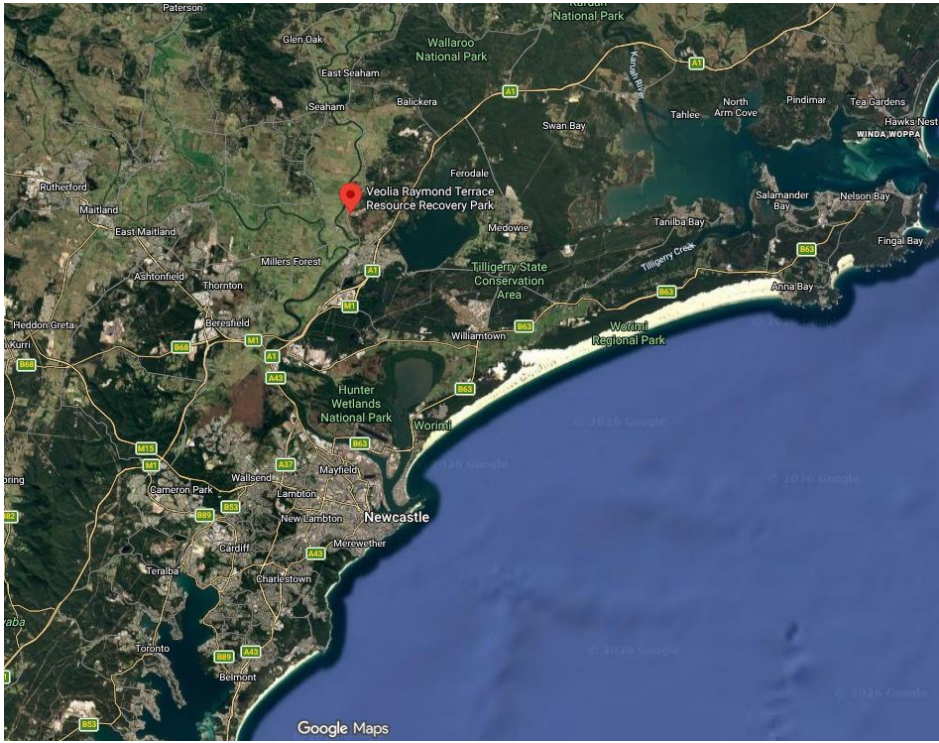
Leachate treatment & disposal at Raymond Terrace Landfill

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Newline Road Landfill, Raymond Terrace

- Located in Port Stephens LGA, about 30 mins north of Newcastle
- Licensed to receive up to 300,000 tonnes/year of non-putrescible GSW and asbestos waste
- Mainly receives C&I and C&D wastes from commercial customers
- The site is a preferred site for asbestos waste disposal



