l	20	38.0	10.2	11.2	1	N	
Manganese	microg/l	30 (AA) / 300 (MAC)	161.0	35.8	52.0	1	N	
Molybdenum	microg/l	70	22.9	22.9		0	N	
Nickel	microg/l	150	75.7	12.4	15.9	0	N	
Selenium	microg/l	10	22.6	12.0	15.0	1	N	
Silica	microg/l		44.1	6.3	9.1		N	
Tin	microg/l	25	97.5	28.5	46.3	1	N	
Titanium	microg/l		18118.8	5280.1	8285.4		N	
Vanadium	microg/l	20	313.3	86.5	73.9	4	N	
Zinc	microg/l	75	687.0	55.8	112.3	1	N	
Cadmium	microg/l	0.15	0.1	0.1		1	N	Hazardous substances infrequently detected at low concentration.
Mercury	microg/l	0.05	0.2	0.1	0.1	3	N	
VOC / SVOC and total hydrocarbons	microg/l		Not specified in this table but typically all <1 microg/l				N	Infrequently detected at low concentration

Note: AA - Annual Average. MAC - Maximum Acceptable Concentration

Table 5-2 Current Analytical Monitoring Programme

	Indicator Suite	Characterisation suite*
Frequency	**Quarterly (Q1, Q2, Q3, Q4)**	**Annually (alternated each year between Q2 and Q4)**
Analysis	pH, Electrical Conductivity, alkalinity, Calcium, Chloride, Chemical Oxygen Demand, Total Organic Carbon, Ammoniacal Nitrogen, Nitrate, Nitrite, Phosphorous, Phosphate, Arsenic	In addition to indicator suite: Sodium, Potassium, Magnesium, Sulphate, Boron, Total Chromium, Copper, Iron, Lead, Vanadium, Zinc, Cadmium, Mercury, VOC and SVOC
*Other parameters may be added depending upon any changes to the types of waste landfilled and review of results from preceding indicator suite		

6 SITE ACTIVITY

6.1 Waste Treatment Centre

Since 2007, Tata has operated a waste treatment centre that comprises recycling, screening, sorting and bailing facilities, together with areas for the storage of processed and unprocessed materials. The facility mostly treats general wastes comprising plastics, paper, timber, glass, brick and concrete. As a consequence, these wastes are largely diverted from landfill. This facility is located to the northwest of the active landfill cells of MNHL, as shown on Figure 3.

6.2 Construction of MNHL

Since issue of the Permit, four cells have been constructed; two biodegradable cells used for the deposition of wastes with a gassing potential and two cells for the deposition of non-hazardous, without a significant gassing potential. A current topographic plan of the cells, as required by Permit condition 3.6.3 is provided in Figure 7. This is based on a topographic survey completed during January 2015. Table 6-1 provides a summary of the cells constructed to date.

Table 6-1 Landfill Cell Details

Cell Name	Leachate Sump	Waste Types	Operational Status
Cell 1	L7	Non-hazardous non-biodegradable	Full, non-active & awaiting capping
Cell 2	L8		Active
Bio Cell A	L1	Non-hazardous biodegradable	Full, non-active & awaiting capping
Bio Cell B	L6		Active

Each cell of MNHL is designed upon the containment principle. Pollutants are kept within the wastes by surrounding the wastes with barriers that are virtually impermeable to water, liquids and gases. The landfill is currently being constructed as a series of cells, each measuring some 200m x 115m. The Engineered Barrier System (EBS) of each cell comprises Bentonite Enhanced Sand (BES) overlain by a High Density Polyethylene (HDPE) liner. Above the EBS is a leachate collection system. A cross section of the key landfill engineering systems is provided in Figure 8.

6.3 Landfilling at MNHL

6.3.1 Waste from Steelworks

A summary of the waste types and tonnages deposited at the landfill as recorded by the landfill operator is regularly submitted to NRW in accordance with the Permit requirements. A graphical record of waste deposition is presented in Appendix 9.

During 2006, part of the filter cake from the unlined Storage Bays located on MCL started to be deposited within Cell 1 of MNHL. Any leachate contained within, or produced by this material would report to landfill sump L7. Leachate from similar material that has been historically landfilled in the upgradient unlined MCL is already impacting groundwater upgradient and down gradient of MNHL.

Since October 2008, hot mill sludge (HMS) filter cake generated by the steelworks has been landfilled in Bio Cell B. This process has subsequently continued at a rate of approximately 500 - 700 tonnes/month. In accordance with Improvement Condition 1 of the Variation Notice this prompted the monthly monitoring of Benzo(a)pyrene (BaP) on samples collected from sump L6. In September 2010 this data was reviewed by Geotechnology to establish whether BaP control levels were required (see report 993r1v1d0910). As the data showed that BaP was not detected in the leachate, control levels were not considered to provide additional environmental protection. Benzo(a)pyrene has continued to be present in leachate below the analytical detection limit.

6.3.2 Third Party Waste Storage

The Tata landfills are only permitted to accept wastes generated by the steelworks. However, during 2011 an exceptional emergency event occurred following which Tata was approached to assist.

On 16 June 2011 a major fire broke out in an industrial unit in Fforestfach, Swansea. The unit contained an estimated 5000t of tyre fluff from the treatment of shredded tyres. During the days immediately following the fire, the Fire Rescue Service (FRS) discovered that the fire could not be readily extinguished using conventional firefighting techniques. A crust was forming on the surface of the material, limiting the effectiveness of the cooling water so the mass kept burning. A multi-agency strategic co-ordinating group was set up to manage what was expected to be a protracted major incident. Using expertise from elsewhere in the country a means of extinguishing the burning waste was developed: a quenching technique that involved mechanically placing excavated masses of the burning material into large water filled skips. This proved to be the only means of extinguishing the fire.

After quenching large volumes, the extinguished material required immediate removal as there was no space at the fire site. As part of an appraisal of potential options for off-site management of the waste, Tata was approached by Swansea City Council on 23 June 2011 with a view to exploring options for the temporary storage of waste at the Morfa site. Following this meeting and a site visit by the Tata landfill operators (Darlow Lloyd and Sons) to Fforestfach, Tata agreed to the use of Cell 2, MNHL (subject to regulatory approval) for the temporary storage of the waste. NPTCBC (Planning Authority), Natural Resources Wales (waste regulators) and waste specialists acting for the SCG met prior to waste movement to discuss this option. Regulatory acceptance from both organisations was made subject to a number of strict controls and conditions. On 25 June Tata started to accept waste into Cell 2 of MNHL. This process continued until 20 July 2011.

This waste was moved from Cell 2 of MNHL into Cell 2 MHL in March 2014. This work was inspected by NRW at the time and a Construction Quality Assurance (CQA) report produced by Geotechnology following the works (see Geotechnology report 1327r1v1d0314). A copy of the Compliance Assessment Report (CAR) summarising observations made by NRW is provided in Appendix 10.

6.4 Construction of Morfa Hazardous Landfill

Two cells have been constructed at MHL. Cell 2 was completed in August 2012. This new cell received the fire waste from Cell 2 of MNHL in March 2014.

6.5 Restoration of Morfa Closed Landfill (MCL)

Phased restoration of unlined MCL has been on-going since September 2004. During 2013, the capping was completed and restoration sand placed. The restoration scheme involves placement of geomembranes which, in combination, provide gas and surface water management as well as providing barriers to precipitation ingress and gas egress. The sympathetic restoration also involves the placement of sand on top of the geomembranes, creating dune morphology similar to the surrounding land.

During 2012 and 2013, restoration included the recovery of materials to be used in the steel making process as the topography was re-profiled. During this phase, waste which has remained undisturbed for several decades was exposed. Such wastes will have been temporarily susceptible to weathering and leaching prior to them being capped. Seepage infiltrating to groundwater in these areas would be expected to pass beneath and around MNHL as MCL is hydraulically upgradient of MNHL.

The cap on MCL is designed to prevent infiltration into the underlying waste mass and provide freshwater for a recharge trench. Currently, the majority of captured rainfall is directed under gravity towards the boundary with Margam Moors in close proximity to BH17, towards the River Kenfig near to BH15 and to the south near BH10. Cells of MNHL which no longer active will ultimately be capped and restored using the same approach.

6.5.1 Recharge Trench

During 2013, a recharge trench system was partly constructed as shown in the photograph below. Ultimately, the trench is designed to capture rainfall from the capped areas and direct it along the boundary with Margam Moors.

Construction of Recharge Trench

The sand restoration layer that has been placed on MCL will permit infiltration to the underlying drainage composite, where it will be directed to percolate toward collector ponds. Overflow pipes from the ponds will then transport the water into stilling chambers before flowing out into a series of ditches excavated into the natural sand along the boundary with Margam moors. This will allow clean surface water to recharge the shallow groundwater, mitigating the loss of natural recharge over MCL. This recharge trench is a specific objective of the restoration scheme required by the Countryside Council for Wales (now part of NRW) to protect the well-established fen habitat that has developed along the edge of the adjacent Margam Moors, where groundwater discharges to the ground surface along a springline.

The accumulation of secondary precipitation in localised areas along this boundary is well documented. These have formed due to near surface interactions between shallow groundwater that is impacted by leachate from the unlined MCL and the atmosphere. Precipitates and poor quality groundwater are present throughout this area but become visible in topographically low areas, where groundwater may be sometimes exposed. Wider dispersion and leaching of these previously accumulated precipitates and groundwater has been previously observed in response to changes in shallow groundwater levels.

6.5.2 Hot Mill Sludge Storage Bays

As part of the capping of MCL, the historic deposits of Hot Mill Sludge (HMS) were first stabilised and then capped.

6.6 Summary of Landfilling and Restoration Activity

The timeline of landfill construction and operation is summarised in Table 6-2.

Table 6-2 Summary of site activity to date

Activity	Start	Finish
Construction of MNHL Cell 1	1 June 2004	19 October 2004
Construction of MHL Cell 1	1 June 2004	19 October 2004
Restoration of MCL	September 2004	8 June 2013
Construction of MNHL Bio Cell A	14 June 2004	8 September 2004
Construction and operation of waste treatment centre	5 December 2006	Ongoing
Construction of MNHL Bio Cell B	August 2007	13 October 2007
Construction of MNHL Cell 2	6 May 2008	31 July 2009
Landfilling of HMS filter cake in MNHL Bio Cell 2	28 October 2008	Ongoing
Construction of MHL Cell 2	October 2011	Ongoing
Temporary storage of fire waste	25 June 2011	20 July 2011
Construction of recharge trench sections A & B	30 Aug 2012	12 Oct 2012
Connection of recharge trenches to ponds and commissioning of system	Ongoing	(to be completed 2015)

7 TOPOGRAPHIC SURVEY AND LANDFILL VOID SPACE

Condition 3.6.3 of the Permit requires an annual topographic survey to be completed.

7.1 Topographic Survey

A topographic survey of the operational landfill cells was carried out on 19 January 2015. Following data acquisition, the digital data was imported into a digital terrain model for each of the cells in order to calculate the available void space.

Previous topographic surveys have been conducted on foot using a Topcon GR-3 base and rover GPS system. The 2013 and 2014 surveys have, however, been completed using an unmanned aerial vehicle (UAV) with survey control established using the GR-3 system. The UAV data was then used together with ground control points to create a digital terrain model. This method of surveying collects data points at significantly closer intervals than methods previously used and is therefore able to create a more detailed topographic model, as shown in Figure 7. The technique also provides detailed aerial imagery.

7.2 Remaining Void Space

Based on a comparison of the topographic levels observed in 2014 and those from 2013 an assessment of void space available in each cell has been made. This is summarised in Table 7-1.

Table 7-1 Volume Remaining in Landfill Cells

Volumes (m^3)	Biodegradable Cell A	Biodegradable cell B	Non-Hazardous Cell 1	Non-Hazardous Cell 2
Total Capacity	74602	93067	197376	208340
Used capacity at December 2014	78249	64877	195850	46667
Available Capacity	-3647	28190	1526	161673
% Available Capacity	0% (Full)	30%	1% (Full)	77%

The apparent 1% availability reported in Cell 1 of MNHL is considered to be due to increased detail acquisition afforded by this year's survey method. This cell is considered full.

Using this data, the remaining volume for the whole landfill has been calculated. This calculation is provided in Table 7-2.

Table 7-2 Remaining Landfill Volume

Void Space (m^3)	Non-Hazardous
Total	2777086
Used 2014	385645
Available	2391441
% Available Space	86.11

8 LEACHATE

8.1 Leachate Level and Volumes

Based on the weekly monitoring results provided by the landfill operator, the variation of leachate levels is illustrated in Appendix 1. The depth of leachate has not exceeded one metre above the base of any leachate monitoring point. This means that this aspect is in accordance with the Permit. During 2013, leachate levels reached the highest levels ever observed in response to the intense heavy rainfall. Similar levels were observed in 2014.

To maintain leachate levels within the Permit levels, significant quantities of leachate are pumped by vacuum tanker from each leachate sump and taken back into the steelworks for treatment. Graphical summaries of the quantities involved, as recorded by the landfill operator are provided in Appendix 1 with key details summarised in Table 8-1.

Table 8-1 Leachate Pumping Records

Year	Leachate Extracted from MNHL and MHL (gallons)	Leachate Extracted from MNHL (gallons)
2011	7,428,000	6,576,000
2012	8,174,000	6,314,000
2013	7,715,000	6,307,000
2014	13,686,000	10,122,000

Given the large volumes involved, Geotechnology suggests that Tata should consider measures to reduce the volume, such as capping and ensure that all potential leachate treatment and re-use opportunities are evaluated.

8.2 Leachate Chemistry

Each landfill cell is monitored at a separate landfill sump. Leachate samples L1 and L6 are located in the sumps in Bio Cell A and B and L7 and L8 in Cell 1 and Cell 2 respectively.

8.2.1 Non-Volatile Species

Analysis of the leachate samples to date has revealed that it is typically dominated by a highly characteristic signature comprising elevated pH, calcium and alkalinity and low sulphate. This signature is strongest in the leachate in Cells 1 and 2 where it is also found to contain significantly elevated chloride. The hydrochemistry of the leachate is illustrated in the graphs included in Appendix 2.

In recent months, the leachate has become more dilute with the electrical conductivity falling due to decreasing levels of ammonia, calcium, alkalinity and most notably chloride.

Filtercake (EWC code 11 01 10) has been placed into Cells 1 and 2 at a rate of approximately 500 - 800t/month since the start of monitoring. Produced by the lime neutralisation of acidic ferrous chloride and pickling solutions at the cold mill effluent treatment plant, the waste comprises iron oxyhydroxide chloride phases, calcium chloride, iron chloride and mixed oxides. Within the landfill, the soluble components of the waste are leached by infiltration, releasing elevated levels of chloride and calcium. As the waste becomes buried and less oxygenated, the oxyhydroxide iron phases may also start to undergo changes. Some may start to age and crystallise, forming more stable iron oxide phases and some may undergo reductive dissolution in anaerobic conditions that may be present in parts of the landfill. This

latter process could potentially release iron into the leachate along with other trace metals adsorbed to the iron precipitates.

This latter process was previously considered to be occurring within Cell 2, as iron significantly increased in concentration from <1mg/l to over 1000 mg/l during the latter part of 2012 and was elevated on several occasions during 2013. At the same time, the leachate was found to be green in colour and the laboratory measured pH variable over a relatively short time period i.e. dropping from over pH 11 to pH 4 and then returning to pH 11 within 12 weeks. During 2014, such trends have not been observed.

Nitrogen and phosphorous species are typically infrequently detected within the leachate.

Hazardous substances such as mercury and cadmium are rarely found and only at very low concentrations. During 2014, low levels of cadmium were detected but mercury was below the analytical level of detection. Similarly, many non-hazardous pollutants are either not present above the analytical levels of detection or present at very low levels, some of which are comparable to or below current Environmental Quality Standards.

8.2.2 Volatile Species

Due to the nature of the waste streams very low levels of hydrocarbons, volatile organic compounds (VOCs) and semi VOCs have been detected to date. No substances were detected during 2014.

8.3 Evaluation against Control Levels and LandSim Criteria

Table 8-2 provides a comparison of recent leachate chemistry with the leachate inventory used in the most recent HRA and the Permit Control Levels. This demonstrates that the most recent leachate chemistry is similar to the Probability Density Functions (PDFs) used to describe the leachate inventory in the most recent HRA and is below the Permit control levels.

Table 8-2 Evaluation of Leachate Chemistry

	Ammonia	**Arsenic**	**Chloride**
	mg/l	**mg/l**	**mg/l**
LandSim PDF*	Triangular (0.05, 10, 50)	Triangular (0.005, 0.3, 3)	Log Triangular (1000, 10000, 61000)
Permit control Levels	70	3	70000
Leachate chemistry 2012			
Maximum 2012 Leachate chemistry (L1, L6, L7, L8)	54.3	0.57	62900
Leachate chemistry 2013			
Maximum 2013 Leachate chemistry (L1, L6, L7, L8)	14.7	0.54	91000
Leachate chemistry 2014			
Maximum 2014 Leachate chemistry (L1, L6, L7, L8)	5.1	0.26	11000
*PDF – Probability Density Function used to describe statistical distribution of parameter. Triangular and Log Triangular are the PDFs used in most recent HRA. Values in parenthesis are minimum, most likely and maximum values used in LandSim model			

8.4 Contingency Actions Taken

No contingency actions have been implemented during 2014.

9 GROUNDWATER

9.1 Groundwater Level and Flow

Groundwater levels in the shallow and deep aquifer are presented in Appendix 3 and Figure 9. The patterns of groundwater flow encountered during 2014 are similar to those observed previously.

9.2 Groundwater Chemistry

9.2.1 Shallow Aquifer

The latest monitoring results are very similar to those observed previously with temporal variations illustrated in Appendix 4. Also included in Appendix 8 are spatial plots highlighting several key parameters.

The monitoring programme continues to confirm the variable impact of leachate from the unlined but capped MCL on groundwater directly upgradient of MNHL. This makes identification of potential seepage from MNHL difficult to identify. However, over the past few years, upgradient groundwater along the northern boundary of MCL has shown a sustained decrease in mineralisation, suggesting an overall change and improvement in water quality. This is most obvious at monitoring positions BH17S - BH20S which are directly upgradient of MNHL and downgradient of MCL. At these positions, there has been sustained decreases in the concentration of several parameters including ammonia, chloride, calcium, alkalinity and Chemical Oxygen Demand (COD) in the shallow aquifer as shown by the time series charts in Appendix 4. With time, the water quality is likely to become less alkaline as less slag based waste is exposed. As the water quality changes trace metals may potentially become slightly more mobile and this may explain why zinc and cadmium were detected in November 2014 at a number of positions.

In the shallow aquifer downgradient of the active cells, samples of groundwater have for some time revealed relatively short-term increases in alkalinity. These are considered to be related to the leaching of alkaline components from MCL and other areas of unlined waste.

There is no evidence to suggest seepage from MNHL is impacting groundwater.

9.2.2 Deep Aquifer

This is the second annual report since the introduction of the reduced monitoring schedule for the deep aquifer. Samples are now only collected annually in Q4 (September–December).

The data suggests that there has been little change in deep groundwater chemistry and that the reduced monitoring programme is not hampering understanding of the site conditions.

9.3 Assessment against Permit Compliance Limits and EQS

The graphs presented in Appendix 4 reveal temporal trends and also compare the data with the control and trigger levels. These reveal that there were few breaches of the trigger level in 2014 (see Table 9-1 for summary). Elevated levels of cadmium, a hazardous substance which is typically absent from all samples (leachate and groundwater) were, however, detected. As cadmium is analysed as part of the annual characterisation suite (due to its

previous lack of detection) the only samples analysed for cadmium were collected in November. Further, this data was not issued by the laboratory until January 2015.

The source of the cadmium is unclear. At this stage, the active landfill is not considered the source as cadmium has not been detected in leachate for many years and no other hydrochemical signs of leachate seepage are evident in the monitoring network. However, cadmium was (unusually) detected in leachate samples collected in November. Given that leachate and groundwater (and some surface water) were found to contain cadmium in November 2014, Geotechnology suspects that the most likely explanation is related to error during sampling or analysis. To test this hypothesis, the indicator suite should be amended during 2015 to include cadmium when samples are collected.

Table 9-1 Comparison of Selected Water Chemistry with Trigger & Compliance Levels

	Date	Cl	Ammoniacal Nitrogen	Alkalinity	pH	EC	Ca	As	Cd
		mg/l	mg/l N	mg/l CaCO3		microS/cm	mg/l	microg/l	microg/l
	EQS		**0.02**		**6-9**				**50**
	BH3S Trigger & Compliance Levels	**250**	**12**	**3000**					**0.1**
BH3S	23/01/2014	72.8	<0.05	222.5	11.8	1065	121.0	<0.10	
BH3S	16/06/2014	67.7	0.28	100	11.3	592	57.0	12.145	
BH3S	23/09/2014	97.9	1.15	83	11.0	637	68.9	13.2	
	13/11/2014	90.87	11.62	305	12.2	1584	146.5	12.6	**0.21**
	BH4S Trigger & Compliance Levels	**250**	**4.00**	**750.0**					**0.1**
BH4S	23/01/2014	39.5	<0.05	220.0	7.1	518	54.4	<0.10	
BH4S	16/06/2014	48.73	<0.05	198	7.6	627	119	4.487	
BH4S	23/09/2014	60.45	<0.05	350	7.4	562	52	10.3	
	13/11/2014	57.95	**36.27**	443	7.5	1047	88.48	1.7	**0.19**
	BH6S Trigger & Compliance Levels	**250**	**18**	**1400.0**					**0.1**
BH6S	23/01/2014	52.1	3.4	80.0	10.3	338	40.1	<0.10	
BH6S	17/06/2014	35.61	0.85	835	12.5	4270	439	2.793	
BH6S	23/09/2014	36.56	2.55	865	12.3	4080	328	5.47	
BH6S	13/11/2014	40.71	2.83	285	12.3	1476	154	25.7	**0.11**
	BH30S Trigger & Compliance Levels	**250**	**4.00**	**750.0**					**0.1**
BH30S	23/01/2014	40.1	<0.05	145.0	11.1	401	58.8	<0.10	
BH30S	16/06/2014	73.58	<0.05	313	12.1	1893	152	2.256	
BH30S	23/09/2014	59.13	<0.05	78	10.9	458	23	13.5	
BH30S	13/11/2014	71.73	<0.05	205	10.3	322	14.99	2.26	**0.32**
	BH11 Compliance Level 2	**200**	**1.10**	**657.0**					**0.1**
BH11	17/06/2014	57.47	<0.05	125	7.6	513	59.9	75.029	
BH11	23/09/2014								
BH11	13/11/2014	75.31	<0.05	305	7.6	631	70.24	2.87	<0.10
	BH12S Compliance Level 2	**200**	**0.52**	**335.0**					**0.1**
BH12S	16/06/2014	43.5	<0.05	102.5	11.4	643	63.7	13.473	
BH12S	13/11/2014	49.7	<0.05	128	11.2	480	37.14	61.5	<0.10
	BH13S Compliance Level 2	**200**	**2.1**	**872.0**					**0.1**
BH13S	17/06/2014	43.64	<0.05	222.5		629	97.8	1.506	
BH13S	13/11/2014	45.57	<0.05	208	7.6	596	80.89	26.1	<0.10

The annual characterisation monitoring, conducted since the start of monitoring, has included the analysis of an extensive list of volatile and semi volatile organic compounds in leachate and groundwater. This data has clearly shown the widespread impact of seepage from MCL and potentially other areas on groundwater upgradient and downgradient of the

landfill. The occurrence of these compounds is not related to MNHL, as many of the compounds have not been found in leachate and where the compounds are detected, they are typically found at lower concentration levels. To date, some of the highest concentration levels detected are found directly upgradient of MNHL, although no compounds have been detected since 2009.

9.4 Contingency Actions Taken

Where necessary, Tata implemented additional monitoring but no further contingency actions were required.

Tata should conduct a review of the current sample collection and laboratory analysis and reporting procedures as some analytical data is not being made available in a timely manner.

10 SURFACE WATER

The results of the surface water monitoring are presented in Appendix 6 and 8. Spatial plots of selected water chemistry are also included in Appendix 8.

10.1 Assessment against Permit Control Levels

Due to the design of MNHL there is a very low risk to surface water quality. Parts of the Margam Moors drainage network immediately adjacent to the site are, however, already impacted by seepage from wastes contained in the unlined MCL and other areas of the site.

Along the northwestern boundary, there is accumulation of secondary precipitates at surface and within the stream beds, due to natural attenuation of the contaminants contained within the leachate issuing from the unlined areas. There is also a springline within the vicinity of SW2 and SW3. Periodically, the precipitates are flushed and leached and the springs flow depending upon the antecedent rainfall and shallow water levels, resulting in further dispersion. Many of the sample points (SW4 – SW10, SW13 & SW14) have become increasingly stagnant during the monitoring period due to the growth of extensive vegetation and the build-up of sediment, although this aspect is being increasingly evaluated by NRW. In some cases this stagnation has affected water level and likely impacted upon water chemistry by changing the redox conditions present.

Due to the low risk that MNHL poses to surface water under active management control and the historical impact of seepage from MCL, there are no Permit Compliance Limits for surface water. Instead, there are two assessment levels (AL1 and AL2). During 2013, none of the levels were breached. In 2014, alkalinity was the only parameter that breached the compliance level. Cadmium was not detected in any surface water samples.

Table 10-1 Comparison of Selected Water Chemistry with Assessment Levels

		Cl	Ammoniacal Nitrogen	Alkalinity	pH	EC	Ca	As	Cd
		mg/l	mg/l N	mg/l CaCO3		microS/cm	mg/l	microg/l	microg/l
	EQS		**0.02**		**6 - 9**				**50**
	Assessment Level 1	**200**	**2.75**	**350.0**					
	Assessment Level 2	**250**	**3.00**	**400.0**					
SW2	21/01/2014	70.5	<0.05	**495.00**	11.9	2330	228.4	<0.10	
SW2	21/02/2014	64.8	2.00	**2207**	11.4	1051	91.1	3	
SW2	18/3/2014	52.63	0.56	**2303.00**	11.9	1196	81.1	2.8	
SW2	01/04/2014	63.4	1.4	90.0	7.5	403.0	52.8	0.9	
SW2	16/06/2014	71.31	<0.05	725	11.6	761	37.4	10.9	
SW2	1/8/2014			300.0					
SW2	23/09/2014	82.96	<0.05	218	11.9	1158	66.6	29.4	
SW2	13/11/2014	22.49	<0.05	168	7.5	583	81.95	1.7	<0.10
SW4	21/01/2014	34.7	<0.05	162.50	7.8	399	63.2	<0.10	
SW4	21/02/2014	53.7	<0.05	**1843**	7.7	535	70.7	1	
SW4	18-Mar	68.33	<0.05	**2061.25**	7.0	593	79.8	3.7	
SW4	01/04/2014	60.2	<0.05	215.0	7.3	606.0	68.3	2.3	
SW4	16/06/2014	46.74	<0.05	**411**	7.7	721	107	2.5	
SW4	1/8/2014			338.0					
SW4	23/09/2014	63.85	<0.05	**365**	7.1	819	116.0	2.5	
SW4	13/11/2014	43.78	<0.05	100	7.3	411	52.76	2.1	<0.10

Over the past four years, elevated alkalinity has been observed at SW4, particularly during the period May-November. These patterns potentially indicate that alkaline precipitates are present in the ditch and when waterlevels rise in response to rainfall, the alkalinity is released. At these times, there may also be increased contributions from the alkaline springline, as suggested by the increased alkalinity in January–March 2014. These observations could have implications for dredging of the ditches.

10.2 Contingency Actions Taken

No contingency actions were required apart from additional monitoring.

11 DUST

11.1 Assessment against Permit Control Levels

The relative locations of the dust monitoring points are as follows:-

- D15 is located at the northern end of the site near the offices and close to the coal stockyards.
- D16 is in the middle of Margam Moors north of MNHL.
- D17 is located east of MNHL near the old landfill bordering the SSSI.
- D18 is located to the southeast of MNHL near the old landfill and rail sidings.
- D19 is located to the west of site near to the beach and road.

The results from the depositional dust monitoring are summarised in Appendix 11.

Since 2012 there have been no breaches of the Permit threshold. This may be due to a combination of the higher frequency of rainfall and implementation of measures to control dust.

During 2012, to help improve understanding of the source of the dust Tata undertook a series of additional investigations. Dust collected at the deposit gauges by Tata was submitted to TSW for chemical analysis. The testing included a combination of bulk chemical measurements (pH, solids content, iron content and carbon content) and a limited number of X-ray diffraction (XRD) analysis. The aim of the testwork was to characterise the bulk chemistry of the deposited dust particles. Unfortunately, the usefulness of the programme was hampered by problems with the XRD analysis resulting in only two samples (both from D19) being examined via XRD. Despite this setback, Tata has continued the chemical analysis of the dusts samples into 2014 with the full datasets presented in Appendix 11.

Based on the variation in the dust Carbon/Iron ratio, the data suggests that the coal stockyards influence dust chemistry to the northeast of the landfill and mobile sand is detected to the south. The results obtained during 2014 are similar to those observed in 2013 although the iron content of the dust at D17 was lower resulting in an increase to the Carbon / Iron ratio. This additional sampling undertaken by Tata since 2012 has helped to improve the understanding of the dust sources. Analysis using XRD, if now possible at TDC, would be of benefit and could ultimately be used to justify modifying the monitoring programme.

Despite the proximity of the open site to the Bristol Channel dust is rarely an issue of concern. This is primarily due to the low dusting potential of most of the waste streams and active dust management by the site operator. Restoration sand is, however, being locally re-mobilised in the recently restored areas of MCL. Plans to improve this situation are being developed in consultation with an ecologist.

11.2 Contingency Actions Taken

No specific contingency actions have been taken by Tata. The landfill operator routinely deploys a bowser to spray water on all landfill haul roads to minimise the generation of dust in accordance with the air quality management plan for the landfill.

12 INTERNAL LANDFILL GAS

Internal landfill gas chemistry can be measured at GA1, GA2 and W1 – W8 within Bio Cell A and W9 – W16 in Bio Cell B. Due to the fixed height of the gas wells they can only be safely monitored when the waste level surrounding the well is sufficiently high.

Until 2011, the monitoring had failed to detect more than 1.6% carbon dioxide or methane and 33 ppm carbon monoxide. In March 2011, this pattern changed with landfill gas containing up to 61% methane and 48% carbon dioxide detected at GA1 and GA2 in Bio Cell A. The occurrence was, however, short-lived and localised. No other gas wells detected such levels and all subsequent measurements at GA1 and GA2 have failed to detect methane and carbon dioxide above 1.5%. In bio cell B, methane has never exceeded 0.6% and carbon dioxide 5.7% with the highest concentrations typically found at W10 and W11. Some of this data is presented in Appendix 7.

As the waste is not capped in either bio-cell the gas is free to vent to the atmosphere and these measurements should only be considered indicative of the processes occurring within the waste.

13 EXTERNAL GAS MONITORING

External landfill gas is monitored around the northern (GA7, GA15 & GA16), eastern (GA8, GA9 & GA10) and southern (GA11 & GA12) boundaries of the bio cell (see Figure 3).

13.1 Assessment against Permit Compliance Limits

Along the southern and eastern boundaries, ground gas has been infrequently detected. During 2014, methane was not detected and carbon dioxide was never measured above 0.2%. Low levels (<10 ppm) of carbon monoxide and hydrogen sulphide were also found.

Historically, the situation has been different along the northern boundary as ground gas has been detected along this boundary for several years, most notably at GA16 but more recently at GA7. In response, the compliance limits for GA16 were increased following an evaluation of the likely ground gas sources, that concluded that the landfill was not the source of the gas. At no point since 2012 have the monitoring results breached the compliance limits at GA15 or GA16. At no point since 2012 has the concentration of methane or carbon dioxide exceeded 0.3%. Low levels (<10 ppm) of carbon monoxide and hydrogen sulphide were also found.

13.2 Contingency Actions Taken

No contingency actions were required.

14 SUMMARY AND RECOMMENDATIONS

14.1 Evaluation and Summary

At MNHL there will always be significant difficulty in determining influences on groundwater as both the shallow and deep aquifers have been impacted by seepage from unlined areas of waste and other off-site sources. Additionally, as the construction of the landfill was subject to CQA during construction and this included a leak location survey, the volume of leakage that is predicted by the LandSim model is small and groundwater dilution high. Identifying seepage from the landfill is not, therefore, straightforward given variations and similarities between the leachate and upgradient groundwater and the low volume predicted to leak.

There is, however, one key tracer and this is chloride. Although the current concentration of chloride has reduced in the leachate sumps it still remains well above the levels observed in groundwater and surface water. Based on the monitoring data collected to date there is no evidence to suggest that the landfill is not behaving as initially predicted and the identified receptors remain protected from impacts related to MNHL. As cells cease to operate, progressive restoration should be taking place as this limits the amount of leachate requiring management, potentially reduces the mineralised content requiring treatment and reduces the potential flux of contaminants.

14.2 Environmental Protection

The initial risk assessments, completed as part of the Permit Application, clearly demonstrated the potential for the landfill to emit non-hazardous pollutants to groundwater and potentially surface water. There was also the potential that the landfill would generate dust during landfilling activity and associated vehicular movements and earthworks. Landfill gas is not likely to be associated with the industrial components of the landfill, but the generation of small amounts could not be wholly discounted, particularly within the biodegradable cell.

To ensure that the landfill performs at least as well as predicted throughout the lifespan of the Permit, a monitoring programme was put in place to evaluate the leachate source concentrations, leachate head, groundwater flow, surface water chemistry, gas generation and dust deposition. Based on the monitoring data reviewed to date, there is no evidence to suggest that the landfill is not behaving as initially predicted and the identified receptors remain protected.

Now that the upgradient unlined MCL is finally capped, Geotechnology will start to develop and use new approaches for evaluating changes in groundwater quality around MNHL. The approach will be more statistically based and will allow background water quality to be numerically taken into account when evaluating downgradient quality and potential leakage from the landfill. The approach may result in grouping of boreholes and changes to the monitoring programme, such that fewer samples are collected but on a more frequent basis. The new approach will also retrospectively evaluate the time series datasets gathered to date.

14.3 Regulatory Framework

Starting in January 2013, a new set of assessment criteria was used. These new criteria appear to be working well at this stage.

14.4 Monitoring

Coupled with the new regulatory framework, a new monitoring programme was also introduced in January 2013. This has also performed well, providing a more efficient use of resources while still enabling environmental protection through focusing on key determinants at key monitoring locations.

14.5 Actions Required

The annual report has identified several items requiring action:

- Tata should conduct a review of the current sample collection and laboratory analysis and reporting procedures as some analytical data is not being made available in a timely manner.
- Given that leachate and groundwater and some surface water was found to contain cadmium in November 2014, Geotechnology suggests the indicator suite should be amended during early 2015 to include cadmium when samples are collected. If cadmium is not found to be present, its analysis should cease.
- Headworks at all positions need to be routinely checked and repaired if necessary.
- Several minor repairs are required to the headworks of the gas wells which have rusted and broken at several positions.
- Vegetation in the vicinity of several sampling points requires routine clearance to enable continual safe access.
- Site weather stations should be routinely maintained to ensure they continue to operate satisfactorily.
- Shallow piezometers TPG and TPV have been removed from the monitoring network due to the construction of Cell 2, MHL. Geotechnology suggests that new piezometers are erected so that shallow groundwater movement can continue to be closely monitored.
- Continue to evaluate the chemistry of the dust at the existing monitoring points. The analysis completed during 2012 indicated that the dust contained Fe and C. If Tata continue with the additional analytical dust testing programme, the analysis should also be extended to include silica, chloride, calcium and speciation of the carbon into inorganic and organic fractions.
- Ensure assessment criteria are integrated into the contingency action plans.

Figure 1 Site Location Plan

Figure 2 Detailed Site Plan Showing Planning and Permit Boundaries

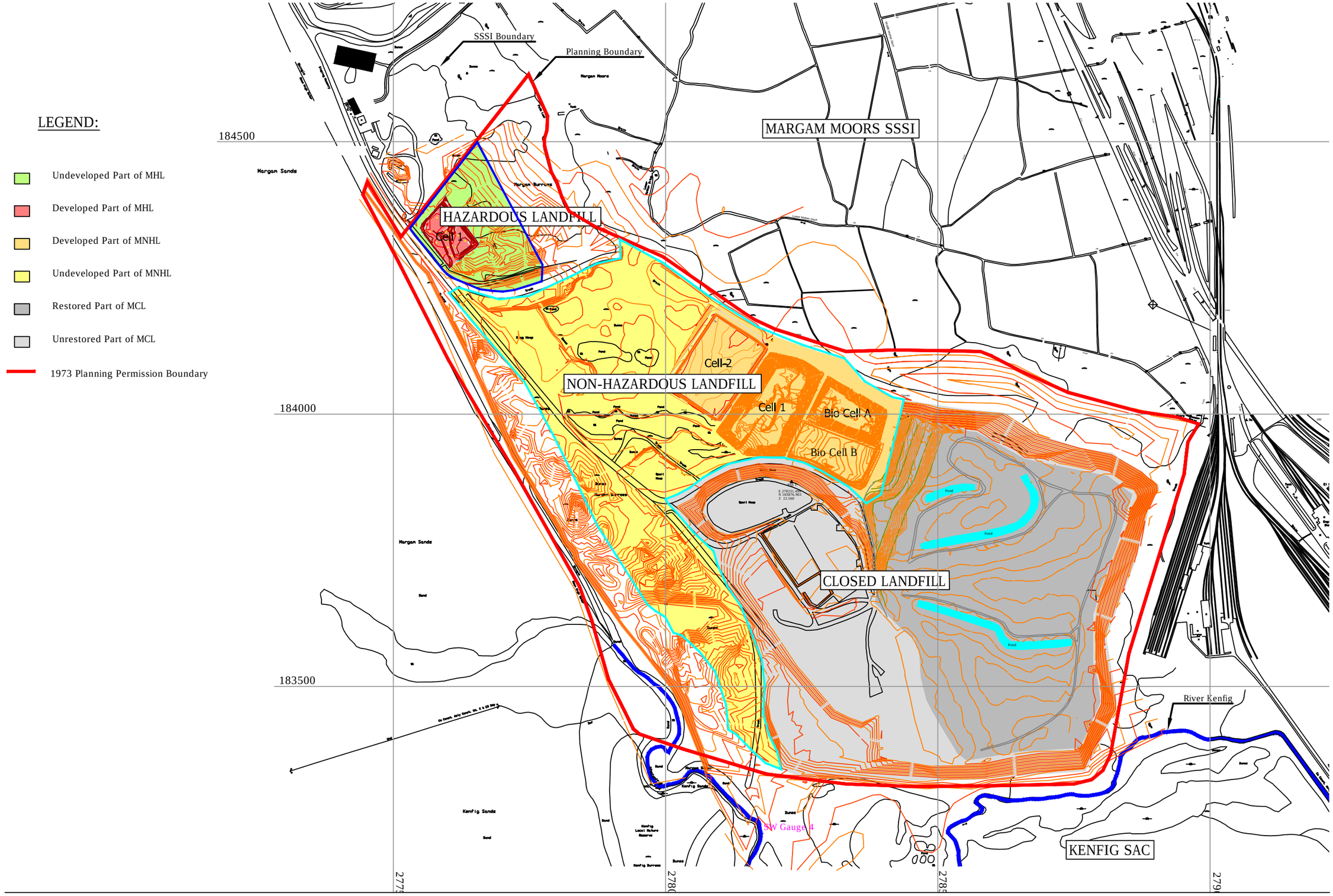


Figure 3 Available Monitoring Network

LEGEND

- Gas Vent
- Leachate Collection Sump
- Weather Station
- Groundwater Well
- Surface Water Sample Point
- Dust Monitor
- Gas and GW Well
- Gas Vent
- Surface Water Gauge Boards
- Pond Gauging and Sampling Point

SORTING STATION

Planning Boundary

Site Offices and Weather Station

Site Weather Station 2

MARGAM MOORS SSSI

HAZARDOUS LANDFILL

NON-HAZARDOUS LANDFILL

CLOSED LANDFILL

RAIL SIDINGS

KENFIG SAC

Waste Management Boundary

River Kenfig

D15 D16 D17 D18 D19

BH1 BH2 BH3 BH4 BH5 BH6 BH7 BH8 BH9 BH10 BH11 BH12 BH13 BH14 BH15 BH16 BH17 BH18 BH19 BH20 BH25 BH26 BH27 BH28 BH29 BH30

SW1 SW2 SW3 SW4 SW5 SW6 SW7 SW8 SW9 SW10 SW11 SW12 SW13 SW14

SW Gauge 1 SW Gauge 2 SW Gauge 3 SW Gauge 4 SW Gauge 5 SW Gauge 6

P1 P2 P3 P4 P5 P6 P7 P8 P9 P10 P11 P12 P13 P14 P15 P16 P17 P18 P19 P20 P21 P22 P23 P24

TPC TPV

GA1/L2 GA2/L3 GA3/W10 GA4/W11 GA5/W14/L5 GA6/W15/L4 GA7 GA8 GA9 GA10 GA11 GA12 GA15 GA16 GA30 GWT3A

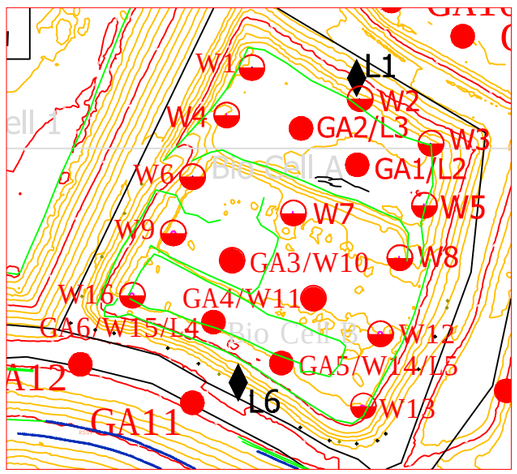
W1 W2 W3 W4 W5 W6 W7 W8 W9 W12 W13 W16

L1 L2 L3 L4 L5 L6 L7 L8

POND 1 POND 2 POND 3 POND 4 POND 5 POND 6 POND 7

GV1 GV2 GV3 GV4 GV5 GV6 GV7 GV8

GAS MONITORING IN BIO CELL A AND B



Revision 0

1392r1v1d0215 Figure 3

Scale As Shown

Figure 4 Extent of Clay Layer

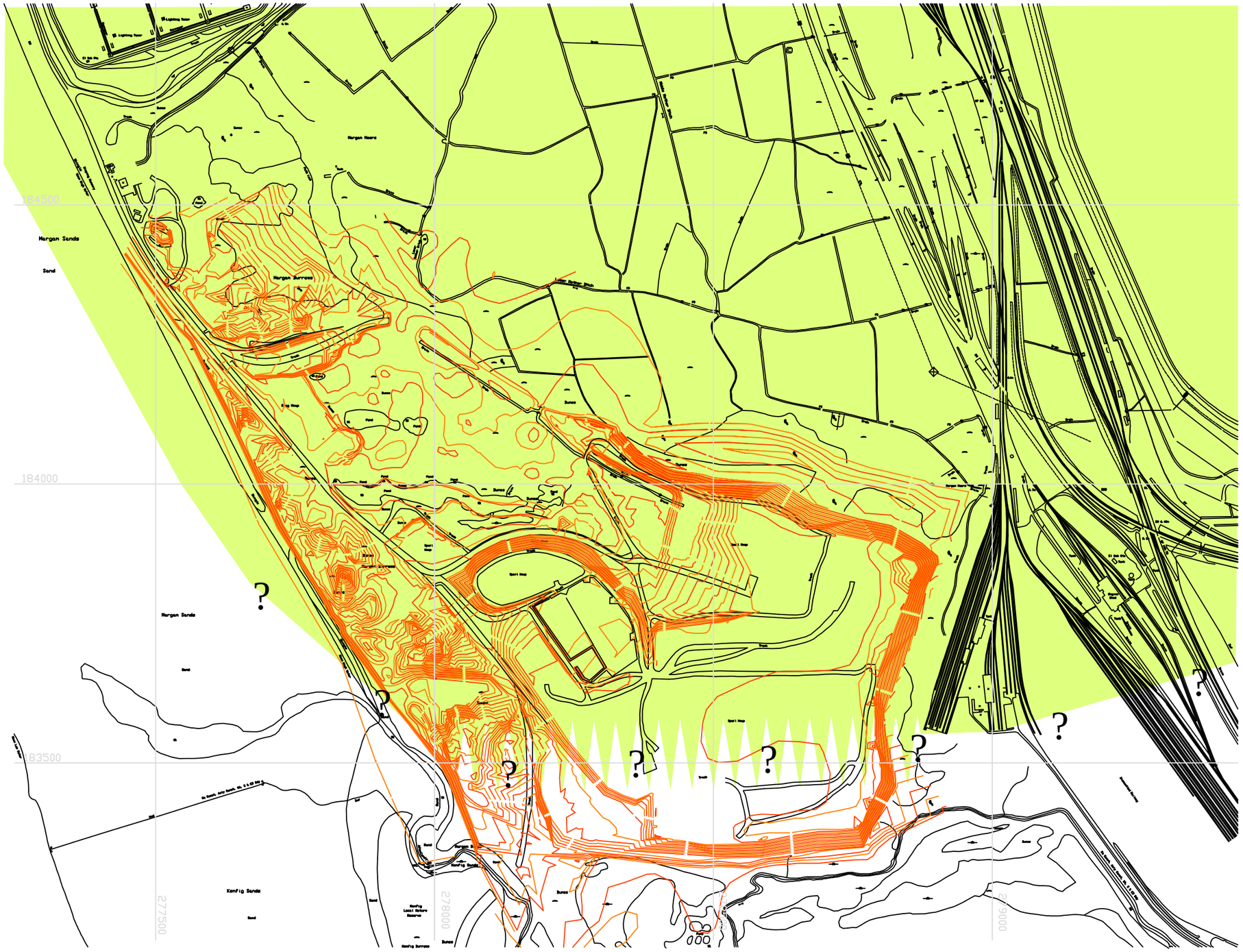


Figure 5 Contour Plan of Piezometric Surface in Shallow Aquifer

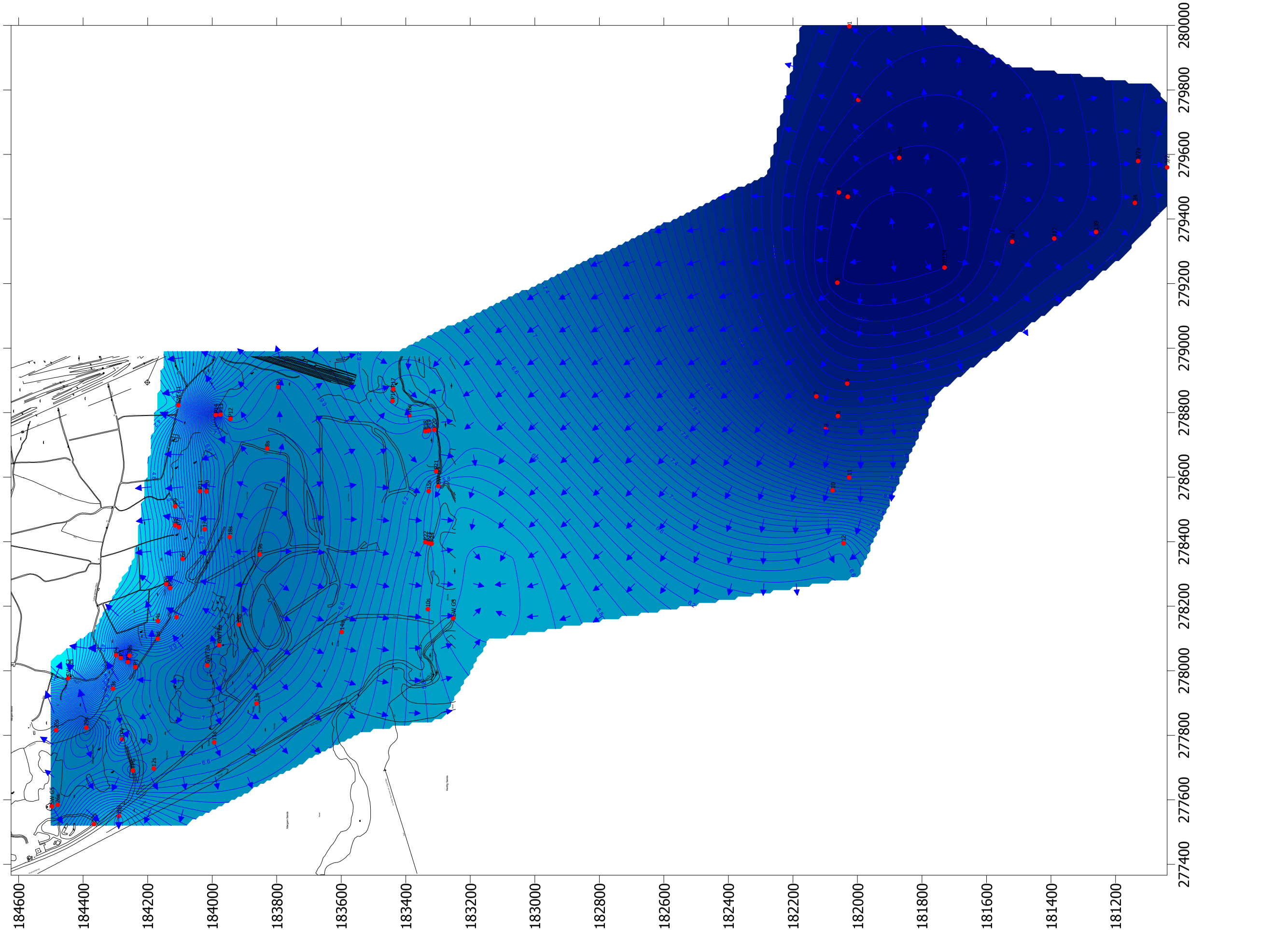


Figure 6 Contour Plan of Piezometric Surface in Deep Aquifer

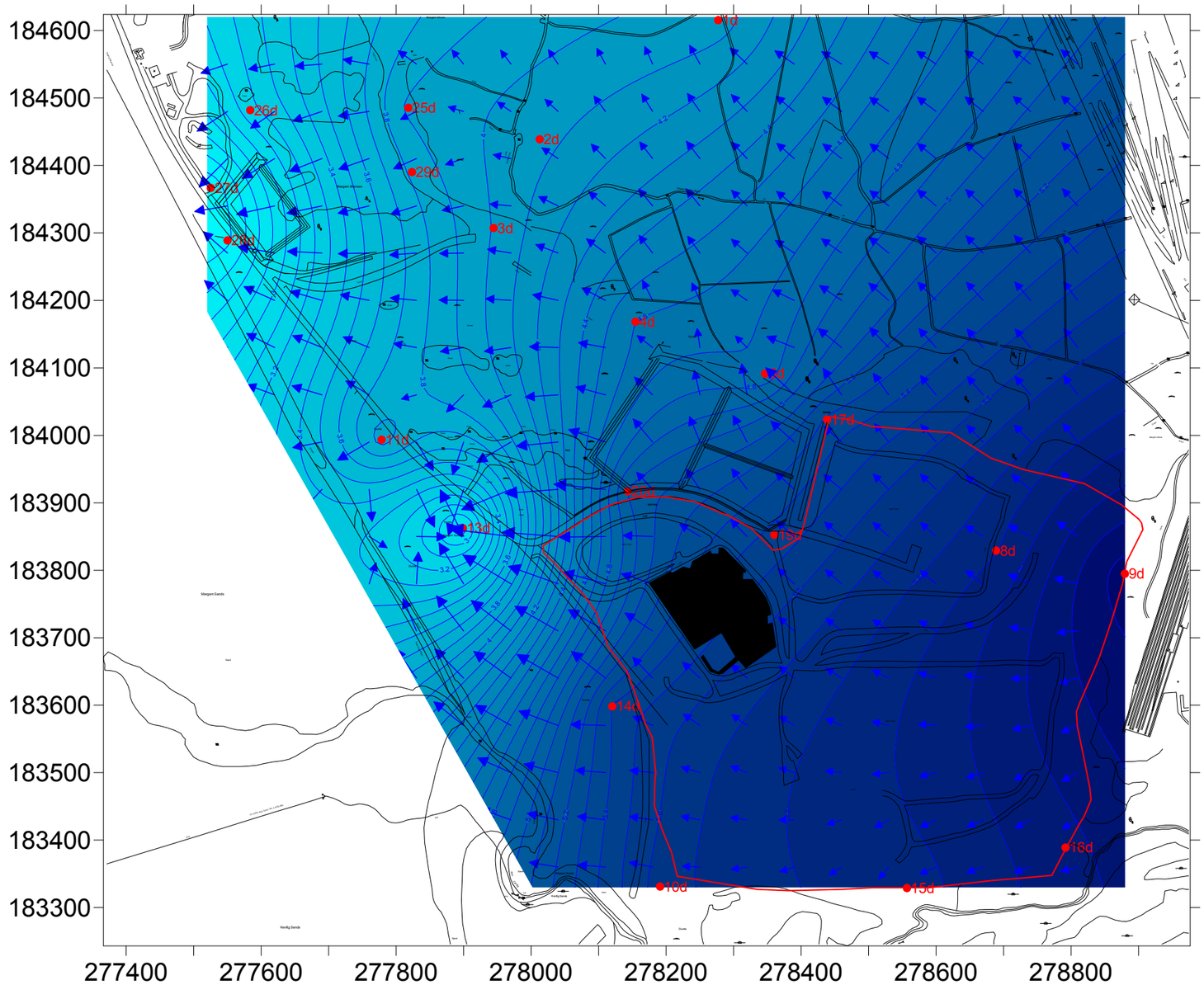
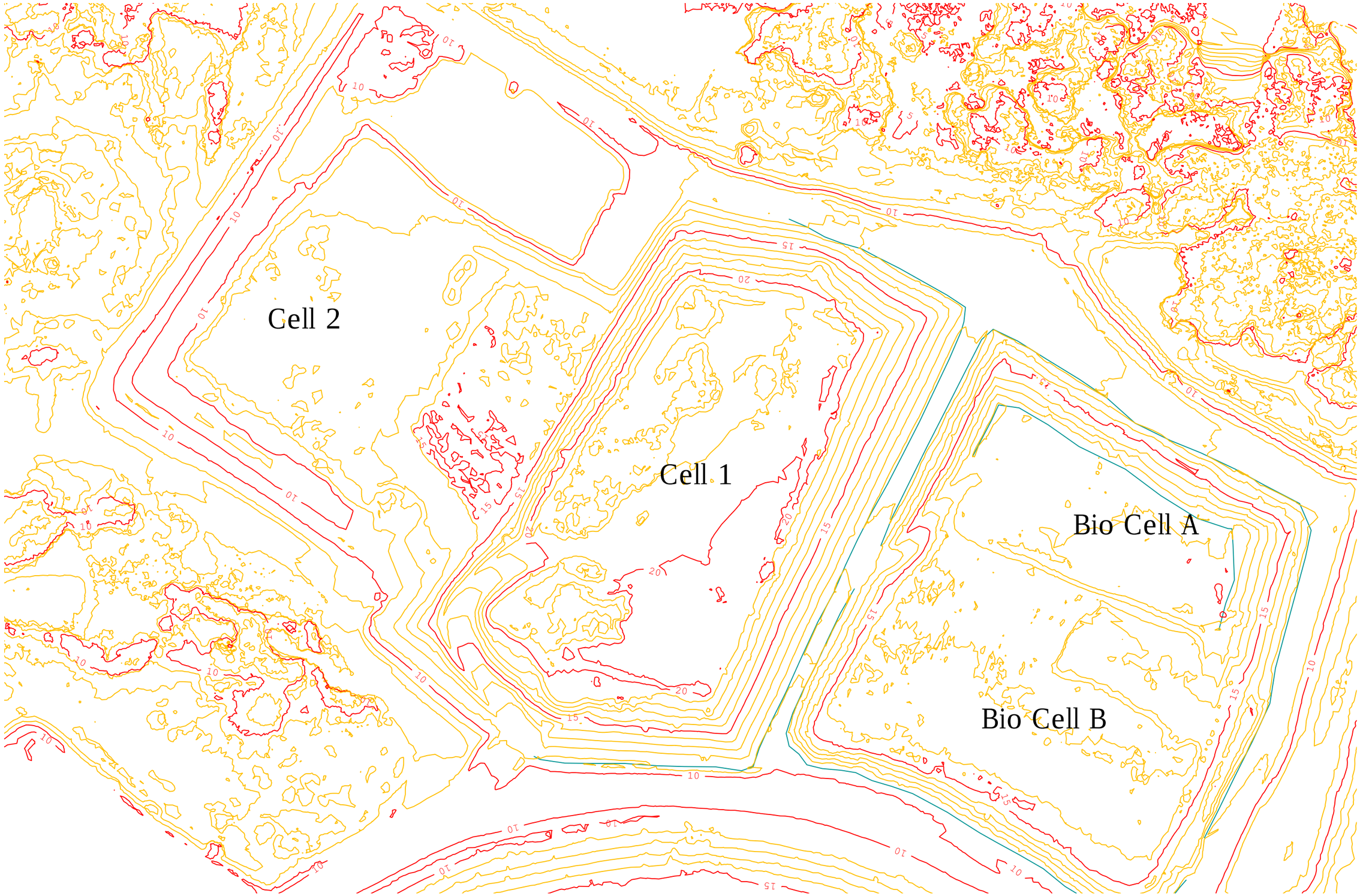


Figure 7 Current Topographic Plan of Landfill Cells



Revision 0

1392r1v1d0215 Figure 7

Scale 1:1250

Figure 8 Cross Sections of Key Landfill Engineering Systems

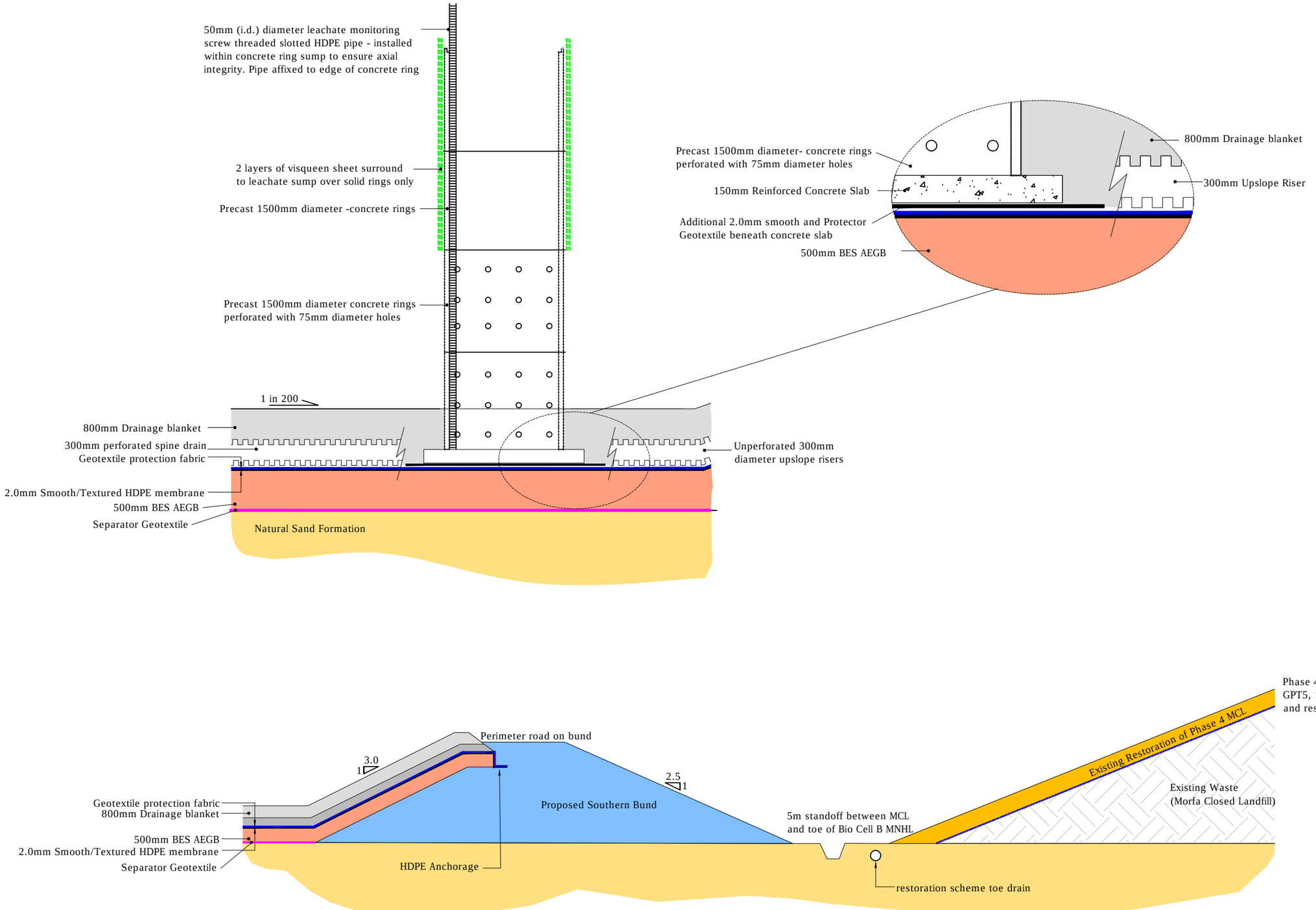
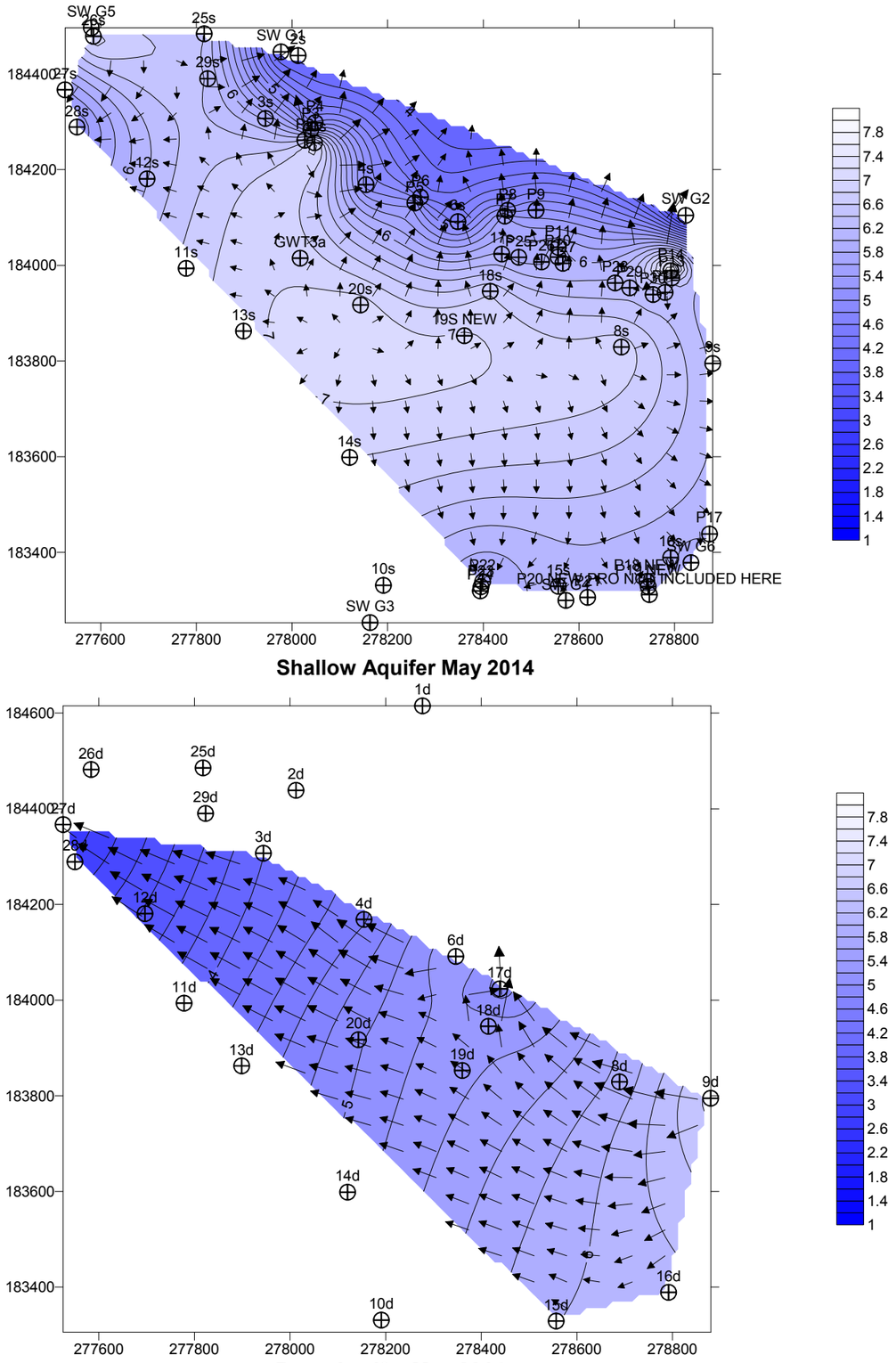
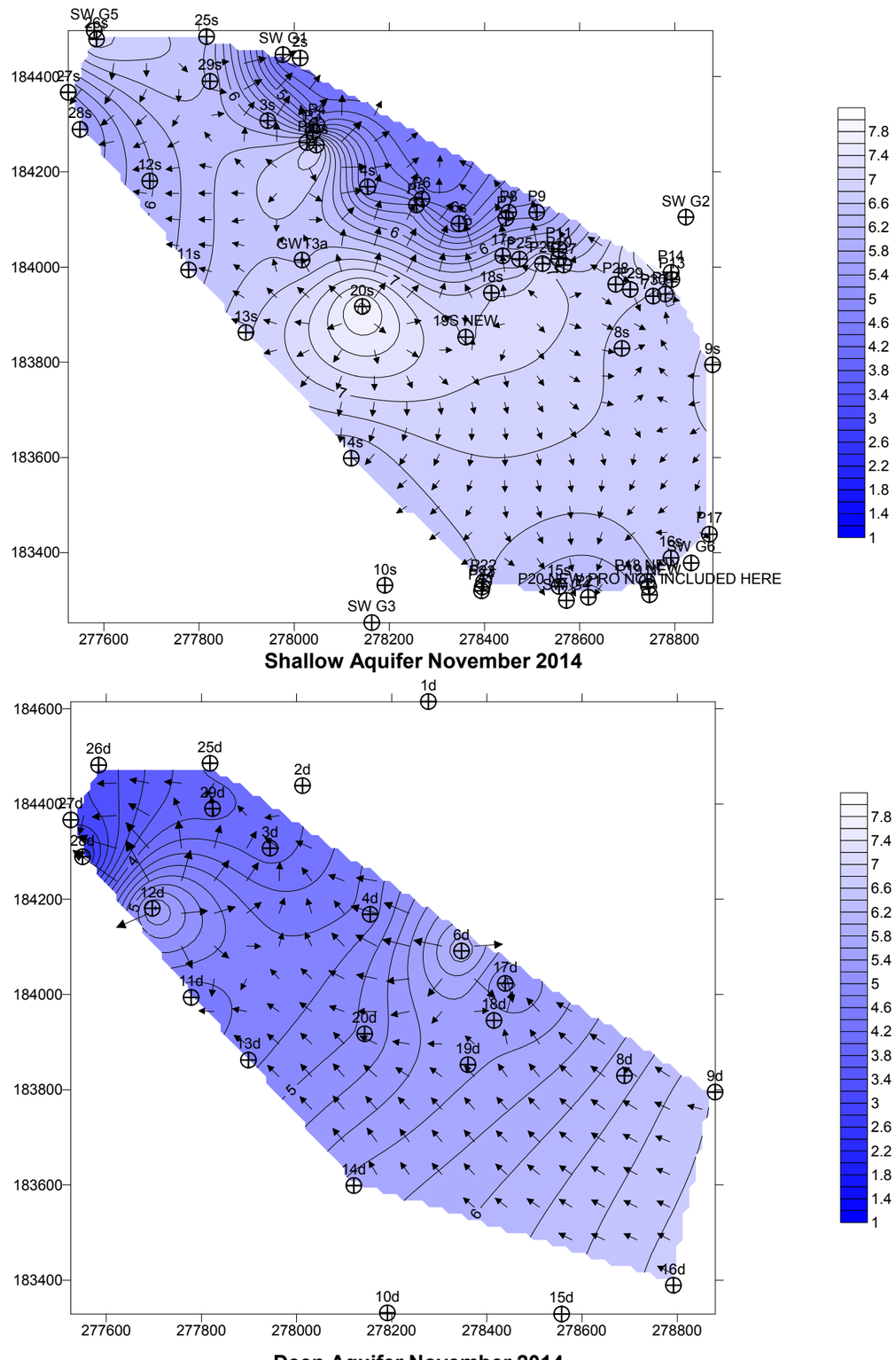


Figure 9 2014 Groundwater Contours





MORFA NON HAZARDOUS LANDFILL, PORT TALBOT

PERMIT BV7311IE

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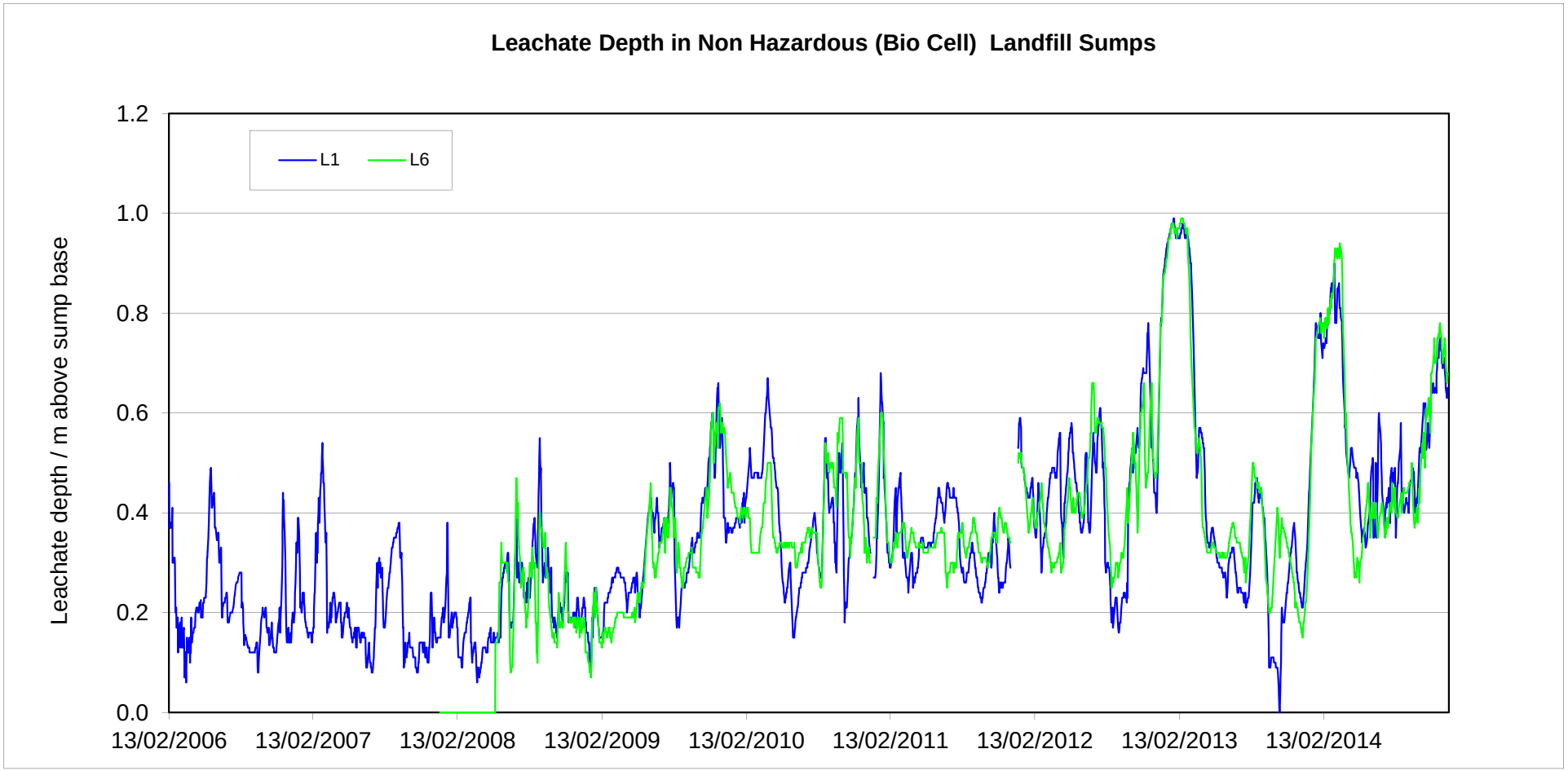
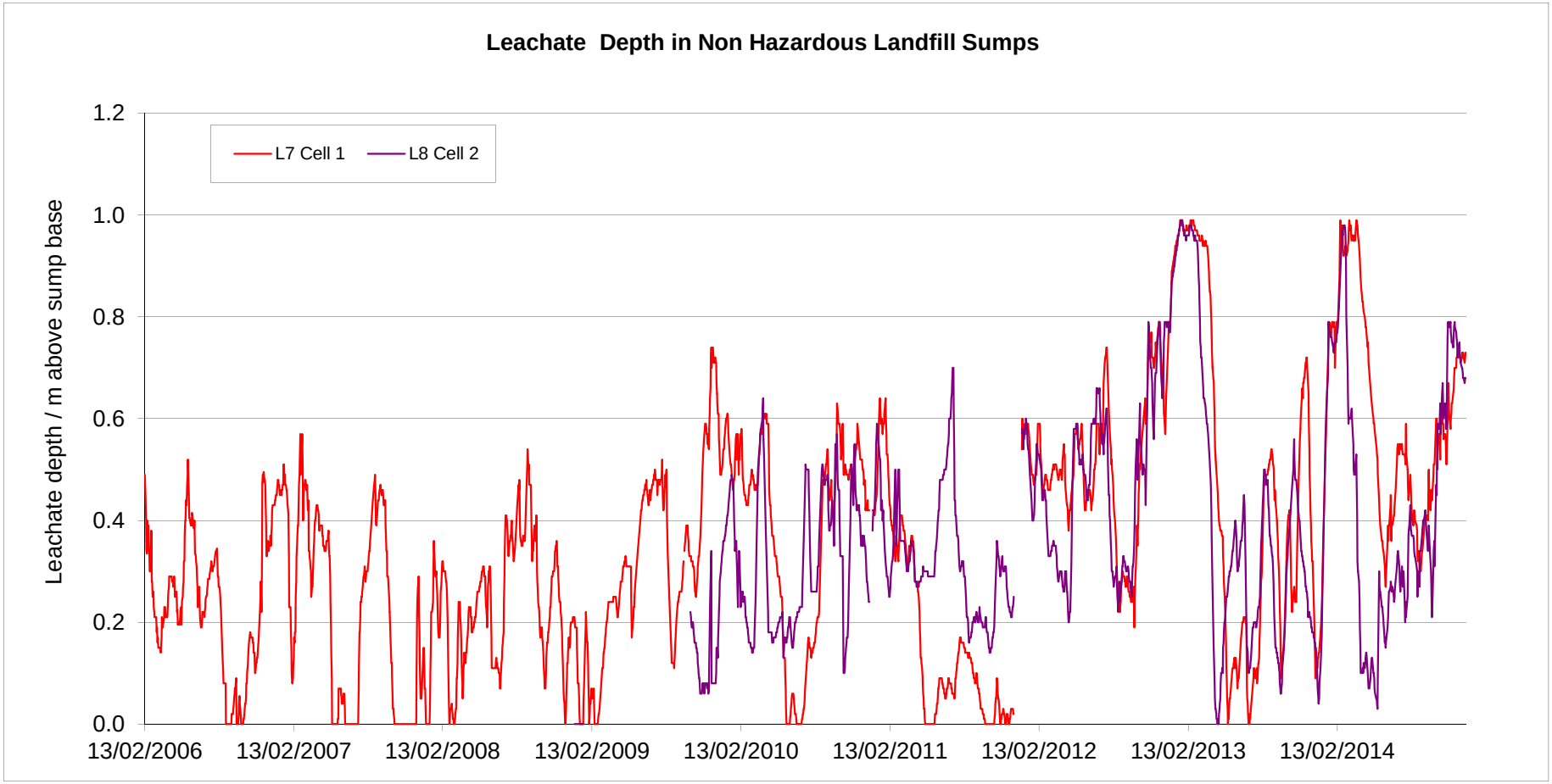
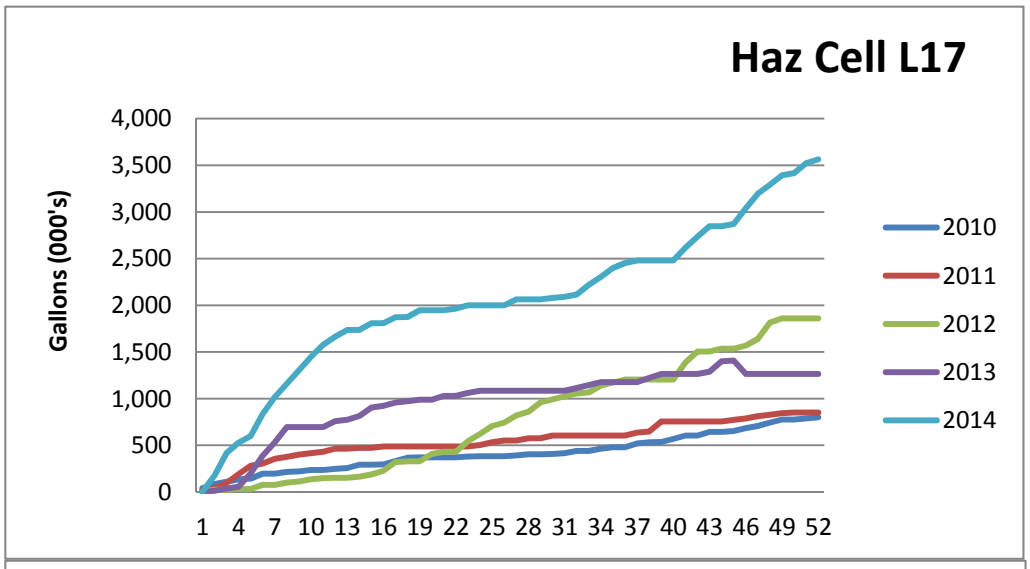
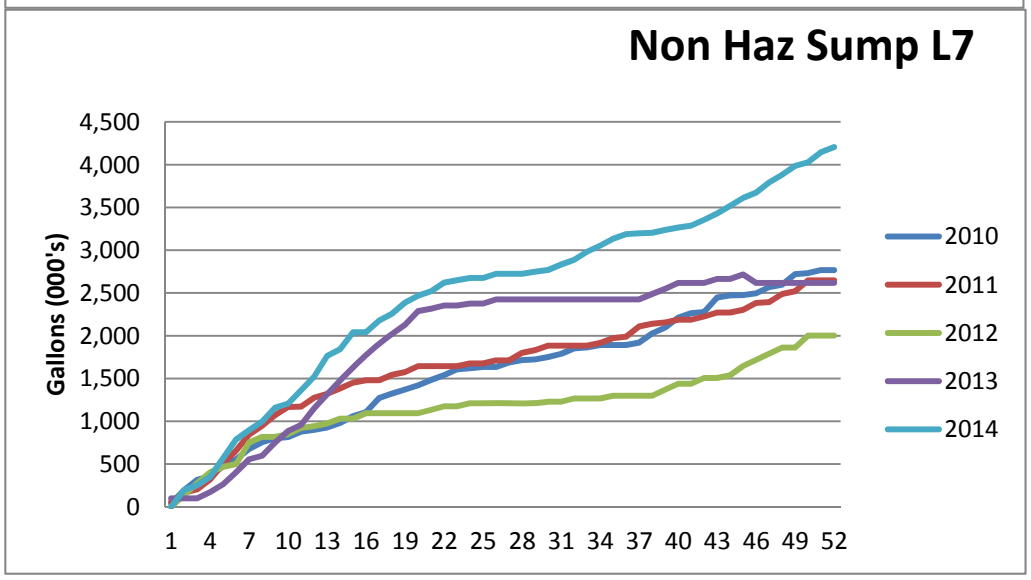
Appendix 1
Temporal variation of leachate levels and leachate pumping volumes

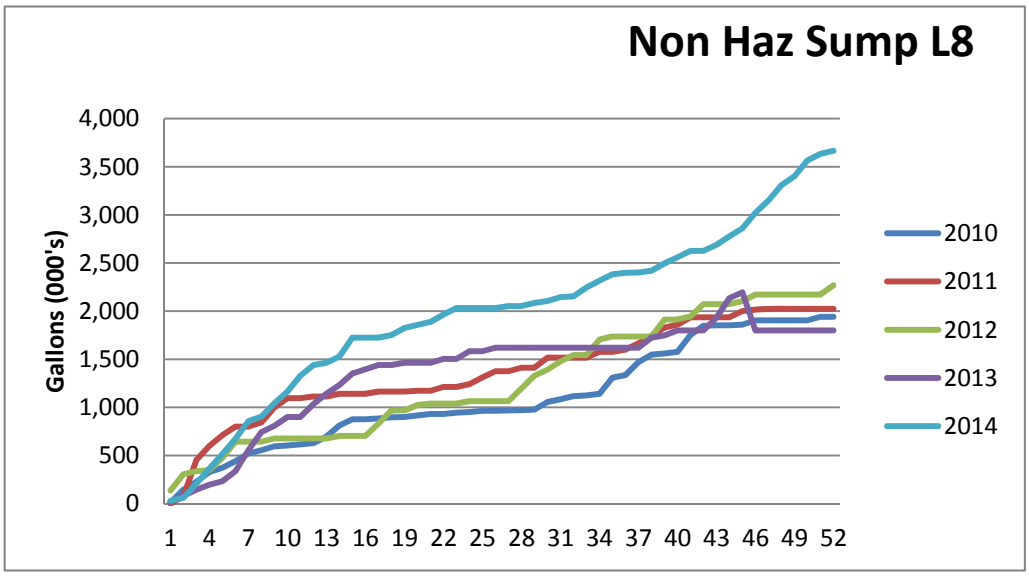
Report Number 1392r1v1d0215

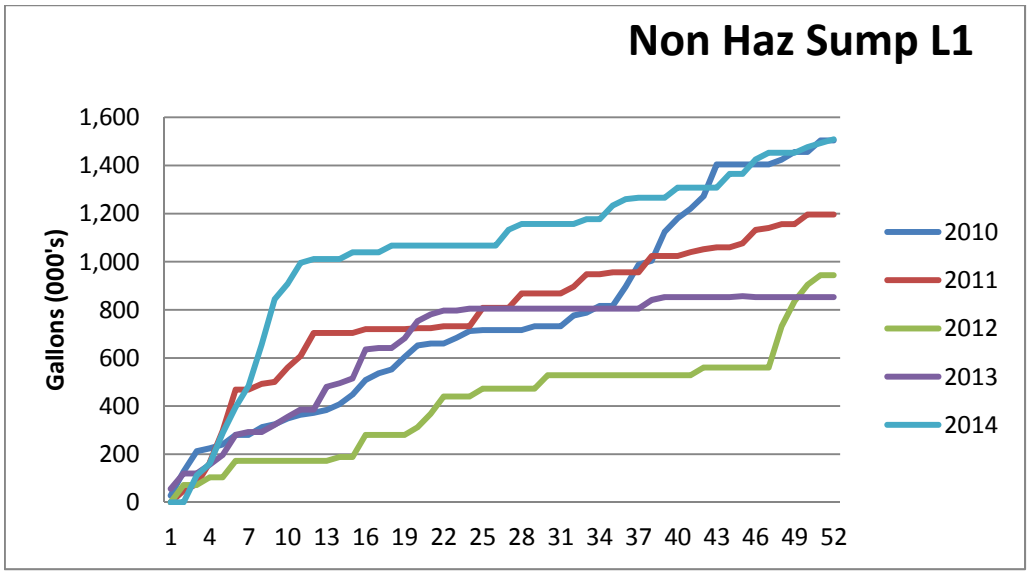

Leachate Depth in Non Hazardous (Bio Cell) Landfill Sumps
L1
L6
Leachate depth / m above sump base
1.2
1.0
0.8
0.6
0.4
0.2
0.0
13/02/2006
13/02/2007
13/02/2008
13/02/2009
13/02/2010
13/02/2011
13/02/2012
13/02/2013
13/02/2014

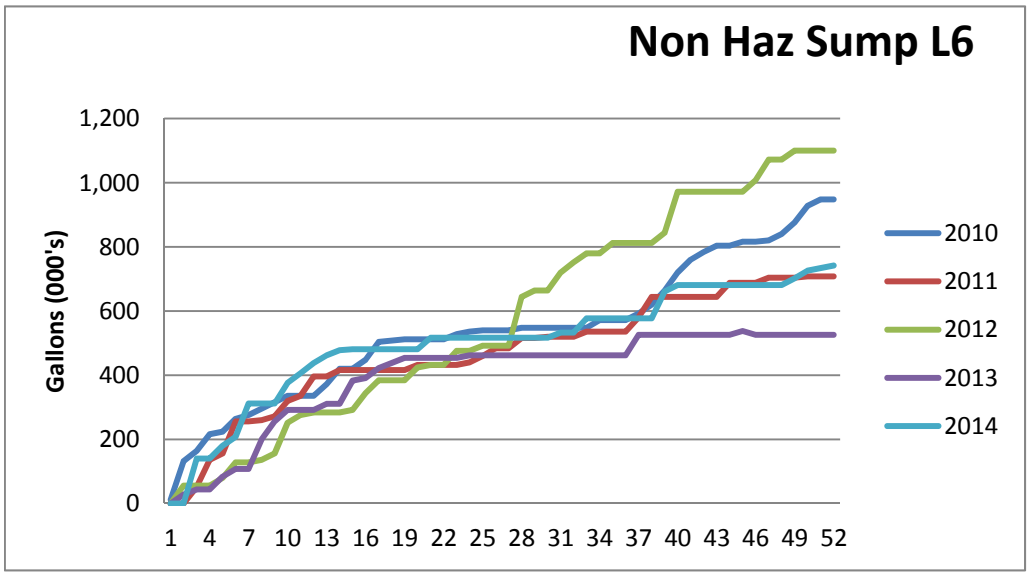

Leachate Depth in Non Hazardous Landfill Sumps
L7 Cell 1
L8 Cell 2
Leachate depth / m above sump base
1.2
1.0
0.8
0.6
0.4
0.2
0.0
13/02/2006
13/02/2007
13/02/2008
13/02/2009
13/02/2010
13/02/2011
13/02/2012
13/02/2013
13/02/2014


Haz Cell L17
Gallons (000's)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52
2010
2011
2012
2013
2014


Non Haz Sump L7
Gallons (000's)
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52
2010
2011
2012
2013
2014


Non Haz Sump L8
Gallons (000's)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52
2010
2011
2012
2013
2014


Non Haz Sump L1
Gallons (000's)
1,600
1,400
1,200
1,000
800
600
400
200
0
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52
2010
2011
2012
2013
2014


Non Haz Sump L6
Gallons (000's)
1,200
1,000
800
600
400
200
0
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52
2010
2011
2012
2013
2014

MORFA NON HAZARDOUS LANDFILL, PORT TALBOT

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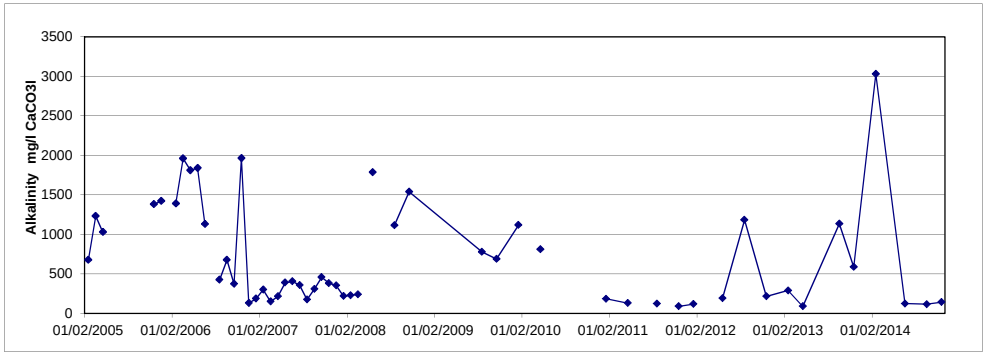
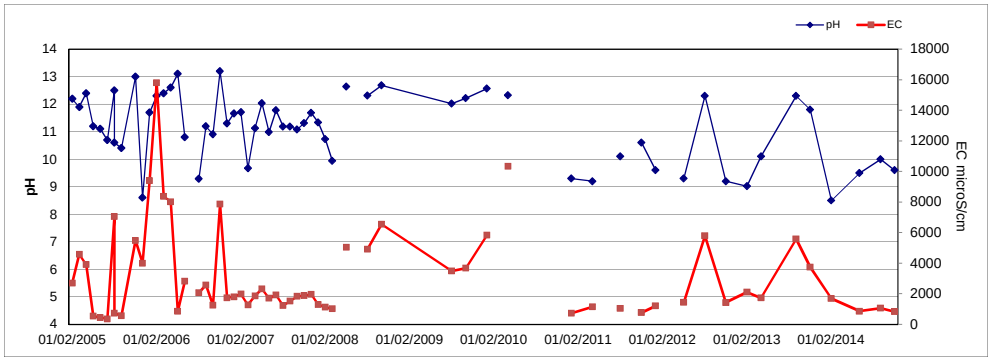
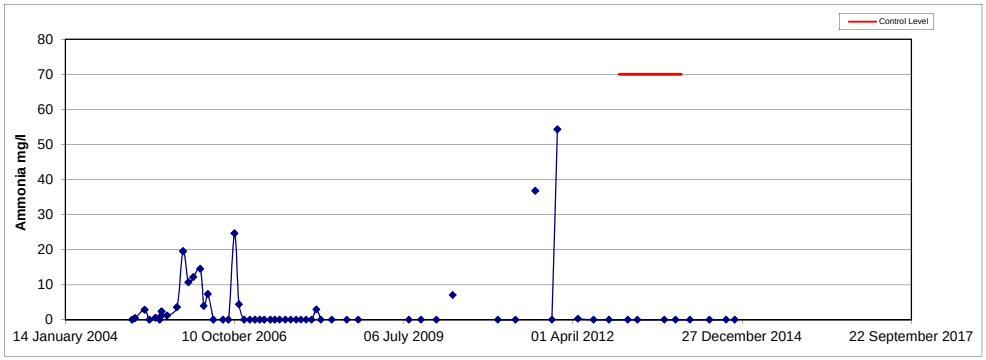
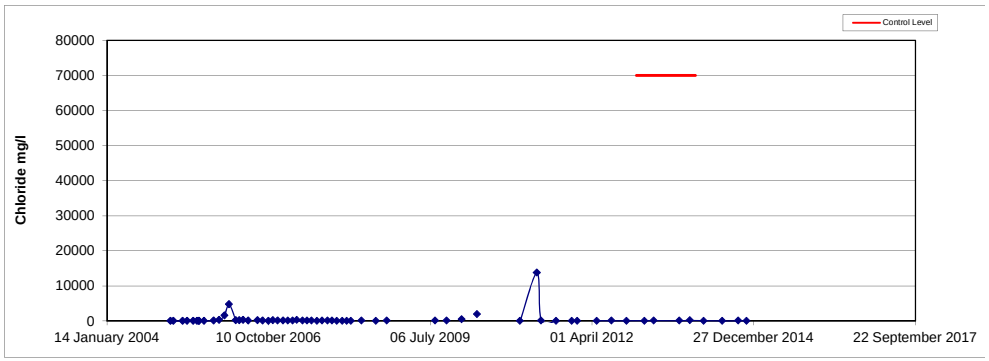
Appendix 2
Temporal variation of leachate chemistry

