SOUTHERN WASTE RESOURCE CO
Application to receive PFAS contaminated waste

Frequently Asked Questions (FAQs) issued 30 July 2020, updated 15 September 2020

Why is there a proposal to dump PFAS in McLaren Vale?

Any landfill operator holding an EPA licence is entitled to apply to the EPA to add PFAS-contaminated waste to the list of wastes it receives, providing it can meet the criteria stipulated in the EPA Landfill disposal criteria for PFAS-contaminated waste and the Environmental management of landfill facilities – solid waste disposal.

The EPA stipulates that the landfill cell must meet the country's two most stringent criteria for waste of this kind, as endorsed by each of the Heads of EPAs and Environment Ministers nationally and outlined in the PFAS National Environment Management Plan 2.0.

The land at the North-Eastern corner of South Road and Tatachilla Road has been operating as a landfill since 1993. In 1996 it received Development Approval to receive contaminated materials, waste treatment plant residues and waste filtration plant residues. The site is privately operated by Southern Waste ResourceCo, who has been authorised since 1996 to receive waste that is specified in EPA licence #32682. On 21 February 2020 SWR applied to the EPA to add 'PFAS-contaminated waste' to the lists of waste it is already licensed to receive.

What's the definition of PFAS-contaminated waste?

PFAS-contaminated waste associated with this application is defined as waste that contains PFAS-contaminated soil, PFAS-contaminated activated carbon and PFAS-contaminated sludge. The EPA does not permit fire-fighting foams or liquids contaminated with PFAS to be disposed of into any landfill in South Australia.

PFAS wastes can be generated through a remediation project - for example, where soil contamination has occurred. Soil contamination usually occurs at the site where the chemicals were used, such as where fire-fighting foams have been used and have entered uncontrolled into the environment. Activated carbon is commonly used in site remediation projects to remove contamination, as well as to remove PFAS contamination from liquid, and is made from materials with high carbon content such as wood, lignite and coal. Sludge is dewatered silt/soils that have been contaminated with PFAS compounds and have had the liquid removed by evaporation (please see below) to meet the definition of solid waste:

Who decides where this waste can go?

If the required engineering and groundwater monitoring have been undertaken, and the landfill cell has been assessed as complying, commercial operators in South Australia are legally able to apply to the EPA and under the *Environment Protection Act 1993* and have its application considered.

Where else can it be disposed of?

The South Australian EPA's criteria for the disposal of PFAS-contaminated waste was published in March 2020. SWR is the first landfill to apply for this waste stream to be added to its licence, and the only landfill to have completed the requisite minimum 12 months of groundwater monitoring and to construct a double composite lined disposal cell. Therefore there is currently nowhere in South Australia that meets the EPA's minimum acceptance standards where PFAS-contaminated waste can be disposed of.

Nationally, there are a number of landfill sites where PFAS-contaminated waste can be disposed of: Victoria, New South Wales, Northern Territory, Tasmania, Queensland and Western Australia.

What's to stop it from leaking?

Landfills are no longer just a 'hole in the ground'. Modern landfills consist of highly engineered cells which provide multiple layers of protection for the environment including the groundwater, surface water as well as other environmental aspects such as minimising the attraction of vermin.

The lining system in the landfill cell that forms this application consists of four layers of protective barriers to prevent the infiltration of leachate into groundwater. From the base layer to the top, this comprises a 1-metre thick compacted clay liner, then a 2-mm geomembrane made of high density polyethylene plastic, a geosynthetic clay liner, and a 2-mm geomembrane made of high-density polyethylene plastic.

In between these layers are the primary and secondary leachate collection layers, both of which are composed of a grid of plastic pipes or geosynthetic drainage systems that collect all leachate generated from the waste. Leachate is generated when rain lands on the waste within the landfill and infiltrates down through the waste mass. The leachate system built inside landfill cells is designed and engineered to prevent the dispersion of leachate to the environment. At all landfills, leachate is recovered and tested for the presence of certain chemicals and in this instance any PFAS that has made its way into the first leachate collection layer can be detected then.