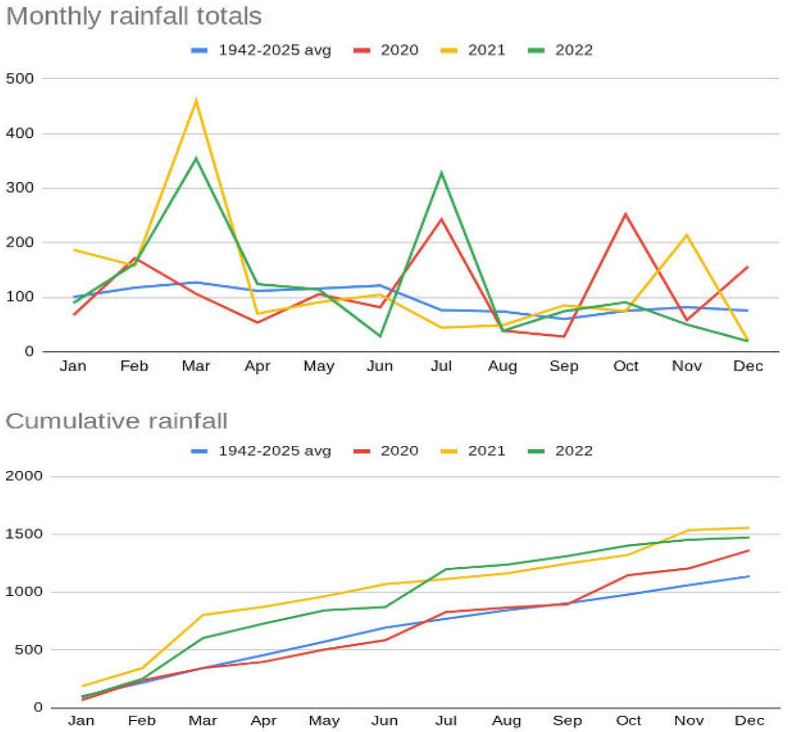


Site history

- Prior to landfilling, the site was used as a hard rock (dacite) quarry resulting in the formation of several voids
- The base of the main void is approx. -12 to -15 mAHD (i.e. below sea level) - Below groundwater level
- Landfilling was approved to occur within quarry voids and commenced around 2000
- Main void has progressively been developed as 6 individual cells from east to west:
  - Cells 1-4: Filled and capped
  - Cell 5: Operational
  - Cell 6: Constructed and awaiting approval to commence filling (expected December 2026)

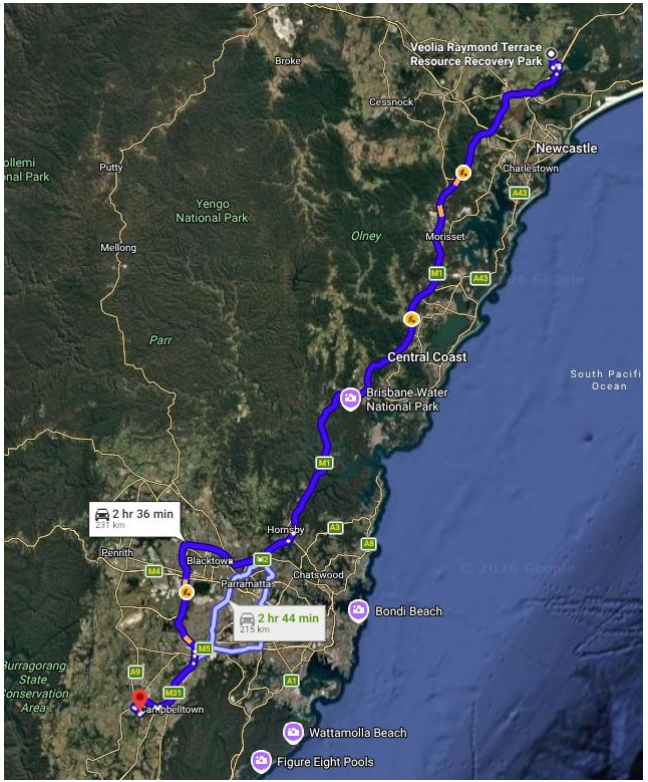
History of leachate treatment/disposal

- **The site does not have a sewer connection**
- Pre-2020 leachate disposal:
  - Irrigated onto the landfill tipping face
  - Evaporated from the leachate collection pond
- The triple-dip ‘La Nina’ years - 2020, 2021 and 2022
  - Long-term average rainfall: 1137 mm
  - 2020: 1362 mm
  - 2021: 1556 mm
  - 2022: 1472 mm
- Leachate levels within the landfill and leachate inventory increased over this period



Early options for leachate treatment & disposal

- No local offsite treatment/disposal options for raw leachate were available
- In late 2020, tankering of raw leachate to Veolia's Spring Farm Liquid Treatment Facility commenced
- Located in SW Sydney, a one-way trip takes close to 3 hours (about 230 kms)
- Significant haulage costs as well as volume limitations (one load = 22 kL)



Basic pre-treatment & tankering to Hunter Water

- Discussions with Hunter Water regarding a trade wastewater agreement commenced in early 2021
- Trade wastewater standard includes concentration limits for various substances
- Main issue was **ammonia**
  - Trade wastewater limit 50 mg/L
  - Raw leachate 1000-2000 mg/L
- Trial of a basic aeration process was commenced to reduce ammonia concentrations (biological treatment / ammonia stripping), which was eventually successful
- Hunter Water accepted the pre-treated leachate for disposal via tankering at Raymond Terrace WWTP (roughly 10 min trip from site)
- Aeration process was very slow to achieve the required ammonia reduction