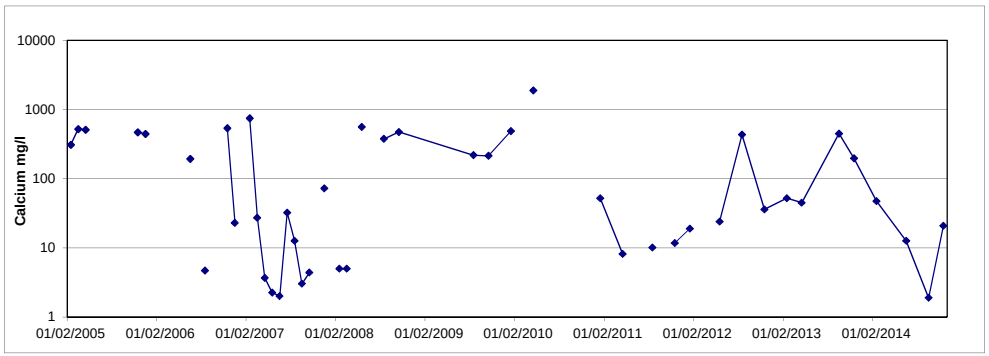
Report Number 1392r1v1d0215

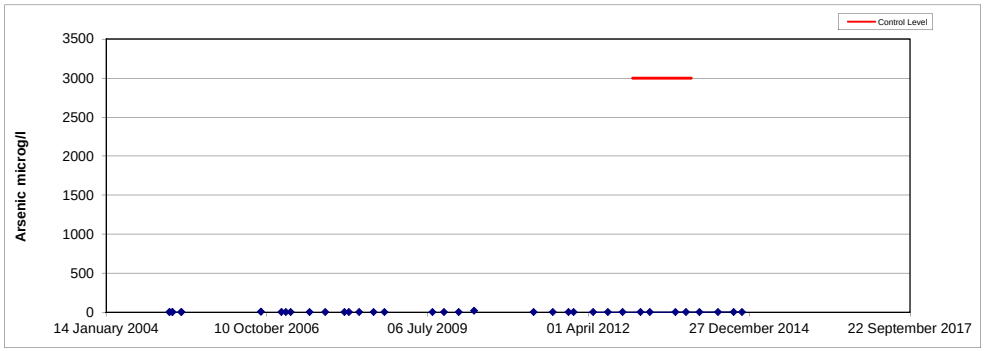

Alkalinity mg/l CaCO3l
3500
3000
2500
2000
1500
1000
500
0
01/02/2005
01/02/2006
01/02/2007
01/02/2008
01/02/2009
01/02/2010
01/02/2011
01/02/2012
01/02/2013
01/02/2014

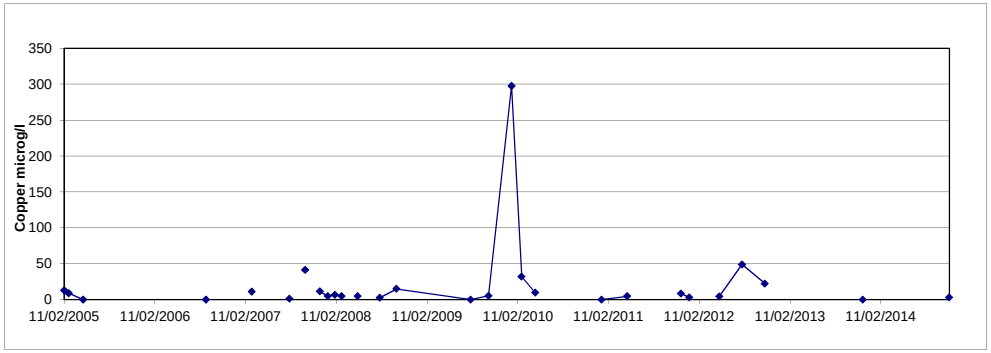

pH
EC
pH
EC microS/cm
14
13
12
11
10
9
8
7
6
5
4
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
01/02/2005
01/02/2006
01/02/2007
01/02/2008
01/02/2009
01/02/2010
01/02/2011
01/02/2012
01/02/2013
01/02/2014

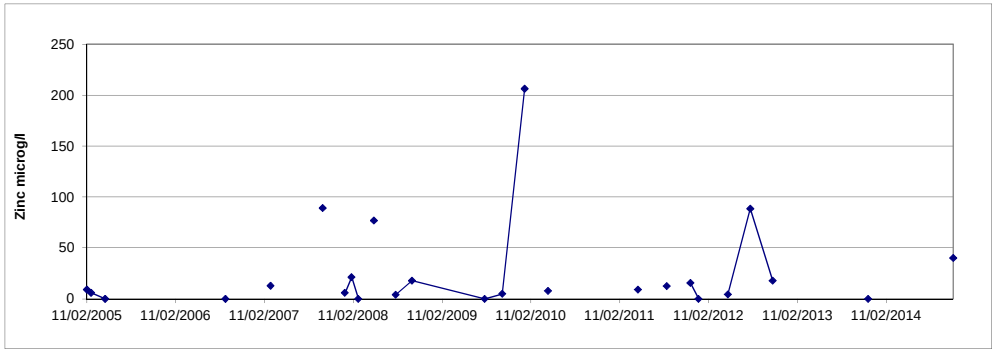

Control Level
Ammonia mg/l
80
70
60
50
40
30
20
10
0
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

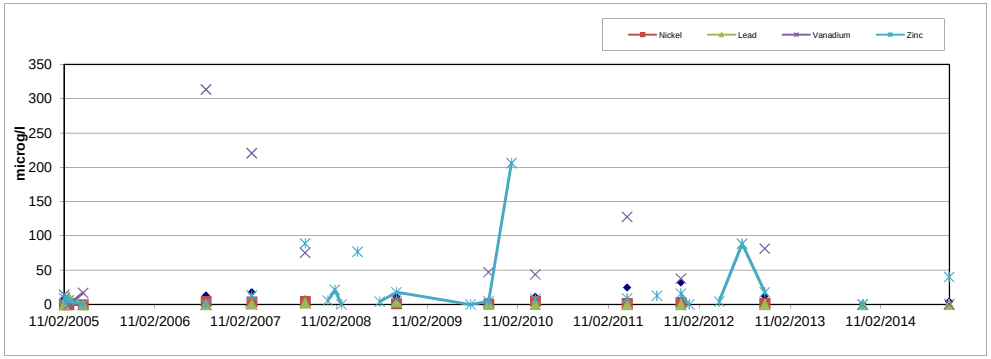

Control Level
Chloride mg/l
80000
70000
60000
50000
40000
30000
20000
10000
0
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

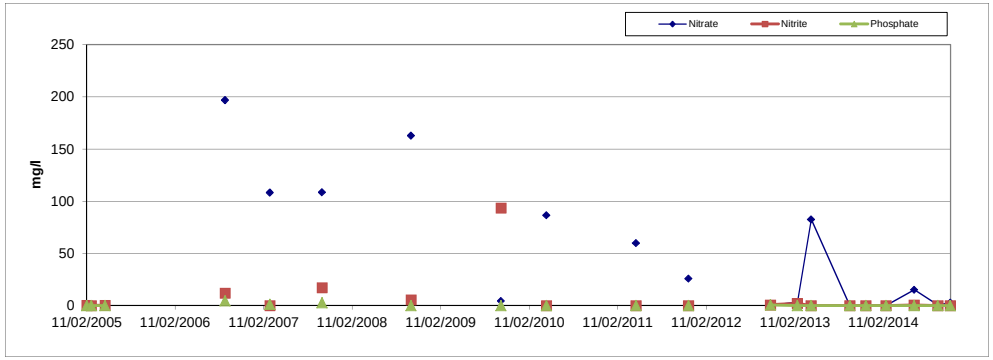

Calcium mg/l
10000
1000
100
10
1
01/02/2005
01/02/2006
01/02/2007
01/02/2008
01/02/2009
01/02/2010
01/02/2011
01/02/2012
01/02/2013
01/02/2014

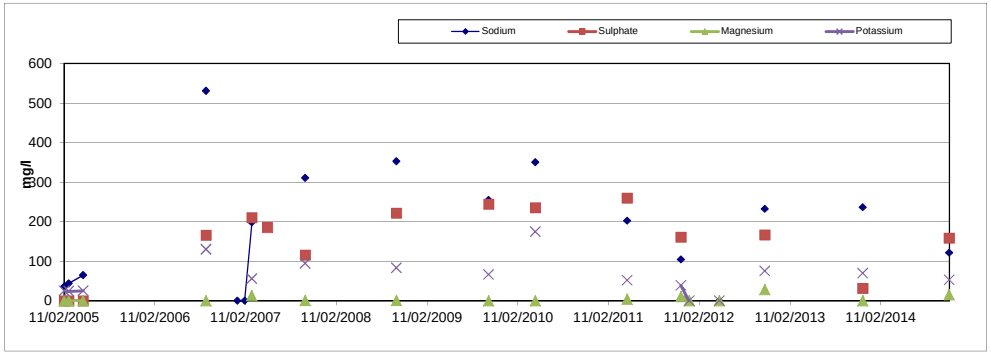

Control Level
Arsenic microg/l
3500
3000
2500
2000
1500
1000
500
0
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

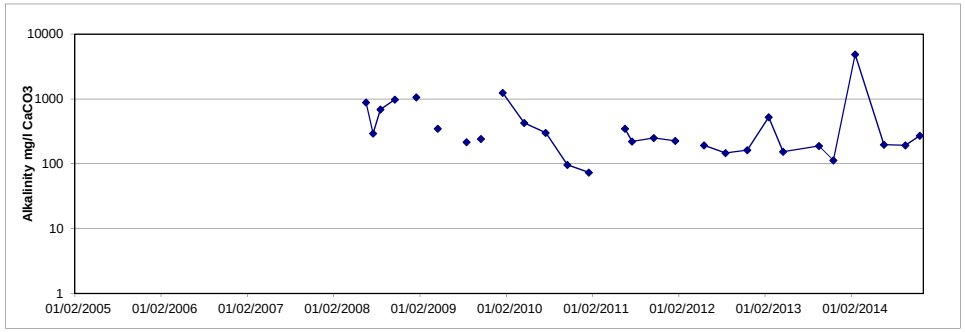

Copper microg/l
350
300
250
200
150
100
50
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

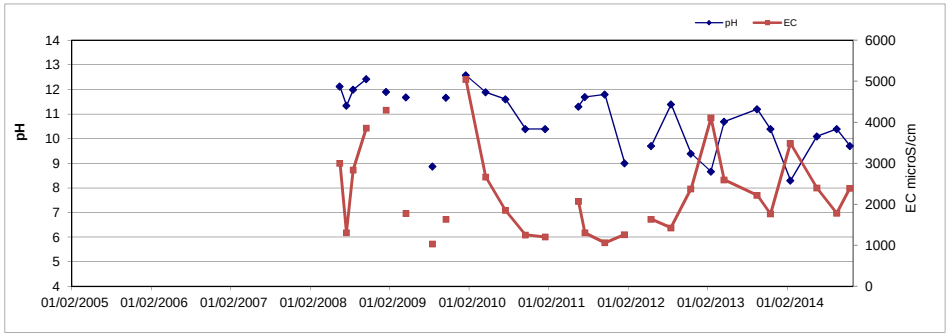

Zinc microg/l
250
200
150
100
50
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

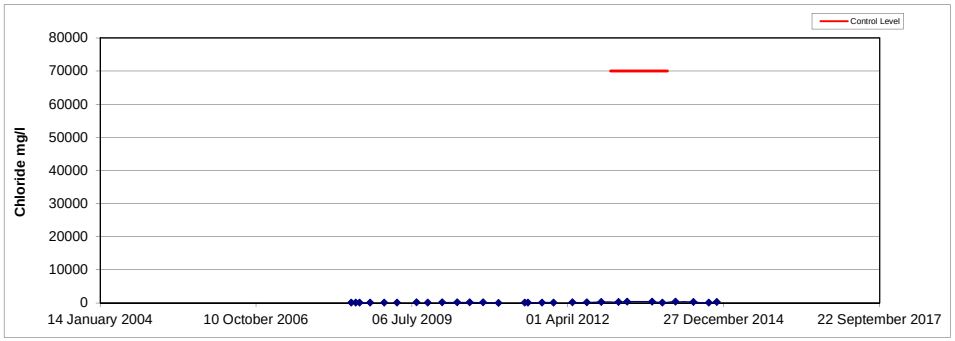

Nickel
Lead
Vanadium
Zinc
microg/l
350
300
250
200
150
100
50
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

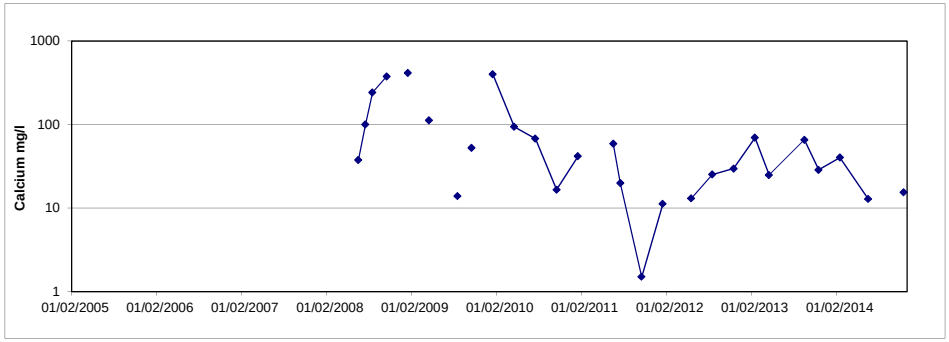

Nitrate
Nitrite
Phosphate
mg/l
250
200
150
100
50
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

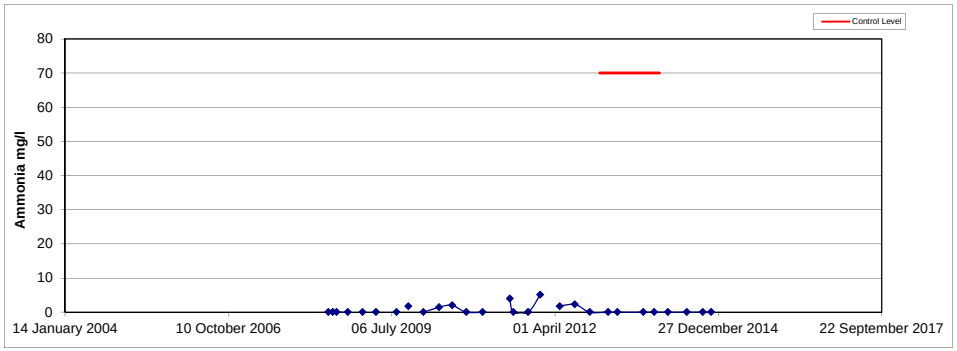

Sodium
Sulphate
Magnesium
Potassium
mg/l
600
500
400
300
200
100
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

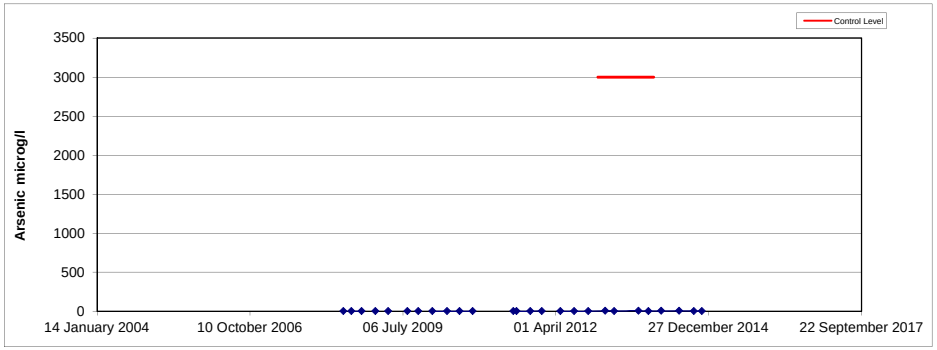

Alkalinity mg/l CaCO3
10000
1000
100
10
1
01/02/2005
01/02/2006
01/02/2007
01/02/2008
01/02/2009
01/02/2010
01/02/2011
01/02/2012
01/02/2013
01/02/2014

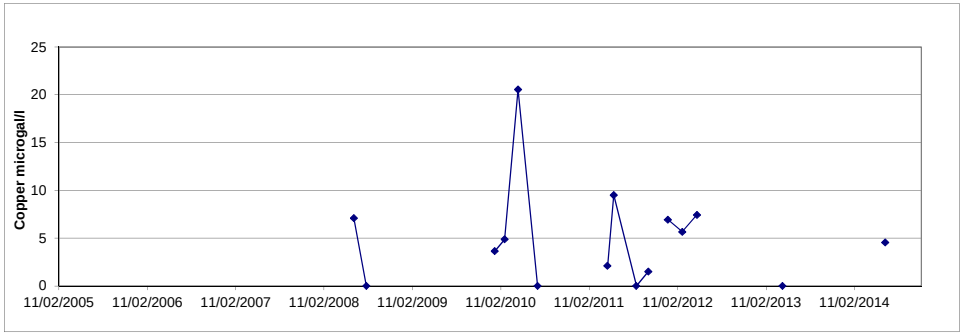

pH
EC
pH
EC micros/cm
14
13
12
11
10
9
8
7
6
5
4
6000
5000
4000
3000
2000
1000
0
01/02/2005
01/02/2006
01/02/2007
01/02/2008
01/02/2009
01/02/2010
01/02/2011
01/02/2012
01/02/2013
01/02/2014

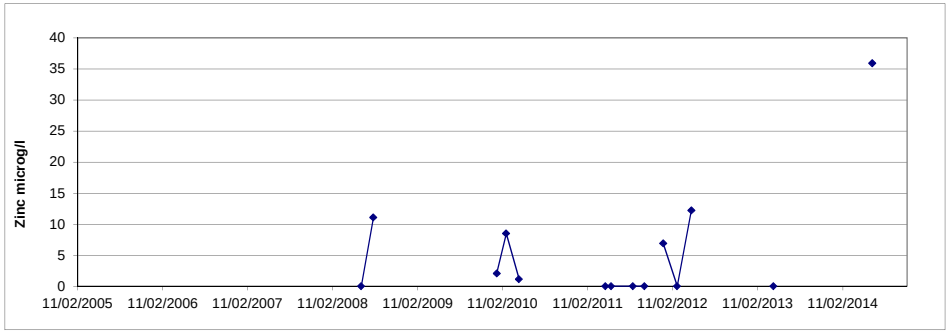

Control Level
Chloride mg/l
80000
70000
60000
50000
40000
30000
20000
10000
0
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

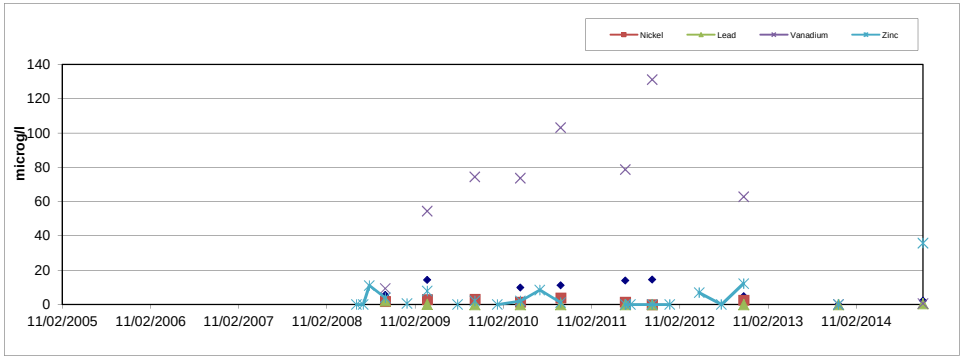

Calcium mg/l
1000
100
10
1
01/02/2005
01/02/2006
01/02/2007
01/02/2008
01/02/2009
01/02/2010
01/02/2011
01/02/2012
01/02/2013
01/02/2014

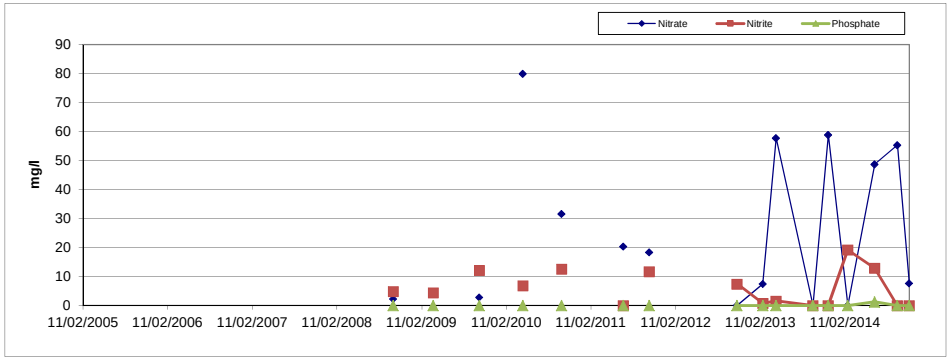

Control Level
Ammonia mg/l
80
70
60
50
40
30
20
10
0
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

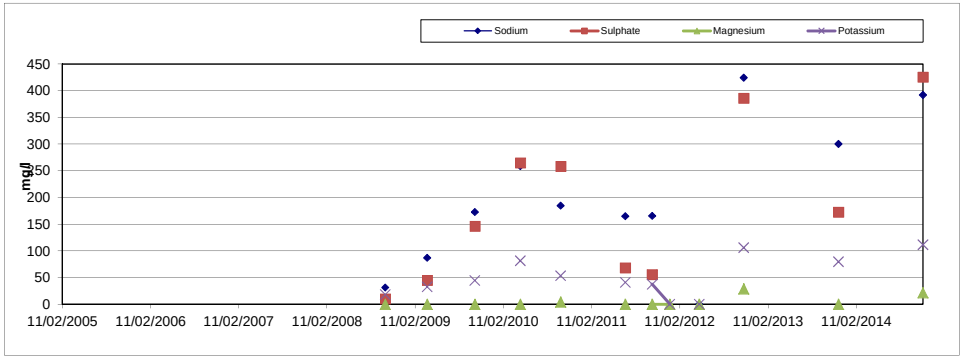

Control Level
Arsenic microg/l
3500
3000
2500
2000
1500
1000
500
0
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

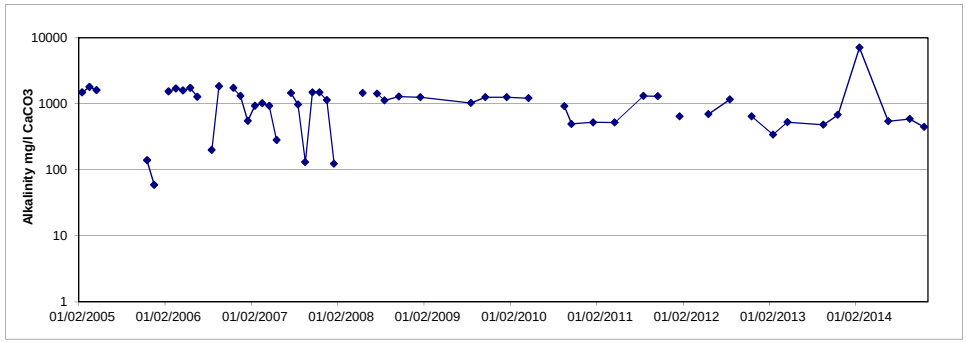

Copper microgal/l
25
20
15
10
5
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

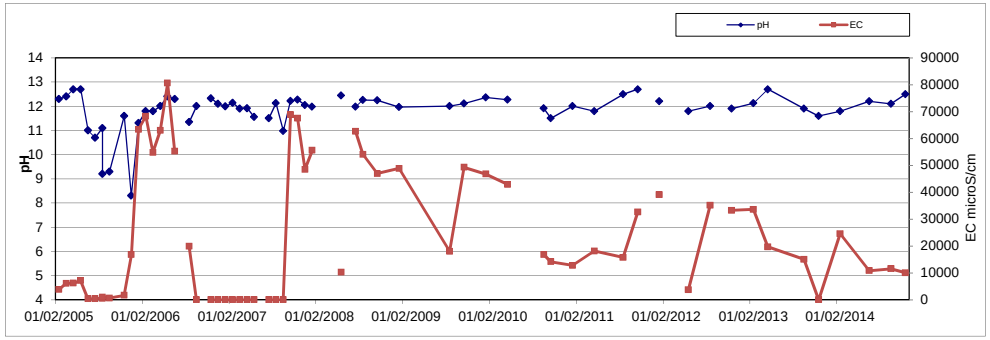

Zinc microg/l
40
35
30
25
20
15
10
5
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

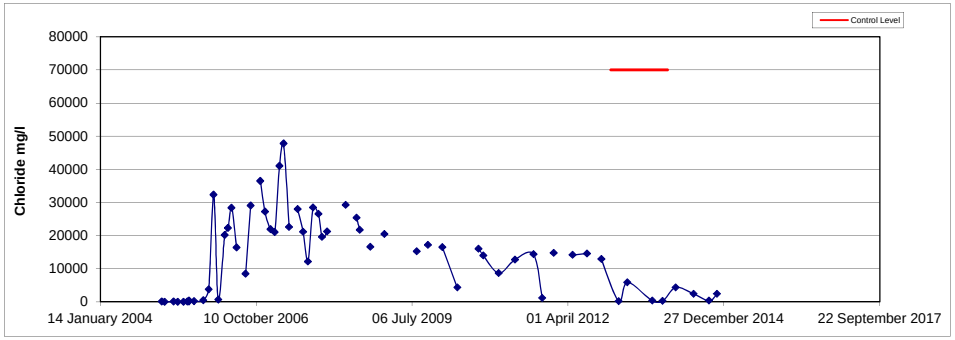

Nickel
Lead
Vanadium
Zinc
microg/l
140
120
100
80
60
40
20
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

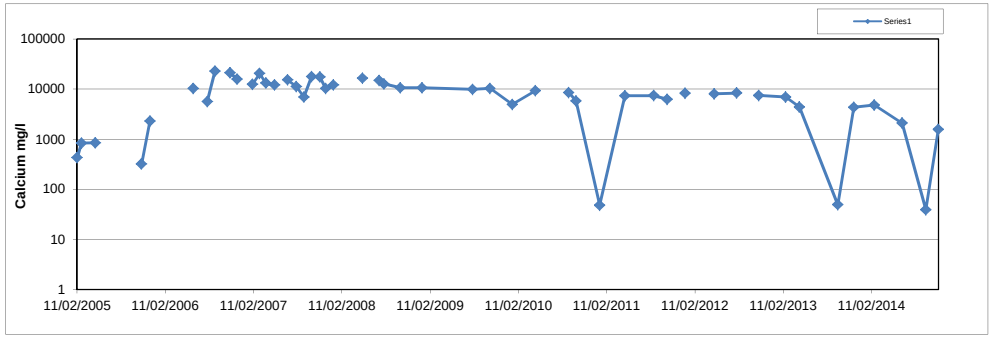

Nitrate
Nitrite
Phosphate
mg/l
90
80
70
60
50
40
30
20
10
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

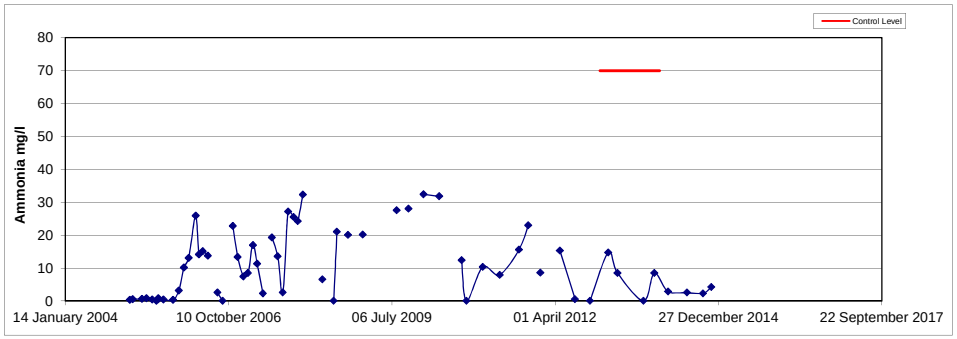

Sodium
Sulphate
Magnesium
Potassium
mg/l
450
400
350
300
250
200
150
100
50
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

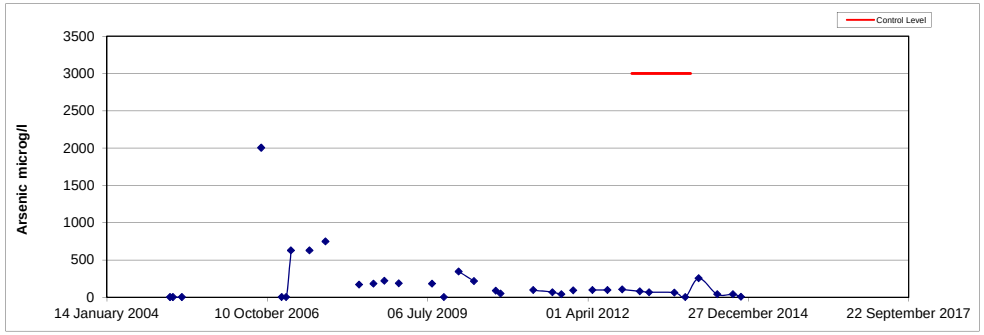

Alkalinity mg/l CaCO3
10000
1000
100
10
1
01/02/2005
01/02/2006
01/02/2007
01/02/2008
01/02/2009
01/02/2010
01/02/2011
01/02/2012
01/02/2013
01/02/2014

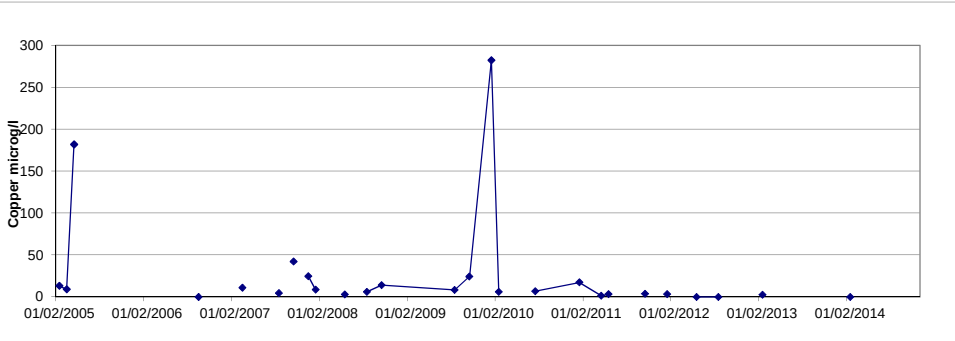

pH
EC
pH
EC microS/cm
14
13
12
11
10
9
8
7
6
5
4
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
01/02/2005
01/02/2006
01/02/2007
01/02/2008
01/02/2009
01/02/2010
01/02/2011
01/02/2012
01/02/2013
01/02/2014

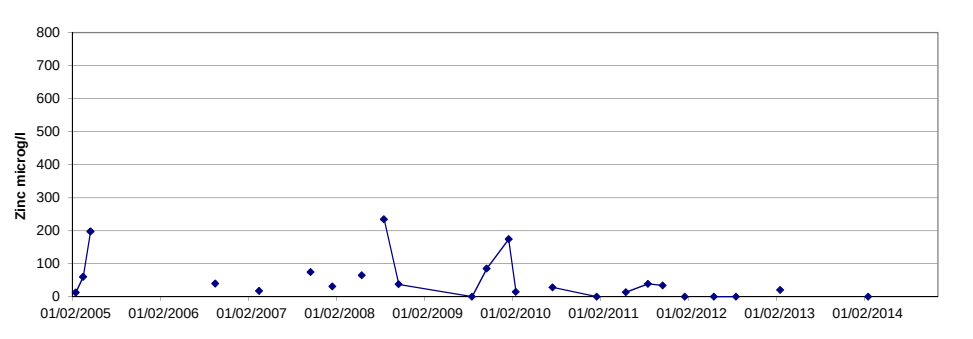

Control Level
Chloride mg/l
80000
70000
60000
50000
40000
30000
20000
10000
0
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

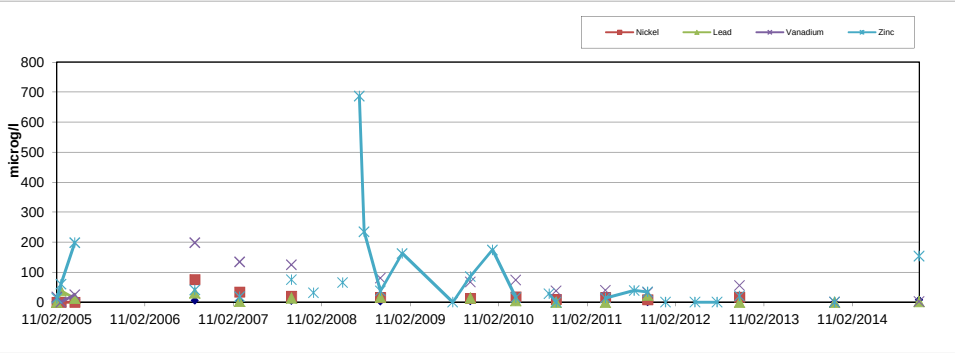

Series1
Calcium mg/l
100000
10000
1000
100
10
1
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

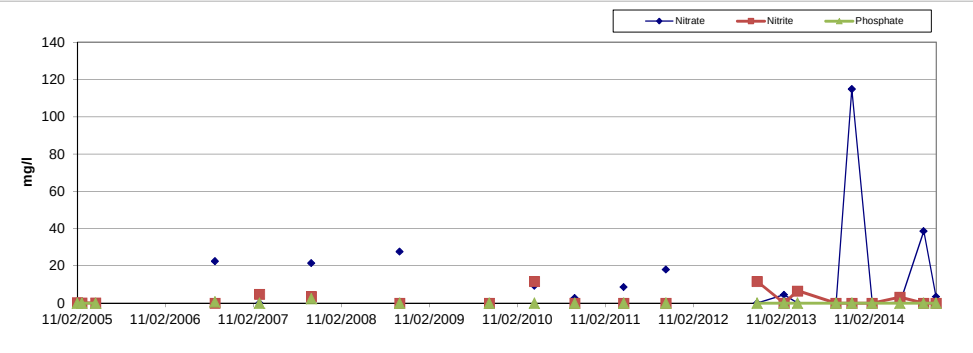

Control Level
Ammonia mg/l
80
70
60
50
40
30
20
10
0
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

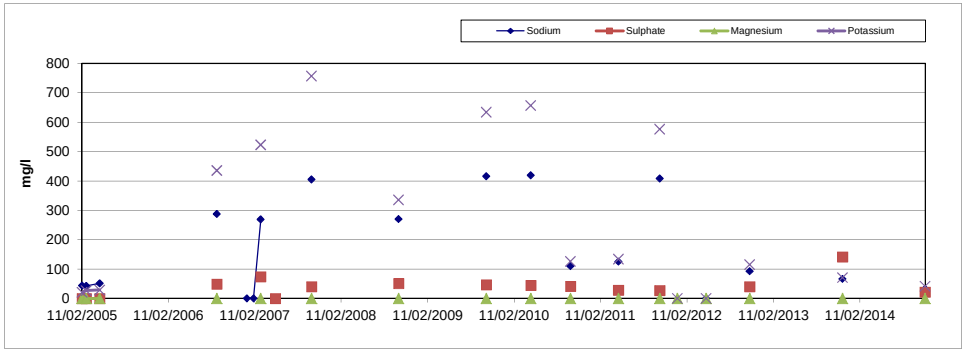

Control Level
Arsenic microg/l
3500
3000
2500
2000
1500
1000
500
0
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

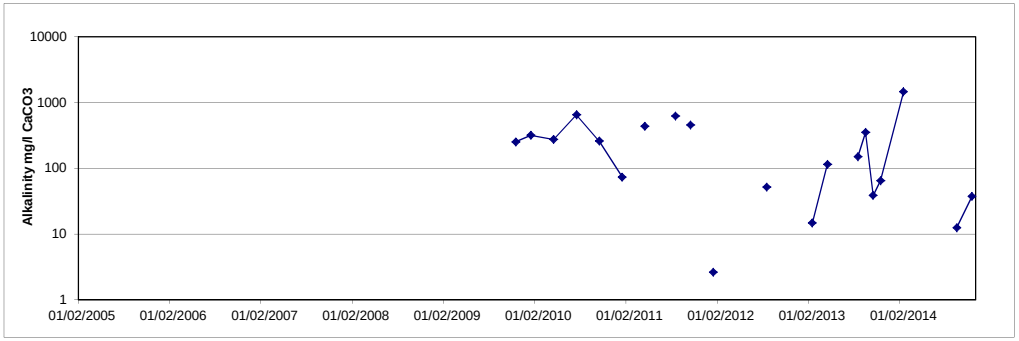

Copper microg/l
300
250
200
150
100
50
0
01/02/2005
01/02/2006
01/02/2007
01/02/2008
01/02/2009
01/02/2010
01/02/2011
01/02/2012
01/02/2013
01/02/2014

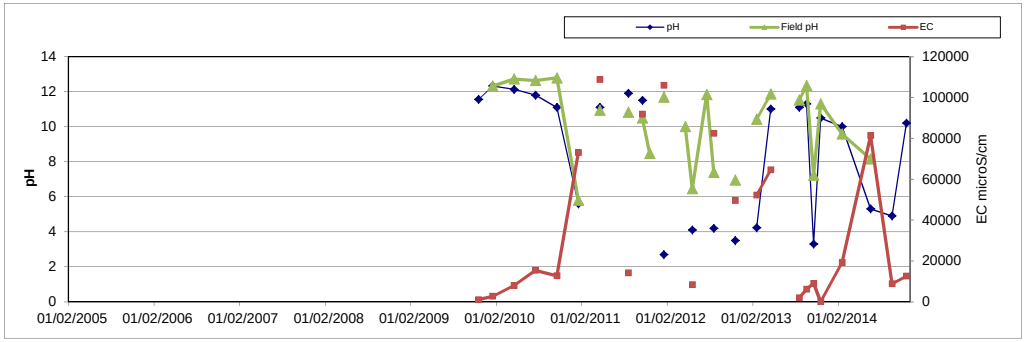

Zinc microg/l
800
700
600
500
400
300
200
100
0
01/02/2005
01/02/2006
01/02/2007
01/02/2008
01/02/2009
01/02/2010
01/02/2011
01/02/2012
01/02/2013
01/02/2014

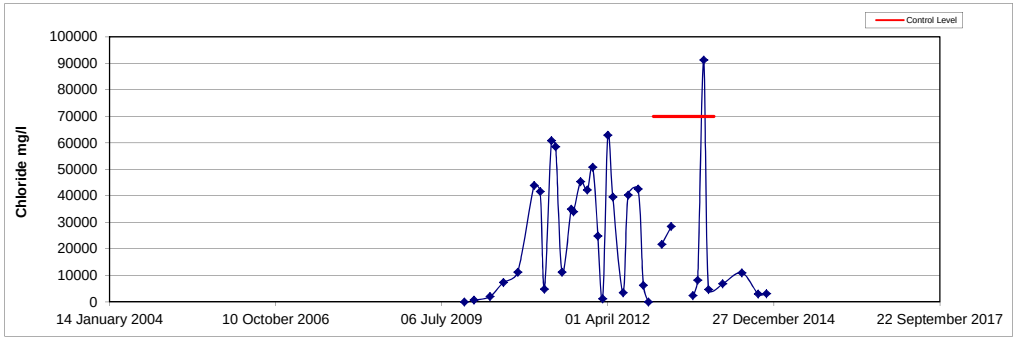

Nickel
Lead
Vanadium
Zinc
microg/l
800
700
600
500
400
300
200
100
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

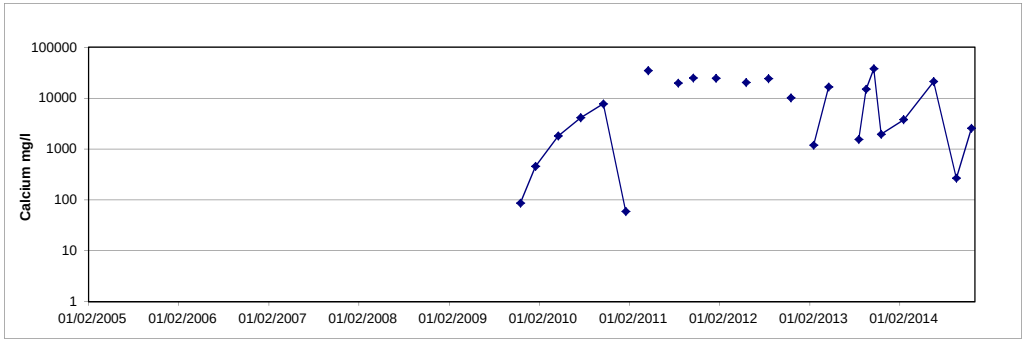

Nitrate
Nitrite
Phosphate
mg/l
140
120
100
80
60
40
20
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

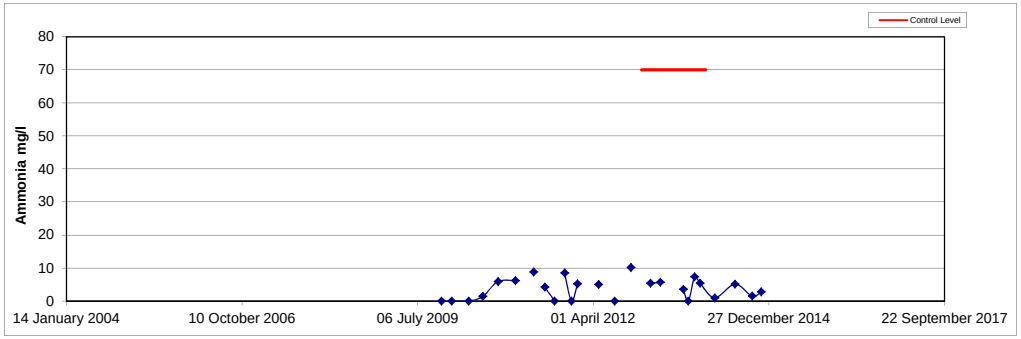

Sodium
Sulphate
Magnesium
Potassium
mg/l
800
700
600
500
400
300
200
100
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

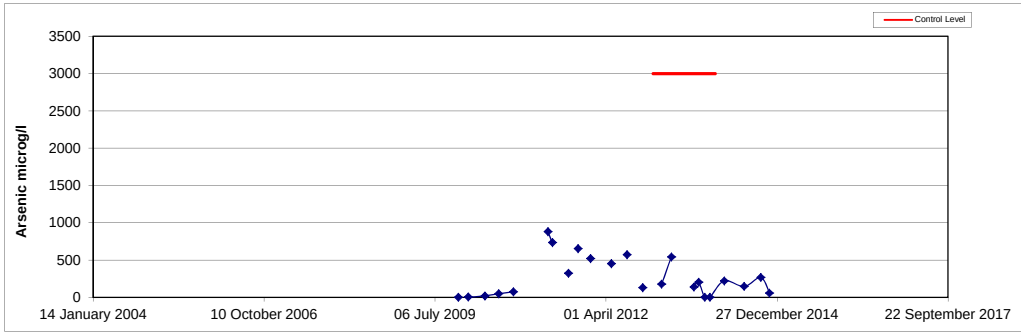

Alkalinity mg/l CaCO3
10000
1000
100
10
1
01/02/2005
01/02/2006
01/02/2007
01/02/2008
01/02/2009
01/02/2010
01/02/2011
01/02/2012
01/02/2013
01/02/2014

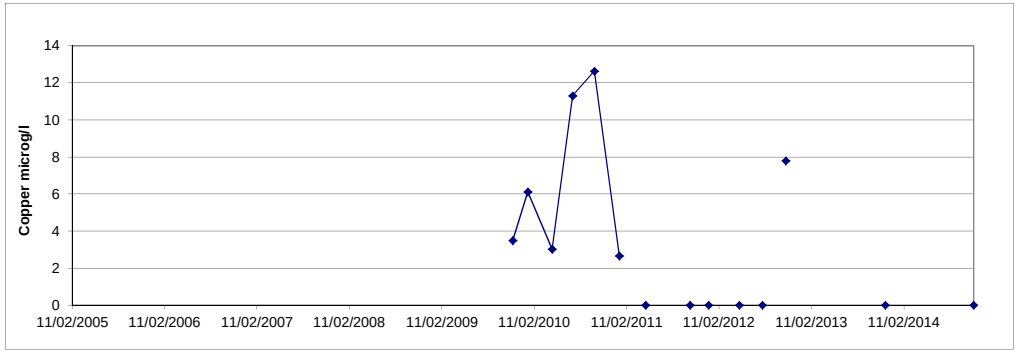

pH
Field pH
EC
pH
EC microS/cm
14
12
10
8
6
4
2
0
120000
100000
80000
60000
40000
20000
0
01/02/2005
01/02/2006
01/02/2007
01/02/2008
01/02/2009
01/02/2010
01/02/2011
01/02/2012
01/02/2013
01/02/2014

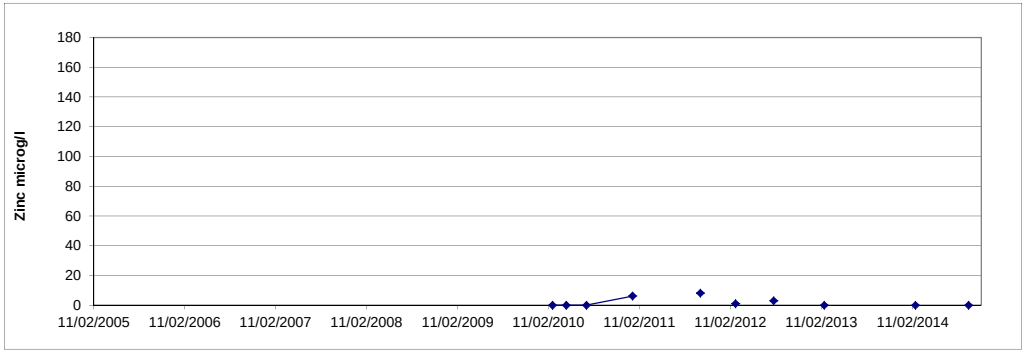

Control Level
Chloride mg/l
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

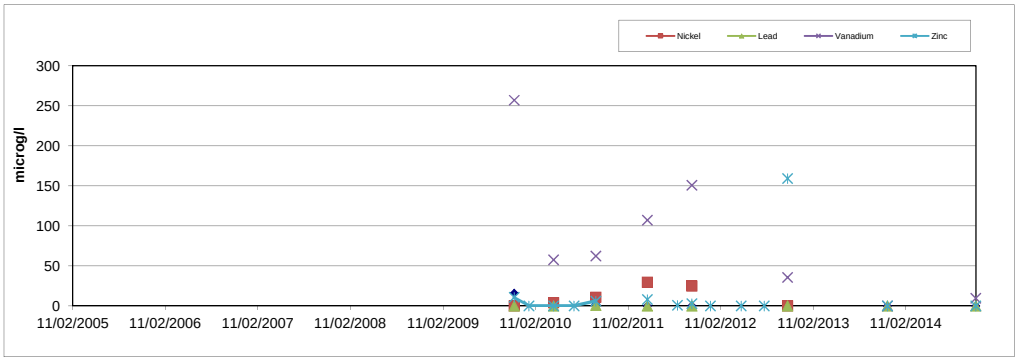

Calcium mg/l
100000
10000
1000
100
10
1
01/02/2005
01/02/2006
01/02/2007
01/02/2008
01/02/2009
01/02/2010
01/02/2011
01/02/2012
01/02/2013
01/02/2014

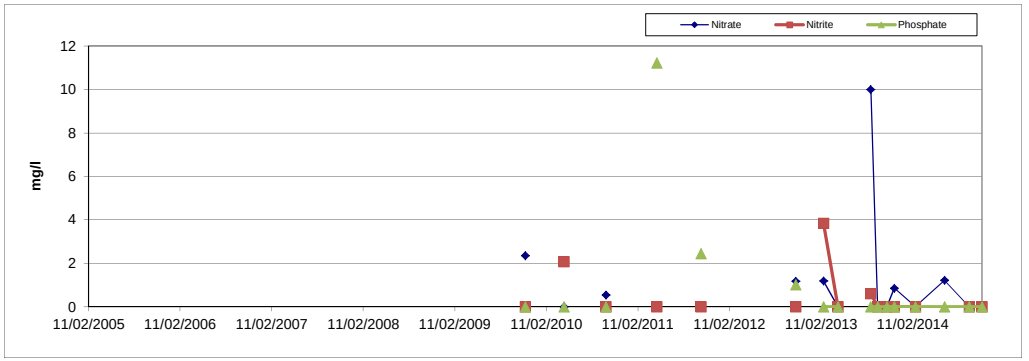

Control Level
Ammonia mg/l
80
70
60
50
40
30
20
10
0
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

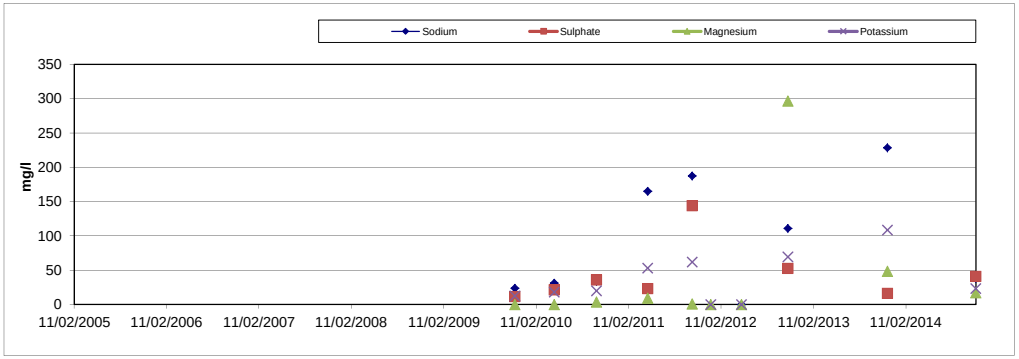

Control Level
Arsenic microg/l
3500
3000
2500
2000
1500
1000
500
0
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017


Copper microg/l
14
12
10
8
6
4
2
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


Zinc microg/l
180
160
140
120
100
80
60
40
20
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


Nickel
Lead
Vanadium
Zinc
microg/l
300
250
200
150
100
50
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


Nitrate
Nitrite
Phosphate
mg/l
12
10
8
6
4
2
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


Sodium
Sulphate
Magnesium
Potassium
mg/l
350
300
250
200
150
100
50
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

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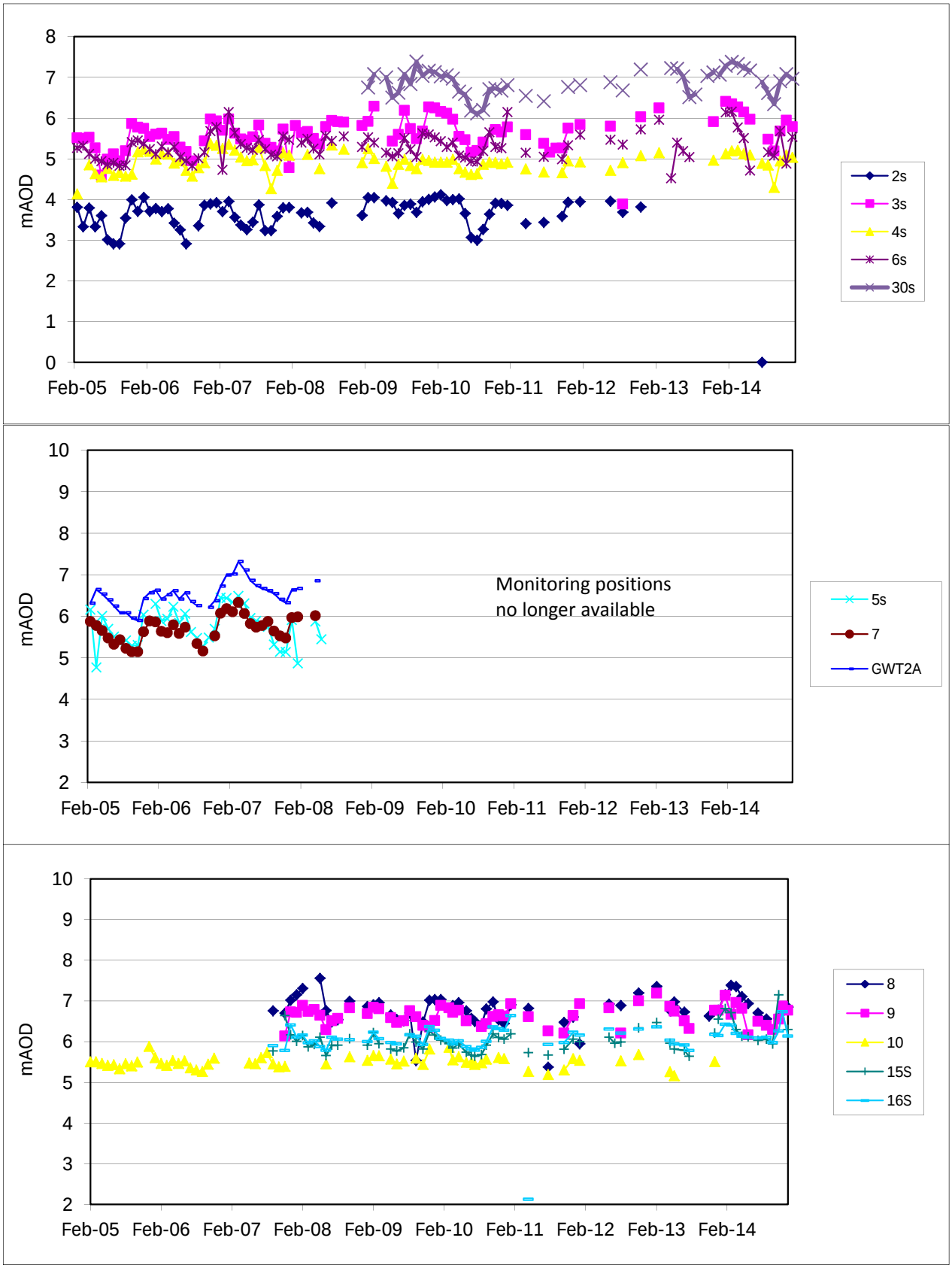
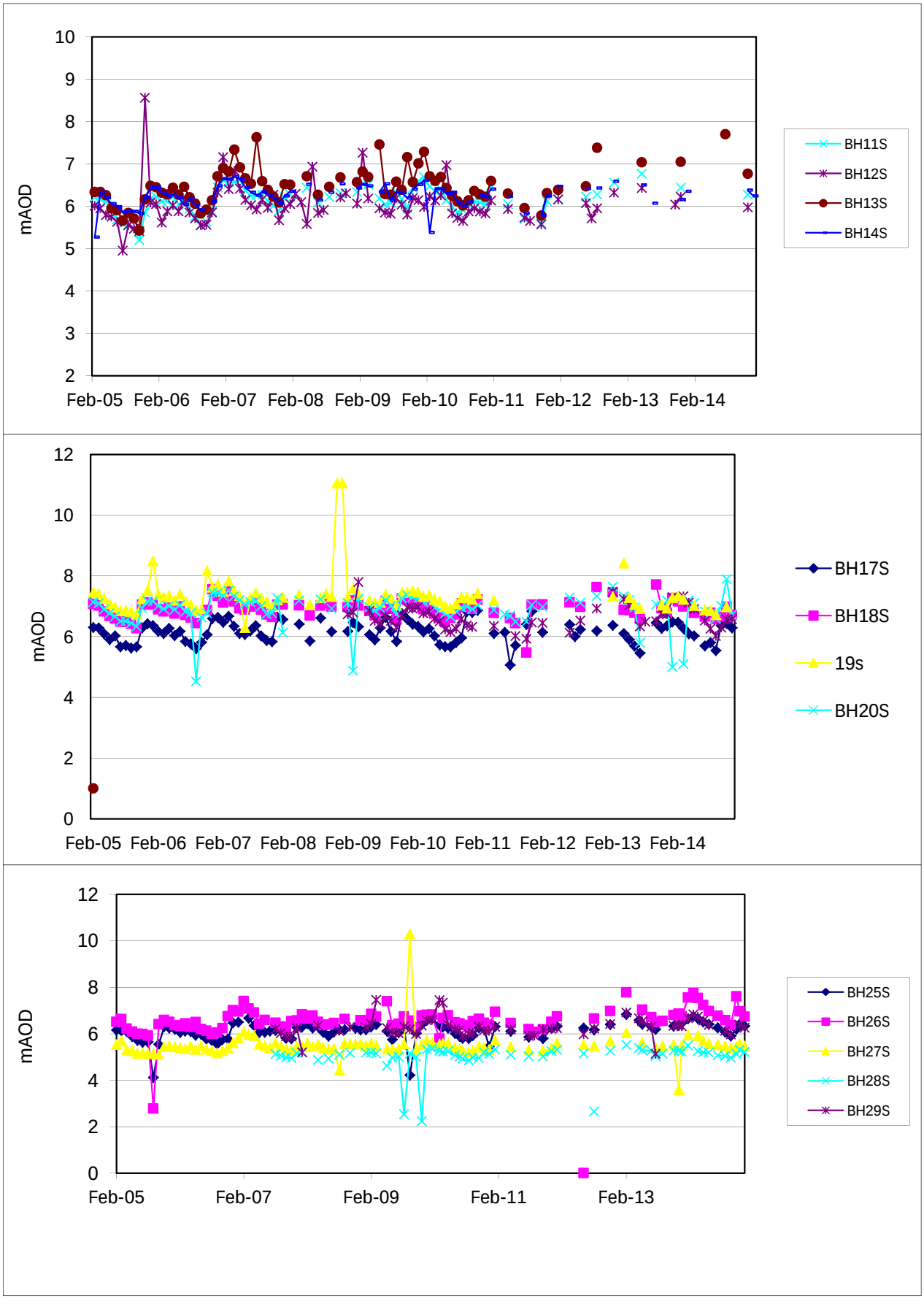
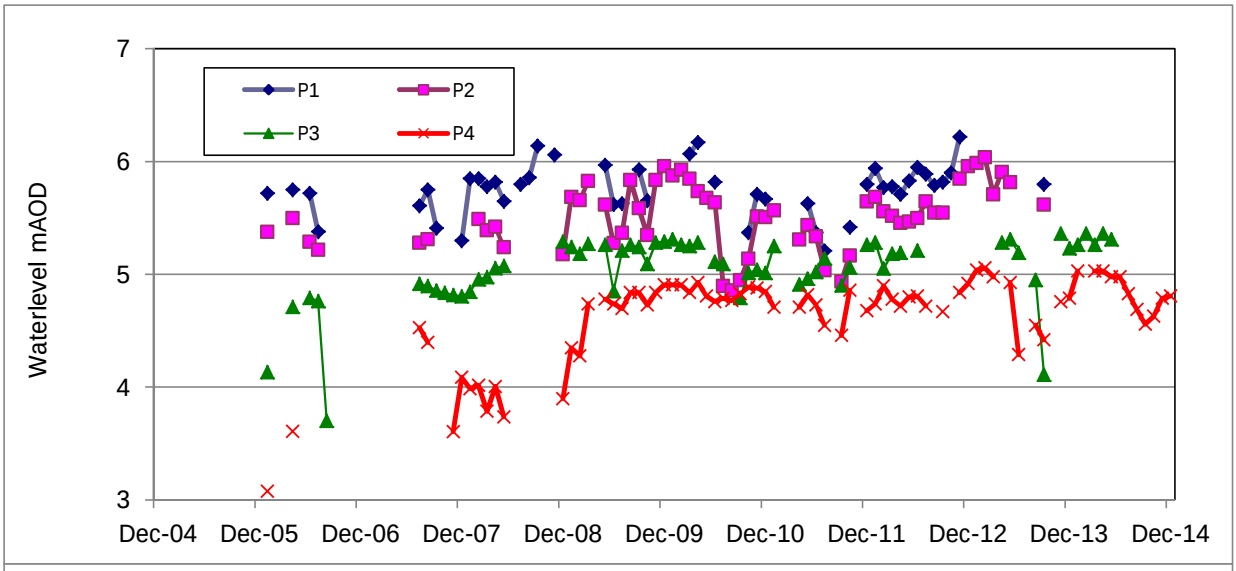
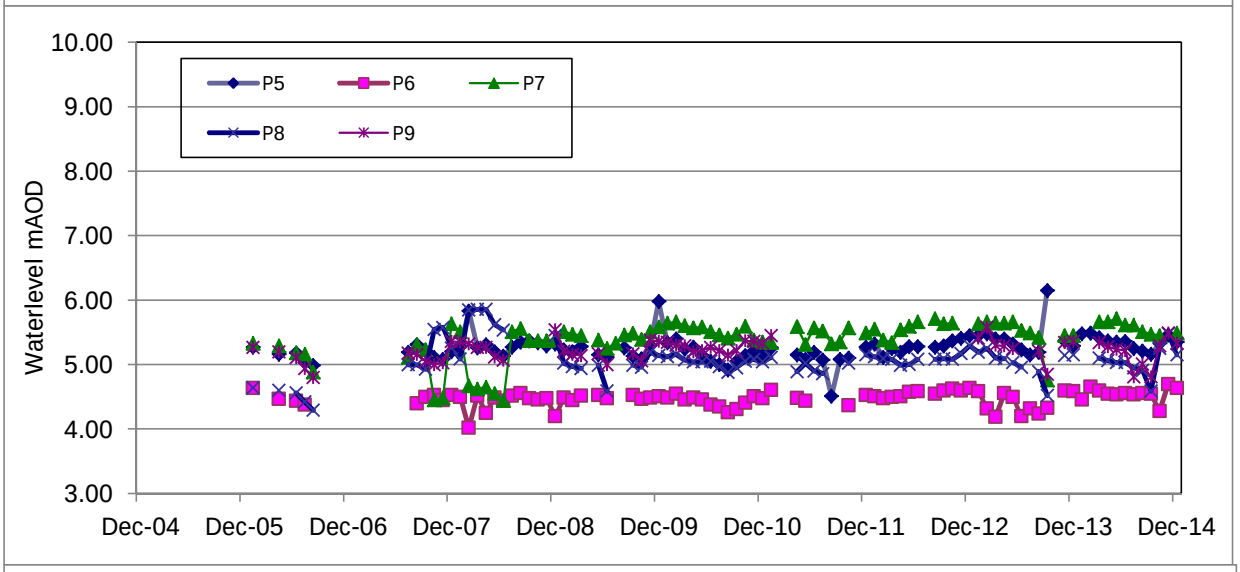
Appendix 3
Temporal variation of groundwater levels

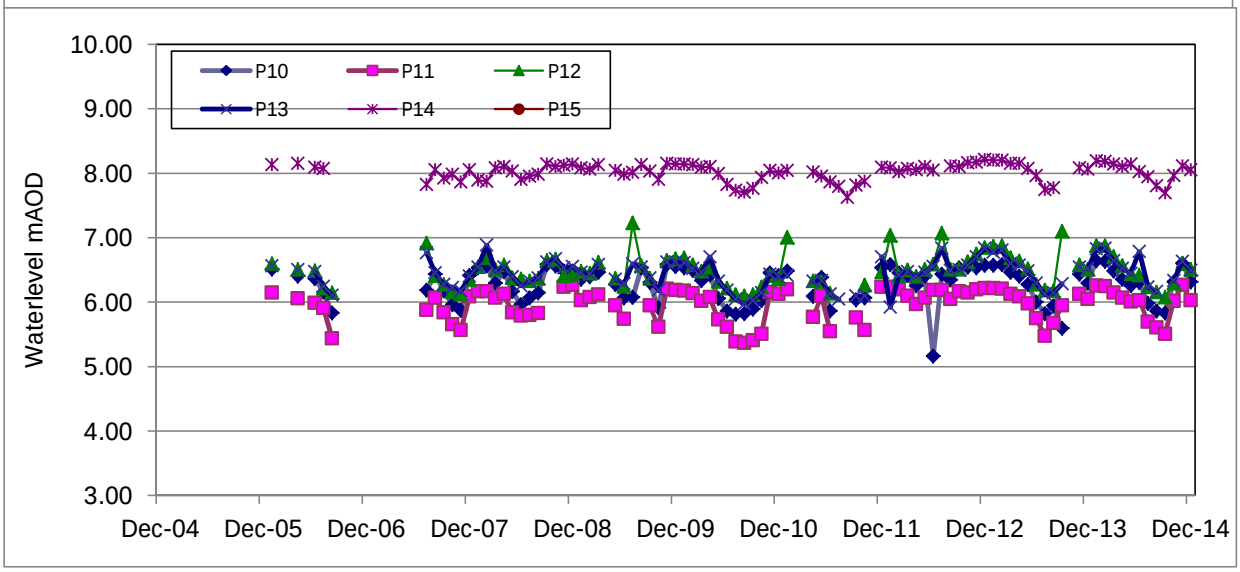
Report Number 1392r1v1d0215

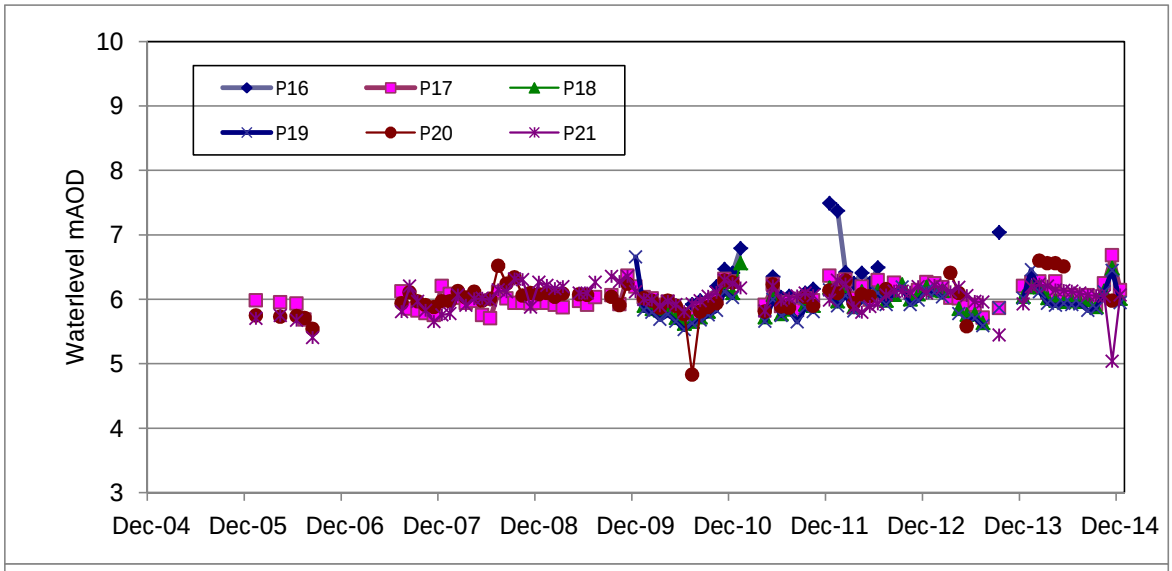

mAOD
Feb-05 Feb-06 Feb-07 Feb-08 Feb-09 Feb-10 Feb-11 Feb-12 Feb-13 Feb-14
2s
3s
4s
6s
30s
Monitoring positions
no longer available
5s
7
GWT2A
8
9
10
15S
16S

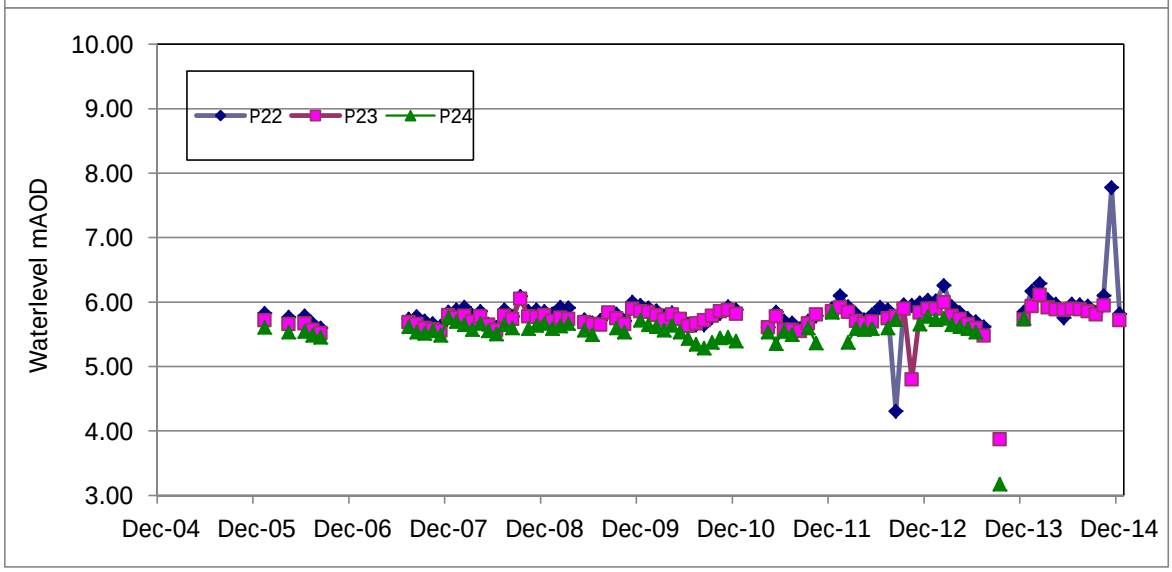

mAOD
10
9
8
7
6
5
4
3
2
Feb-05 Feb-06 Feb-07 Feb-08 Feb-09 Feb-10 Feb-11 Feb-12 Feb-13 Feb-14
BH11S
BH12S
BH13S
BH14S
mAOD
12
10
8
6
4
2
0
Feb-05 Feb-06 Feb-07 Feb-08 Feb-09 Feb-10 Feb-11 Feb-12 Feb-13 Feb-14
BH17S
BH18S
19s
BH20S
mAOD
12
10
8
6
4
2
0
Feb-05 Feb-07 Feb-09 Feb-11 Feb-13
BH25S
BH26S
BH27S
BH28S
BH29S

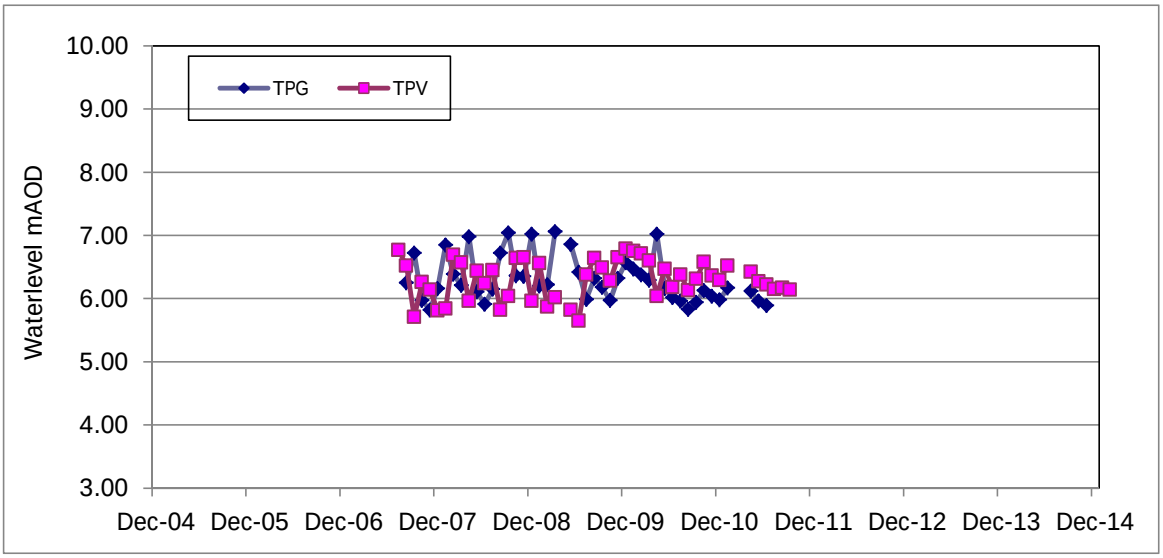

Waterlevel mAOD
7
6
5
4
3
P1
P2
P3
P4
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14

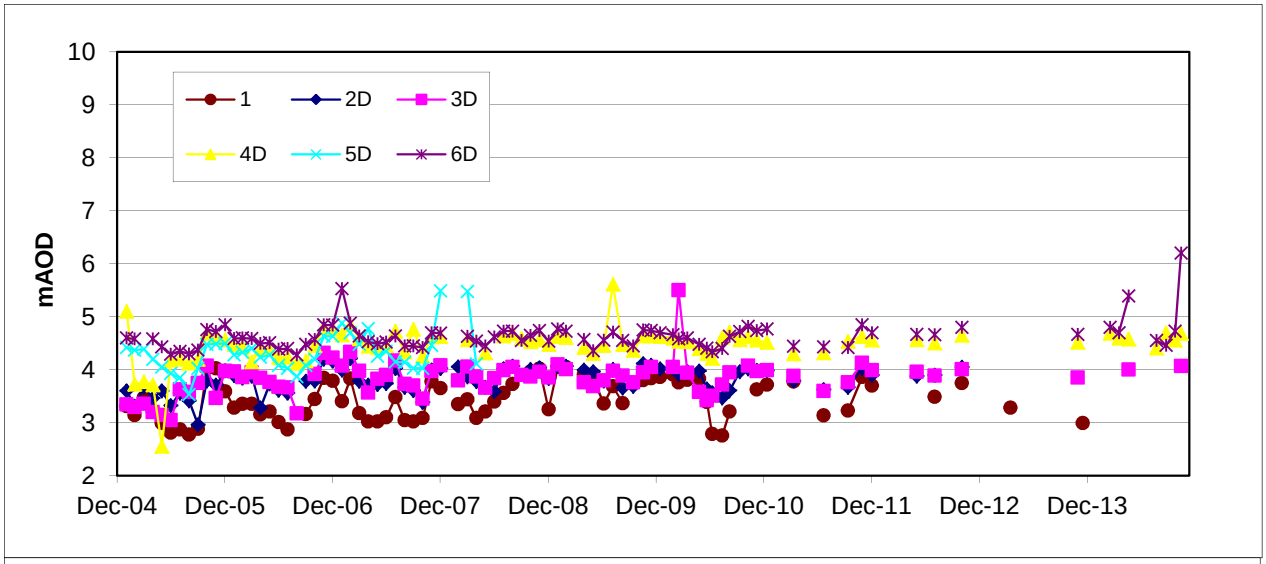

Waterlevel mAOD
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
P5
P6
P7
P8
P9
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14

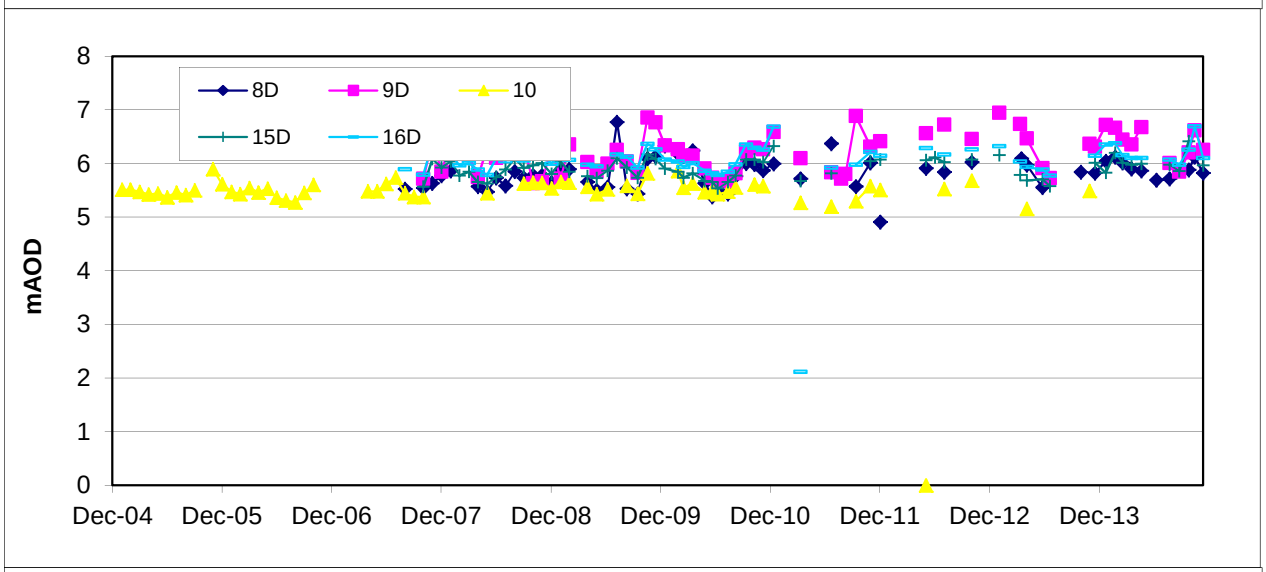

Waterlevel mAOD
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
P10
P11
P12
P13
P14
P15
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14

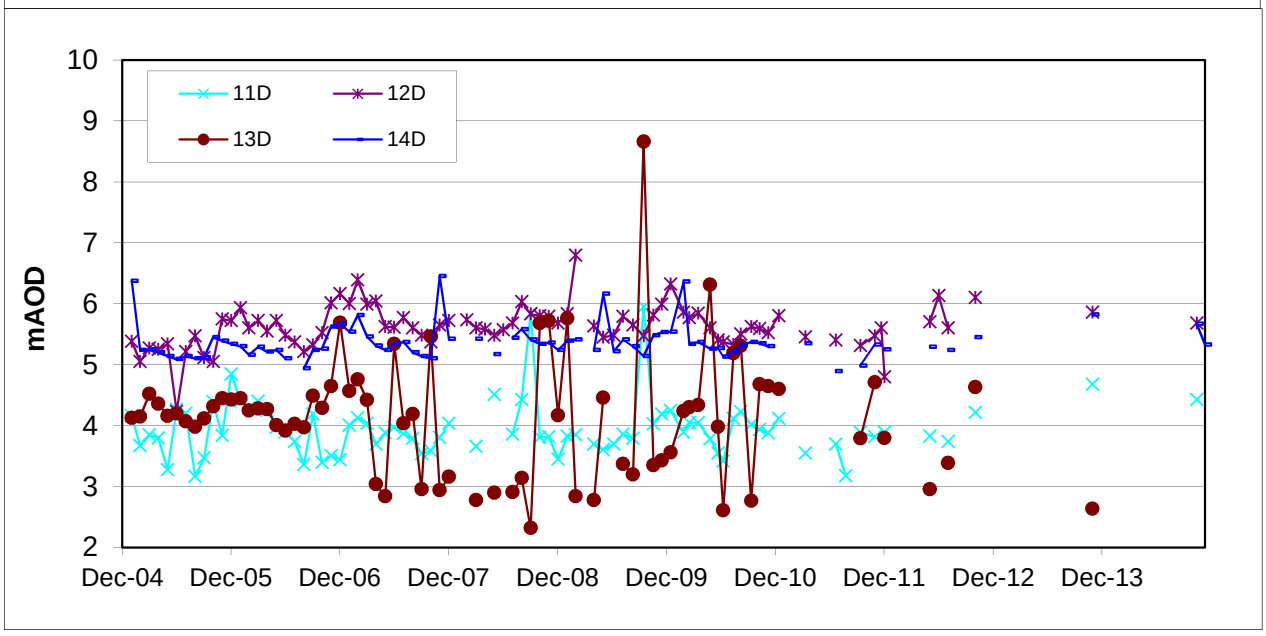

Waterlevel mAOD
10
9
8
7
6
5
4
3
P16
P17
P18
P19
P20
P21
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14

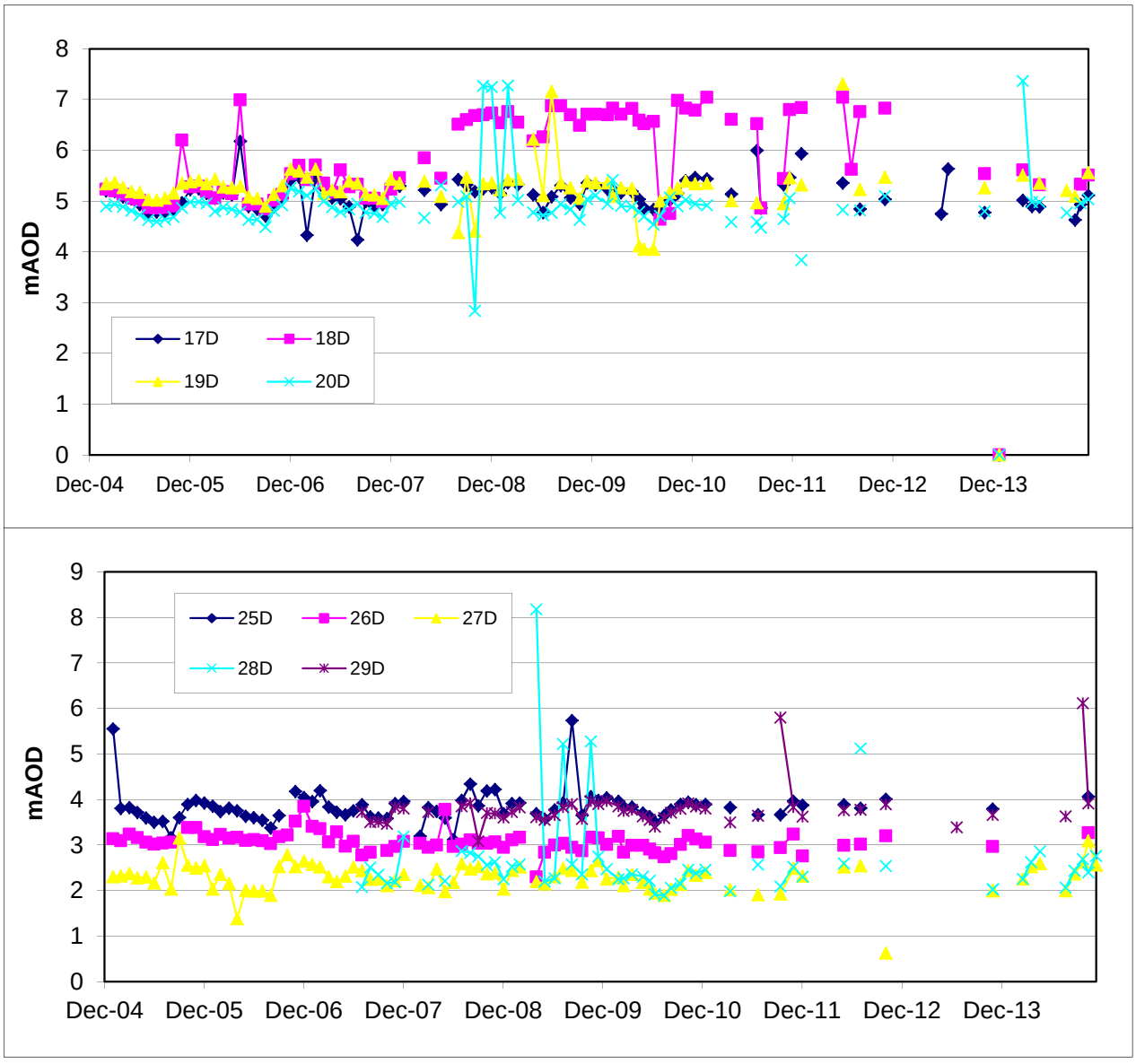

Waterlevel mAOD
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
P22
P23
P24
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14


Waterlevel mAOD
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
TPG
TPV
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14


mAOD
10
9
8
7
6
5
4
3
2
1
2D
3D
4D
5D
6D
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13


mAOD
8
7
6
5
4
3
2
1
0
8D
9D
10
15D
16D
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13


mAOD
10
9
8
7
6
5
4
3
2
11D
12D
13D
14D
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13


mAOD
0
1
2
3
4
5
6
7
8
17D
18D
19D
20D
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
mAOD
0
1
2
3
4
5
6
7
8
9
25D
26D
27D
28D
29D
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13

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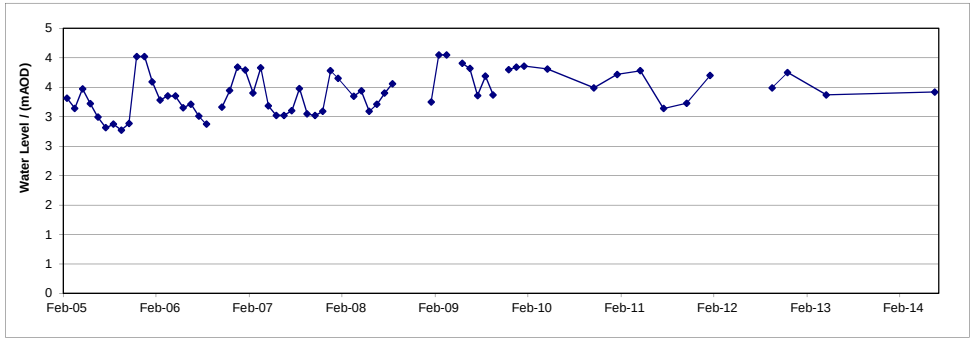
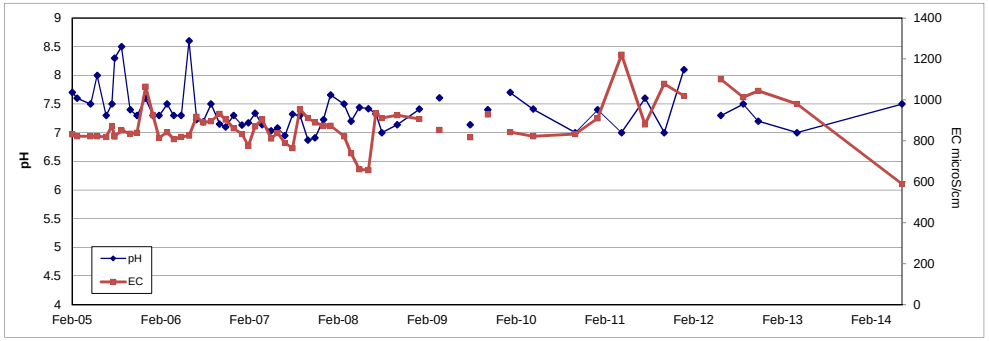
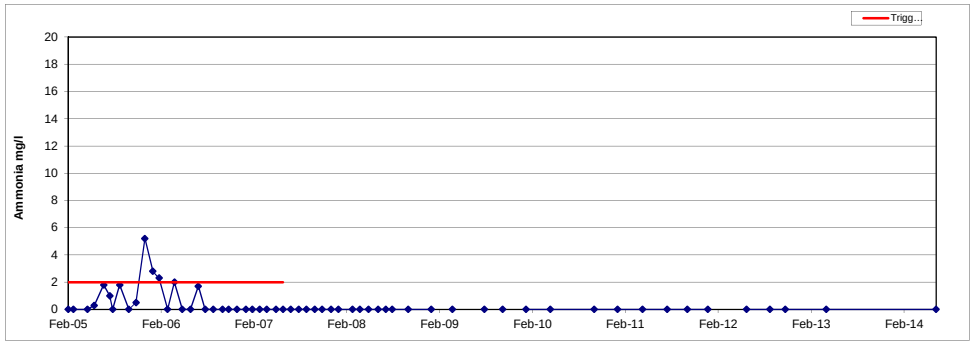
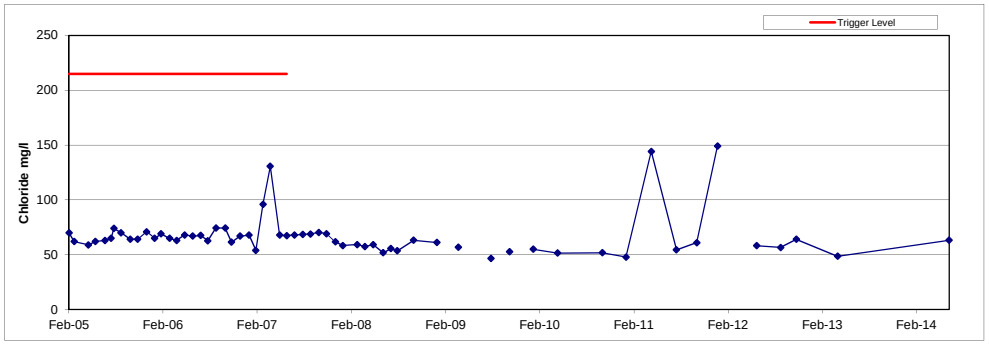
Appendix 4
Temporal variation of groundwater chemistry