What happens before receipt and disposal and how is this monitored?

If the EPA approves the application, SWR's licence would be amended to strengthen the EPA's regulatory control over the onsite management of PFAS-contaminated waste.

Prior to the actual receipt of waste, SWR would be required to submit a testing report to demonstrate the levels of PFAS. If the dry weight concentration exceeded the EPA's criteria of 50 $^{mg}/_{kg}$, the waste would automatically be banned from entering the landfill. Anything above 50 $^{mg}/_{kg}$ would need to undergo a treatment process that irreversibly transforms PFAS into less hazardous compounds[1]. Such treatment processes include incineration or other thermal destruction, which are not currently available in SA. Non-complying waste would have to be transported interstate for further treatment and disposal.

[1] This is in conformance with the Stockholm Convention on persisting organic pollutants.

If the PFAS dry weight concentrations were compliant, the waste would still be subjected to leachability assessment to demonstrate compliance with the leachate criteria as stated in the disposal guideline. The EPA requires that any leachate testing conducted in SA is employed using the standard SW 846: Test Method 1320 Multiple Extraction Procedure (MEP). This is a robust and conservative standard method used worldwide to simulate the leaching that a waste will undergo from repetitive precipitation of acid rain on an improperly designed landfill (i.e. no lining at all).

Compliance with the leachate criteria using MEP would provide confidence that PFAS in waste is less likely to leach even if the engineered lining is compromised. PFAS-contaminated waste, like any other wastes, are subject to tracking requirements. The EPA regulates a waste monitoring and tracking system that all waste producers, transporters and receiving facilities are required to follow and adhere to.

How will you know if it leaks?

Any potential leaching from the landfill cell (not just PFAS) would first be picked up through regular monitoring and extraction of leachate within the primary leachate collection system. That is the 300mm gravel drainage and collection pipework system closest to the layer of waste at the base of the cell.

There are a series of liners and barriers to prevent further vertical migration of the leachate beyond the primary leachate collection system. The primary liner is composed of a geomembrane made from high density polyethylene, overlaying a geosynthetic clay liner.

Currently, if there is a spike in analyte concentrations of any chemicals at the primary leachate collection barrier, it is removed to a similarly lined leachate evaporation pond. Once the liquid has evaporated, the sediments are removed and pumped out, and then undergo treatment to render them safe for disposal.

If the series of primary liners and barriers fail, then the PFAS or other analytes are detected in the secondary leachate collection system. At this point an investigation to determine the cause and actions taken to fix any breach of the primary high density polyethylene and geosynthetic clay liner composite systems would be undertaken to prevent causing environmental harm.

What happens to groundwater if it does leak?

Groundwater below the landfill cells are within the upper Quaternary aquifers which are separated structurally from the Willunga Basin in the south and the Adelaide Basin in the north. Site contamination affecting groundwater is an offence under the *Environment Protection Act 1993.*

Groundwater in this region is flowing in a westerly direction away from McLaren Vale toward the coast. If the lower secondary liners and barriers fail (high density polyethelene and 1-metre low permeability compacted clay), then PFAS and other chemicals would be detected in the onsite sentinel groundwater wells and the EPA would need to consider compliance and enforcement actions.

If this were to occur, it is likely that the EPA would require actions be undertaken such as the construction of a series of large diameter groundwater bores across the width of the contaminated groundwater plume. Groundwater can be drawn to the surface through a series of pipes, valves and a pump.

The water would then be cleaned using a modified granulated activated carbon to remove the PFAS and reinjected up-hydraulic gradient, which is a proven remediation technology. This effectively creates a hydraulic barrier preventing the groundwater from moving offsite.

Who pays if it leaks – now or in 50 years' time?

Under the *Environment Protection Act 1993* (EP Act), known or suspected site contamination must be reported to the EPA. The authority can then require assessment, and if necessary remediation which means to treat, contain, remove or manage the contamination. This legislation is retrospective and can be enforced at any time into the future.

