East Northants Resource Management Facility – Monitoring

A comprehensive suite of monitoring is conducted at the East Northants Resource Management Facility (ENRMF) as specified in the site permits. The monitoring is conducted at numerous locations around and within the site for physical, chemical, and radiological parameters at a range of frequencies.

Thousands of data points are generated which are reported regularly to the Environment Agency and are publicly available. However much of this data needs certain technical knowledge to fully understand. To provide more accessible information so that the community can understand the impact of the site on the environment we present on the web pages linked below key selected data in respect of groundwater quality, air quality, dust, and asbestos together with radioactivity. For each selected parameter the reason for selection and its interpretation are explained. The data is for the most recent 6 months of data submitted to the Environment Agency each quarter.

Interpretation of monitoring data

There are several means of interpreting monitoring data:

- Compare against background data before the operation started
- Compare against historic data
- Compare upstream with downstream/upwind with downwind
- Look for trends in the data by using graphical presentation
- Compare against trigger levels (Trigger levels are set at a value lower than that which would cause harm but indicate action should be taken to investigate further)
- Compare against quality standards such as the Drinking Water Standard
- Consider combinations of parameters for example elevated chloride and ammoniacal nitrogen, together could indicate the presence of leachate from biodegradable wastes but alone suggest some other source of contamination.

The interpretation of monitoring data is rarely straightforward. Many of the parameters monitored are naturally present in the environment for example elevated carbon dioxide can indicate the presence of landfill gas but is also generated by the degradation of vegetation and is present in limestone. The contribution of measured chemical species generated as a result of surrounding current and historic activities such as agriculture and industry need to be taken into account. The addition of de-icing salt to roads for example can cause elevated concentrations of chloride in nearby boreholes. While samples are taken and analysed using strict quality protocols cross contamination of samples and equipment can occur affecting results. Interpretation therefore must take into account the natural environment, surrounding activities and the monitoring history. Outlier results are treated with caution and re-analysis, or re-sampling is undertaken to confirm the result.

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Groundwater

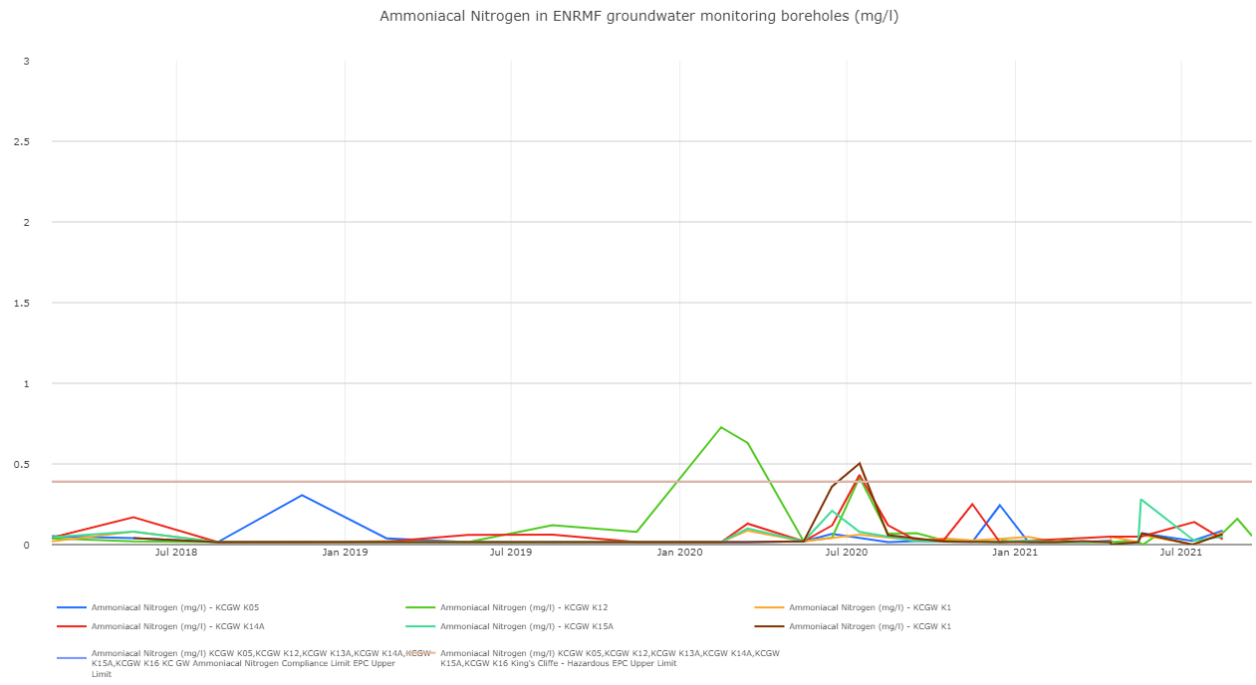
Groundwater is protected by the installation of a low permeability clay liner and High Density Polyethylene (HDPE) liner in the base of the site. Groundwater varies between 6.2m and 9.8m below the base of the site. Groundwater is monitored in 16 boreholes strategically installed around the site. From each borehole, on a quarterly basis, samples are taken and analysed for a wide range of parameters including salts, organic substances, and metals. The Environment Agency set trigger levels for selected parameters and for selected boreholes against which the performance of the site is assessed.

In addition, we confirm that the Environment Agency has previously tested the Horsewater Spring in Kings Cliffe Village, and that they already regularly test other water bodies in the area such as streams and rivers including the Willow Brook and River Nene.