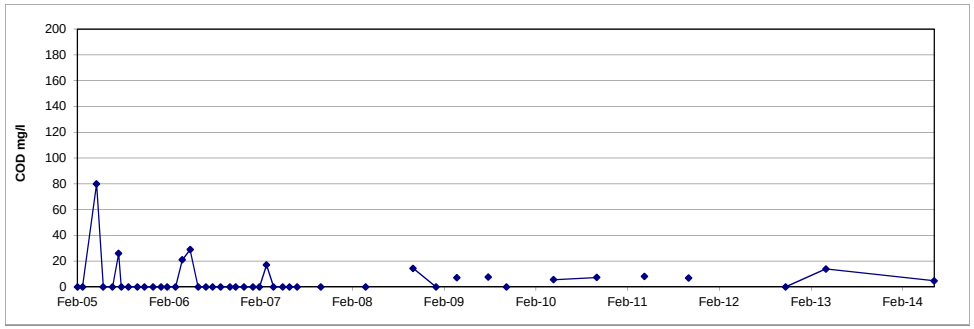
Report Number 1392r1v1d0215

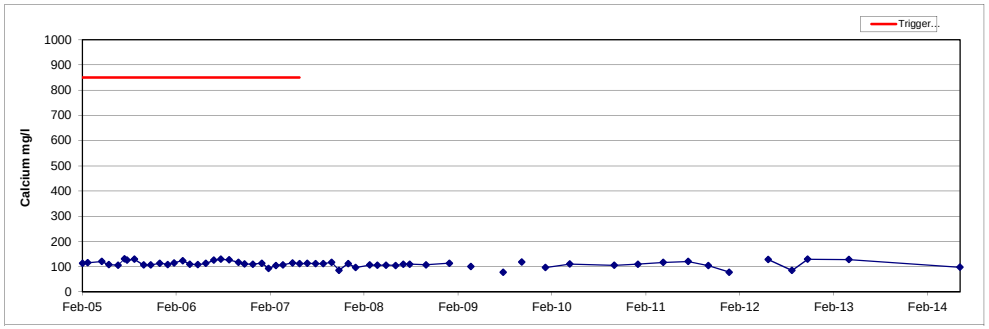

Water Level / (mAOD)
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

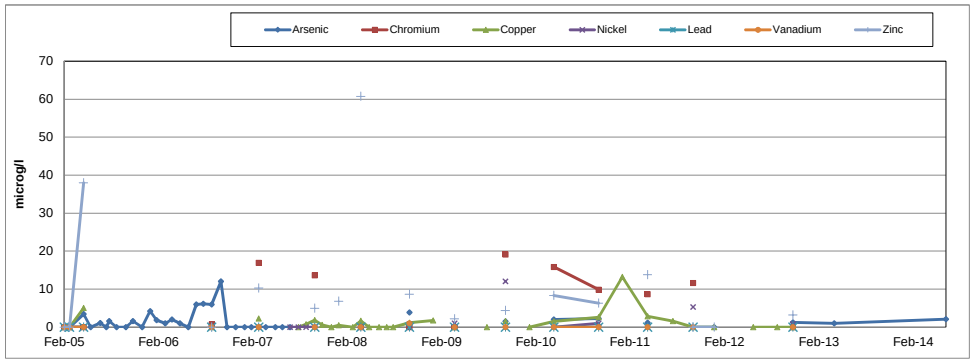

pH
EC micro S/cm
pH
EC
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

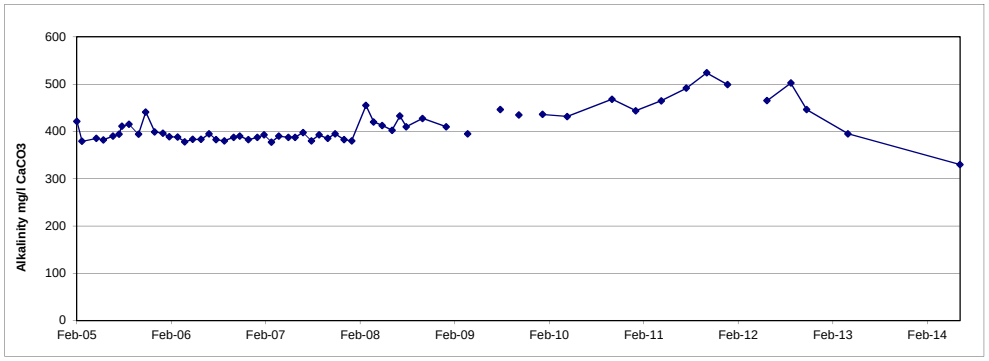

Trigg...
Ammonia mg/l
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

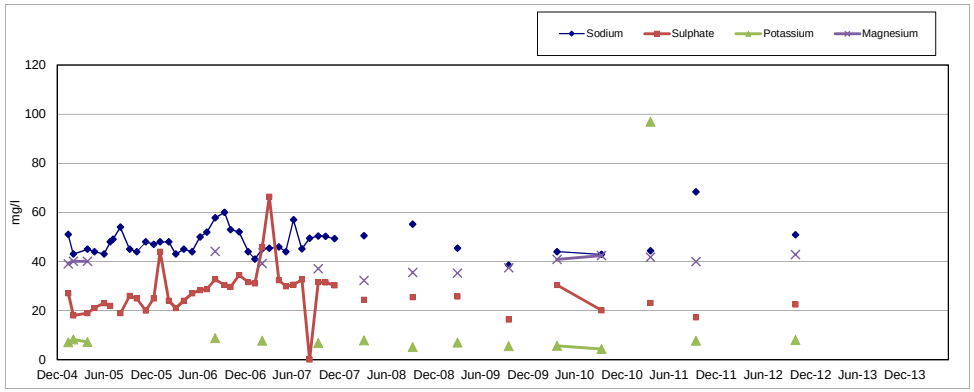

Trigger Level
Chloride mg/l
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

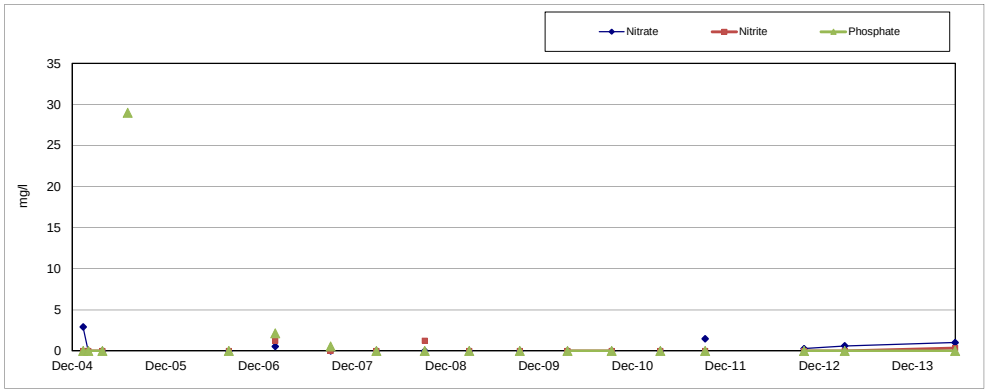

COD mg/l
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

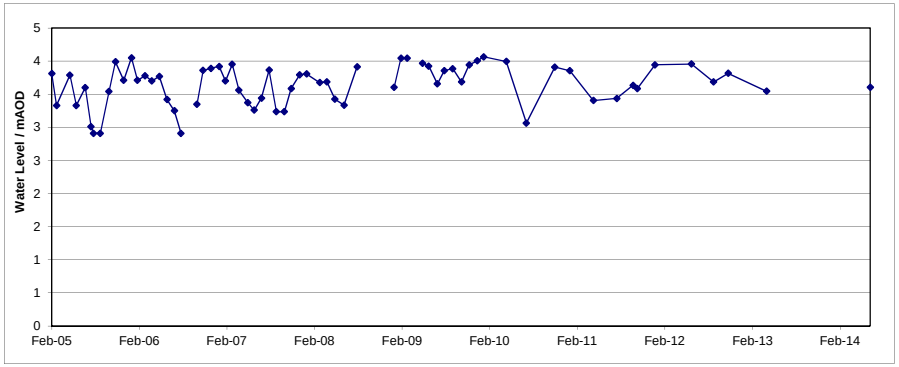

Trigger...
Calcium mg/l
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

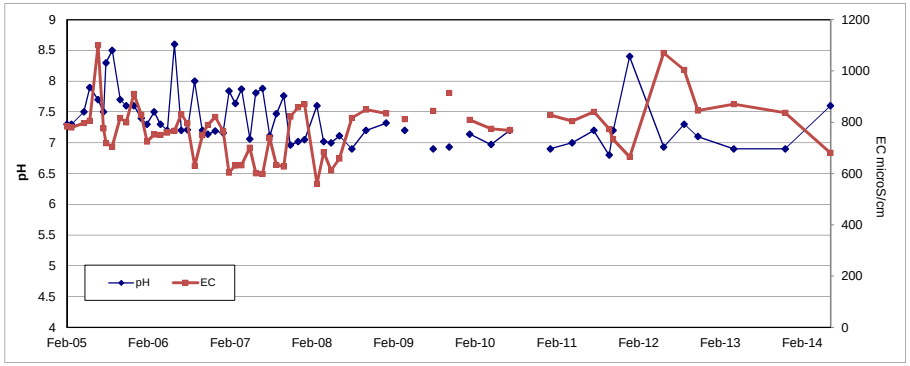

Arsenic
Chromium
Copper
Nickel
Lead
Vanadium
Zinc
microg/l
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

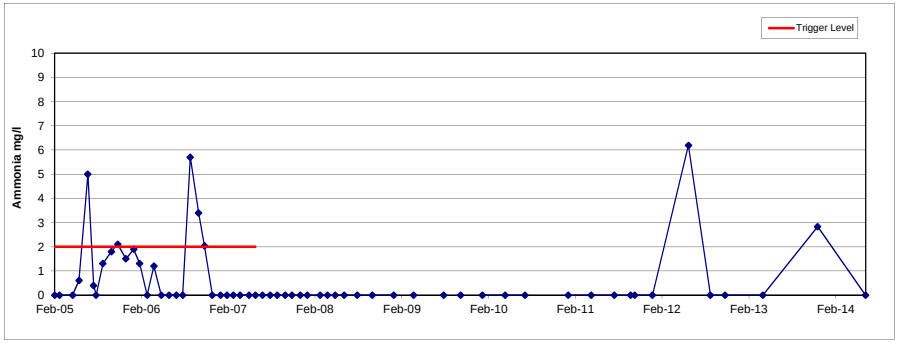

Alkalinity mg/l CaCO3
600
500
400
300
200
100
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

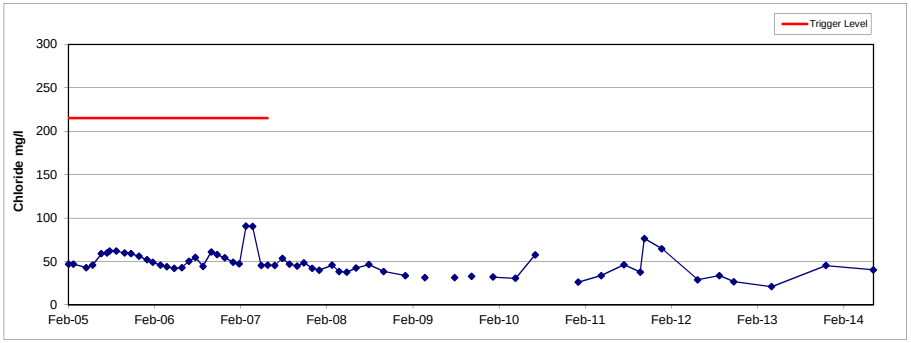

Sodium
Sulphate
Potassium
Magnesium
mg/l
120
100
80
60
40
20
0
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Dec-10
Jun-11
Dec-11
Jun-12
Dec-12
Jun-13
Dec-13

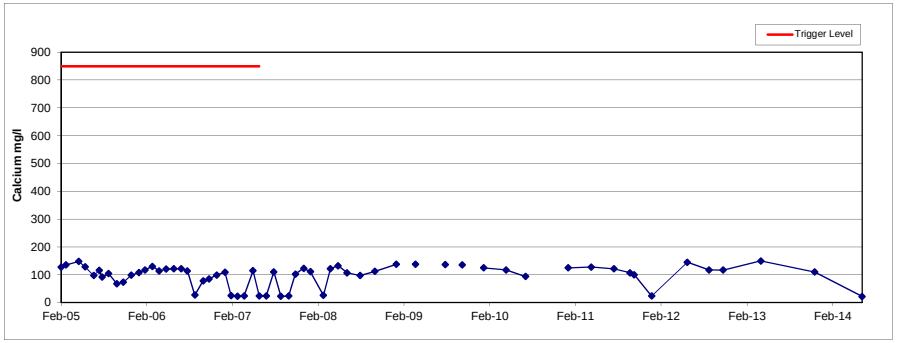

Nitrate
Nitrite
Phosphate
mg/l
35
30
25
20
15
10
5
0
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13

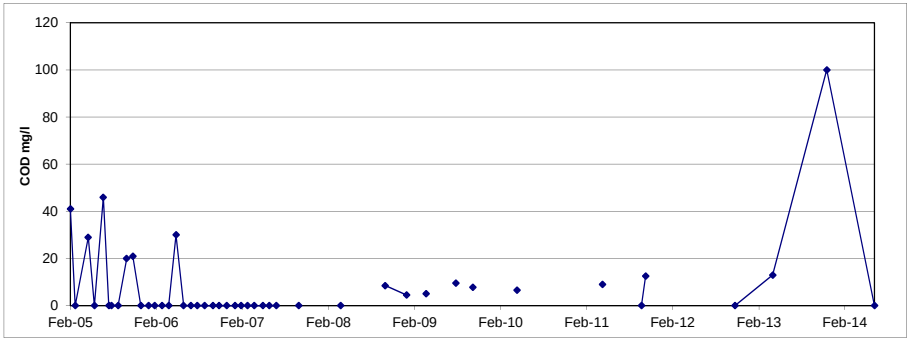

Water Level / mAOD
0
1
1
2
2
3
3
4
4
5
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

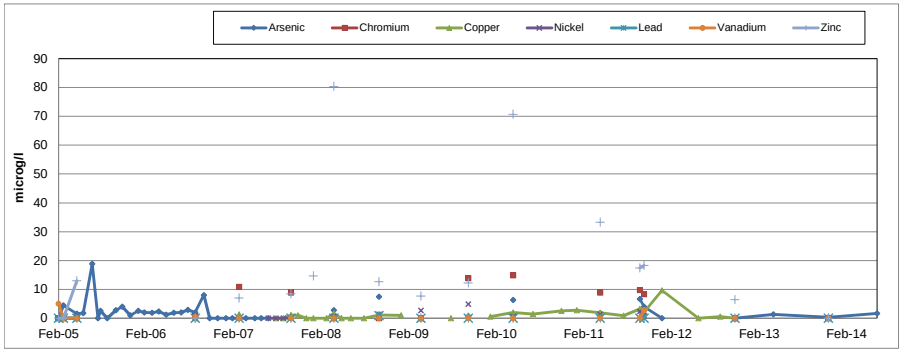

pH
EC microS/cm
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
0
200
400
600
800
1000
1200
pH
EC
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

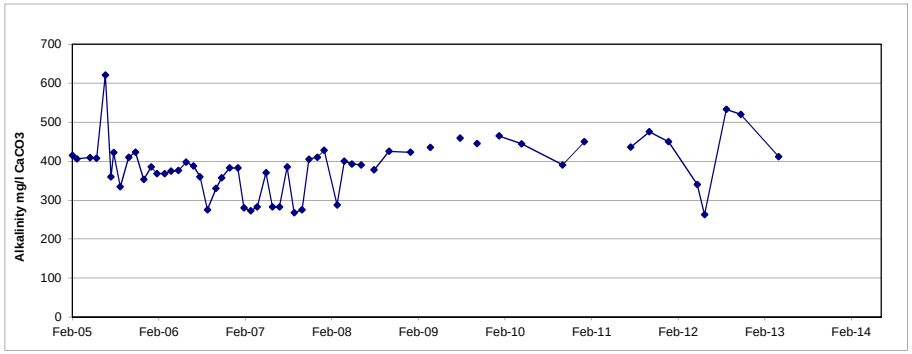

Trigger Level
Ammonia mg/l
0
1
2
3
4
5
6
7
8
9
10
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

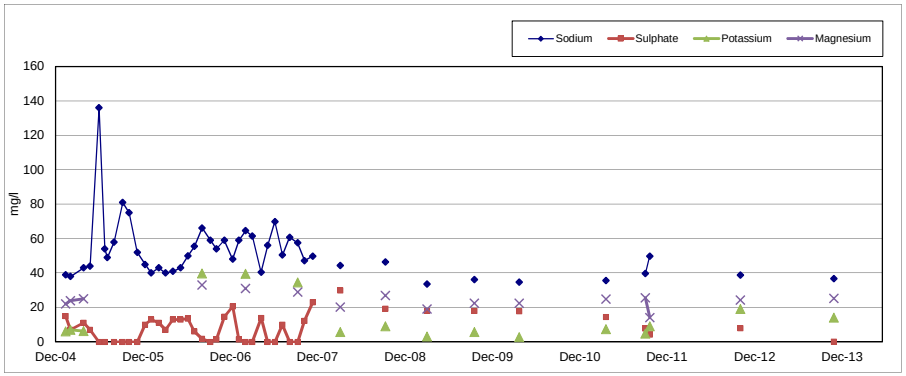

Trigger Level
Chloride mg/l
0
50
100
150
200
250
300
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

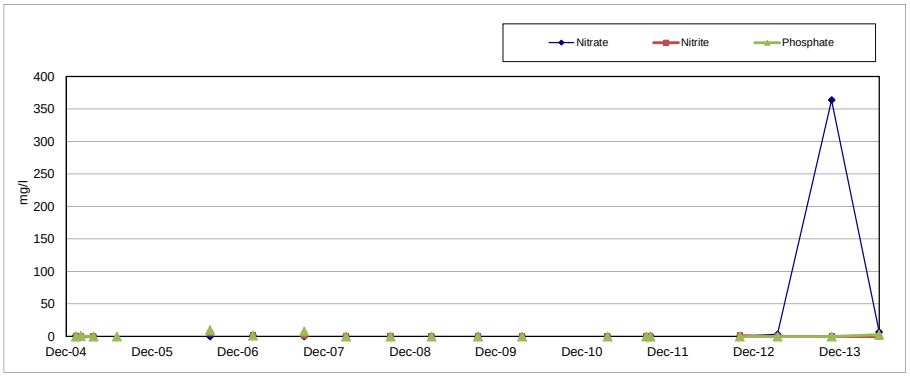

Trigger Level
Calcium mg/l
0
100
200
300
400
500
600
700
800
900
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

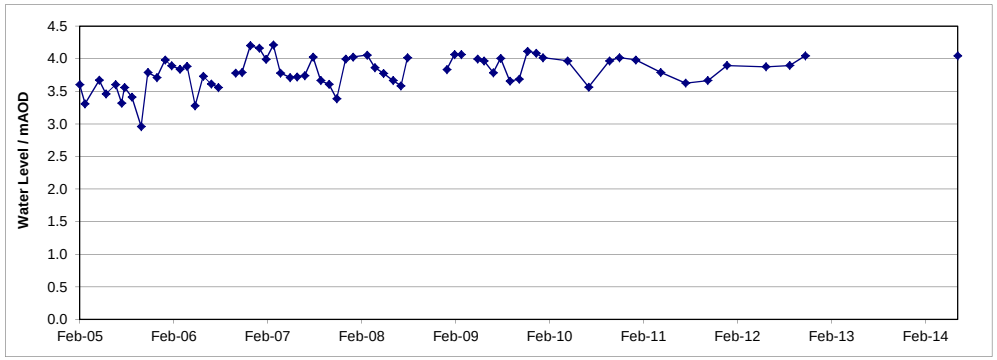

COD mg/l
0
20
40
60
80
100
120
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

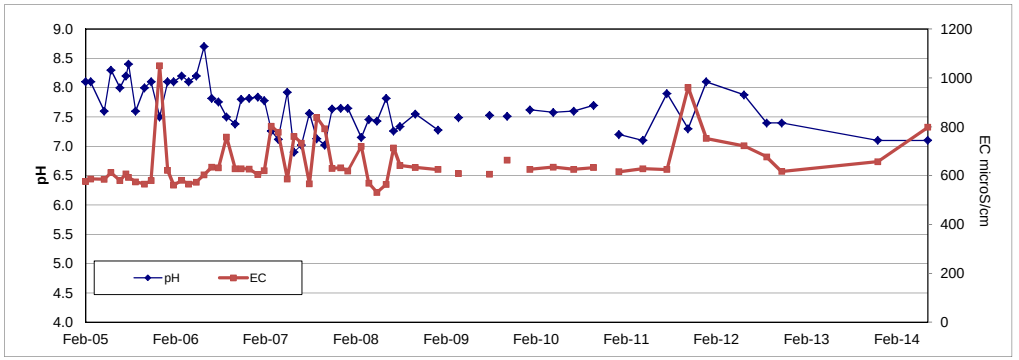

Arsenic
Chromium
Copper
Nickel
Lead
Vanadium
Zinc
microg/l
0
10
20
30
40
50
60
70
80
90
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

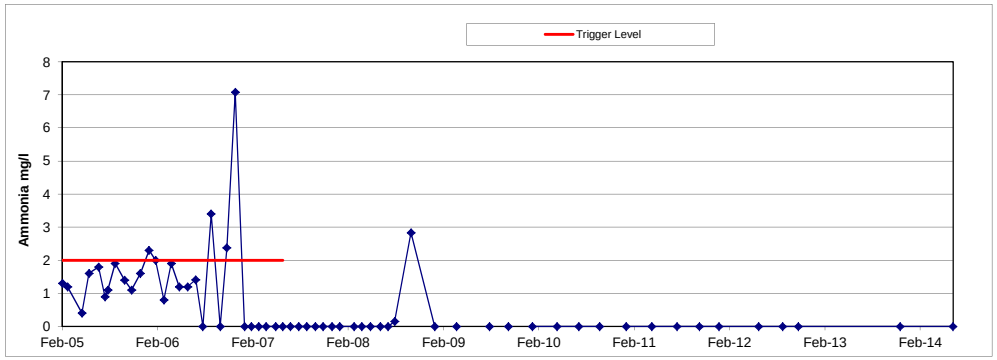

Alkalinity mg/l CaCO3
0
100
200
300
400
500
600
700
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

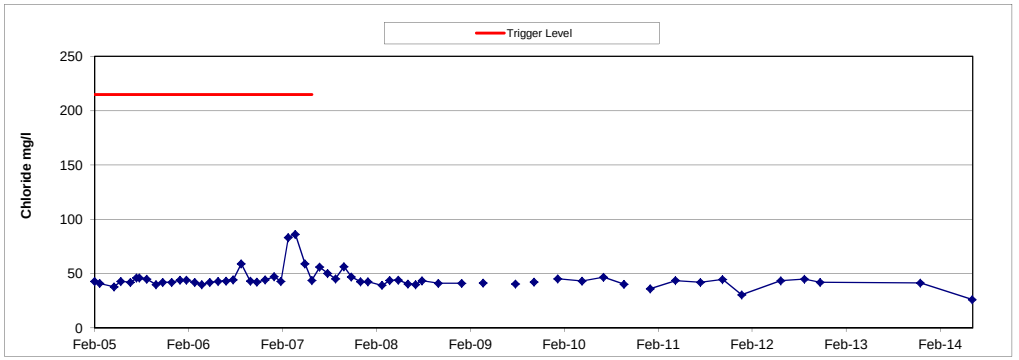

Sodium
Sulphate
Potassium
Magnesium
mg/l
0
20
40
60
80
100
120
140
160
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13

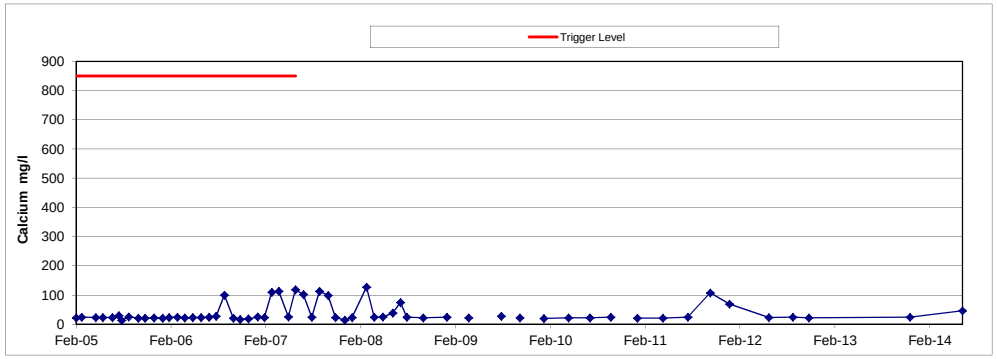

Nitrate
Nitrite
Phosphate
mg/l
0
50
100
150
200
250
300
350
400
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13

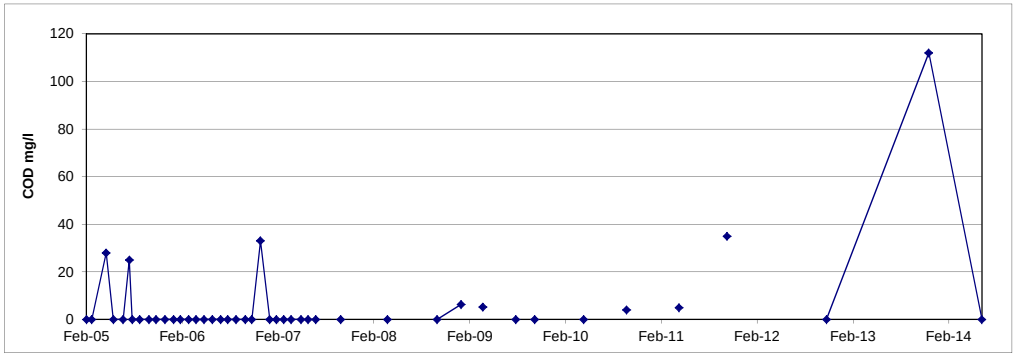

Water Level / mAOD
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

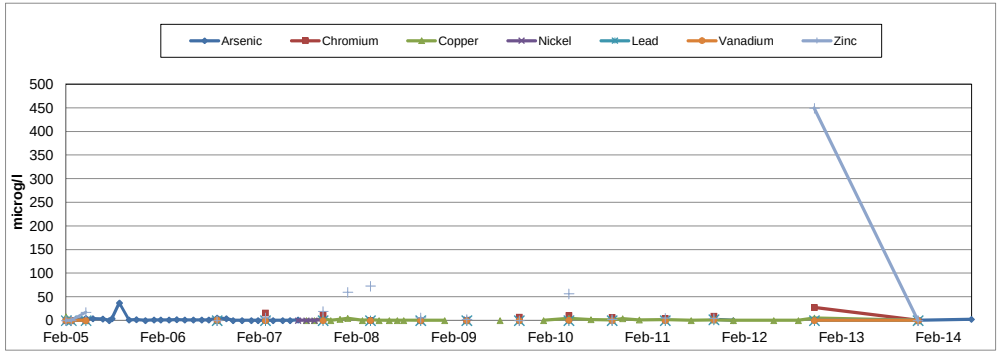

pH
EC microS/cm
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
1200
1000
800
600
400
200
0
pH
EC
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

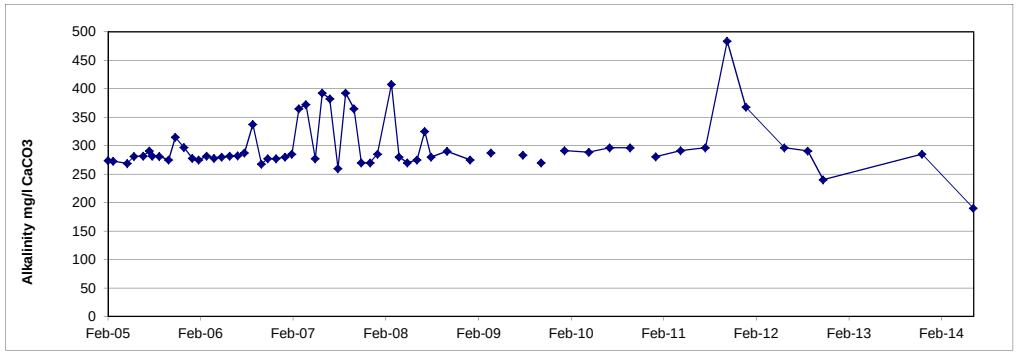

Trigger Level
Ammonia mg/l
8
7
6
5
4
3
2
1
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

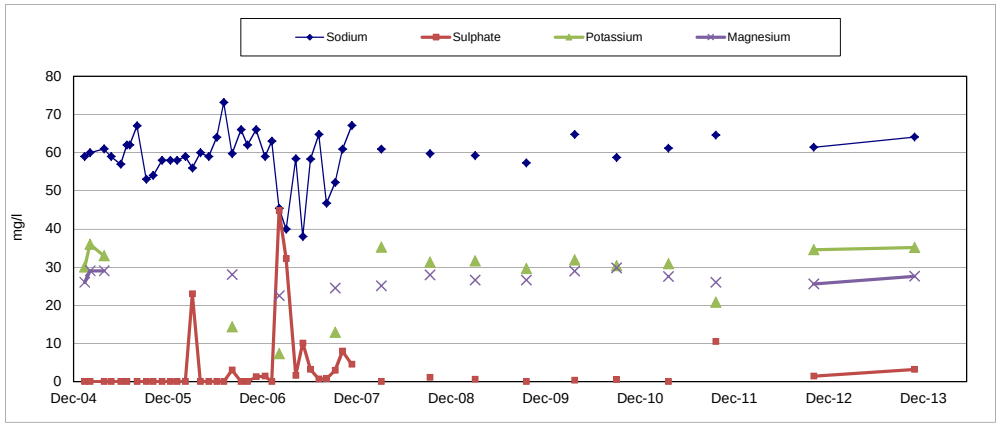

Trigger Level
Chloride mg/l
250
200
150
100
50
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

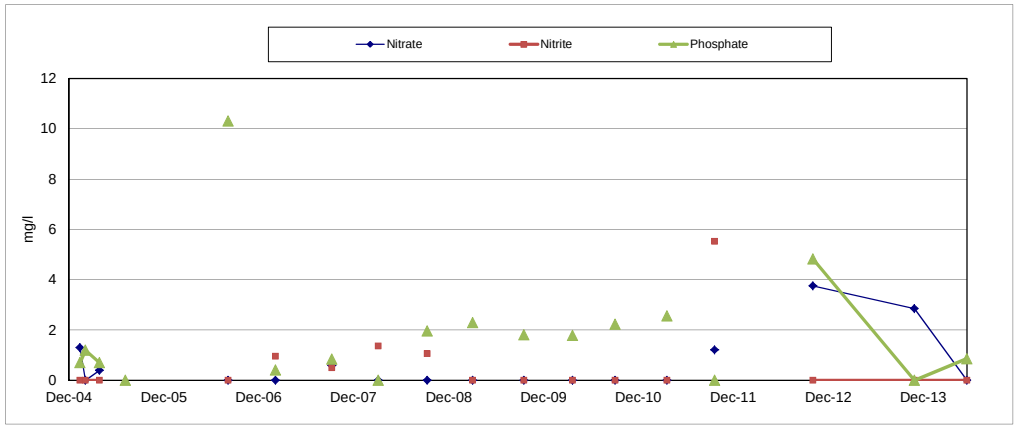

Trigger Level
Calcium mg/l
900
800
700
600
500
400
300
200
100
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

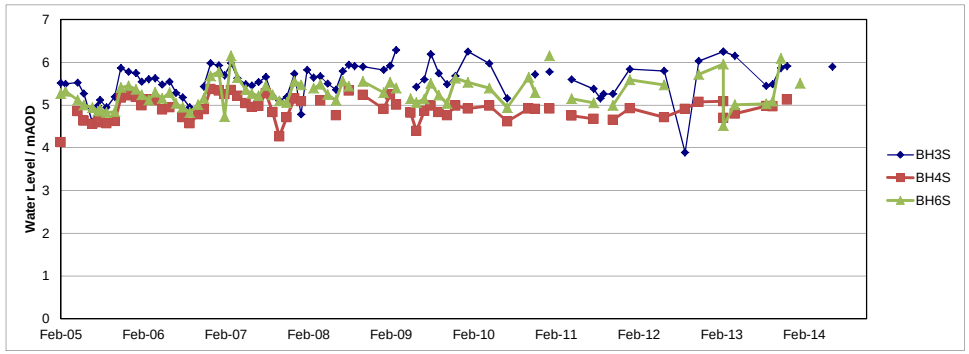

COD mg/l
120
100
80
60
40
20
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

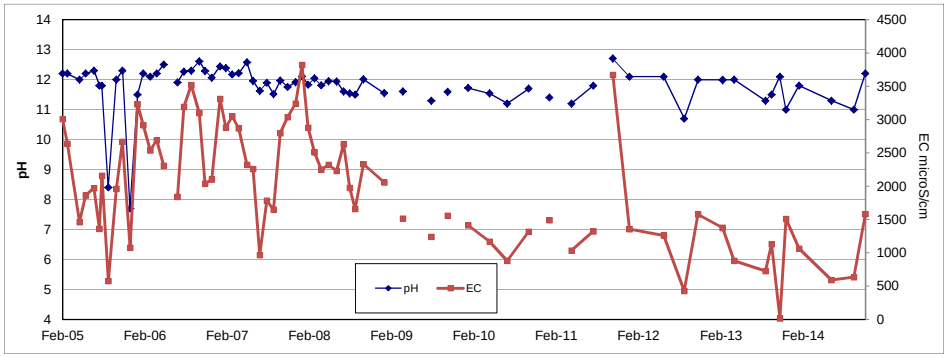

Arsenic
Chromium
Copper
Nickel
Lead
Vanadium
Zinc
microg/l
500
450
400
350
300
250
200
150
100
50
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

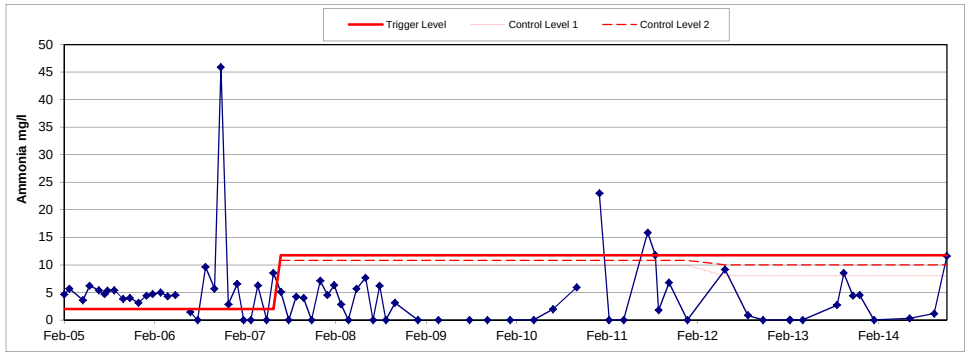

Alkalinity mg/l CaCO3
500
450
400
350
300
250
200
150
100
50
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

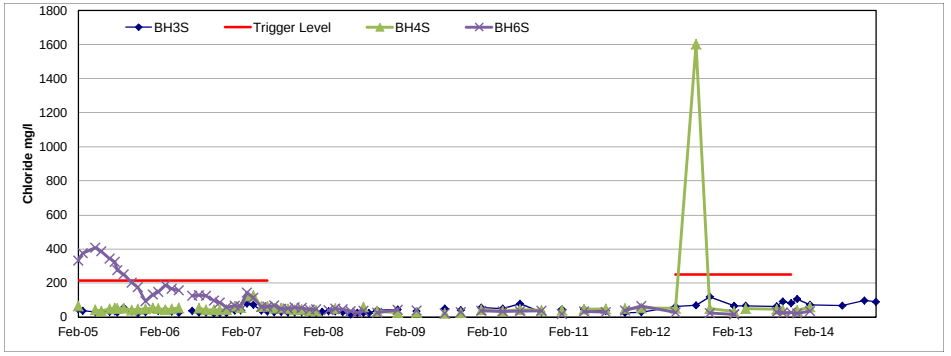

Sodium
Sulphate
Potassium
Magnesium
mg/l
80
70
60
50
40
30
20
10
0
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13

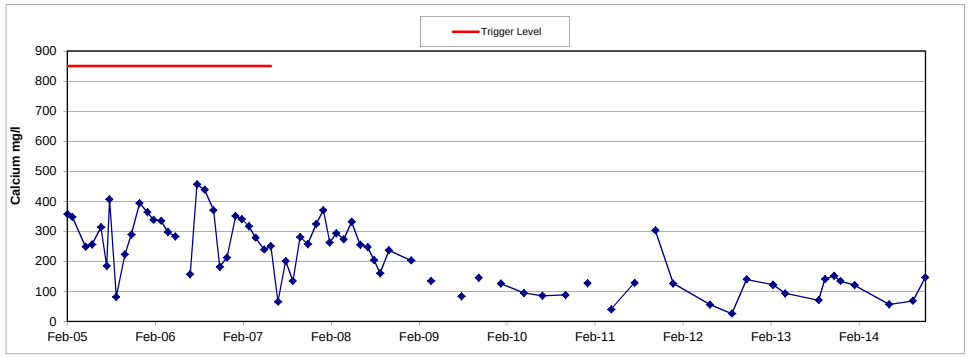

Nitrate
Nitrite
Phosphate
mg/l
12
10
8
6
4
2
0
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13

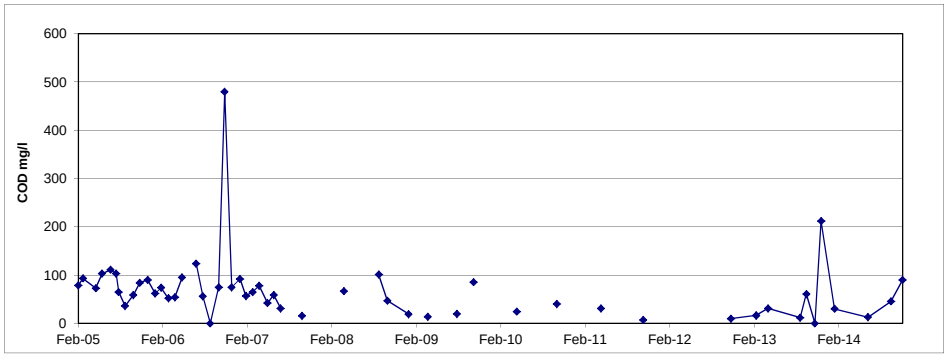

Water Level / mAOD
BH3S
BH4S
BH6S
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

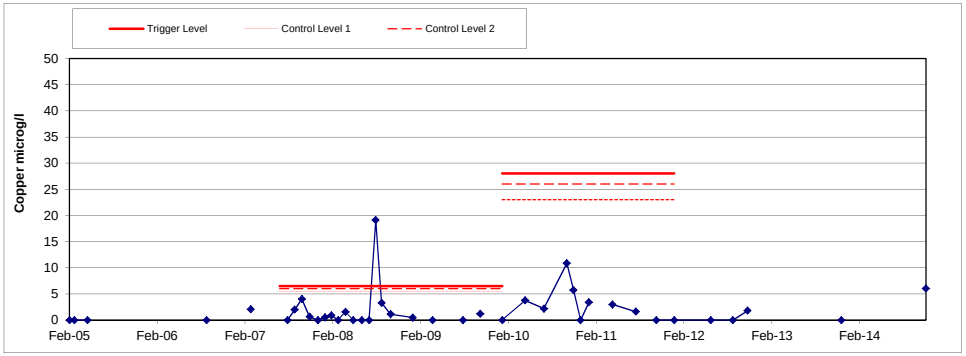

pH
EC
EC microS/cm
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

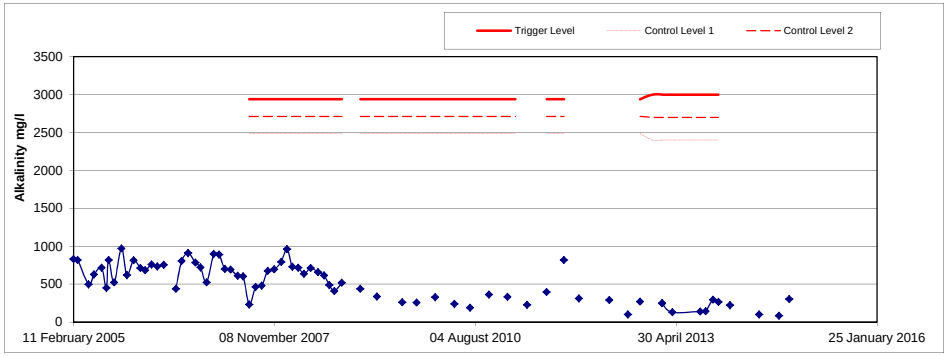

Trigger Level
Control Level 1
Control Level 2
Ammonia mg/l
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

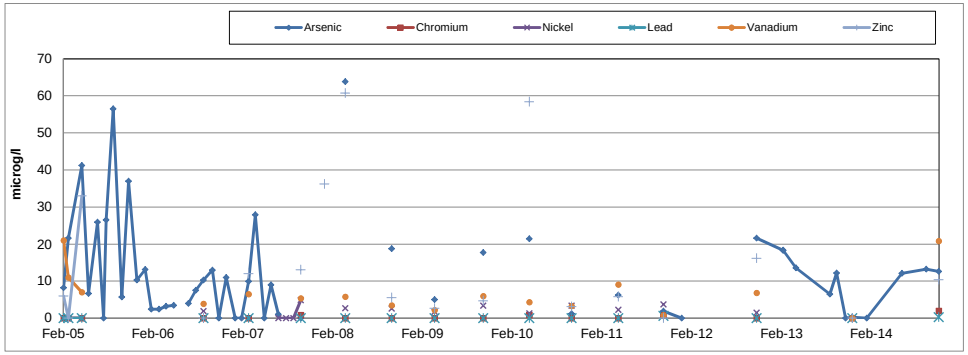

BH3S
Trigger Level
BH4S
BH6S
Chloride mg/l
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

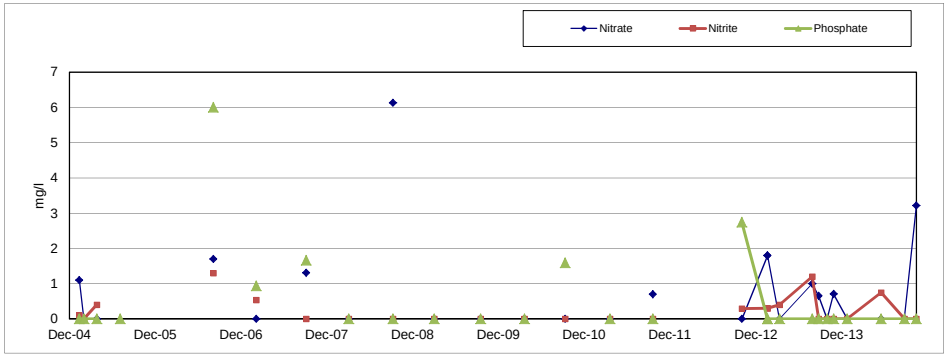

Trigger Level
Calcium mg/l
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

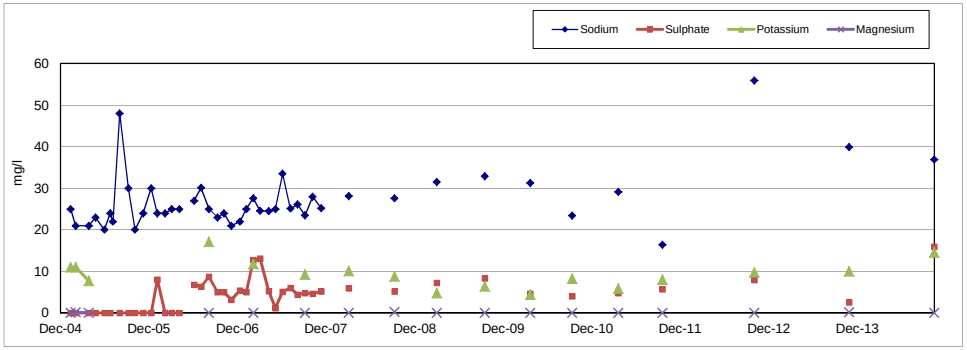

COD mg/l
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

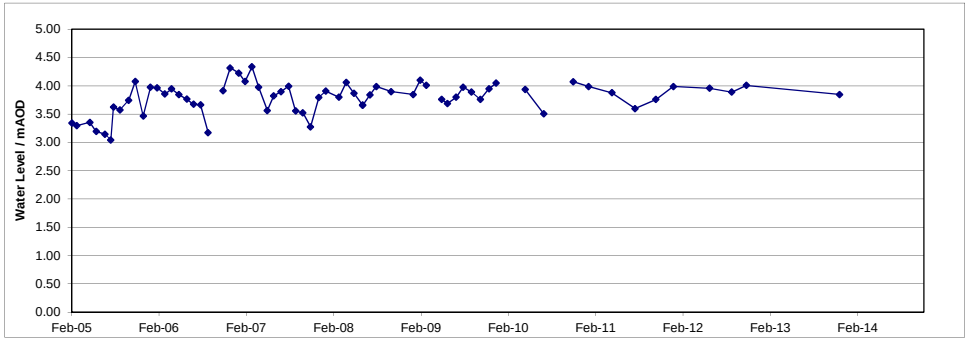

Trigger Level
Control Level 1
Control Level 2
Copper microg/l
50
45
40
35
30
25
20
15
10
5
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

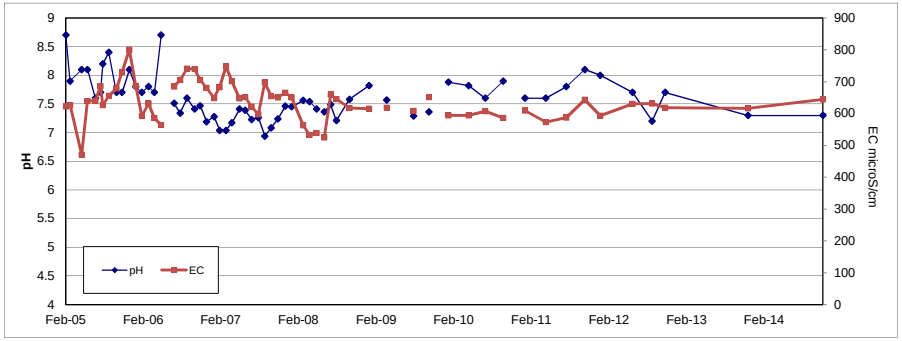

Trigger Level
Control Level 1
Control Level 2
Alkalinity mg/l
3500
3000
2500
2000
1500
1000
500
0
11 February 2005
08 November 2007
04 August 2010
30 April 2013
25 January 2016

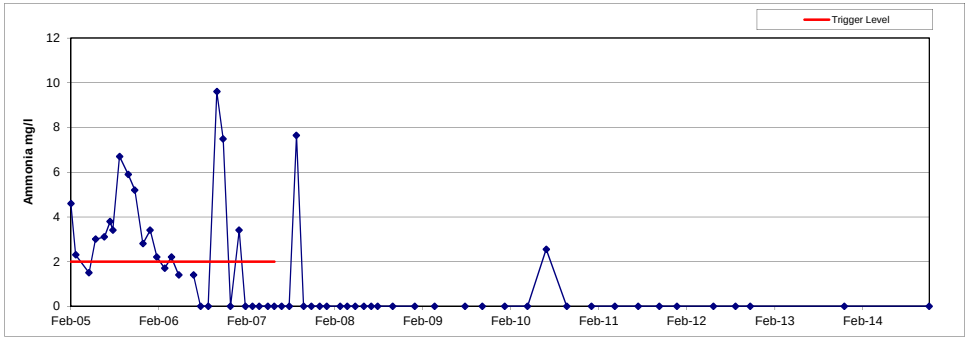

Arsenic
Chromium
Nickel
Lead
Vanadium
Zinc
microg/l
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

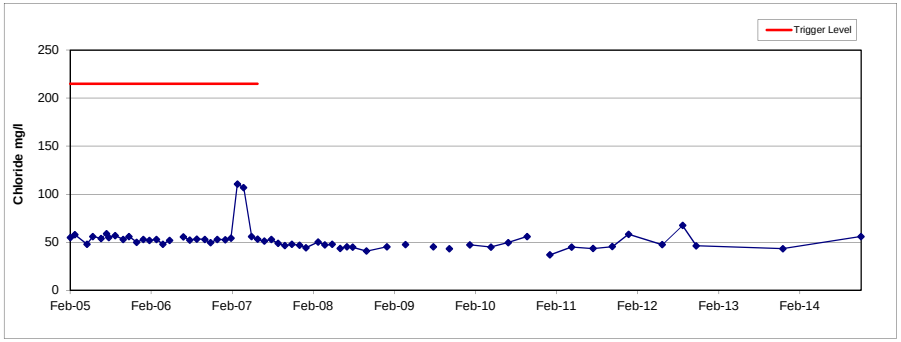

Nitrate
Nitrite
Phosphate
mg/l
7
6
5
4
3
2
1
0
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13

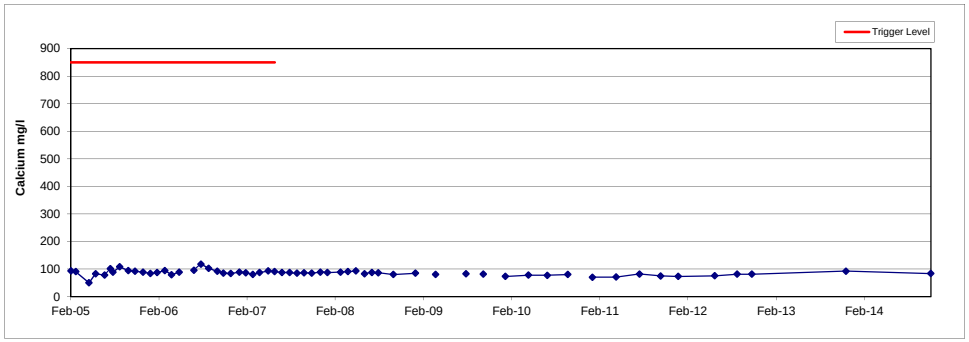

Sodium
Sulphate
Potassium
Magnesium
mg/l
60
50
40
30
20
10
0
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13

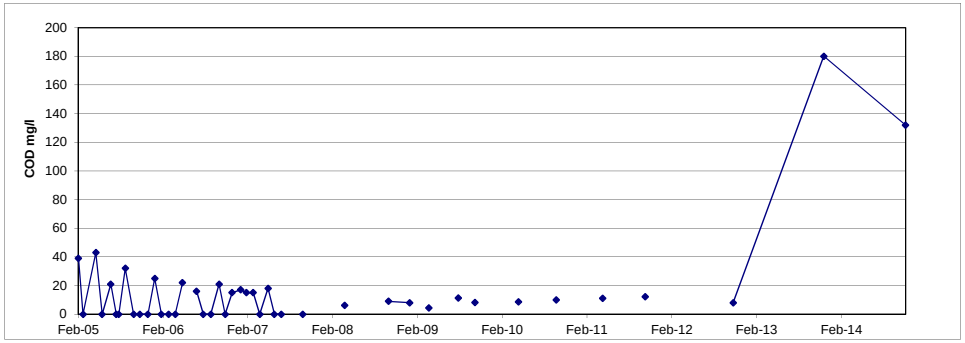

Water Level / mAOD
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

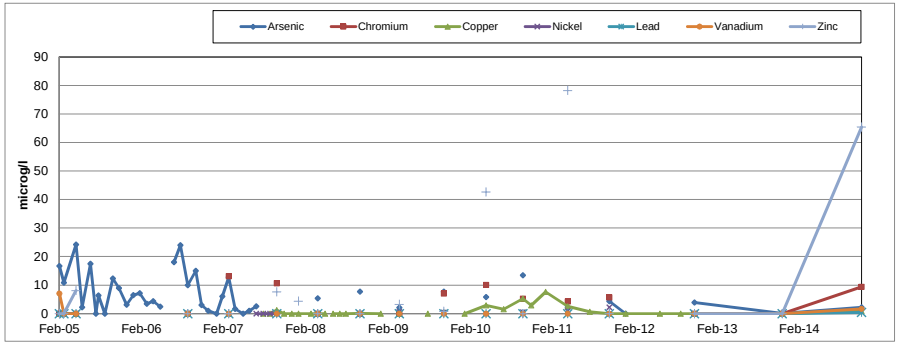

pH
EC micro S/cm
pH
EC
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

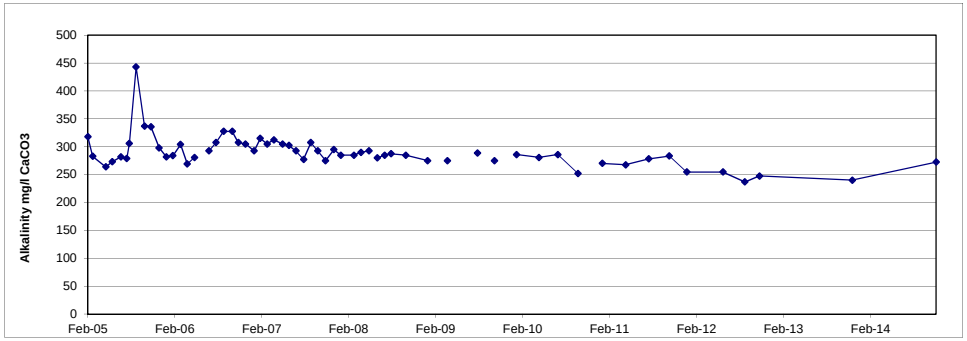

Trigger Level
Ammonia mg/l
12
10
8
6
4
2
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

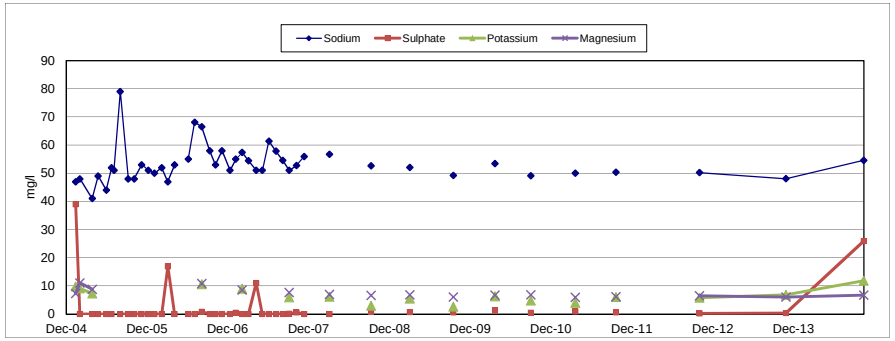

Trigger Level
Chloride mg/l
250
200
150
100
50
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

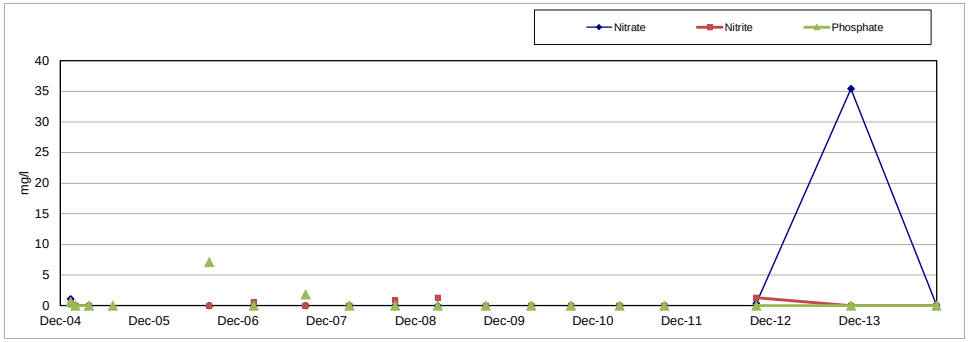

Trigger Level
Calcium mg/l
900
800
700
600
500
400
300
200
100
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

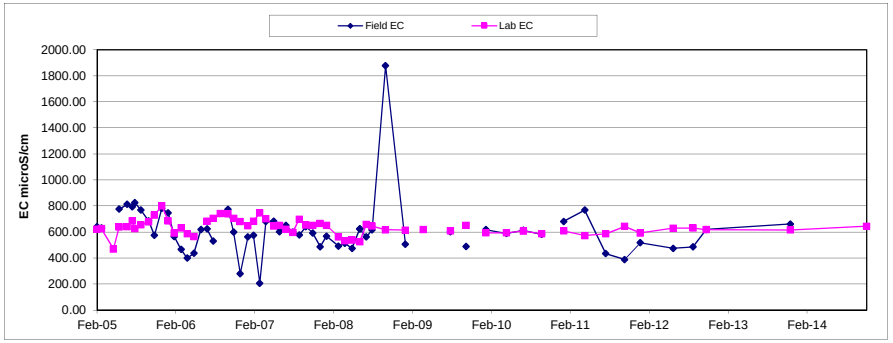

COD mg/l
200
180
160
140
120
100
80
60
40
20
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

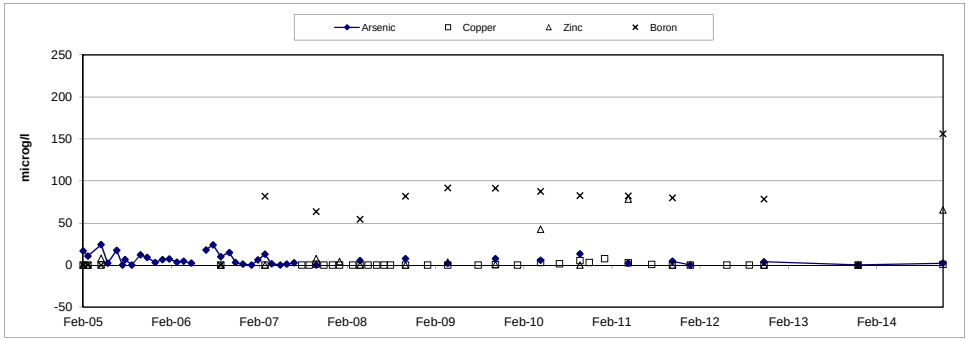

Arsenic
Chromium
Copper
Nickel
Lead
Vanadium
Zinc
microg/l
90
80
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

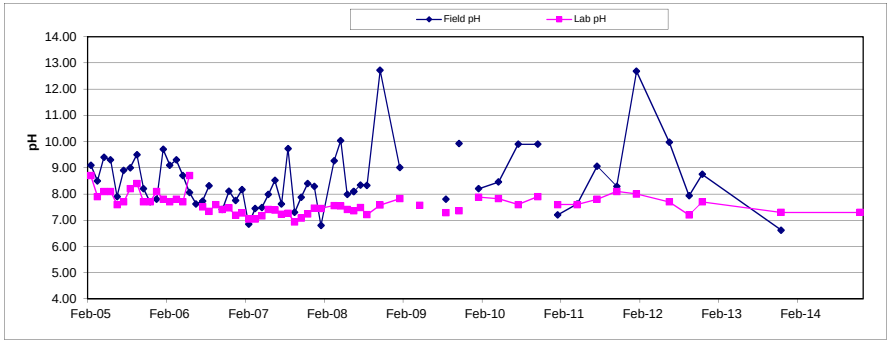

Alkalinity mg/l CaCO3
500
450
400
350
300
250
200
150
100
50
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

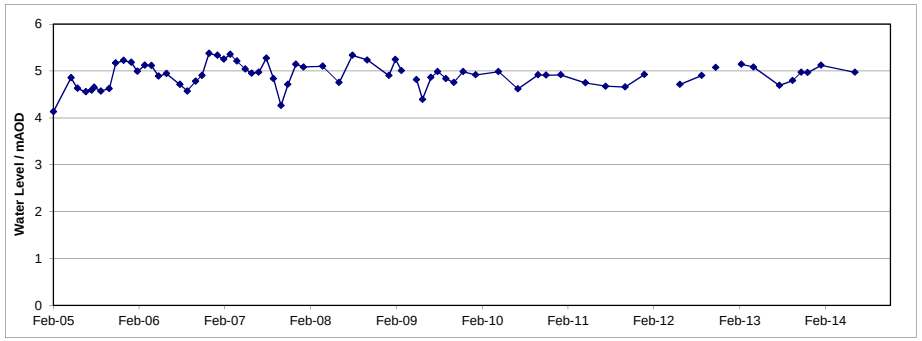

Sodium
Sulphate
Potassium
Magnesium
mg/l
90
80
70
60
50
40
30
20
10
0
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13

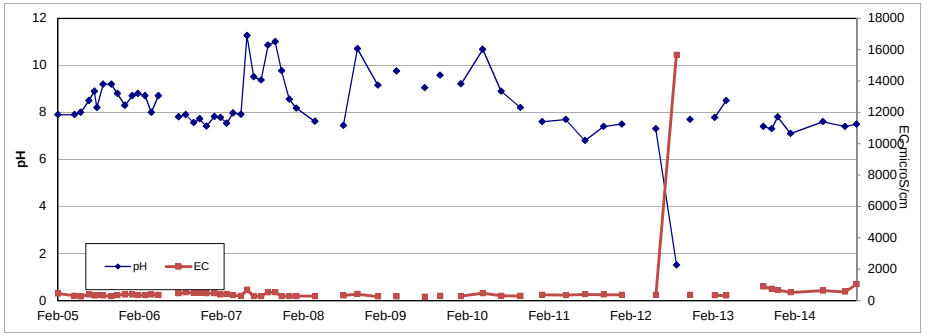

Nitrate
Nitrite
Phosphate
mg/l
40
35
30
25
20
15
10
5
0
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13

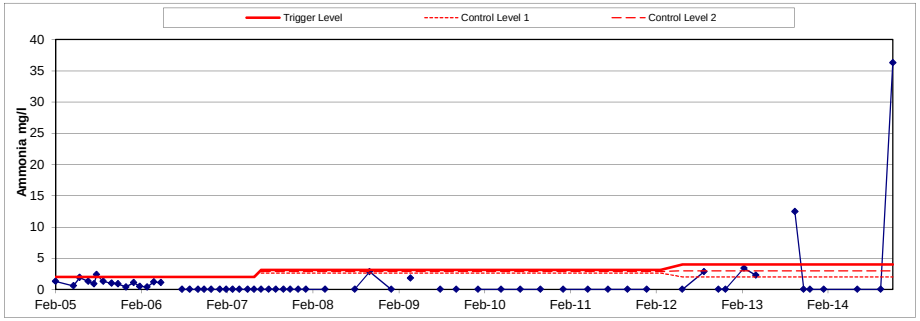

Field EC
Lab EC
EC microS/cm
2000.00
1800.00
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

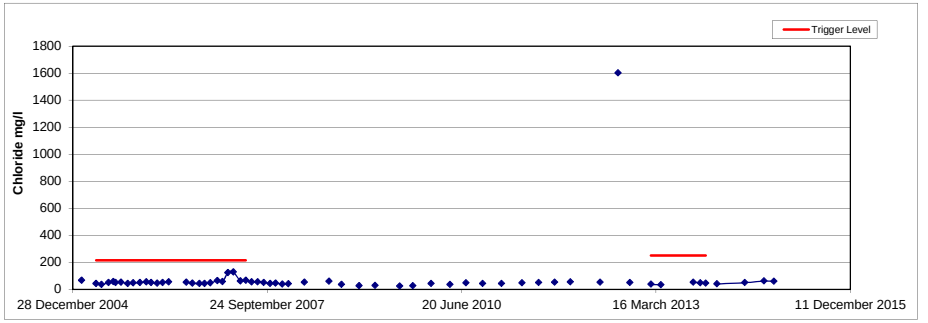

Arsenic
Copper
Zinc
Boron
microg/l
250
200
150
100
50
0
-50
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

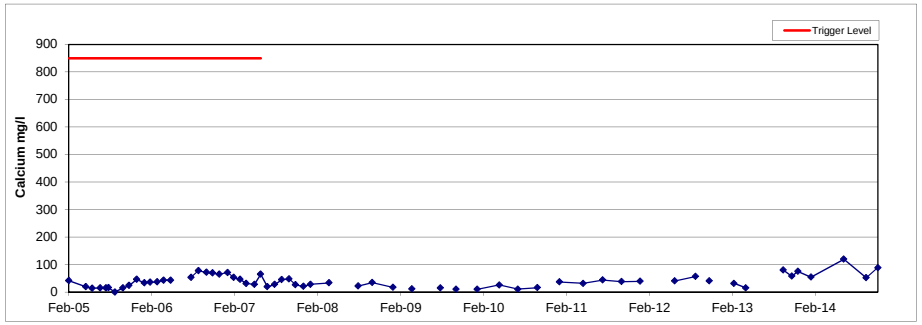

Field pH
Lab pH
pH
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

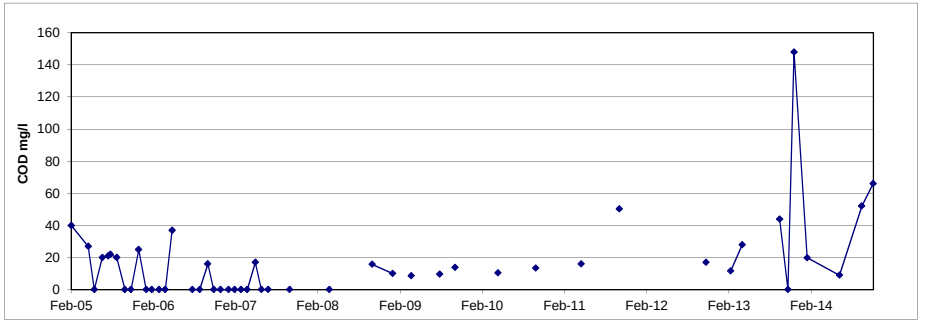

Water Level / mAOD
0
1
2
3
4
5
6
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

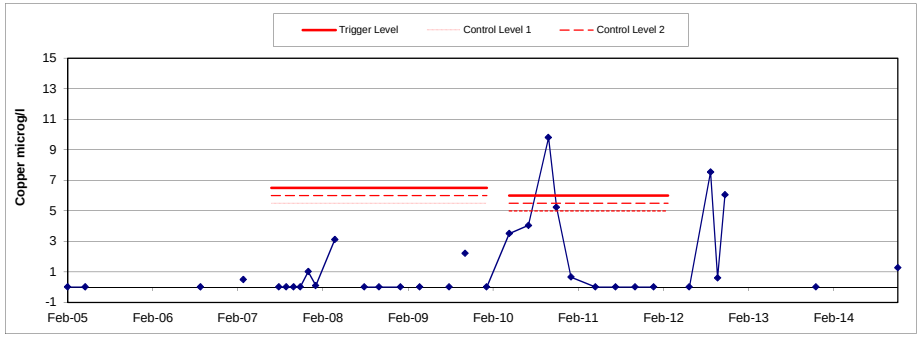

pH
EC
EC microS/cm
0
2
4
6
8
10
12
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

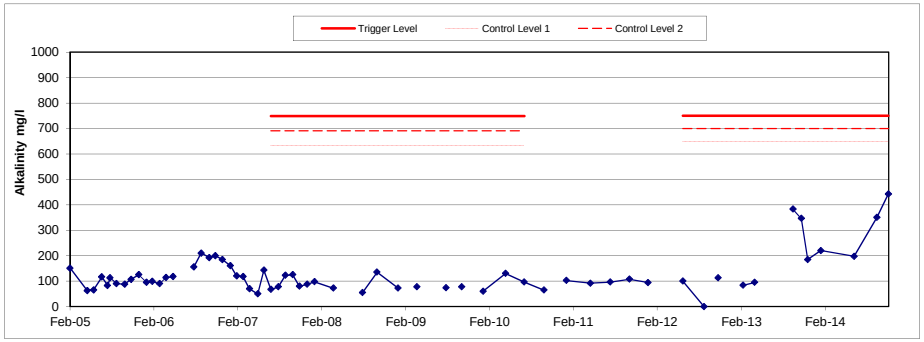

Trigger Level
Control Level 1
Control Level 2
Ammonia mg/l
0
5
10
15
20
25
30
35
40
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

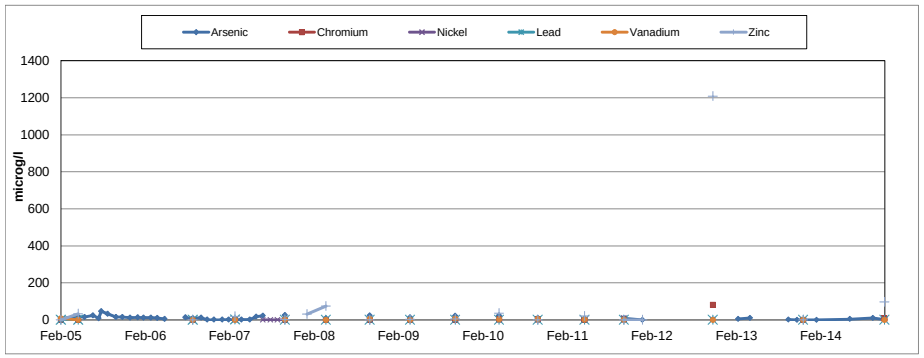

Trigger Level
Chloride mg/l
0
200
400
600
800
1000
1200
1400
1600
1800
28 December 2004
24 September 2007
20 June 2010
16 March 2013
11 December 2015

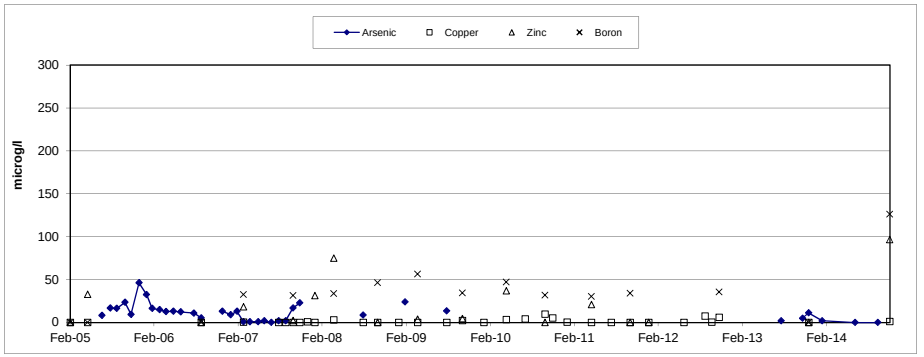

Trigger Level
Calcium mg/l
0
100
200
300
400
500
600
700
800
900
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

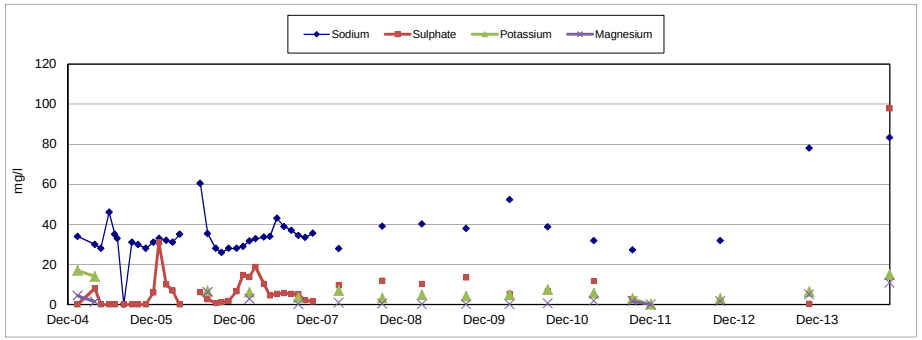

COD mg/l
0
20
40
60
80
100
120
140
160
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

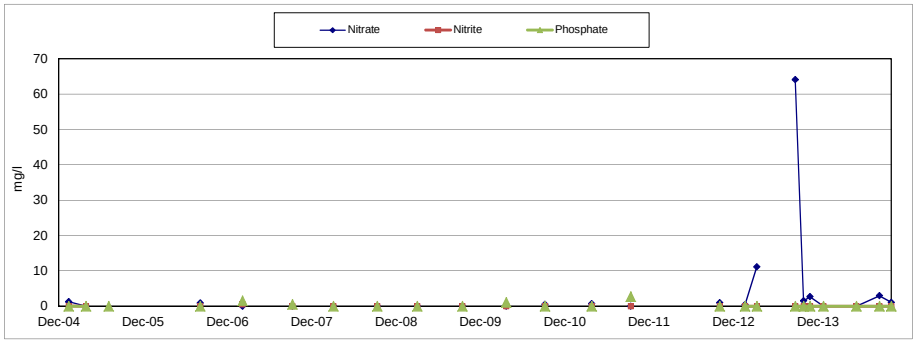

Trigger Level
Control Level 1
Control Level 2
Copper microg/l
15
13
11
9
7
5
3
1
-1
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

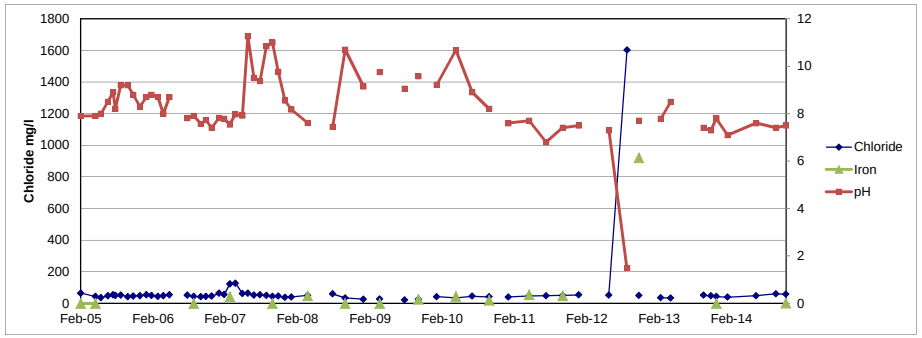

Trigger Level
Control Level 1
Control Level 2
Alkalinity mg/l
1000
900
800
700
600
500
400
300
200
100
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

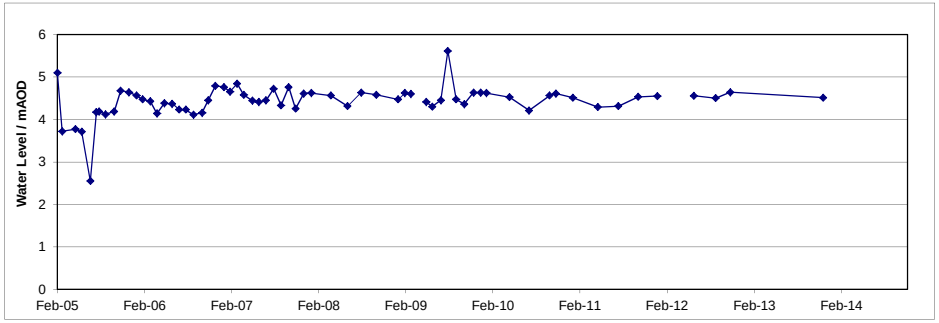

Arsenic
Chromium
Nickel
Lead
Vanadium
Zinc
microg/l
1400
1200
1000
800
600
400
200
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

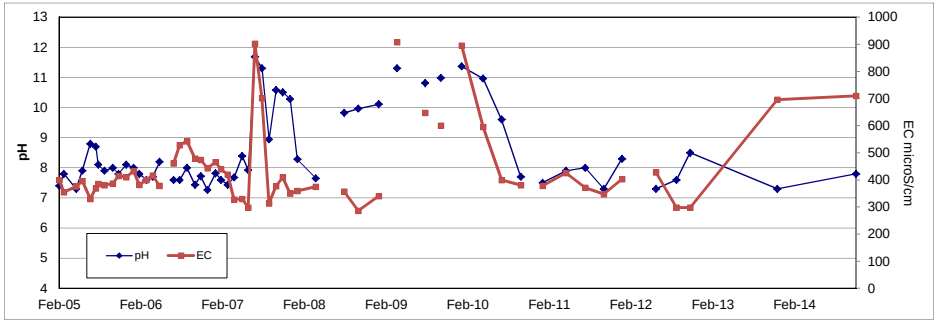

Arsenic
Copper
Zinc
Boron
microg/l
300
250
200
150
100
50
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

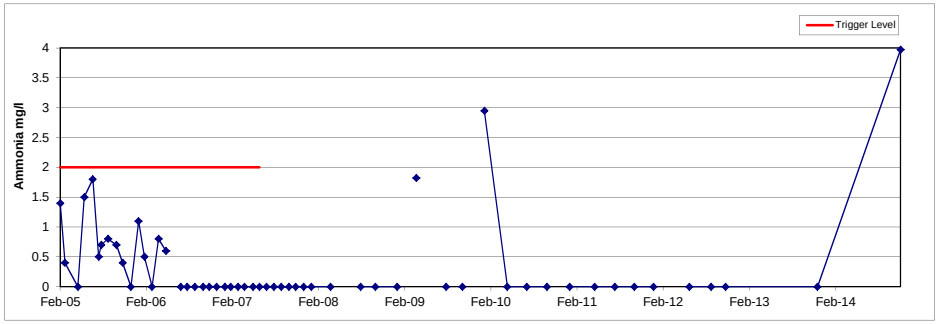

Sodium
Sulphate
Potassium
Magnesium
mg/l
120
100
80
60
40
20
0
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13

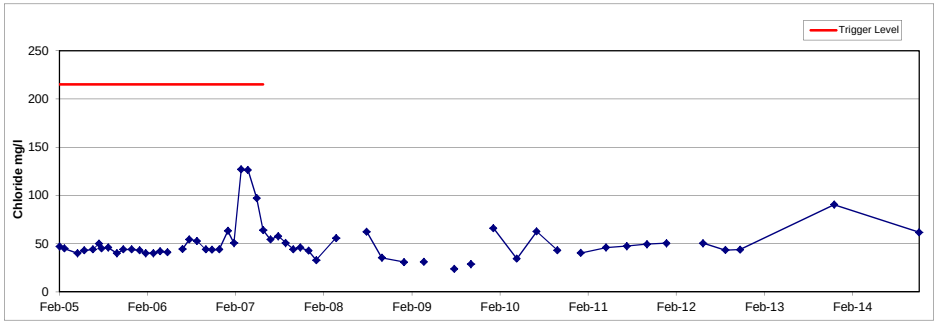

Nitrate
Nitrite
Phosphate
mg/l
70
60
50
40
30
20
10
0
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13

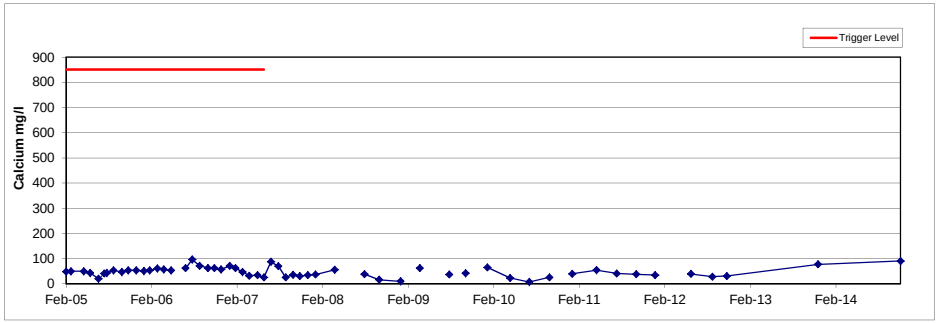

Chloride mg/l
1800
1600
1400
1200
1000
800
600
400
200
0
12
10
8
6
4
2
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14
Chloride
Iron
pH

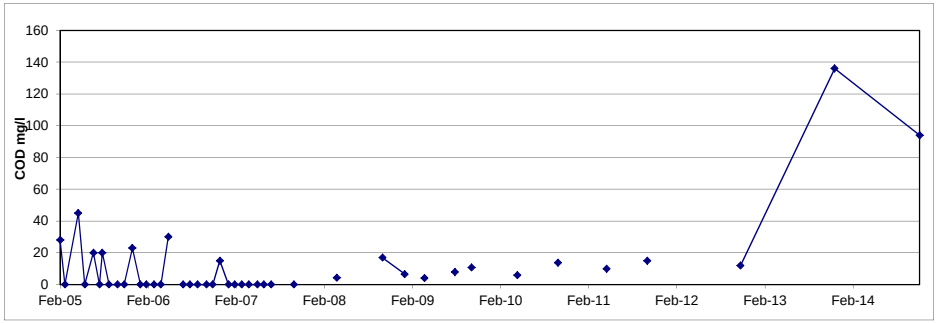

Water Level / mAOD
0
1
2
3
4
5
6
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

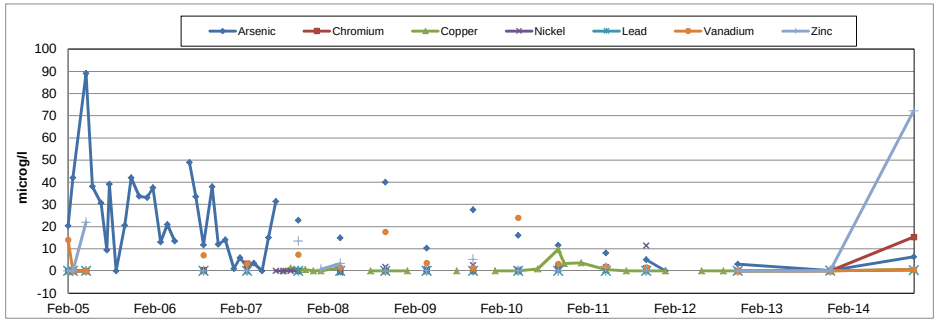

pH
EC microS/cm
pH
EC
4
5
6
7
8
9
10
11
12
13
0
100
200
300
400
500
600
700
800
900
1000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

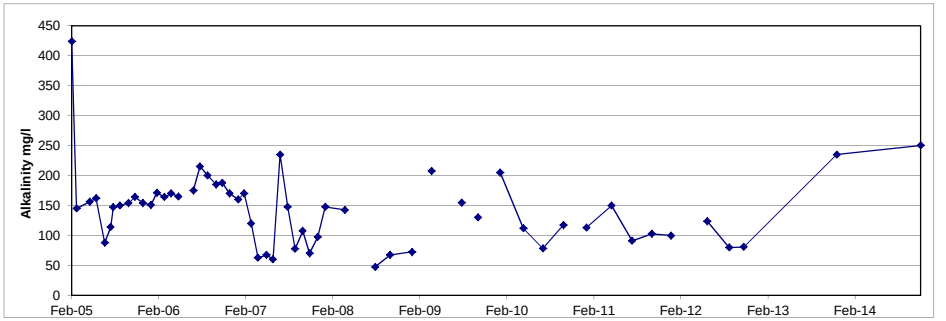

Trigger Level
Ammonia mg/l
0
0.5
1
1.5
2
2.5
3
3.5
4
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

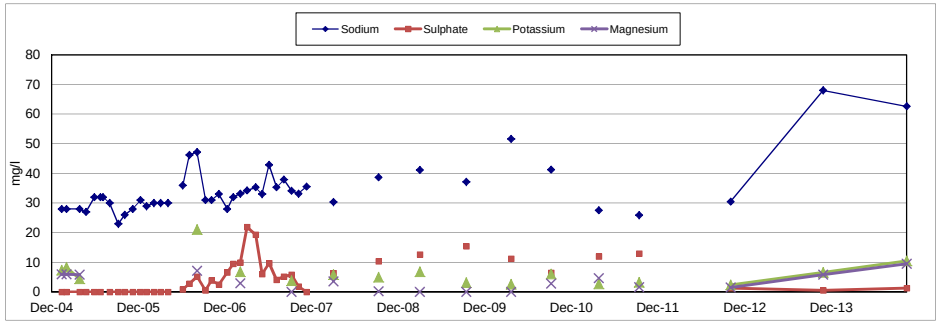

Trigger Level
Chloride mg/l
0
50
100
150
200
250
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

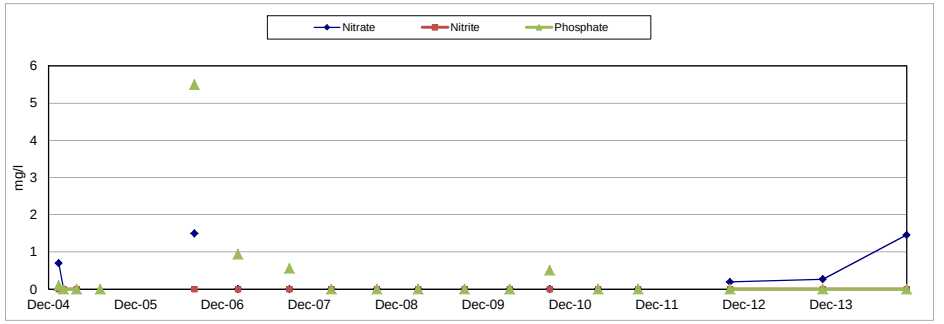

Trigger Level
Calcium mg/l
0
100
200
300
400
500
600
700
800
900
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

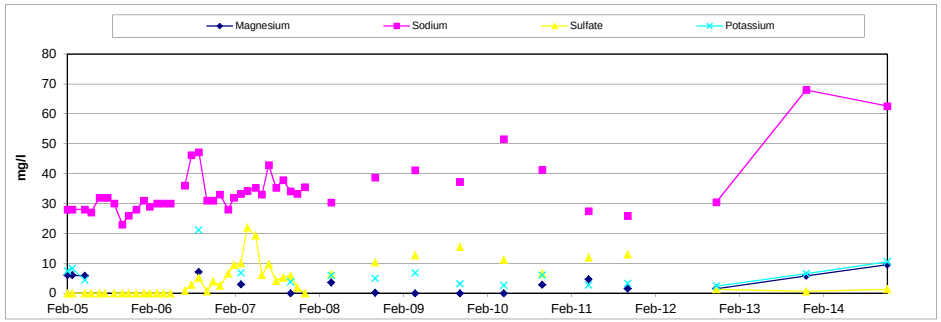

COD mg/l
0
20
40
60
80
100
120
140
160
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

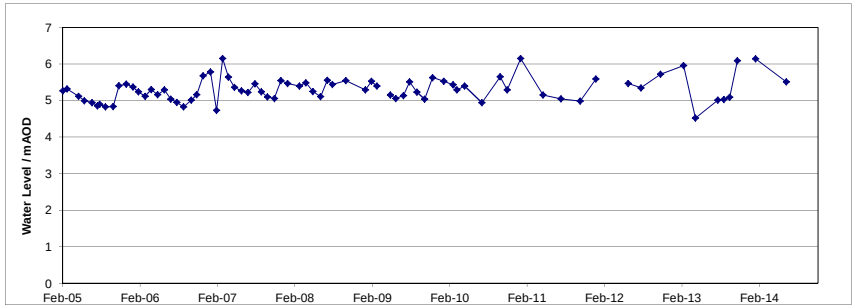

Arsenic
Chromium
Copper
Nickel
Lead
Vanadium
Zinc
microg/l
100
90
80
70
60
50
40
30
20
10
0
-10
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

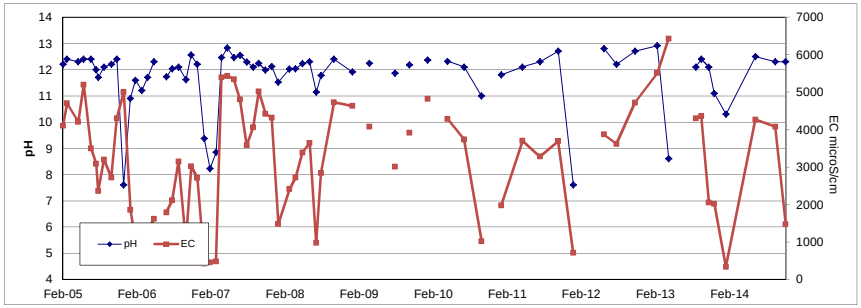

Alkalinity mg/l
450
400
350
300
250
200
150
100
50
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

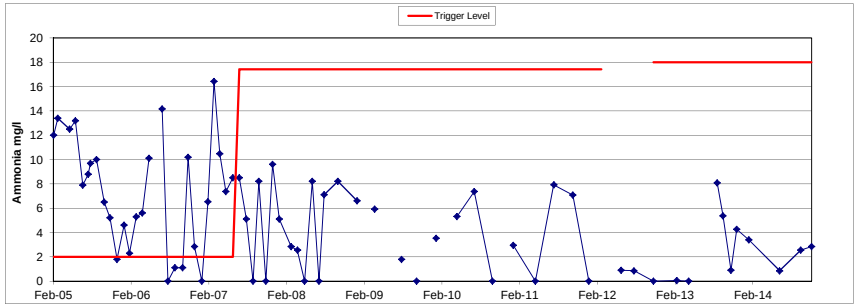

Sodium
Sulphate
Potassium
Magnesium
mg/l
80
70
60
50
40
30
20
10
0
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13