Groundwater impact identified

- In late 2021, groundwater monitoring identified indicators of leachate impact in a number of on-site groundwater monitoring wells
- The EPA issued a Pollution Reduction Program (PRP) requiring Veolia to investigate the impact and implement remedial solutions
- Groundwater impact likely caused by increase in leachate levels within the landfill due to above-average rainfall in 2020 and 2021
- EPA issued Clean Up Notice requiring leachate levels to be reduced to address groundwater impacts
- Water balance model identified average of 180 kL/day leachate to be removed from the landfill

Hunter Water ceases acceptance

- In early 2023, Hunter Water raised concerns about the concentrations of a number of parameters within the aerated leachate, including elevated concentrations of bromine, COD, TDS and PFAS
- The aeration process was not capable of treating these parameters, and Hunter Water ceased acceptance of the aerated leachate

Problem!

- No alternative local leachate disposal options
- Tankering to Spring Farm is prohibitive due to significant distances and haulage costs. Not possible to tanker all volume to Spring Farm
- Clean Up Notice in force requiring reduction in leachate levels - Quick action required, long-term projects were not feasible
- Cell 6 footprint (remaining unfilled part of Void 4) was flooded by leachate-impacted water, which required dewatering prior to commencement of cell construction - Tight timeframes for dewatering



Decision making

- Effluent disposal at Hunter Water was still deemed the most viable all-weather option, being close enough to tanker sufficient volumes
- Additional treatment processes were required to reliably meet the Hunter Water trade wastewater standard - Need to gain Hunter Water's trust and confidence
- Reverse Osmosis was deemed necessary to meet the discharge requirements for specific analytes (including PFAS) that were not treated by the aeration process
- Containerised, modular treatment process utilising hired equipment provides flexibility for increasing/decreasing capacity and altering the process, while also avoiding unbudgeted CAPEX
- Performance guarantees required - Minimum volume and quality targets, subject to an agreed 'raw leachate quality envelope'

Leachate Treatment Plant (LTP) overview

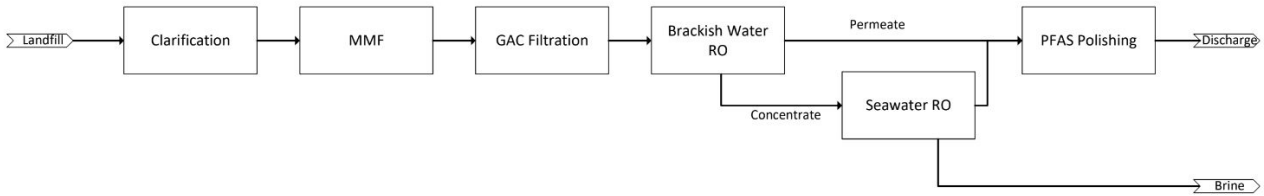
- Initially required to produce at least 220 m3/day of treated effluent meeting Hunter Water trade wastewater standard **(including nil detect (<0.002 μg/L, 2 nanogram/L) PFAS limit)**
- Capacity was later increased to 500 m3/day due to Cell 6 dewatering and construction timeframes
- Raw leachate quality envelope established for contract baseline (ammonia 2,000 mg/L, PFAS 25 μg/L)
- Services agreement (initially awarded to Excalibur Water, now internalised at Veolia Remediation Services), includes:
  - Installation and hire of equipment
  - O&M of the LTP
  - Provision of required chemicals and consumables
  - Validation and in-plant sampling
- Treated effluent tankered to Hunter Water WWTPs



Leachate treatment process

Multi-stage treatment process utilising Reverse Osmosis to produce a clean permeate effluent and a concentrated brine by-product:

- 1st Stage: Clarification - Removes the bulk of suspended solids in the raw water
- 2nd Stage: Multimedia filtration - Further removal of finer suspended solids.
- 3rd Stage: GAC Filtration - organics (TOC) removal. This is to reduce the load on the RO units and increase the time between CIPs (chemical clean in place).
- 4th Stage: Brackish water RO - initial permeate production, removing almost all contaminants (PFAS, ammonia, remaining TOC, metals, etc).
- 5th Stage: Seawater RO - concentrate from the brackish water RO is reprocessed by the Seawater RO. This further concentrates the waste and produces a highly concentrated brine.
- 6th Stage: Polishing GAC - permeate from both RO units is polished through GAC. Contingency to capture any PFAS in the permeate due to the stringent PFAS limits in the discharge criteria.