Presented below are graphs for boreholes with associated trigger levels, representing the last four years of site data with the inclusion of the most recent 6 months of data submitted to the Environment Agency for ammoniacal nitrogen, chloride, cadmium, and nickel. For each graph the reason the parameter has been selected and its significance are explained above the graph. The results are discussed below each graph.

Ammoniacal Nitrogen

Ammoniacal nitrogen is an indicator of organic contamination. In combination with elevated chloride, it could indicate the presence of landfill leachate. Elevated levels of ammoniacal nitrogen on its own may indicate an organic source such as agricultural waste or seasonal dieback of vegetation. A trigger limit of 0.39mg/l is set in the Environmental Permit based on background concentrations in the groundwater.



There have been no exceedances of the permitted concentrations of Ammoniacal Nitrogen in groundwater at the ENRMF site during 2021. There were minor exceedances noted in 2020, these concentrations quickly returned to previously observed concentrations and no further exceedances have been noted. Ammoniacal nitrogen concentrations at the site are generally stable and within ranges expected at the site.

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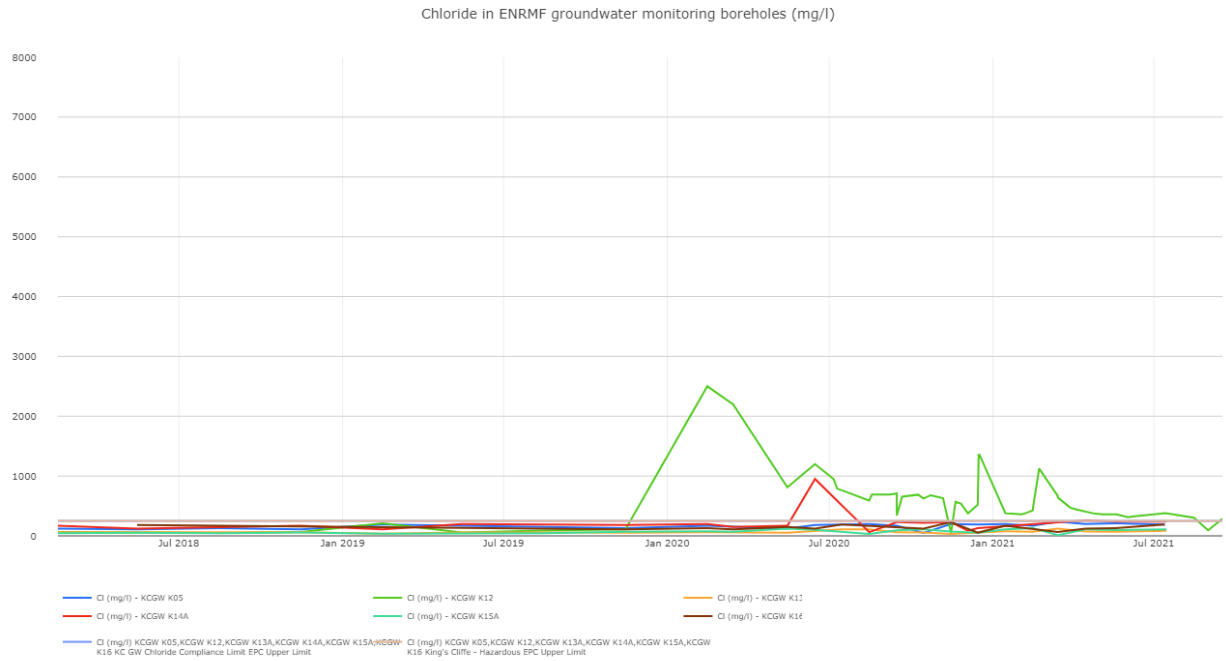
Chloride

Chloride is a good indicator of the presence of salts. In combination with ammoniacal nitrogen it can indicate the presence of leachate. Elevated levels of chloride on their own can naturally occur or could be due to contamination from road salt. A trigger level of 250mg/l is set within the permit and based on the UK's Drinking Water Standards.



The winter of 2019/20 was the wettest on record. The sequence of heavy storms (including Ciara, Dennis and Jorge) in February combined with saturated ground conditions resulted in flooding of the ground immediately north of the site and in the northern part of the site.

In March 2020 elevated concentrations of Chloride were detected in a number of boreholes up and down gradient (i.e. upstream and down-steam) of the ENRMF site. Investigations into these exceedances indicate the source of the chloride was potentially a haul road north of the soil treatment facility as a result of the flooding.

Monitoring frequencies for the affected boreholes were increased and the Environment Agency were notified. Additional water control measures have been implemented by the site staff to prevent re-occurrence and concentrations of chloride have been steadily declining indicating that they were the result of a one of event. Augean agreed that the increased monitoring frequency will continue until concentrations return to previously observed ranges. Augean took expert advice on the potential effects of the issue which found the impact was localised and not a risk to human health.

While the trend of chloride levels has continued downwards, during the winter of 2020/21 a small increase was observed which was thought to be flushing due to heavy rain.. This is supported by the heavy rains and flooding experienced in December 2020 and February 2021 where the first week of rainfall exceeded the long-term average for the month.

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By October 2021 chloride level were within compliance limits. The concentrations of chloride will be closely monitored to ensure they remain within previously observed ranges and monitoring frequencies will be increased as necessary if any increase is observed in the future.