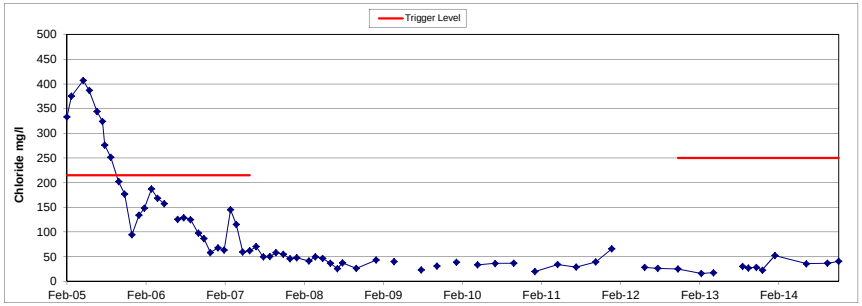

Nitrate
Nitrite
Phosphate
mg/l
6
5
4
3
2
1
0
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13

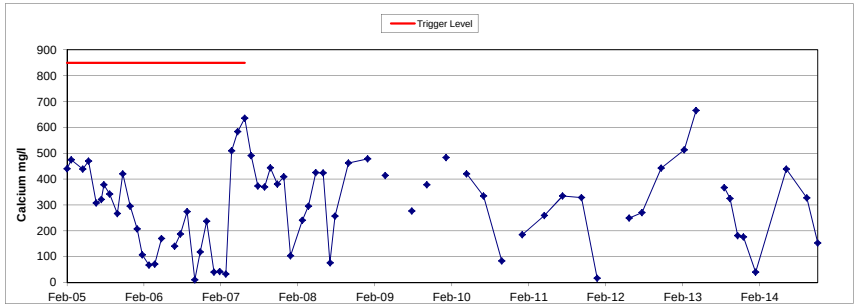

Magnesium
Sodium
Sulfate
Potassium
mg/l
80
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

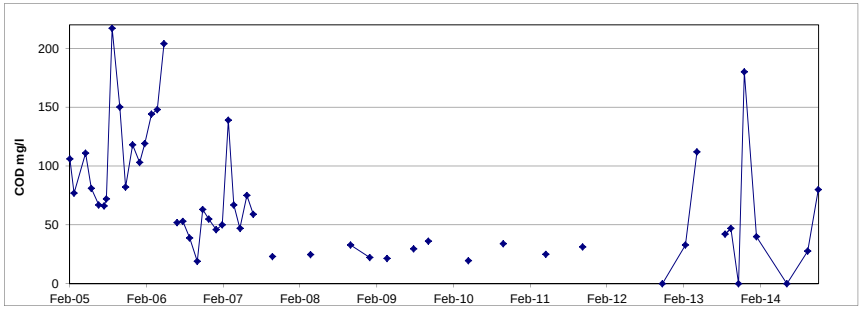

Water Level / mAOD
0
1
2
3
4
5
6
7
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

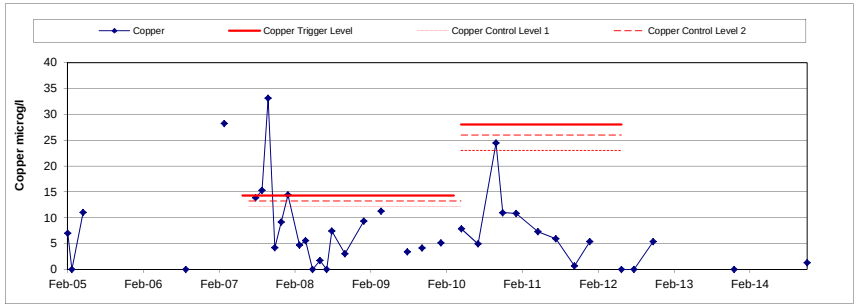

pH
EC microS/cm
pH
EC
4
5
6
7
8
9
10
11
12
13
14
0
1000
2000
3000
4000
5000
6000
7000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

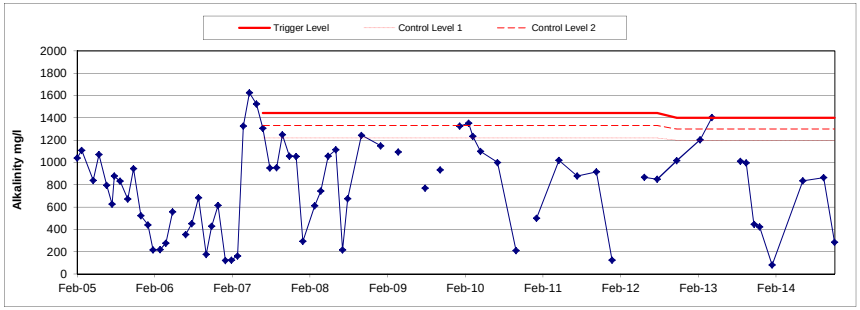

Trigger Level
Ammonia mg/l
0
2
4
6
8
10
12
14
16
18
20
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

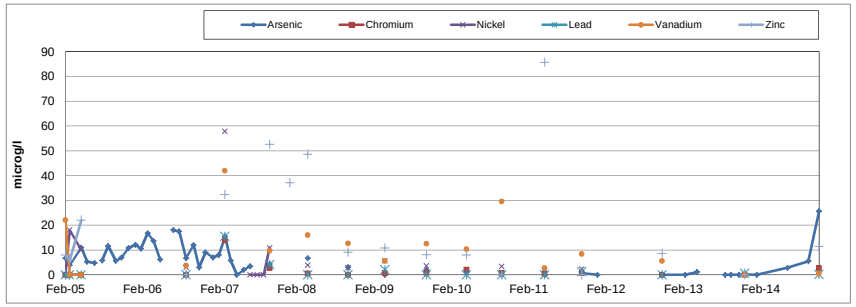

Trigger Level
Chloride mg/l
0
50
100
150
200
250
300
350
400
450
500
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

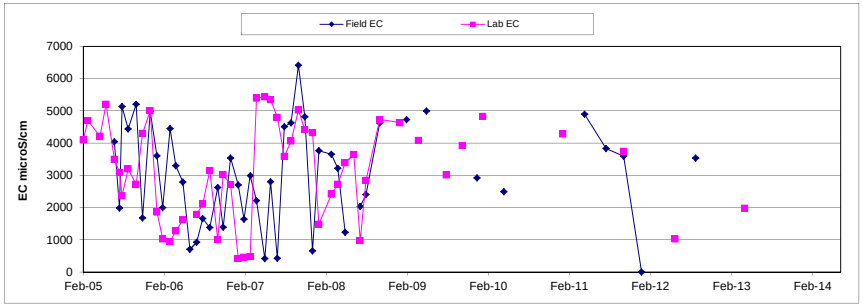

Trigger Level
Calcium mg/l
0
100
200
300
400
500
600
700
800
900
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

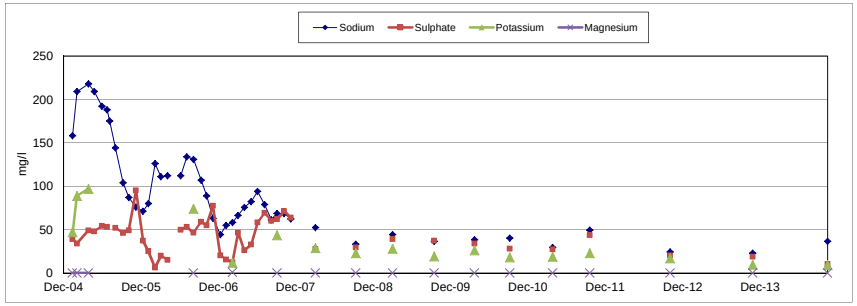

COD mg/l
0
50
100
150
200
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

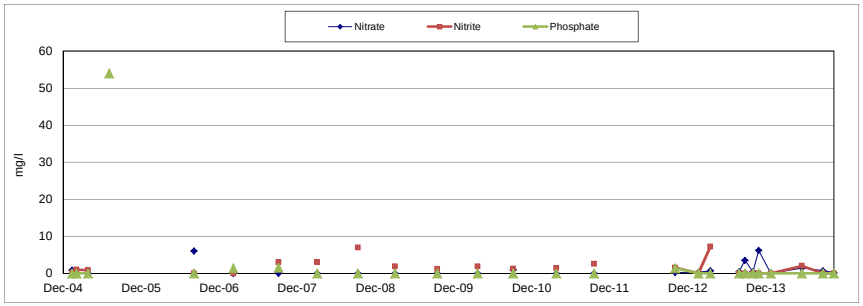

Copper
Copper Trigger Level
Copper Control Level 1
Copper Control Level 2
Copper microg/l
0
5
10
15
20
25
30
35
40
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

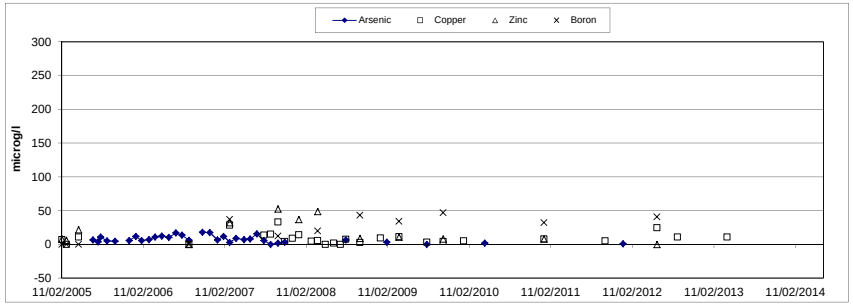

Trigger Level
Control Level 1
Control Level 2
Alkalinity mg/l
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

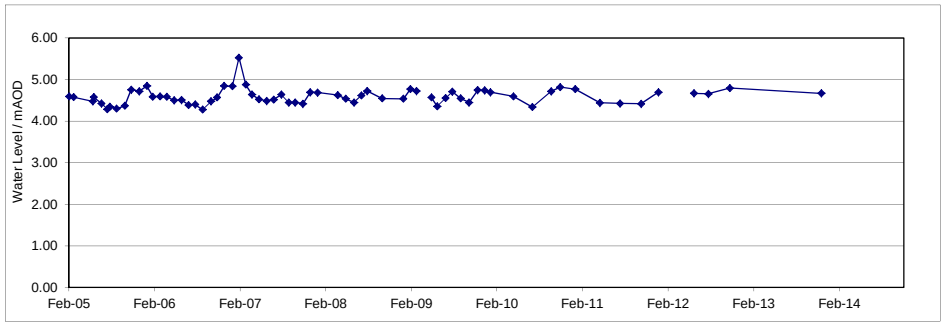

Arsenic
Chromium
Nickel
Lead
Vanadium
Zinc
microg/l
0
10
20
30
40
50
60
70
80
90
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

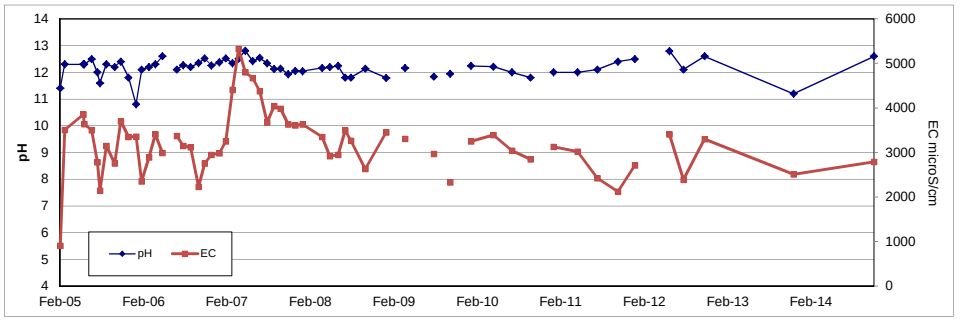

Field EC
Lab EC
EC microS/cm
0
1000
2000
3000
4000
5000
6000
7000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

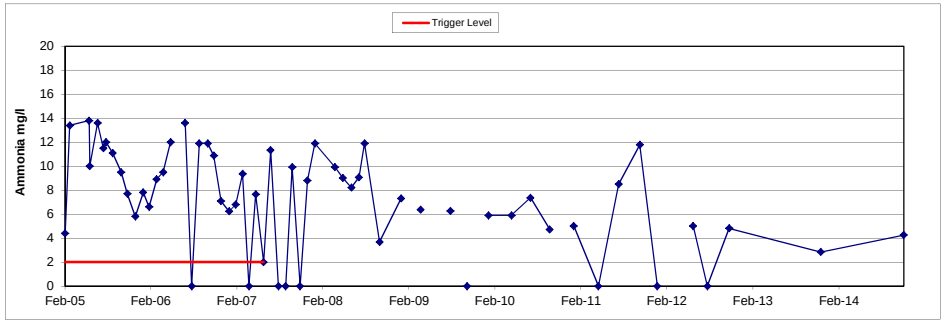

Sodium
Sulphate
Potassium
Magnesium
mg/l
250
200
150
100
50
0
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13

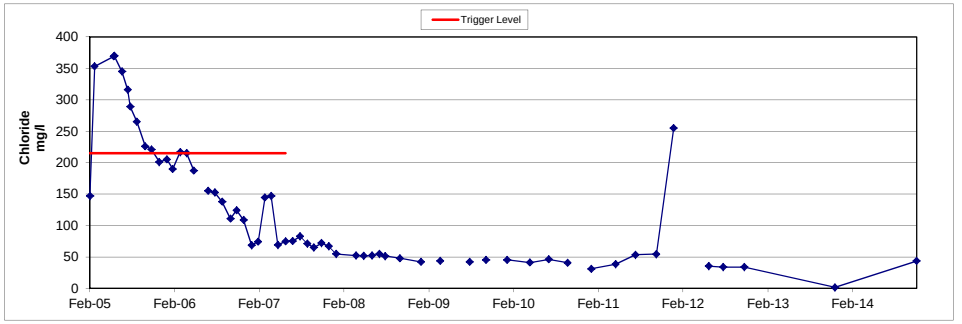

Nitrate
Nitrite
Phosphate
mg/l
60
50
40
30
20
10
0
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13

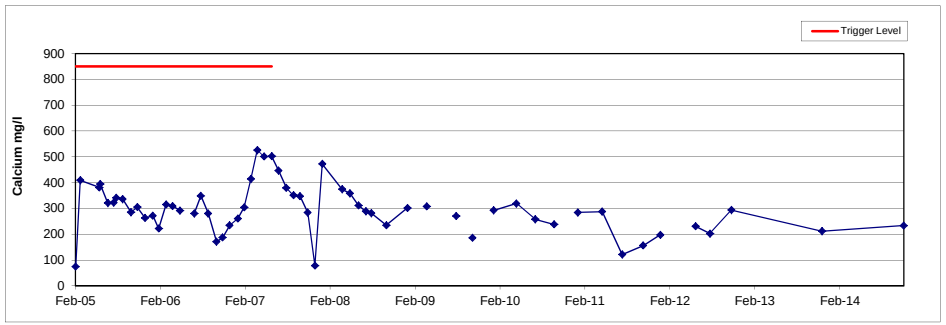

Arsenic
Copper
Zinc
Boron
microg/l
300
250
200
150
100
50
0
-50
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

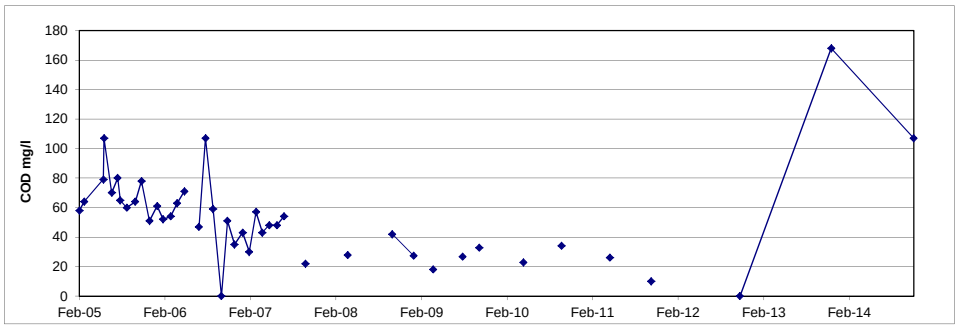

Water Level / mAOD
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

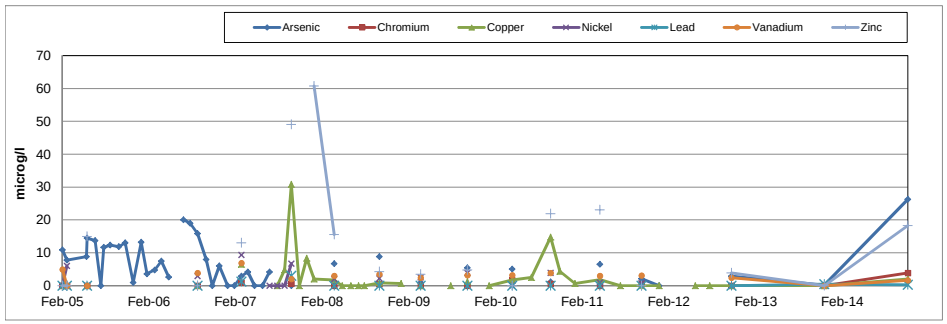

pH
EC micro S/cm
pH
EC
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

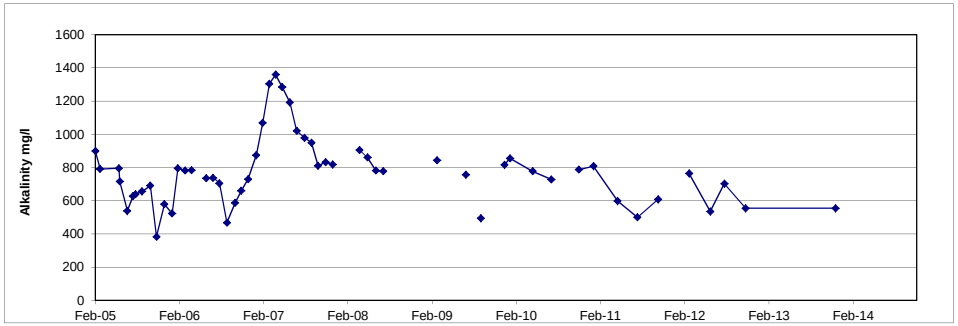

Trigger Level
Ammonia mg/l
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

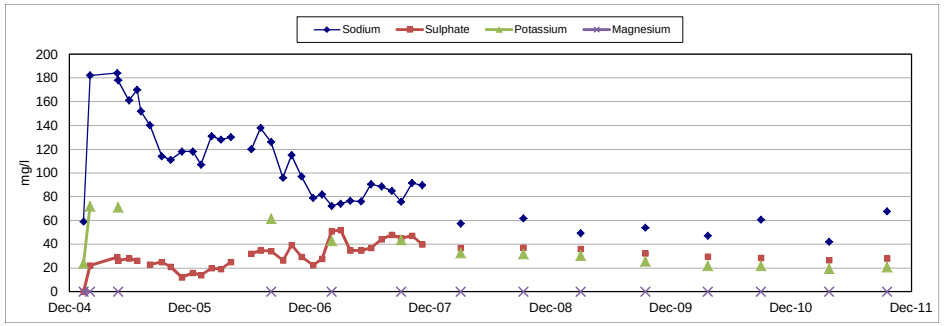

Trigger Level
Chloride mg/l
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

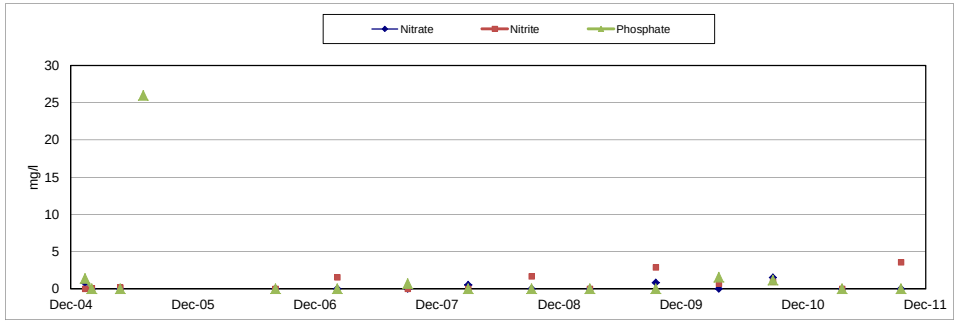

Trigger Level
Calcium mg/l
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

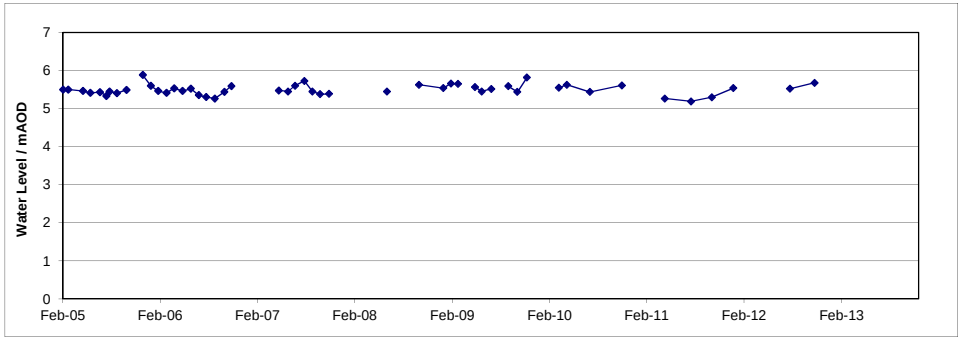

COD mg/l
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

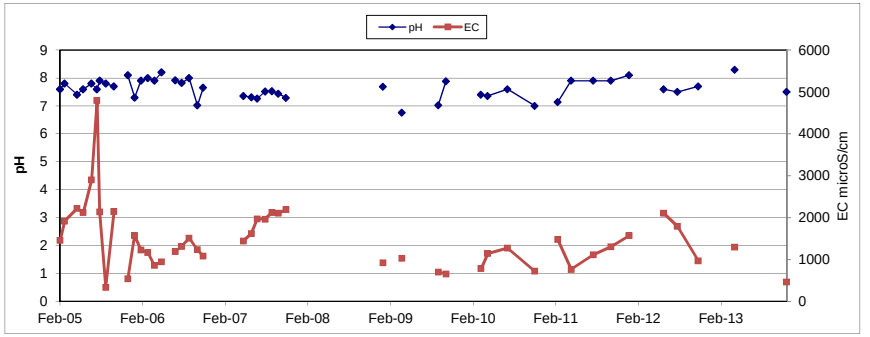

Arsenic
Chromium
Copper
Nickel
Lead
Vanadium
Zinc
microg/l
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

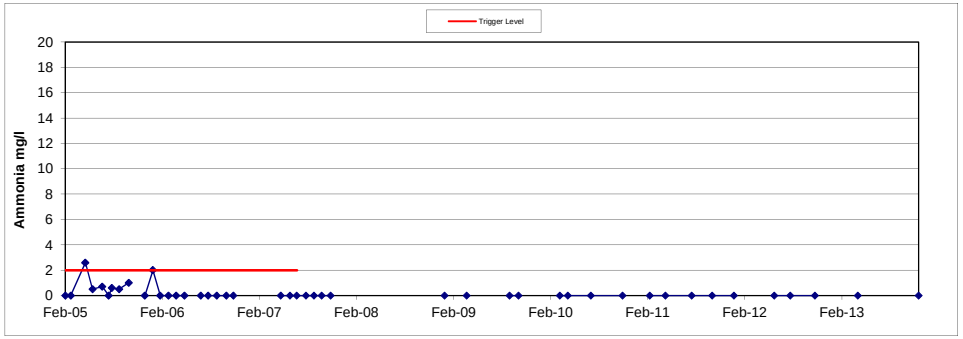

Alkalinity mg/l
1600
1400
1200
1000
800
600
400
200
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

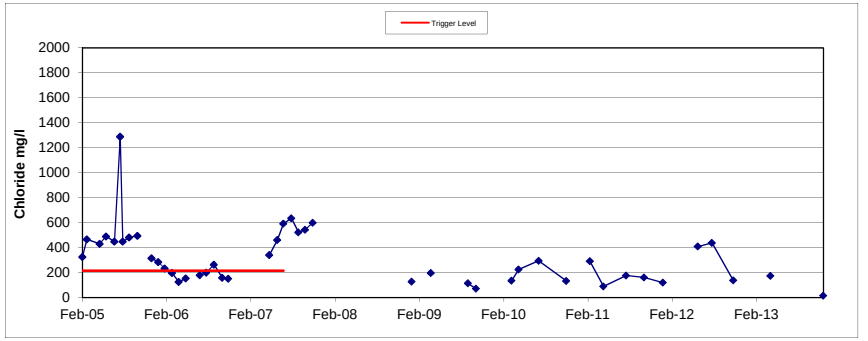

Sodium
Sulphate
Potassium
Magnesium
mg/l
200
180
160
140
120
100
80
60
40
20
0
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11

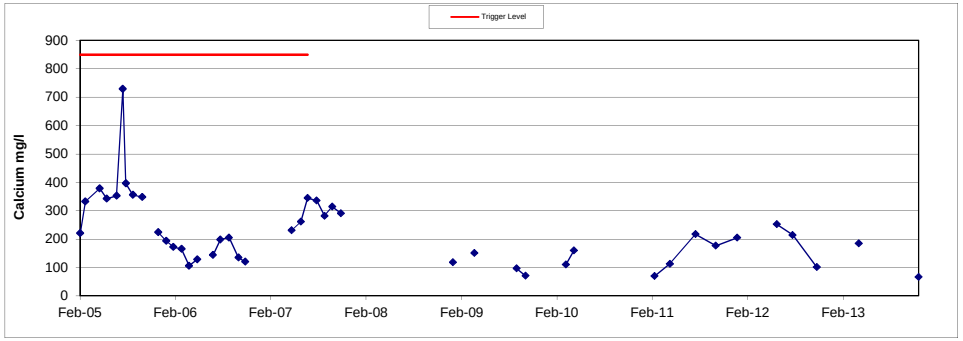

Nitrate
Nitrite
Phosphate
mg/l
30
25
20
15
10
5
0
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11

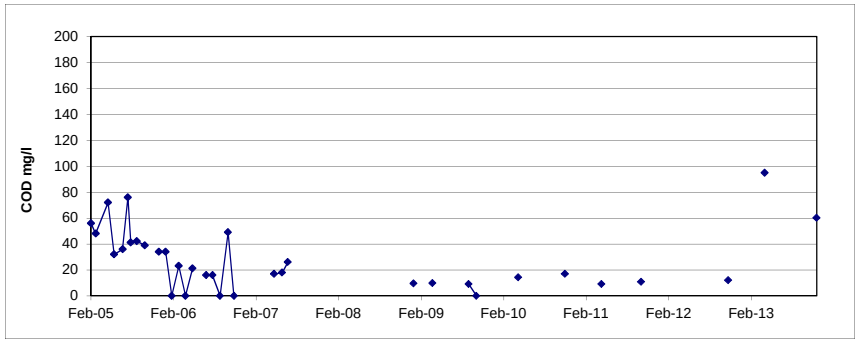

Water Level / mAOD
0
1
2
3
4
5
6
7
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

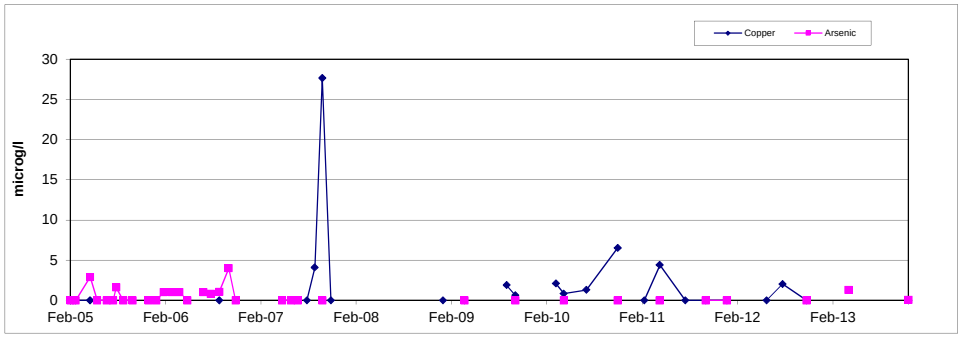

pH
EC
pH
EC microS/cm
0
1
2
3
4
5
6
7
8
9
0
1000
2000
3000
4000
5000
6000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

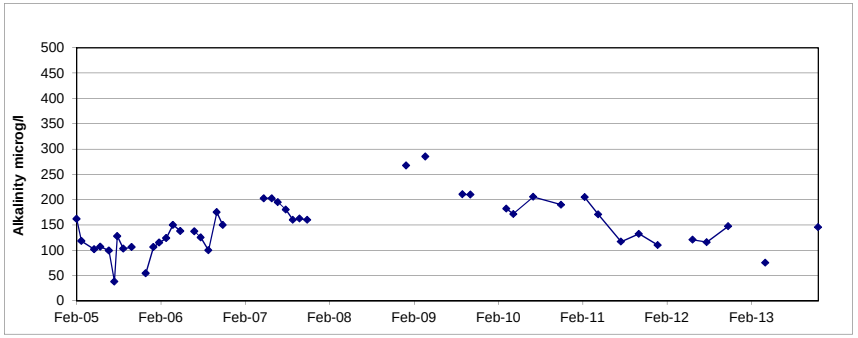

Trigger Level
Ammonia mg/l
0
2
4
6
8
10
12
14
16
18
20
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

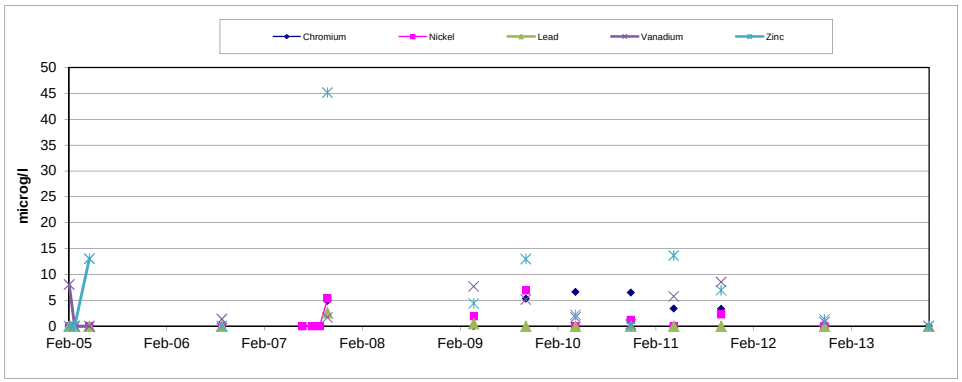

Trigger Level
Chloride mg/l
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

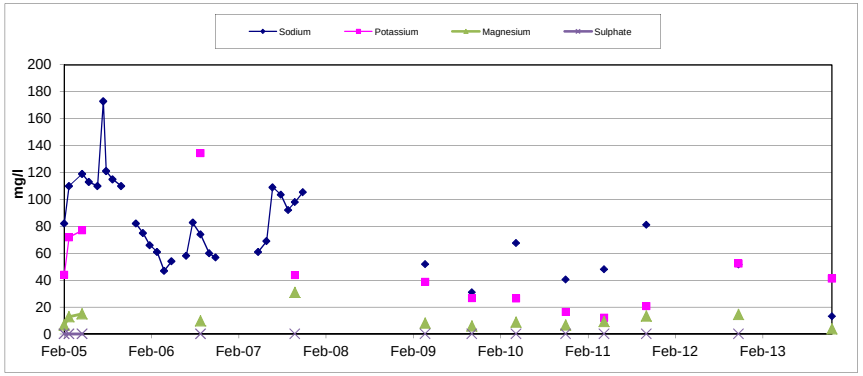

Trigger Level
Calcium mg/l
0
100
200
300
400
500
600
700
800
900
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

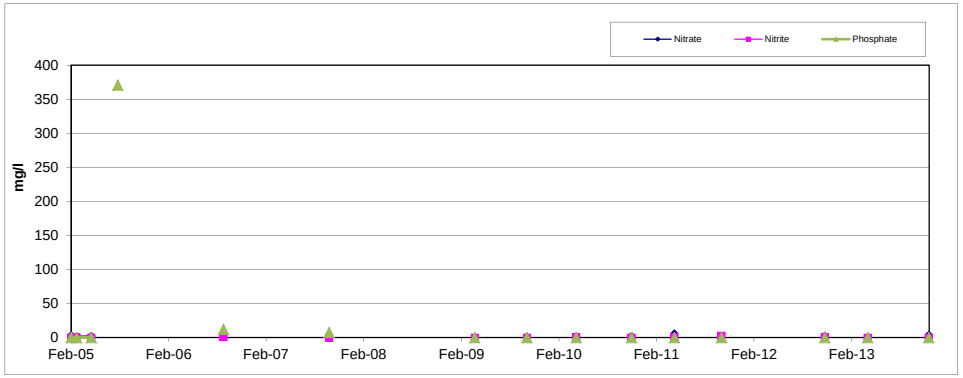

COD mg/l
0
20
40
60
80
100
120
140
160
180
200
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

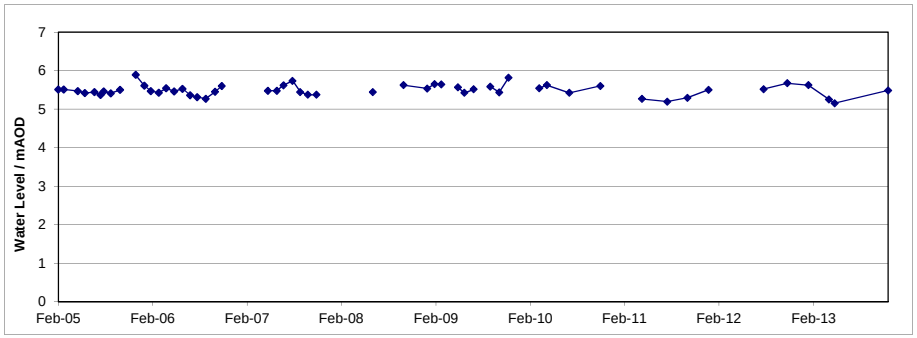

Copper
Arsenic
microg/l
30
25
20
15
10
5
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

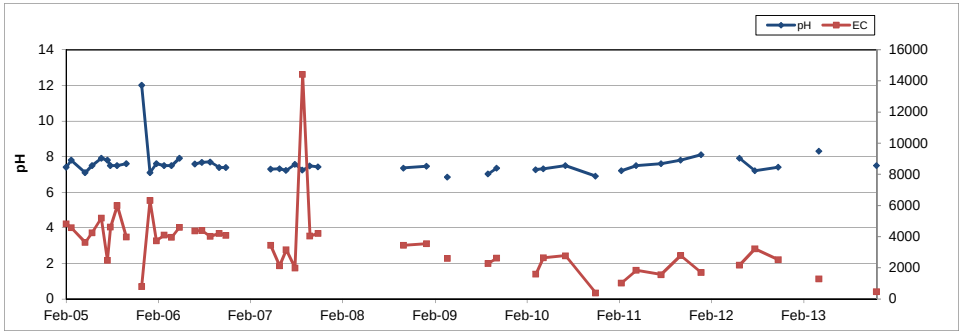

Alkalinity microg/l
500
450
400
350
300
250
200
150
100
50
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

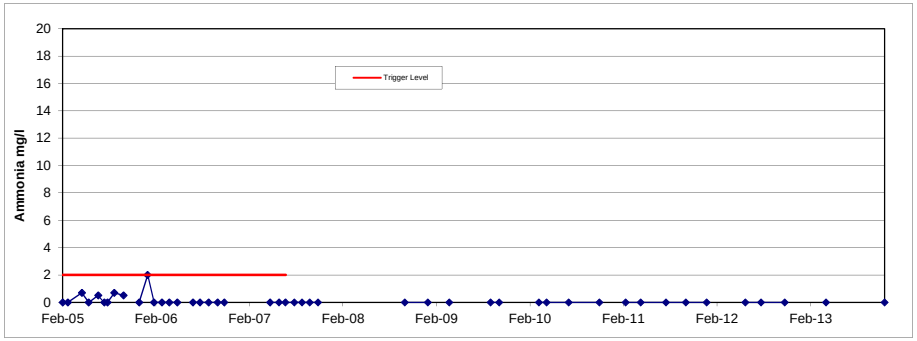

Chromium
Nickel
Lead
Vanadium
Zinc
microg/l
50
45
40
35
30
25
20
15
10
5
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

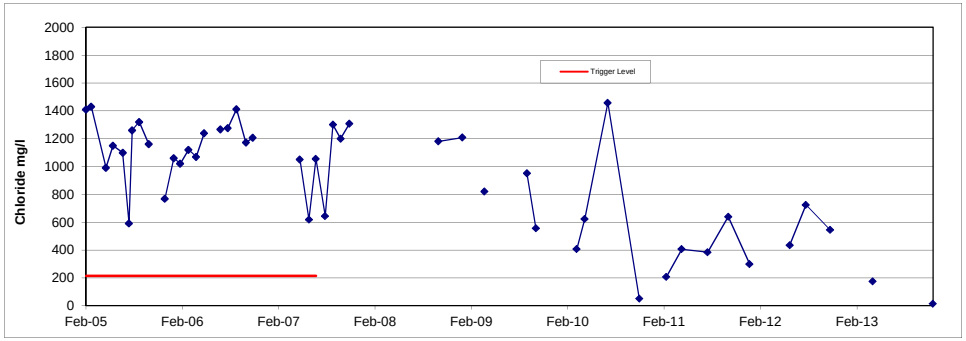

Sodium
Potassium
Magnesium
Sulphate
mg/l
200
180
160
140
120
100
80
60
40
20
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

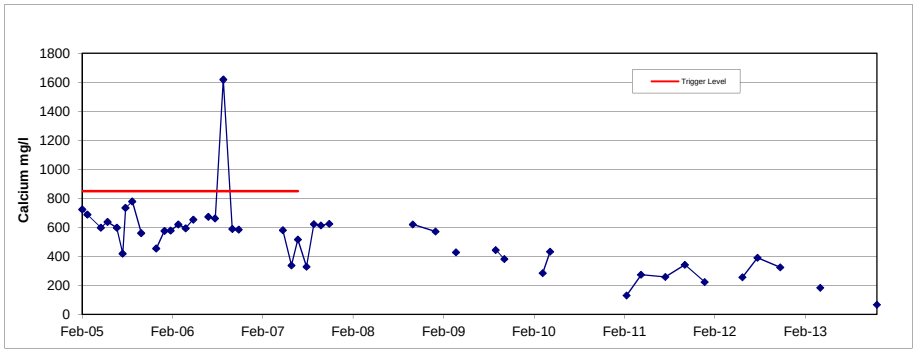

Nitrate
Nitrite
Phosphate
mg/l
400
350
300
250
200
150
100
50
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

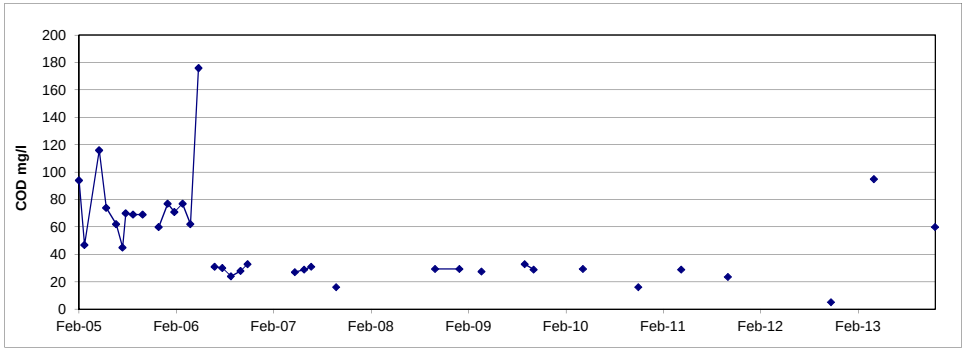

Water Level / mAOD
0
1
2
3
4
5
6
7
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

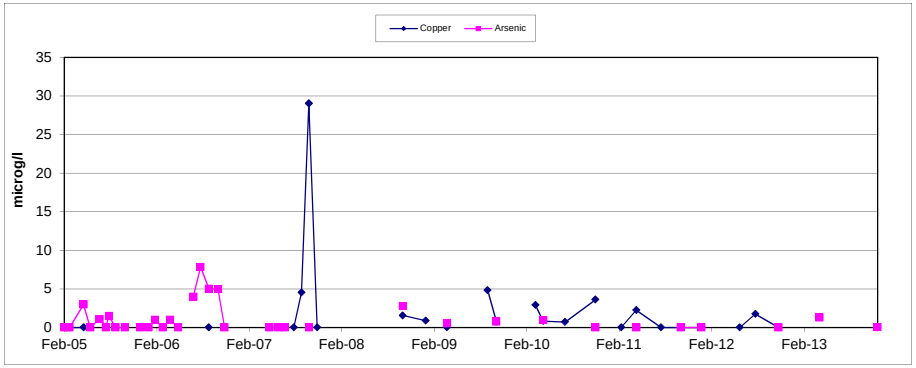

pH
EC
pH
0
2
4
6
8
10
12
14
0
2000
4000
6000
8000
10000
12000
14000
16000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

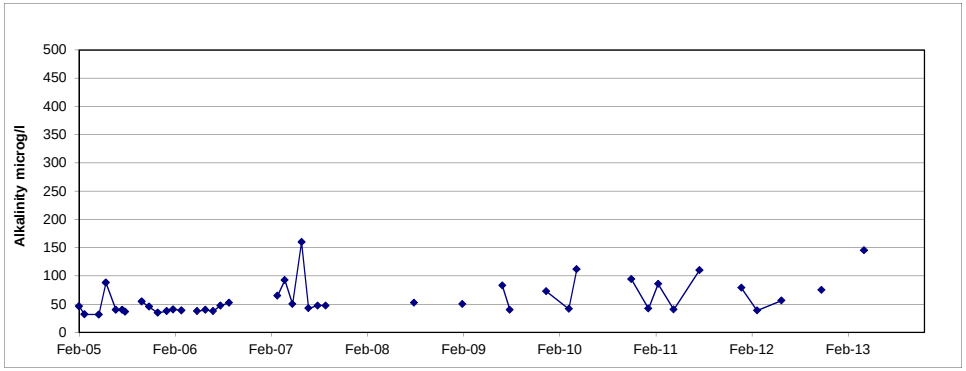

Trigger Level
Ammonia mg/l
0
2
4
6
8
10
12
14
16
18
20
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

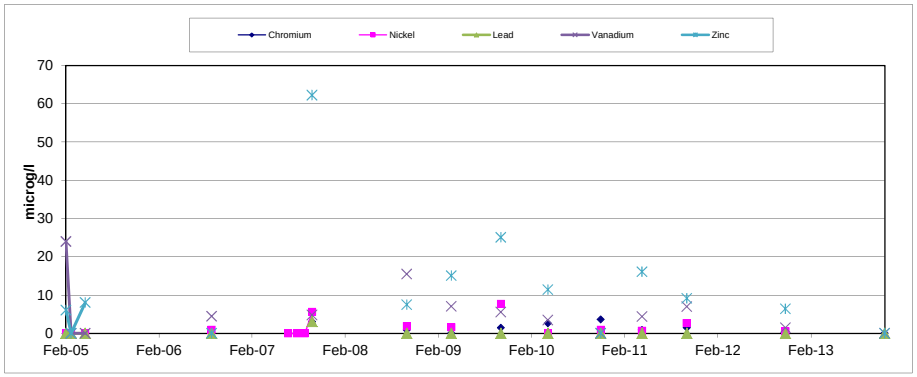

Trigger Level
Chloride mg/l
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

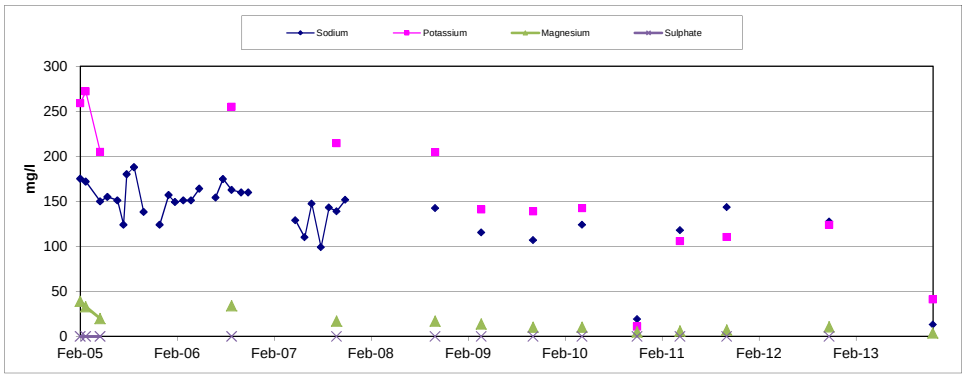

Trigger Level
Calcium mg/l
0
200
400
600
800
1000
1200
1400
1600
1800
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

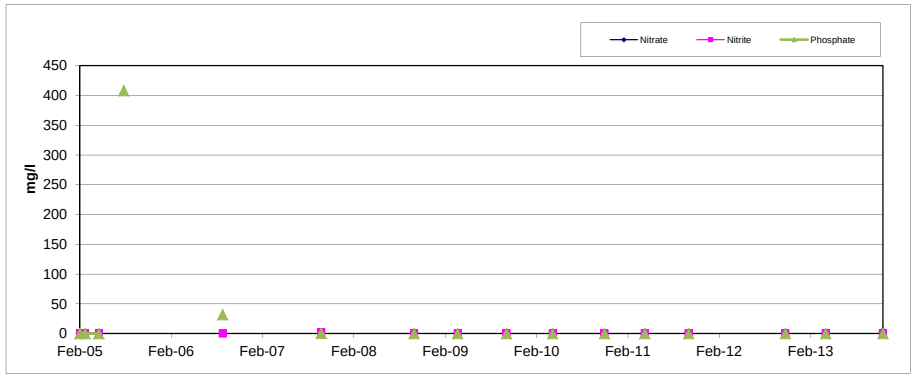

COD mg/l
0
20
40
60
80
100
120
140
160
180
200
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

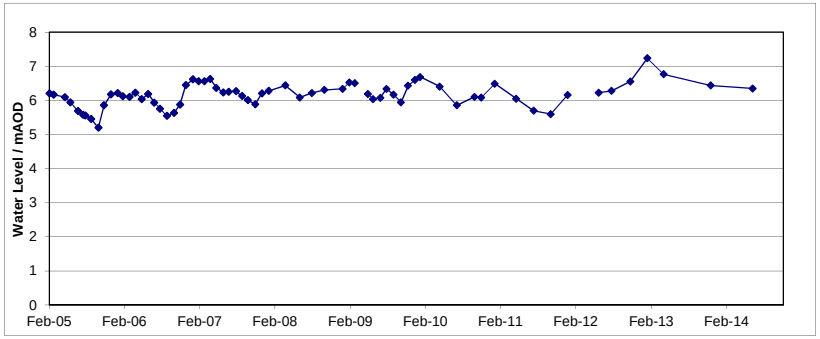

Copper
Arsenic
microg/l
0
5
10
15
20
25
30
35
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

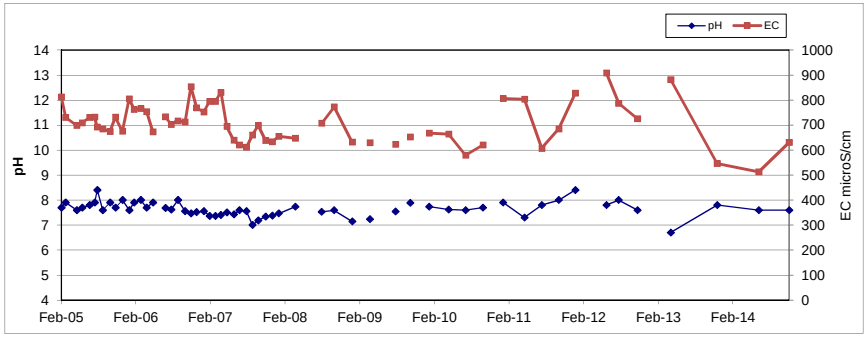

Alkalinity microg/l
0
50
100
150
200
250
300
350
400
450
500
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

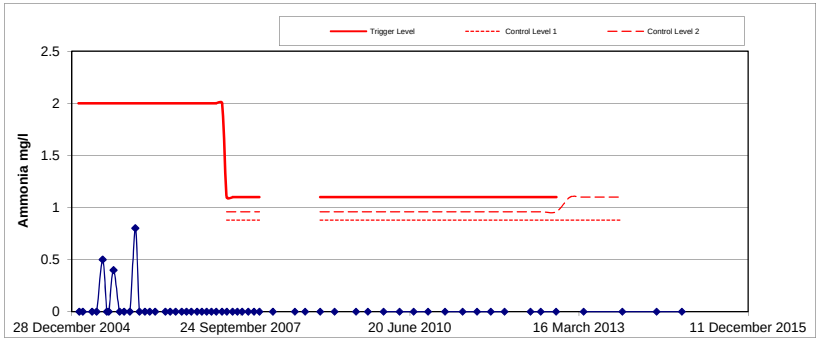

Chromium
Nickel
Lead
Vanadium
Zinc
microg/l
0
10
20
30
40
50
60
70
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

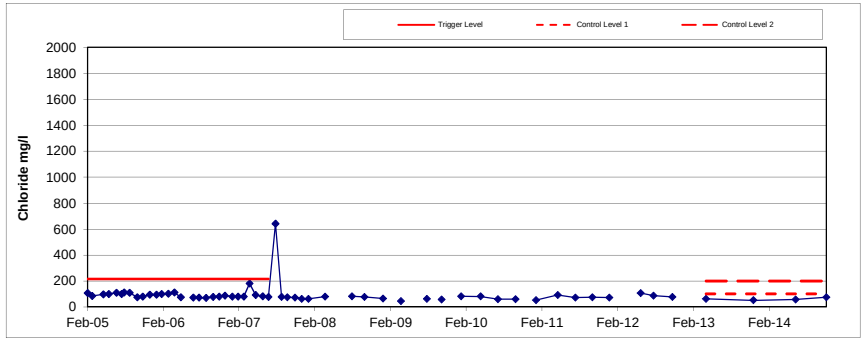

Sodium
Potassium
Magnesium
Sulphate
mg/l
0
50
100
150
200
250
300
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

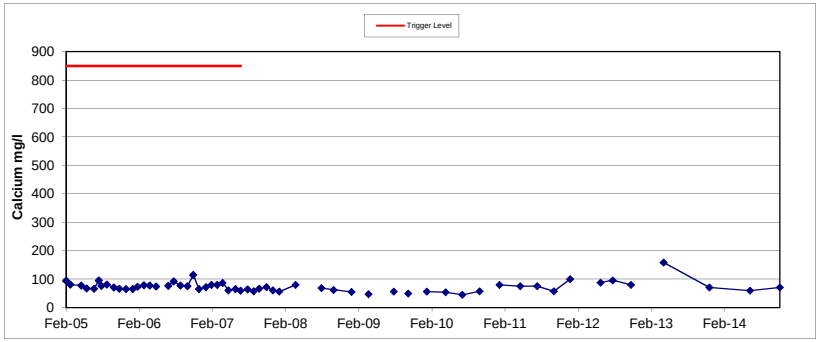

Nitrate
Nitrite
Phosphate
mg/l
0
50
100
150
200
250
300
350
400
450
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

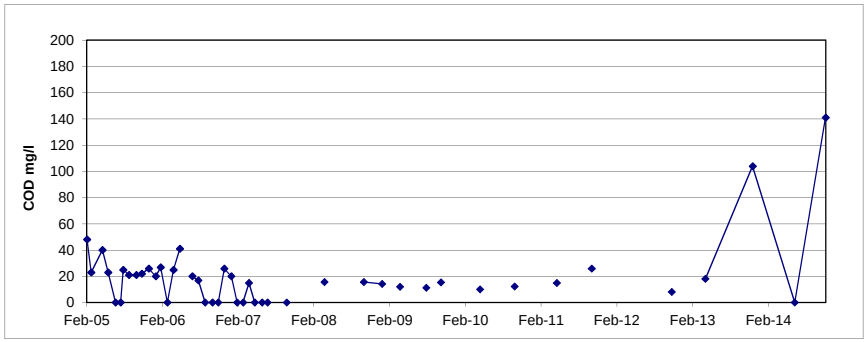

Water Level / mAOD
0
1
2
3
4
5
6
7
8
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

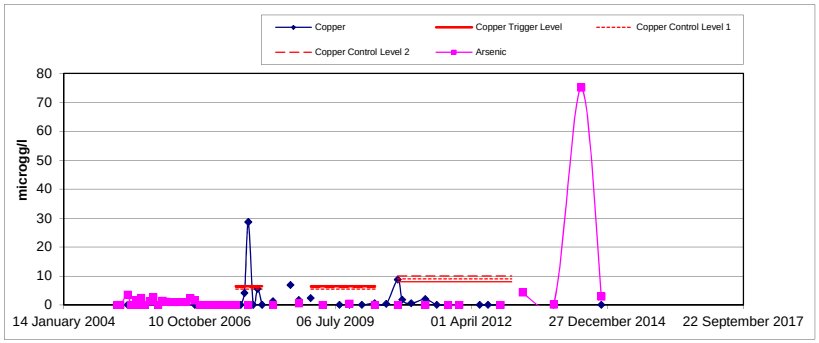

pH
EC
pH
EC microS/cm
4
5
6
7
8
9
10
11
12
13
14
0
100
200
300
400
500
600
700
800
900
1000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

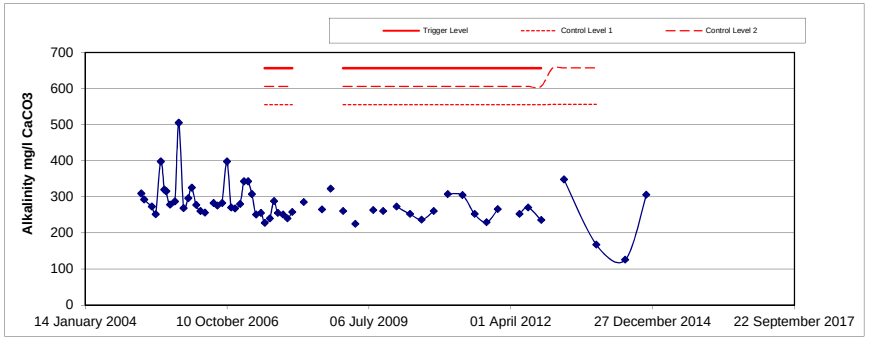

Trigger Level
Control Level 1
Control Level 2
Ammonia mg/l
0
0.5
1
1.5
2
2.5
28 December 2004
24 September 2007
20 June 2010
16 March 2013
11 December 2015

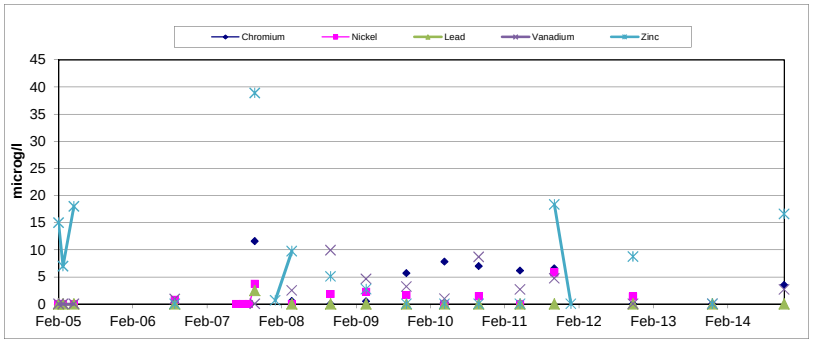

Trigger Level
Control Level 1
Control Level 2
Chloride mg/l
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

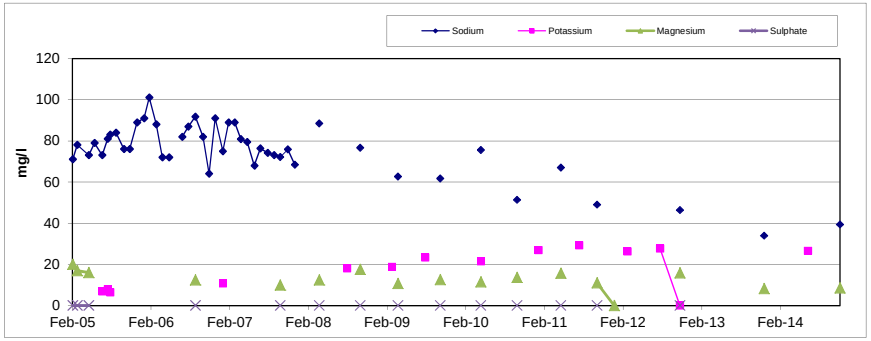

Trigger Level
Calcium mg/l
0
100
200
300
400
500
600
700
800
900
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

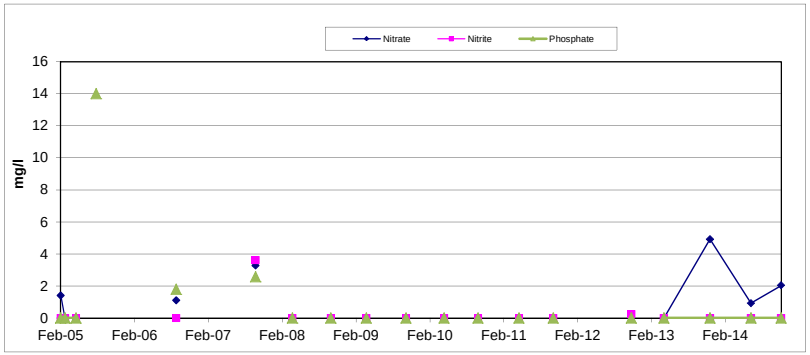

COD mg/l
0
20
40
60
80
100
120
140
160
180
200
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

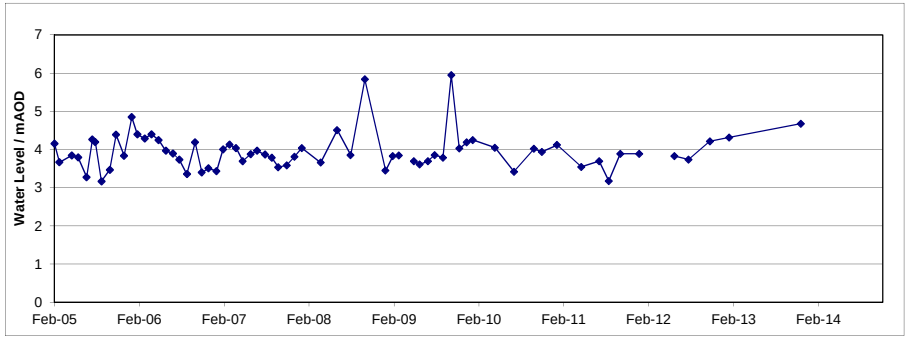

Copper
Copper Trigger Level
Copper Control Level 1
Copper Control Level 2
Arsenic
microgg/l
0
10
20
30
40
50
60
70
80
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

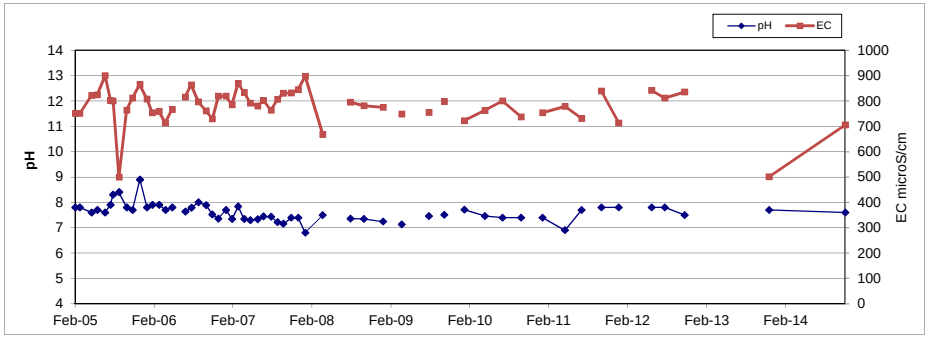

Trigger Level
Control Level 1
Control Level 2
Alkalinity mg/l CaCO3
0
100
200
300
400
500
600
700
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

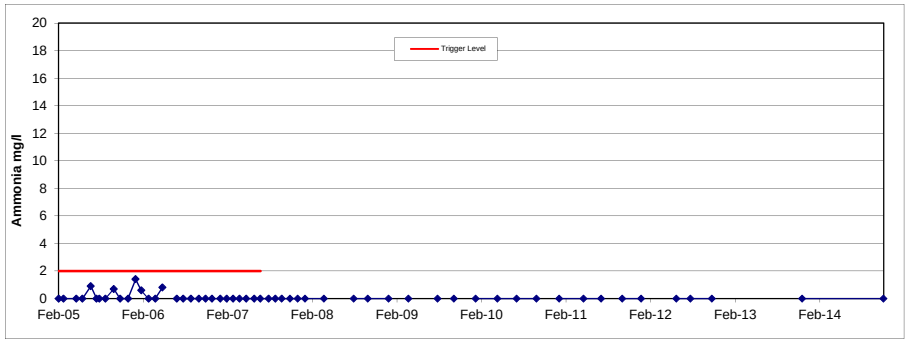

Chromium
Nickel
Lead
Vanadium
Zinc
microg/l
0
5
10
15
20
25
30
35
40
45
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

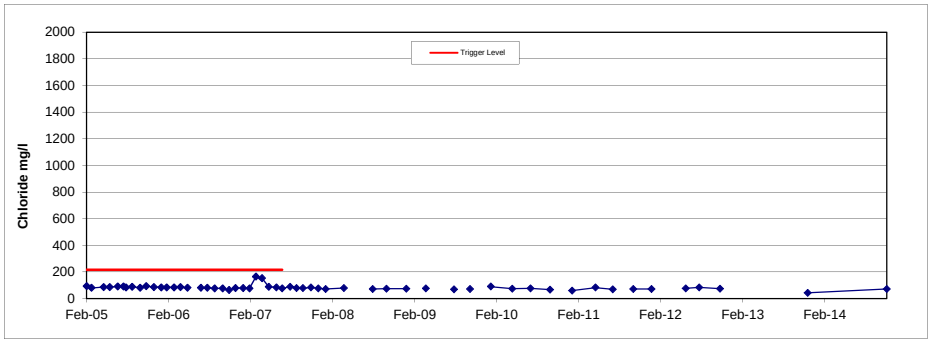

Sodium
Potassium
Magnesium
Sulphate
mg/l
0
20
40
60
80
100
120
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

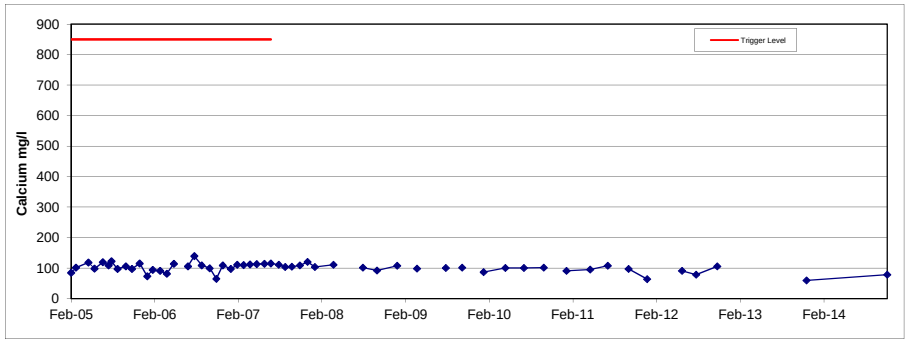

Nitrate
Nitrite
Phosphate
mg/l
0
2
4
6
8
10
12
14
16
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

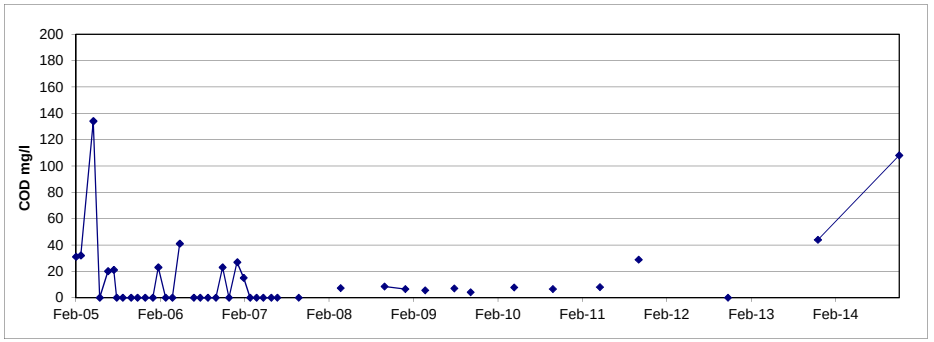

Water Level / mAOD
0
1
2
3
4
5
6
7
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

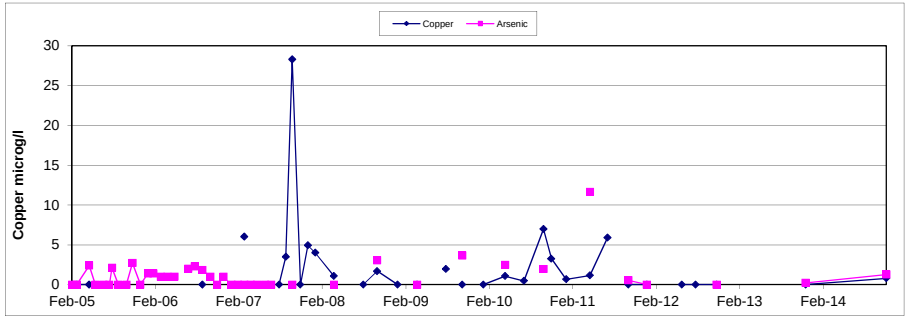

pH
EC
pH
EC microS/cm
4
5
6
7
8
9
10
11
12
13
14
0
100
200
300
400
500
600
700
800
900
1000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

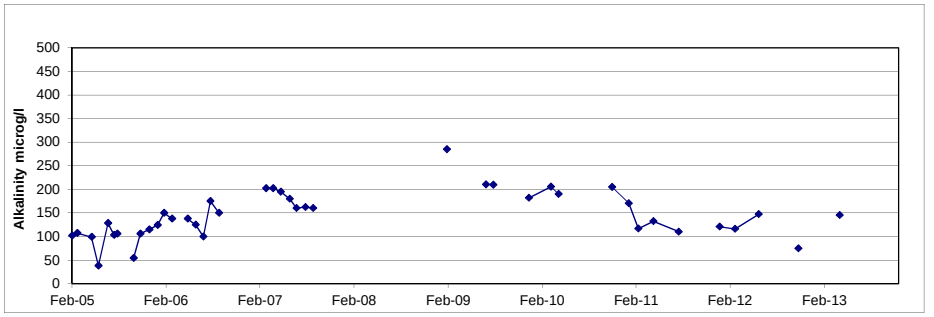

Trigger Level
Ammonia mg/l
0
2
4
6
8
10
12
14
16
18
20
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

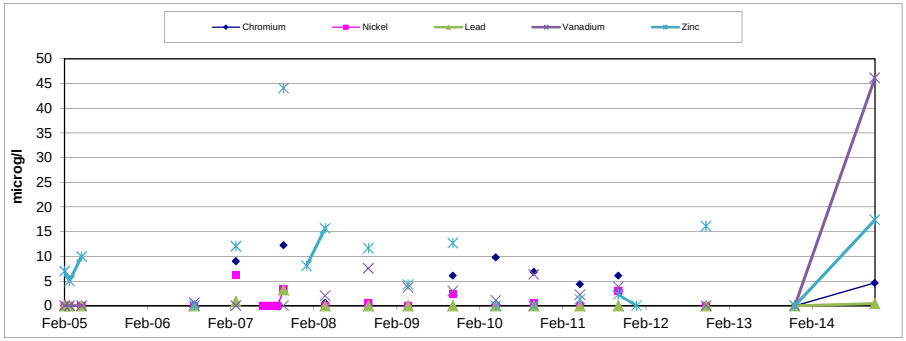

Trigger Level
Chloride mg/l
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

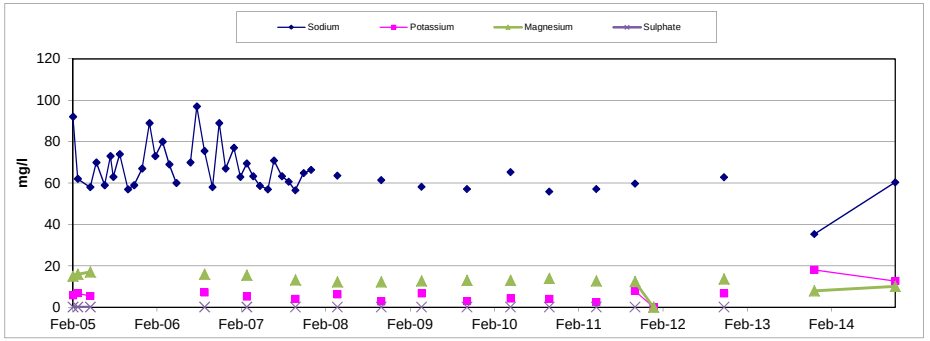

Trigger Level
Calcium mg/l
0
100
200
300
400
500
600
700
800
900
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

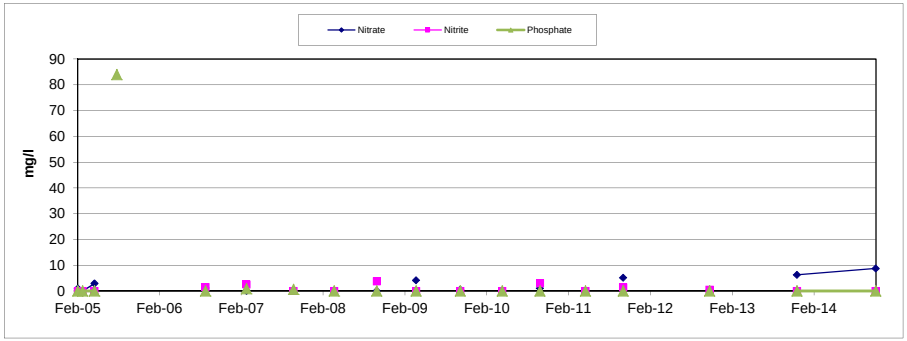

COD mg/l
0
20
40
60
80
100
120
140
160
180
200
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

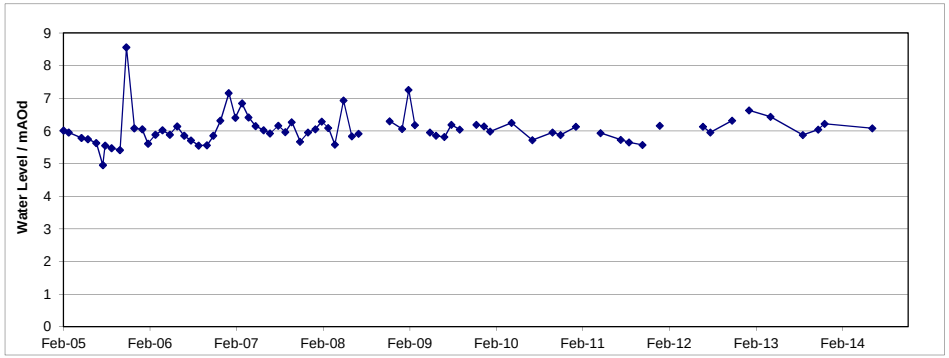

Copper
Arsenic
Copper microg/l
30
25
20
15
10
5
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

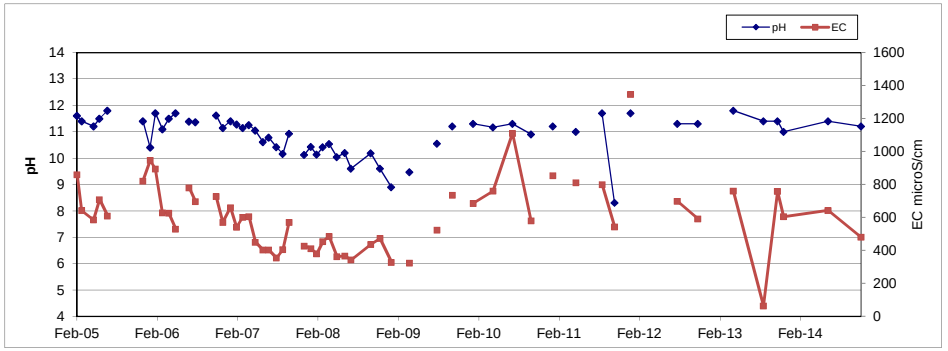

Alkalinity microg/l
500
450
400
350
300
250
200
150
100
50
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13

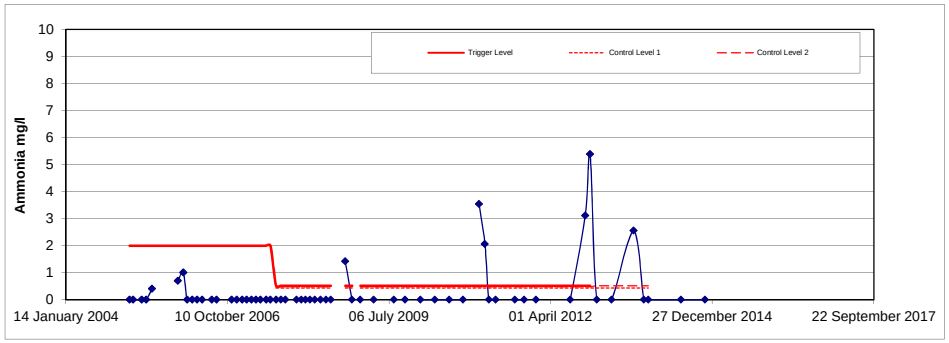

Chromium
Nickel
Lead
Vanadium
Zinc
microg/l
50
45
40
35
30
25
20
15
10
5
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

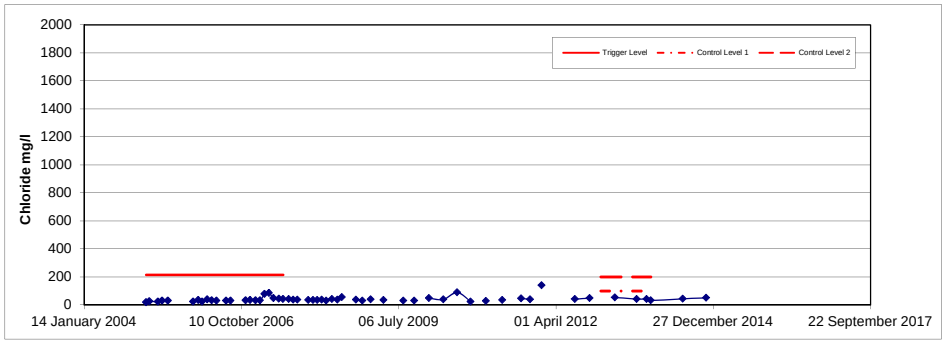

Sodium
Potassium
Magnesium
Sulphate
mg/l
120
100
80
60
40
20
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

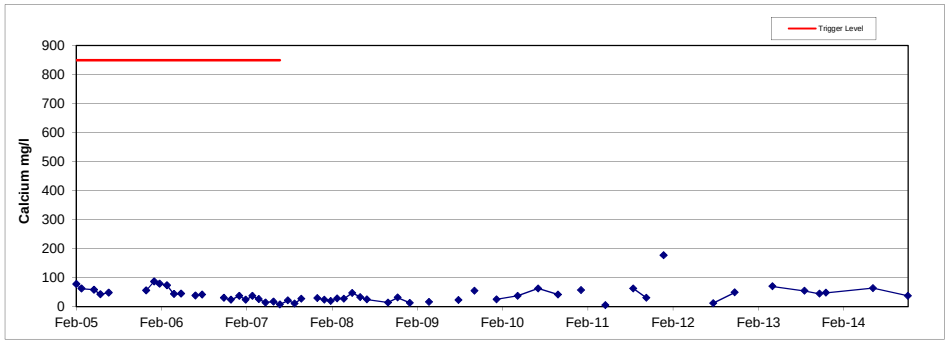

Nitrate
Nitrite
Phosphate
mg/l
90
80
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

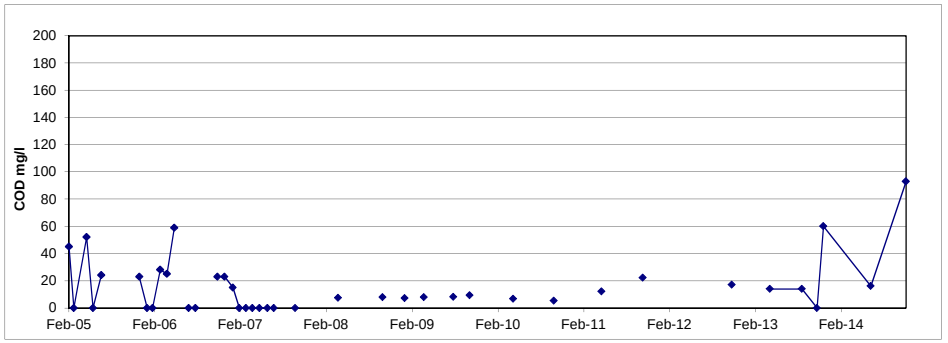

Water Level / mAOd
0
1
2
3
4
5
6
7
8
9
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

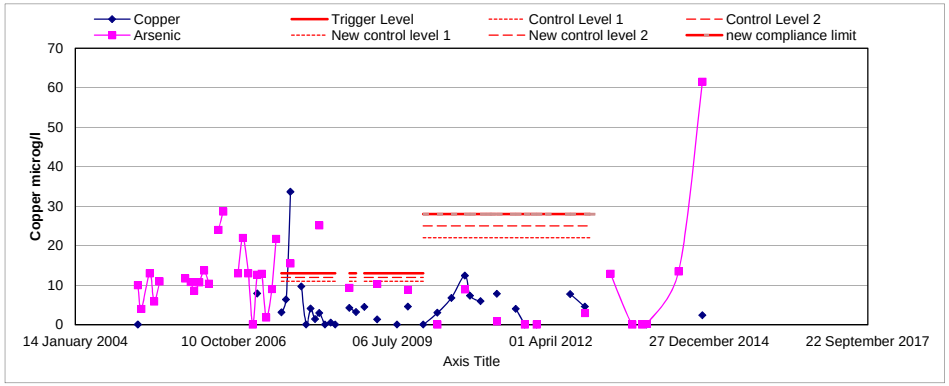

pH
EC
pH
EC microS/cm
4
5
6
7
8
9
10
11
12
13
14
0
200
400
600
800
1000
1200
1400
1600
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

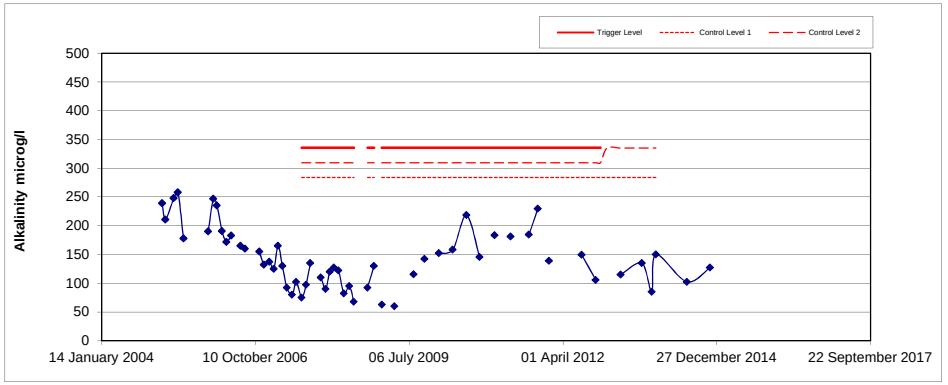

Trigger Level
Control Level 1
Control Level 2
Ammonia mg/l
0
1
2
3
4
5
6
7
8
9
10
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

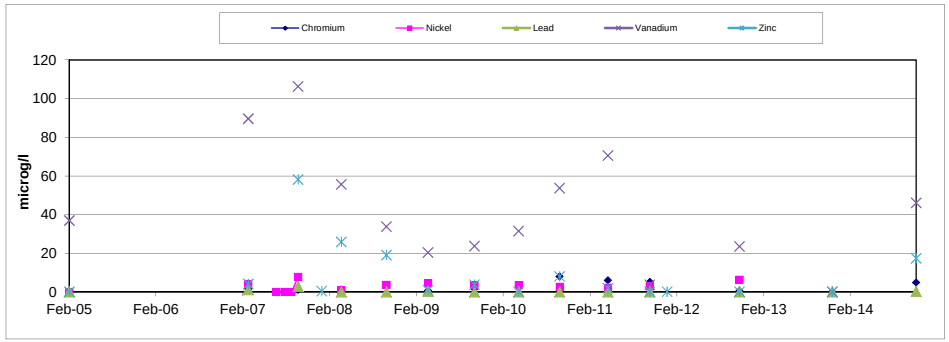

Trigger Level
Control Level 1
Control Level 2
Chloride mg/l
0
200
400
600
800
1000
1200
1400
1600
1800
2000
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

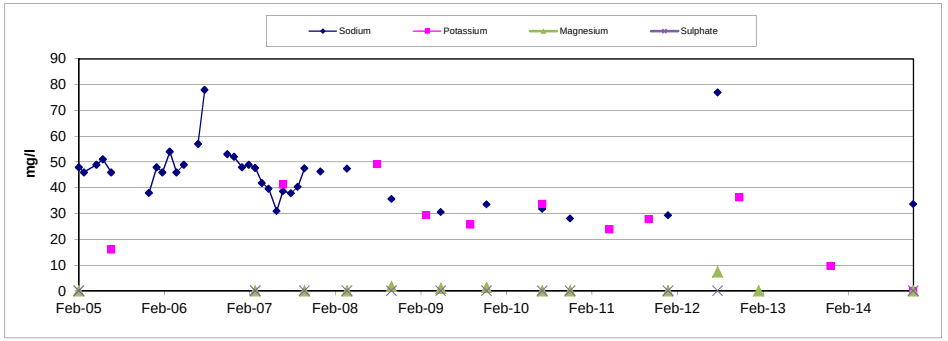

Trigger Level
Calcium mg/l
0
100
200
300
400
500
600
700
800
900
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

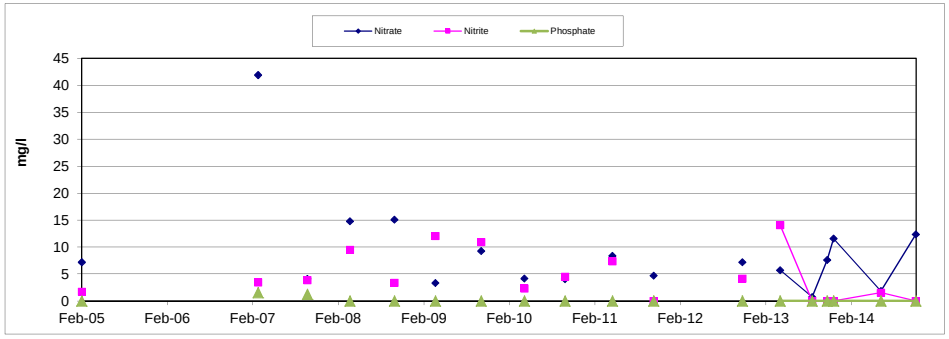

COD mg/l
0
20
40
60
80
100
120
140
160
180
200
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

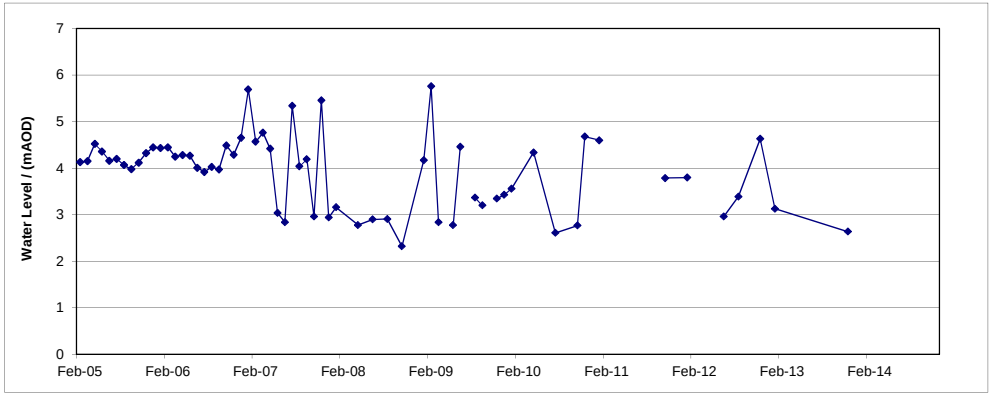

Copper
Arsenic
Trigger Level
New control level 1
Control Level 1
New control level 2
Control Level 2
new compliance limit
Copper microg/l
0
10
20
30
40
50
60
70
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017
Axis Title

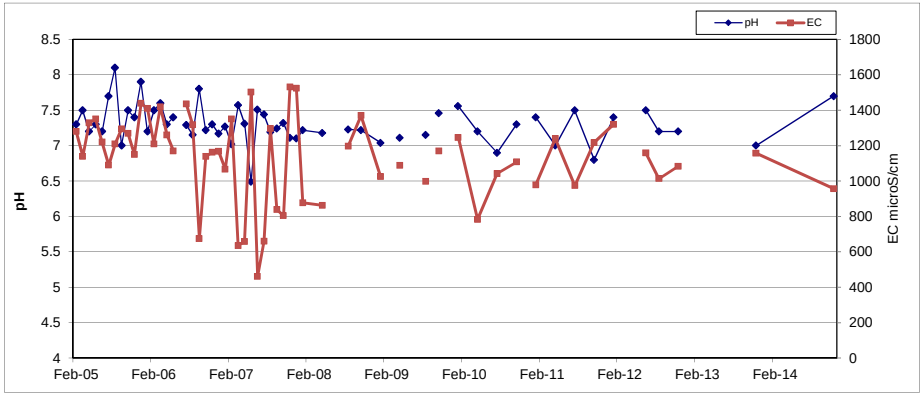

Trigger Level
Control Level 1
Control Level 2
Alkalinity microg/l
0
50
100
150
200
250
300
350
400
450
500
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

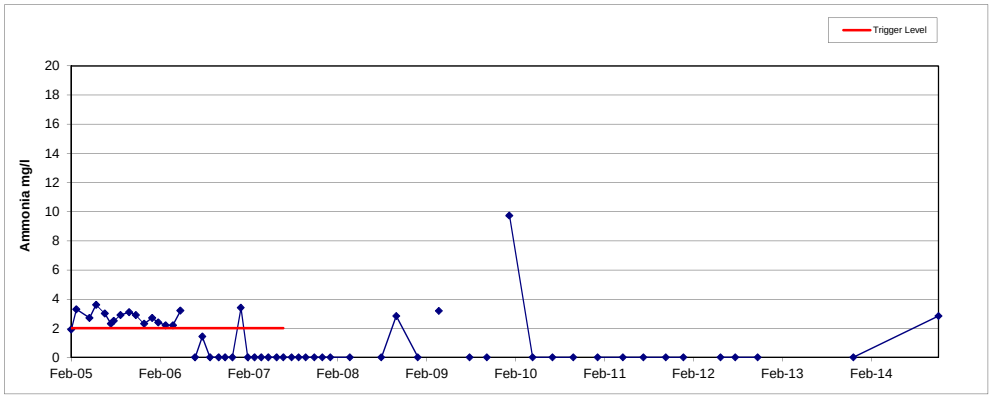

Chromium
Nickel
Lead
Vanadium
Zinc
microg/l
0
20
40
60
80
100
120
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

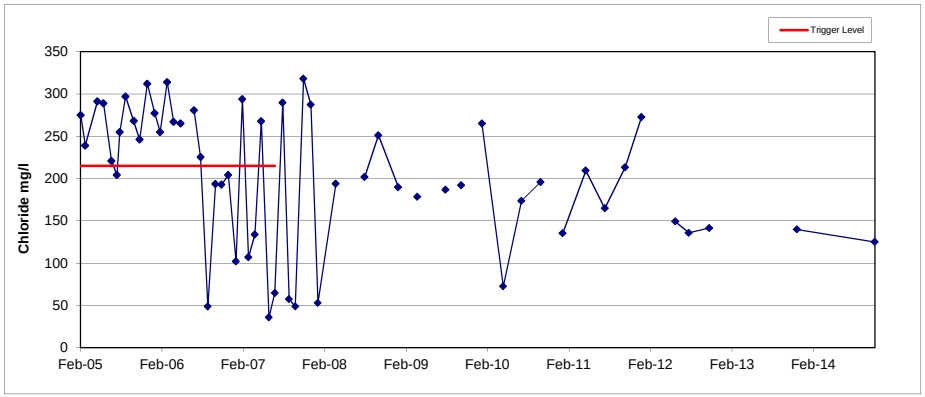

Sodium
Potassium
Magnesium
Sulphate
mg/l
0
10
20
30
40
50
60
70
80
90
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