The EPA has a set of regulatory tools at its disposal should environmental contamination happen as a result of site activities. The EPA has the authority to impose further requirements via the licence, as well as issue Orders to undertake action in a timely manner. These tools have been effectively used in various forms to compel individuals or businesses to clean up environmental contamination resulting from their activities and operations.

Pollution of the environment has been an offence since 1995 and carries hefty criminal and civil penalties. Responsibility for site contamination is assigned according to the 'polluter pays' principle – this means that the original polluter is liable for any clean-up and associated costs caused on and off the source site, regardless of when it was caused.

Responsibility for site contamination can only be transferred through a legal 'Transfer of Liability' and there are financial safeguards in place to ensure that a company pays a portion of the cost of any future assessment or remediation to be held in trust by the EPA. Before an EPA licence holder can relinquish their liability for a site, they must submit a 'closure plan' to the EPA that allows for progressive rehabilitation of the site.

Has it leaked anywhere else?

PFAS is a group of pervasive chemicals that are found not only in fire fighting foams but also in general household commodities such as non-stick cookware, carpets, leather products, plastic wares and furniture. Most of these commodities are disposed into landfills as municipal solid waste or general household waste therefore technically, PFAS-contaminated waste in this particular form have been disposed of into landfills in Australia. Less engineered cells across Australia have historically been constructed using compacted clay and in view of this landfill cells for municipal solid waste do not necessarily have a highly engineered lining. Most are constructed only with compacted clay liners so it is reasonable to conclude that PFAS may have leaked to a certain degree in landfills that are not built in accordance to the best modern standard.

What's the risk to my health?

PFAS contaminated waste, when properly disposed of at a licensed waste depot, does not pose a risk to workers or surrounding residents as there are protections in place to prevent it from entering the groundwater. For most people, food is expected to be the primary source of exposure to these chemicals, and PFAS can bioaccumulate up food chains. PFAS enter the body through ingestion, not through skin contact. That means you need to eat or drink food or liquids containing PFAS in order for them to enter your body.

Because of the widespread use and persistence of PFAS in the environment, a blood test will show that all people in Australia will have some PFAS (most commonly PFOS) in their body. It is important that known PFAS contaminated waste is removed from the general environment where the exposure risks are not easily mitigated.

The EPA is guided by SA Health for advice on all health issues and we suggest you visit the SA Health website on www.sahealth.sa.gov.au (type 'PFAS' into the search bar) for detailed information or call (08) 8226 7100 for tailored advice specific to your situation.

Where does the PFAS come from?

In addition to waste that might come from industrial and commercial sites, PFAS have been commonly used in household products such as non-stick cookware, paints, textiles, coatings, and food packaging. Residents currently dispose of these in their municipal solid waste bins so it is expected that PFAS will be present in small quantities in all landfills.

The main areas where large amounts of PFAS have been found in South Australia are at the RAAF Base Edinburgh (including Penfield, Direk, Burton, Salisbury North, Paralowie, Waterloo Corner, St Kilda and Bolivar), Adelaide Airport, Parafield Airport, several sites on Le Fevre Peninsula and Brukunga. These mostly relate to historical use of firefighting foams (AFFF) which contained PFAS.

Interstate jurisdictions have raised concerns regarding PFAS where they have been found in groundwater which is used for drinking. For the majority of South Australia, mains water (tap water) is not sourced from groundwater and is safe. In some regional areas where mains water is sourced from groundwater in South Australia, PFAS contamination is not present.

South Australia was the first state to ban potentially hazardous fluorinated firefighting foams on 30 January 2018. The ban came into effect following the amendment of the Environment Protection (Water Quality) Policy 2015 under the *Environment Protection Act 1993*.

This ban effectively negates further environmental and human health risks associated with their use, and provides the community and industry with certainty around the use of these products.

What is leachate?

Leachate is the fluid created during waste disposal, particularly when rain falls on a landfill cell and permeates through the waste into the leachate collection system. The volume of leachate created is dependent on the amount of rainfall.

How is the leachate disposed of?