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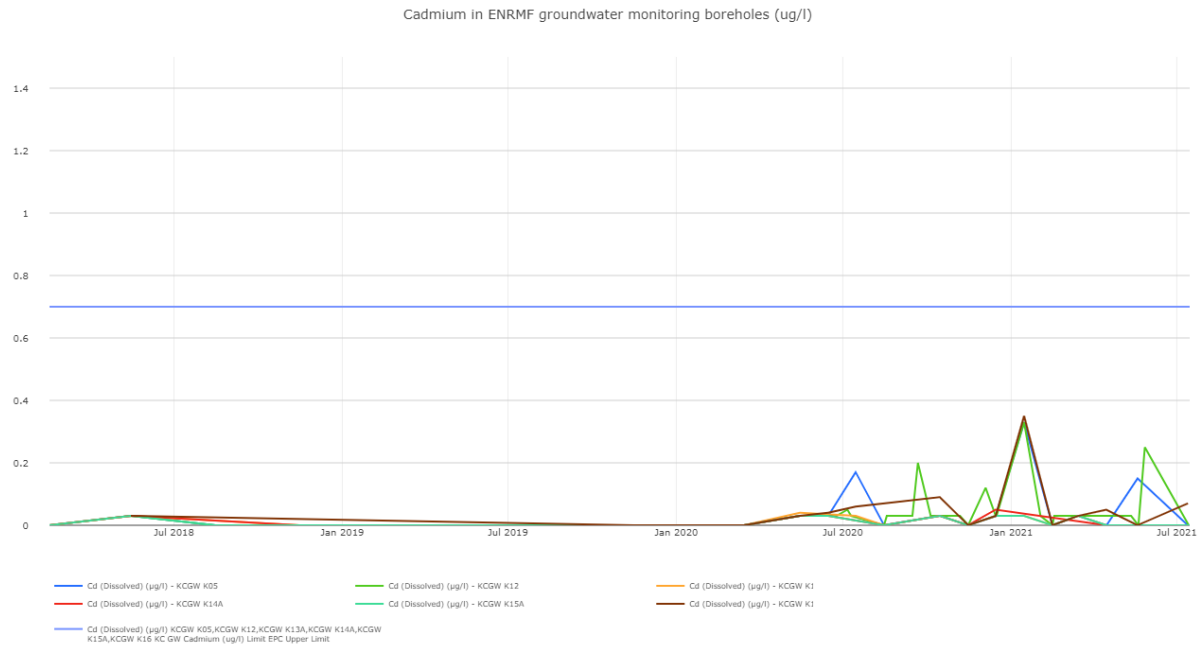
Cadmium

Cadmium is a heavy metal commonly associated with hazardous waste landfill sites (HPA:2010).



There have been no cadmium exceedances observed at the site and concentrations have generally fluctuated within previously observed ranges, there was a minor increase observed in certain boreholes during the winter 2020 and minor increases/ increased fluctuations are observed in certain boreholes during the first half of 2021 as well as during the winter of 2020 with all concentrations returning to previously observed concentrations after July 2021.

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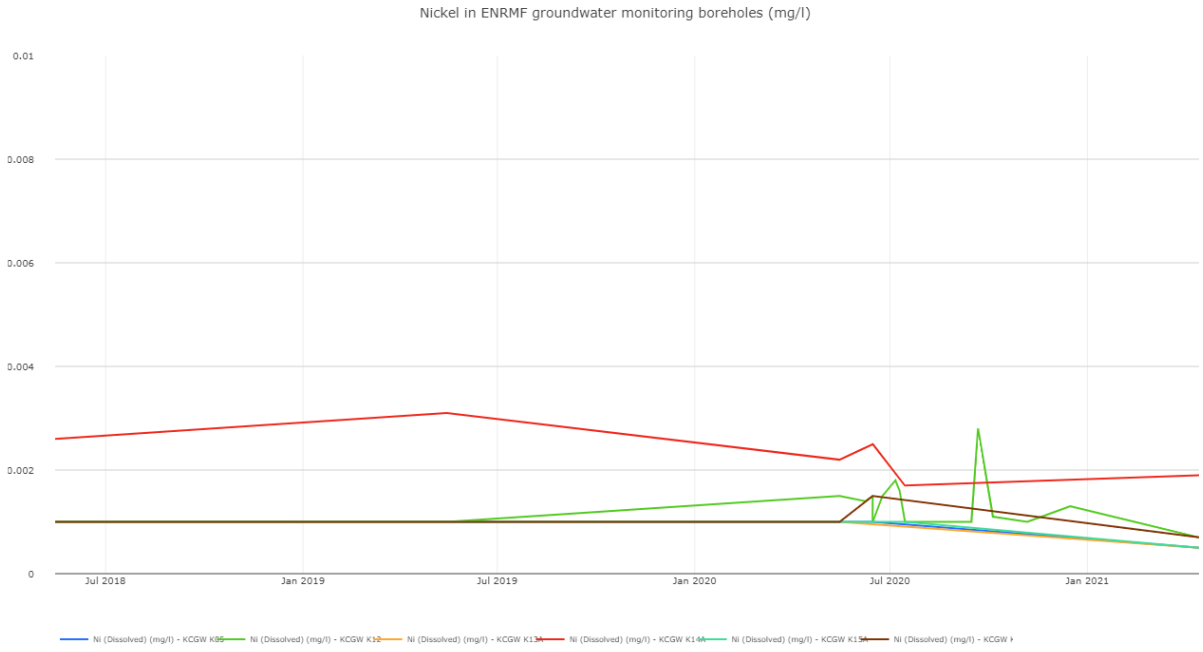
Nickel

Nickel has a trigger limit of 20µg/l as set by the Environment Agency's Permit for ENRMF). This value represents the limit set in the UK Drinking Water Standards.



There have been no elevated nickel concentrations recorded at the facility, concentrations have been within previously observed ranges.