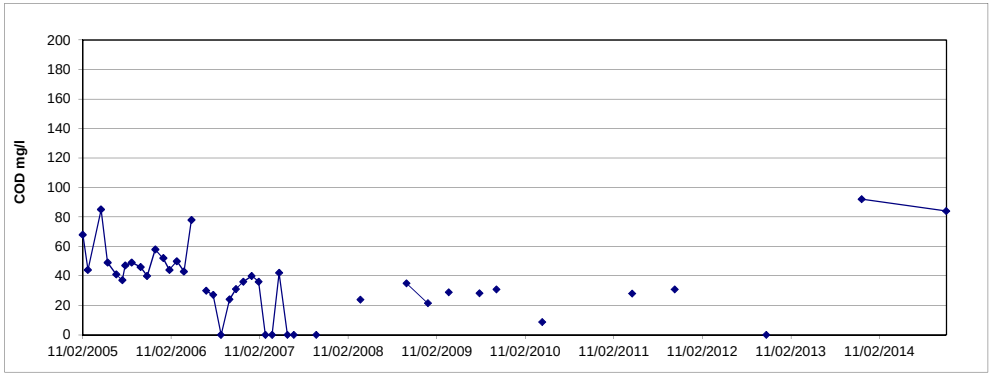

Nitrate
Nitrite
Phosphate
mg/l
0
5
10
15
20
25
30
35
40
45
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

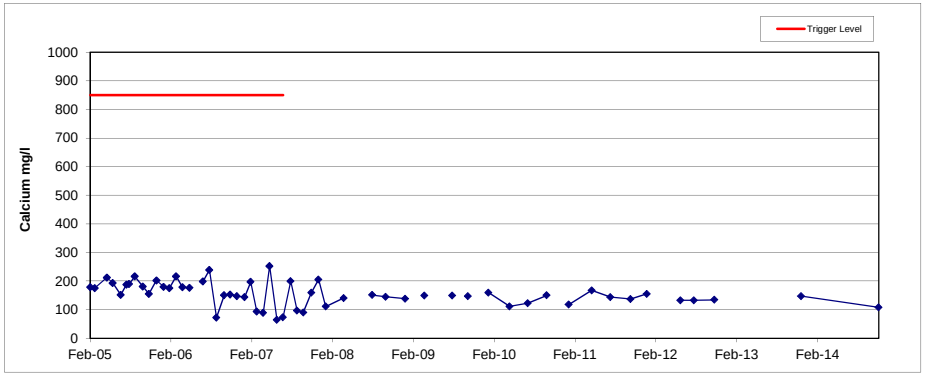

Water Level / (mAOD)
0
1
2
3
4
5
6
7
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

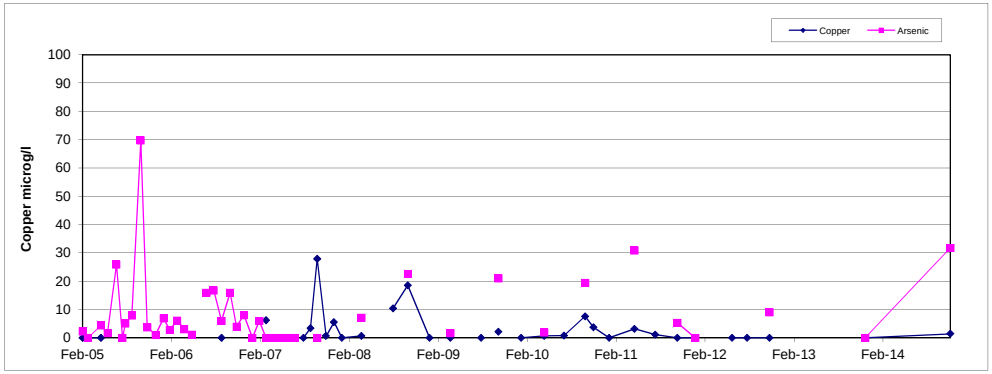

pH
EC
pH
EC microS/cm
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
0
200
400
600
800
1000
1200
1400
1600
1800
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

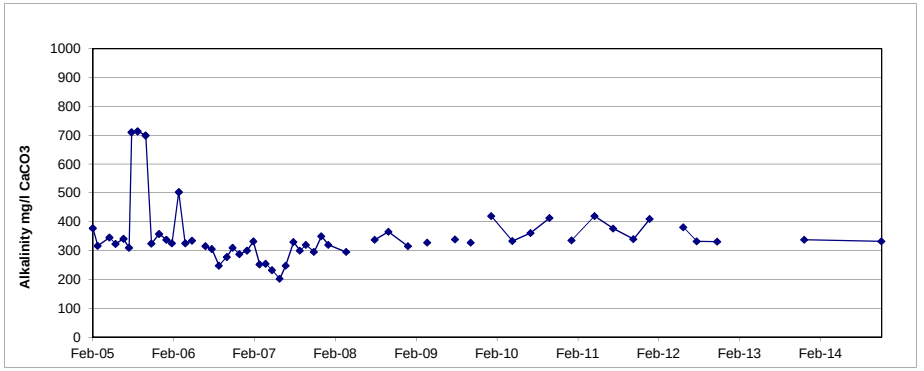

Trigger Level
Ammonia mg/l
0
2
4
6
8
10
12
14
16
18
20
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

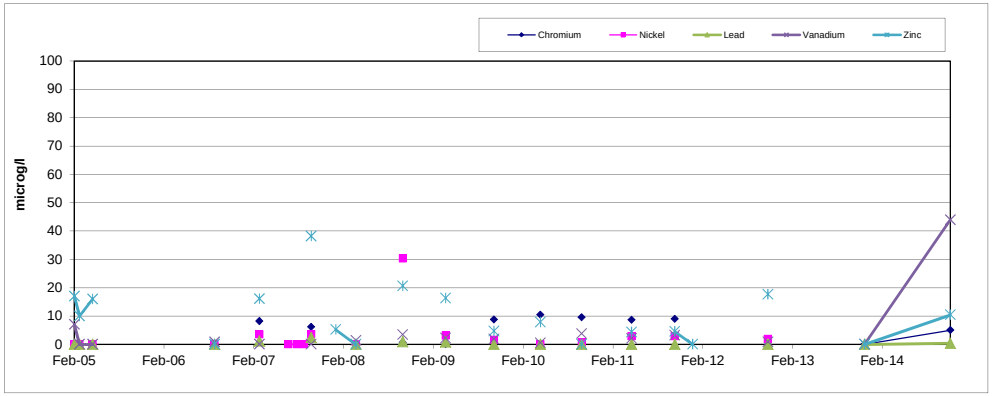

Trigger Level
Chloride mg/l
0
50
100
150
200
250
300
350
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

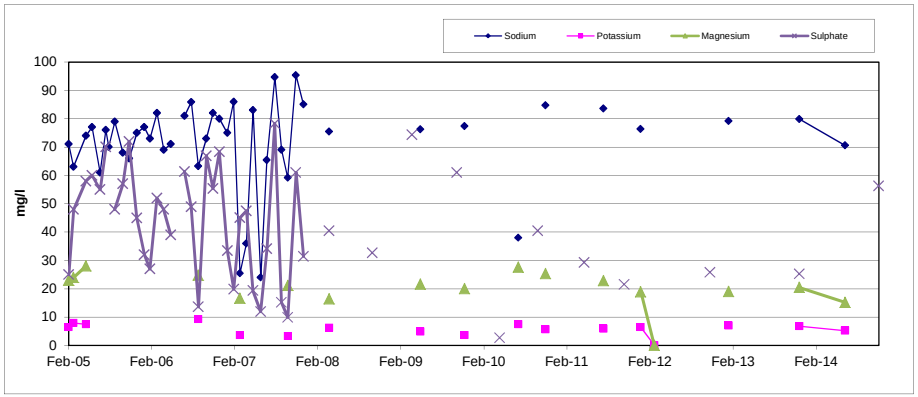

COD mg/l
0
20
40
60
80
100
120
140
160
180
200
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

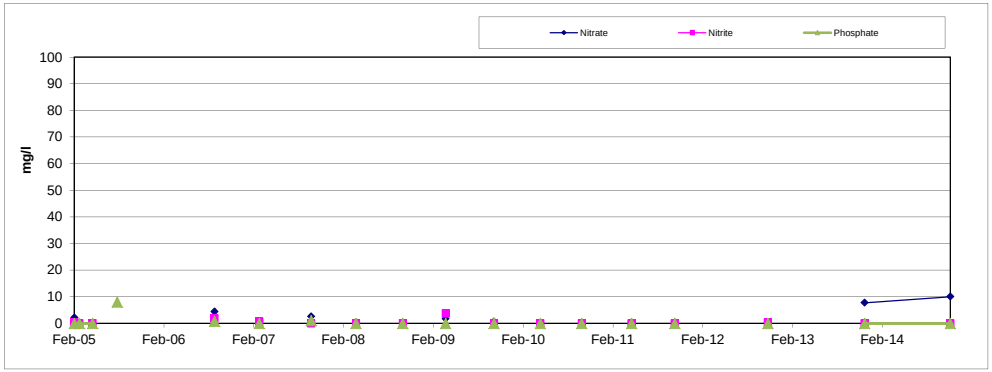

Trigger Level
Calcium mg/l
0
100
200
300
400
500
600
700
800
900
1000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

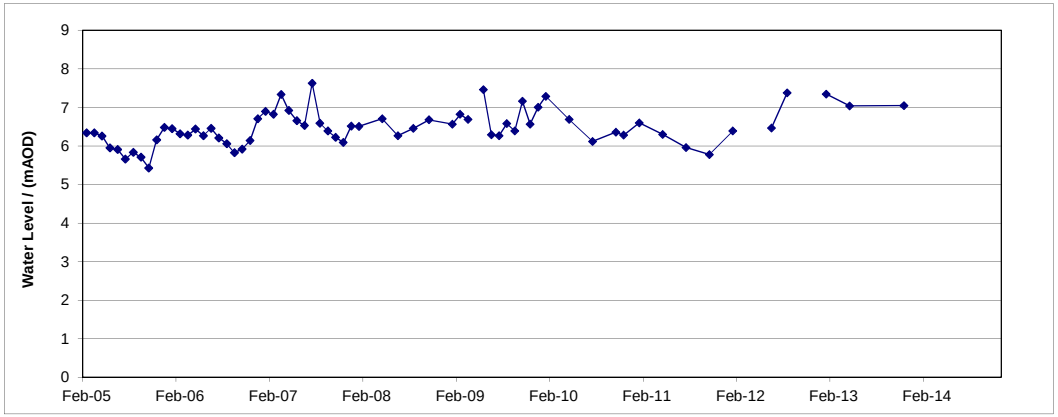

Copper
Arsenic
Copper microg/l
100
90
80
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

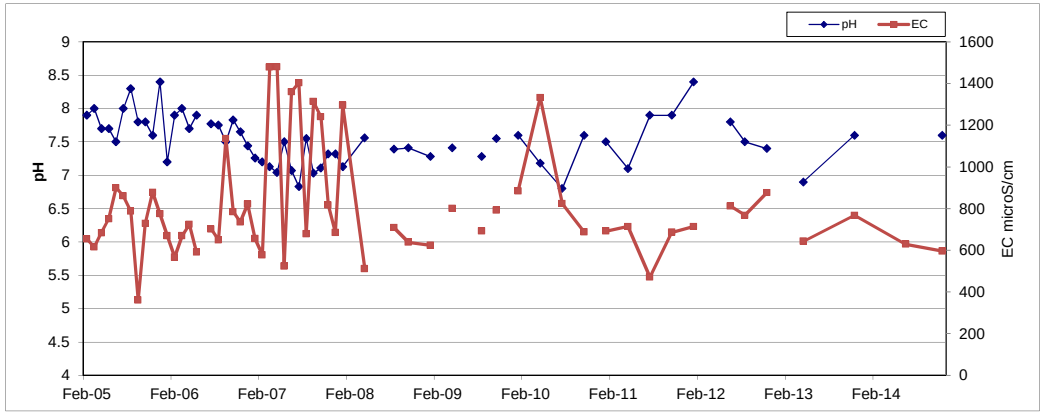

Alkalinity mg/l CaCO3
1000
900
800
700
600
500
400
300
200
100
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

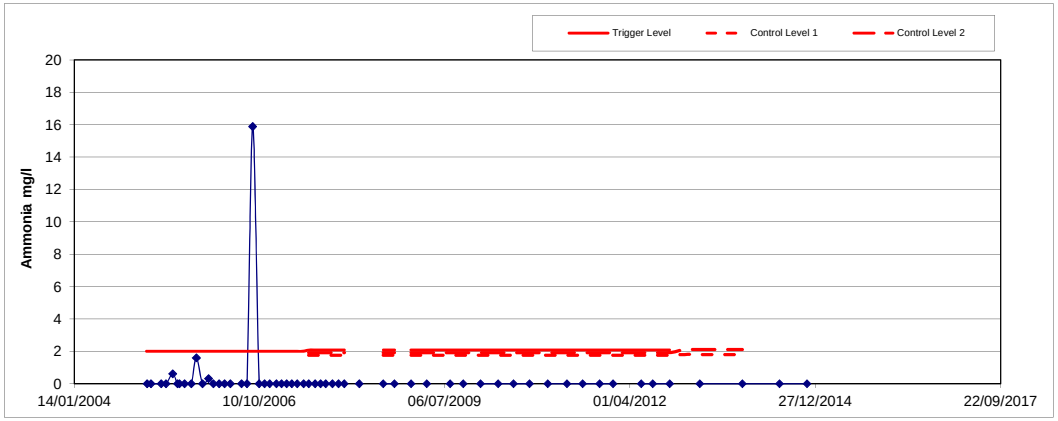

Chromium
Nickel
Lead
Vanadium
Zinc
microg/l
100
90
80
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

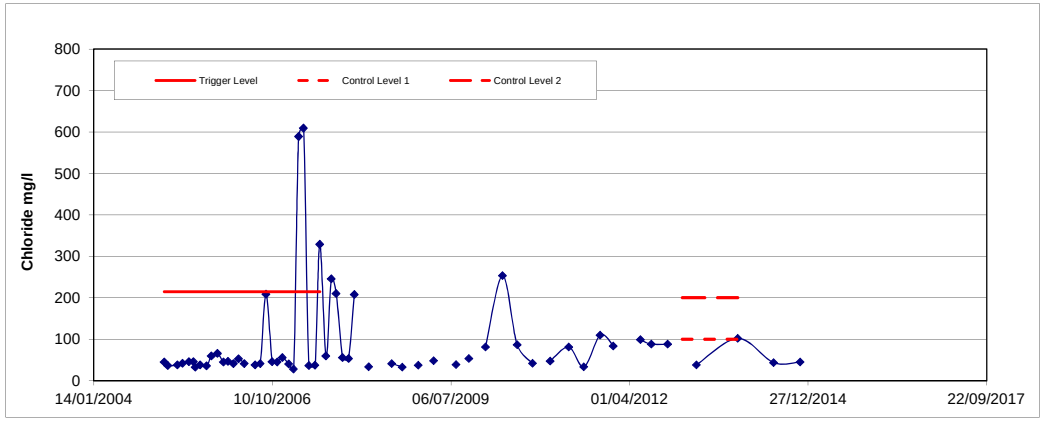

Sodium
Potassium
Magnesium
Sulphate
mg/l
100
90
80
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

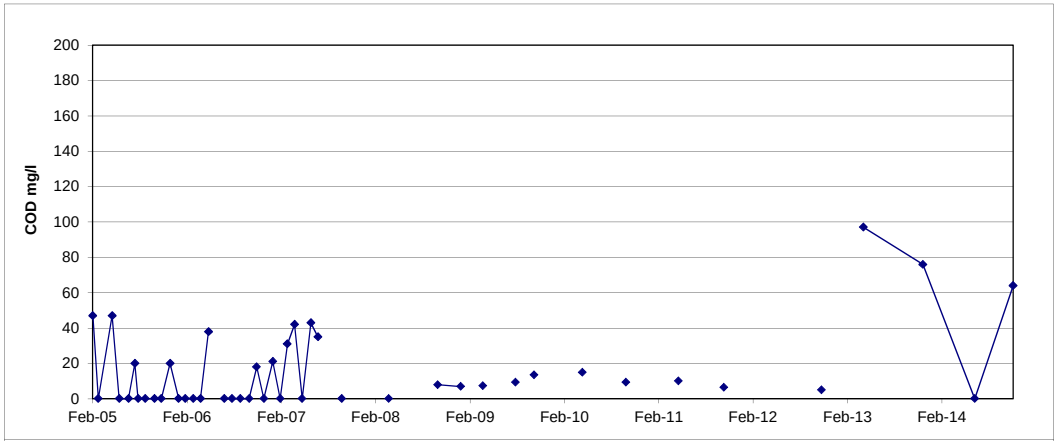

Nitrate
Nitrite
Phosphate
mg/l
100
90
80
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

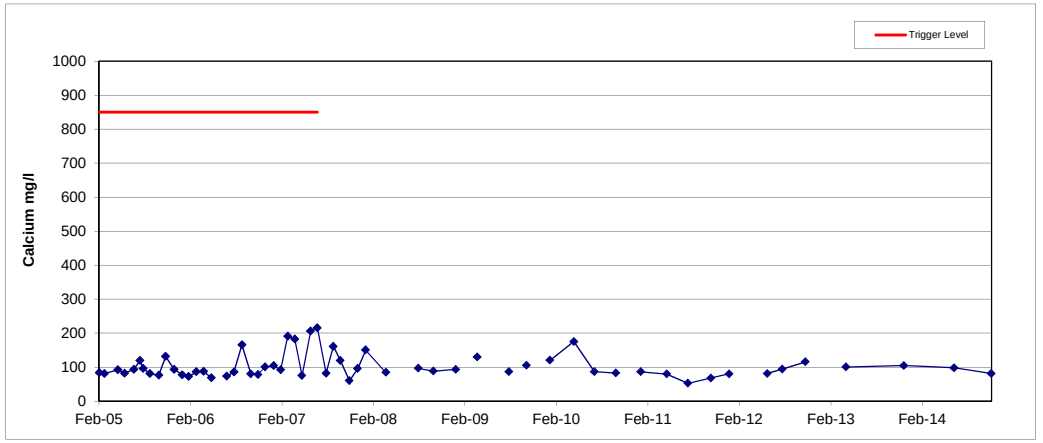

Water Level / (mAOD)
0
1
2
3
4
5
6
7
8
9
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

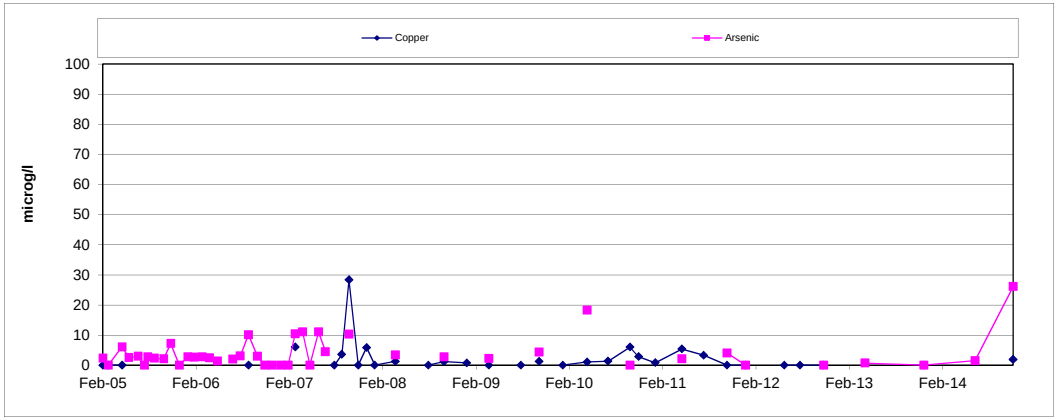

pH
EC
pH
EC micro S/cm
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
0
200
400
600
800
1000
1200
1400
1600
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

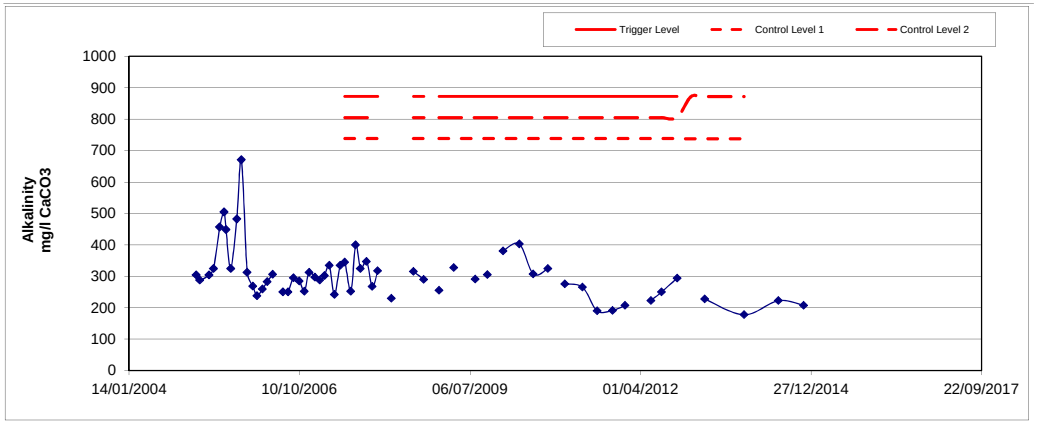

Trigger Level
Control Level 1
Control Level 2
Ammonia mg/l
0
2
4
6
8
10
12
14
16
18
20
14/01/2004
10/10/2006
06/07/2009
01/04/2012
27/12/2014
22/09/2017

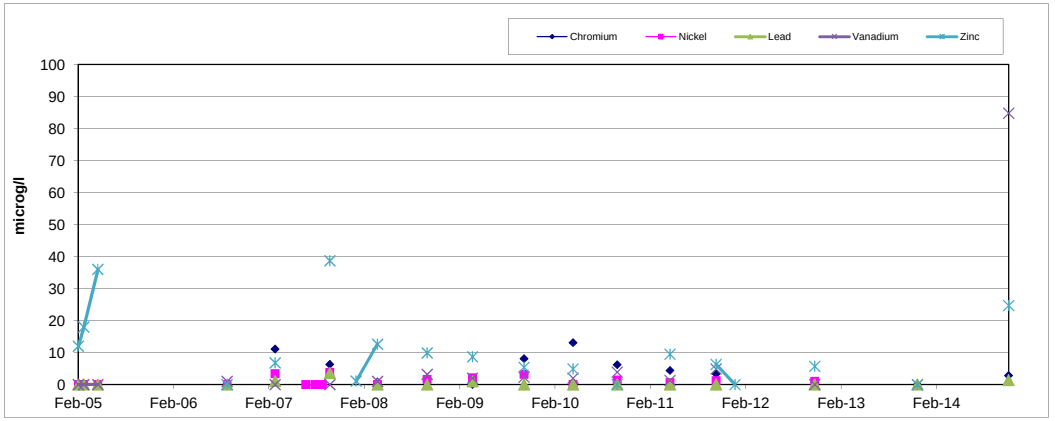

Trigger Level
Control Level 1
Control Level 2
Chloride mg/l
0
100
200
300
400
500
600
700
800
14/01/2004
10/10/2006
06/07/2009
01/04/2012
27/12/2014
22/09/2017

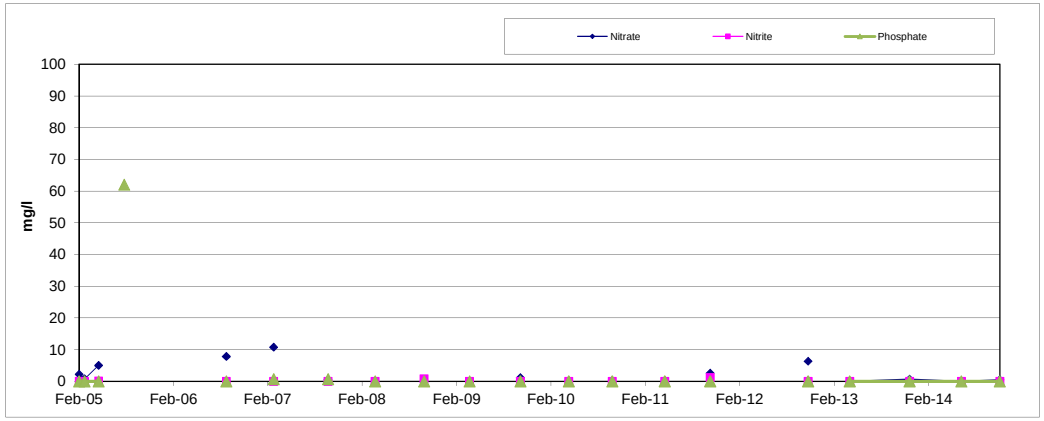

COD mg/l
0
20
40
60
80
100
120
140
160
180
200
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

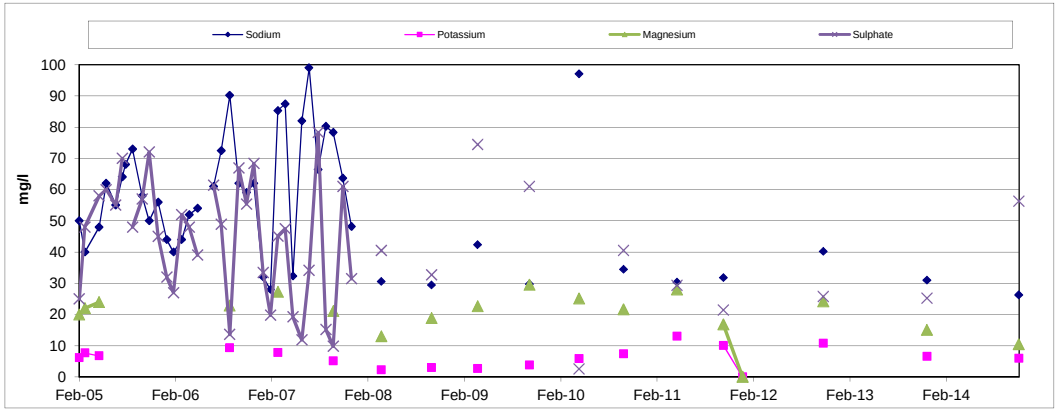

Trigger Level
Calcium mg/l
0
100
200
300
400
500
600
700
800
900
1000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

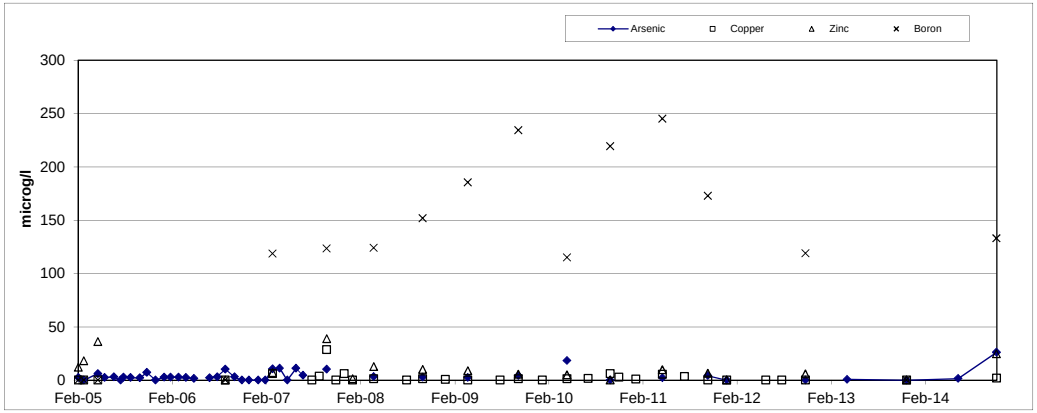

Copper
Arsenic
microg/l
100
90
80
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

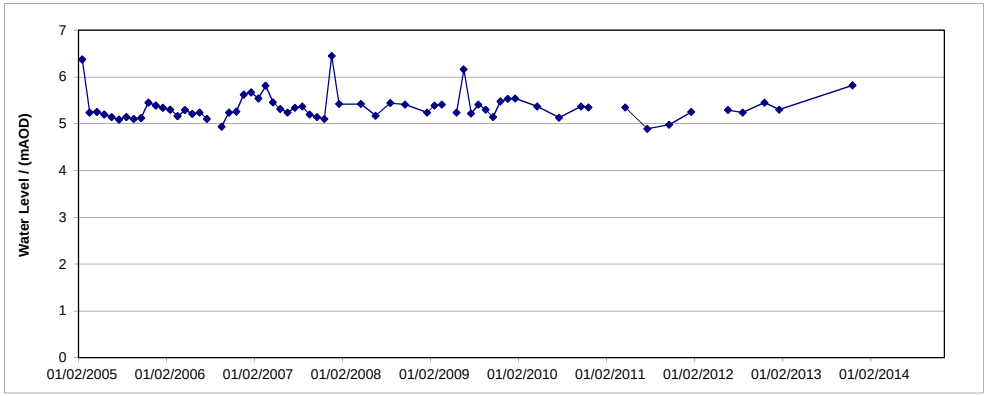

Trigger Level
Control Level 1
Control Level 2
Alkalinity mg/l CaCO3
1000
900
800
700
600
500
400
300
200
100
0
14/01/2004
10/10/2006
06/07/2009
01/04/2012
27/12/2014
22/09/2017

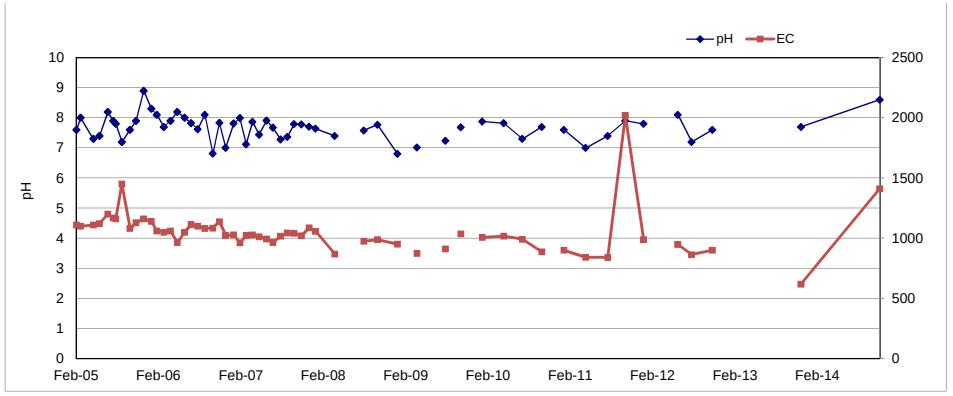

Chromium
Nickel
Lead
Vanadium
Zinc
microg/l
100
90
80
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

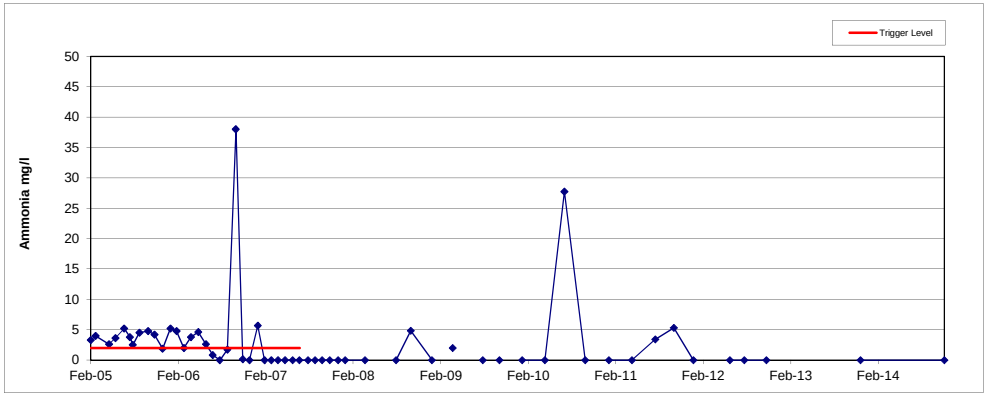

Nitrate
Nitrite
Phosphate
mg/l
100
90
80
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

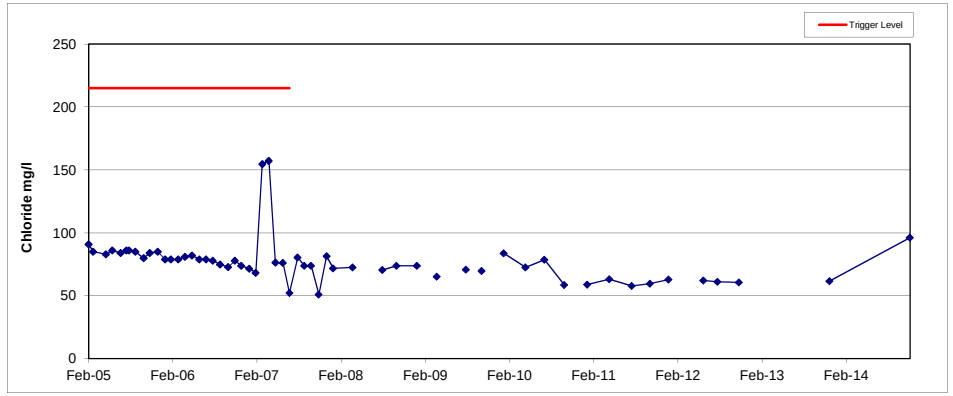

Sodium
Potassium
Magnesium
Sulphate
mg/l
100
90
80
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

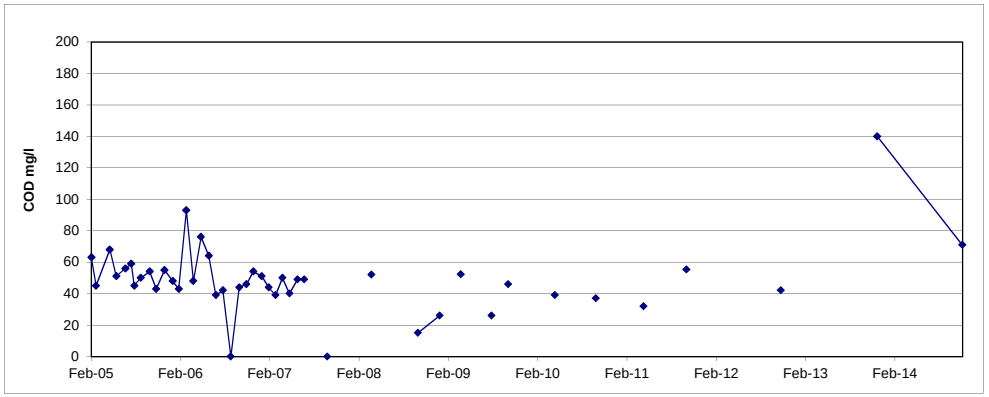

Arsenic
Copper
Zinc
Boron
microg/l
300
250
200
150
100
50
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

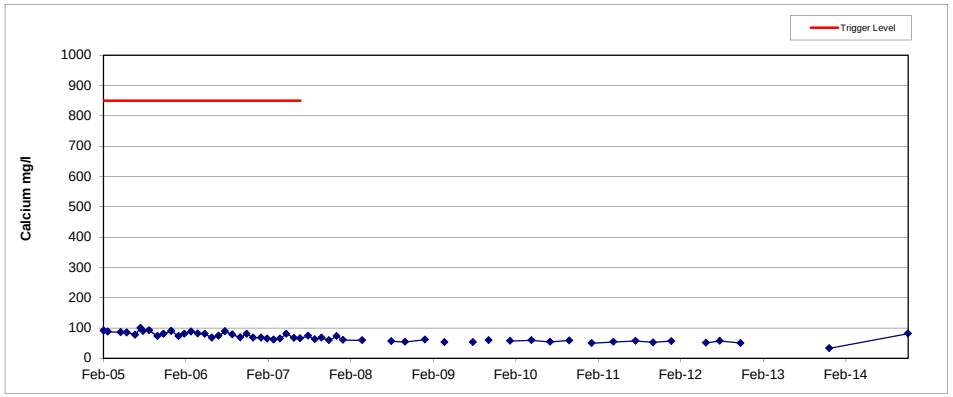

Water Level / (mAOD)
0
1
2
3
4
5
6
7
01/02/2005
01/02/2006
01/02/2007
01/02/2008
01/02/2009
01/02/2010
01/02/2011
01/02/2012
01/02/2013
01/02/2014

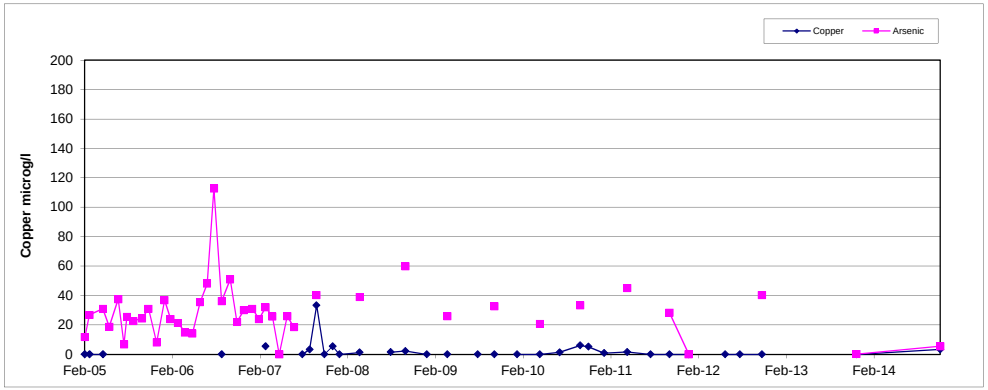

pH
EC
pH
0
1
2
3
4
5
6
7
8
9
10
0
500
1000
1500
2000
2500
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

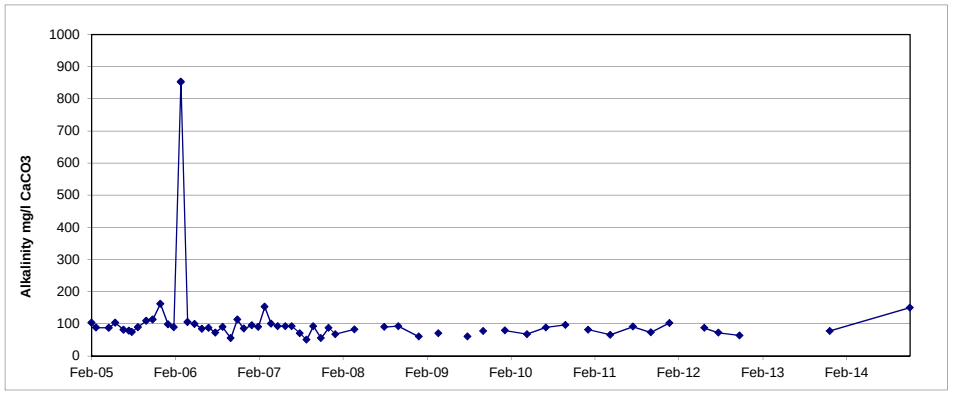

Trigger Level
Ammonia mg/l
0
5
10
15
20
25
30
35
40
45
50
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

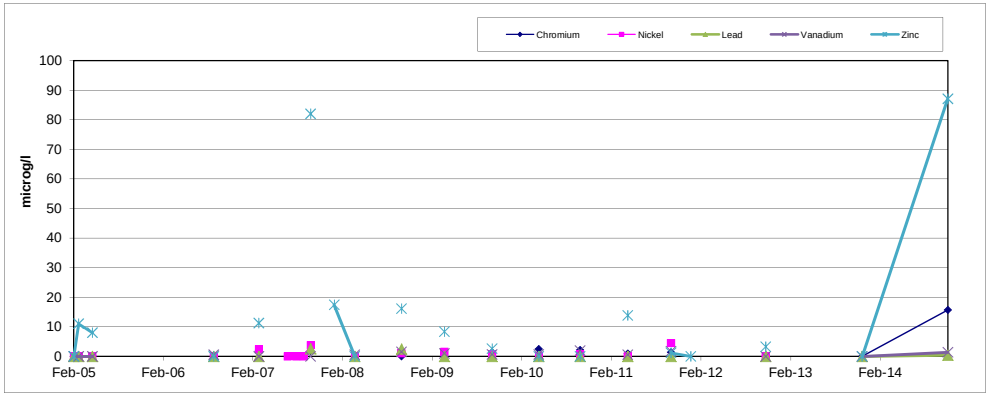

Trigger Level
Chloride mg/l
0
50
100
150
200
250
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

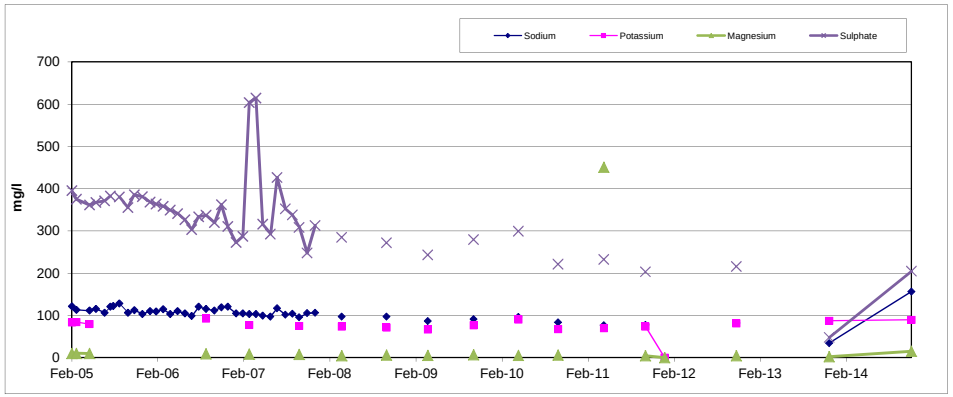

COD mg/l
0
20
40
60
80
100
120
140
160
180
200
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

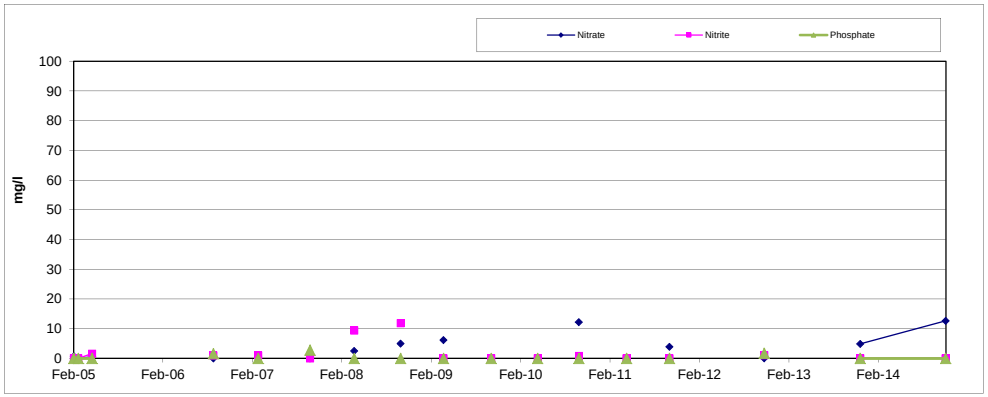

Trigger Level
Calcium mg/l
0
100
200
300
400
500
600
700
800
900
1000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

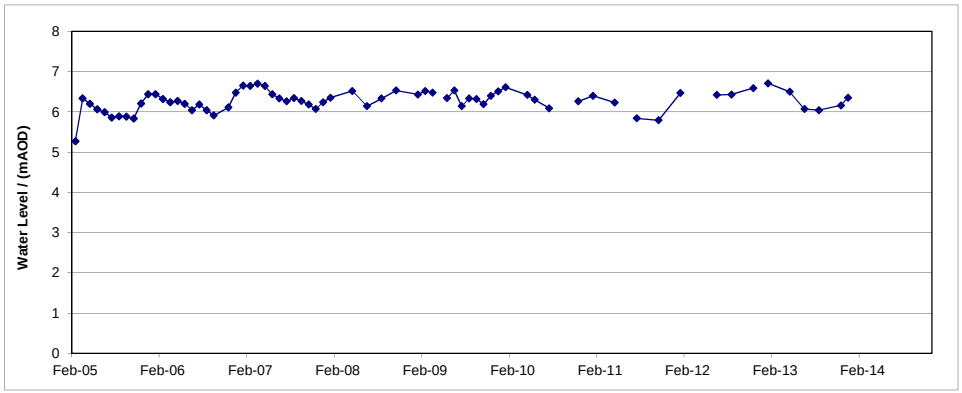

Copper
Arsenic
Copper microg/l
0
20
40
60
80
100
120
140
160
180
200
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

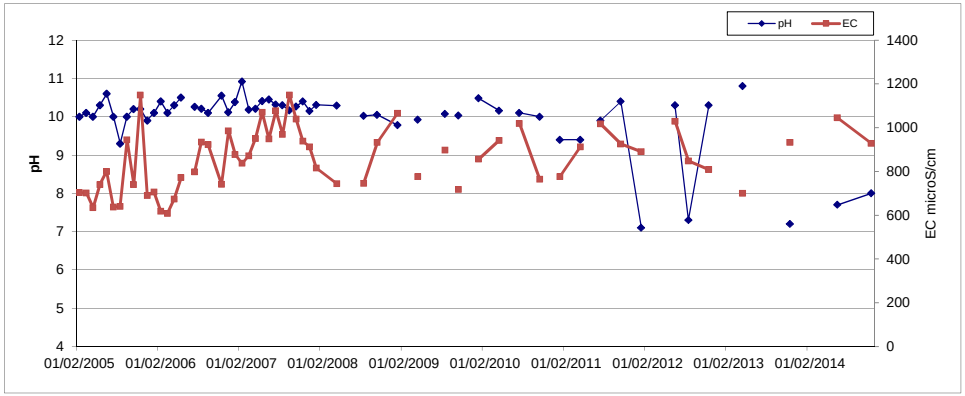

Alkalinity mg/l CaCO3
0
100
200
300
400
500
600
700
800
900
1000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

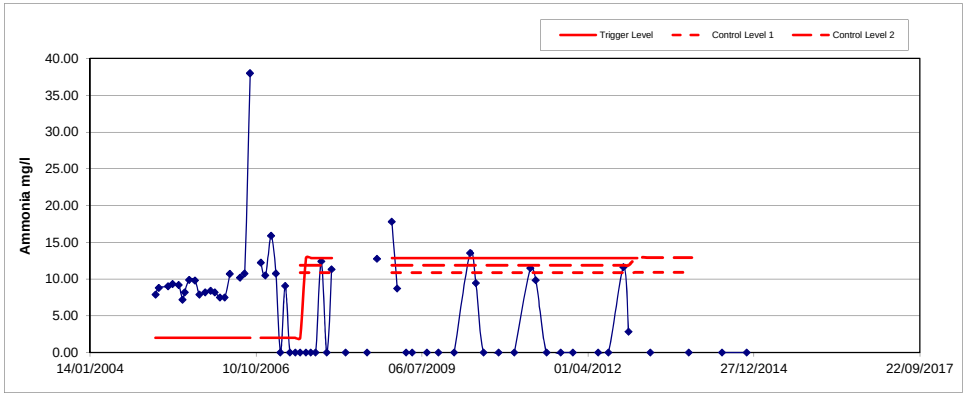

Chromium
Nickel
Lead
Vanadium
Zinc
microg/l
0
10
20
30
40
50
60
70
80
90
100
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

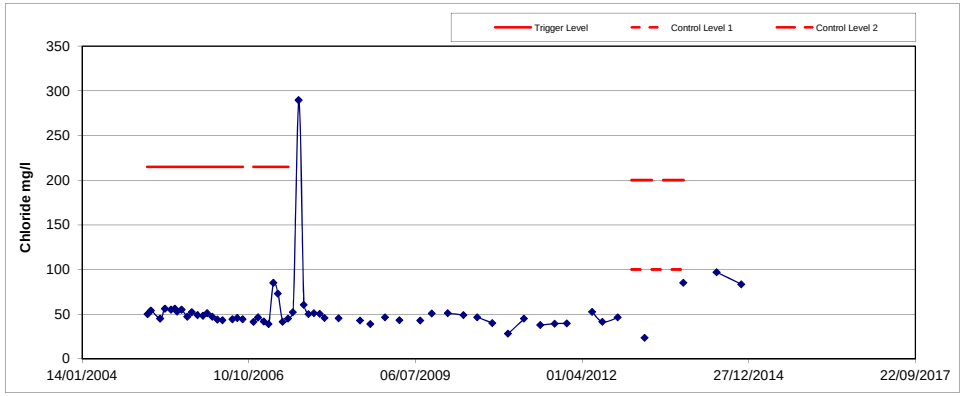

Sodium
Potassium
Magnesium
Sulphate
mg/l
0
100
200
300
400
500
600
700
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

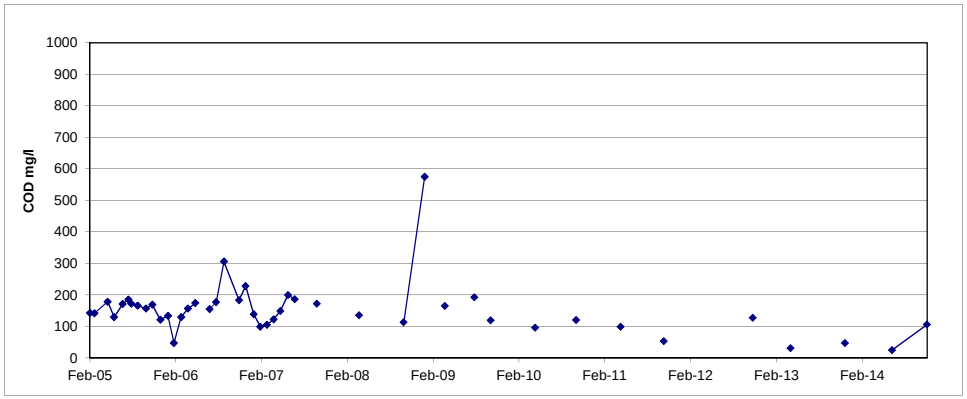

Nitrate
Nitrite
Phosphate
mg/l
0
10
20
30
40
50
60
70
80
90
100
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

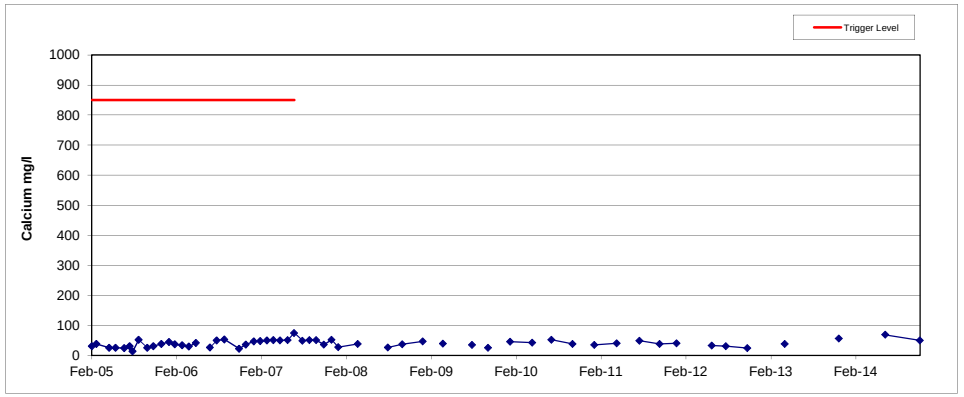

Water Level / (mAOD)
0
1
2
3
4
5
6
7
8
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

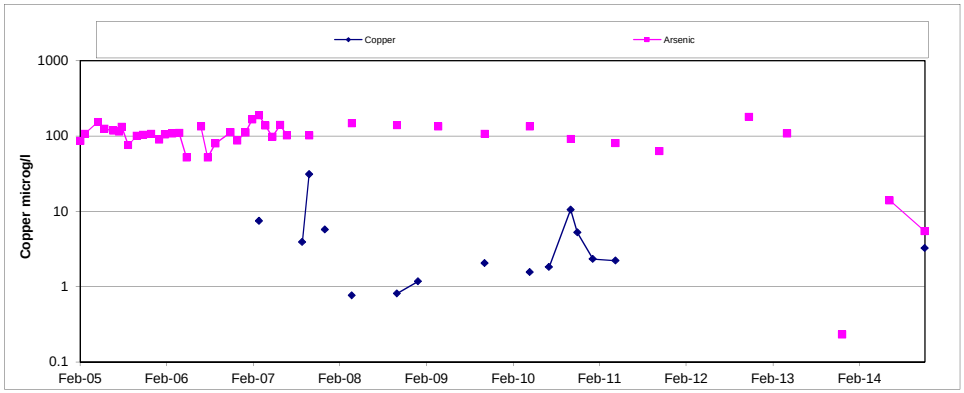

pH
EC
pH
EC microS/cm
4
5
6
7
8
9
10
11
12
0
200
400
600
800
1000
1200
1400
01/02/2005
01/02/2006
01/02/2007
01/02/2008
01/02/2009
01/02/2010
01/02/2011
01/02/2012
01/02/2013
01/02/2014

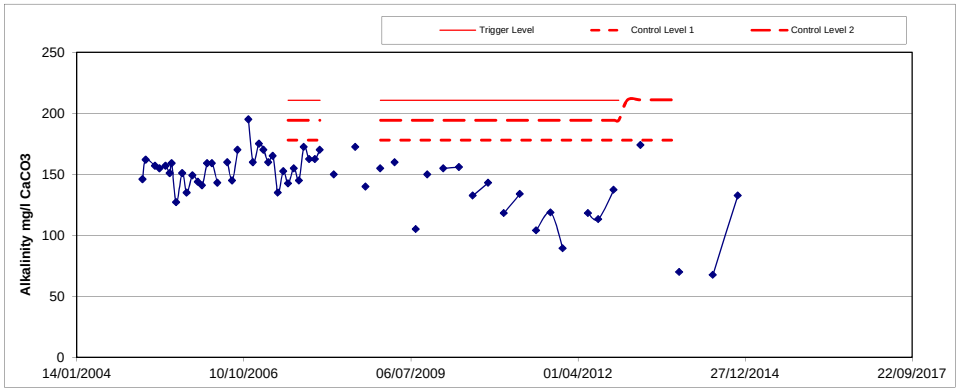

Trigger Level
Control Level 1
Control Level 2
Ammonia mg/l
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
14/01/2004
10/10/2006
06/07/2009
01/04/2012
27/12/2014
22/09/2017

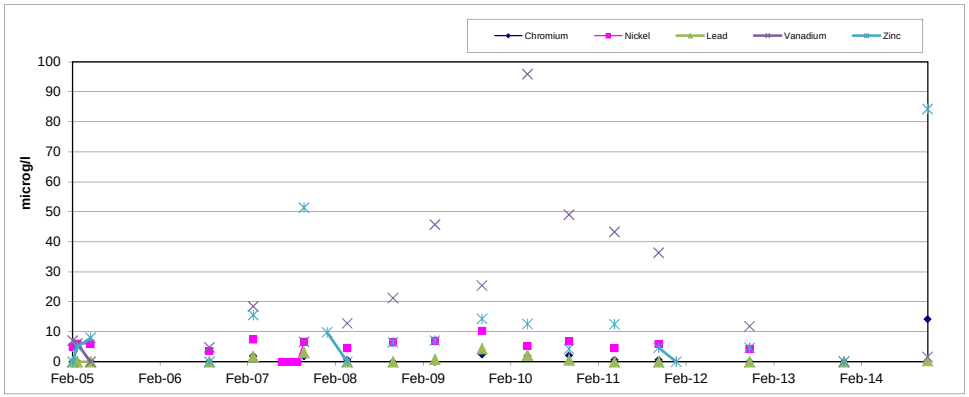

Trigger Level
Control Level 1
Control Level 2
Chloride mg/l
0
50
100
150
200
250
300
350
14/01/2004
10/10/2006
06/07/2009
01/04/2012
27/12/2014
22/09/2017

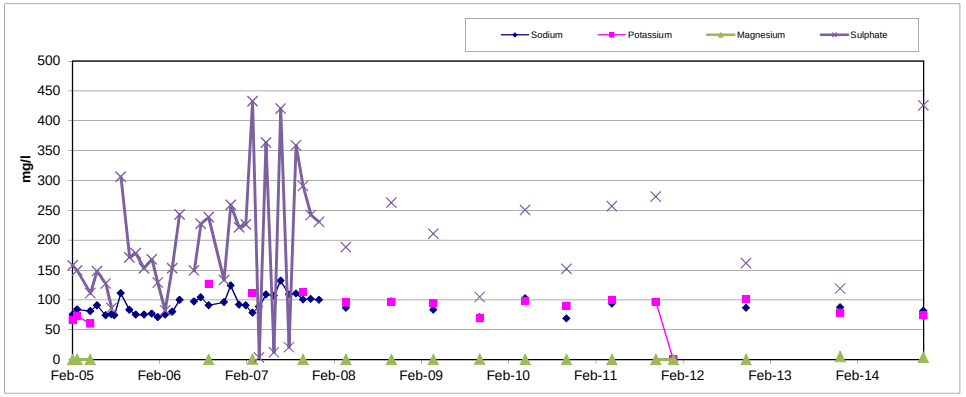

COD mg/l
0
100
200
300
400
500
600
700
800
900
1000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

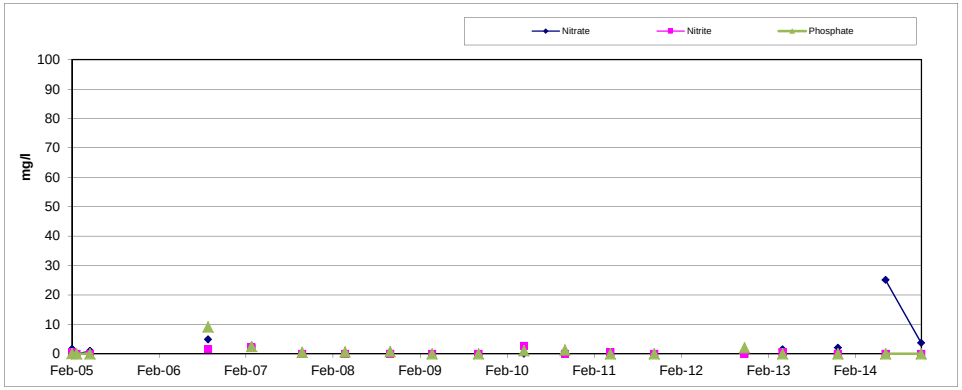

Trigger Level
Calcium mg/l
0
100
200
300
400
500
600
700
800
900
1000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

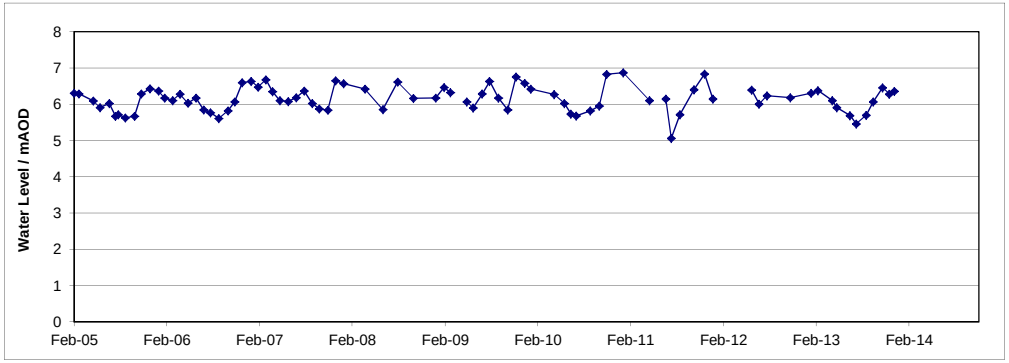

Copper
Arsenic
Copper microg/l
1000
100
10
1
0.1
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

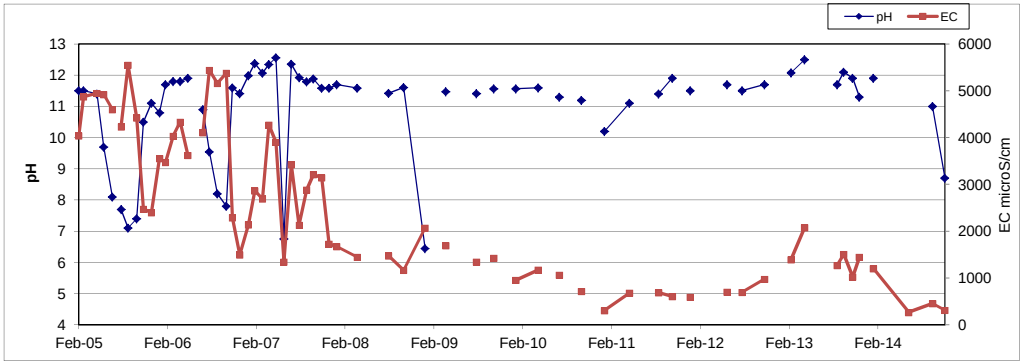

Trigger Level
Control Level 1
Control Level 2
Alkalinity mg/l CaCO3
250
200
150
100
50
0
14/01/2004
10/10/2006
06/07/2009
01/04/2012
27/12/2014
22/09/2017

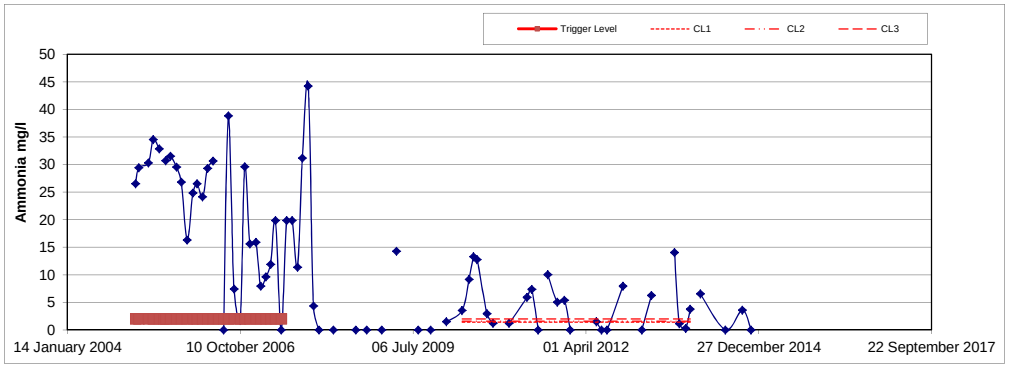

Chromium
Nickel
Lead
Vanadium
Zinc
microg/l
100
90
80
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

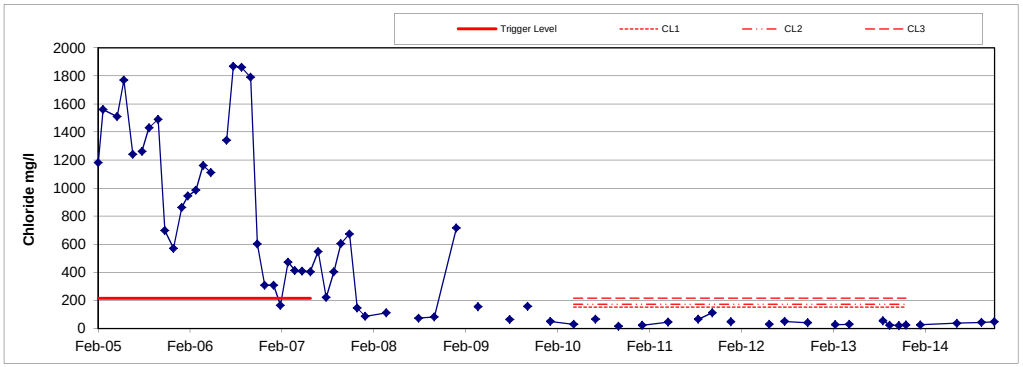

Sodium
Potassium
Magnesium
Sulphate
mg/l
500
450
400
350
300
250
200
150
100
50
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

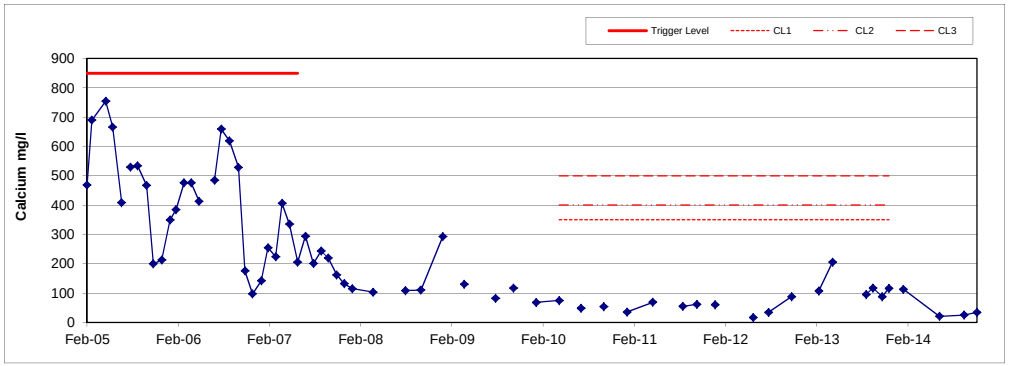

Nitrate
Nitrite
Phosphate
mg/l
100
90
80
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

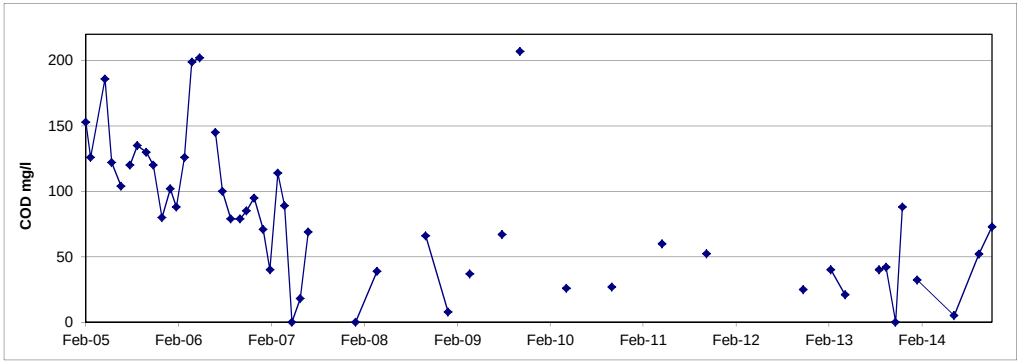

Water Level / mAOD
0
1
2
3
4
5
6
7
8
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

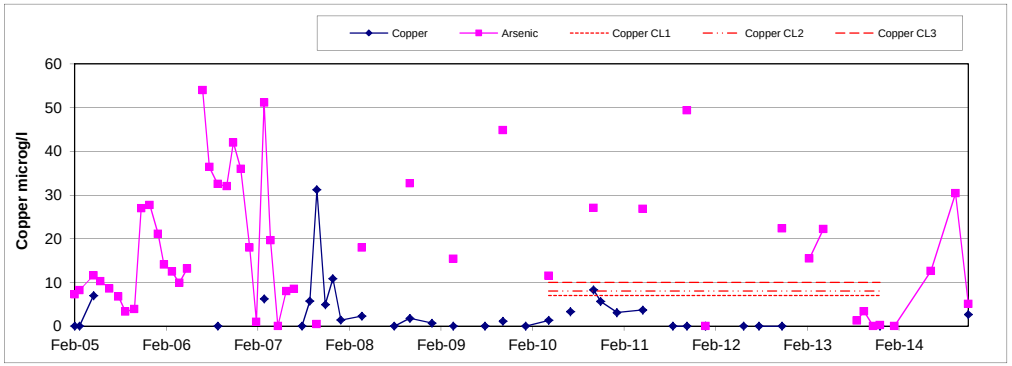

pH
EC
pH
EC microS/cm
4
5
6
7
8
9
10
11
12
13
0
1000
2000
3000
4000
5000
6000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

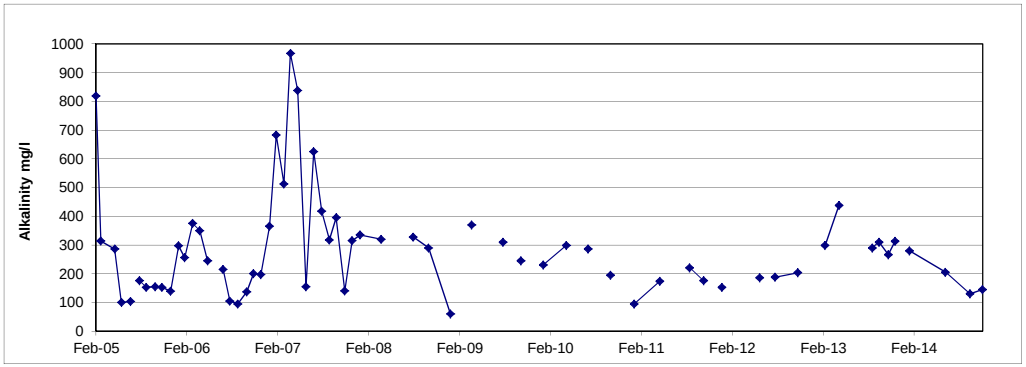

Trigger Level
CL1
CL2
CL3
Ammonia mg/l
0
5
10
15
20
25
30
35
40
45
50
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

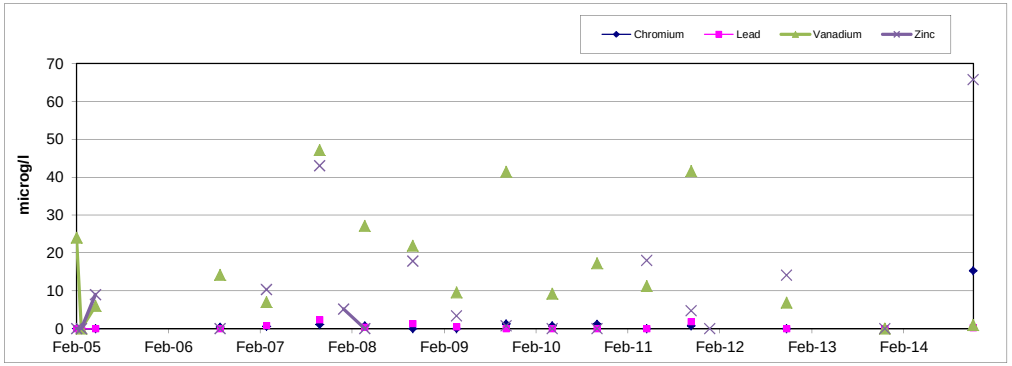

Trigger Level
CL1
CL2
CL3
Chloride mg/l
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

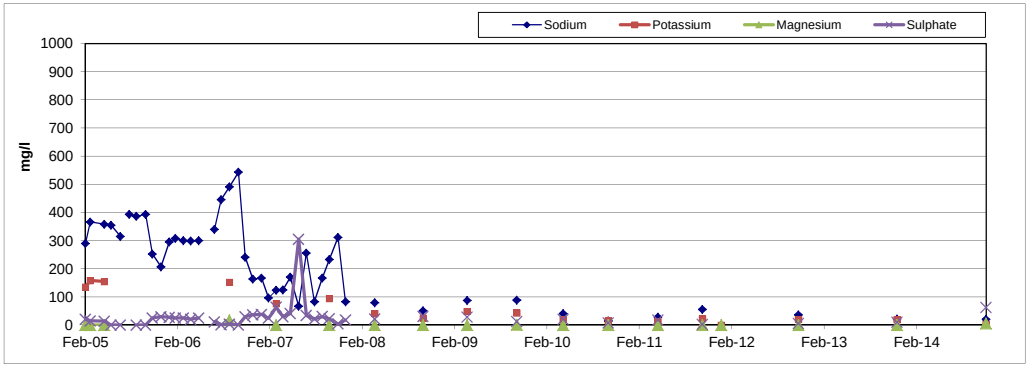

Trigger Level
CL1
CL2
CL3
Calcium mg/l
0
100
200
300
400
500
600
700
800
900
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

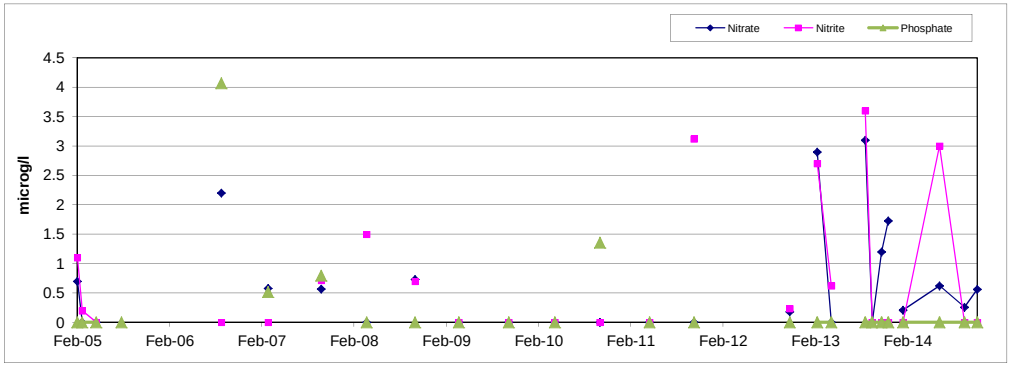

COD mg/l
0
50
100
150
200
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

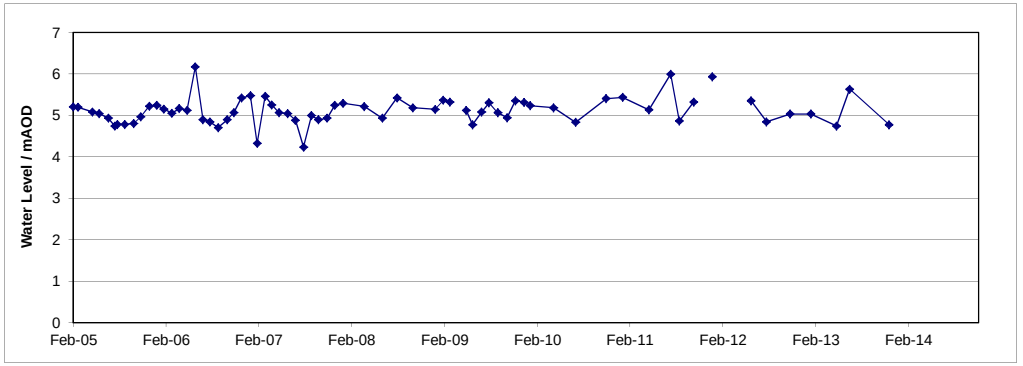

Copper
Arsenic
Copper CL1
Copper CL2
Copper CL3
Copper microg/l
0
10
20
30
40
50
60
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

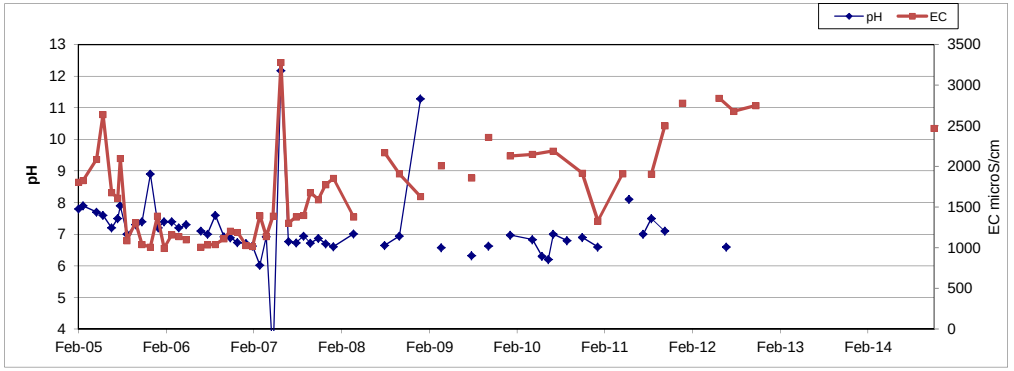

Alkalinity mg/l
0
100
200
300
400
500
600
700
800
900
1000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

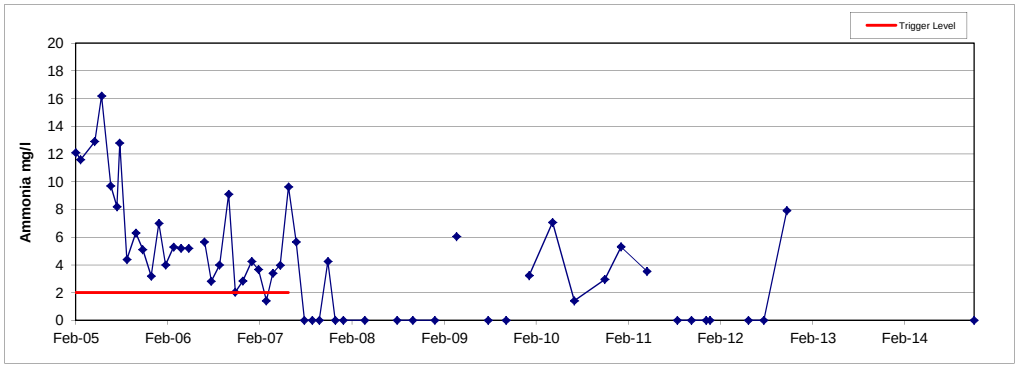

Chromium
Lead
Vanadium
Zinc
microg/l
0
10
20
30
40
50
60
70
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

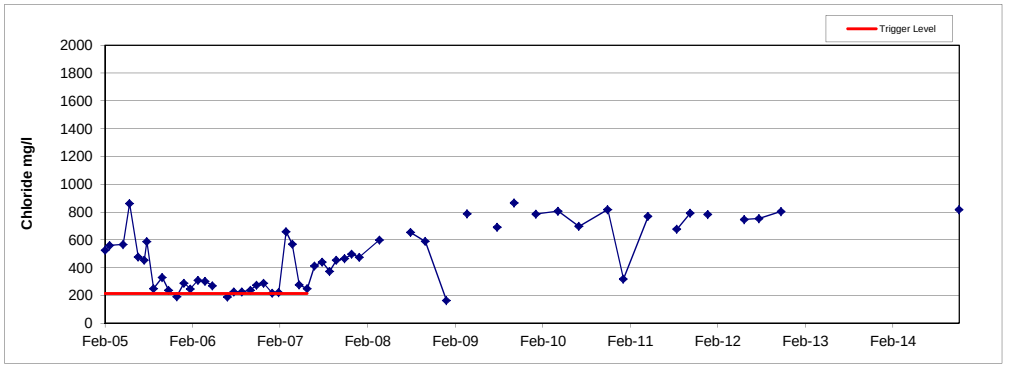

Sodium
Potassium
Magnesium
Sulphate
mg/l
0
100
200
300
400
500
600
700
800
900
1000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

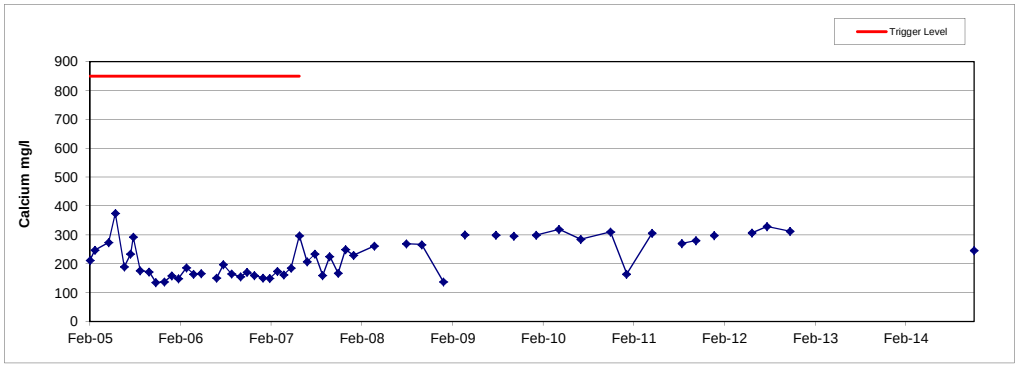

Nitrate
Nitrite
Phosphate
microg/l
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

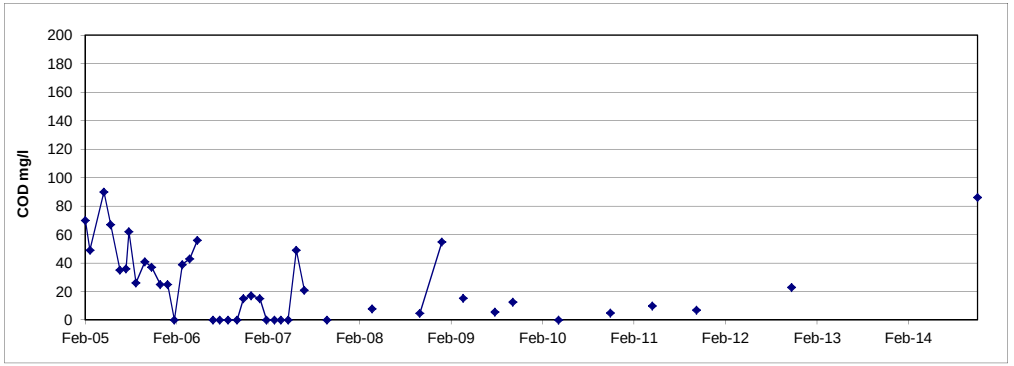

Water Level / mAOD
0
1
2
3
4
5
6
7
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

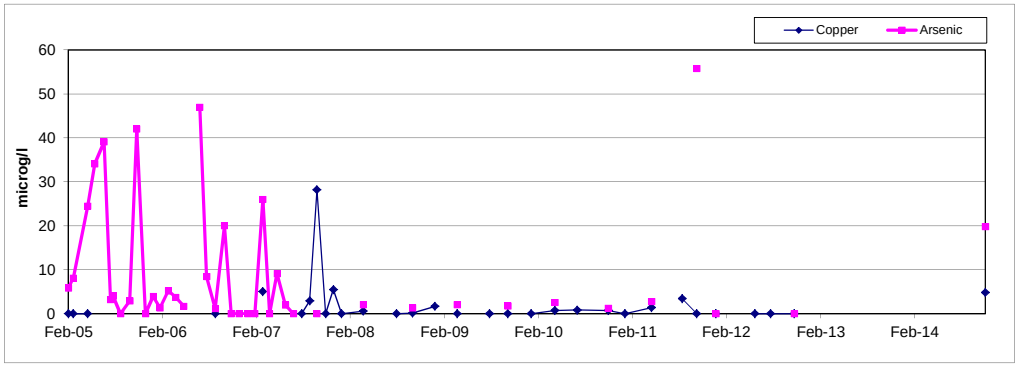

pH
EC
pH
EC microS/cm
4
5
6
7
8
9
10
11
12
13
0
500
1000
1500
2000
2500
3000
3500
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

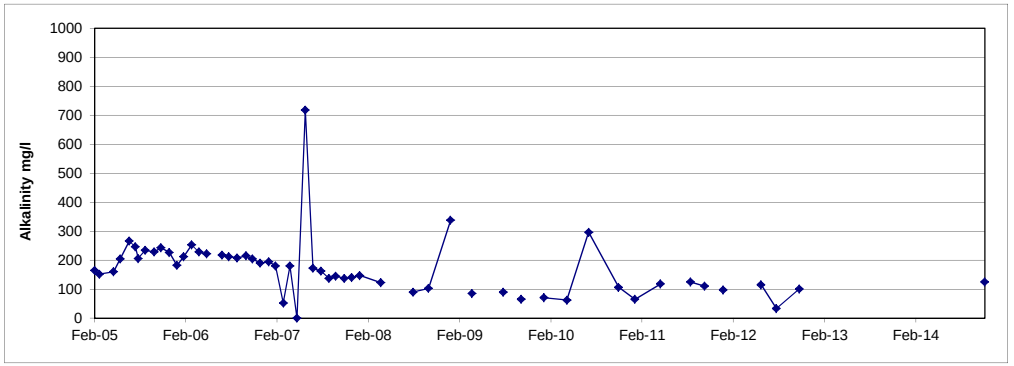

Trigger Level
Ammonia mg/l
0
2
4
6
8
10
12
14
16
18
20
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

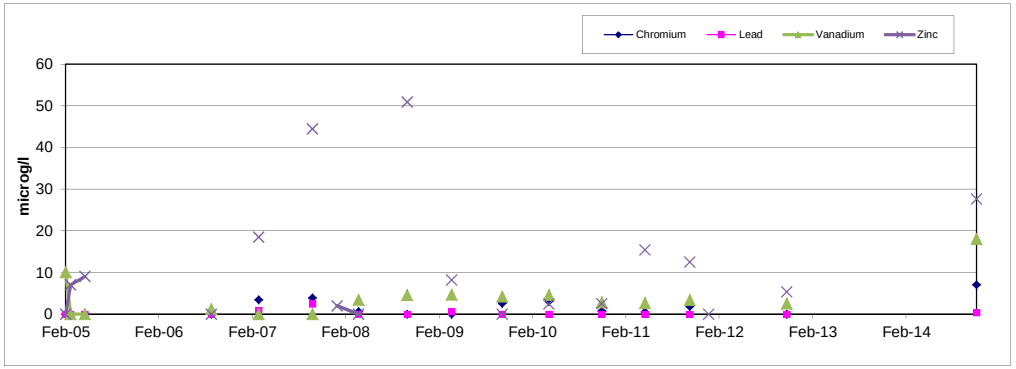

Trigger Level
Chloride mg/l
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

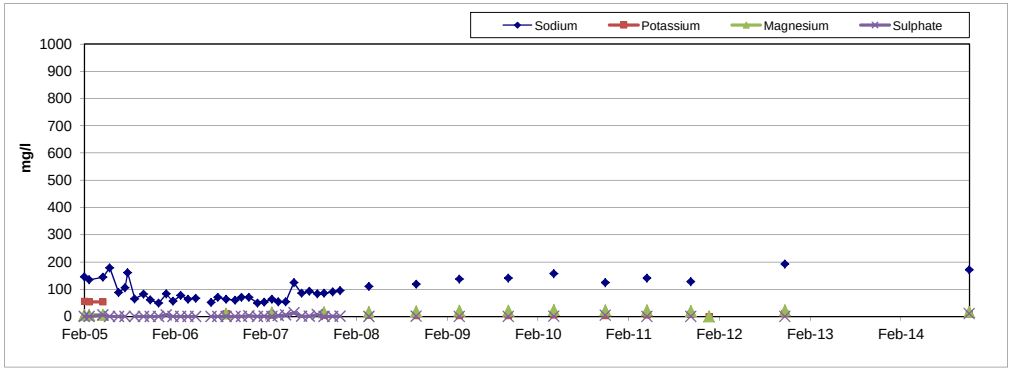

Trigger Level
Calcium mg/l
0
100
200
300
400
500
600
700
800
900
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

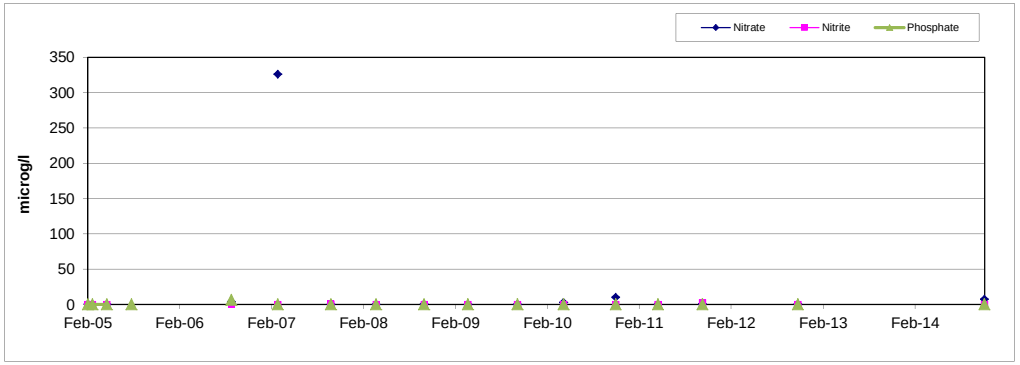

COD mg/l
0
20
40
60
80
100
120
140
160
180
200
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

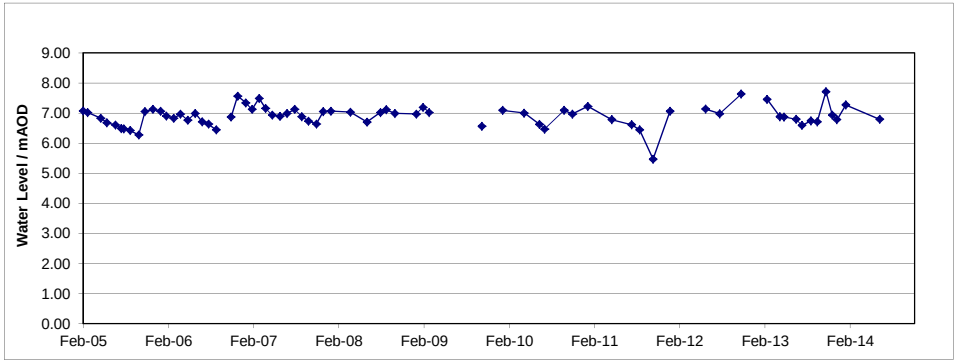

Copper
Arsenic
microg/l
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

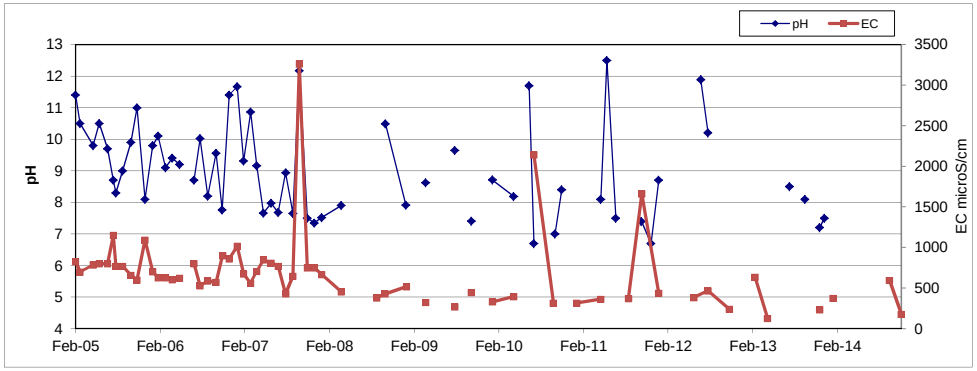

Alkalinity mg/l
1000
900
800
700
600
500
400
300
200
100
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