Leachate treatment process

- Left = Raw, untreated leachate



- Right = Treated permeate

Permeate management

- Initially, all permeate was tankered to Hunter Water WWTPs for disposal under the trade wastewater discharge agreement
- Results generally compliant with the Hunter Water trade wastewater standard, with the exception of a few batches requiring re-processing and a small number of false-positives being identified
- A beneficial reuse assessment was subsequently carried out to determine whether the permeate was suitable for any uses on site
- Following EPA approval, the permeate is now being used on site for operational purposes, including dust suppression, irrigation, and asbestos wet-down at the tip face (subject to strict controls)

Parameter	Units	Hunter Water Limits	September Results
pH	pH unit	6.5 - 10.0	7.54
TDS	mg/L	4000	136
TSS	mg/L	500	<5
Sulfur/Sulfate	mg/L	2000	3
Ammonia	mg/L	50	23.6
TKN	mg/L	150	23.8
Total Phosphorus	mg/L	20	0.07
Sulfite	mg/L	15	<2
COD	mg/L	1500	<10
BOD	mg/L	500	3
Sum of PFAS	µg/L	Nil Detect <0.002	<0.0003
TRH (C6-C40)	mg/L	30	<0.050
BTEXN	mg/L	-	<0.001
Total Metals			
- Aluminium	mg/L	100.0	<0.01
- Arsenic	mg/L	0.5	0.001
- Cadmium	mg/L	0.5	<0.0001
- Chromium	mg/L	2.0	<0.001
- Cobalt	mg/L	2.0	<0.001
- Copper	mg/L	2.0	<0.001
- Lead	mg/L	0.04	<0.001
- Manganese	mg/L	2.0	<0.001
- Molybdenum	mg/L	10.0	<0.001
- Nickel	mg/L	1.0	<0.001
- Selenium	mg/L	2.0	<0.004
- Silver	mg/L	0.5	<0.001
- Iron	mg/L	30.0	<0.05
Total Mercury		Prohibited	<0.0001