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Air Quality

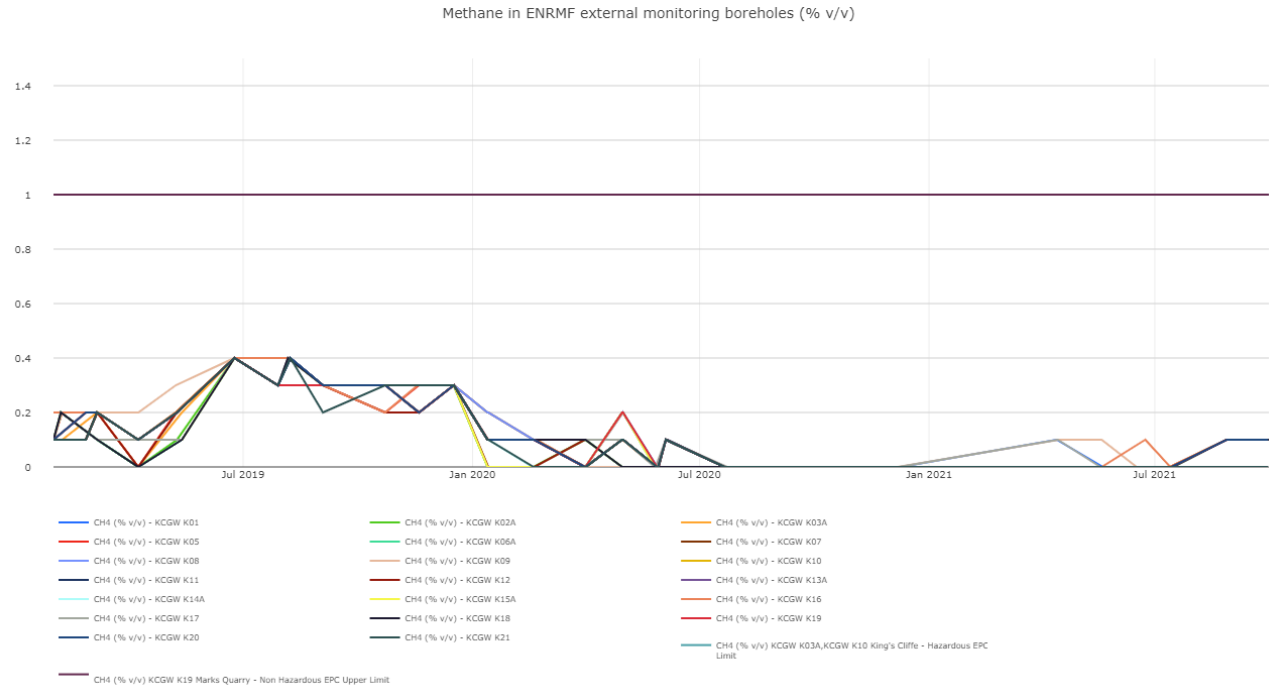
The progressive degradation of the wastes disposed of in landfill sites generates landfill gas which is largely a combination of methane (approximately 60%) and carbon dioxide (approximately 40%). There are also trace components such as hydrogen sulphide which can cause landfill gas to become odorous. In a hazardous waste landfill, the quantity of landfill gas is much less than a typical domestic waste landfill, but ENRMF still has full gas control systems to ensure that any gas generated is appropriately managed.

At ENRMF air quality is monitored in the site's external monitoring boreholes and in the ambient air monthly and weekly respectively.

Below are presented graphs showing the available results for the last 4 years of monitoring of methane in boreholes and the ambient air and hydrogen sulphide in the ambient air, with the inclusion of the latest 6 months of data.

Methane in Boreholes

Methane is monitored in boreholes to confirm that landfill gas generated in the landfill is not migrating from the site into the surrounding ground. Methane is not toxic but it is a greenhouse gas and is flammable so it must be controlled. Methane can however be generated by the breakdown of vegetation hence detection of the gas must be interpreted in the context of the surrounding environment. A trigger level of 1% methane has been set by the Environment Agency which is well below a concentration of concern.



There have been no elevated CH4 readings in the external monitoring boreholes during recent monitoring.

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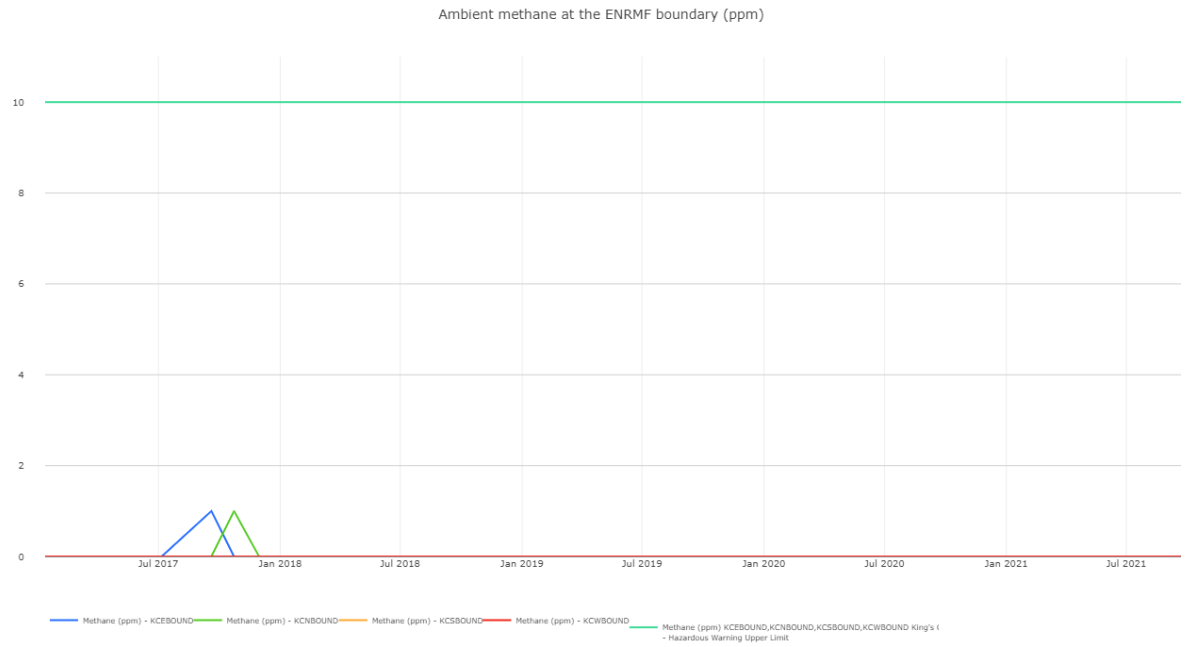
Ambient methane