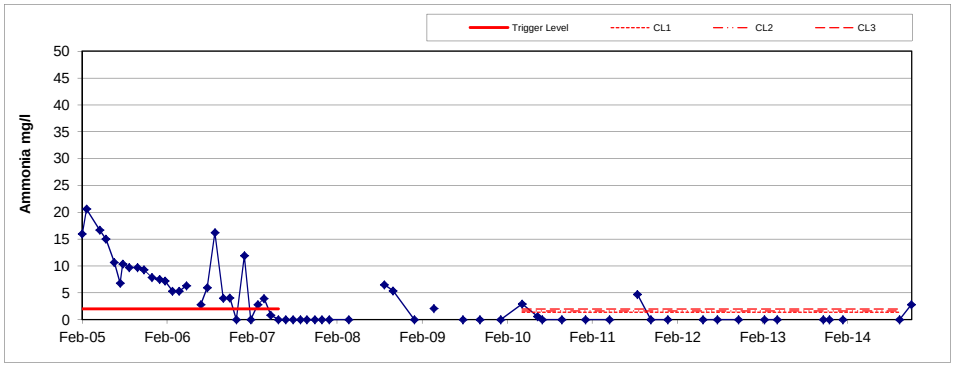

Chromium
Lead
Vanadium
Zinc
microg/l
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

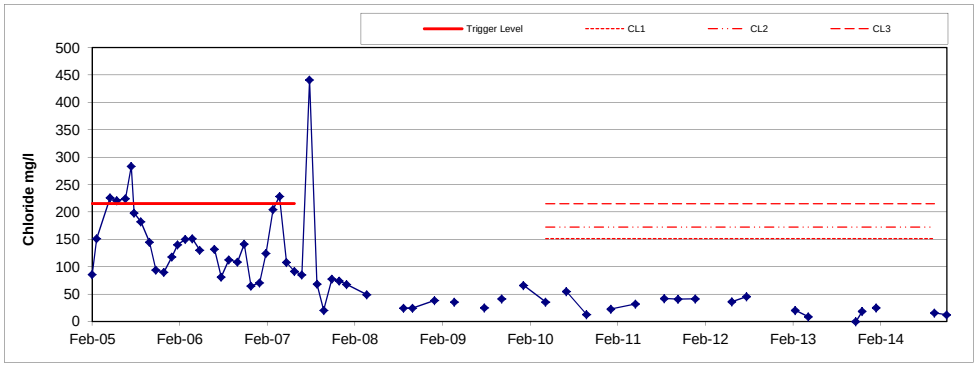

Sodium
Potassium
Magnesium
Sulphate
mg/l
1000
900
800
700
600
500
400
300
200
100
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

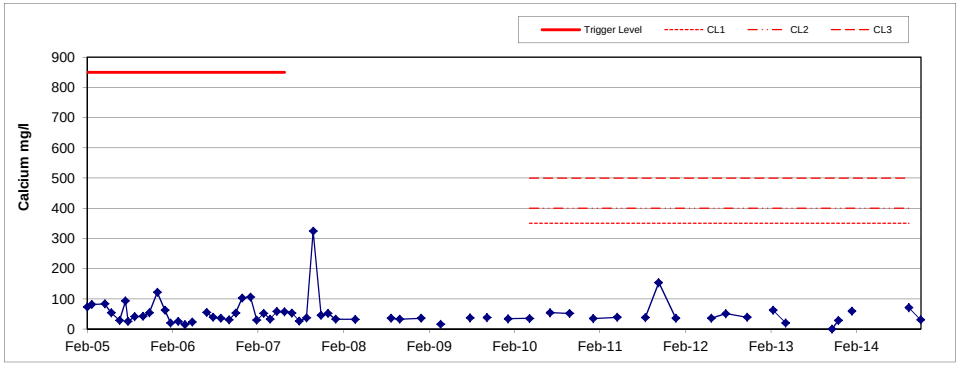

Nitrate
Nitrite
Phosphate
microg/l
350
300
250
200
150
100
50
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

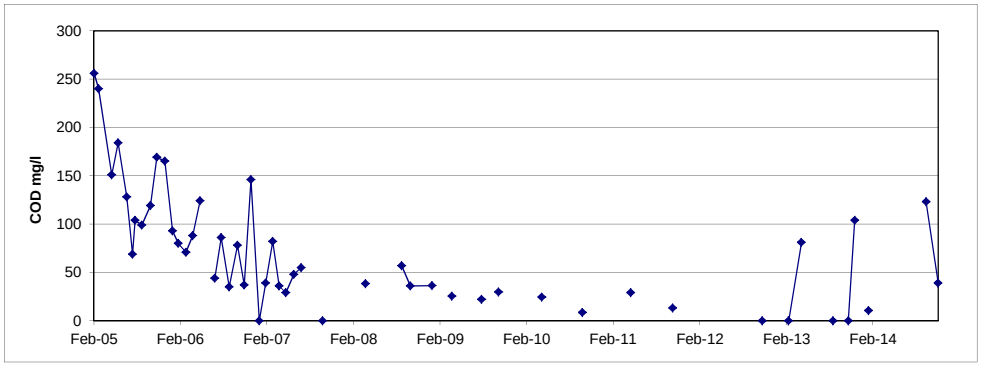

Water Level / mAOD
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Feb-05 Feb-06 Feb-07 Feb-08 Feb-09 Feb-10 Feb-11 Feb-12 Feb-13 Feb-14

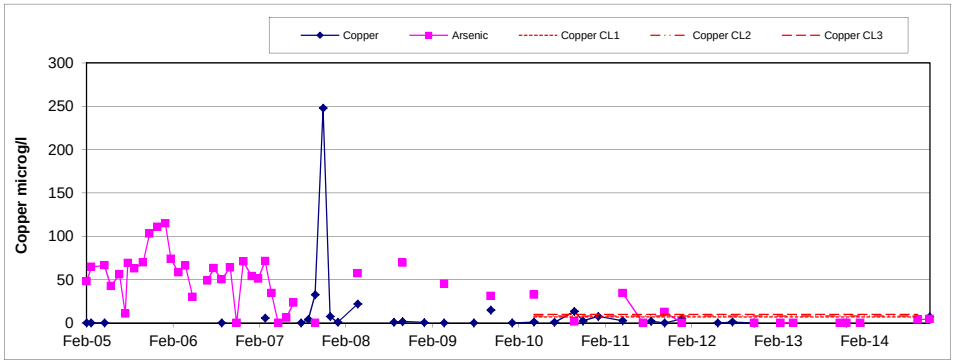

pH
EC
pH
EC microS/cm
13 12 11 10 9 8 7 6 5 4
3500 3000 2500 2000 1500 1000 500 0
Feb-05 Feb-06 Feb-07 Feb-08 Feb-09 Feb-10 Feb-11 Feb-12 Feb-13 Feb-14

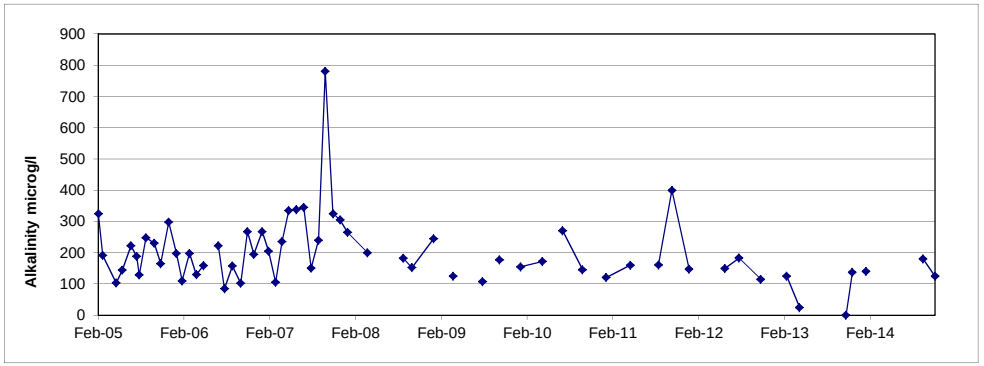

Trigger Level
CL1
CL2
CL3
Ammonia mg/l
50 45 40 35 30 25 20 15 10 5 0
Feb-05 Feb-06 Feb-07 Feb-08 Feb-09 Feb-10 Feb-11 Feb-12 Feb-13 Feb-14

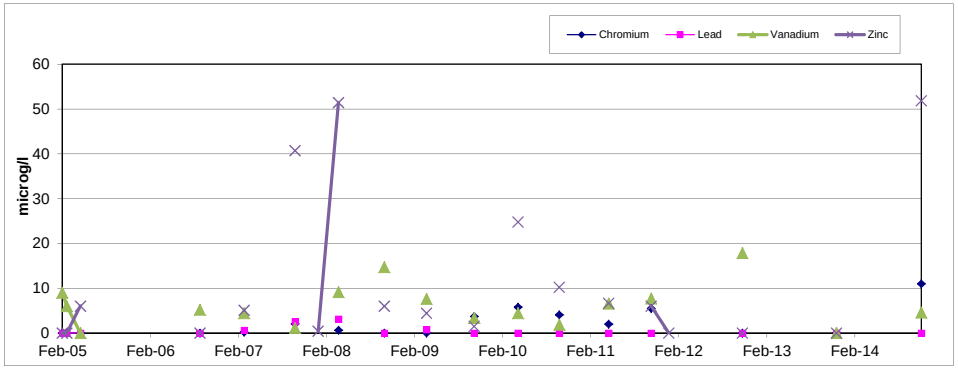

Trigger Level
CL1
CL2
CL3
Chloride mg/l
500 450 400 350 300 250 200 150 100 50 0
Feb-05 Feb-06 Feb-07 Feb-08 Feb-09 Feb-10 Feb-11 Feb-12 Feb-13 Feb-14

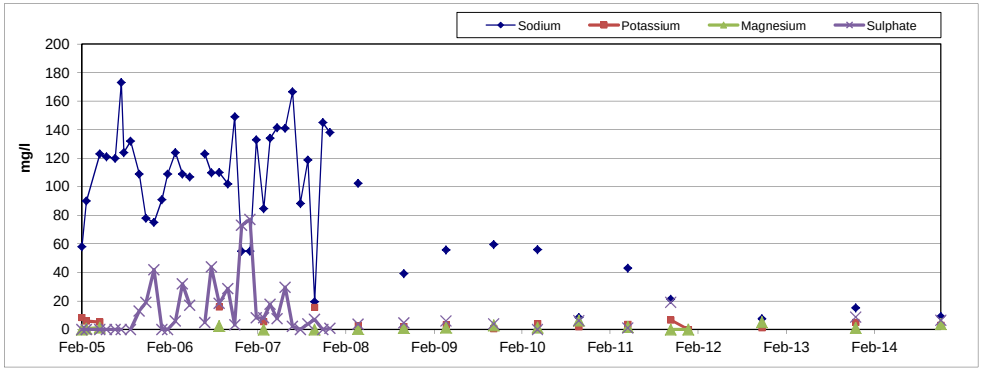

Trigger Level
CL1
CL2
CL3
Calcium mg/l
900 800 700 600 500 400 300 200 100 0
Feb-05 Feb-06 Feb-07 Feb-08 Feb-09 Feb-10 Feb-11 Feb-12 Feb-13 Feb-14

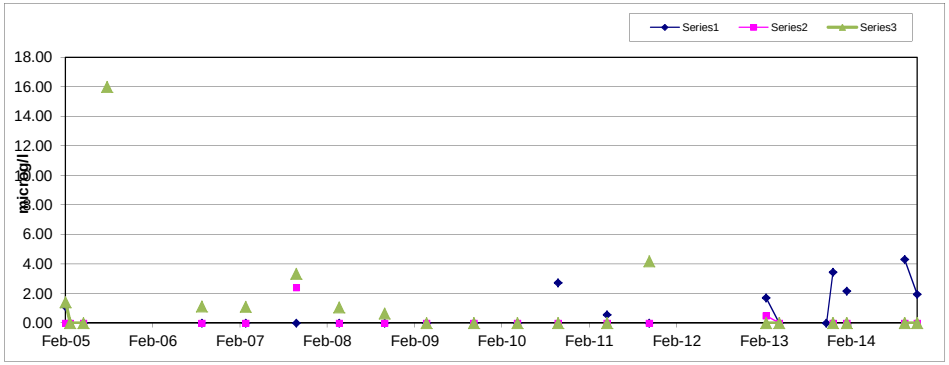

COD mg/l
300 250 200 150 100 50 0
Feb-05 Feb-06 Feb-07 Feb-08 Feb-09 Feb-10 Feb-11 Feb-12 Feb-13 Feb-14

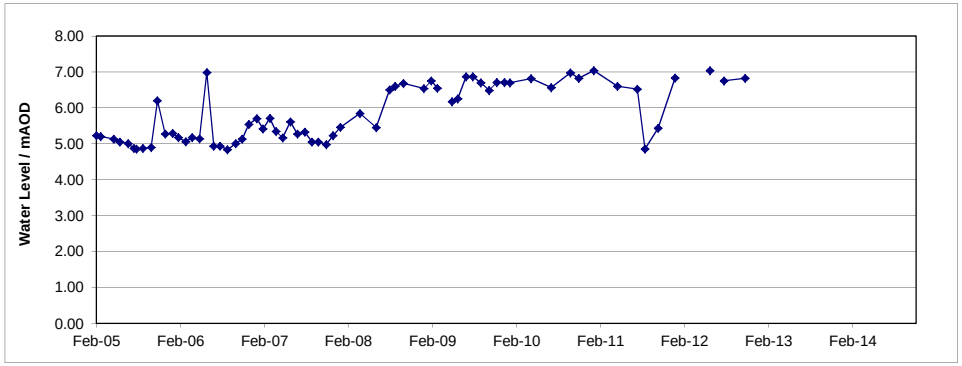

Copper
Arsenic
Copper CL1
Copper CL2
Copper CL3
Copper microg/l
300
250
200
150
100
50
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

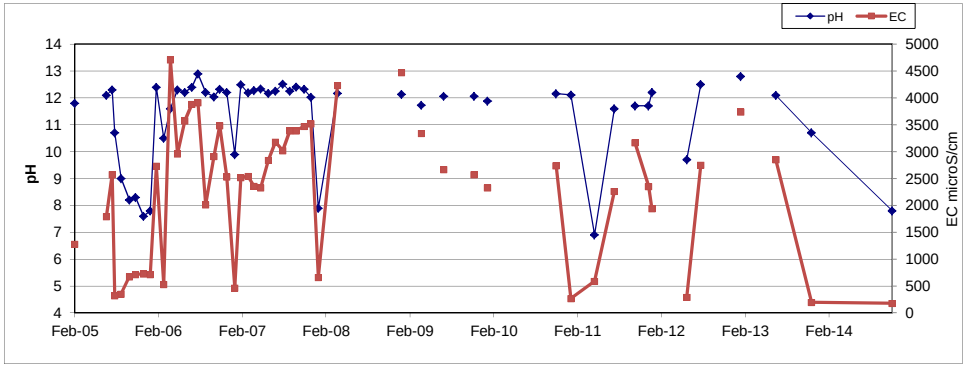

Alkalinity microg/l
900
800
700
600
500
400
300
200
100
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

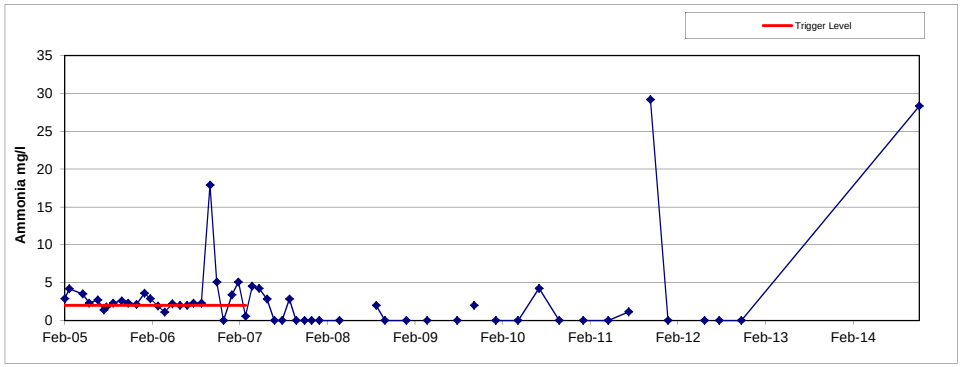

Chromium
Lead
Vanadium
Zinc
microg/l
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

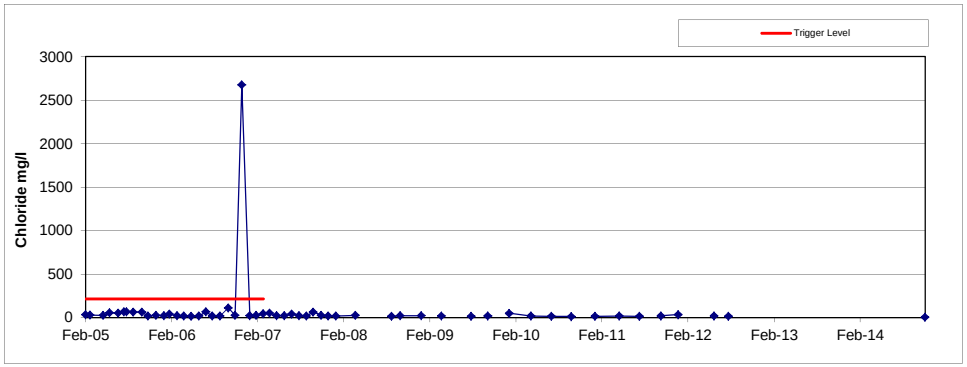

Sodium
Potassium
Magnesium
Sulphate
mg/l
200
180
160
140
120
100
80
60
40
20
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

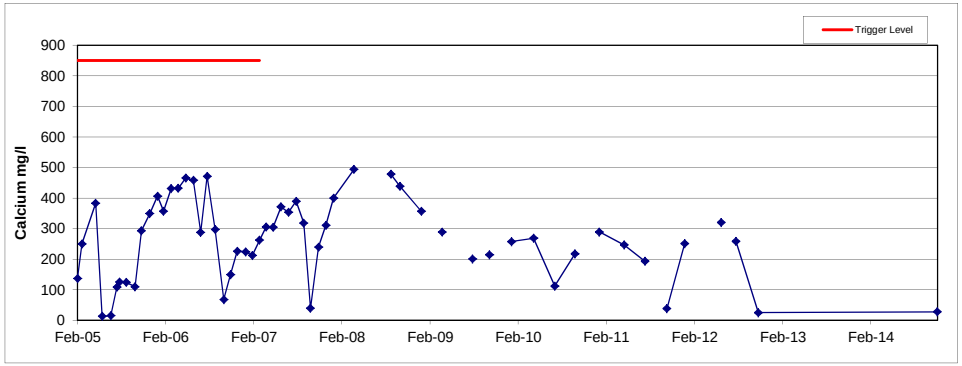

Series1
Series2
Series3
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

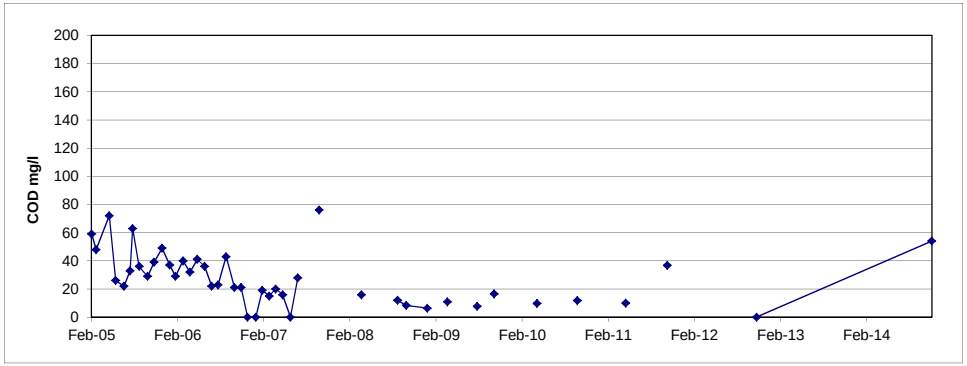

Water Level / mAOD
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

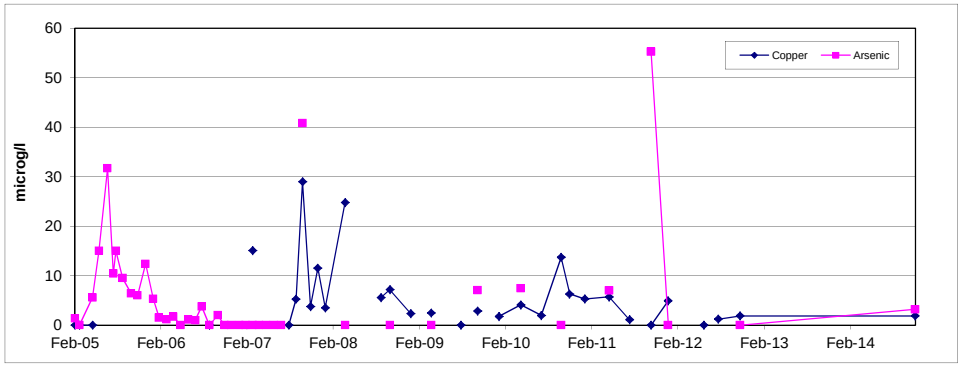

pH
EC
pH
EC microS/cm
14
13
12
11
10
9
8
7
6
5
4
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

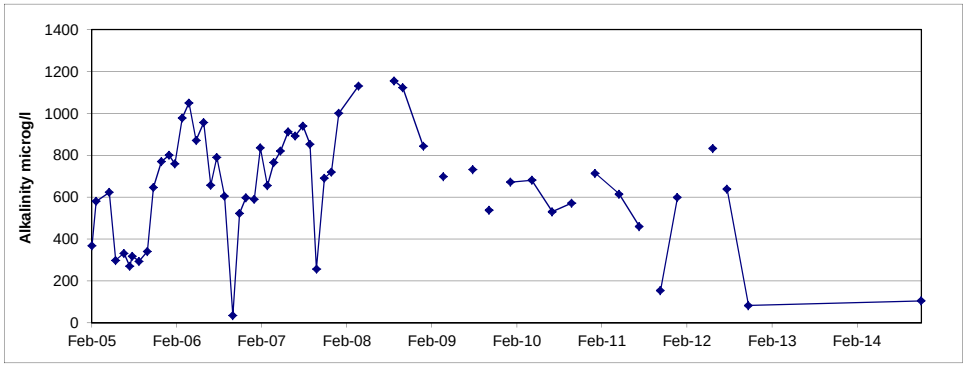

Trigger Level
Ammonia mg/l
35
30
25
20
15
10
5
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

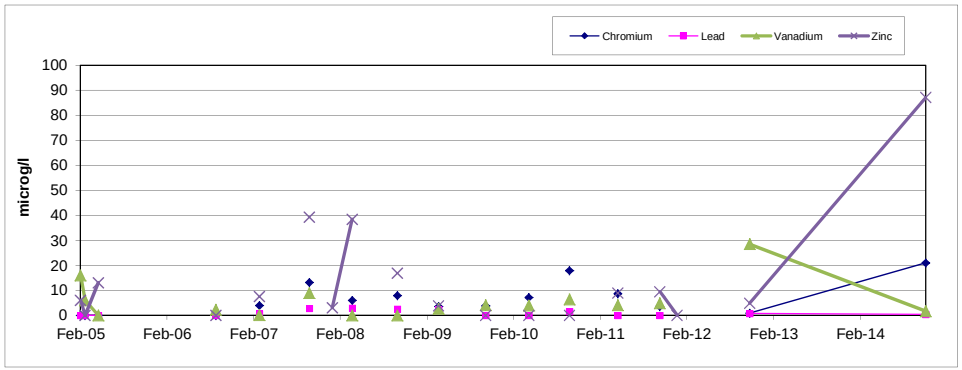

Trigger Level
Chloride mg/l
3000
2500
2000
1500
1000
500
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

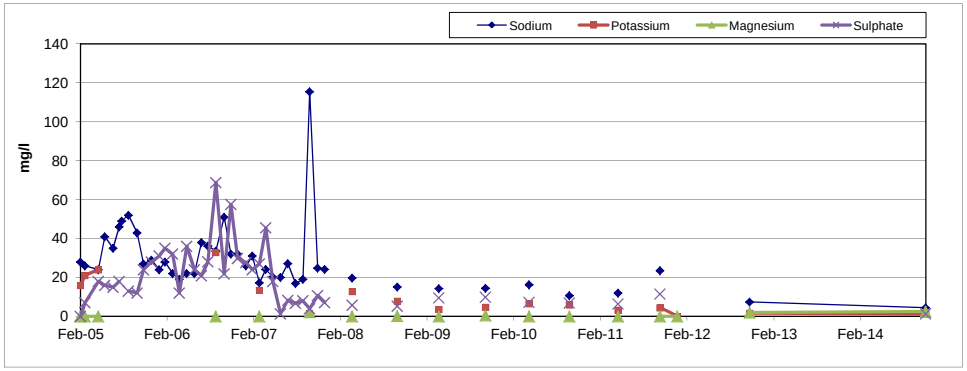

Trigger Level
Calcium mg/l
900
800
700
600
500
400
300
200
100
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

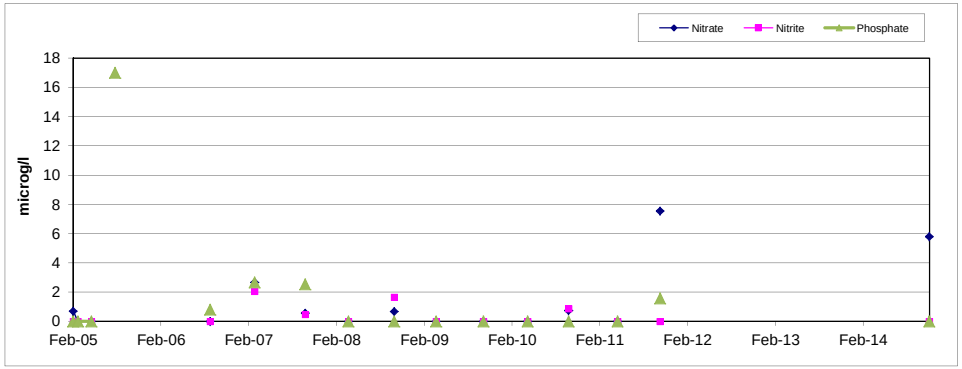

COD mg/l
200
180
160
140
120
100
80
60
40
20
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

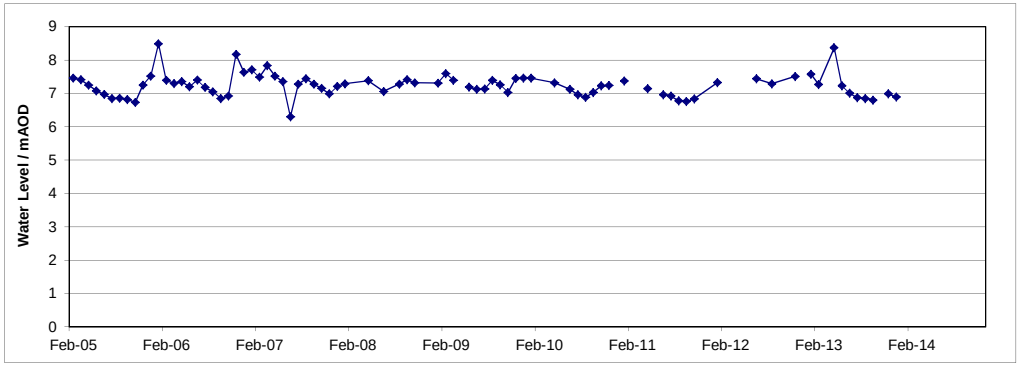

Copper
Arsenic
microg/l
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

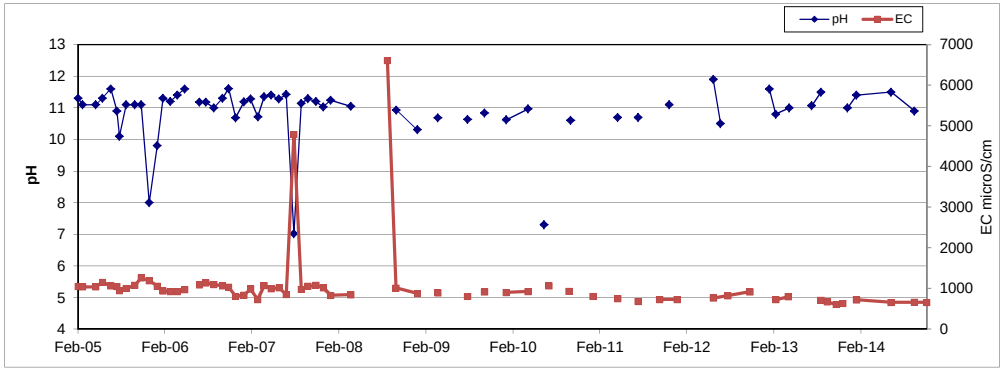

Alkalinity microg/l
1400
1200
1000
800
600
400
200
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

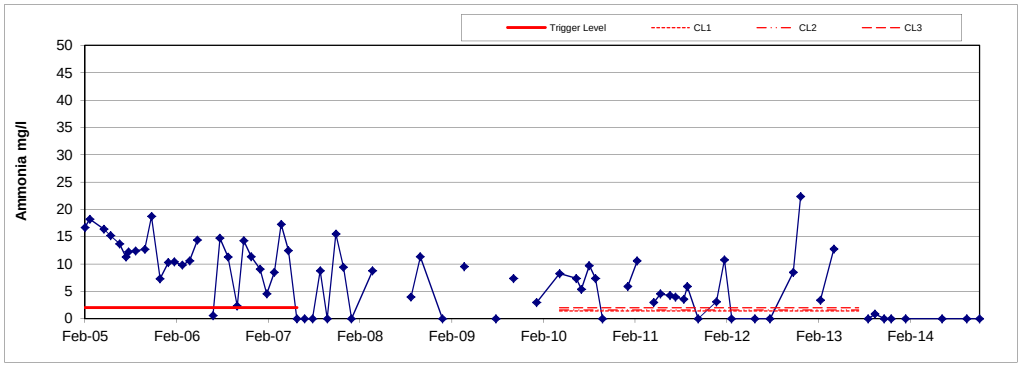

Chromium
Lead
Vanadium
Zinc
microg/l
100
90
80
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

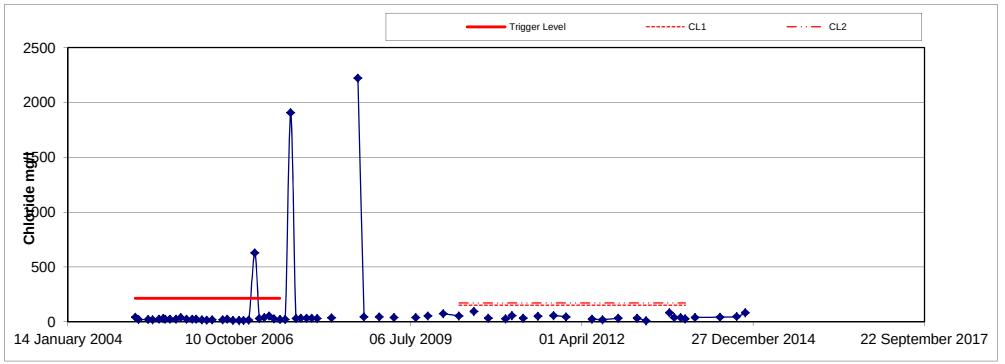

Sodium
Potassium
Magnesium
Sulphate
mg/l
140
120
100
80
60
40
20
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

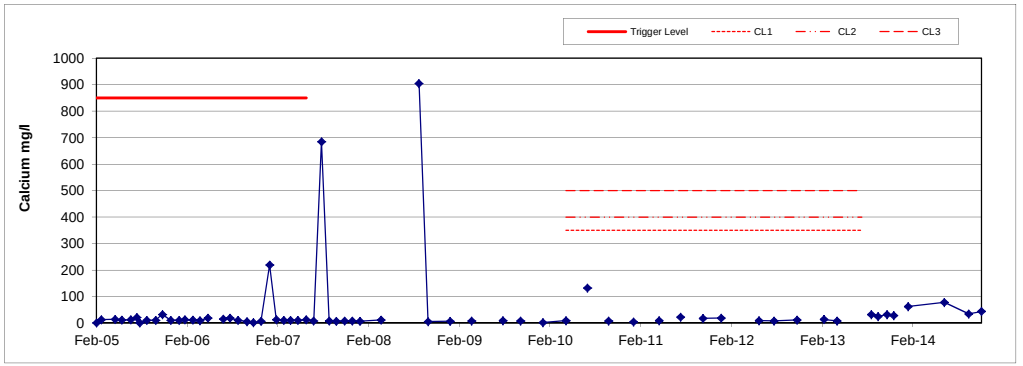

Nitrate
Nitrite
Phosphate
microg/l
18
16
14
12
10
8
6
4
2
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

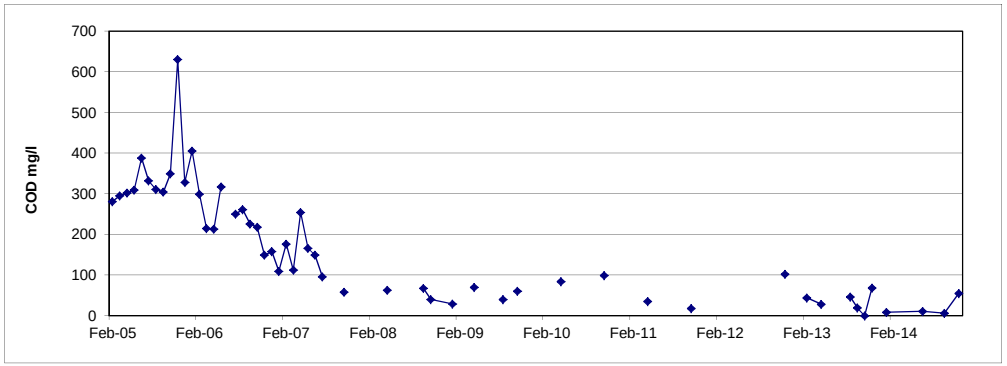

Water Level / mAOD
0
1
2
3
4
5
6
7
8
9
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

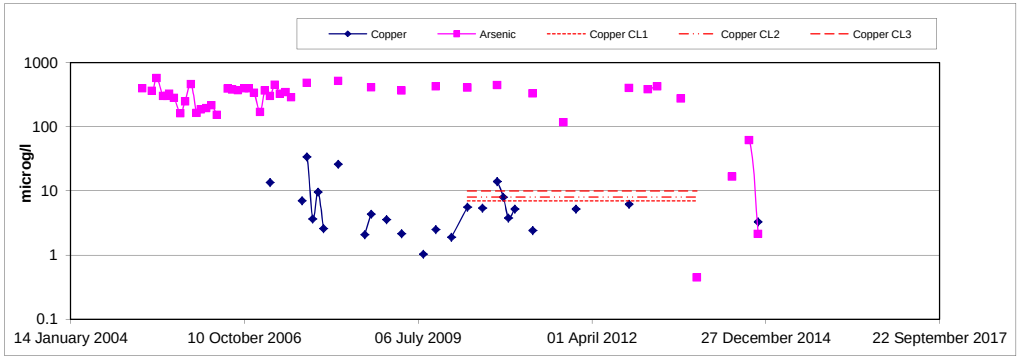

pH
EC
pH
EC microS/cm
4
5
6
7
8
9
10
11
12
13
0
1000
2000
3000
4000
5000
6000
7000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

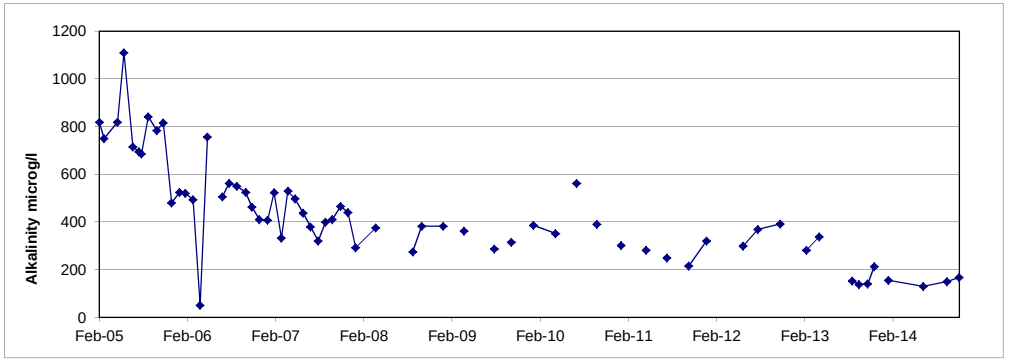

Trigger Level
CL1
CL2
CL3
Ammonia mg/l
0
5
10
15
20
25
30
35
40
45
50
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

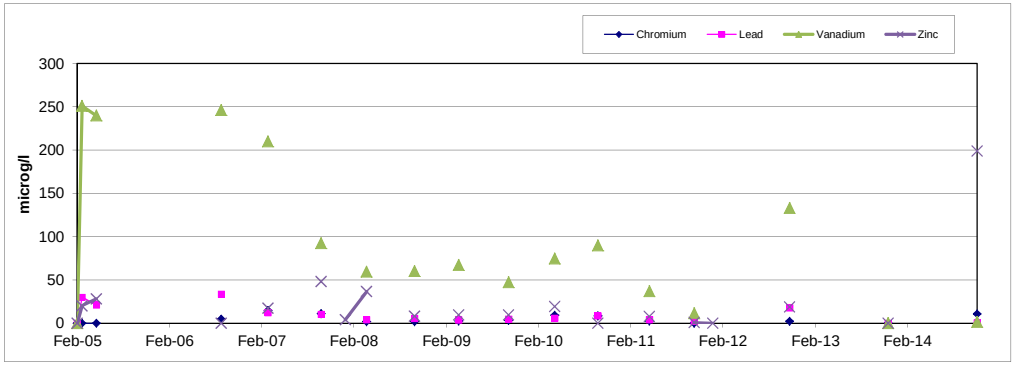

Trigger Level
CL1
CL2
Chloride mg/l
0
500
1000
1500
2000
2500
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

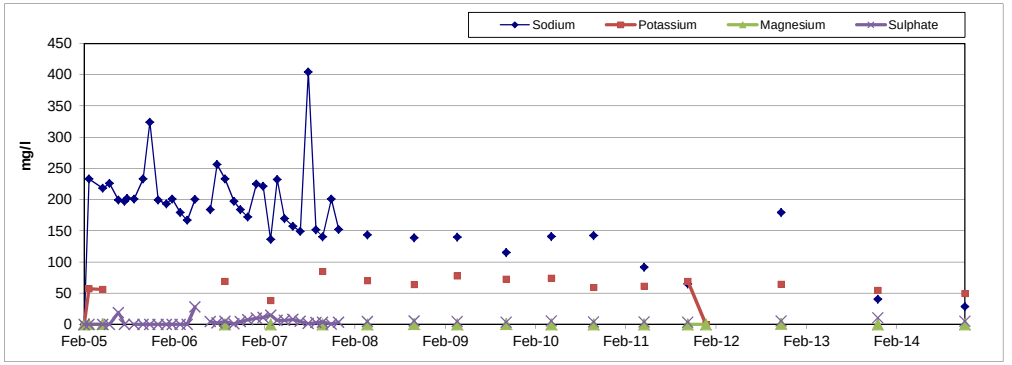

Trigger Level
CL1
CL2
CL3
Calcium mg/l
0
100
200
300
400
500
600
700
800
900
1000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

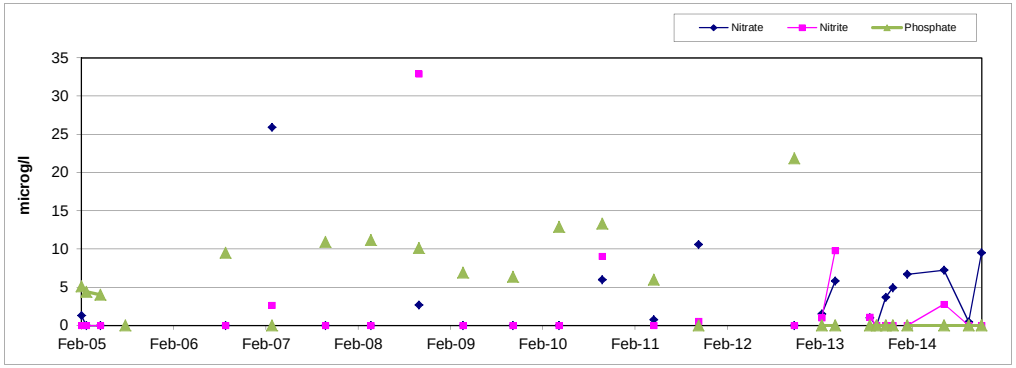

COD mg/l
0
100
200
300
400
500
600
700
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

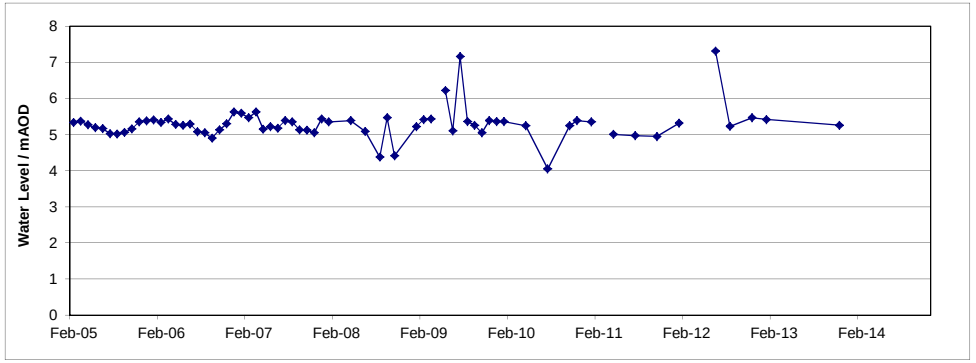

Copper
Arsenic
Copper CL1
Copper CL2
Copper CL3
microg/l
1000
100
10
1
0.1
14 January 2004
10 October 2006
06 July 2009
01 April 2012
27 December 2014
22 September 2017

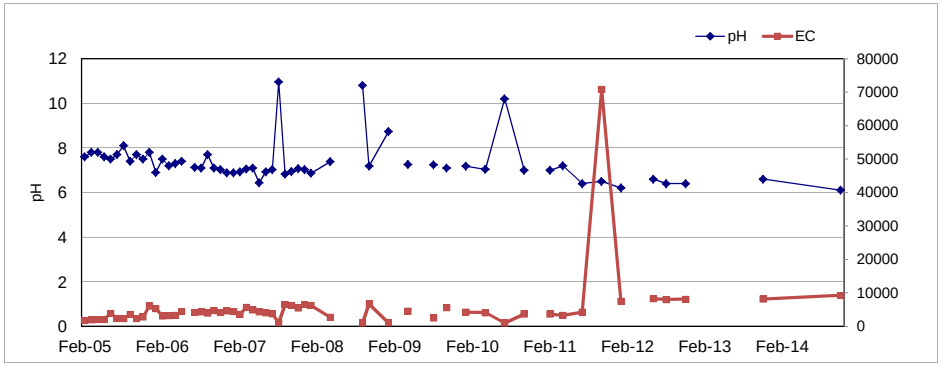

Alkalinity microg/l
1200
1000
800
600
400
200
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

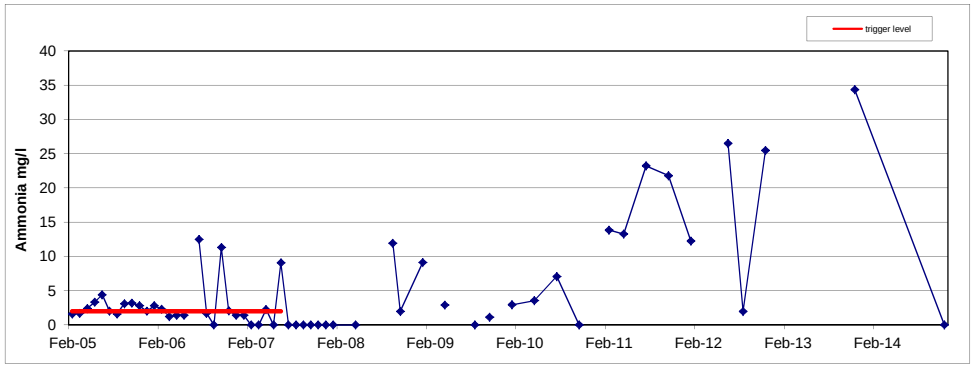

Chromium
Lead
Vanadium
Zinc
microg/l
300
250
200
150
100
50
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

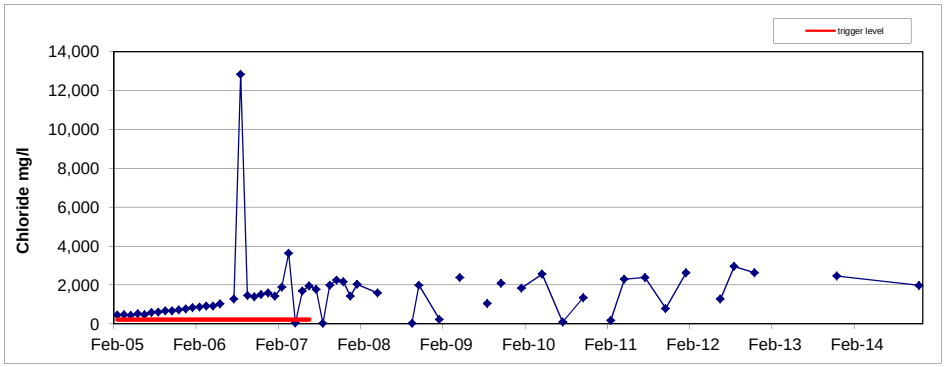

Sodium
Potassium
Magnesium
Sulphate
mg/l
450
400
350
300
250
200
150
100
50
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

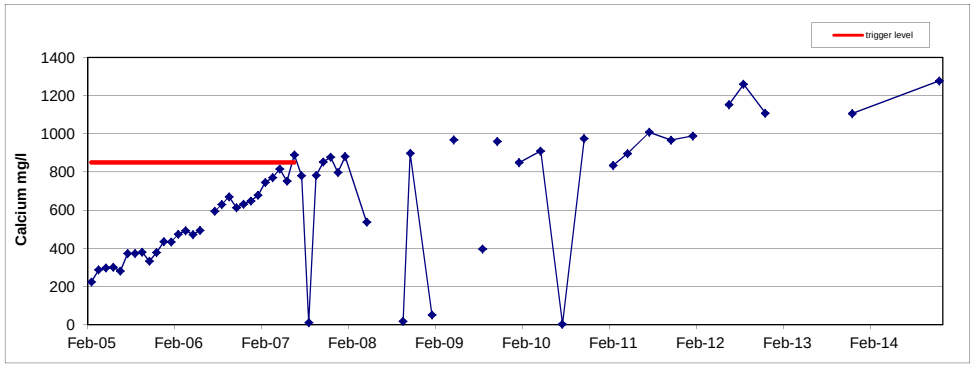

Nitrate
Nitrite
Phosphate
microg/l
35
30
25
20
15
10
5
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

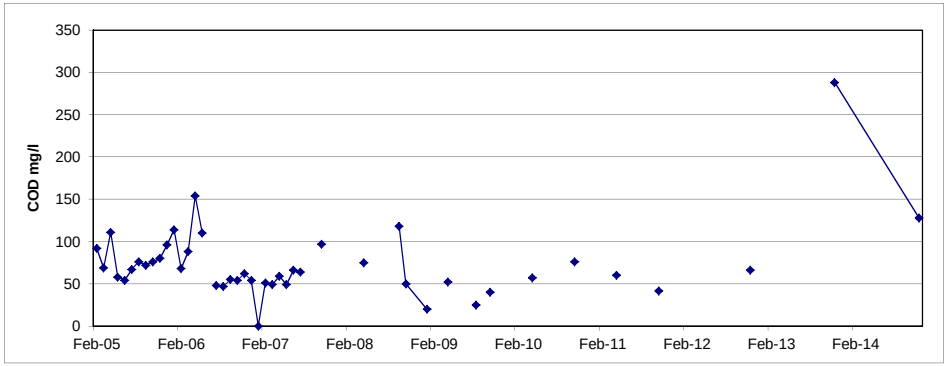

Water Level / mAOD
0
1
2
3
4
5
6
7
8
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

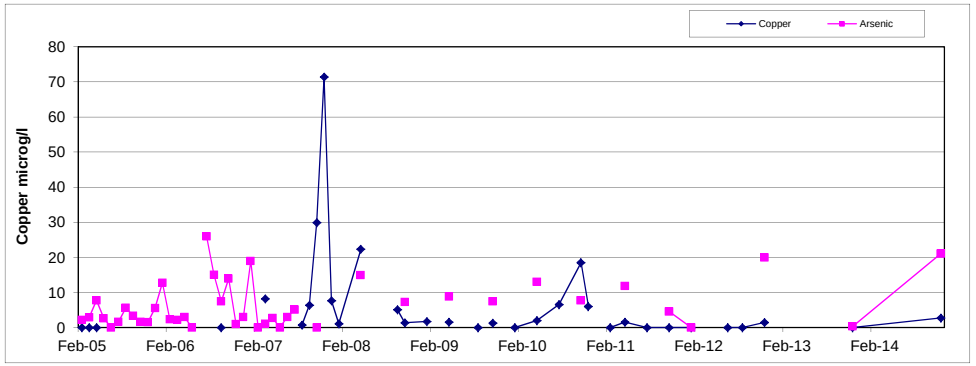

pH
EC
pH
0
2
4
6
8
10
12
0
10000
20000
30000
40000
50000
60000
70000
80000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

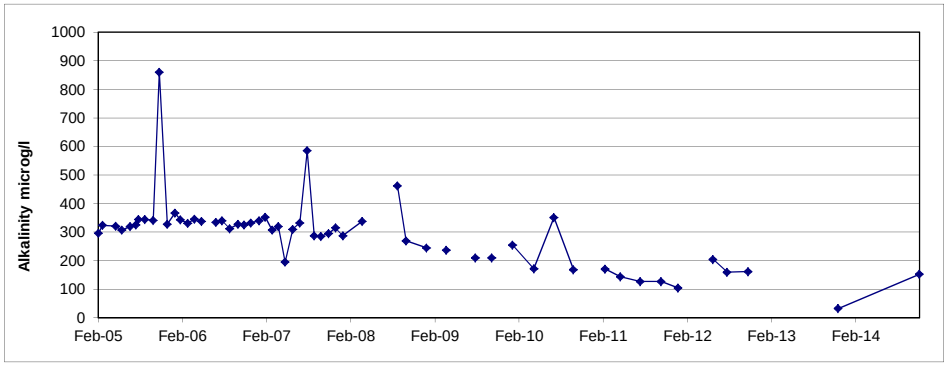

trigger level
Ammonia mg/l
0
5
10
15
20
25
30
35
40
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

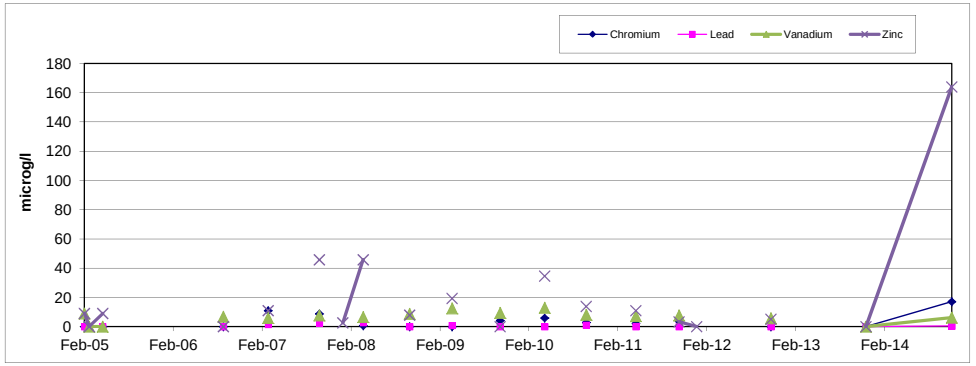

trigger level
Chloride mg/l
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

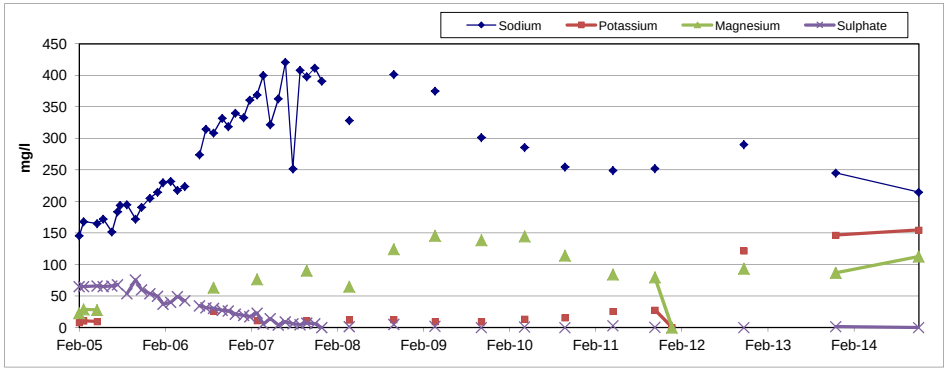

trigger level
Calcium mg/l
0
200
400
600
800
1000
1200
1400
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

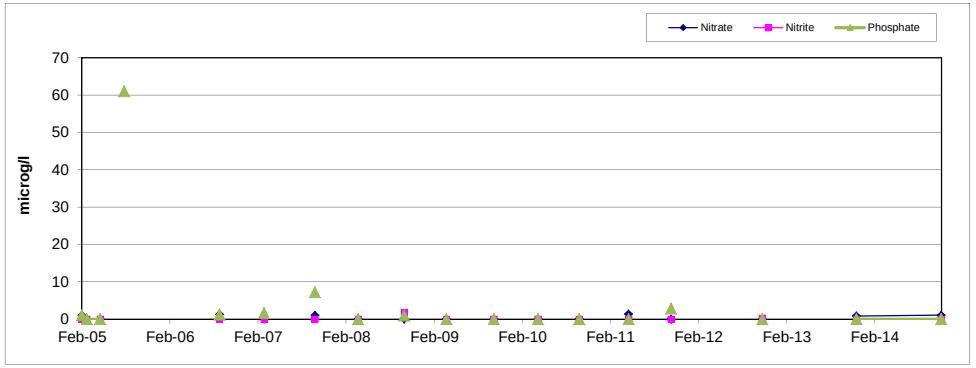

COD mg/l
0
50
100
150
200
250
300
350
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

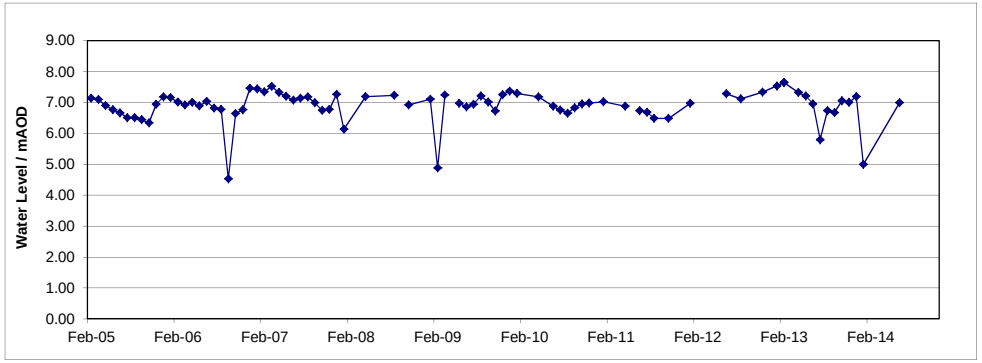

Copper
Arsenic
Copper microg/l
0
10
20
30
40
50
60
70
80
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

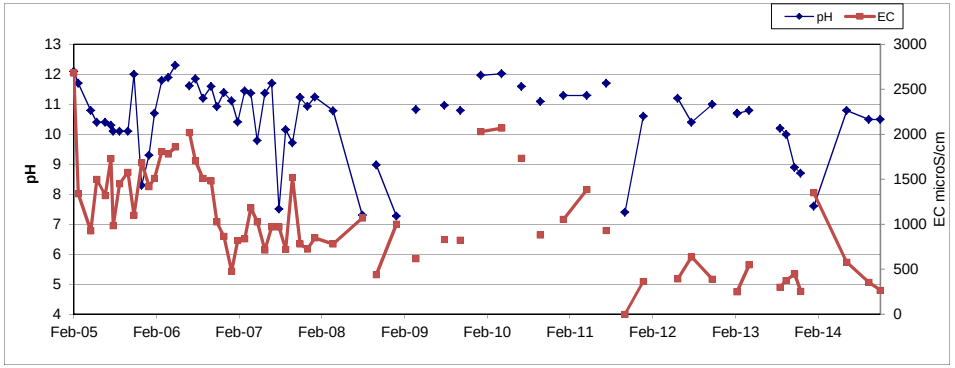

Alkalinity microg/l
0
100
200
300
400
500
600
700
800
900
1000
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

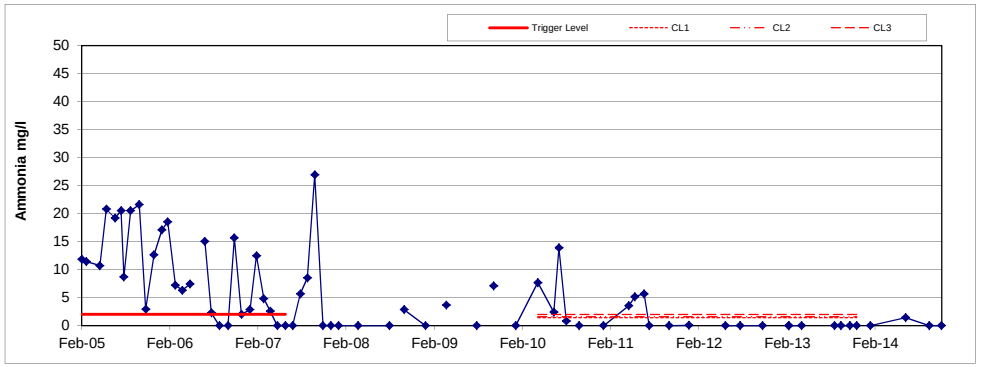

Chromium
Lead
Vanadium
Zinc
microg/l
0
20
40
60
80
100
120
140
160
180
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

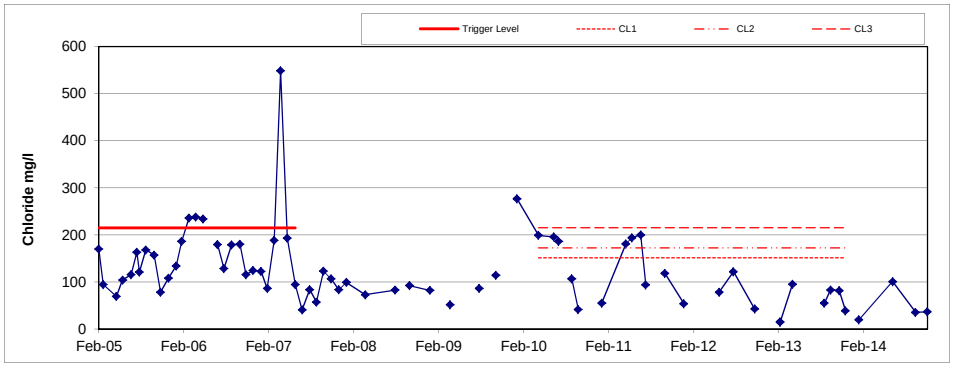

Sodium
Potassium
Magnesium
Sulphate
mg/l
0
50
100
150
200
250
300
350
400
450
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

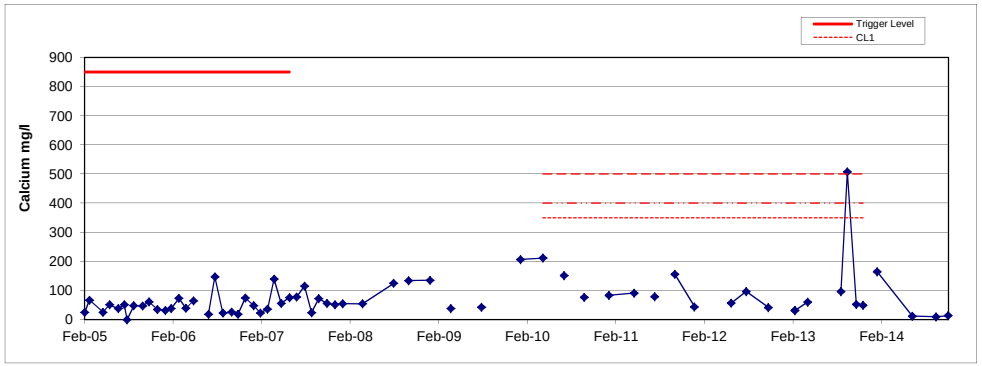

Nitrate
Nitrite
Phosphate
microg/l
0
10
20
30
40
50
60
70
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

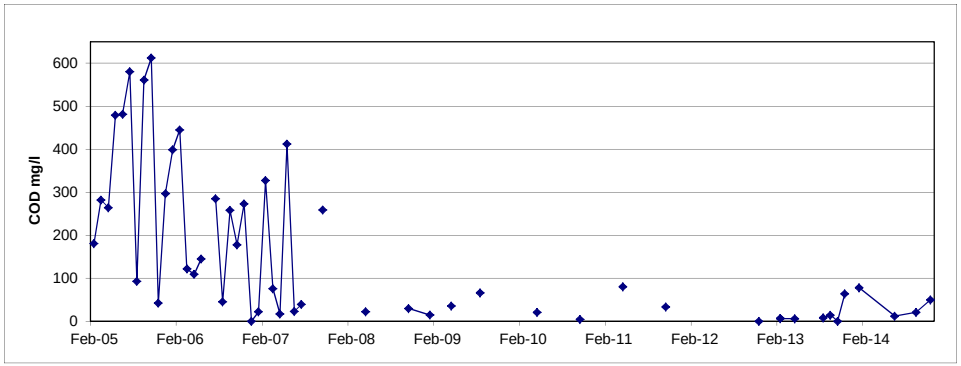

Water Level / mAOD
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Feb-05 Feb-06 Feb-07 Feb-08 Feb-09 Feb-10 Feb-11 Feb-12 Feb-13 Feb-14

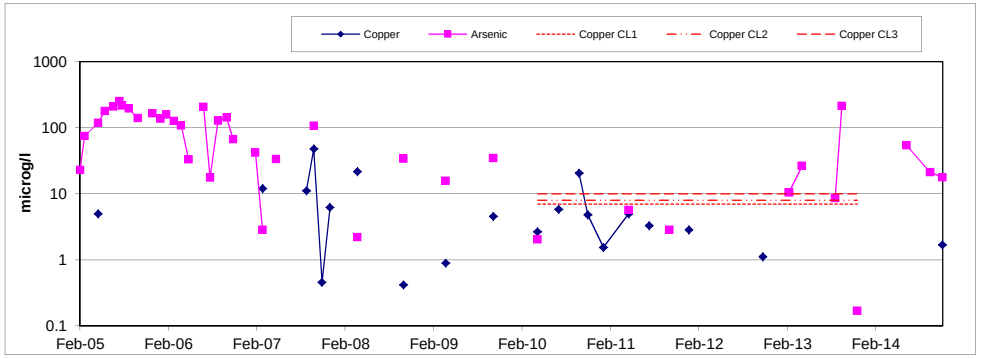

pH
EC
pH
EC microS/cm
13 12 11 10 9 8 7 6 5 4
3000 2500 2000 1500 1000 500 0
Feb-05 Feb-06 Feb-07 Feb-08 Feb-09 Feb-10 Feb-11 Feb-12 Feb-13 Feb-14

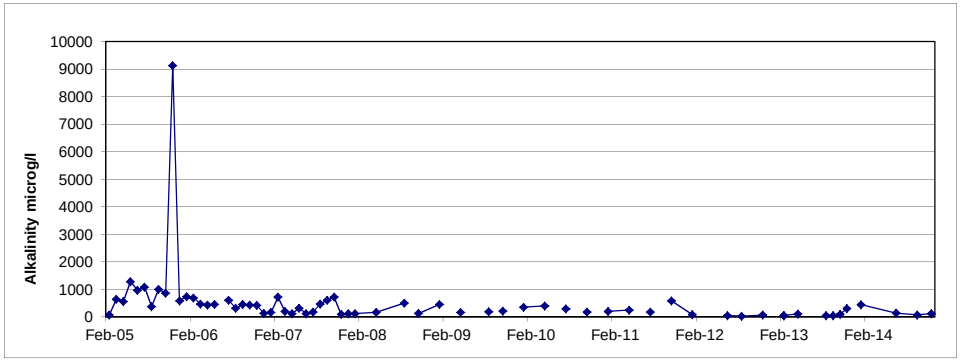

Trigger Level
CL1
CL2
CL3
Ammonia mg/l
50 45 40 35 30 25 20 15 10 5 0
Feb-05 Feb-06 Feb-07 Feb-08 Feb-09 Feb-10 Feb-11 Feb-12 Feb-13 Feb-14

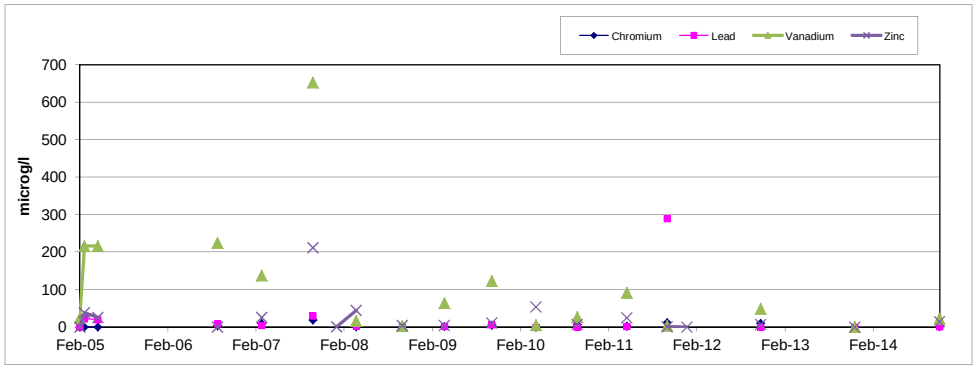

Trigger Level
CL1
CL2
CL3
Chloride mg/l
600 500 400 300 200 100 0
Feb-05 Feb-06 Feb-07 Feb-08 Feb-09 Feb-10 Feb-11 Feb-12 Feb-13 Feb-14

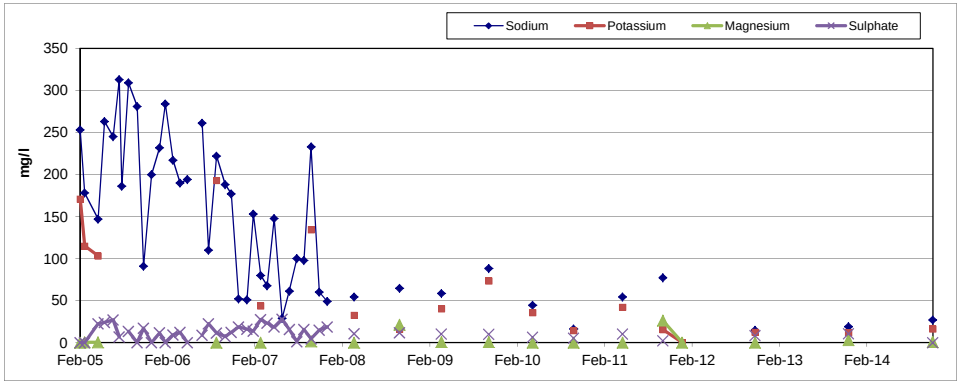

Trigger Level
CL1
Calcium mg/l
900 800 700 600 500 400 300 200 100 0
Feb-05 Feb-06 Feb-07 Feb-08 Feb-09 Feb-10 Feb-11 Feb-12 Feb-13 Feb-14

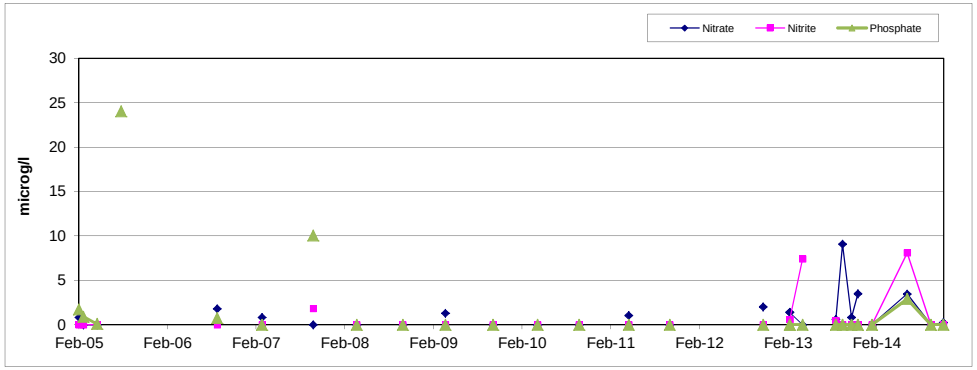

COD mg/l
600 500 400 300 200 100 0
Feb-05 Feb-06 Feb-07 Feb-08 Feb-09 Feb-10 Feb-11 Feb-12 Feb-13 Feb-14

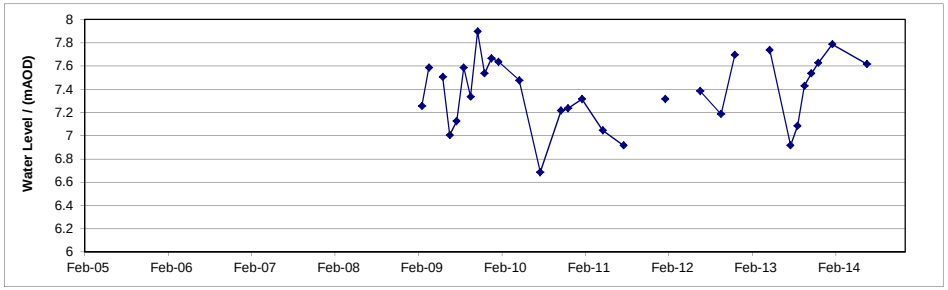

Copper
Arsenic
Copper CL1
Copper CL2
Copper CL3
microg/l
1000
100
10
1
0.1
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

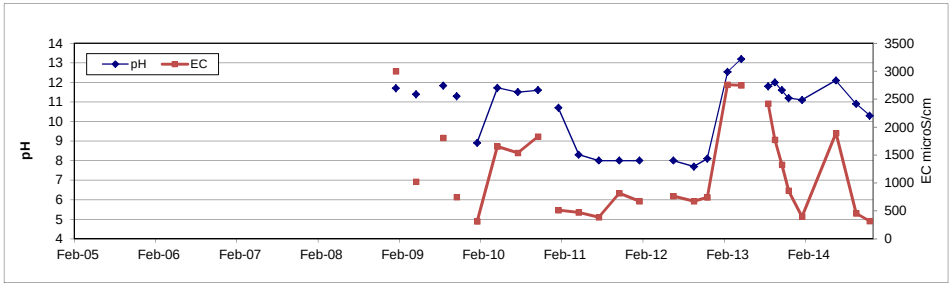

Alkalinity microg/l
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

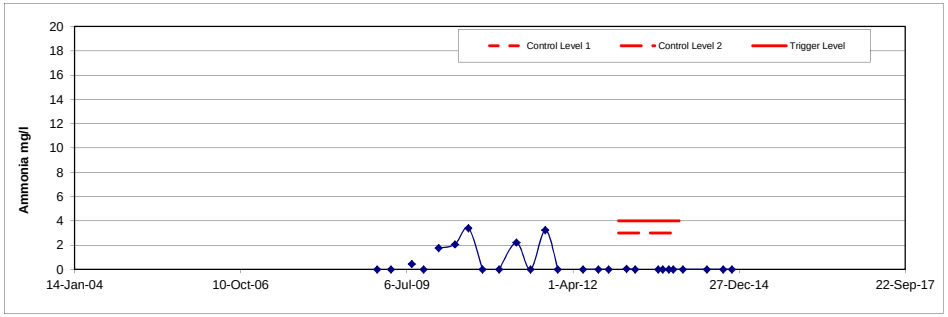

Chromium
Lead
Vanadium
Zinc
microg/l
700
600
500
400
300
200
100
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

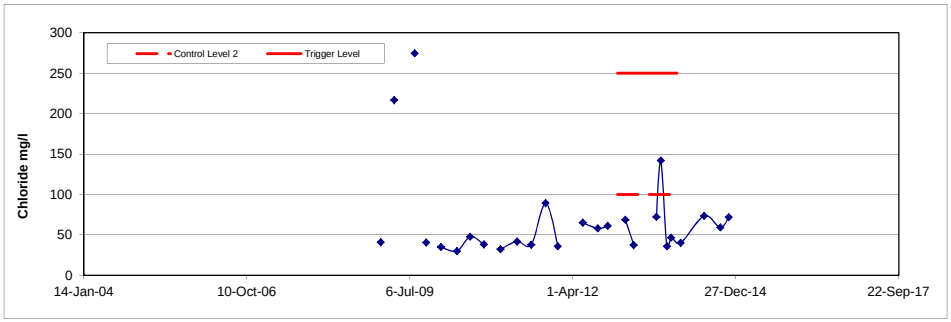

Sodium
Potassium
Magnesium
Sulphate
mg/l
350
300
250
200
150
100
50
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

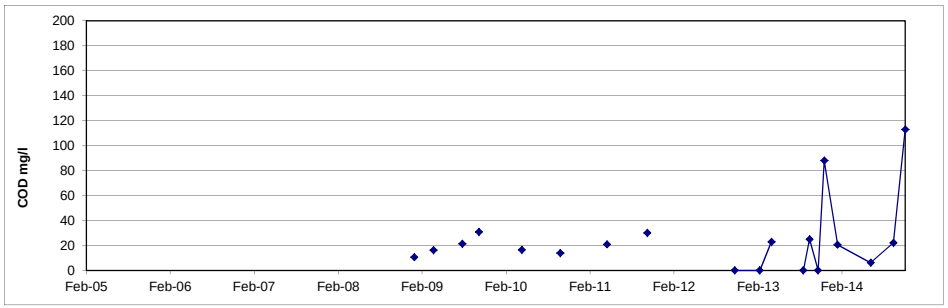

Nitrate
Nitrite
Phosphate
microg/l
30
25
20
15
10
5
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

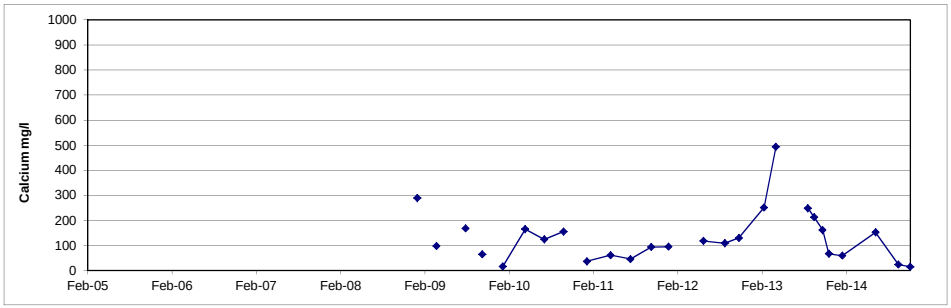

Water Level / (mAOD)
8
7.8
7.6
7.4
7.2
7
6.8
6.6
6.4
6.2
6
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

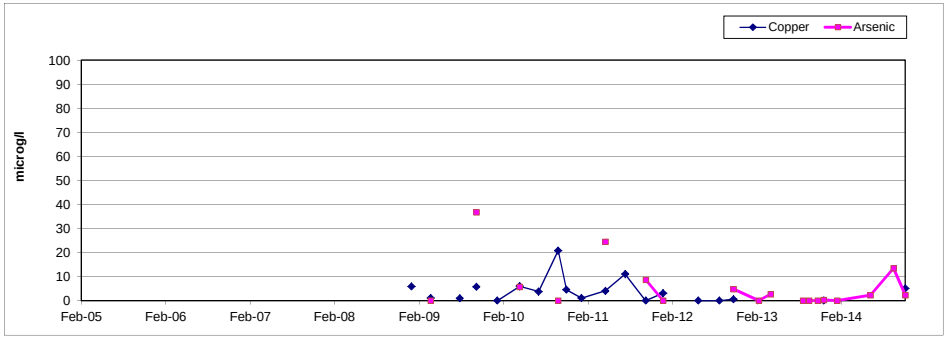

pH
EC
14
13
12
11
10
9
8
7
6
5
4
3500
3000
2500
2000
1500
1000
500
0
EC microS/cm
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

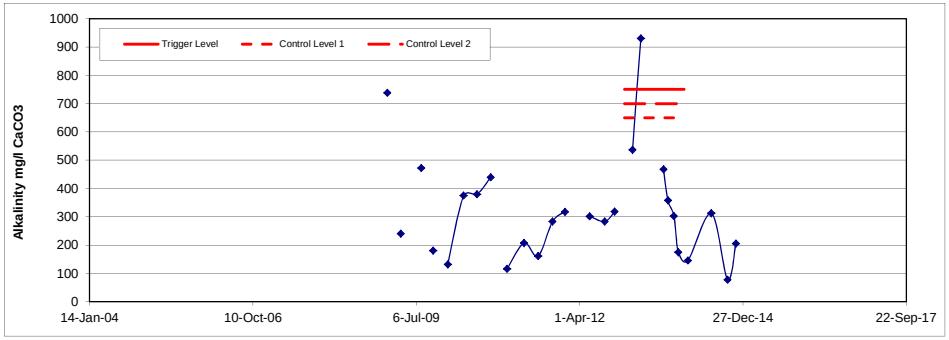

Control Level 1
Control Level 2
Trigger Level
Ammonia mg/l
20
18
16
14
12
10
8
6
4
2
0
14-Jan-04
10-Oct-06
6-Jul-09
1-Apr-12
27-Dec-14
22-Sep-17

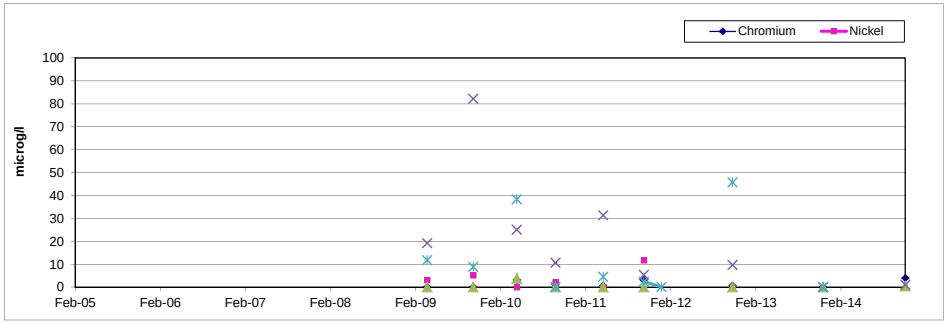

Control Level 2
Trigger Level
Chloride mg/l
300
250
200
150
100
50
0
14-Jan-04
10-Oct-06
6-Jul-09
1-Apr-12
27-Dec-14
22-Sep-17

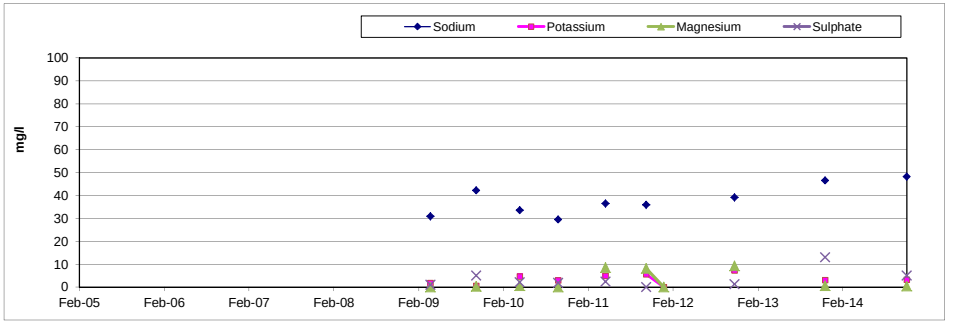

COD mg/l
200
180
160
140
120
100
80
60
40
20
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

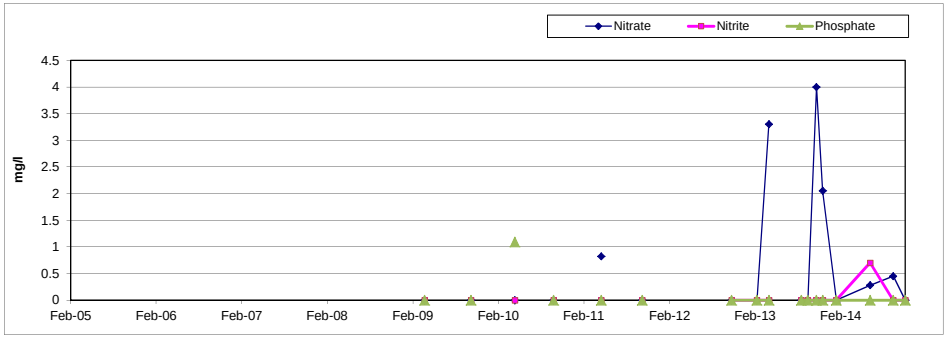

Calcium mg/l
1000
900
800
700
600
500
400
300
200
100
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14


Copper
Arsenic
microg/l
100
90
80
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14


Trigger Level
Control Level 1
Control Level 2
Alkalinity mg/l CaCO3
1000
900
800
700
600
500
400
300
200
100
0
14-Jan-04
10-Oct-06
6-Jul-09
1-Apr-12
27-Dec-14
22-Sep-17


Chromium
Nickel
microg/l
100
90
80
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14


Sodium
Potassium
Magnesium
Sulphate
mg/l
100
90
80
70
60
50
40
30
20
10
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14


Nitrate
Nitrite
Phosphate
mg/l
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14

MORFA NON HAZARDOUS LANDFILL, PORT TALBOT

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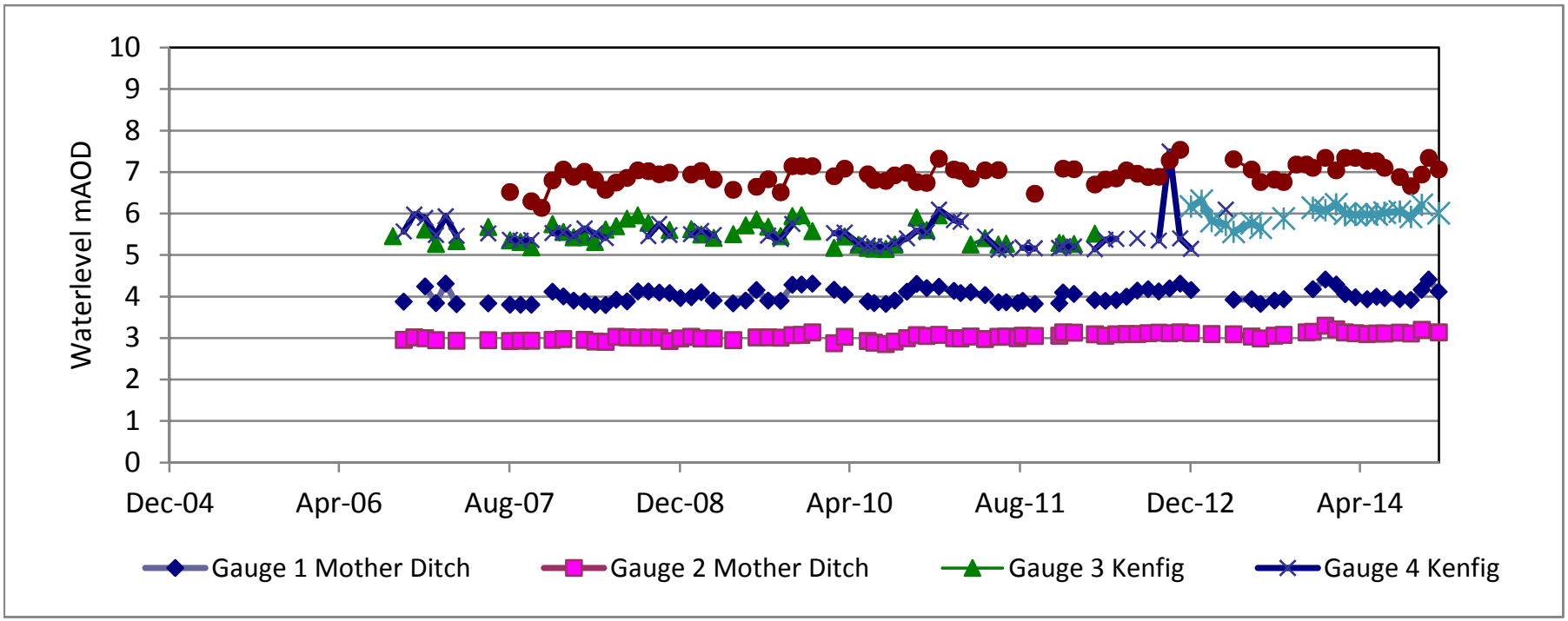
Appendix 5
Temporal variation of surface water levels

Report Number 1392r1v1d0215


Waterlevel mAOD
10
9
8
7
6
5
4
3
2
1
0
Dec-04
Apr-06
Aug-07
Dec-08
Apr-10
Aug-11
Dec-12
Apr-14
Gauge 1 Mother Ditch
Gauge 2 Mother Ditch
Gauge 3 Kenfig
Gauge 4 Kenfig

MORFA NON HAZARDOUS LANDFILL, PORT TALBOT

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2014 Annual Review of Environmental Monitoring

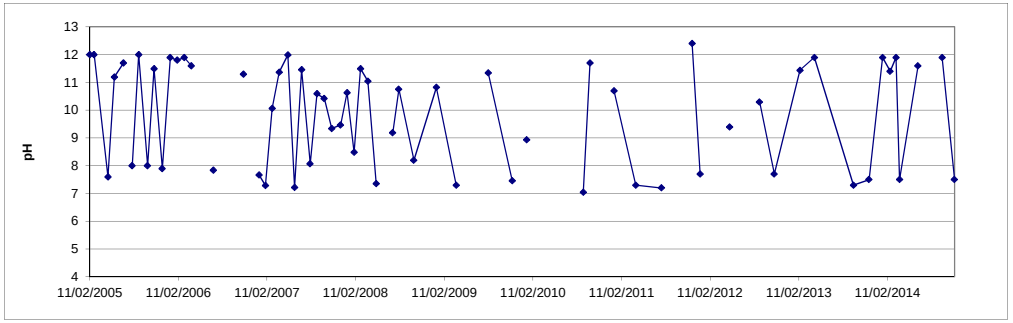
Appendix 6
Temporal variation of surface water chemistry