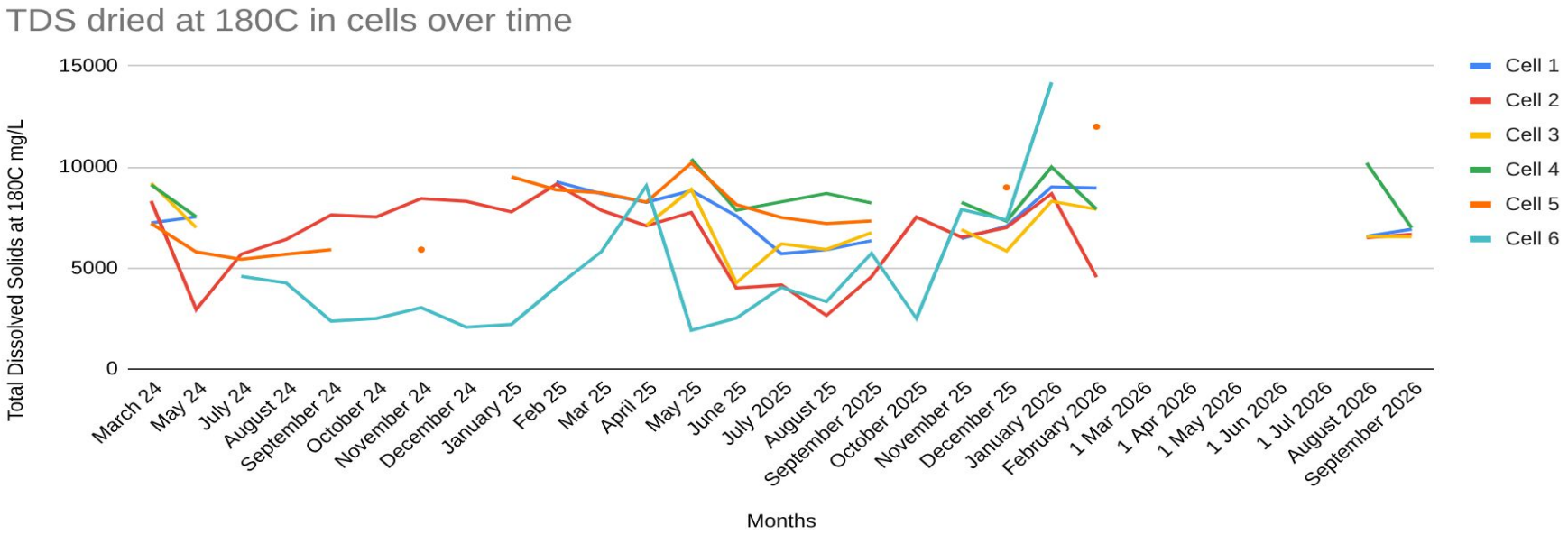
Concentrate (brine) management

- Recovery rate typically 60-70% (i.e. 30-40% of incoming volume is rejected)
- Concentrate is reinjected into the landfill via soak pits/trenches - This is an ongoing challenge. Soak pits are effective at first but block up relatively quickly, requiring relocation
- Seepages from near the reinjection location also require ongoing management - E.g. return pumping to leachate pond, installation of gravel drainage and/or placement of clay plugs
- Currently investigating network of vertical reinjection wells to get concentrate deeper into the landfill