The purpose of monitoring ambient methane is principally to confirm that significant amounts of this greenhouse gas are not escaping from the site. Ambient methane is measured by walking around the site boundary with a handheld meter. The concentration is measured in parts per million (1ppm = 0.0001%).



All methane recordings at the boundary of the site have been significantly below the 10ppm permit limit.

Ambient hydrogen sulphide

Hydrogen sulphide is the cause of the smell of rotten eggs. At high concentrations it can be poisonous. It is monitored largely because of its odour generating potential as the smell is noticed at a very low concentration. Ambient hydrogen sulphide is measured by walking around the site boundary with a handheld meter. The concentration is measured in parts per million (1ppm = 0.0001%). Hydrogen sulphide is only measured if ambient methane levels are elevated above the permitted trigger limit. No elevated levels of ambient methane have been recorded so it has not been necessary to monitor hydrogen sulphide.

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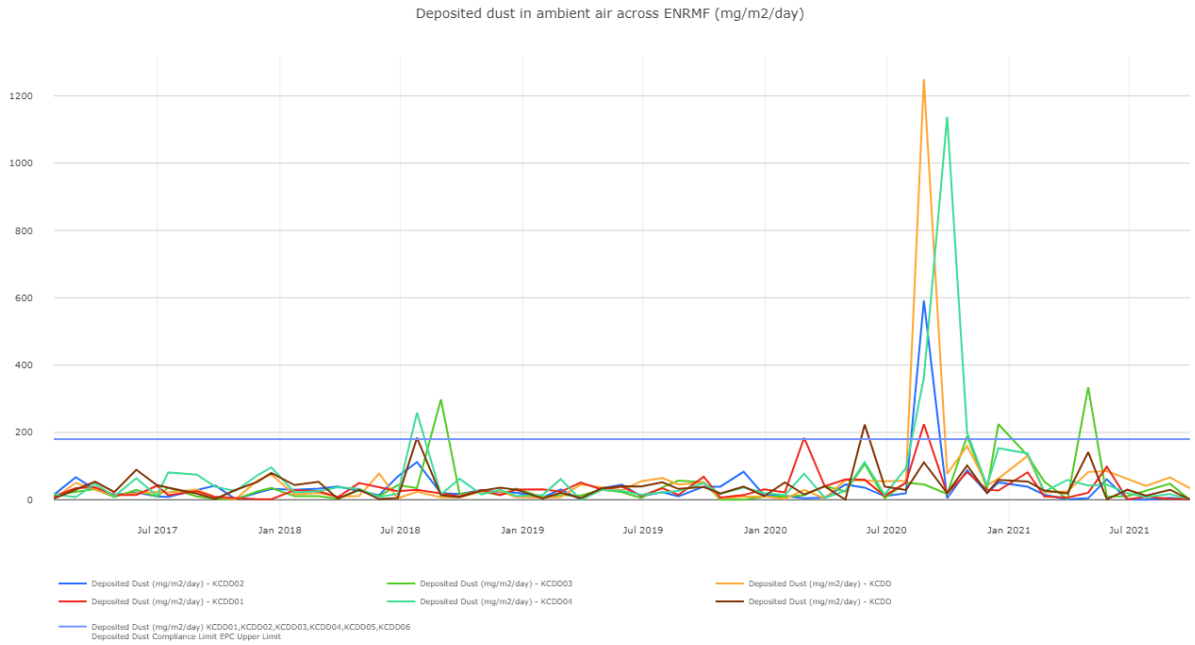
Dust and Asbestos

Particulates including nuisance dust, breathable dust (PM10) and asbestos are monitored at the site boundary. The monitoring locations under the permit are determined based on the prevailing wind and the location of sensitive properties. In response to community requests, we have increased the number of dust monitoring points at the boundary of the site to provide measurement in all directions. The interpretation of dust monitoring needs to take care to consider activities taking place off site for example agricultural activities such as ploughing and lime spreading.

Deposited Dust

Dust is potentially generated at the site as a result of vehicle movements, wind blow and handling of dusty materials. Measures are in place to suppress dust to prevent dust leaving the site. In addition to a fleet of mobile dust suppression units, recent investments to site secured the purchase of additional atomiser units and the installation of a dust suppression fence line around the treatment area. Deposited dust is often referred to as nuisance dust and is so called as it comprises large particles that are considered a nuisance where they settle for example on windows or paint surfaces.



Two very minor exceedances in DD03 and DD04 were recorded in July and August 2018 respectively, these quickly returned to previously observed ranges. DD05 during May 2020, this was due to agricultural activity on the neighbouring fields

There were 4 exceedances during summer 2020, it is believed that these exceedances were due to harvesting activity during very dry weather on the adjacent farmland. Observations made by the site staff confirm dust arising from farming activity during this monitoring period and photos were taken to support these observations.