Leachate is directed underneath the landfill cell through a network of pipes to the centralised collection pond. Depending on the chemical, proper management is required to prevent environmental contamination.

Most landfills with a centralised collection pond manage leachate by evaporation. Sediments and sludge that settled at the base of the pond are considered contaminated and will be subjected to further assessment. This is an essential process to determine the appropriate treatment method to employ before the solid waste material is disposed into the landfill. The most common types of effective and commercially available treatment technologies for this particular form of waste are the following:

- **Biological** – Sediments and sludge that settled at the base of the pond are sent to waste stockpiles to be treated with reagents that contain micro-organisms to break down the contaminants into less hazardous compounds. This process is applicable for wastes contaminated with petroleum hydrocarbons.
- **Chemical fixation –** Sediments and sludge that settled at the base of the pond are sent to waste stockpiles to be treated with reagents that are chemically enhanced to stabilise the contaminants present. The reagent binds the contaminants to a more stable matrix to render contaminants immobile, thus substantially reducing the potential for leaching. This technology has been tested to be effective for a wide range of contaminants including heavy metals and PFAS.

Landfills that do not have a centralised pond or lagoon will engage a third party contractor to manage the leachate. The leachate is pumped straight from the cell sump and transported offsite for treatment. There are a number of effective and commercially available technologies depending on the nature of contamination. Specifically for PFAS, the following treatment methods or a combination of these are available:

- Coagulation and flocculation
- Foam fractionation
- Membrane process
- Electrochemical oxidation
- Electrochemical coagulation
- Plasma destruction

Further information on each of these can be provided upon request.

How is it monitored and how regularly?

Since 2017, SWR has undertaken testing of PFAS in leachate and groundwater. Because PFAS is contained in domestic products and therefore the waste that is placed inside municipal solid waste bins each week, all landfills are expected to have existing PFAS levels.

Prior to making their submission, SWR had established more than 12 months of baseline leachate and groundwater monitoring data to the EPA. This data indicates that there is no existing PFAS in the on-site groundwater monitoring wells. Trivial amounts of PFAS have been detected in the leachate and this is expected as a result of PFAS-containing municipal household waste being disposed in landfills. The leachate is regularly extracted from the cell sump and transferred to the collection pond as part of the leachate testing and treatment processes (please see 'How is the leachate disposed of?') above.

SWR is required to undertake groundwater monitoring twice a year for all analytes in groundwater, leachate and surface water. Regular leachate monitoring undertaken by SWR ensures that any spikes are detected at the primary and secondary leachate systems to ensure that any failures are detected well before the groundwater is impacted.

How much PFAS will be contained in this cell?

The landfill cell proposed to be used for the disposal of PFAS contaminated waste has a total waste volume of 400 000 m^3. If the application is approved, the EPA expects that a maximum of 5% of this waste would contain PFAS, noting that the licence does not stipulate by volume but by types of waste allowed.

Regardless of the volume of waste contaminated with PFAS, the waste itself cannot exceed the EPA's PFAS criteria of 50 milligrams per kilogram in dry weight, and 7 micrograms per litre in leachate (PFOS+PFHxS) or 56 micrograms per litre in leachate (PFOA). This is stipulated in the EPA's landfill guidelines for the disposal of PFAS contaminated waste.

Is the site on a fault line?

No. The site is not on a fault line. Geologically, structural faults such as the Ochre Cove/Clarendon fault can either impede (called a 'no flow boundary') or assist (called a 'flow through boundary') the flow of groundwater. Usually active faults, where movement along them causes tremors or earthquakes, are a flow through boundary. The general regional direction of groundwater flows from north–west, away from the site toward the coast.

NEW: What is the life expectancy of the cell?