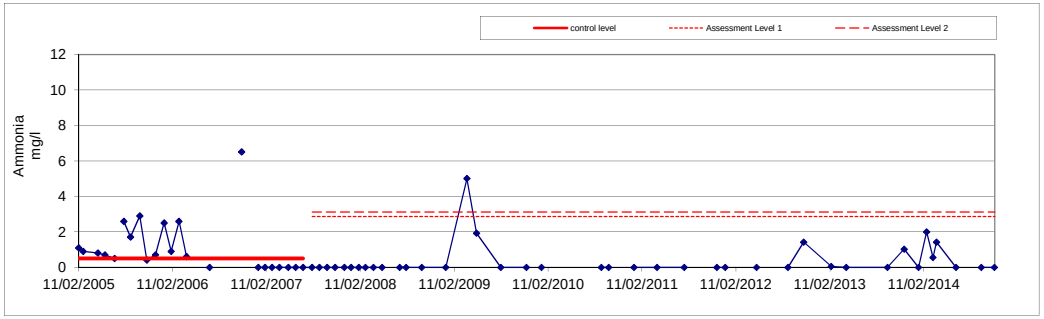
Report Number 1392r1v1d0215

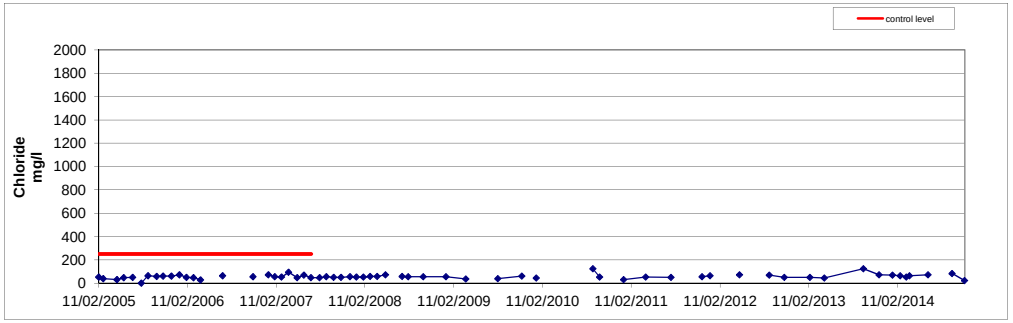
Morfa Landfill

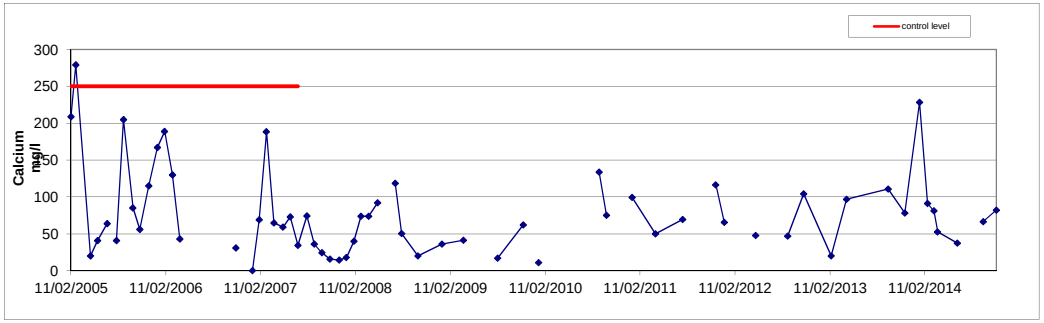
Monitoring data for SW 2

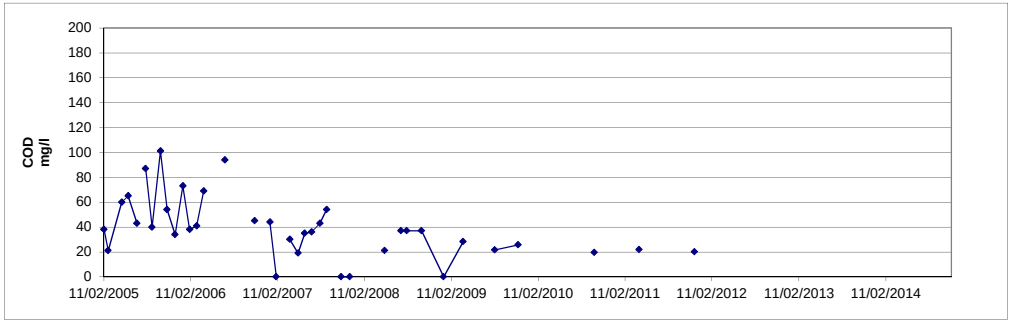
Tata Steel (UK) Ltd

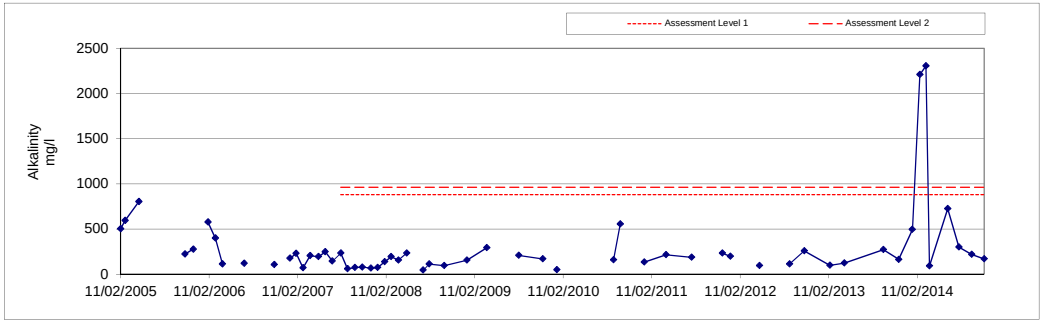


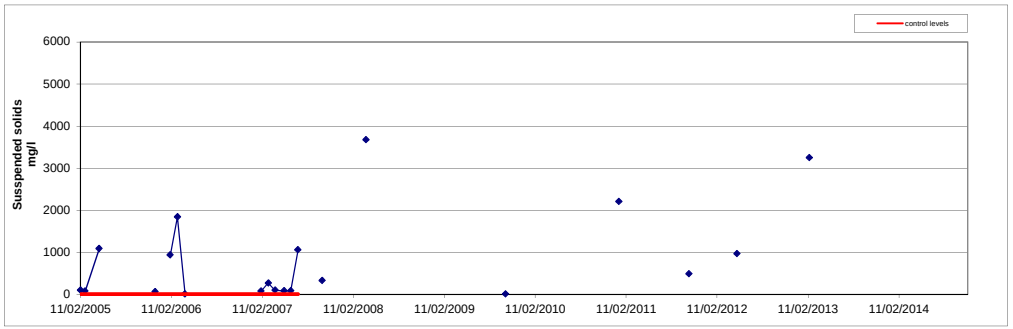


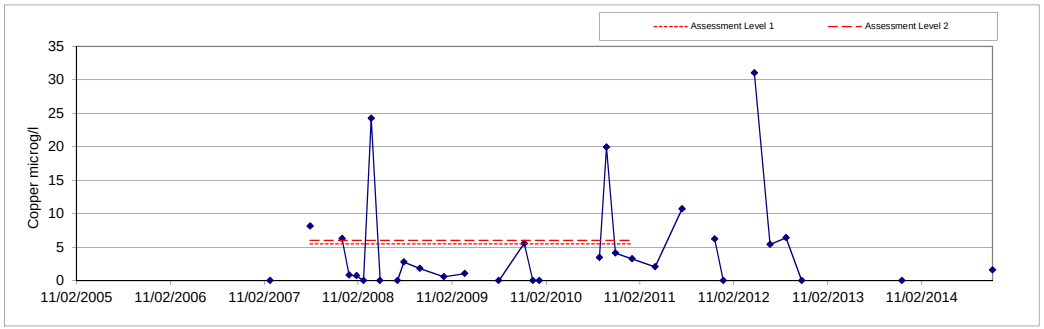


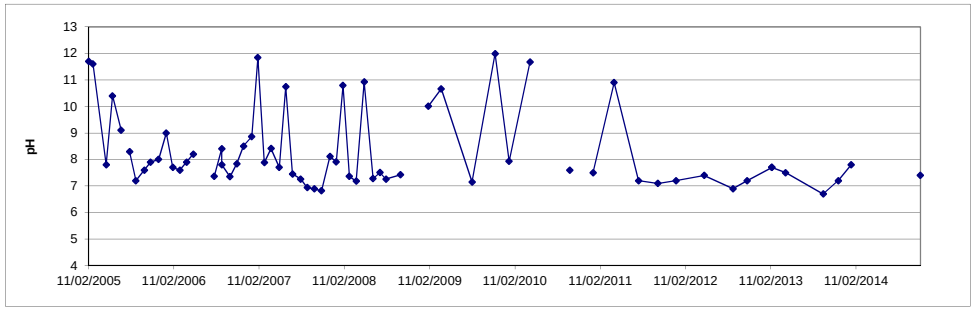











pH
13
12
11
10
9
8
7
6
5
4
11/02/2005
11/02/2006
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11/02/2012
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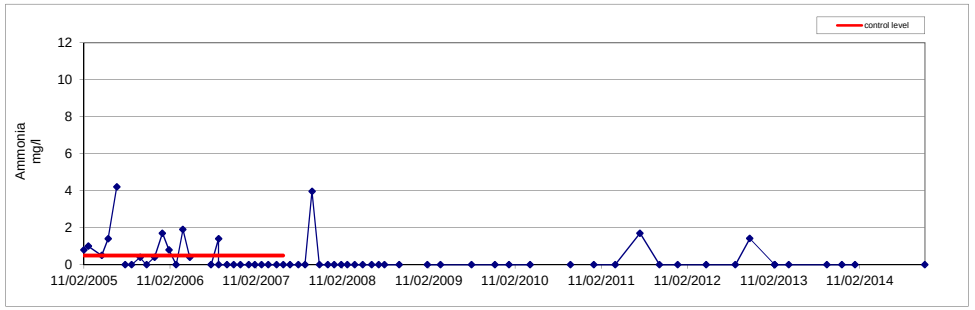
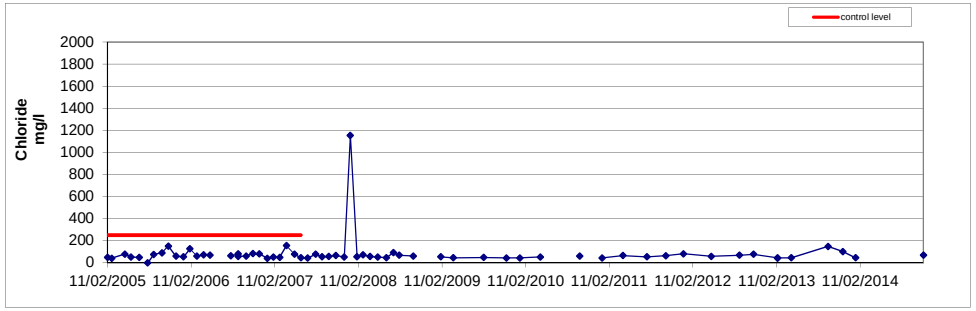
11/02/2014


control level
Ammonia mg/l
12
10
8
6
4
2
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


control level
Chloride mg/l
2000
1800
1600
1400
1200
1000
800
600
400
200
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
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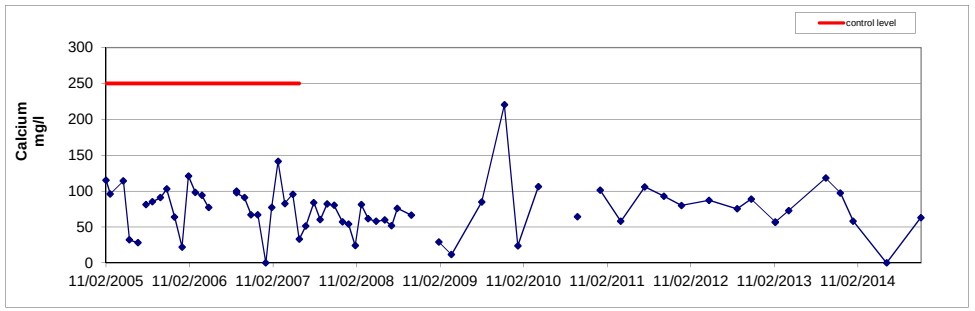
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


control level
Calcium mg/l
300
250
200
150
100
50
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
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11/02/2010
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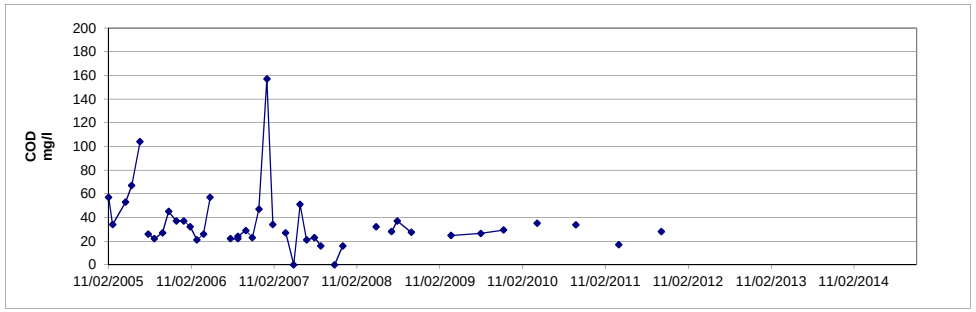
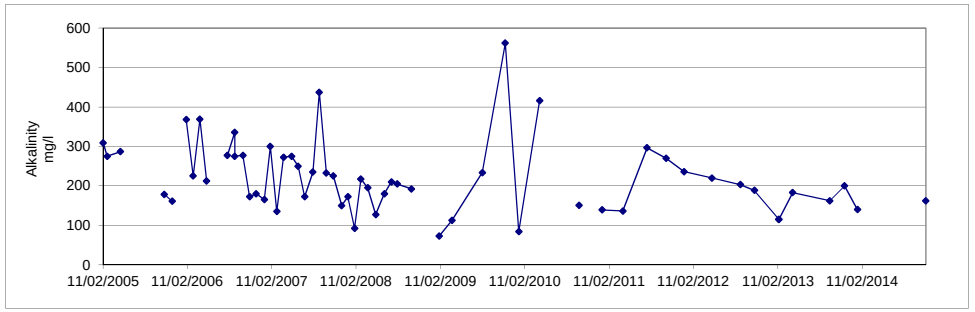
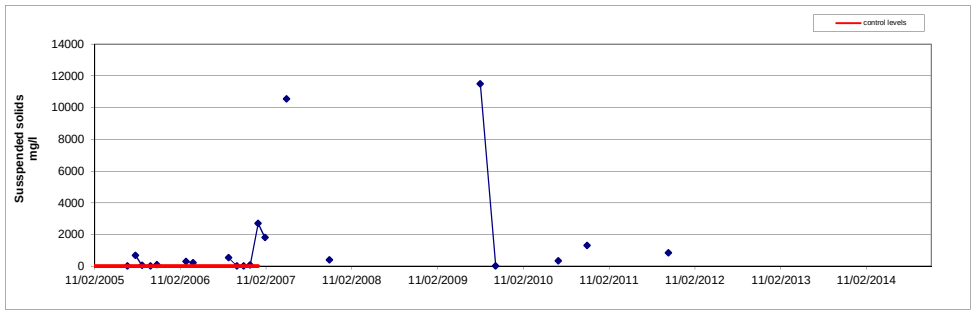
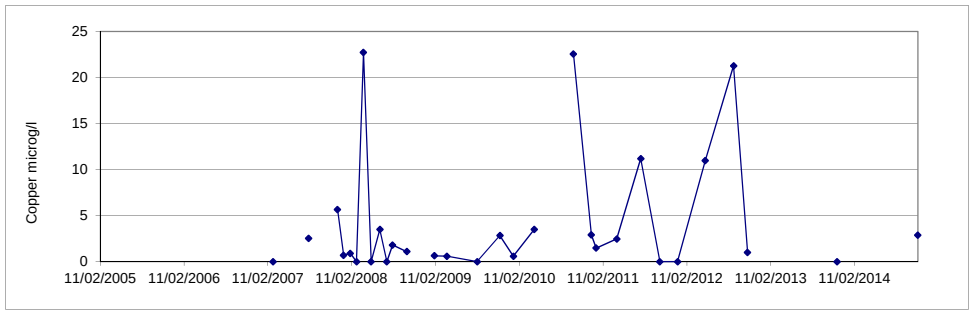
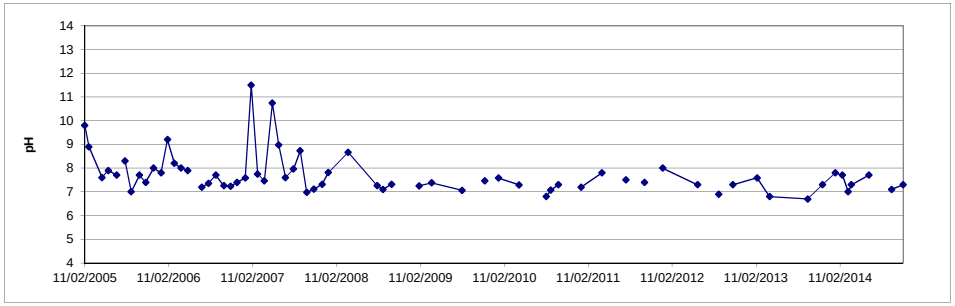
11/02/2013
11/02/2014


COD mg/l
200
180
160
140
120
100
80
60
40
20
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


Alkalinity mg/l
600
500
400
300
200
100
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


control levels
Suspended solids mg/l
14000
12000
10000
8000
6000
4000
2000
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


Copper microg/l
25
20
15
10
5
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


pH
14
13
12
11
10
9
8
7
6
5
4
11/02/2005
11/02/2006
11/02/2007
11/02/2008
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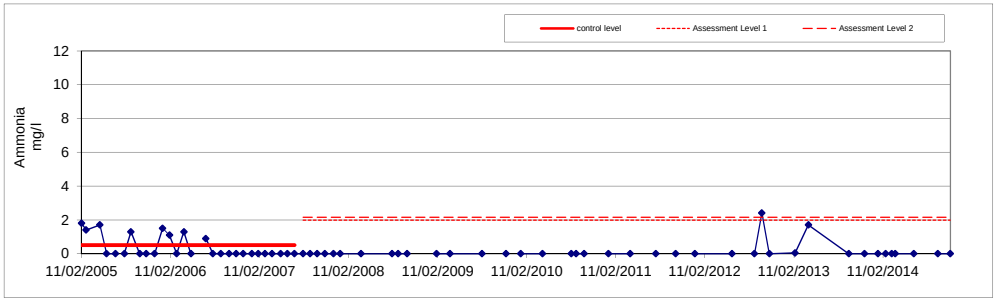
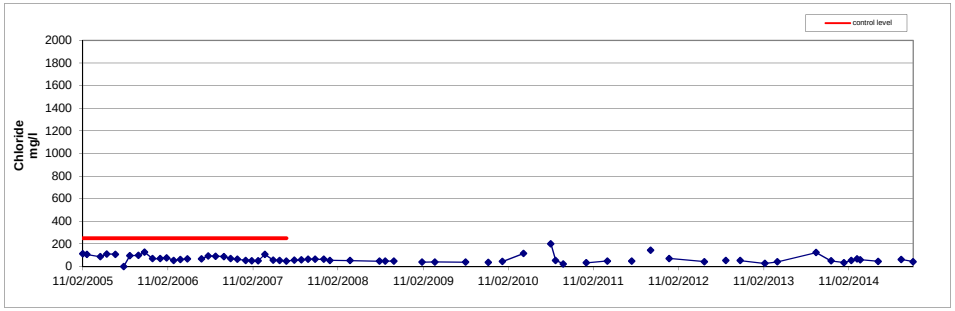
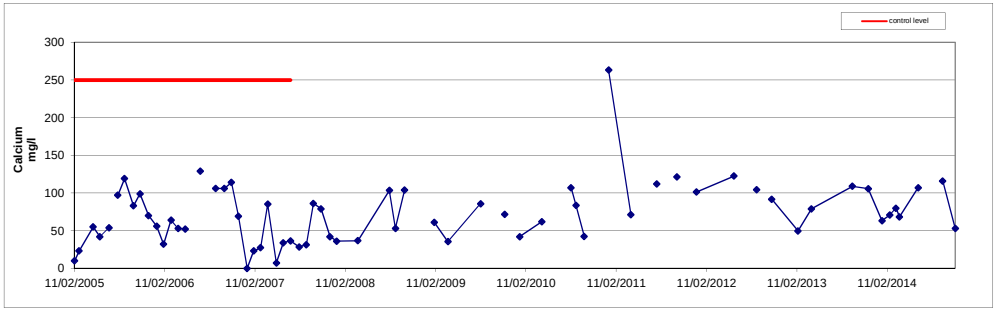
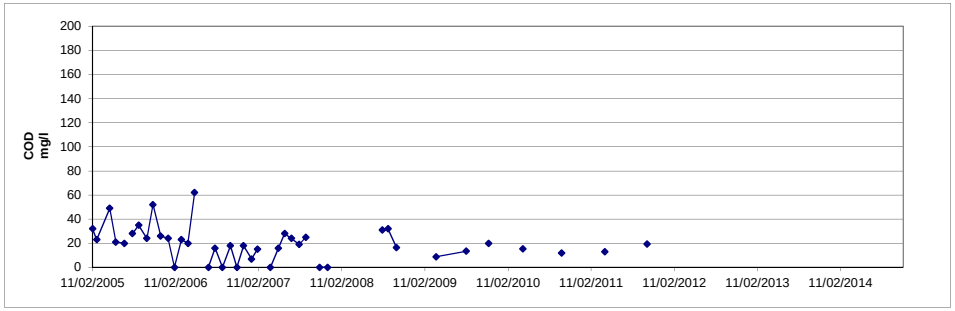
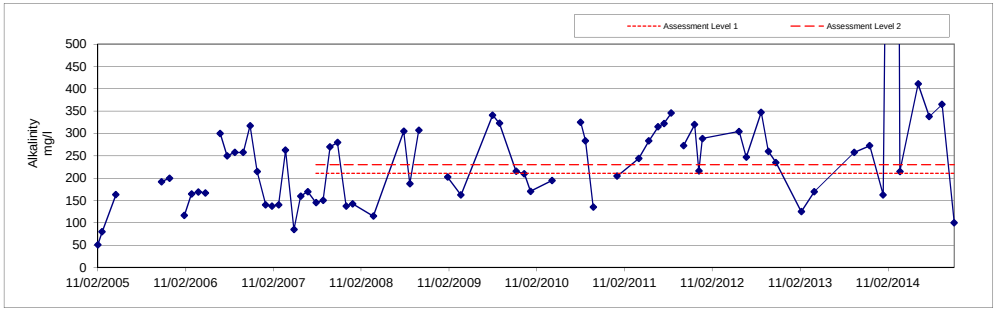
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

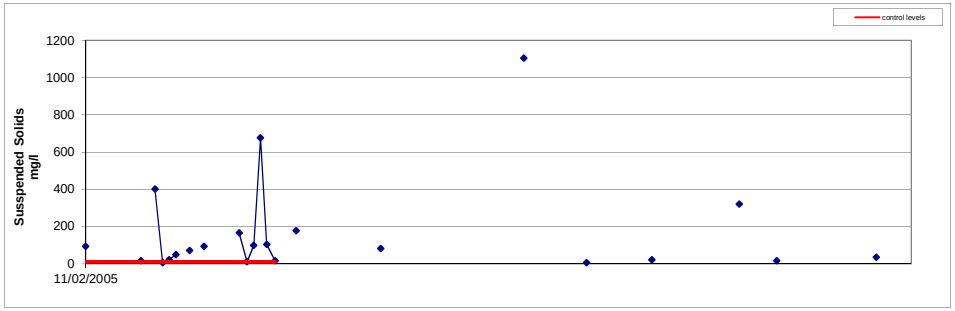

control level
Assessment Level 1
Assessment Level 2
Ammonia mg/l
12
10
8
6
4
2
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

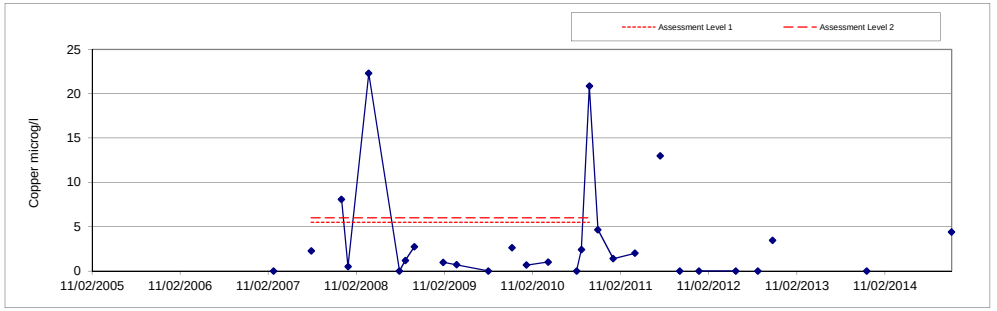

control level
Chloride mg/l
2000
1800
1600
1400
1200
1000
800
600
400
200
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


control level
Calcium mg/l
300
250
200
150
100
50
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

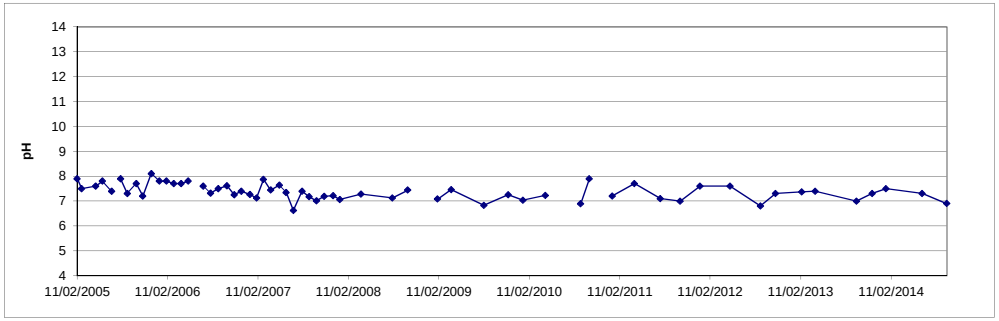

COD mg/l
200
180
160
140
120
100
80
60
40
20
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

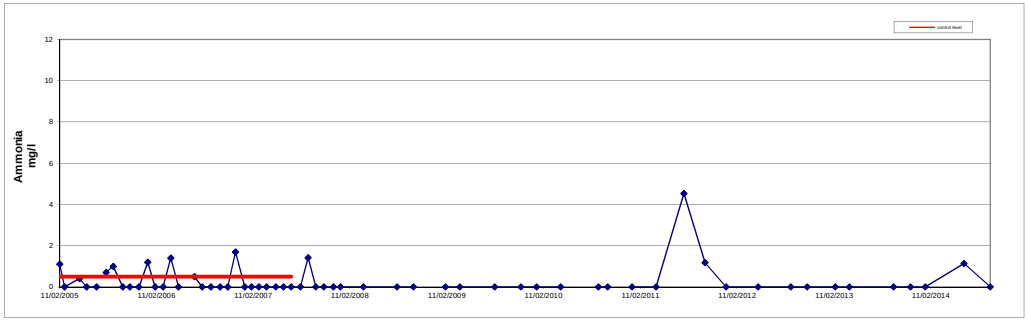

Assessment Level 1
Assessment Level 2
Alkalinity mg/l
500
450
400
350
300
250
200
150
100
50
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

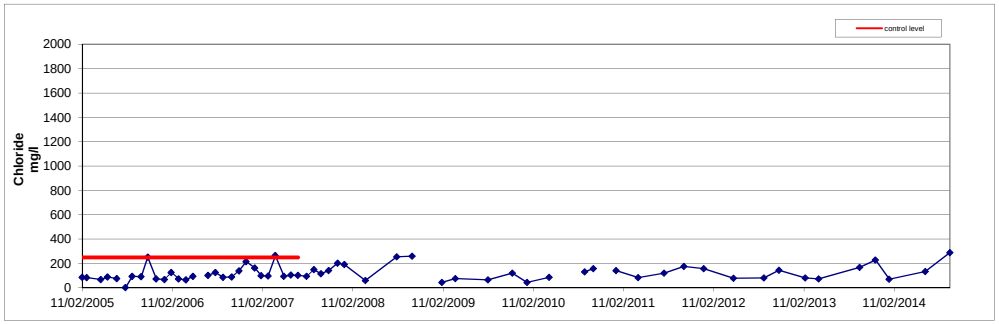

control levels
Suspended Solids mg/l
1200
1000
800
600
400
200
0
11/02/2005

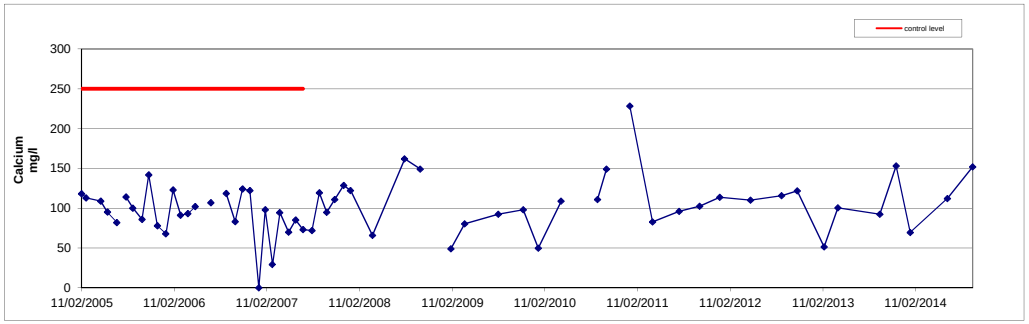

Assessment Level 1
Assessment Level 2
Copper microg/l
25
20
15
10
5
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

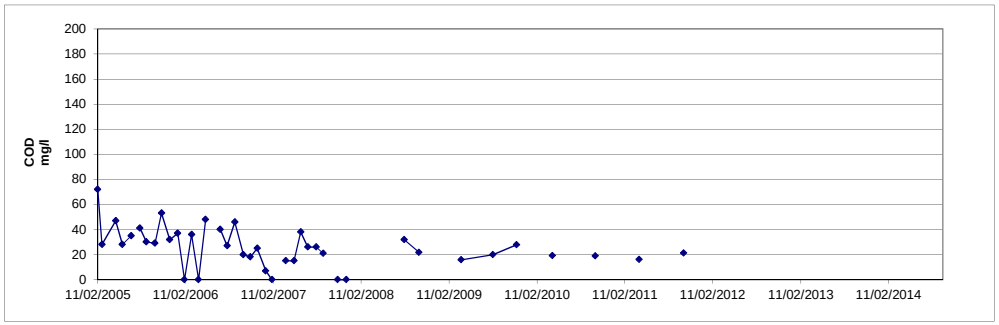
Monitoring data for SW 5

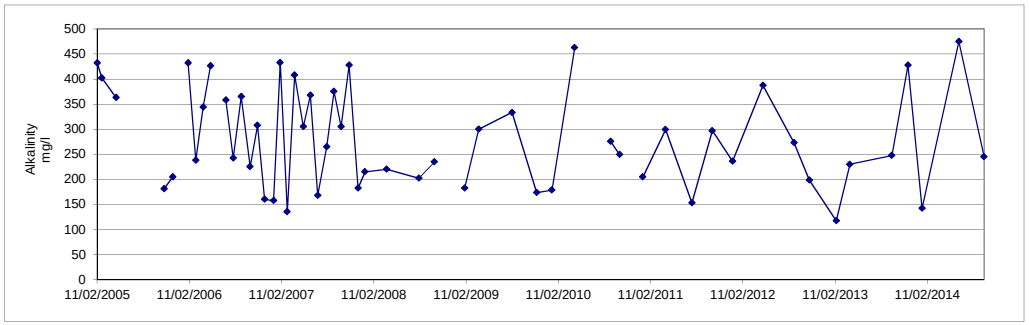


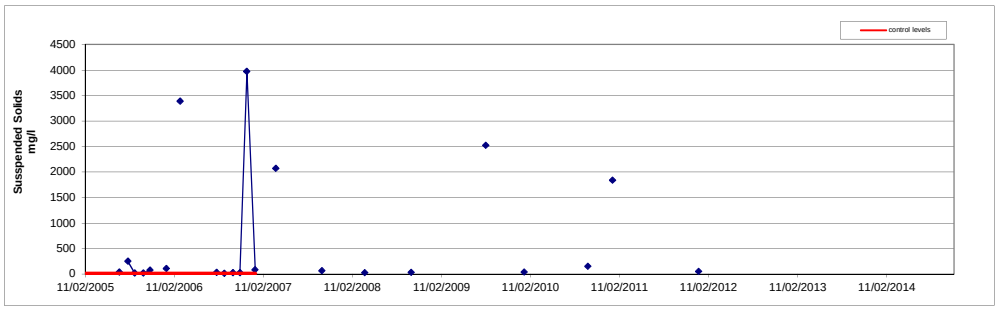


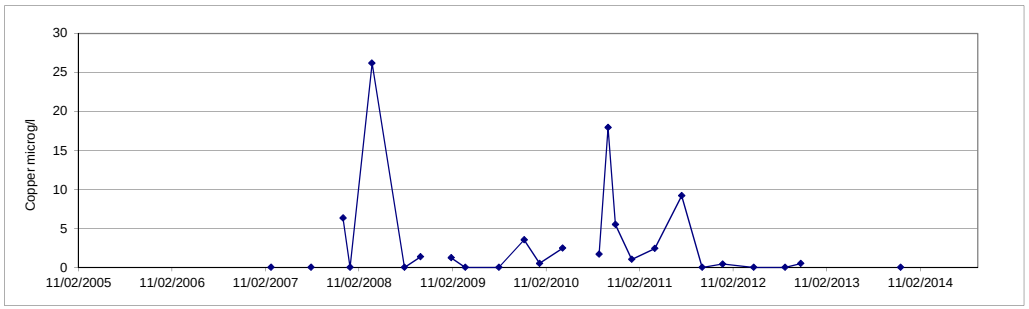


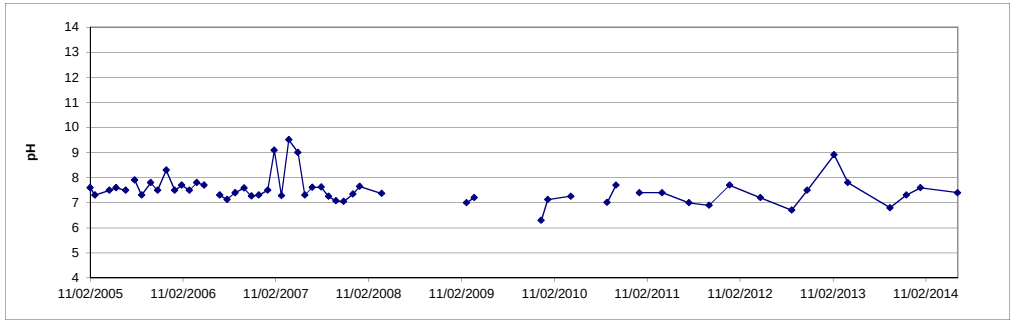











pH
14
13
12
11
10
9
8
7
6
5
4
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
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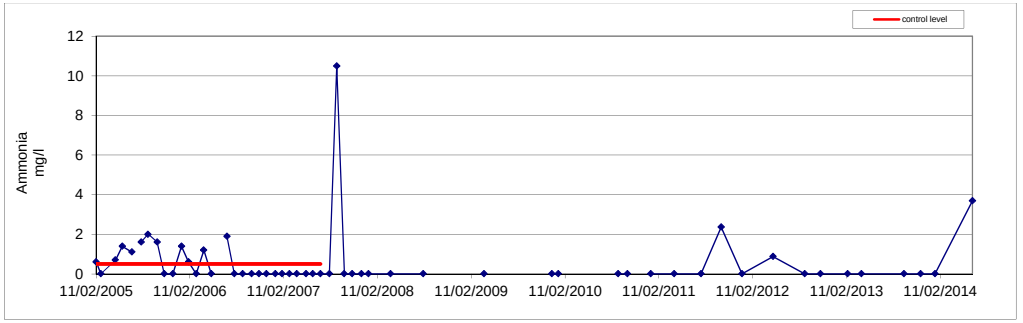
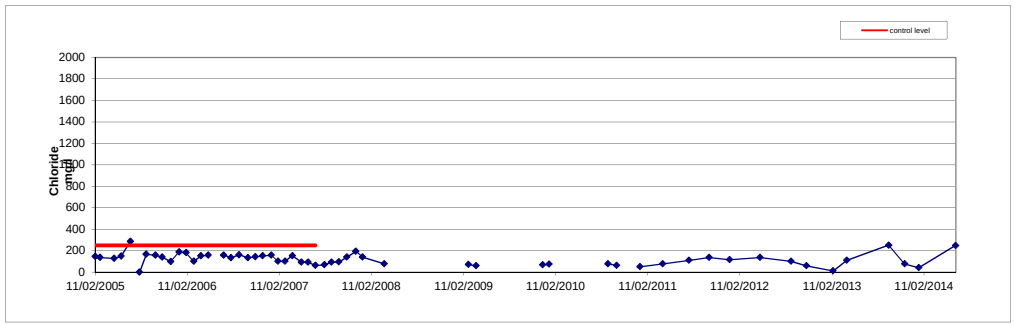
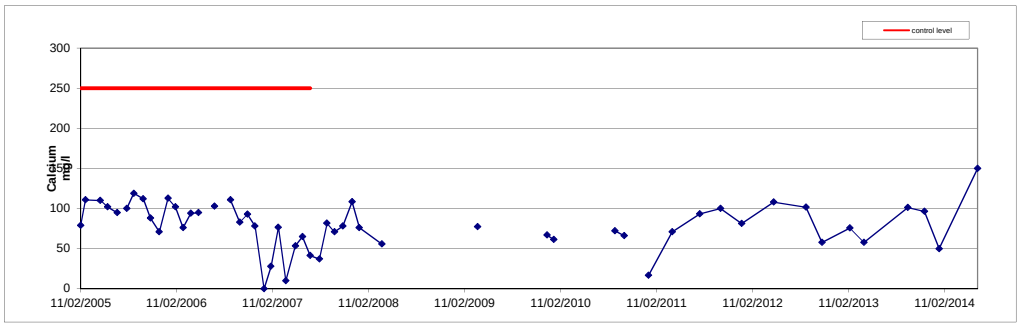
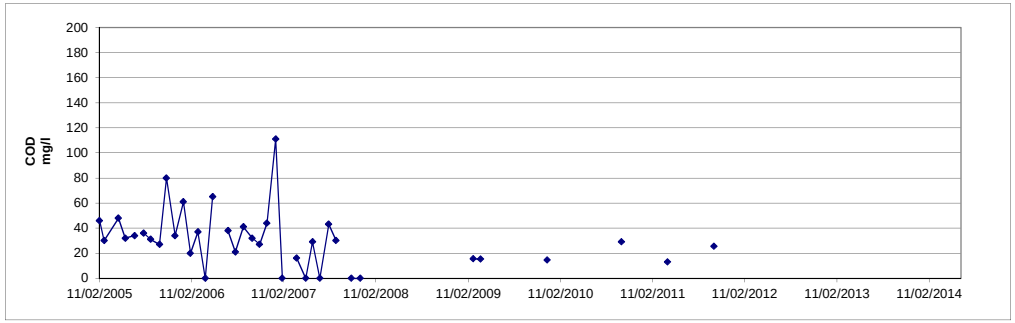
11/02/2014


control level
Ammonia mg/l
12
10
8
6
4
2
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


control level
Chloride mg/l
2000
1800
1600
1400
1200
1000
800
600
400
200
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


control level
Calcium mg/l
300
250
200
150
100
50
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


COD mg/l
200
180
160
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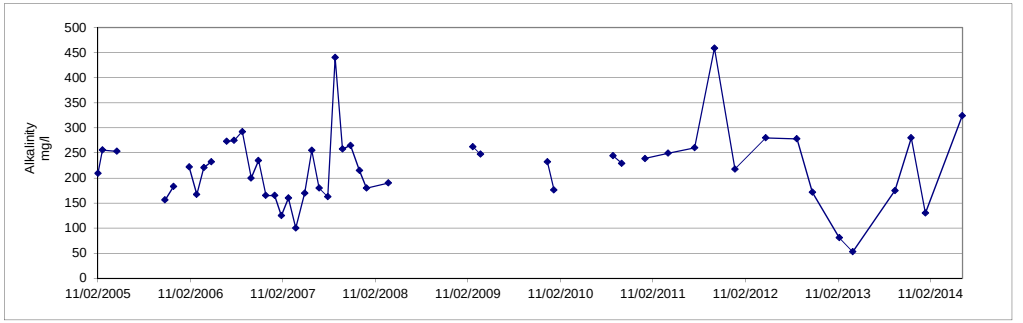
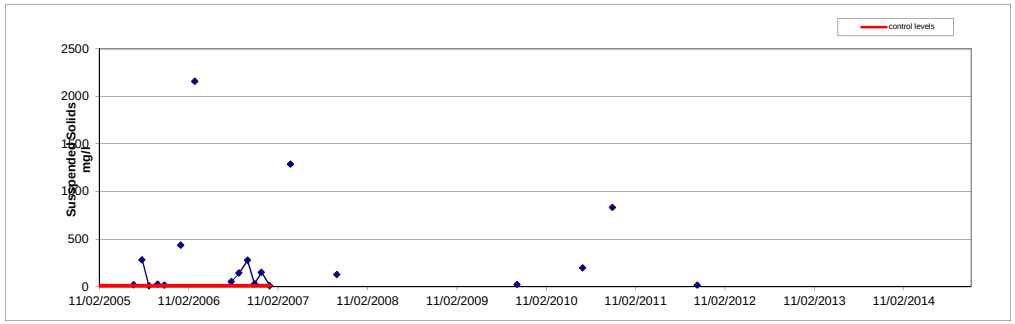
120
100
80
60
40
20
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


Alkalinity mg/l
500
450
400
350
300
250
200
150
100
50
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


control levels
Suspended Solids mg/l
2500
2000
1500
1000
500
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
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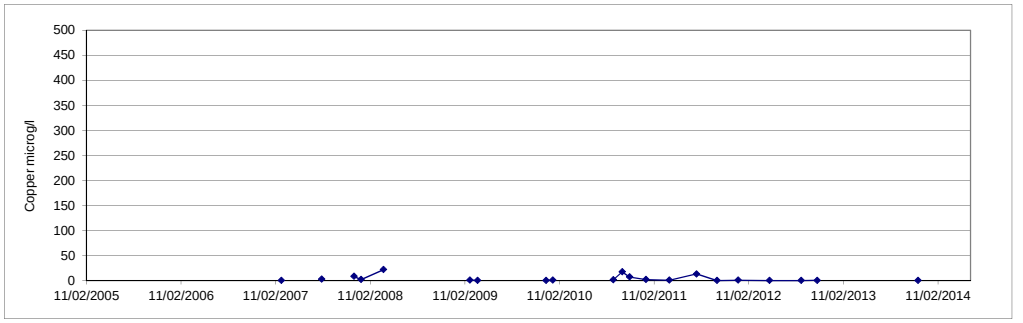
Copper microg/l
500
450
400
350
300
250
200
150
100
50
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
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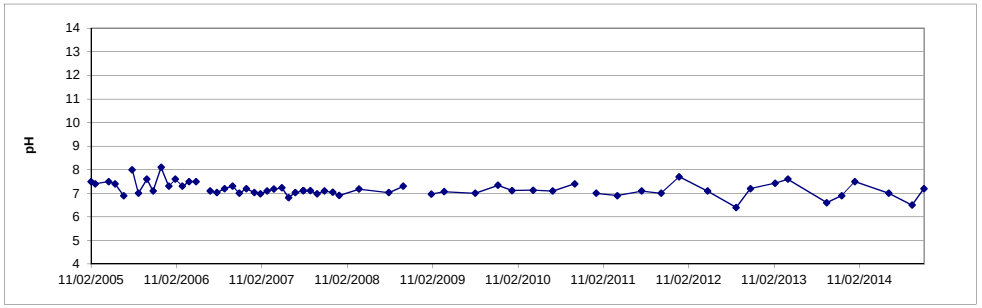
pH
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11
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7
6
5
4
11/02/2005
11/02/2006
11/02/2007
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11/02/2010
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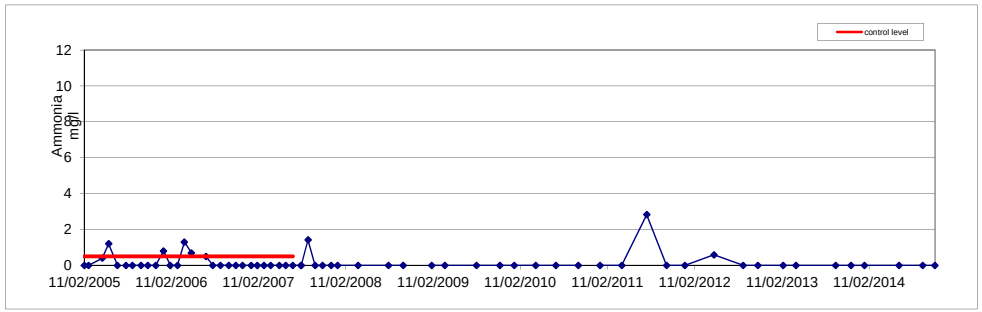
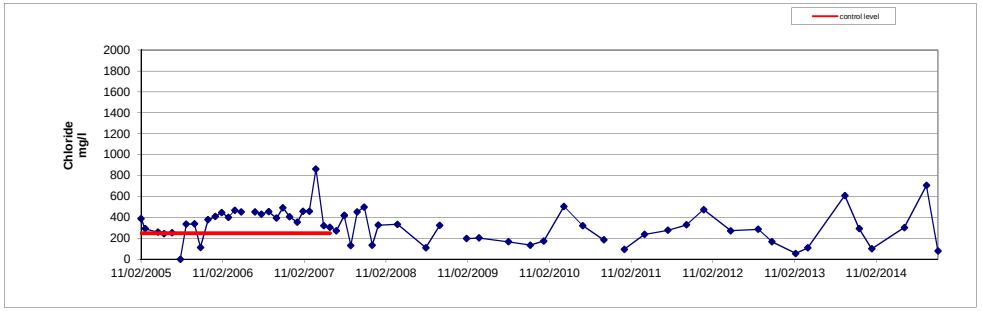
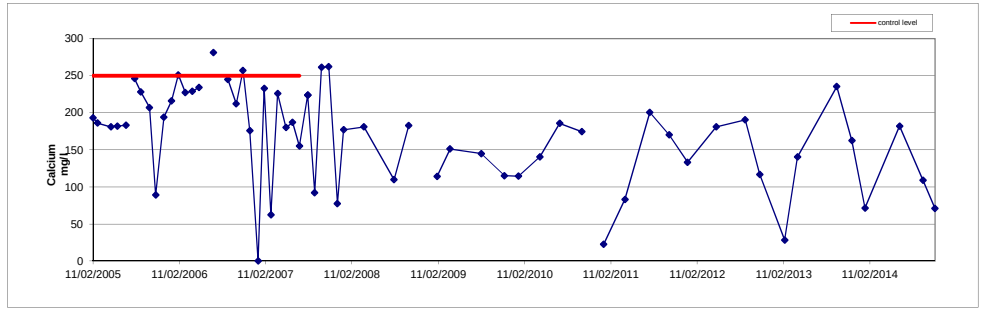
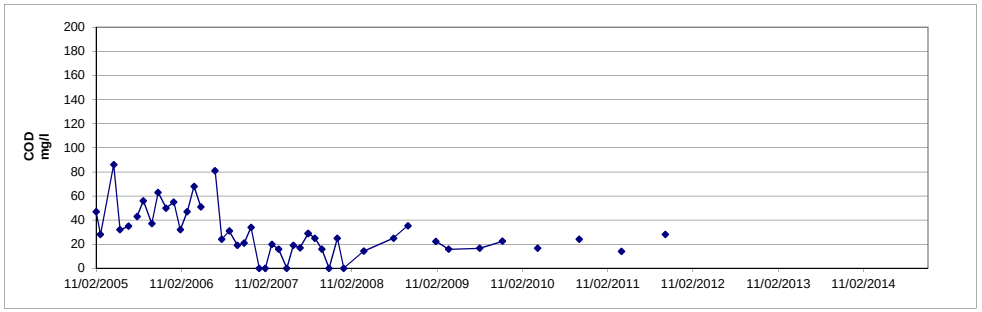
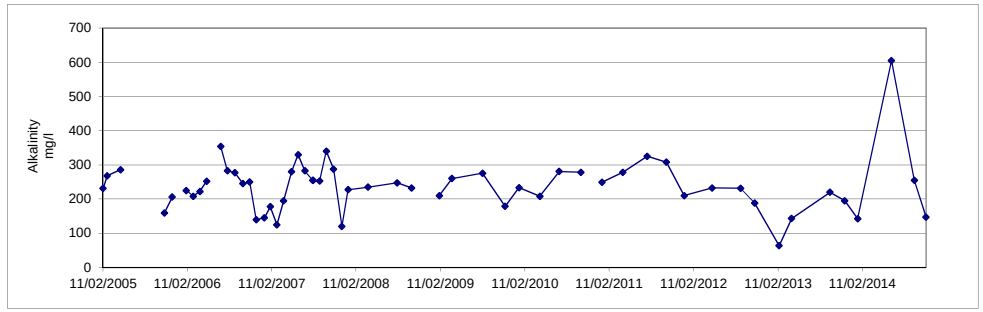
11/02/2012
11/02/2013
11/02/2014

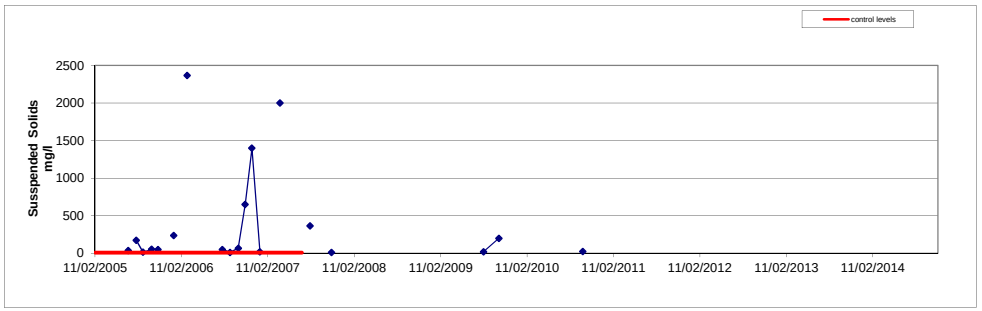

control level
Ammonia mg/l
12
10
8
6
4
2
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

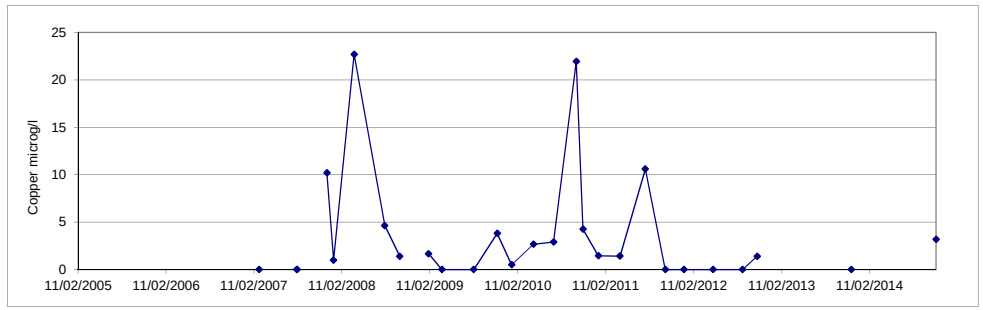

control level
Chloride mg/l
2000
1800
1600
1400
1200
1000
800
600
400
200
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


control level
Calcium mg/l
300
250
200
150
100
50
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

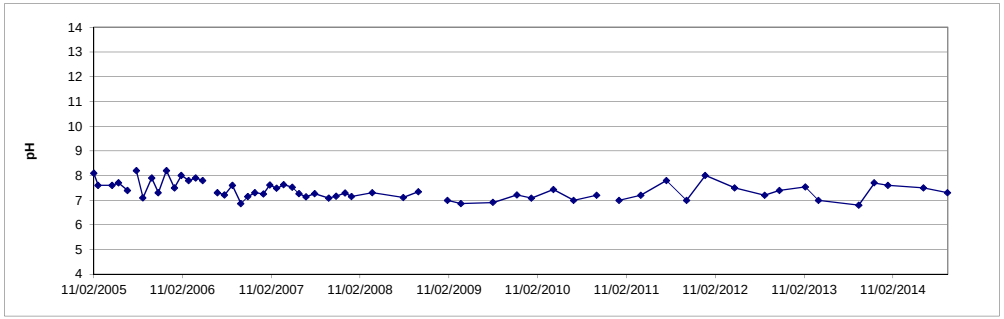

COD mg/l
200
180
160
140
120
100
80
60
40
20
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

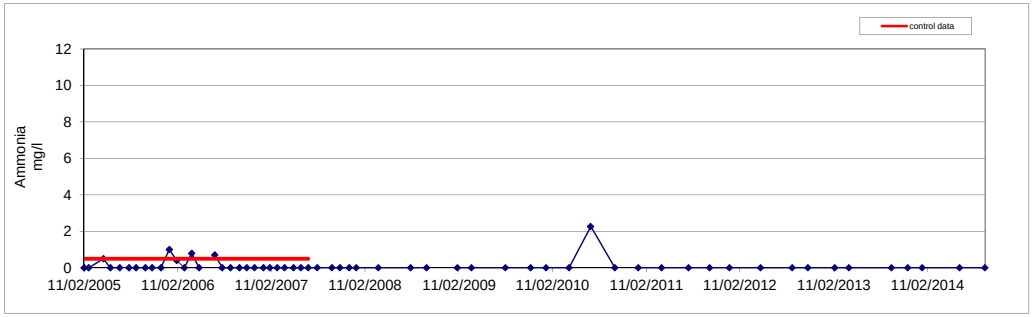

Alkalinity mg/l
700
600
500
400
300
200
100
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

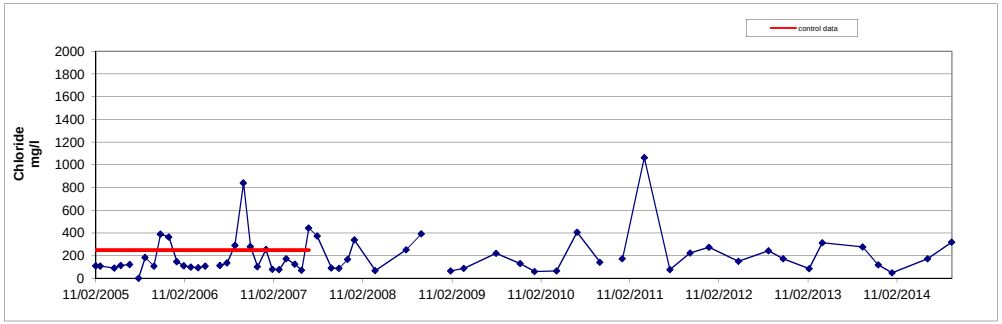

control levels
Susspended Solids mg/l
2500
2000
1500
1000
500
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

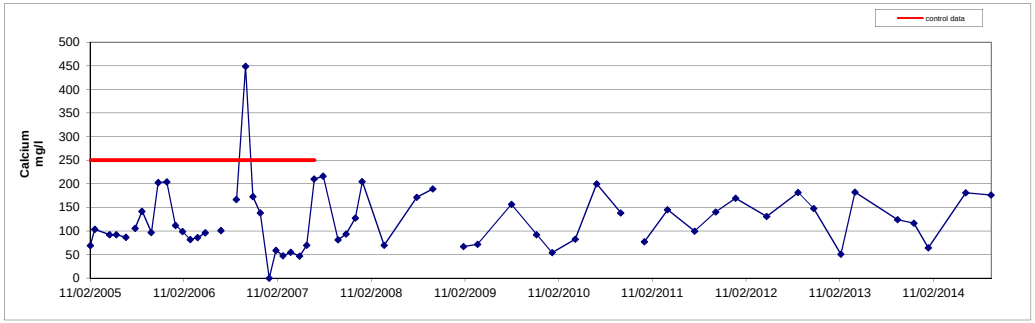

Copper microg/l
25
20
15
10
5
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

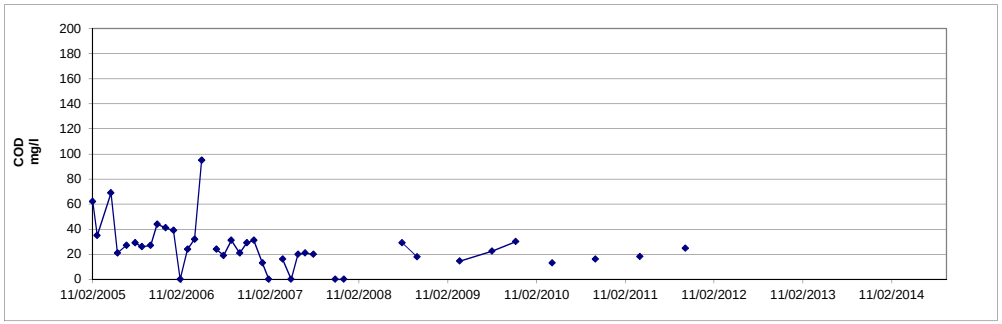
Monitoring data for SW 8

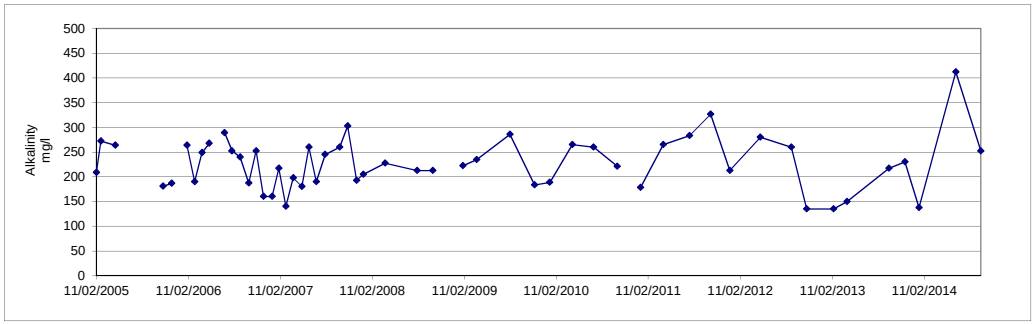


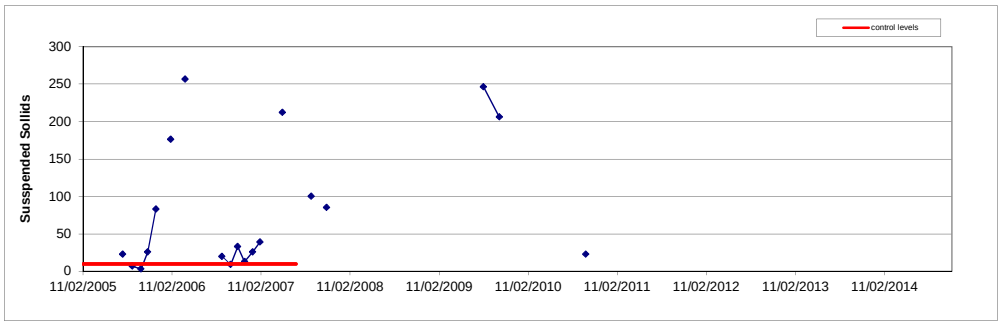


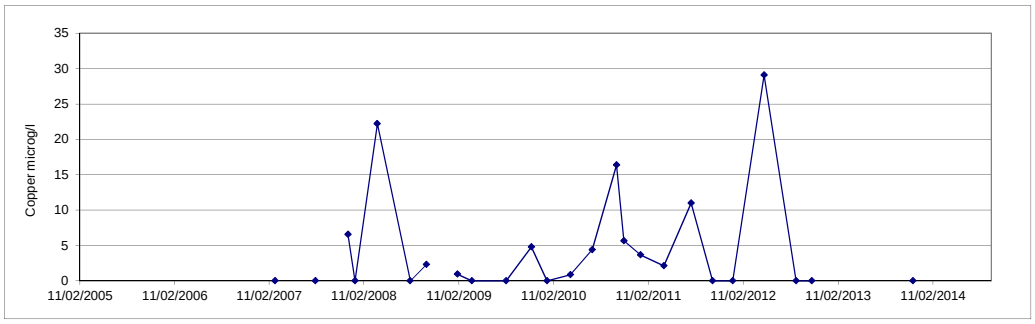


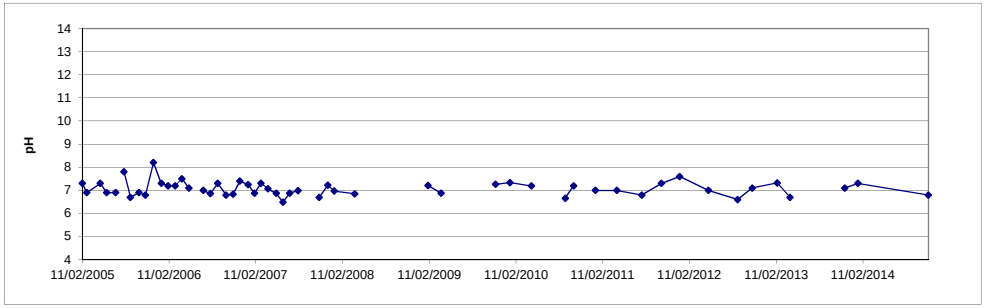


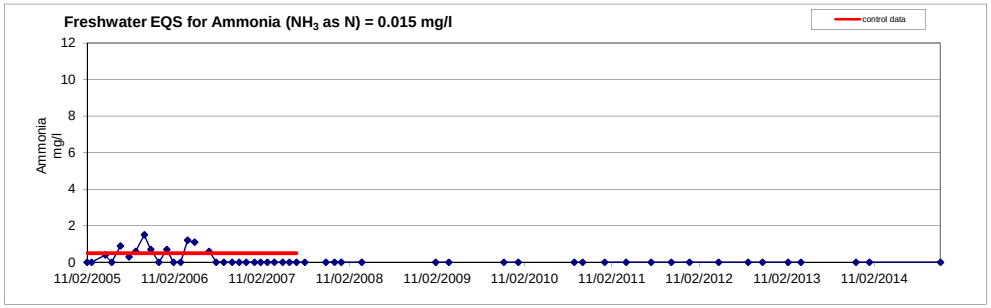


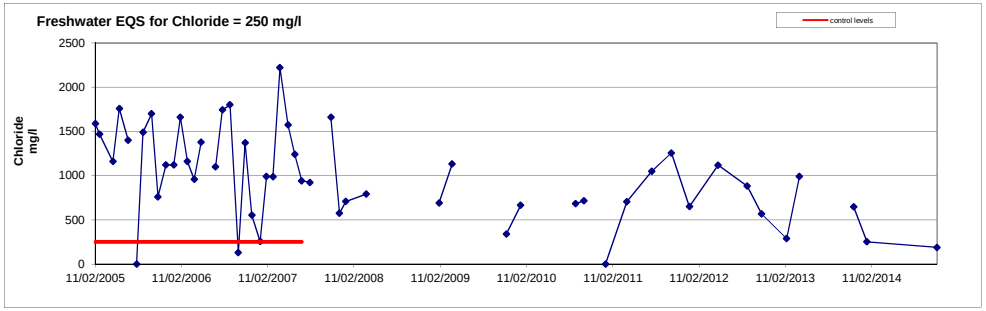


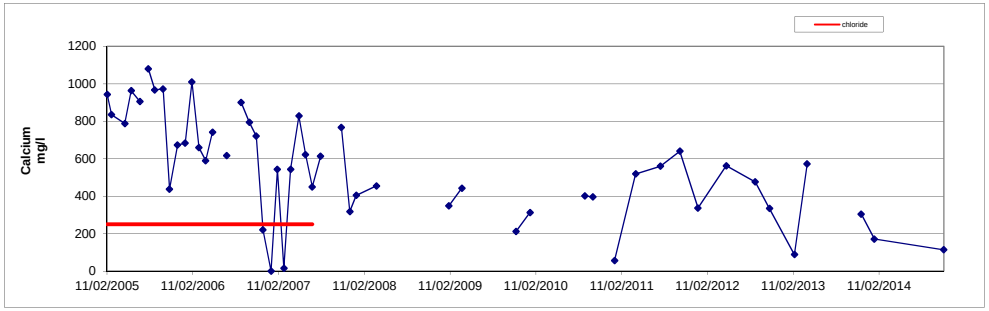


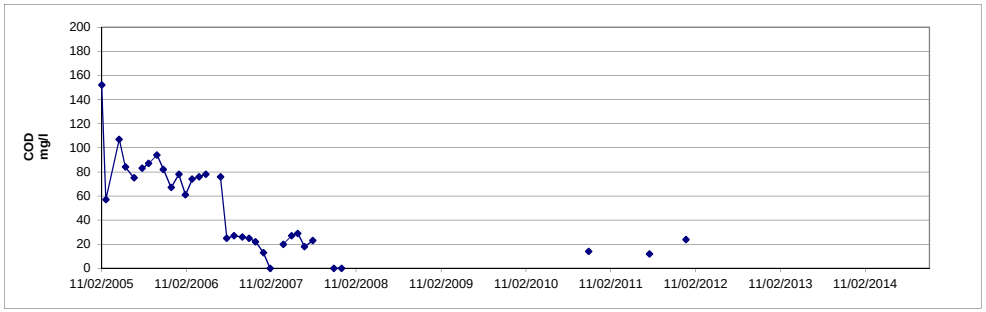


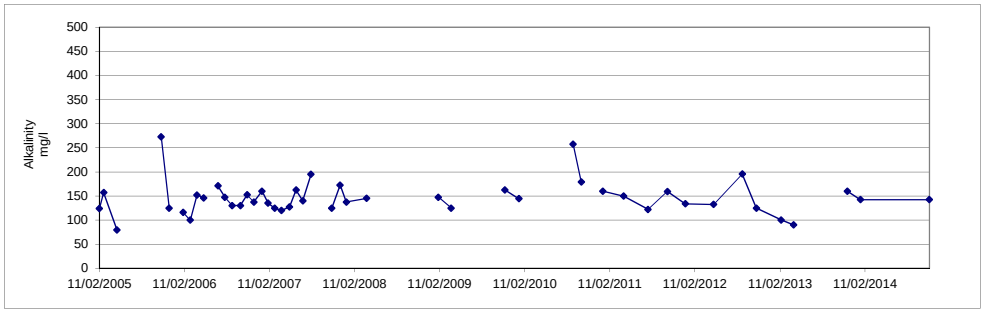

pH
14
13
12
11
10
9
8
7
6
5
4
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

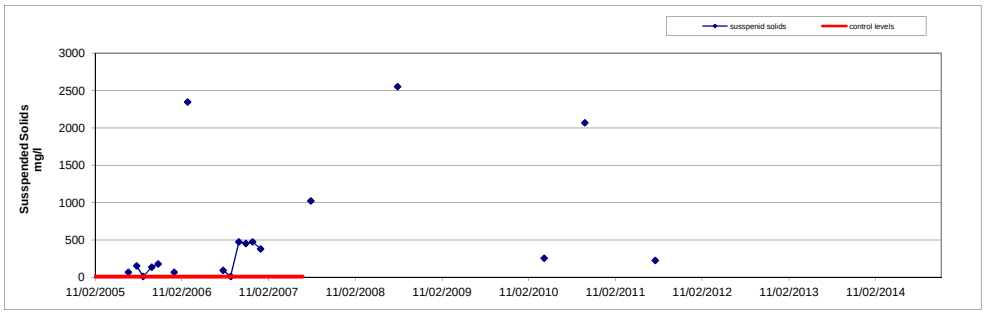

Freshwater EQS for Ammonia (NH_3 as N) = 0.015 mg/l
control data
Ammonia mg/l
12
10
8
6
4
2
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

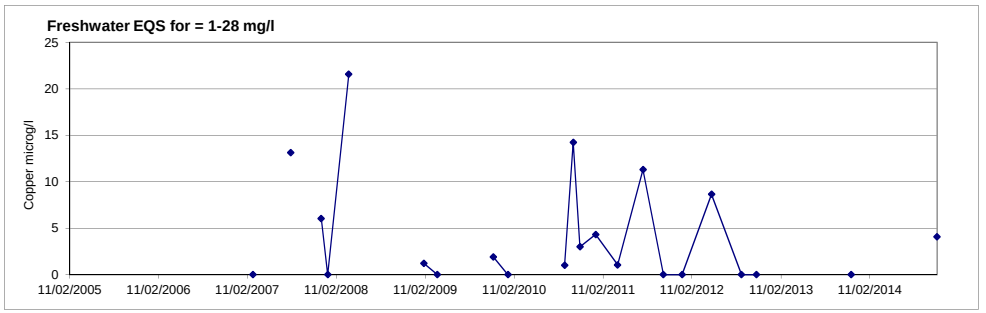

Freshwater EQS for Chloride = 250 mg/l
control levels
Chloride mg/l
2500
2000
1500
1000
500
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

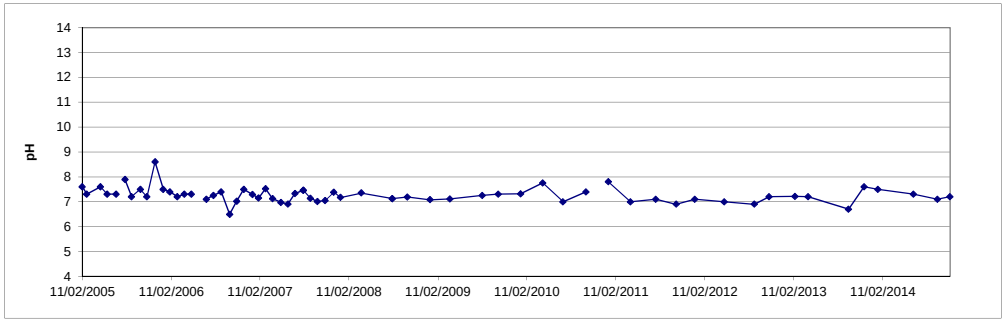

chloride
Calcium mg/l
1200
1000
800
600
400
200
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

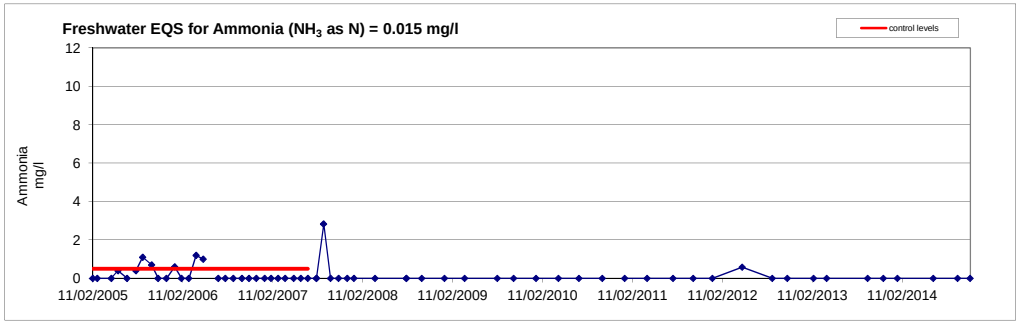

COD mg/l
200
180
160
140
120
100
80
60
40
20
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

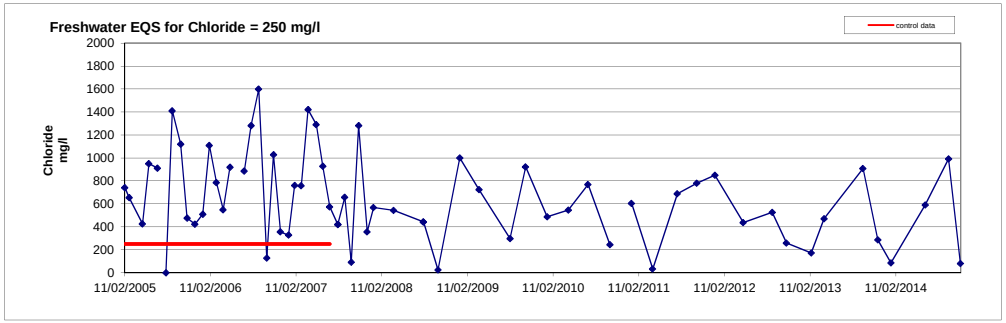

Alkalinity mg/l
500
450
400
350
300
250
200
150
100
50
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

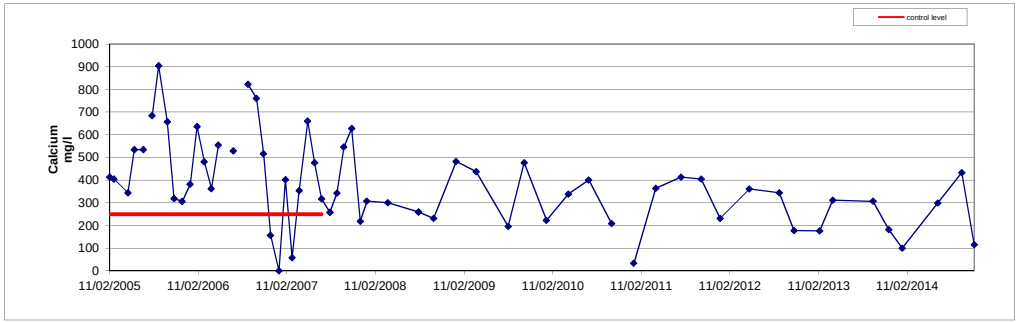

susspenid solids
control levels
Suspended Solids mg/l
3000
2500
2000
1500
1000
500
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

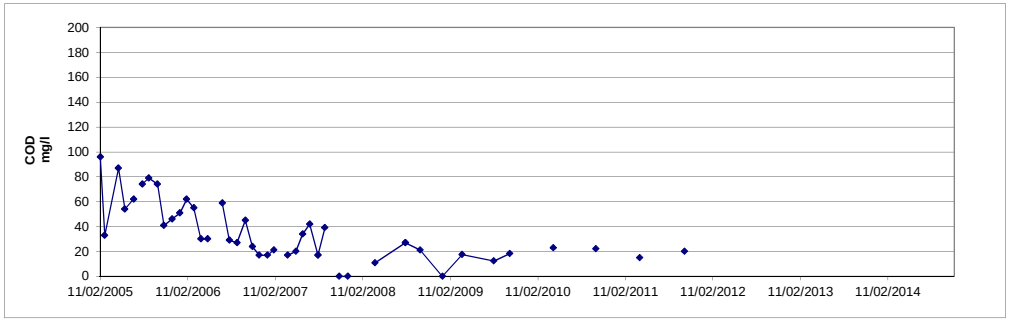

Freshwater EQS for = 1-28 mg/l
Copper microg/l
25
20
15
10
5
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

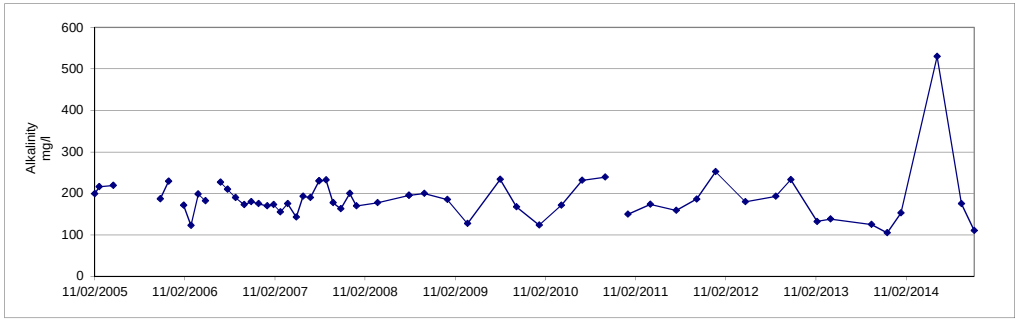

pH
14
13
12
11
10
9
8
7
6
5
4
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

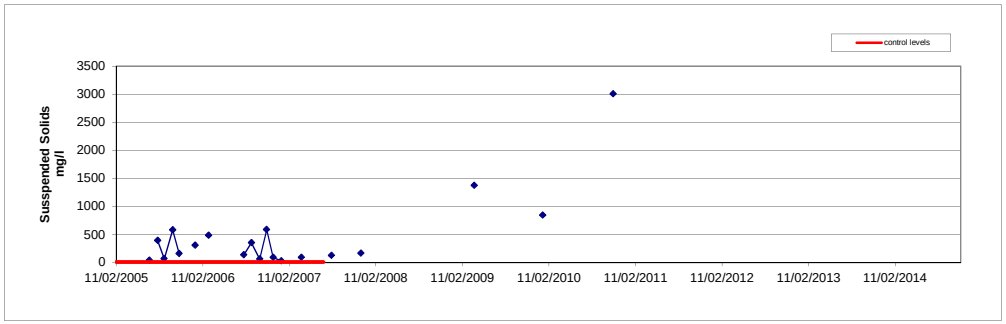

Freshwater EQS for Ammonia (NH_3 as N) = 0.015 mg/l
control levels
Ammonia mg/l
12
10
8
6
4
2
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

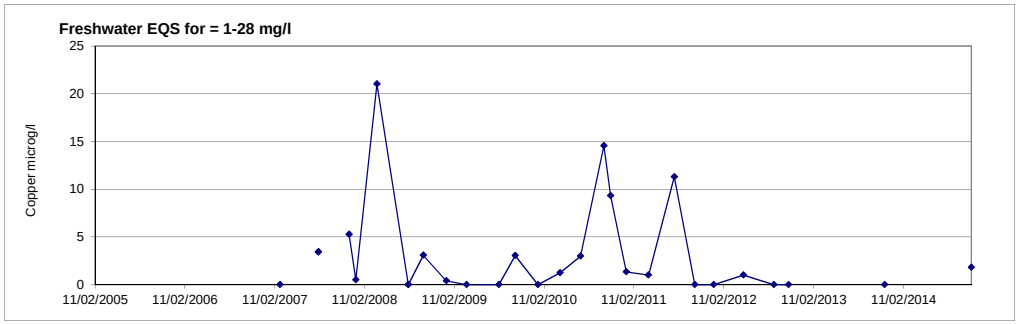

Freshwater EQS for Chloride = 250 mg/l
control data
Chloride mg/l
2000
1800
1600
1400
1200
1000
800
600
400
200
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


control level
Calcium mg/l
1000
900
800
700
600
500
400
300
200
100
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


COD mg/l
200
180
160
140
120
100
80
60
40
20
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


Alkalinity mg/l
600
500
400
300
200
100
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


control levels
Susspended Solids mg/l
3500
3000
2500
2000
1500
1000
500
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014


Freshwater EQS for = 1-28 mg/l
Copper microg/l
25
20
15
10
5
0
11/02/2005
11/02/2006
11/02/2007
11/02/2008
11/02/2009
11/02/2010
11/02/2011
11/02/2012
11/02/2013
11/02/2014

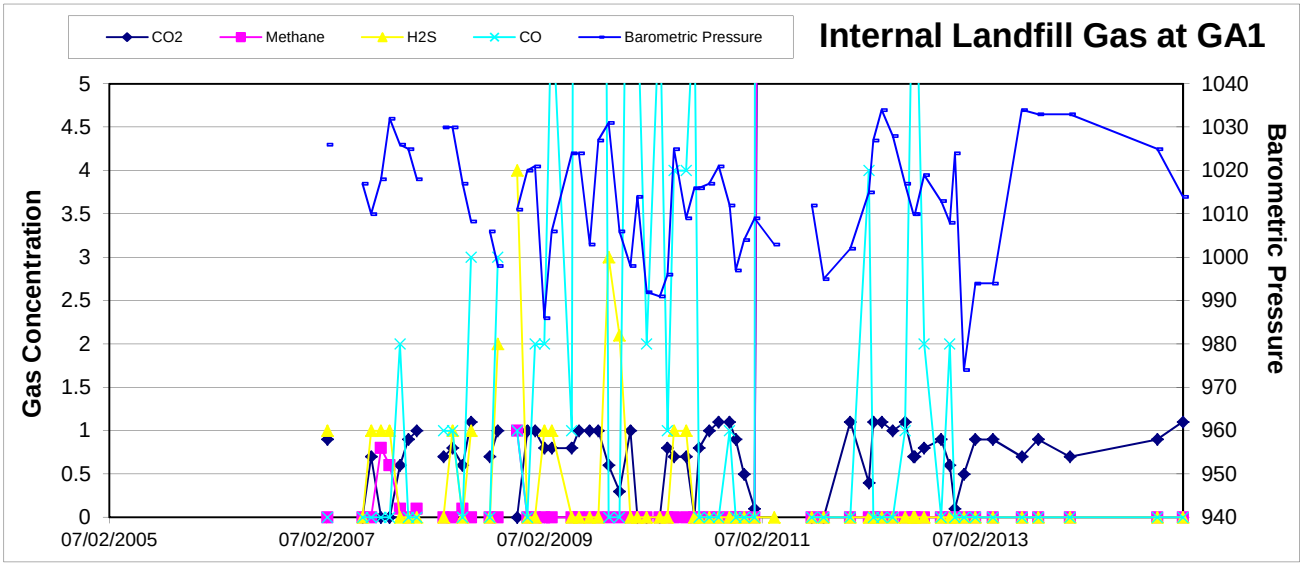
MORFA NON HAZARDOUS LANDFILL, PORT TALBOT

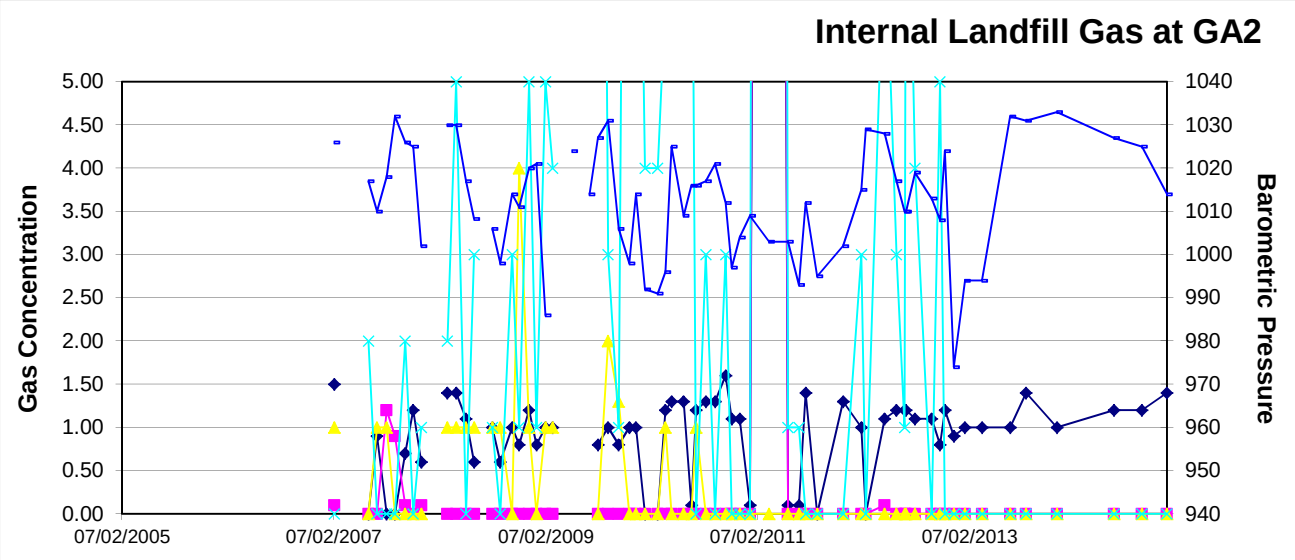
PERMIT BV7311IE

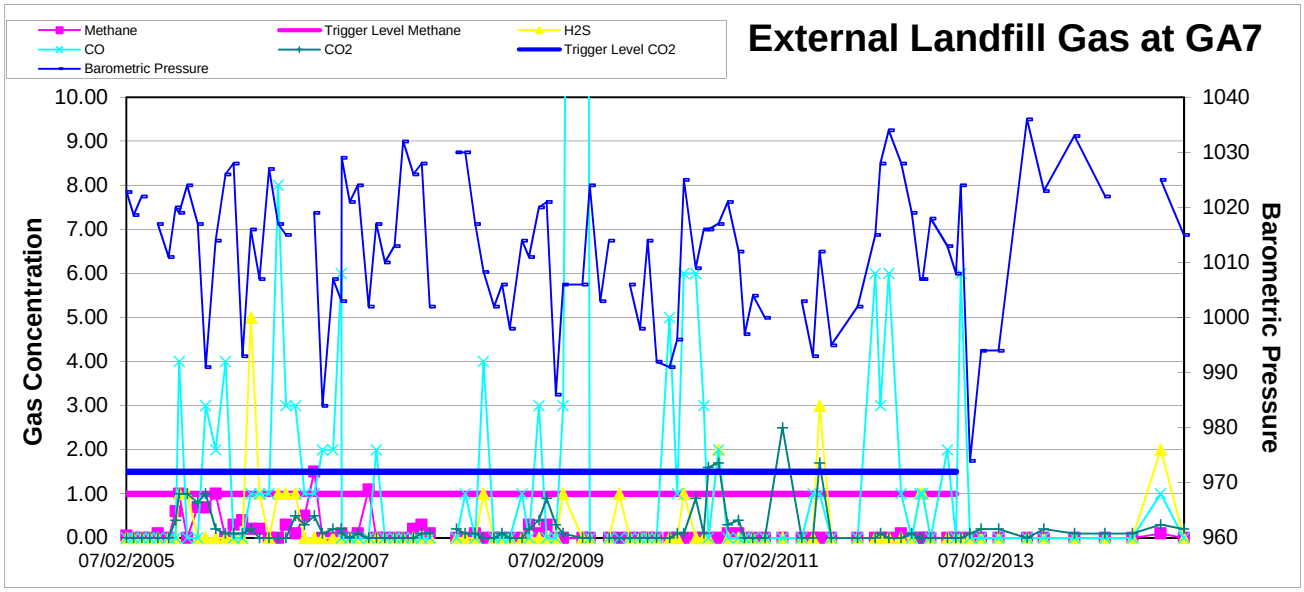
2014 Annual Review of Environmental Monitoring

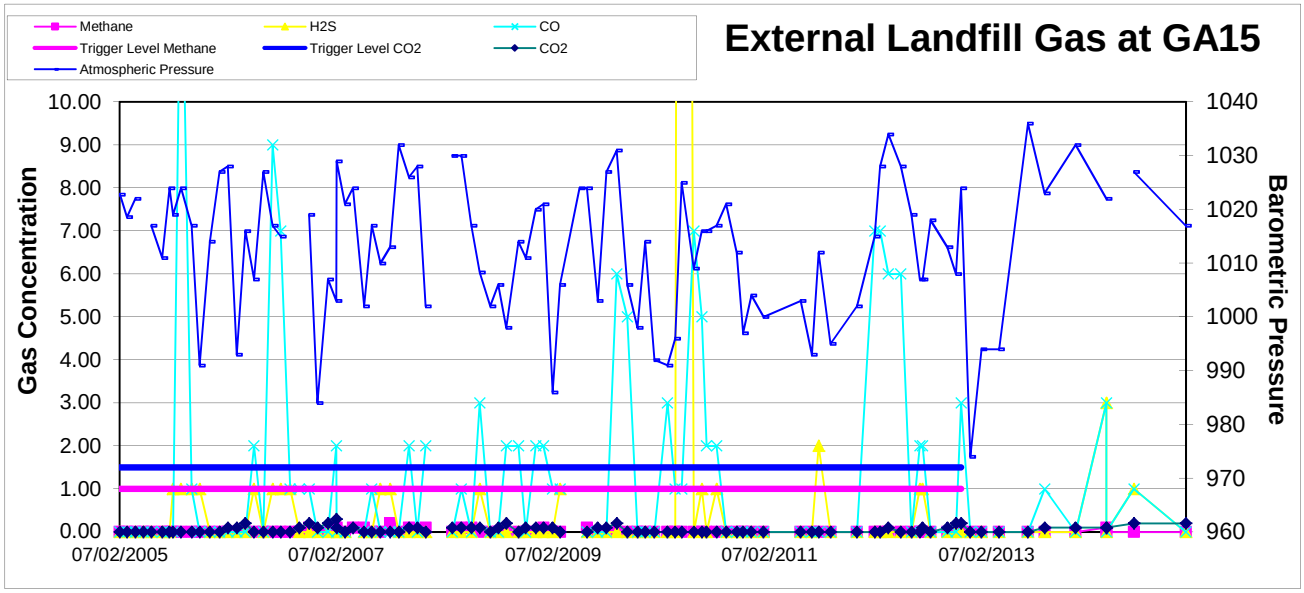
Appendix 7
Temporal variation of landfill gas chemistry

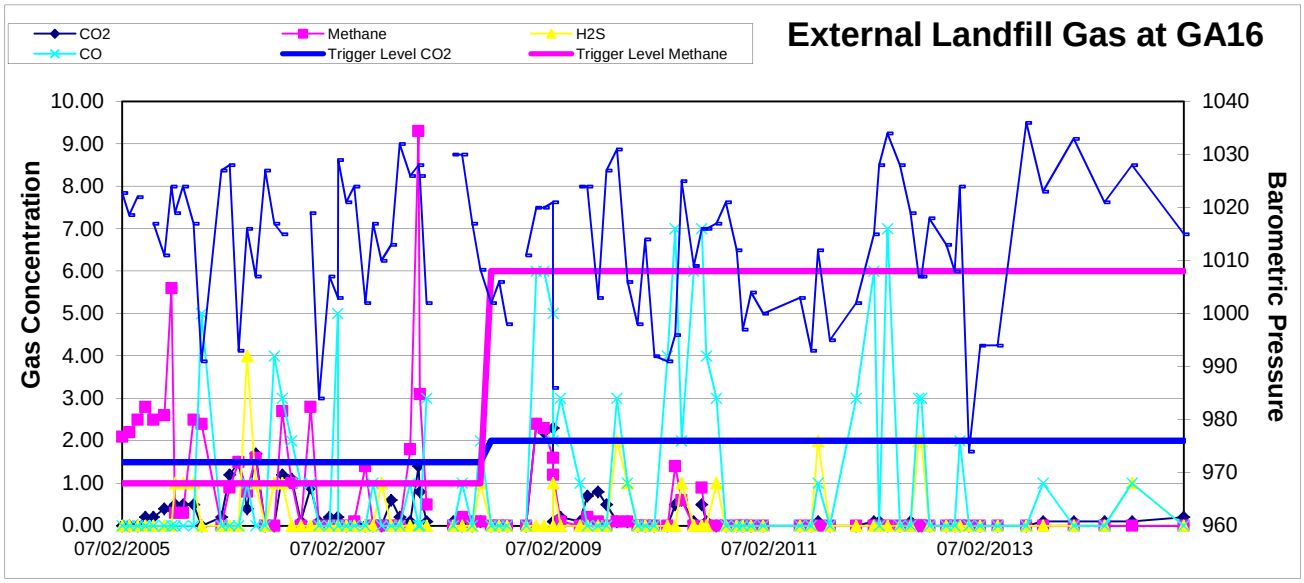
Report Number 1392r1v1d0215

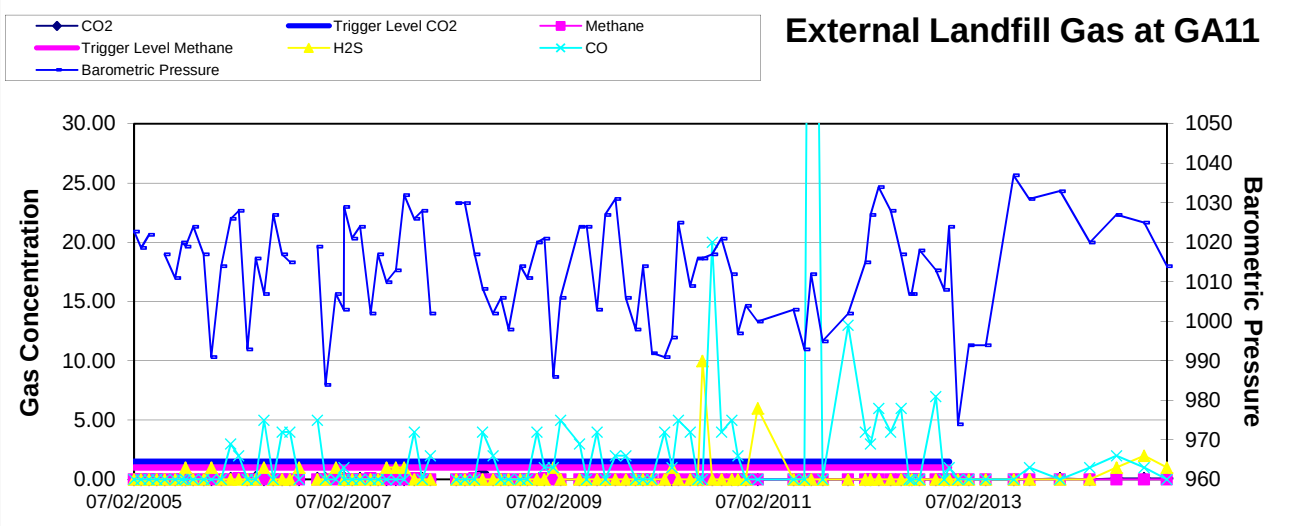

CO2
Methane
H2S
CO
Barometric Pressure
Internal Landfill Gas at GA1
Gas Concentration
Barometric Pressure
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1040
1030
1020
1010
1000
990
980
970
960
950
940
07/02/2005
07/02/2007
07/02/2009
07/02/2011
07/02/2013