It is noted that the site was undertaking engineering works during the summer months and additional dust dampening was undertaken throughout these works to ensure that dust on site was controlled.

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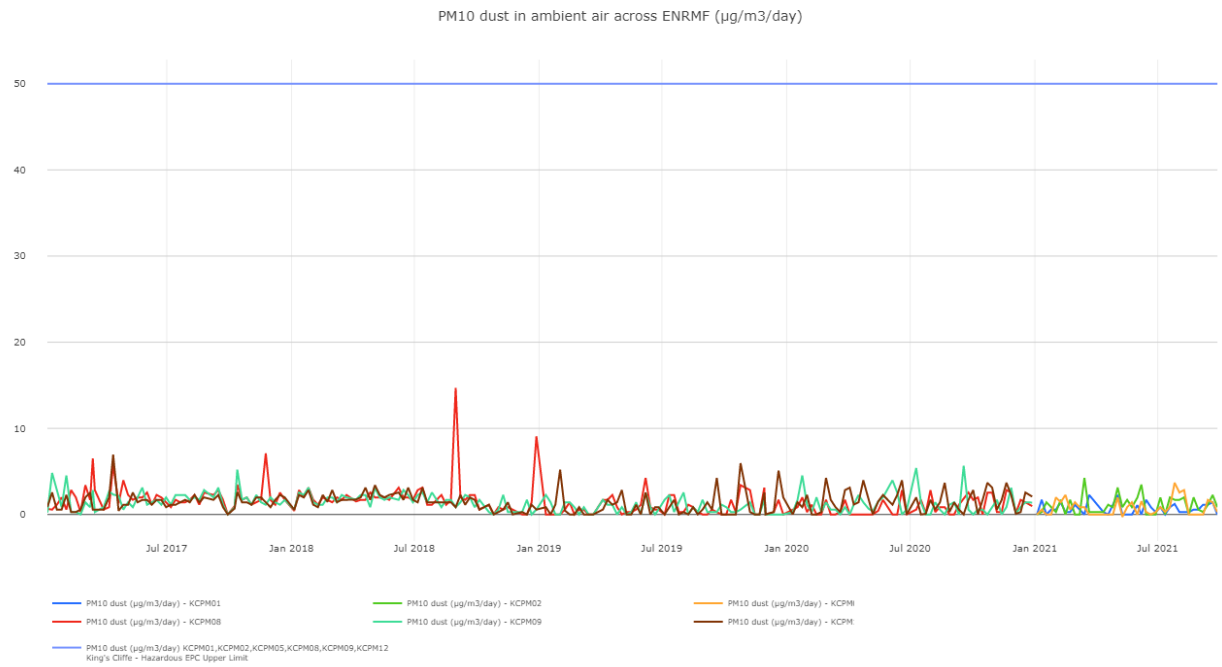
During the second quarter of 2021, the site reported one exceedance for deposited dust. The dust gauge is located in the south-eastern corner of the site boundary, and with reference to the average wind speed and direction during the time of the exceedance, it was considered up-wind of the facility. Observations of agricultural activities in the adjacent fields surrounding the southern boundary of the site during April may have exacerbated this result.

Breathable dust (PM10)

Breathable dust is defined as small size particles of less than 10 micrometres in diameter. They are generated by similar mechanisms to deposited dust, but the amount generated depends on the source material. They are controlled by similar means. They are important to monitor because they are inhalable and prolonged exposure to high levels can have health effects



There have been no exceedances of the permitted limits for PM10's (particulates <10 microns) at the site and concentrations have remained within expected ranges.

Asbestos

Asbestos is disposed of at the site. Asbestos is only a risk if fibres become airborne hence the handling methods are designed to contain the asbestos. All asbestos is received double wrapped and immediately covered on placement in the landfill. As a precaution monitoring is undertaken at the site boundaries. Asbestos fibres can be present in the environment historically for example from vehicle brake linings.

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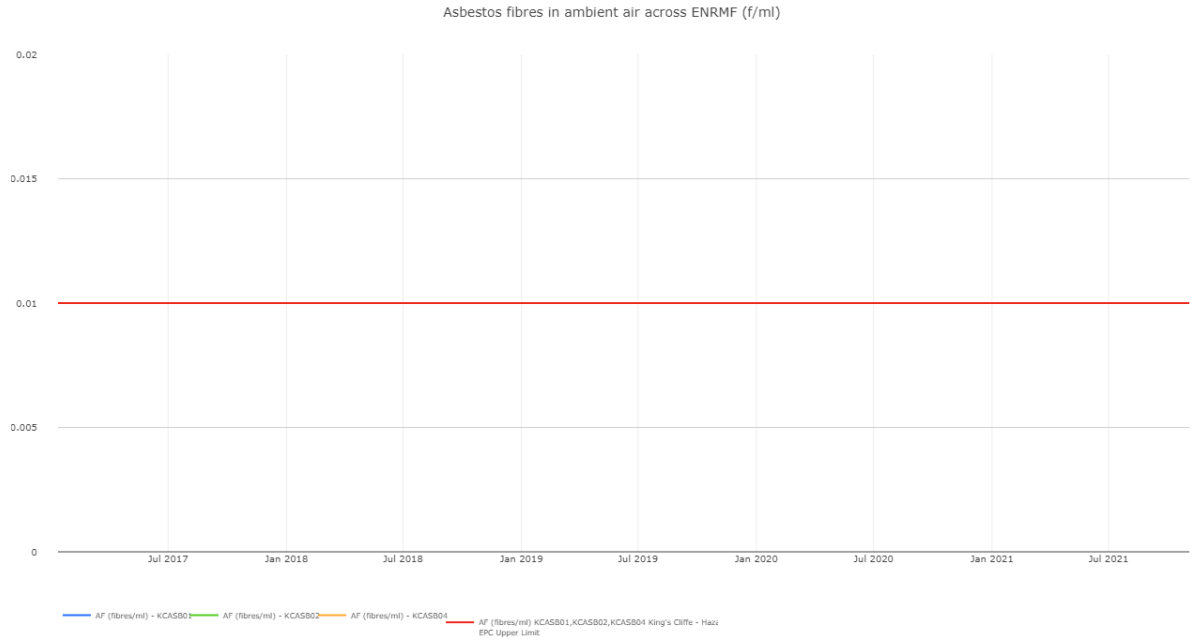