Geomembrane lining systems have exhibited durability and long-term integrity when used as barriers between contaminants and groundwater. Since the early 1980s, high density polyethylene has been the most commonly used type of geomembrane because of its strength, flexibility and chemical and weather resistance. Studies suggest that in solid waste landfills, chemical dissolution and degradation of high density polyethylene geomembrane is not considered to be an issue due the inert property of the plastic in the presence of different types of chemicals such as hydrocarbons (aliphatic and aromatic), chlorinated/oxygenated solvents, organic/inorganic solvents and heavy metals. However, practical experience on the longevity of high density polyethylene in lining systems is around 30 years, as high density polyethylene only became prominent in the 1980s. Before that, engineered lining systems only consisted of compacted clay liners. Simulations have estimated that the lifetime of high density polyethylene geomembranes in landfill lining systems fall between 200 and 750 years. Other estimates indicated the lifespan (half-life predictions) of high density polyethylene liners to be more than 400 years in covered applications such landfills.

Note that studies resulting to these predictions are focused on the high density polyethylene geomembrane only. Therefore, it is reasonable to assume that a cell constructed with high density polyethylene in composite with other types of lining materials such as compacted clay liner, geosynthetic clay liner and/or another high density polyethylene geomembrane such as the case of a double composite lining system may attain a lifespan longer than what is predicted for high density polyethylene geomembrane alone.

NEW: What is the life expectancy of PFAS?

Studies suggest that the serum elimination half-life is estimated at 2 to 4 years for perfluorooctanoic acid (PFOA), 5 years for perfluorooctane sulfonate (PFOS), and 8.5 years for perfluorohexane sulfonate (PFHxS). Elimination half-life of a particular substance denotes the time it takes for the original amount of that substance in the plasma or in the body to reduce by 50%. Note that the rate of decomposition of PFAS may differ depending on the medium the chemicals are attached to. The half-life of PFAS in soils may have a different numerical value. There is not much available information about the lifespan of PFAS in soil.

NEW: What about future generations[2]?

Generally, the release of contaminants from solid waste in a landfill cell is governed by decomposition processes, and the rate and volume of water infiltration through the cap. This process typically dictates the pollutant load (which includes quality and quantity of leachate and landfill gas) produced throughout the cell's active life, until years following cell closure. Organic matter in a landfill cell will continue to undergo chemical and physical decomposition after landfill cells are covered and capped.

Landfill studies have shown a general trend towards contaminants in leachate reaching maximum values during the first years of operation of a landfill (2-3 years) and then gradually decreasing thereafter. This trend also applies to organic indicators such as chemical oxygen demand, biological oxygen demand, total organic carbon and microbial population. Leachate constituents (including iron, zinc, phosphate, chloride, sodium, copper, organic nitrogen, total solids and suspended solids) exhibit steady decrease in concentrations over 3 to 5 years due to continued flushing of waste inside the cell. With regular extraction of leachate from the cell, accumulation of contaminants at the base of the liner is minimised.

In terms of landfill gas, appreciable amounts are generated within the first few years of a cell being active with the amount of organic waste an important factor in determining how long landfill gas production lasts. In warm and humid environments, peak production of landfill gas usually occurs 5 to 7 years after wastes are disposed, whilst in dry climates peak production may extend to 20 years. Nevertheless, the majority of landfill gas is produced within the first 20 years after waste is disposed in a cell, with smaller quantities being generated for 50 or more years. It should be noted that different sections of a landfill cell may be in different phases of the decomposition process at the same time, depending on when the waste was originally placed in each area.

[2] References:

1. Christensen, T.H., Cossu, R. & Stegmann, R., 1992, Landfilling of Waste: Leachate, Elsevier Science Publishers Ltd, Essex, England
2. Christensen, T.H., Cossu, R. & Stegmann, R., 1996, Landfilling of Waste: Biogas, E & FN Spon, Boundary Row, England
3. Christensen, T.H., Cossu, R. & Stegmann, R., 1989, Sanitary Landfilling: Process, Technology and Environmental Impact, Academic Press Ltd, London, United Kingdom
4. Qasim, S.R. & Chiang, W., 1994, Sanitary Landfill Leachate, Technomic Publishing AG, Basel, Switzerland
5. Agency for Toxic Substances and Disease Registry, Landfill Gas Primer - An Overview for Environmental Health Professionals, Atlanta, Georgia USA

FURTHER INFO

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