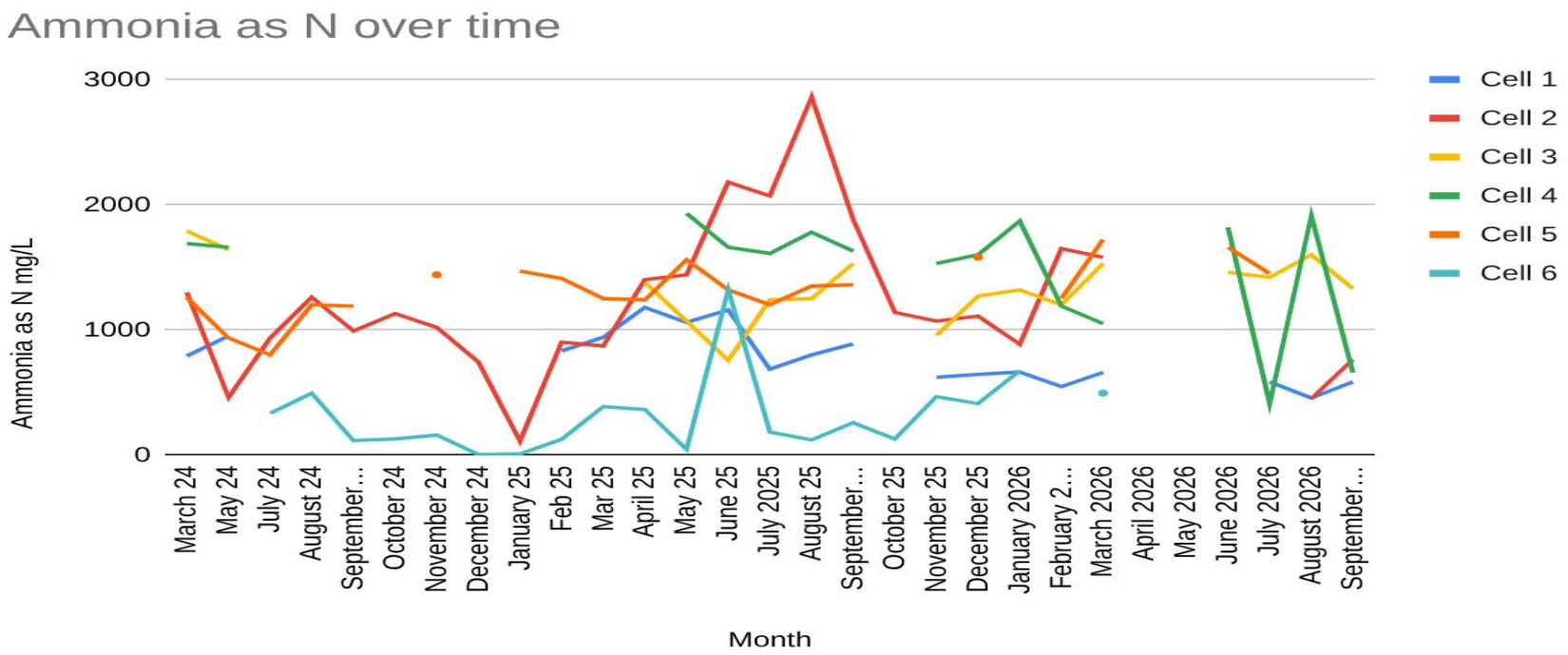
Concentration analysis

- **Anticipated risk - Raw leachate concentrations may increase due to concentrate reinjection**
- We have been closely monitoring raw leachate concentrations to monitor the impact of concentrate reinjection
- **Main indicator is TDS - RO becomes ineffective once TDS concentrations exceed 30,000 mg/L**
- Also monitoring ammonia, BOD and PFAS as indicators
- No observable concentration increases to date - Temporal concentration variations due to rainfall (i.e. dilution occurs during wet conditions, concentration occurs during dry conditions)