There have been no exceedances of the permitted limit for asbestos fibres at the site during the past 5 years of monitoring.

Radiological

To confirm that the site is performing in accordance with the radiological risk assessment Augean undertakes radiological analysis of groundwater, surface water, leachate, gas and dust.

A number of technical terms and reference to units of measurement are used in this section. Definitions of the terms and units are presented at the end of the section.

Radiation in context

All matter on earth is radioactive. We are continuously exposed to radiation from space, from the ground and in our food. The average natural radiation exposure in the UK is 2.2mSv/a (Sv = Sievert) which provides a measure of effective exposure taking into account fatal and non-fatal outcomes, the effect on unborn babies, effects on all age groups (including children and the elderly), the cumulative effect on all organs and effects from external and internal irradiation.

In parts of the UK due to the geology there is the potential for additional exposure from radon gas which is released from underlying rocks. In Cornwall for example the average annual exposure to natural radiation is 7.4mSv/a. Some areas of Northamptonshire have an average annual exposure to natural radiation of 3.6mSv/a. The potential for exposure occurs principally in the valleys where deposits such as clay are not present over the underlying rocks. In areas covered in clay such as at ENRMF the radon levels are very low. At the request of the Kings Cliffe Liaison Group Augean produced a report on radon in the local area.

We also receive radiation from a range of common activities and sources for example:

100g of Brazil nuts = 0.004 mSv

1L per day bottled water = up to 0.024mSv

Return flight to the USA = 0.1 mSv

Chest x-ray = 0.02 mSv

Medical Abdominal CT Examination = 10 mSv

Potential for exposure from low level activity LLW disposal at ENRMF

The design limit of public exposure from the ENRMF is 0.02mSv/a which is less than 1% of the average natural background level in the UK. As exposure declines exponentially with distance the potential exposure at nearby villages is many orders of magnitude less.

Risk assessments are undertaken to ensure that the acceptance of the waste will not result in exceedance of the design limits. Risk assessments are the standard tool and approach used for all forms of environmental management. This is not just a series of theoretical mathematical models. Risk assessments are based on well understood processes such as the fate and transport of individual contaminants, groundwater flow, air dispersion and acceptable exposures. Where there is uncertainty, conservative or worst-case assumptions are made. Where the effectiveness of a protection measure is not clear, it is assumed that the protection measure is not present. Risk assessment therefore generates a conservative assessment of the maximum impact.

There are three main types of radiation that must be considered in assessing risk: alpha, beta and gamma. The environmental monitoring requirements include all three types of radiation.

If you wish to know more about radiation you might find the following sources of information helpful:

Living with radiation – It is available in hard copy only. We have a number of copies which we should be pleased to send on request.

Public Health England website

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Radiological monitoring

In accordance with good environmental practice radiological monitoring in the site and around the site is undertaken to confirm that the site is behaving the way that is predicted in the risk assessments. In the unlikely event the results of monitoring show a variance with the assumptions in the risk assessment action can be taken at an early stage to ensure this does not result in significant impact. The Environmental Permit requires monitoring of the behaviour of the site in all media. As with the chemical data there is a large amount of information. Key selected data is presented relating to:

- Groundwater
- Dust
- Surface soils
- Ambient air
- Personal monitoring of site staff