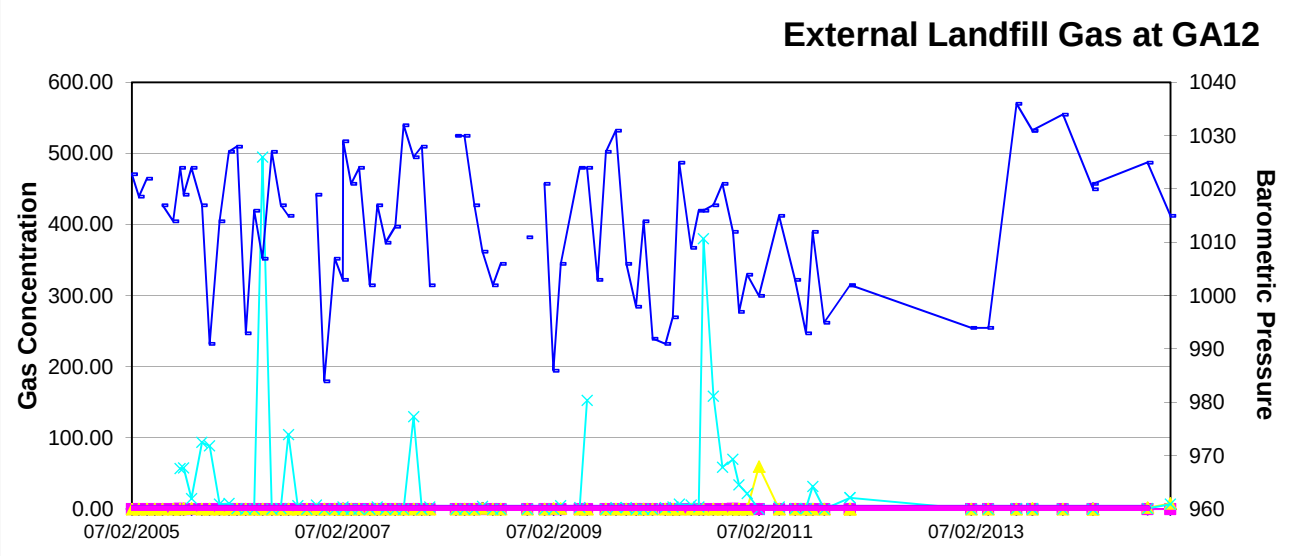

Internal Landfill Gas at GA2
Gas Concentration
Barometric Pressure
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1040
1030
1020
1010
1000
990
980
970
960
950
940
07/02/2005
07/02/2007
07/02/2009
07/02/2011
07/02/2013

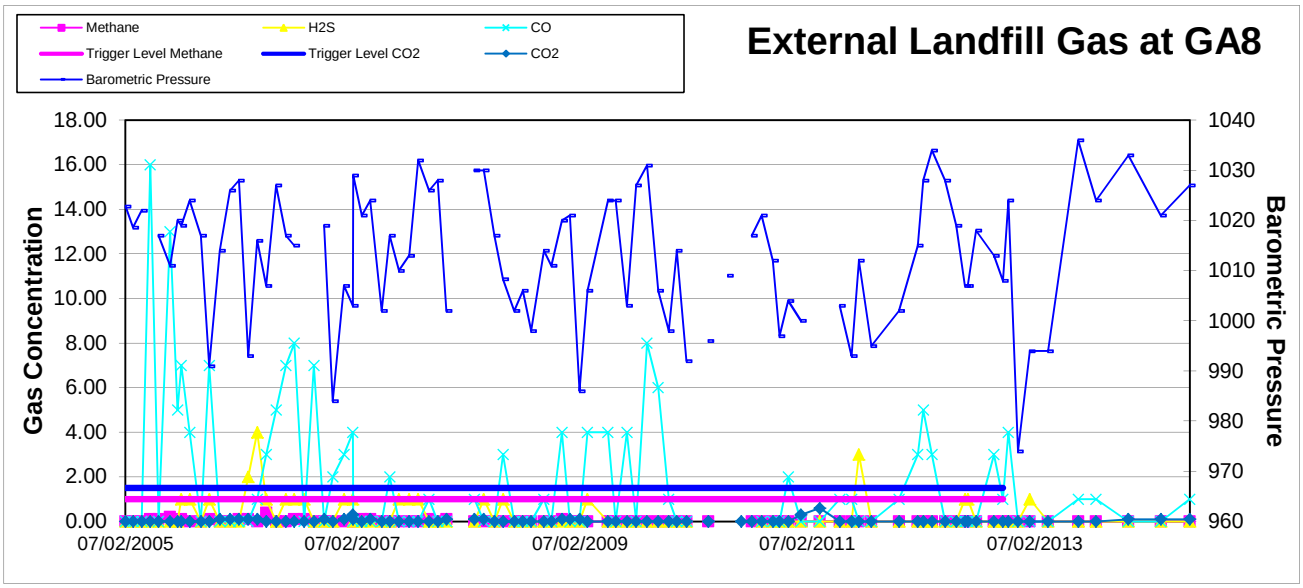

External Landfill Gas at GA7
Methane
Trigger Level Methane
H2S
CO
CO2
Trigger Level CO2
Barometric Pressure
Gas Concentration
Barometric Pressure
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1040
1030
1020
1010
1000
990
980
970
960
07/02/2005
07/02/2007
07/02/2009
07/02/2011
07/02/2013

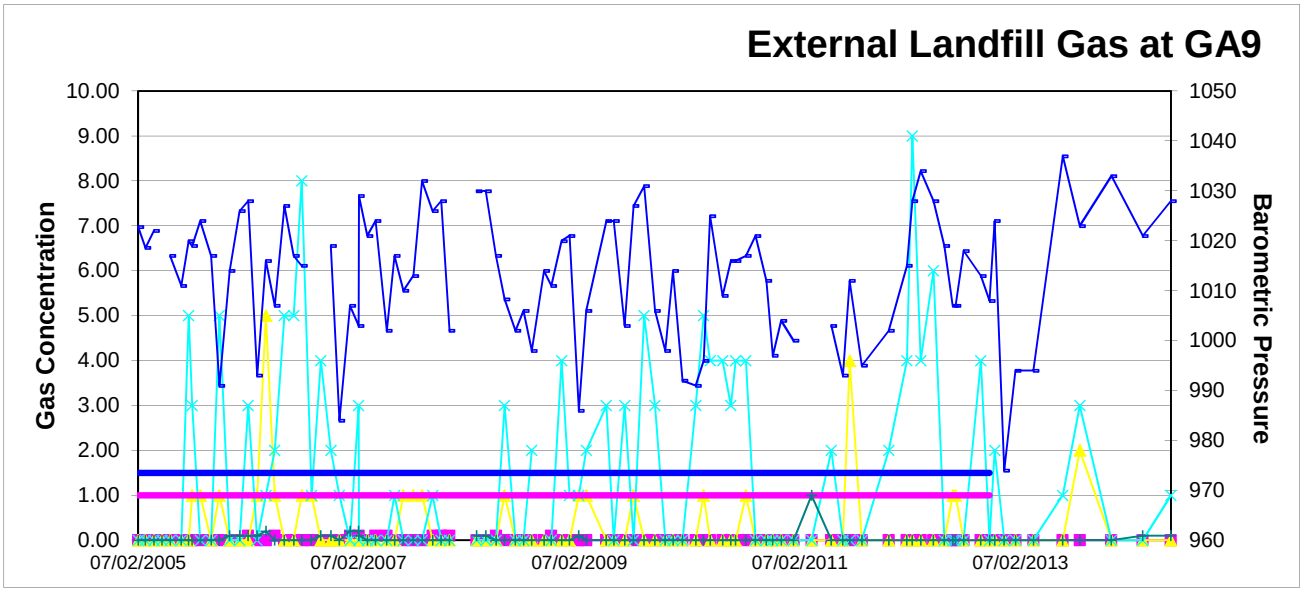

External Landfill Gas at GA15
Methane
H2S
CO
Trigger Level Methane
Trigger Level CO2
CO2
Atmospheric Pressure
Gas Concentration
Barometric Pressure
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1040
1030
1020
1010
1000
990
980
970
960
07/02/2005
07/02/2007
07/02/2009
07/02/2011
07/02/2013

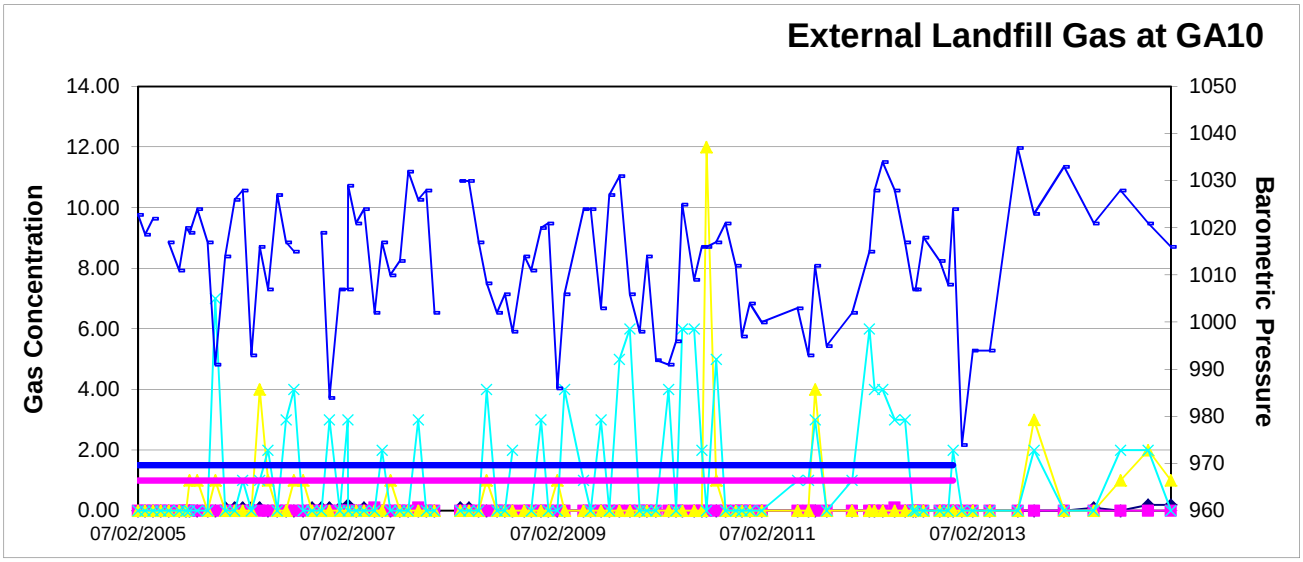

External Landfill Gas at GA16
CO2
Methane
H2S
CO
Trigger Level CO2
Trigger Level Methane
Gas Concentration
Barometric Pressure
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1040
1030
1020
1010
1000
990
980
970
960
07/02/2005
07/02/2007
07/02/2009
07/02/2011
07/02/2013


External Landfill Gas at GA11
CO2
Trigger Level CO2
Methane
Trigger Level Methane
H2S
CO
Barometric Pressure
Gas Concentration
Barometric Pressure
30.00
25.00
20.00
15.00
10.00
5.00
0.00
1050
1040
1030
1020
1010
1000
990
980
970
960
07/02/2005
07/02/2007
07/02/2009
07/02/2011
07/02/2013


External Landfill Gas at GA12
Gas Concentration
Barometric Pressure
600.00
500.00
400.00
300.00
200.00
100.00
0.00
1040
1030
1020
1010
1000
990
980
970
960
07/02/2005
07/02/2007
07/02/2009
07/02/2011
07/02/2013


External Landfill Gas at GA8
Methane
H2S
CO
Trigger Level Methane
Trigger Level CO2
CO2
Barometric Pressure
Gas Concentration
Barometric Pressure
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
1040
1030
1020
1010
1000
990
980
970
960
07/02/2005
07/02/2007
07/02/2009
07/02/2011
07/02/2013


External Landfill Gas at GA9
Gas Concentration
Barometric Pressure
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1050
1040
1030
1020
1010
1000
990
980
970
960
07/02/2005
07/02/2007
07/02/2009
07/02/2011
07/02/2013


External Landfill Gas at GA10
Gas Concentration
Barometric Pressure
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
1050
1040
1030
1020
1010
1000
990
980
970
960
07/02/2005
07/02/2007
07/02/2009
07/02/2011
07/02/2013

MORFA NON HAZARDOUS LANDFILL, PORT TALBOT

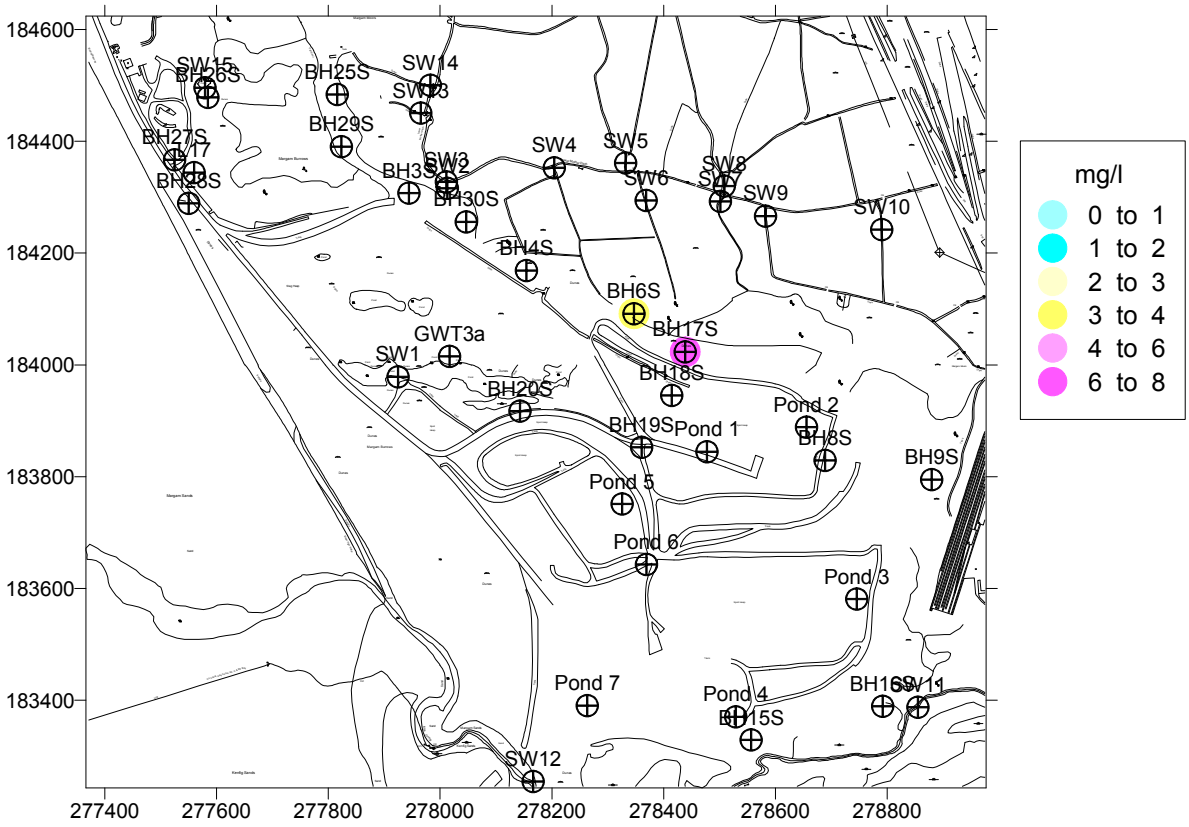
PERMIT BV7311IE

2014 Annual Review of Environmental Monitoring

Appendix 8
Spatial variation of Key Parameters

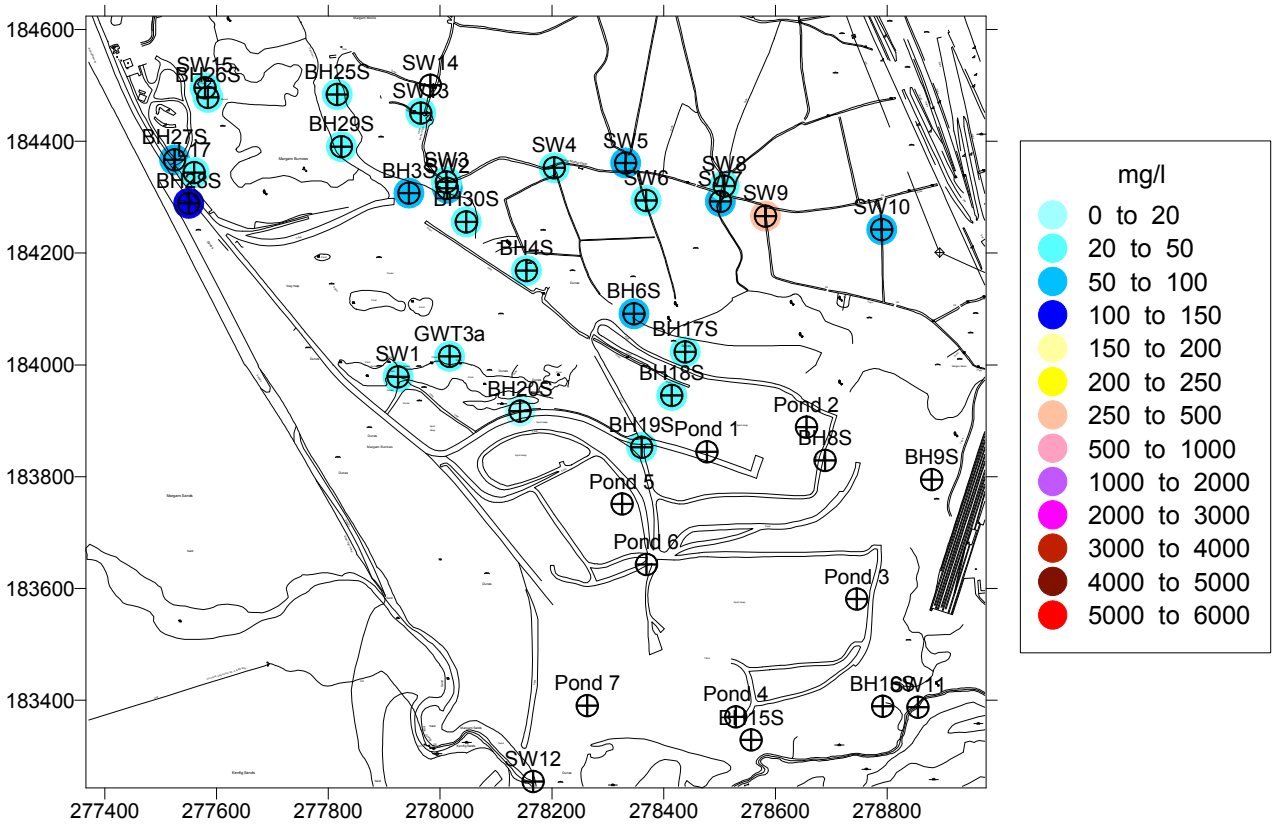
Report Number 1392r1v1d0215

Shallow Groundwater, Leachate and Surface Water Chemistry

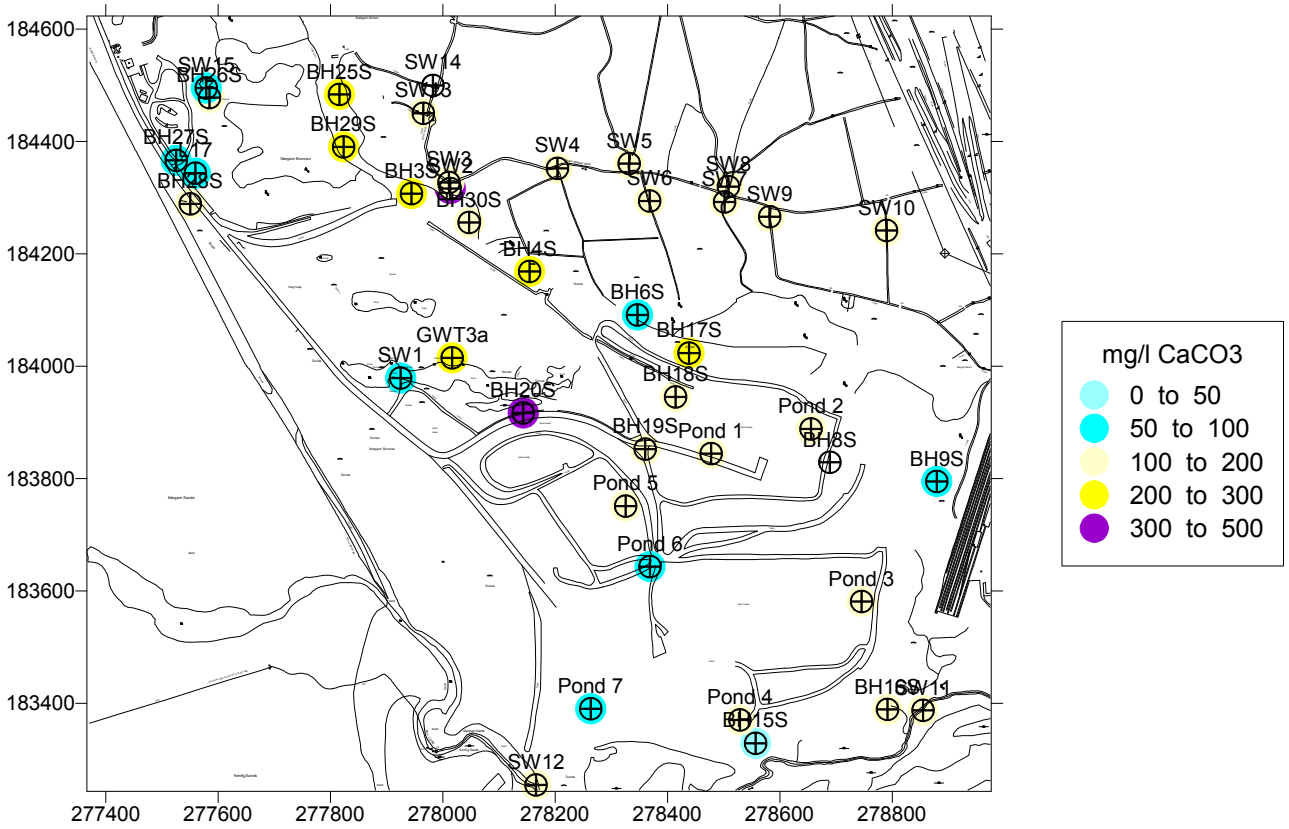


January 2014 Ammonia

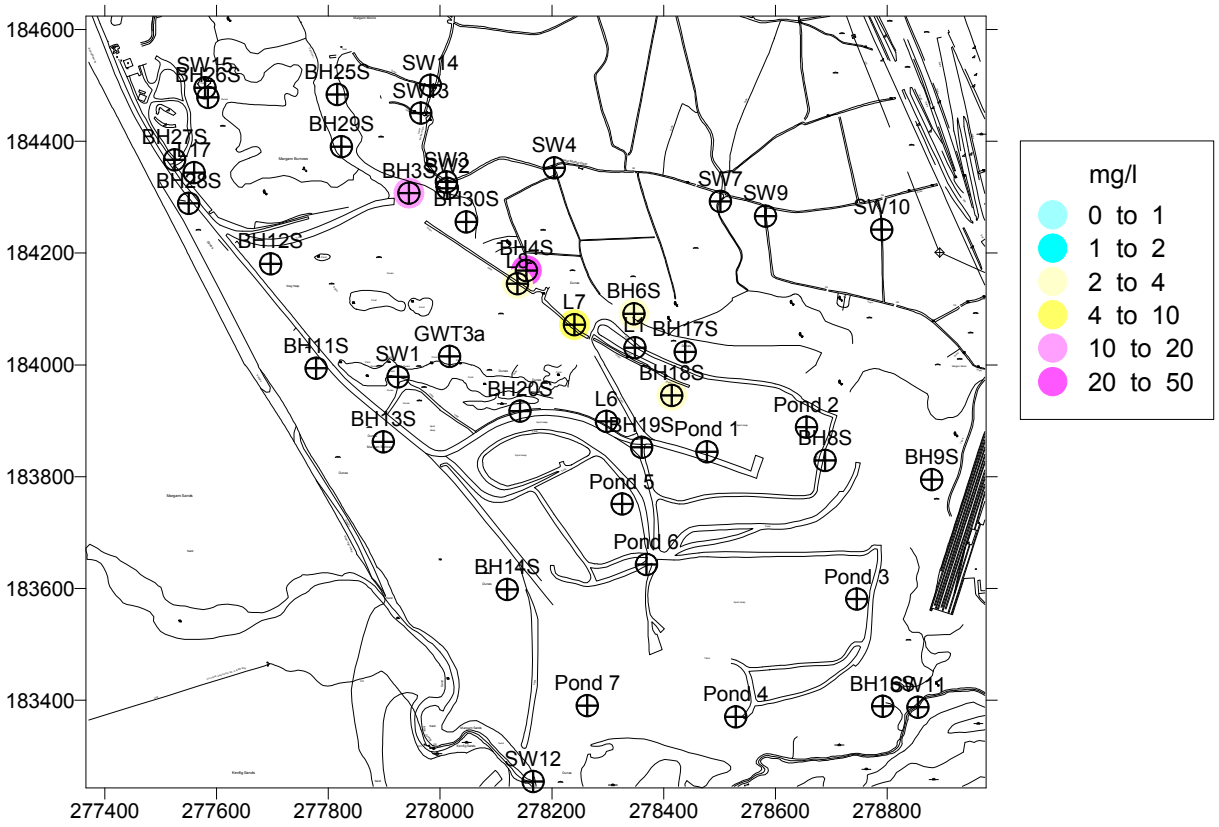
Shallow Groundwater, Leachate and Surface Water Chemistry



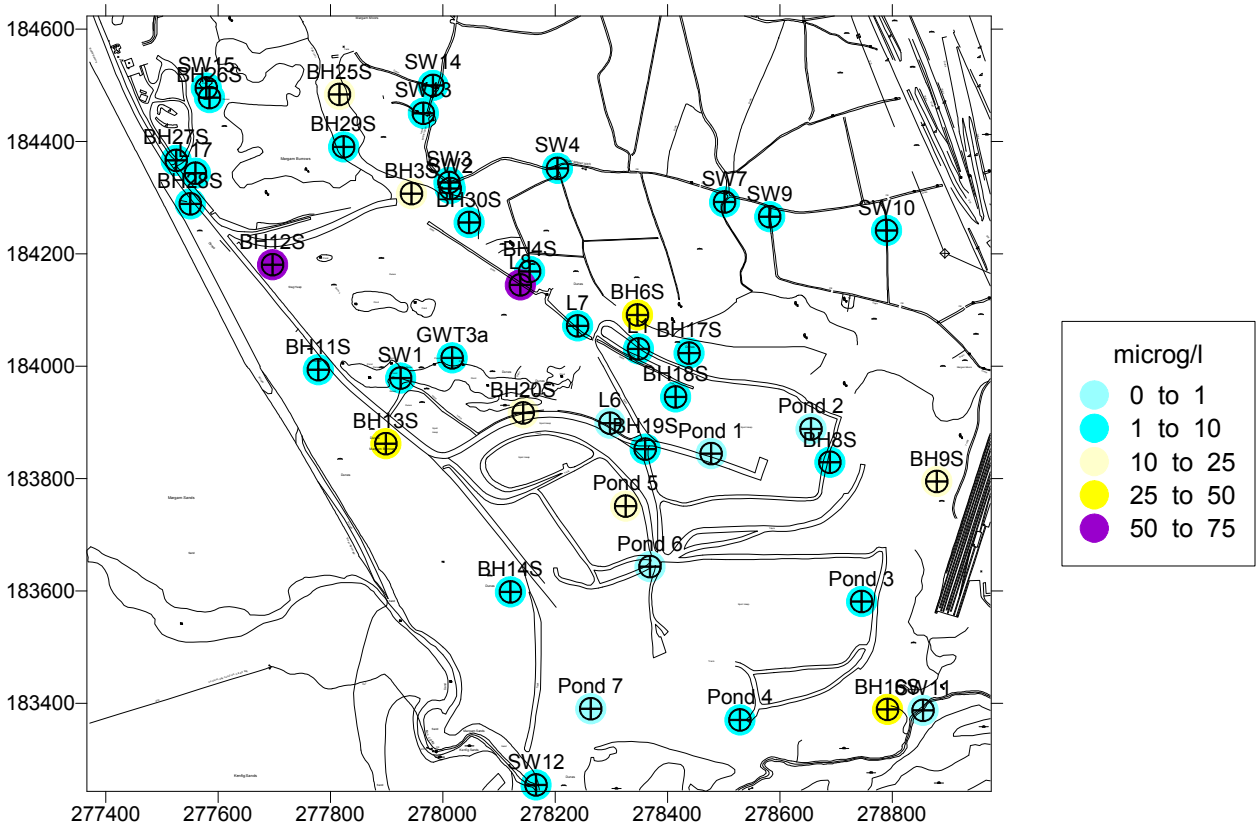
January 2014 Chloride



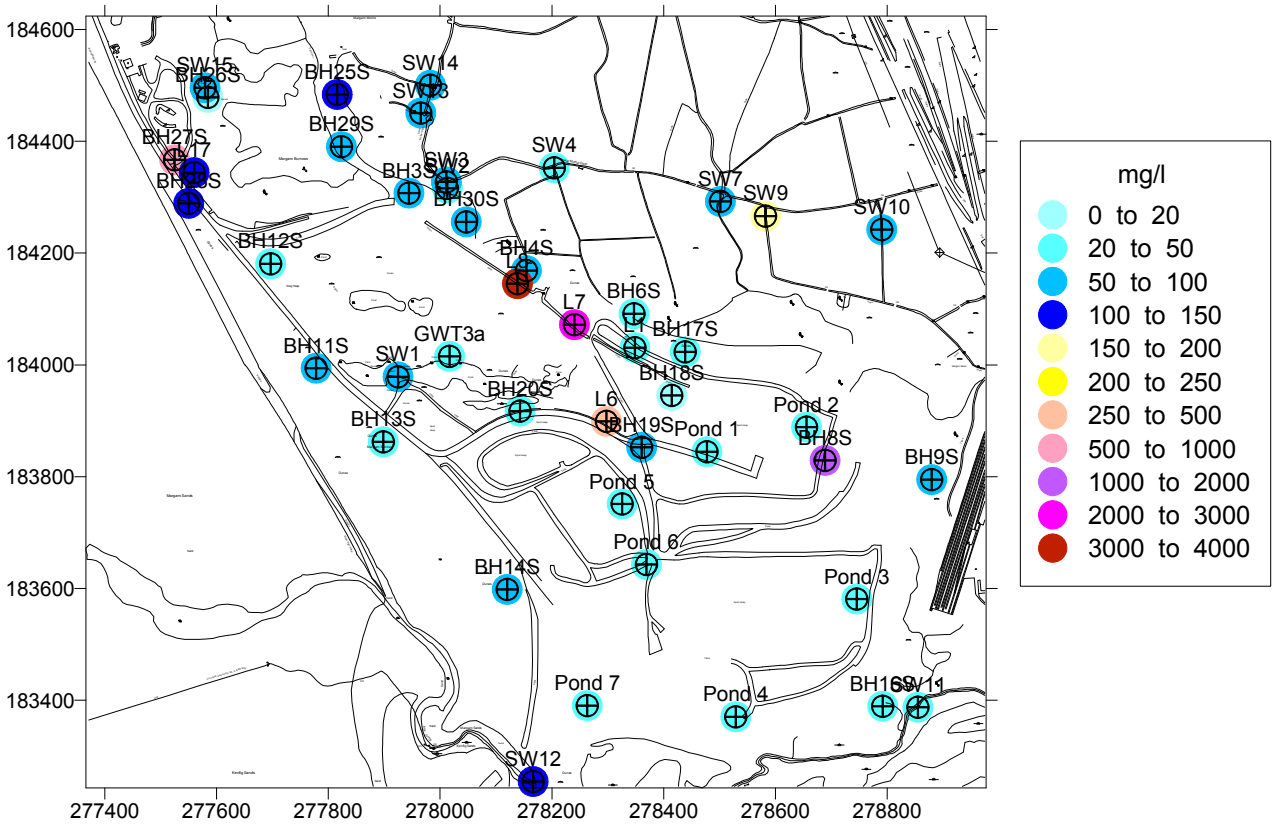
January 2014 Alkalinity



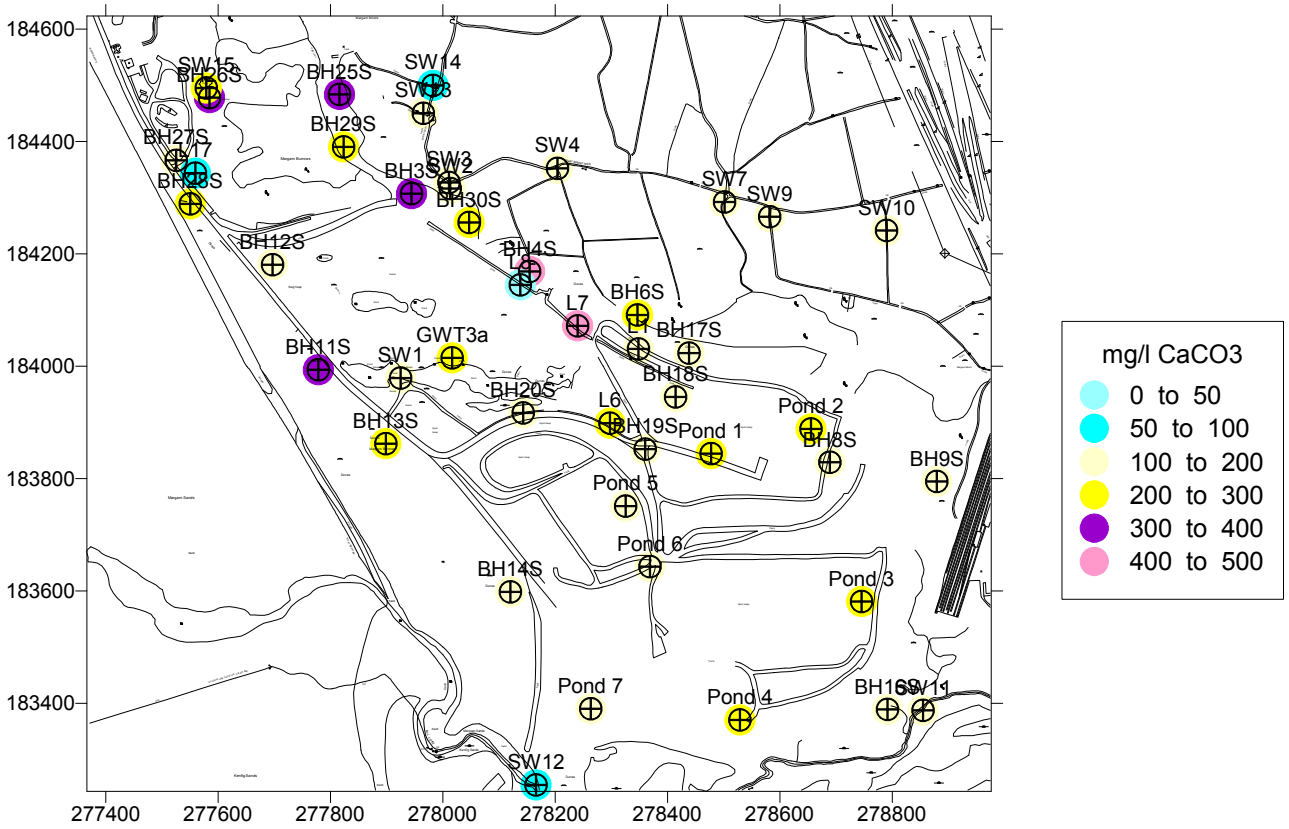
November 2014 Ammonia



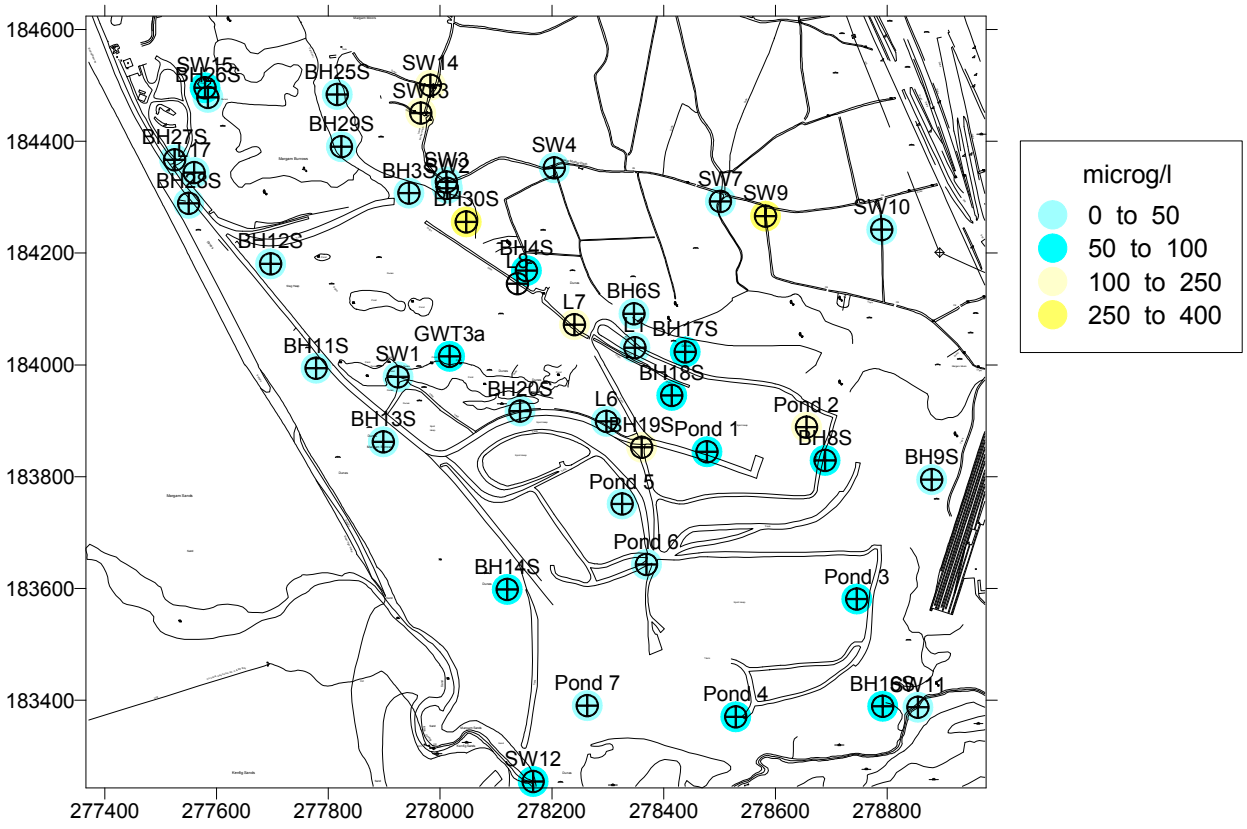
November 2014 Arsenic



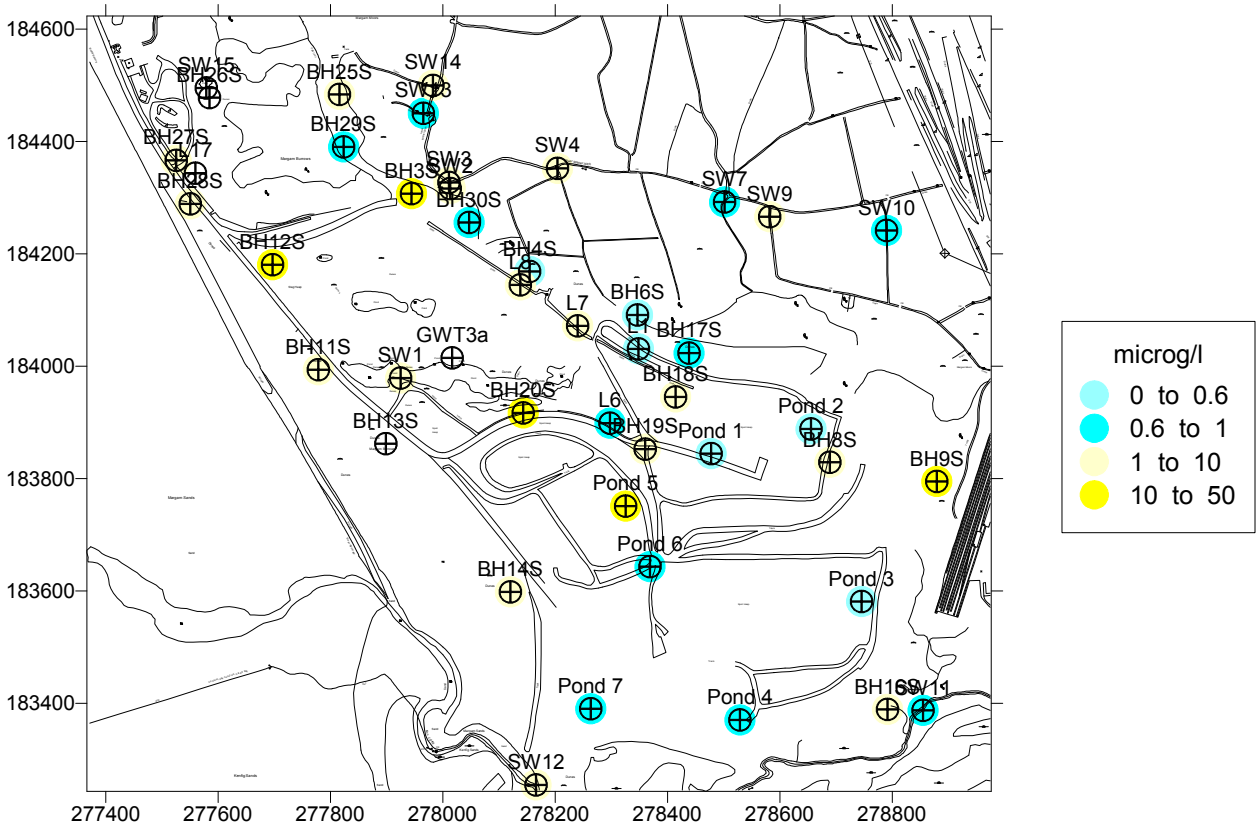
November 2014 Chloride



November 2014 Alkalinity



November 2014 Zinc



November 2014 Vanadium

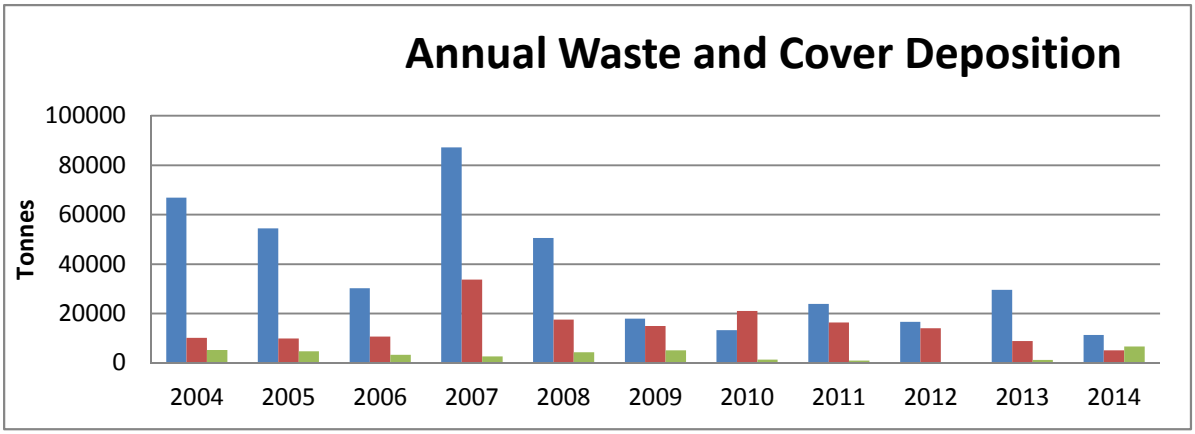
MORFA NON HAZARDOUS LANDFILL, PORT TALBOT

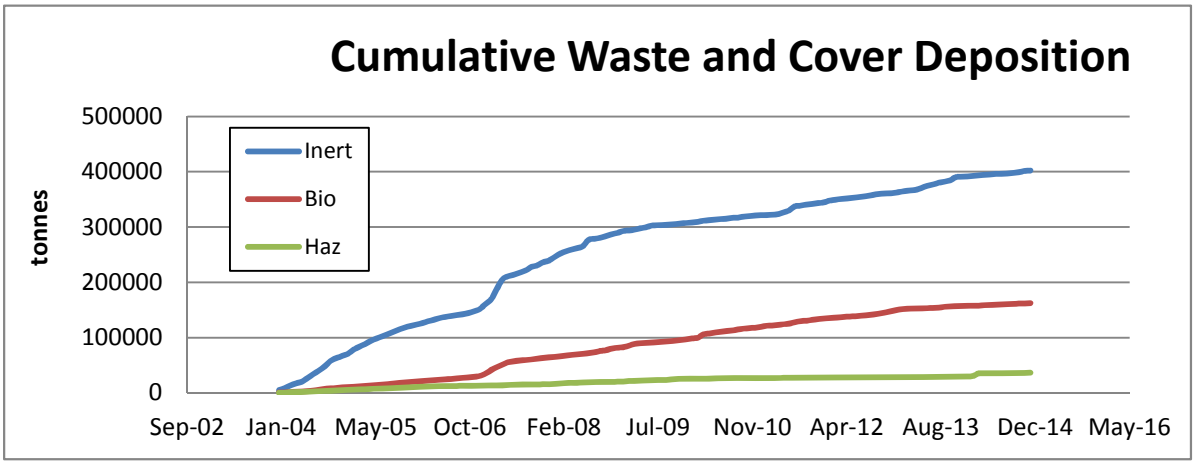
PERMIT BV7311IE

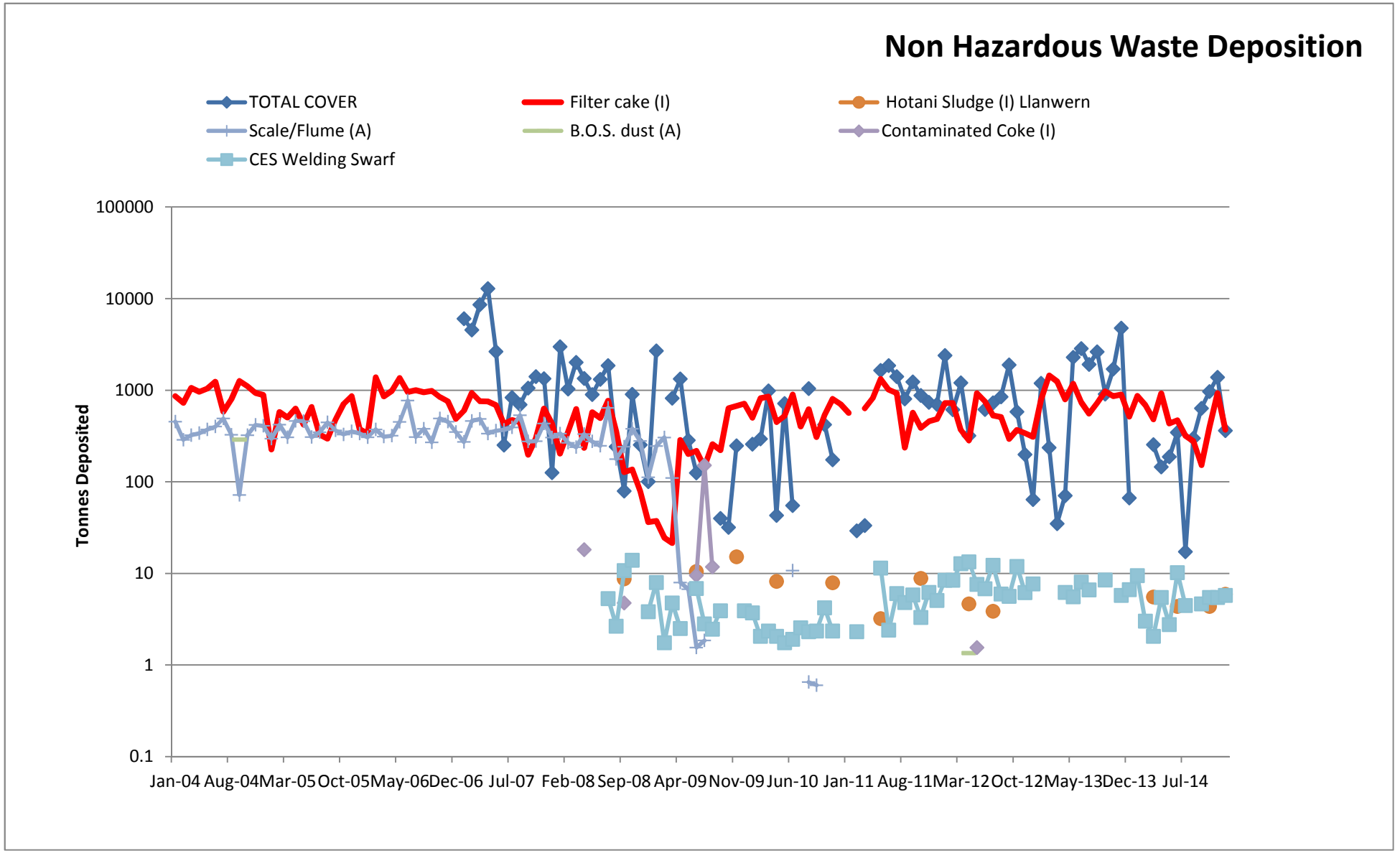
2014 Annual Review of Environmental Monitoring

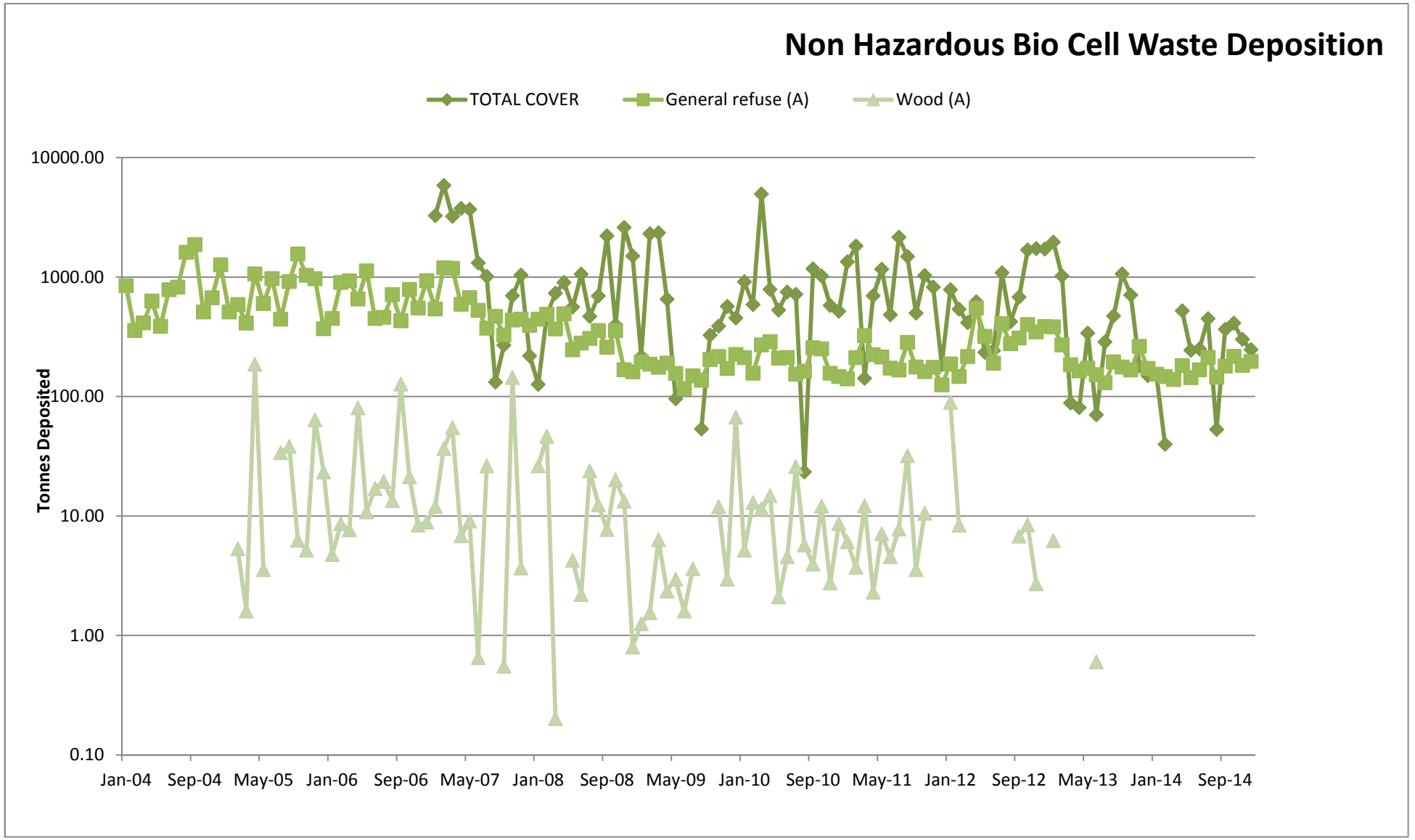
Appendix 9
Record of Landfilled Waste

Report Number 1392r1v1d0215


Annual Waste and Cover Deposition
Tonnes
100000
80000
60000
40000
20000
0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014


Cumulative Waste and Cover Deposition
tonnes
500000
400000
300000
200000
100000
0
Inert
Bio
Haz
Sep-02
Jan-04
May-05
Oct-06
Feb-08
Jul-09
Nov-10
Apr-12
Aug-13
Dec-14
May-16


Non Hazardous Waste Deposition
TOTAL COVER
Filter cake (I)
Hotani Sludge (I) Llanwern
Scale/Flume (A)
B.O.S. dust (A)
Contaminated Coke (I)
CES Welding Swarf
Tonnes Deposited
100000
10000
1000
100
10
1
0.1
Jan-04 Aug-04 Mar-05 Oct-05 May-06 Dec-06 Jul-07 Feb-08 Sep-08 Apr-09 Nov-09 Jun-10 Jan-11 Aug-11 Mar-12 Oct-12 May-13 Dec-13 Jul-14


Non Hazardous Bio Cell Waste Deposition
TOTAL COVER
General refuse (A)
Wood (A)
Tonnes Deposited
10000.00
1000.00
100.00
10.00
1.00
0.10
Jan-04
Sep-04
May-05
Jan-06
Sep-06
May-07
Jan-08
Sep-08
May-09
Jan-10
Sep-10
May-11
Jan-12
Sep-12
May-13
Jan-14
Sep-14

MORFA NON HAZARDOUS LANDFILL, PORT TALBOT

PERMIT BV7311IE

2014 Annual Review of Environmental Monitoring

Appendix 10 Compliance Assessment Reports from NRW

Report Number 1392r1v1d0215

Cyfoeth Naturiol Cymru / Natural Resources Wales	**EPR Compliance Assessment Report**	Report ID: 5516

This form will report compliance with your permit as determined by an NRW officer

Site	Morfa Non-Hazardous Landfill & Hazardous Landfill			Permit Ref	BV7311IE & BW2692IM		
Operator/ Permit holder	Tata UK Ltd						
Date	10th March 2014			Time in	--	Out	-
What parts of the permit were assessed	Relocation of the Fforestfach fire wastes from the Non Hazardous Landfill to the Hazardous Landfill						
Assessment	Inspection	EPR Activity:	Installation X	Waste Op		Water Discharge	
Recipient's name/position	Owain Lloyd						
Officer's name	Neil Herbert			Date issued	20th March 2014		

Section 1 - Compliance Assessment Summary

This is based on the requirements of the permit under the Environmental Permitting Regulations. A detailed explanation and any action you may need to take are given in the "Detailed Assessment of Compliance" (section 3). This summary details where we believe any non-compliance with the permit has occurred, the relevant condition and how the non-compliance has been categorised using our Compliance Classification Scheme (CCS). CCS scores can be consolidated or suspended, where appropriate, to reflect the impact of some non-compliances more accurately. For more details of our CCS scheme, contact your local office.

Permit Conditions and Compliance Summary				Condition(s) breached
a) Permitted activities	**1**. Specified by permit	A		
b) Infrastructure	**1.** Engineering for prevention & control of pollution	N		
	2. Closure & decommissioning	N		
	3. Site drainage engineering (clean & foul)	N		
	4. Containment of stored materials	N		
	5. Plant and equipment	N		
c) General management	**1**. Staff competency/ training	N		
	2. Management system & operating procedures	A		
	3. Materials acceptance	N		
	4. Storage handling, labelling, segregation	N		
d) Incident management	**1**. Site security	N		
	2. Accident, emergency & incident planning	N		
e) Emissions	**1.** Air	A		
	2. Land & Groundwater	N		
	3. Surface water	N		
	4. Sewer	N		
	5. Waste	N		
f) Amenity	**1**. Odour	N		
	2. Noise	N		
	3. Dust/fibres/particulates	A		
	4. Pests, birds & scavengers	N		
	5. Deposits on road	N		
g) Monitoring and records, maintenance and reporting	**1**. Monitoring of emissions & environment	N		
	2. Records of activity, site diary, journal & events	N		
	3. Maintenance records	N		
	4. Reporting & notification	N		
h) Resource efficiency	**1**. Efficient use of raw materials	N		
	2. Energy	N		

KEY: **C1, C2, C3, C4** = CCS breach category **(* suspended scores are marked with an asterisk),**
A = Assessed or assessed in part (no evidence of non-compliance), **N** = Not assessed, **NA** = Not Applicable

Number of breaches recorded	0	**Total compliance score** (see section 5 for scoring scheme)	0

If the Total No Breaches is greater than zero, then please see Section 3 for details of our proposed enforcement response

Section 2 – Compliance Assessment Report Detail

This section contains a report of our findings and will usually include information on:

- the part(s) of the permit that were assessed (e.g. maintenance, training, combustion plant, etc)
- where the type of assessment was 'Data Review' details of the report/results triggering the assessment
- any non-compliances identified
- any non-compliances with directly applicable legislation
- details of any multiple non-compliances
- information on the compliance score accrued inc. details of suspended or consolidated scores.
- details of advice given
- any other areas of concern
- all actions requested
- any examples of good practice.
- a reference to photos taken

The visit was undertaken in order to inspect the relocation of the Fforestfach fire waste (currently in temporary storage within Cell 2) from the Non Hazardous Landfill to the Morfa Hazardous Landfill.

Prior to the site visit I examined the available asbestos monitoring data undertaken at the site during the material transfer. The results indicate that asbestos levels were compliant.

We were accompanied around site by Mr Owain Lloyd who explained that the areas had been cordoned off and a strict vehicle movement system was in place. Asbestos monitoring experts were on site during the works undertaking aerial emission monitoring.

Hazardous Landfill

Waste delivered to site appeared to be appropriately covered on transfer and deposit and a thick cover layer applied following deposit. This appeared compliant.

Non Hazardous Landfill

I observed the waste being carefully removed from the storage area in cell 2 and noted the presence of staff applying water to damp down the area under excavation. The work appeared compliant.

I attach to this report a series of photographs showing the works in progress.

Cyfoeth Naturiol Cymru Natural Resources Wales	**EPR Compliance Assessment Report**	Report ID: 5516

This form will report non-compliance with your permit as determined by an NRW officer

Site	Morfa Non-Hazardous Landfill & Hazardous Landfill	Permit	BV7311IE & BW2692IM
Operator/ Permit	Tata UK Ltd	Date	10th March 2014

Section 3- Enforcement Response **Only one of the boxes below should be ticked**

You must take immediate action to rectify any non-compliance and prevent repetition.
Non-compliance with your permit conditions constitutes an offence and can result in criminal prosecutions and/or suspension or revocation of a permit. Please read the detailed assessment in Section 2 and the steps you need to take in Section 4 below.

Other than the provision of advice and guidance, at present we do not intend to take further enforcement action in respect of the non-compliance identified above. This does not preclude us from taking enforcement action if further relevant information comes to light or advice isn't followed.	N/A
In respect of the above non-compliance you have been issued with a warning. At present we do not intend to take further enforcement action. This does not preclude us from taking additional enforcement action if further relevant information comes to light or offences continue.	N/A
We will now consider what enforcement action is appropriate and notify you, referencing this form.	N/A

Section 4- Action(s)

Where a non - compliance has been detected and an enforcement response has been selected above, this section summarises the steps you need to take to return to compliance and also provides timescales for this to be done.

Criteria Ref.	CCS Category	Action Required/Advised	Due Date
See Section 1 above			
N/A	N/A		N/A

Section 5 - Compliance notes for the Operator

To ensure you correct actual or potential non-compliance we may

- advise on corrective actions verbally or in writing
- require you to take specific actions in writing
- issue a notice
- require you to review your procedures or management system
- change some of the conditions of your permit
- decide to undertake a full review of your permit

Any breach of a permit condition is an offence and we may take legal action against you.

- We will normally provide advice and guidance to assist you to come back into compliance either after an offence is committed or where we consider that an offence is likely to be committed. This is without prejudice to any other enforcement response that we consider may be required.
- Enforcement action can include the issue of a formal caution, prosecution, the service of a notice and or suspension or revocation of the permit.

See our Enforcement and Civil Sanctions guidance for further information

This report does not relieve the site operator of the responsibility to

- ensure you comply with the conditions of the permit at all times and prevent pollution of the environment
- ensure you comply with other legislative provisions which may apply.

Non-compliance scores and categories

CCS category	Description	Score
C1	A non-compliance which could have a **major** environmental effect	60
C2	A non-compliance which could have a **significant** environmental effect	31
C3	A non-compliance which could have a **minor** environmental effect	4
C4	A non-compliance which has **no** potential environmental effect	0.1

Operational Risk Appraisal (Opra) - Compliance assessment findings may affect your Opra score and/or your charges. This score influences the resource we use to assess permit compliance.

Section 6 – General Information

Data protection notice

The information on this form will be processed by Natural Resources Wales (NRW) to fulfill its regulatory and monitoring functions and to maintain the relevant public register(s). NRW may also use and/or disclose it in connection with:

- offering/providing you with its literature/services relating to environmental matters
- consulting with the public, public bodies and other organisations (e.g. Health and Safety Executive, local authorities) on environmental issues
- carrying out statistical analysis, research and development on environmental issues
- providing public register information to enquirers
- investigating possible breaches of environmental law and taking any resulting action
- preventing breaches of environmental law
- assessing customer service satisfaction and improving its service
- Freedom of Information Act/Environmental Information Regulations request.

NRW may pass it on to its agents/representatives to do these things on its behalf. You should ensure that any persons named on this form are informed of the contents of this data protection notice.

Disclosure of information

NRW will provide a copy of this report to the public register(s). However, if you consider that any information contained in this report should not be released to the public register(s) on the grounds of commercial confidentiality, you must write to your local area office within twenty working days of receipt of this form indicating which information it concerns and why it should not be released, giving your reasons in full.

Customer charter

What can I do if I disagree with this compliance assessment report?

If you are unable to resolve the issue with your site officer, you should firstly discuss the matter with the officer's line managers. If you wish to raise your dispute further through our official Complaints and Commendations procedure, phone our general enquiry number 0300 065 3000 (Mon to Fri 08.00–18.00) and ask for the Customer Contact team or send an email to enquiries@naturalresourceswales.gov.uk If you are still dissatisfied you can make a complaint to the Public Services Ombudsman for Wales. For advice on how to complain to the Ombudsman phone their helpline on (0845) 601 0987.

Photograph showing the fire deposit with a thick cover layer (arrow). Hazardous Landfill

Asbestos decontamination unit.

Fire wastes being carefully removed from the Non Hazardous cell for transfer top the Hazardous landfill


KOMATSU


KOMATSU

Cyfoeth Naturiol Cymru / Natural Resources Wales	**EPR Compliance Assessment Report**	Report ID: 05479

This form will report compliance with your permit as determined by an NRW officer

Site	Morfa Non Hazardous Landfill			Permit Ref	BV7311IE		
Operator/ Permit holder	Tata Steel KU Limited						
Date	18/02/14			Time in	NA	Out	NA
What parts of the permit were assessed	Notification Ref: LUR/13/01A Condition 3.6.1c, Condition 4.3.1b, Condition 3.2.3						
Assessment	Choose an item.	EPR Activity:	Installation X	Waste Op		Water Discharge	
Recipient's name/position	Stephen Thomas, Environmental Engineer						
Officer's name	Ffion Thomas			Date issued	18/02/14		

Section 1 - Compliance Assessment Summary

This is based on the requirements of the permit under the Environmental Permitting Regulations. A detailed explanation and any action you may need to take are given in the "Detailed Assessment of Compliance" (section 3). This summary details where we believe any non-compliance with the permit has occurred, the relevant condition and how the non-compliance has been categorised using our Compliance Classification Scheme (CCS). CCS scores can be consolidated or suspended, where appropriate, to reflect the impact of some non-compliances more accurately. For more details of our CCS scheme, contact your local office.

Permit Conditions and Compliance Summary				Condition(s) breached
a) Permitted activities	**1.** Specified by permit	A		
b) Infrastructure	**1.** Engineering for prevention & control of pollution	N		
	2. Closure & decommissioning	N		
	3. Site drainage engineering (clean & foul)	N		
	4. Containment of stored materials	N		
	5. Plant and equipment	N		
c) General management	**1.** Staff competency/ training	N		
	2. Management system & operating procedures	N		
	3. Materials acceptance	N		
	4. Storage handling, labelling, segregation	N		
d) Incident management	**1.** Site security	N		
	2. Accident, emergency & incident planning	N		
e) Emissions	**1.** Air	N		
	2. Land & Groundwater	C3		3.2.3
	3. Surface water	N		
	4. Sewer	N		
	5. Waste	N		
f) Amenity	**1.** Odour	N		
	2. Noise	N		
	3. Dust/fibres/particulates	N		
	4. Pests, birds & scavengers	N		
	5. Deposits on road	N		
g) Monitoring and records, maintenance and reporting	**1.** Monitoring of emissions & environment	A		
	2. Records of activity, site diary, journal & events	N		
	3. Maintenance records	N		
	4. Reporting & notification	A		
h) Resource efficiency	**1.** Efficient use of raw materials	N		
	2. Energy	N		

KEY: **C1, C2, C3, C4** = CCS breach category **(* suspended scores are marked with an asterisk),**
A = Assessed or assessed in part (no evidence of non-compliance), **N** = Not assessed, **NA** = Not Applicable

Number of breaches recorded	1	**Total compliance score** (see section 5 for scoring scheme)	4

If the Total No Breaches is greater than zero, then please see Section 3 for details of our proposed enforcement response

Section 2 – Compliance Assessment Report Detail

This section contains a report of our findings and will usually include information on:

- the part(s) of the permit that were assessed (e.g. maintenance, training, combustion plant, etc)
- where the type of assessment was 'Data Review' details of the report/results triggering the assessment
- any non-compliances identified
- any non-compliances with directly applicable legislation
- details of any multiple non-compliances
- information on the compliance score accrued inc. details of suspended or consolidated scores.
- details of advice given
- any other areas of concern
- all actions requested
- any examples of good practice.
- a reference to photos taken

Condition 3.6.1(c) of the permit requires the operator to carry out groundwater monitoring specified in Tables S4.3 and S4.9. Condition 3.2.3 requires that the emission limits detailed in Schedule 4 Table 4.3 shall not be exceeded.

A schedule 6 notification has been received as per condition 4.3.1(b), following the detection of an exceedance in the permitted limits.

A result of 1403mg/l & 930mg/l were recorded at BH6 (Shallow)& BH30 (Shallow) respectively against a permit limits of 1400mg/l at BH6 (Shallow) & 750mg/l at BH30 (Shallow) these results were recorded on 26/7/14 following monitoring undertaken on 15/04/2013

The operator reported that: *As per contingency action if Compliance level is exceeded notify the NRW. Examine data trends across site….*
Further to the Morfa Landfill - Review Meeting on the 08/05/2013 and specifically discussions around the groundwater investigation, please find a brief outline of our findings and recommended actions.
Morfa Groundwater Investigation: The occurrence of highly alkaline deposits around the Morfa landfill site is well documented, particularly along the fringe with Margam Moors. In the past few months, recent observations of alkaline surface water and ochreous deposits in several locations, some of which have not been previously observed. This has prompted further consideration of the cause and any additional actions that may be required to protect the environment and reduce the risk to site users.
Cause of Alkaline Deposits: For several decades rainwater has infiltrated into Morfa Closed Landfill resulting in the release of leachable components to shallow groundwater. Where this groundwater meets the surface environment, such as along springlines and in topographic low points, the dissolved components react with the air resulting in the precipitation of alkaline and sometimes ochreous deposits and shallow pools of highly alkaline water develop e.g. pH >11.5. This leaching process within the closed landfill will ultimately be minimised by the landfill capping which is almost complete. During the past few months groundwater levels have risen as a consequence of elevated rainfall. Where the groundwater levels have risen sufficiently to intersect ground surface alkaline deposits and shallow pools have formed.
Proposed Actions: As part of the construction of the recharge trench CCW (now part of NRW) gave permission for a well documented topographic low,that sometimes contains an alkaline pool and is coated with alkaline deposits, to be backfilled with site won sand. The objective of the backfilling is to primarily minimise the opportunity wildlife, and to some extent, humans, have to come into direct dermal contact with the alkaline water and deposits. Tata now plan on extending this logic to other small topographic low points as shallow alkaline pools have been noted in these areas as a Consequence of the increased rainfall.

The proposed action above is acceptable, however further monitoring is requested.

Action 18/2/14/01 Operator to provide details of their investigation into data trends and potential source of the problem, and any other actions taken on completion of the proposed action within the annual report.

This limit breach has been scored and recorded under reference 210656 on CCS as a Cat.3 and a warning added to this CAR form.

Council for Wales, the Forestry Commissioners and the Environment Agency in Wales.

[End]

Cyfoeth Naturiol Cymru Natural Resources Wales	**EPR Compliance Assessment Report**	Report ID**:** 5479

This form will report non-compliance with your permit as determined by an NRW officer			
Site	Morfa Non Hazardous Landfill	Permit	BV7311IE
Operator/ Permit	Tata Steel	Date	18/2/14

Section 3- Enforcement Response **Only one of the boxes below should be ticked**	
You must take immediate action to rectify any non-compliance and prevent repetition. Non-compliance with your permit conditions constitutes an offence and can result in criminal prosecutions and/or suspension or revocation of a permit. Please read the detailed assessment in Section 2 and the steps you need to take in Section 4 below.	
Other than the provision of advice and guidance, at present we do not intend to take further enforcement action in respect of the non-compliance identified above. This does not preclude us from taking enforcement action if further relevant information comes to light or advice isn't followed.	
In respect of the above non-compliance you have been issued with a warning. At present we do not intend to take further enforcement action. This does not preclude us from taking additional enforcement action if further relevant information comes to light or offences continue.	X
We will now consider what enforcement action is appropriate and notify you, referencing this form.	

Section 4- Action(s)

Where a non - compliance has been detected and an enforcement response has been selected above, this section summarises the steps you need to take to return to compliance and also provides timescales for this to be done.

Criteria Ref.	**CCS Category**	**Action Required/Advised**	**Due Date**
See Section 1 above			
E2	3	Condition 3.2.3 requires that the emission limits detailed in Schedule 4 Table 4.3 shall not be exceeded. **Operator to provide details of their investigation into data trends and potential source of the problem, and any other actions taken on completion of the proposed action within the annual report.**	28/2/14 within annual report

Section 5 - Compliance notes for the Operator

To ensure you correct actual or potential non-compliance we may

- advise on corrective actions verbally or in writing
- require you to take specific actions in writing
- issue a notice
- require you to review your procedures or management system
- change some of the conditions of your permit
- decide to undertake a full review of your permit

Any breach of a permit condition is an offence and we may take legal action against you.

- We will normally provide advice and guidance to assist you to come back into compliance either after an offence is committed or where we consider that an offence is likely to be committed. This is without prejudice to any other enforcement response that we consider may be required.
- Enforcement action can include the issue of a formal caution, prosecution, the service of a notice and or suspension or revocation of the permit.

See our Enforcement and Civil Sanctions guidance for further information

This report does not relieve the site operator of the responsibility to

- ensure you comply with the conditions of the permit at all times and prevent pollution of the environment
- ensure you comply with other legislative provisions which may apply.

Non-compliance scores and categories

CCS category	Description	Score
C1	A non-compliance which could have a **major** environmental effect	60
C2	A non-compliance which could have a **significant** environmental effect	31
C3	A non-compliance which could have a **minor** environmental effect	4
C4	A non-compliance which has **no** potential environmental effect	0.1

Operational Risk Appraisal (Opra) - Compliance assessment findings may affect your Opra score and/or your charges. This score influences the resource we use to assess permit compliance.

Section 6 – General Information

Data protection notice

The information on this form will be processed by Natural Resources Wales (NRW) to fulfill its regulatory and monitoring functions and to maintain the relevant public register(s). NRW may also use and/or disclose it in connection with:

- offering/providing you with its literature/services relating to environmental matters
- consulting with the public, public bodies and other organisations (e.g. Health and Safety Executive, local authorities) on environmental issues
- carrying out statistical analysis, research and development on environmental issues
- providing public register information to enquirers
- investigating possible breaches of environmental law and taking any resulting action
- preventing breaches of environmental law
- assessing customer service satisfaction and improving its service
- Freedom of Information Act/Environmental Information Regulations request.

NRW may pass it on to its agents/representatives to do these things on its behalf. You should ensure that any persons named on this form are informed of the contents of this data protection notice.

Disclosure of information

NRW will provide a copy of this report to the public register(s). However, if you consider that any information contained in this report should not be released to the public register(s) on the grounds of commercial confidentiality, you must write to your local area office within twenty working days of receipt of this form indicating which information it concerns and why it should not be released, giving your reasons in full.

Customer charter

What can I do if I disagree with this compliance assessment report?

If you are unable to resolve the issue with your site officer, you should firstly discuss the matter with the officer's line managers. If you wish to raise your dispute further through our official Complaints and Commendations procedure, phone our general enquiry number 0300 065 3000 (Mon to Fri 08.00–18.00) and ask for the Customer Contact team or send an email to enquiries@naturalresourceswales.gov.uk If you are still dissatisfied you can make a complaint to the Public Services Ombudsman for Wales. For advice on how to complain to the Ombudsman phone their helpline on (0845) 601 0987.

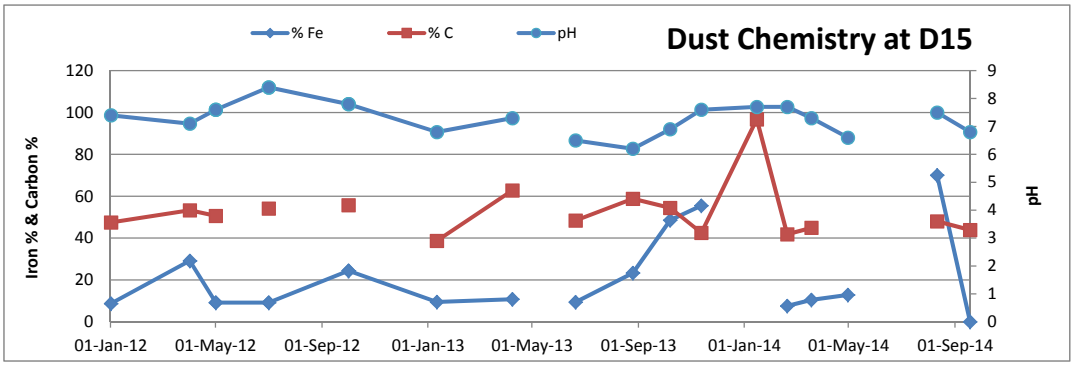
MORFA NON HAZARDOUS LANDFILL, PORT TALBOT

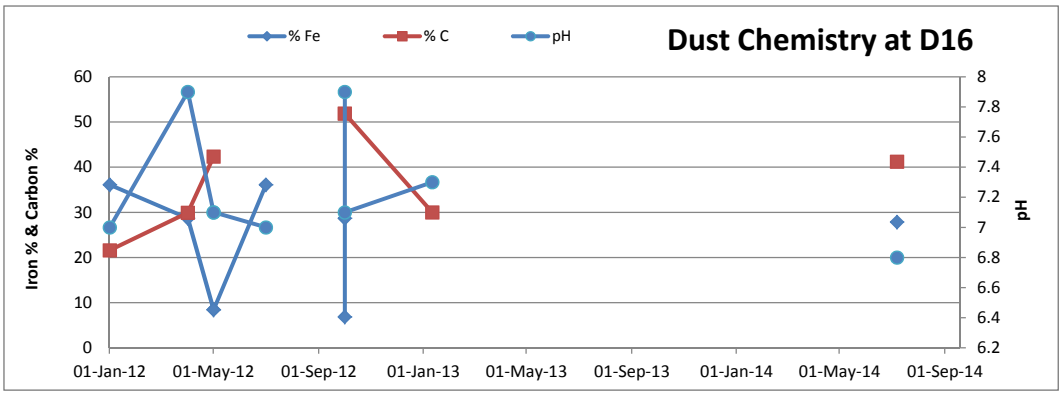
PERMIT BV7311IE

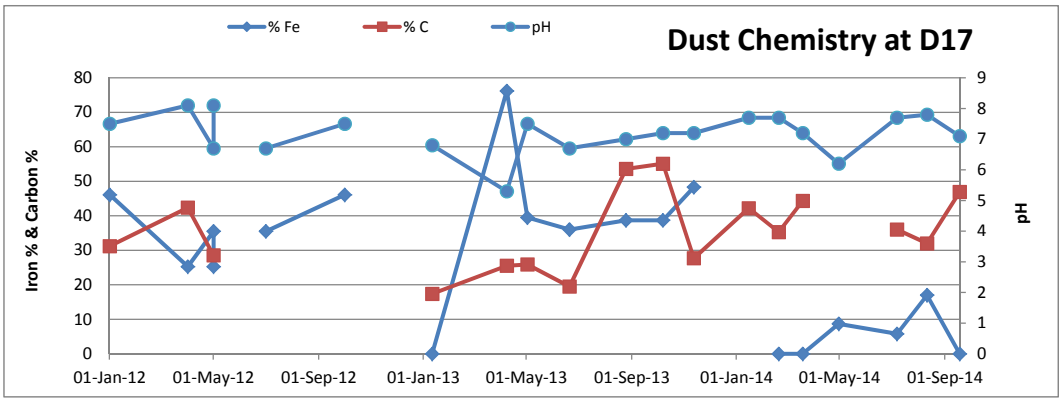
2014 Annual Review of Environmental Monitoring

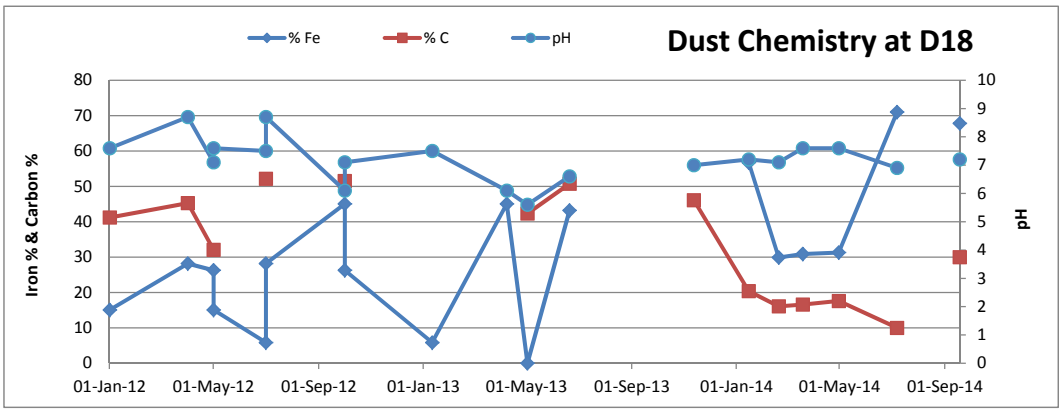
Appendix 11
Results from dust monitoring gauges

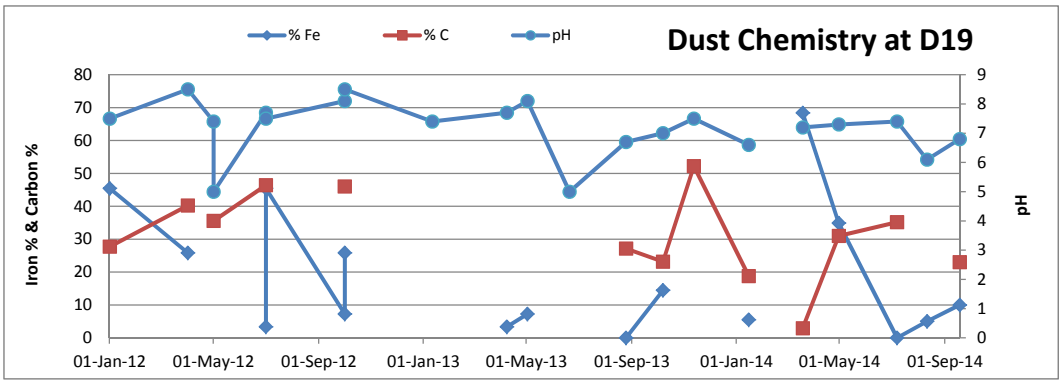
Report Number 1392r1v1d0215

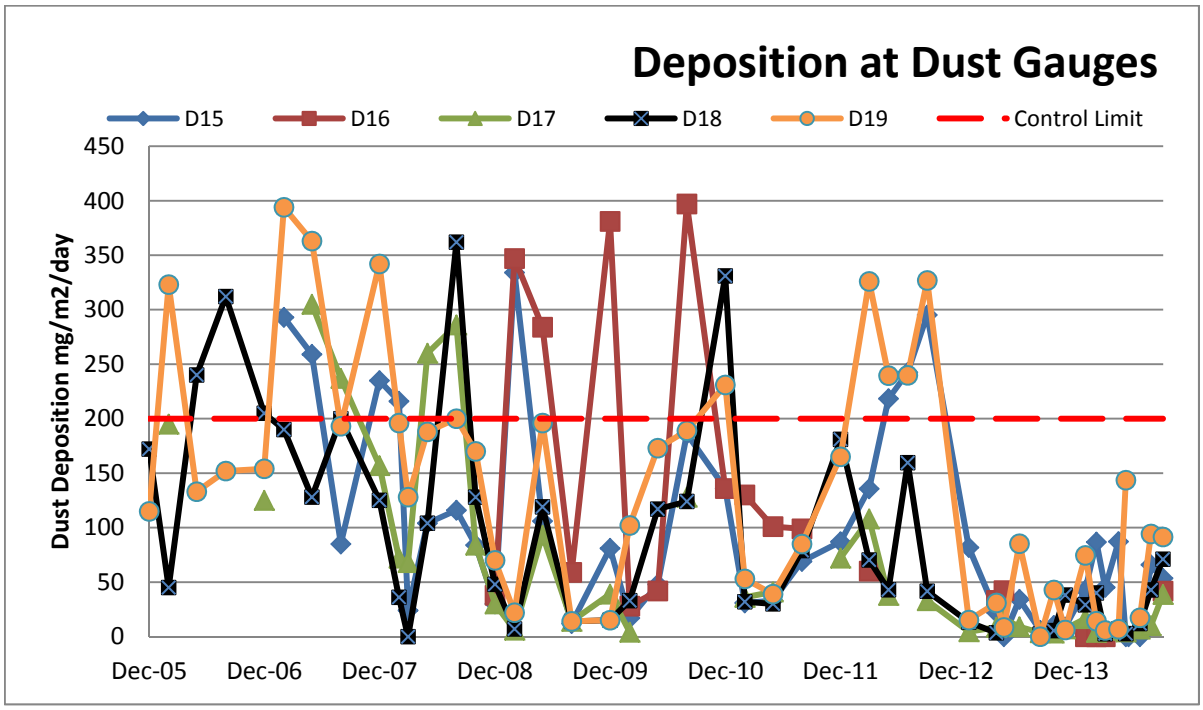

Dust Chemistry at D15
% Fe
% C
pH
Iron % & Carbon %
pH
01-Jan-12
01-May-12
01-Sep-12
01-Jan-13
01-May-13
01-Sep-13
01-Jan-14
01-May-14
01-Sep-14

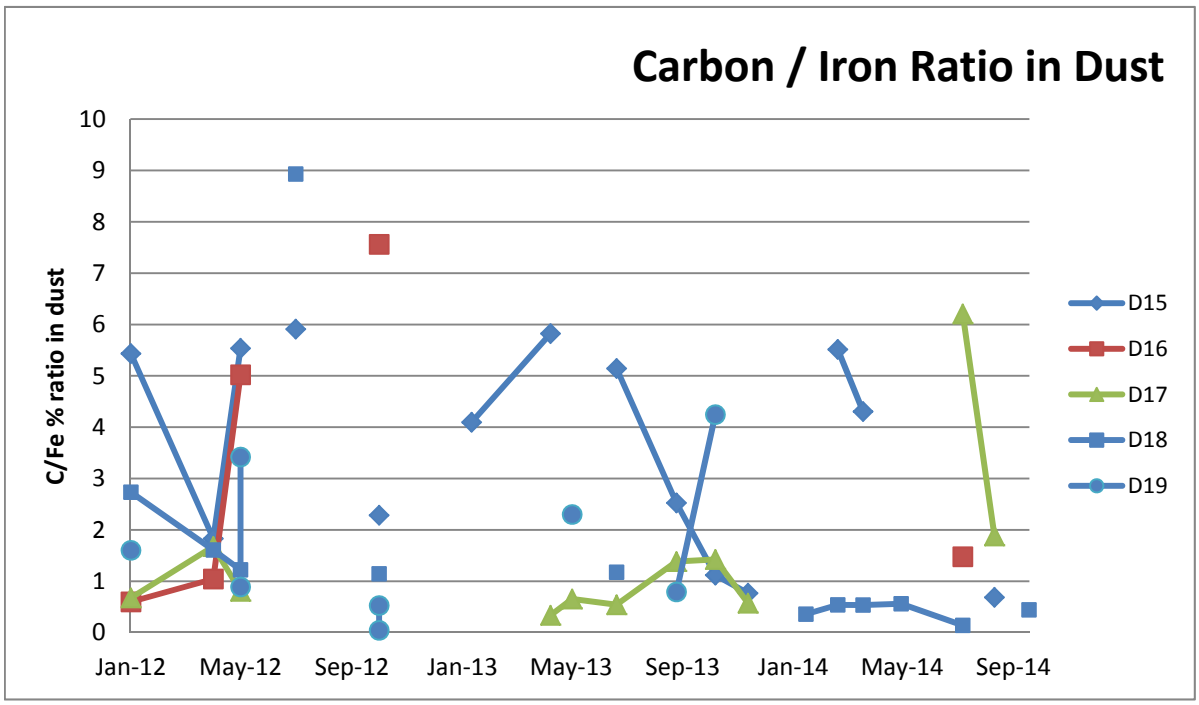

Dust Chemistry at D16
% Fe
% C
pH
Iron % & Carbon %
pH
01-Jan-12
01-May-12
01-Sep-12
01-Jan-13
01-May-13
01-Sep-13
01-Jan-14
01-May-14
01-Sep-14


Dust Chemistry at D17
% Fe
% C
pH
Iron % & Carbon %
pH
01-Jan-12
01-May-12
01-Sep-12
01-Jan-13
01-May-13
01-Sep-13
01-Jan-14
01-May-14
01-Sep-14


Dust Chemistry at D18
% Fe
% C
pH
Iron % & Carbon %
pH
01-Jan-12
01-May-12
01-Sep-12
01-Jan-13
01-May-13
01-Sep-13
01-Jan-14
01-May-14
01-Sep-14


Dust Chemistry at D19
% Fe
% C
pH
Iron % & Carbon %
pH
01-Jan-12
01-May-12
01-Sep-12
01-Jan-13
01-May-13
01-Sep-13
01-Jan-14
01-May-14
01-Sep-14


Deposition at Dust Gauges
D15
D16
D17
D18
D19
Control Limit
Dust Deposition mg/m2/day
450
400
350
300
250
200
150
100
50
0
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13


Carbon / Iron Ratio in Dust
C/Fe % ratio in dust
10
9
8
7
6
5
4
3
2
1
0
Jan-12
May-12
Sep-12
Jan-13
May-13
Sep-13
Jan-14
May-14
Sep-14
D15
D16
D17
D18
D19