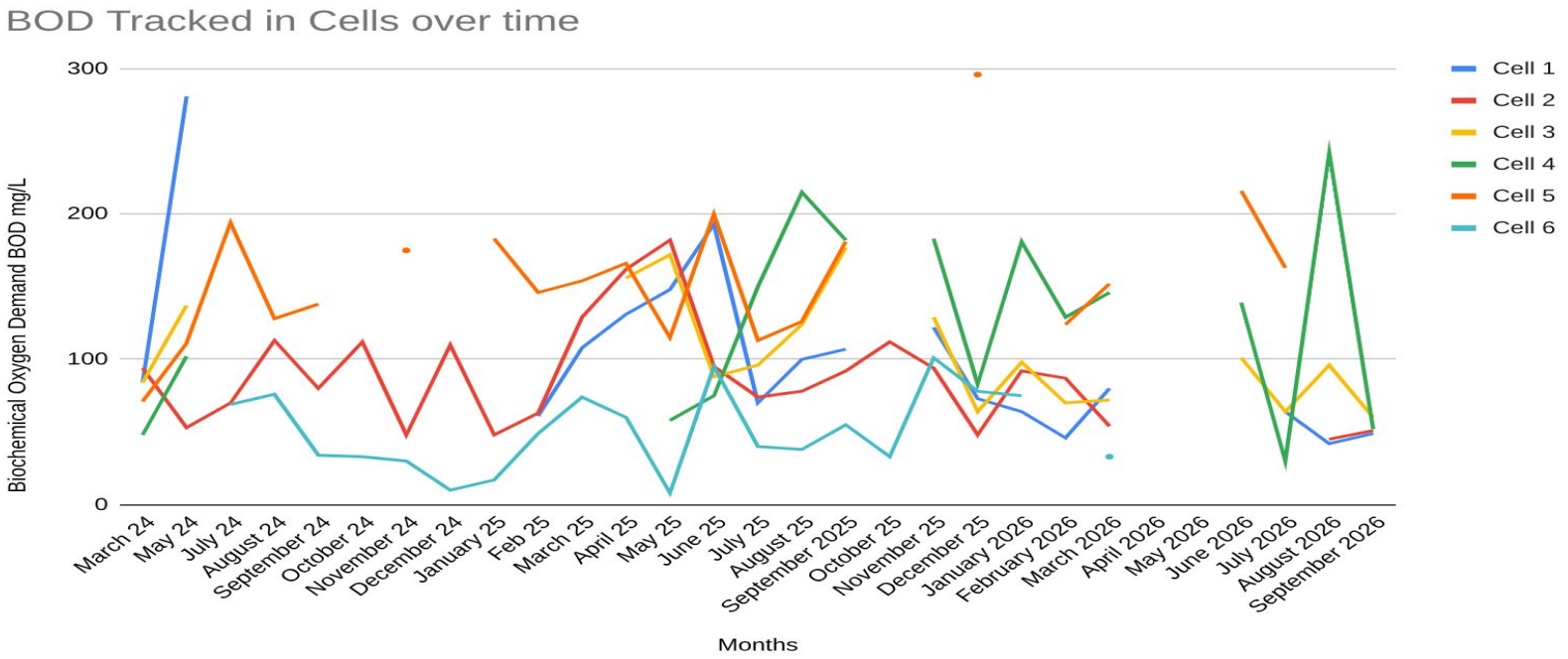
Raw leachate - TDS concentrations



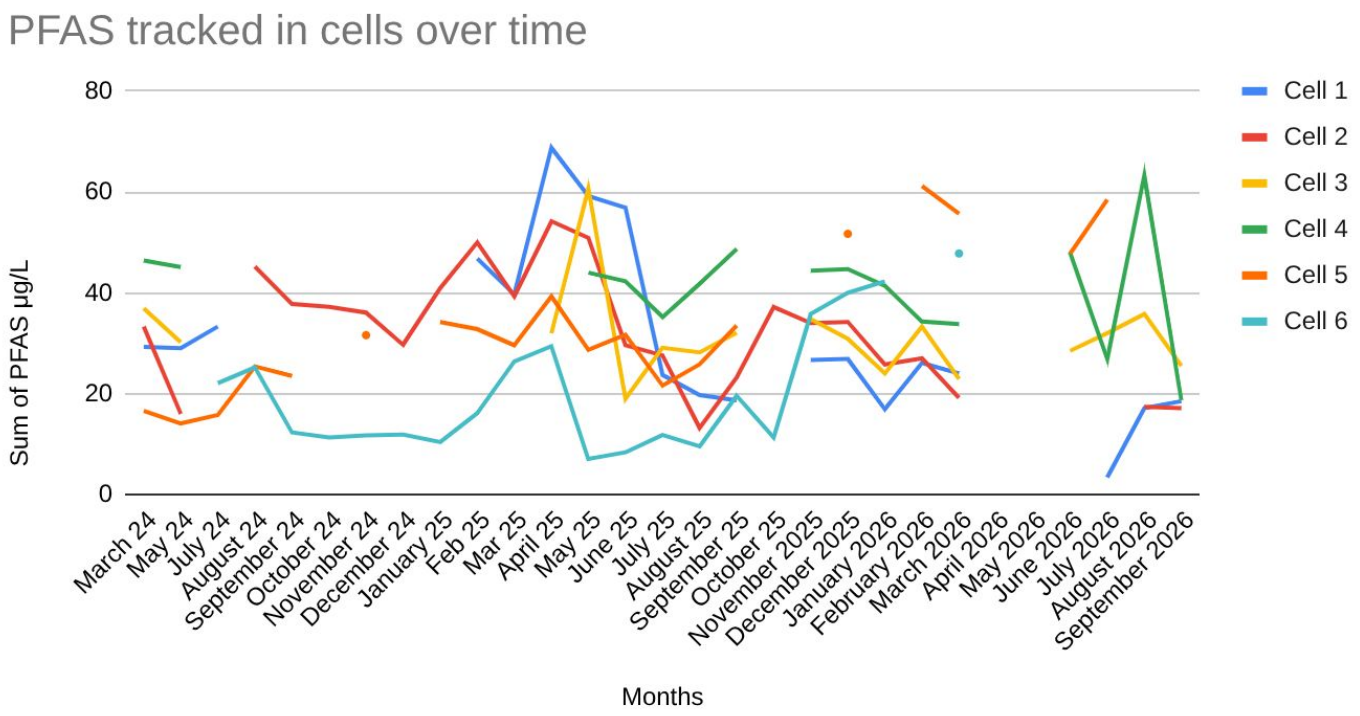
Raw leachate - Ammonia concentrations



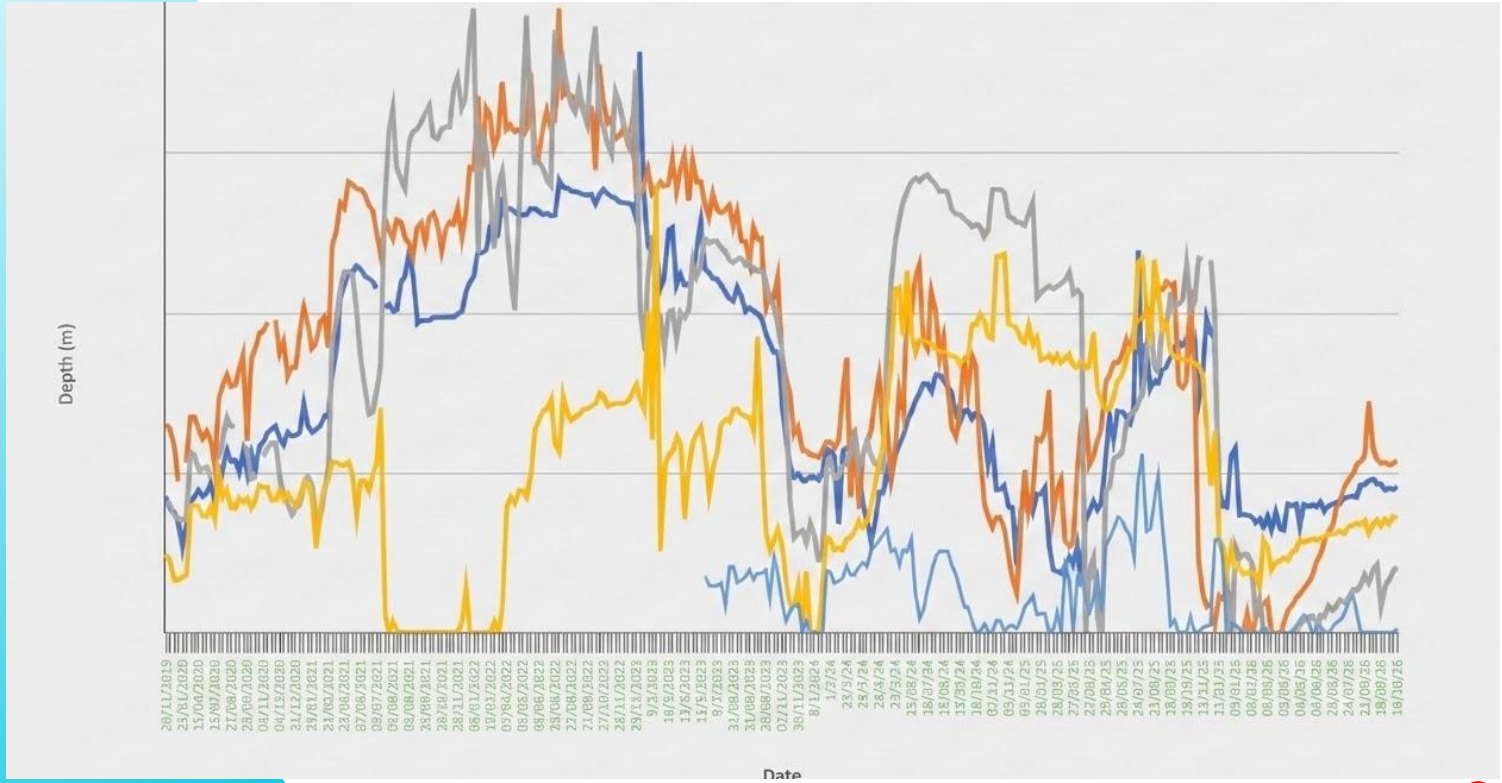
Raw leachate - BOD concentrations



Raw leachate - PFAS concentrations



Results - Leachate depth within cells



Results - Estimated leachate volume



Results - Cell 6 dewatered and constructed






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