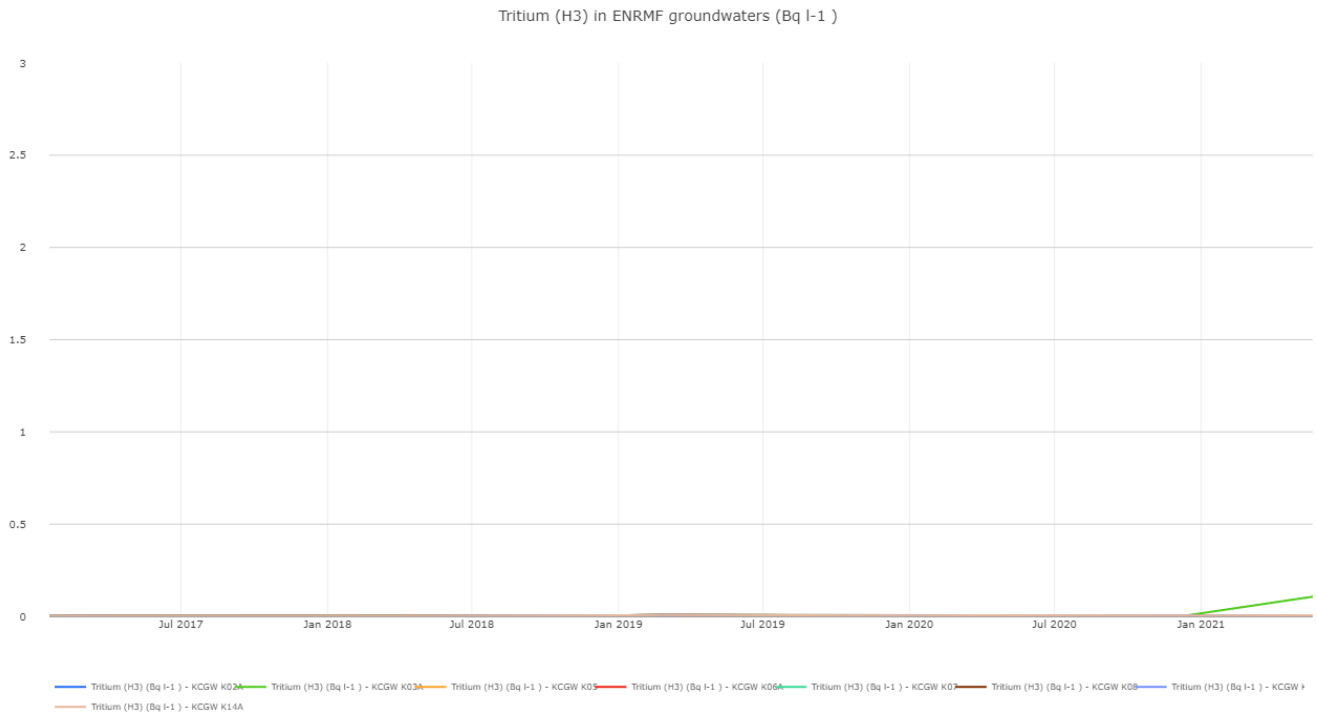
Full monitoring commenced on receipt of the first loads of LLW in December 2011. The results are submitted to the Environment Agency in accordance with the permit requirements.

The monitoring points for these environmental media are at or beyond the boundary of the site. The Environment Agency and UKHSA also undertake periodic radiological monitoring of the environment around the site.

Before accepting LLW Augean undertook background monitoring at the site. The results of this background monitoring show that, as expected, radiation such as tritium is naturally present at the site but is generally below detection limits. The data can be viewed here.

LLW monitoring

The results of the Tritium in groundwater at the ENRMF, including both background data and post LLW monitoring data are shown. Tritium is a good indicator as it migrates relatively quickly and would be the first isotope to be found if there was a problem.



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The graph shows that no significant levels of Tritium have been detected in down-gradient boreholes since low-level radioactive waste has been accepted at the ENRMF site. All post LLW monitoring data for surface soils, groundwater, site perimeter dose rate monitoring and deposited dusts can be viewed here.

The LLW radiological monitoring data shows that all analytical results were almost identical to the background data, with the majority of results showing that levels were below or equal to the Limit of Detection (LOD) of the test method used for the parameter listed at the time of analysis.

Definition of Radiological terms

Exposure is the amount of radiation received by a human or living thing.

A measured dose is the amount of exposure received by a human or living thing over a specified period of time.

Dose exposure is measured in Sieverts (Sv/hr or Sv/a). As the doses associated with the ENRMF are low (well below natural background levels of 2.2mSv/a) the doses are expressed in millisieverts per hour (mSv/hr). In accordance with the ENRMF's procedures, a dose limit of 0.01 mSv/hr at a metre from the Low-level waste (LLW) in its container is assigned to all incoming LLW loads, before they can be accepted for disposal and burial in a designated area of the landfill.

Activity is the amount of radioactive decay occurring in a particular substance for example in a soil disposed of in the site. Activity is calculated in Becquerels per litre (Bq/l) or Becquerels per gram (Bq/g) depending on whether the substance being analysed is a gas, liquid or solid.

A *radionuclide* (an atom with an unstable nucleus) goes through the process of radioactive decay. These are also known as radioactive isotopes. For example, *tritium* is a well-known radioactive isotope of hydrogen. Tritium can combine with oxygen to produce Tritiated Water (HTO), meaning it has rapid rate of transport through a substance. Therefore, Tritium is analysed as a good indicator of the movement of radioactivity within the landfill.

Radionuclides undergoing radioactive decay emit *gamma* rays and/or *alpha* and *beta* particles.

Alpha particles consist of two protons and two neutrons. Radionuclides including Americium-241, radium-226 and Thorium-232 are some of the key alpha emitters. Due to their slow movement, alpha particles are unable to penetrate paper and can reach only the very outer layers of human skin. They can also pass through only a few centimetres of air due to their rapid loss of energy. Alpha radiation cannot pass through the packaging used to transport and dispose of waste at ENRMF.

Beta particles are high-energy electrons. Radionuclides including Caesium-137, Carbon-14, Cobalt-60. Lead-210 and Tritium (H-3) are all beta emitters. Despite their high energy, beta particles can be stopped by solid materials including cardboard, however they are slightly more mobile in air than alpha particles and can travel up to several feet. Beta particles are also more harmful than alpha particles as they can penetrate skin and tissue further which can result in more widespread cellular damage. Beta radiation is significantly attenuated by the packaging used to transport and dispose of waste at ENRMF.

Gamma radiation (also known as gamma rays) is high energy ionising radiation. Gamma photons can travel significant distances in air due to their high energy and can also pass through many materials including human tissue. However, the dose declines rapidly with distance due to energy loss. Lead is one of the materials that can significantly prevent movement of gamma rays. Radionuclides including Caesium-137 and Cobalt-60 are gamma emitters. Both Caesium-137 and Cobalt-60 are commonly used in the treatment of cancer, whilst Cobalt-60 is also utilised in the sterilisation of medical apparatus.